RUSH

RUSH

Contract Routing Form

ROUTING: Urgent Rush printed on: 01/23/2018

==========

Contract between: Miron Construction Co Inc
and Dept. or Division: Engineering Division
Name/Phone Number:

Project: Madison Fire Station 14

Contract No.: 8027 File No.: 49971
Enactment No.: RES-18-00057 Enactment Date: 01/22/2018
Dollar Amount: 6,390,783.00

(Please DATE before routing)

Signatures Required	Date Received	Date Signed
City Clerk	1-23-18	1-23-18
Director of Civil Rights	1.23.18	1.23.2018 FNJ
Risk Manager	1-24-18	1/24/18 KEN
Finance Director	1-24-18	1/25/18 MCR
City Attorney	1-26-18	1-26-18
Mayor	1.26.18	1.26.18

Please return signed Contracts to the City Clerk's Office
Room 103, City-County Building for filing.

Original + 2 Copies

01/23/2018 12:02:17 enjls - Jon Evans 243-5893

Dis Rights: OK / N/A / Problem - Hold
Prev Wage: AA / Agency / No
Contract Value: 6,390,783.00
AA Plan: Approved
Amendment / Addendum # N/A
Type: POS / Dvlp / Sbdv / Gov't / Grant / (PW) / Goal / Loan / Agrmt

File #:	49971 Version: 1	Name:	Awarding Public Works Contract No. 8027, Madison Fire Station 14.
Type:	Resolution	Status:	Passed
File created:	12/27/2017	In control:	BOARD OF PUBLIC WORKS
On agenda:	1/16/2018	Final action:	1/16/2018
Enactment date:	1/22/2018	Enactment #:	RES-18-00057
Title:	Awarding Public Works Contract No. 8027, Madison Fire Station 14.		
Sponsors:	BOARD OF PUBLIC WORKS		
Attachments:	1. CONTRACT 8027.pdf		

History (3) Text

Fiscal Note
The proposed resolution awards the contract for Fire Station 14 contingent upon adoption of the budget amendment per resolution #49908. passed 1-16-18 final action

Title
Awarding Public Works Contract No. 8027, Madison Fire Station 14.

Body
BE IT RESOLVED, that the awarding of Contract No. 8027, Madison Fire Station 14, will be contingent on the approval of a separate resolution by the Common Council to amend the 2018 Capital Budget in order to provide the necessary funding. In the event that the Common Council does not approve the budget amendment, the contract will not be awarded.

BE IT FURTHER RESOLVED, that the following low bids for miscellaneous improvements be accepted and that the Mayor and City Clerk be and are hereby authorized and directed to enter into a contract with the low bidders contained herein, subject to the Contractor's compliance with Section 39.02 of the Madison General Ordinances concerning compliance with the Affirmative Action provisions **and subject to the Contractor's compliance with Section 33.07 of the Madison General Ordinances regarding Best Value Contracting:**

BE IT FURTHER RESOLVED, that the funds be encumbered to cover the cost of the projects contained herein.

See attached document (Contract No. 8027) for itemization of bids.

PROJECT	CONTRACTOR	AMOUNT OF BID
CONTRACT NO 8027 MADISON FIRE STATION 14 (BASE BID – ALTERNATE 1 NOT ACCEPTED)		
	MIRON CONSTRUCTION CO., INC	$6,390,783.00

Account No. 17451-30-140	6,390,783.00
Contingency 4%	$255,631.32
GRAND TOTAL	**$6,646,414.32**

Jurisdiction: Wisconsin

Demographics

Company Name: Fidelity and Deposit Company of Maryland
Short Name:
SBS Company Number: 54219634
NAIC CoCode: 39306
FEIN: 13-3046577
Domicile Type: Foreign
State of Domicile: Maryland
Country of Domicile: United States
NAIC Group Number: 212 - ZURICH INS GRP
Organization Type: Stock
Date of Incorporation: 03/18/1969
Merger Flag: No

Address

Business Address
1299 ZURICH WAY
Schaumburg, IL 60196
United States
Mailing Address
1299 ZURICH WAY
Schaumburg, IL 60196
United States
Statutory Home Office Address
600 Red Brook Blvd
Owings Mills, MD 21117-5153
United States
Main Administrative Office Address
1299 ZURICH WAY
Schaumburg, IL 60196
United States

Phone, E-mail, Website

Phone

Type	Number
Business Primary Phone	(847) 605-6000
Business Toll Free Phone	(800) 382-2150
Mailing Primary Phone	(847) 605-6000
Mailing Toll Free Phone	(800) 382-2150
Statutory Home Office Primary Phone	(847) 605-6000
Statutory Home Office Toll Free Phone	(800) 382-2150
Main Admin Office Primary Phone	(847) 605-6000
Main Admin Office Toll Free Phone	(800) 382-2150

Email

Line of Business	Citation Type	Effective Date
Aircraft	Aircraft	01/01/1982
Automobile	Automobile	01/01/1982
Credit Insurance	Credit Insurance	01/01/1982
Fidelity Insurance	Fidelity Insurance	01/01/1982
Fire, Inland Marine and Other Property Insurance	Fire, Inland Marine and Other Property Insurance	01/01/1982
Liability and Incidental Medical Expense Insurance (other than automobile)	Liability and Incidental Medical Expense Insurance (other than automobile)	01/01/1982
Miscellaneous	Miscellaneous	01/01/1982
Ocean Marine Insurance	Ocean Marine Insurance	01/01/1982
Surety Insurance	Surety Insurance	01/01/1982
Workers Compensation Insurance	Workers Compensation Insurance	01/01/1982

First Previous 1 Next Last

Contact

Filter

Contact Type	Preferred Name	Name	E-mail	Phone	Address
Registered Agent for Service of Process		*			**Other** CORPORATION SERVICE COMPANY 8040 EXCELSIOR DR STE 400 MADISON, WI 53717 United States

First Previous 1 Next Last

Company Merger

No results found.

Name Change History

Filter

$6,390,783.00
CONTRACTOR'S OFFICE COPY

BID OF **MIRON CONSTRUCTION CO., INC.**

2017

PROPOSAL, CONTRACT, BOND AND SPECIFICATIONS

FOR

MADISON FIRE STATION 14

CONTRACT NO. 8027

MUNIS NO. 17451

IN

MADISON, DANE COUNTY, WISCONSIN

AWARDED BY THE COMMON COUNCIL
MADISON, WISCONSIN ON **JANUARY 16, 2018**

CITY ENGINEERING DIVISION
1600 EMIL STREET
MADISON, WISCONSIN 53713

https://bidexpress.com/login

MADISON FIRE STATION 14
CONTRACT NO. 8027

INDEX

This Proposal, and Agreement have
been prepared by:

CITY ENGINEERING DIVISION
CITY OF MADISON
MADISON, DANE COUNTY, WISCONSIN

Robert F. Phillips, P.E., City Engineer

RFP: je

STANDARD SPECIFICATIONS

The City of Madison's Standard Specifications for Public Works Construction - 2017 Edition, as supplemented and amended from time to time, forms a part of these contract documents as if attached hereto.

These standard specifications are available on the City of Madison Public Works website, www.cityofmadison.com/Business/PW/specs.cfm.

The Contractor shall review these Specifications prior to preparation of proposals for the work to be done under this contract, with specific attention to Article 102, "BIDDING REQUIREMENTS AND CONDITIONS" and Article 103, "AWARD AND EXECUTION OF THE CONTRACT." For the convenience of the bidder, below are highlights of three subsections of the specifications.

SECTION 102.1: PRE-QUALIFICATION OF BIDDERS

In accordance with Wisconsin State Statutes 66.0901 (2) and (3), all bidders must submit to the Board of Public Works proof of responsibility on forms furnished by the City. The City requires that all bidders be qualified on a biennial basis.

Bidders must present satisfactory evidence that they have been regularly engaged in the type of work specified herein and they are fully prepared with necessary capital, materials, machinery and supervisory personnel to conduct the work to be contracted for to the satisfaction of the City. All bidders must be pre-qualified by the Board of Public Works for the type of construction on which they are bidding prior to the opening of the bid.

In accordance with Section 39.02(9)(a)I. of the General Ordinances, all bidders shall submit in writing to the Affirmative Action Division Manager of the City of Madison, a Certificate of Compliance or an Affirmative Action Plan at the same time or prior to the submission of the proof of responsibility forms.

The bidder shall be disqualified if the bidder fails to or refuses to, prior to opening of the bid, submit a Certificate of compliance, Affirmative Action Plan or Affirmative Action Data Update, as applicable, as defined by Section 39.02 of the General Ordinances (entitled Affirmative Action) and as required by Section 102.11 of the Standard Specifications.

SECTION 102.4 PROPOSAL

No bid will be accepted that does not contain an adequate or reasonable price for each and every item named in the Schedule of Unit Prices.

A lump sum bid for the work in accordance with the plans and specifications is required. The lump sum bid must be the same as the total amounts bid for the various items and it shall be inserted in the space provided.

All papers bound with or attached to the proposal form are considered a part thereof and must not be detached or altered when the proposal is submitted. The plans, specifications and other documents designated in the proposal form will be considered a part of the proposal whether attached or not.

A proposal submitted by an individual shall be signed by the bidder or by a duly authorized agent. A proposal submitted by a partnership shall be signed by a member/partner or by a duly authorized agent thereof. A proposal submitted by a corporation shall be signed by an authorized officer or duly authorized registered agent of such corporation, and the proposal shall show the name of the State under the laws of which such corporation was chartered. The required signatures shall in all cases appear in the space provided thereof on the proposal.

Each proposal shall be placed, together with the proposal guaranty, in a sealed envelope, so marked as to indicate name of project, the contract number or option to which it applies, and the name and address

Bidders for this Contract(s) must be Pre-Qualified for at least one of the following type(s) of construction denoted by an ☒

Building Demolition

101 ☐ Asbestos Removal
120 ☐ House Mover
110 ☐ Building Demolition

Street, Utility and Site Construction

201 ☐ Asphalt Paving
205 ☐ Blasting
210 ☐ Boring/Pipe Jacking
215 ☐ Concrete Paving
220 ☐ Con. Sidewalk/Curb & Gutter/Misc. Flat Work
221 ☐ Concrete Bases and Other Concrete Work
222 ☐ Concrete Removal
225 ☐ Dredging
230 ☐ Fencing
235 ☐ Fiber Optic Cable/Conduit Installation
240 ☐ Grading and Earthwork
241 ☐ Horizontal Saw Cutting of Sidewalk
242 ☐ Infrared Seamless Patching
245 ☐ Landscaping, Maintenance
246 ☐ Ecological Restoration
250 ☐ Landscaping, Site and Street
251 ☐ Parking Ramp Maintenance
252 ☐ Pavement Marking
255 ☐ Pavement Sealcoating and Crack Sealing
260 ☐ Petroleum Above/Below Ground Storage Tank Removal/Installation
262 ☐ Playground Installer
265 ☐ Retaining Walls, Precast Modular Units
270 ☐ Retaining Walls, Reinforced Concrete
275 ☐ Sanitary, Storm Sewer and Water Main Construction
276 ☐ Sawcutting
280 ☐ Sewer Lateral Drain Cleaning/Internal TV Insp.
285 ☐ Sewer Lining
290 ☐ Sewer Pipe Bursting
295 ☐ Soil Borings
300 ☐ Soil Nailing
305 ☐ Storm & Sanitary Sewer Laterals & Water Svc.
310 ☐ Street Construction
315 ☐ Street Lighting
318 ☐ Tennis Court Resurfacing
320 ☐ Traffic Signals
325 ☐ Traffic Signing & Marking
332 ☐ Tree pruning/removal
333 ☐ Tree, pesticide treatment of
335 ☐ Trucking
340 ☐ Utility Transmission Lines including Natural Gas, Electrical & Communications
399 ☐ Other_____

Bridge Construction

501 ☐ Bridge Construction and/or Repair

Building Construction

401 ☐ Floor Covering (including carpet, ceramic tile installation, rubber, VCT
402 ☐ Building Automation Systems
403 ☐ Concrete
404 ☐ Doors and Windows
405 ☐ Electrical - Power, Lighting & Communications
410 ☐ Elevator - Lifts
412 ☐ Fire Suppression
413 ☐ Furnishings - Furniture and Window Treatments
415 ☐ General Building Construction, Equal or Less than $250,000
420 ☐ General Building Construction, $250,000 to $1,500,000
425 ☒ General Building Construction, Over $1,500,000
428 ☐ Glass and/or Glazing
429 ☐ Hazardous Material Removal
430 ☐ Heating, Ventilating and Air Conditioning (HVAC)
433 ☐ Insulation - Thermal
435 ☐ Masonry/Tuck pointing
437 ☐ Metals
440 ☐ Painting and Wallcovering
445 ☐ Plumbing
450 ☐ Pump Repair
455 ☐ Pump Systems
460 ☐ Roofing and Moisture Protection
464 ☐ Tower Crane Operator
461 ☐ Solar Photovoltaic/Hot Water Systems
465 ☐ Soil/Groundwater Remediation
466 ☐ Warning Sirens
470 ☐ Water Supply Elevated Tanks
475 ☐ Water Supply Wells
480 ☐ Wood, Plastics & Composites - Structural & Architectural
499 ☐ Other_____

State of Wisconsin Certifications

1 ☐ Class 5 Blaster - Blasting Operations and Activities 2500 feet and closer to inhabited buildings for quarries, open pits and road cuts.
2 ☐ Class 6 Blaster - Blasting Operations and Activities 2500 feet and closer to inhabited buildings for trenches, site excavations, basements, underwater demolition, underground excavations, or structures 15 feet or less in height.
3 ☐ Class 7 Blaster - Blasting Operations and Activities for structures greater than 15 ' in height, bridges, towers, and any of the objects or purposes listed as "Class 5 Blaster or Class 6 Blaster".
4 ☐ Petroleum Above/Below Ground Storage Tank Removal and Installation (Attach copies of State Certifications.)
5 ☐ Hazardous Material Removal (Contractor to be certified for asbestos and lead abatement per the Wisconsin Department of Health Services, Asbestos and Lead Section (A&LS).) See the following link for application: www.dhs.wisconsin.gov/Asbestos/Cert. State of Wisconsin Performance of Asbestos Abatement Certificate must be attached.
6 ☐ Certification number as a Certified Arborist or Certified Tree Worker as administered by the International Society of Arboriculture
7 ☐ Pesticide application (Certification for Commercial Applicator For Hire with the certification in the category of turf and landscape (3.0) and possess a current license issued by the DATCP)
8 ☐ State of Wisconsin Master Plumbers License.

SECTION C: SMALL BUSINESS ENTERPRISE

Instructions to Bidders
City of Madison
SBE Program Information

2 Small Business Enterprise (SBE) Program Information

2.1 Policy and Goal

The City of Madison reaffirms its policy of nondiscrimination in the conduct of City business by maintaining a procurement process which remains open to all who have the potential and ability to sell goods and services to the City. It is the policy of the City of Madison to allow Small Business Enterprises (SBE) maximum feasible opportunity to participate in City of Madison contracting. The bidder acknowledges that its bid has been submitted in accordance with the SBE program and is for the public's protection and welfare.

Please refer to the "ADVERTISEMENT FOR BIDS" for the goal for the utilization of SBEs on this project. SBEs may participate as subcontractors, vendors and/or suppliers, which provide a commercially useful function. The dollar value for SBE suppliers or 'materials only' vendors shall be discounted to 60% for purposes of meeting SBE goals.

A bidder which achieves or exceeds the SBE goal will be in compliance with the SBE requirements of this project. In the event that the bidder is unable to achieve the SBE goal, the bidder must demonstrate that a good faith effort to do so was made. Failure to either achieve the goal or demonstrate a good faith effort to do so will be grounds for the bidder being deemed a non-responsible contractor ineligible for award of this contract.

A bidder may count towards its attainment of the SBE goal only those expenditures to SBEs that perform a commercially useful function. For purposes of evaluating a bidder's responsiveness to the attainment of the SBE goal, the contract participation by an SBE is based on the percentage of the total base bid proposed by the Contractor. The total base bid price is inclusive of all addenda.

Work performed by an SBE firm in a particular transaction can be counted toward the goal only if it involves a commercially useful function. That is, in light of industry practices and other relevant considerations, does the SBE firm have a necessary and useful role in the transaction, of a kind for which there is a market outside the context of the SBE Program, or is the firm's role a superfluous step added in an attempt to obtain credit towards goals? If, in the judgment of the Affirmative Action Division, the SBE firm will not perform a commercially useful function in the transaction, no credit towards goals will be awarded.

The question of whether a firm is performing a commercially useful function is completely separate from the question of whether the firm is an eligible SBE. A firm is eligible if it meets the definitional criteria and ownership and control requirements, as set forth in the City of Madison's SBE Program.

If the City of Madison determines that the SBE firm is performing a commercially useful function, then the City of Madison must then decide what that function is. If the commercially useful function is that of an SBE vendor / supplier that regularly transacts business with the respective product, then the City of Madison will count 60% of the value of the product supplied toward SBE goals.

2.3 Certification of SBE by City of Madison

The Affirmative Action Division maintains a directory of SBEs which are currently certified as such by the City of Madison. Contact the Contract Compliance Officer as indicated in Section 2.2 to receive a copy of the SBE Directory or you may access the SBE Directory online at www.cityofmadison.com/dcr/aaTBDir.cfm.

All contractors, subcontractors, vendors and suppliers seeking SBE status must complete and submit the **Targeted Business Certification Application** to the City of Madison Affirmative Action Division by the time and date established for receipt of bids. A copy of the Targeted Business Certification Application is available by contacting the Contract Compliance Officer at the address and telephone indicated in Section 2.2 or you may access the Targeted Business Certification Application online at www.cityofmadison.com/dcr/aaTBDir.cfm. Submittal of the Targeted Business Certification Application by the time specified does not guarantee that the applicant will be certified as a SBE eligible to be utilized towards meeting the SBE goal for this project.

2.4 Small Business Enterprise Compliance Report

2.4.1 Good Faith Efforts

Bidders shall take all necessary affirmative steps to assure that SBEs are utilized when possible and that the established SBE goal for this project is achieved. A contractor who self performs a portion of the work, and is pre-qualified to perform that category of work, may subcontract that portion of the work, but shall not be required to do so. When a bidder is unable to achieve the established SBE goal, the bidder must demonstrate that a good faith effort to do so was made. Such a good faith effort should include the following:

2.4.1.1 Attendance at the pre-bid meeting.

2.4.1.2 Using the City of Madison's directory of certified SBEs to identify SBEs from which to solicit bids.

2.4.1.3 Assuring that SBEs are solicited whenever they are potential sources.

2.4.1.4 Referring prospective SBEs to the City of Madison Affirmative Action Division for certification.

2.4.1.5 Dividing total project requirements into smaller tasks and/or quantities, where economically feasible, to permit maximum feasible SBE participation.

2.4.1.6 Establishing delivery schedules, where requirements permit, which will encourage participation by SBEs.

2.4.1.7 Providing SBEs with specific information regarding the work to be performed.

2.4.1.8 Contacting SBEs in advance of the deadline to allow such businesses sufficient time to prepare a bid.

2.4.1.9 Utilizing the bid of a qualified and competent SBE when the bid of such a business is deemed reasonable (i.e. 5% above the lowest bidder), although not necessarily low.

2.4.1.10 Contacting SBEs which submit a bid, to inquire about the details of the bid and confirm that the scope of the work was interpreted as intended.

2.4.1.11 Completion of Cover Page (page C-6), Summary Sheet (page C-7) and SBE Contact Reports (pages C-8 and C9) if applicable.

The City will monitor the project to ensure that the actual percentage commitment to SBE firms is carried out.

2.7 SBE Definition and Eligibility Guidelines

A Small Business Enterprise is a business concern awarded certification by the City of Madison. For the purposes of this program a Small Business Enterprise is defined as:

A. An independent business operated under a single management. The business may not be a subsidiary of any other business and the stock or ownership may not be held by any individual or any business operating in the same or a similar field. In determining whether an entity qualifies as a SBE, the City shall consider all factors relevant to being an independent business including, but not limited to, the date the business was established, adequacy of its resources for the work in which it proposes to involve itself, the degree to which financial, equipment leasing and other relationships exist with other ineligible firms in the same or similar lines of work. SBE owner(s) shall enjoy the customary incidents of ownership and shall share in the risks and profits commensurate with their enjoyment interests, as demonstrated by an examination of the substance rather than form or arrangements that may be reflected in its ownership documents.

B. A business that has averaged no more than $4.0 million in annual gross receipts over the prior three year period and the principal owner(s) do not have a personal net worth in excess of $1.32 million.

Firm and/or individuals that submit fraudulent documents/testimony may be barred from doing business with the City and/or forfeit existing contracts.

SBE certification is valid for one (1) year unless revoked.

SECTION D: SPECIAL PROVISIONS

MADISON FIRE STATION 14
CONTRACT NO. 8027

It is the intent of these Special Provisions to set forth the final contractual intent as to the matter involved and shall prevail over the Standard Specifications and plans whenever in conflict therewith. In order that comparisons between the Special Provisions can be readily made, the numbering system for the Special Provisions is equivalent to that of the Specifications.

Whenever in these Specifications the term "Standard Specifications" appears, it shall be taken to refer to the City of Madison Standard Specifications for Public Works Construction and Supplements thereto.

ARTICLE 102.9 BIDDER'S UNDERSTANDING

Tax Exempt Status. Effective with all contracts executed after January 1, 2016, the sales price from the sale, storage, use or other consumption of tangible personal property that is used in conjunction with a public works improvement for a tax exempt entity (including the City of Madison), is exempt from State sales tax. Said property must become a component of the project owned by the tax exempt entity and includes: any building; shelter; parking lot; parking garage; athletic field; storm sewer; water supply system; or sewerage and waste water treatment facility, but does not include a highway, street or road. The contractor shall ensure that the exemption for sales and use tax available under Wis. Stat. Sec. 77.54(9m) applies where available. The contractor shall provide all necessary documentation as required by the State of Wisconsin and the City of Madison to comply with this exemption.

See link to Wisconsin Department of Revenue Tax Bulletin, January 2016, Number 192 and 2015 Wis. Act 126 for additional information.

Contractors wishing to sub contract with a non-union Small Business Enterprise (SBE) may encourage the non-union SBE subcontractor to consider entering into a Project Labor Agreement with the subject union specific to the Fire Station 14 project, to enable the General Contractor to count the participation of the non-union SBE for SBE Goal achievement. Interested SBE Subcontractors may contact the Executive Director, Building and Construction Trades Council of South Central Wisconsin at btrades@sbcglobal.net or at (608) 256-3161 to discuss entering into such an agreement.

SECTION 102.12: BEST VALUE CONTRACTING

This Contract shall be considered a Best Value Contract if the Contractor's bid is equal to or greater than $59,000 for a single trade contract; or equal to or greater than $288,000 for a multi-trade contract pursuant to MGO 33.07(7).

ARTICLE 103 AWARD AND EXECUTION OF THE CONTRACT

The awarded Contractor shall completely execute the signing of all contract documents and submit them to City Engineering (Attn: Alane Boutelle, 1600 Emil Street, Madison, WI 53703) prior to **12:00pm on Thursday, January 18, 2018**. Delays by the Contractor in submitting the required completed contract documents will not adjust the project completion date.

The Payment and Performance Bonds shall be dated no sooner than Wednesday, January 17, 2018.

The bidder must completely fill in the base bid and the alternate. After the initial bid advertisement and prior to bid opening the City will establish a Construction Budget Dollar Value. If any responsible bidder submits a base bid plus alternate one (1) that is below the Construction Budget Dollar Value, the City will award the contract based on the base bid plus alternate one (1). If the above is not satisfied, the contract shall be awarded based on the base bid only. The City shall have the right to proceed or not proceed with alternate one (1) regardless of how the bid was awarded. The City shall have the right to reject all bids regardless of the value of the bids submitted.

REF DOC 2 - 2013 Geotechnical Report: Entitled Preliminary Geotechnical Exploration Report - Proposed Fire Station No. 14 & Fire Training Facility, dated August 9, 2013, prepared by CGC, Inc.
REF DOC 3 - 2017 Addendum to Geotechnical Report: Entitled Geotechnical Exploration Report - Proposed Fire Station No. 14, dated July 13, 2017, prepared by CGC, Inc.
REF Doc 4 - Seismic Testing Report: Entitled Seismic Site Classification at the Proposed Madison Fire Station, Madison, Wisconsin, dated August 3, 2017, prepared by GEI Consultants.
REF Doc 5 - Helical Pier Bore and Geotechnical Report: Entitled Supplemental Geotechnical Exploration Report Proposed Fire Station No. 14 - Helical Pier Alternative, dated September 26, 2017, prepared by CGC, Inc.

SECTION 105.5 INSPECTION OF WORK

The Contractor shall coordinate directly with any and all regulatory agencies having jurisdiction over the licensing, permitting, and inspection of work as described in the construction documents.

All Contractors shall be familiar with Specification 01 45 16 – Field Quality Control Procedures regarding City of Madison policies and procedures for Quality Assurance and Quality Control.

SECTION 105.6 CONTRACTORS RESPONSIBILITY FOR WORK

The Contractor shall not take advantage of any discrepancy in the plans or specifications. This shall include but not be limited to apparent errors, omissions, and interpretations involving codes, regulations, and standards.

Any Contractor who identifies such a discrepancy during the bidding process shall notify the Project Architect and City Project Manager of the discrepancy prior to the "Questions and Clarifications Deadline" as noted in Section A of the bid documents.

Any Contractor who identifies such a discrepancy after the bidding process and/or after contract signing shall immediately notify the Project Architect and City Project Manager in writing and request clarification on how to proceed. See Specification 01 26 13 – Request for Information (RFI).

SECTION 105.7 CONTRACT DOCUMENTS

The General Contractor is responsible for reproducing all construction documents necessary to complete the Work at their own cost. This shall include plans, specifications, addenda for the General Contractor and all Sub-contractors.

SECTION 105.9 SURVEYS, POINTS, AND INSTRUCTIONS

The General Contractor is responsible for providing all survey, benchmarks, points, and elevations required for this project. City will provide corners and benchmark for verification purposes.

SECTION 105.12 COOPERATION BY THE CONTRACTOR

The Contractor shall notify adjacent property owners for any work affecting neighboring facilities. Contractor shall provide sufficient notification time to avoid any disruption to neighboring facility operations.

The City will have additional separate construction and vendor contracts in process concurrent with the duration of this contract. This work includes fiber optic installation, audio-visual equipment, plymovent installation, USDD installation and furniture installation. City will coordinate with the Contractor on these items so as not to adversely affect the work of this contract.

Periodically there may be request for tours of the building project, by persons not directly related to the design/construction project, while under construction. The City will coordinate/lead the tours and intends

The Contractor shall be responsible for compliance with all required permits including the City of Madison Erosion Control permit and the Wisconsin Department of Natural Resources WRAPP Storm Water NOI permit.

The Contractor shall be responsible for any fines issued due to non-compliance with the project permits.

Prior to beginning work in the public right of ways, the Contractor shall review all plans with the City's Project/Construction Manager and obtain the City of Madison's "Application to Excavate in Public Right-Of-Way Connect to City Sanitary And/Or Storm Sewer" and "Street Occupancy Permit". The applications are located at http://www.cityofmadison.com/engineering/permits.cfm and http://www.cityofmadison.com/development-services-center/land-development/public-right-of-way/street-occupancy . The City will provide inspections and pay for all City inspections in the public right-of-way. The City will also pay the application fees.

Contractor is responsible for coordinating all inspections related to all permits and licenses. Re-inspection fees associated with non-complaint or incomplete work shall be the responsibility of the Contractor.

SECTION 109.7 TIME OF COMPLETION

Work shall only begin after the contract is completely executed and the start work letter is received. It is anticipated that the start work letter shall be issued on or about February 5, 2018.

The Contractor shall review Specifications 01 29 76 Progress Payment Procedures and 01 77 00 Closeout Procedures and be completely familiar with the progress payment milestones and definitions related to construction closeout and contract closeout.

The Contractor shall have reached a level of Construction Closeout **NO LATER THAN Friday, December 21, 2018**. This milestone by definition of the specifications includes Owner Occupancy of all spaces.

SECTION 109.9 LIQUIDATED DAMAGES

The fixed, agreed upon, liquidated damages for failure to complete all work within the Contract Time, shall be calculated in accordance with Article 109 of Standard Specifications.

SECTION 110.2: PARTIAL PAYMENTS

The City reserves the right to pay the Contractor with checks that are made payable to the Contractor and one or more subcontractors. In addition, pursuant to the requirements of Wis. Stat. Sec. 779.15, the City may also directly pay a subcontractor to satisfy a valid public improvement lien.

SECTION 207 SEEDING

Follow Project Specification 32 9219 Seeding with the following exception for: No Mow Turf w/annual rye. Seeding rate was incorrect based on producer's website. Revised to 5lbs per 1,000 SF or 220lbs per acre instead of 5lbs per acre. Seeding window was revised to meet producer's recommendations and to reduce weed competition. Revised to late August – Mid October instead of April 15 to September 15th and after October 15th to snow cover.

SECTION 208 SODDING

Follow Project Specification 32 9223 Sodding with the following exception for: Provide specific sod selection from local producer for Kentucky bluegrass and fescue blend that will be more drought tolerant and better blend with No Mow seeded area. Specified sod is "Black Beauty Tall Fescue Kentucky Bluegrass" from Paul's Turf and Tree Nursery of Marshall, WI

Project Manual

Madison Fire Station 14

City of Madison Fire Department

Bid Documents

Volume 1 of 2

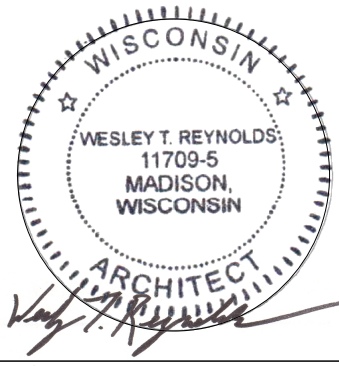
November 3, 2017

Madison Project No. 17451
Madison Contract No. 8027
OPN Project No. 17207000

OPN ARCHITECTS

ARCHITECT OF RECORD:

OPN ARCHITECTS



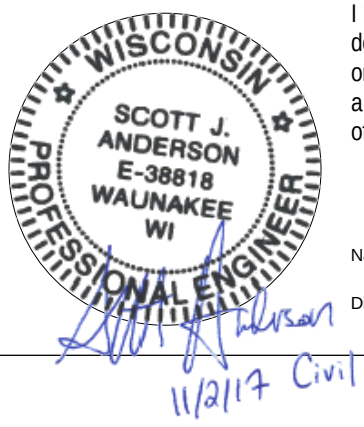
I hereby certify these plans and specifications were prepared by me or under my direct personal supervision and that I am a duly Registered Architect under the laws of the State of Wisconsin.

Name: WESLEY REYNOLDS

Dicipline: ARCHITECT

CIVIL ENGINEER:

SNYDER & ASSOCIATES, INC.



I hereby certify that this civil engineering document and the related work was prepared by me or under my direct personal supervision and that I am a duly licensed Professional Engineer under the laws of the State of Wisconsin.

Name: SCOTT ANDERSON

Dicipline: CIVIL ENGINEER

STRUCTURAL ENGINEER:

IMEG CORP.

I hereby certify that this engineering document was prepared by me or under my direct supervision and that I am a duly licensed Professional Engineer under the laws of the State of Wisconsin.

Name: ABBY A. PERTZBORN

Dicipline: STRUCTURAL ENGINEER

MECHANICAL / ELECTRICAL ENGINEER:

IMEG CORP.

I hereby certify that this engineering document was prepared by me or under my direct supervision and that I am a duly licensed Professional Engineer under the laws of the State of Wisconsin.

Name: PAUL HANSEN

Dicipline: MECHANICAL ENGINEER

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DIVISION 22 - PLUMBING

DIVISION 23 – HEATING, VENTILATING, AND AIR-CONDITIONING (HVAC)

DIVISION 26 – ELECTRICAL

SECTION 00 31 00

AVAILABLE PROJECT INFORMATION

PART 1 GENERAL

1.1 EXISTING CONDITIONS

A. Copies of the following reports are provided for infomational purposes:
   1. Wetland Delineation Report: Entitled Wetland Delineation Report - Fire Station #14, dated August 8, 2013, prepared by NES Ecological Services.
      a. A copy of this report is included after this section.
   2. 2013 Geotechnical Report: Entitled Preliminary Geotechnical Exploration Report - Proposed Fire Station No. 14 & Fire Training Facility, dated August 9, 2013, prepared by CGC, Inc.
      a. A copy of this report is included after this section.
   3. 2017 Addendum to Geotechnical Report: Entitled Geotechnical Exploration Report - Proposed Fire Station No. 14, dated July 13, 2017, prepared by CGC, Inc.
      a. A copy of this report is included after this section.
   4. Siesmic Testing Report: Entitled Seismic Site Classification at the Proposed Madison Fire Station, Madison, Wisconsin, dated August 3, 2017, prepared by GEI Consultants.
      a. A copy of this report is included after this section.
   5. Helical Pier Bore and Geotechnical Report: Entitled Supplemental Geotechnical Exploration Report Proposed Fire Station No. 14 - Helical Pier Alternative, dated September 26, 2017, prepared by CGC, Inc.
      a. A copy of this report is included after this section.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

WETLAND DELINEATION REPORT
FIRE STATION #14

Prepared for

City of Madison - Engineering
210 Martin Luther King Jr. Boulevard, Room 406
Madison, Wisconsin 53703-3345
Project #15220004

Authored By:

Theresa Stantz

August 8, 2013

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Fax: 920-662-9141
www.neswi.com

NES ECOLOGICAL SERVICES
A Division of Robert E. Lee & Associates, Inc.

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INTRODUCTION

NES Ecological Services (NES) – A Division of Robert E. Lee & Associates, Inc., under contract with the City of Madison, conducted a wetland delineation within the Fourth Addition to World Dairy Center (Lots 34,35,36, Part of Lot 51, 52 & 53) in the City of Madison, Dane County, Wisconsin (Appendix A). The area investigated is approximately 14.6 acres in size and contains approximately 0.49 acre of wetland. The delineation was conducted to detect wetland resources that may be impacted during the construction of a proposed municipal fire station and training center.

NES is a natural resources firm focusing entirely on issues associated with wetlands, native habitat restoration and wildlife management. NES staffs ecologists specializing in wetlands, botany, and wildlife who are well qualified to assist individuals, companies, and municipalities with a variety of wetland services, ecological surveys, natural resource planning, and native habitat restoration projects. The wetland ecologists involved with this project are Theran Stautz and Troy Anderson. Mr. Stautz has a B.S. in Forest Science and over seven years of wetland delineation, monitoring and restoration experience. Mr. Anderson has fifteen years of restoration ecology experience.

Mr. Stautz is a Wisconsin Department of Natural Resources (WDNR) Assured Wetland Delineator.

PRE-FIELD REVIEW

An initial review of the United States Geological Survey (USGS) Topographic Map (National Geographic Society, 2013), the Wisconsin Department of Natural Resources (WDNR) Surface Water Data Viewer (2013), 1995, 2000, 2005 and 2010 Dane County orthophotos, the Natural Resource Conservation Service (NRCS) Web Soil Survey (2013), the NRCS Official Soil Series Descriptions, and the NRCS Hydric Soils List of Wisconsin was performed prior to the wetland delineation in order to gain familiarity with the site's topography, existing wetland vegetation and soils data.

Topography

The USGS topographic map indicates the project area is flat (Appendix A).

Past Land Uses

Based on the 1995 and 2000 aerial photographs, it appears that several businesses occupied the project area. Several lots are cleared in the 2005 photograph and Dairy Drive has been constructed. The 2010 photograph indicates that all the lots have gone fallow.

Wetland Mapping

The WDNR Wetlands Inventory indicates the presence of a forested/emergent wetland (T3/E1K) and narrow-leaved emergent wetland (E2K) within the project area (Appendix B).

Mapped Soils

The NRCS Web Soil Survey indicates the presence of five soil series within the site (Table 1 and Appendix B). A description of these soils can be found in Appendix C.

Table 1. Mapped Soil Units within Project Area.

Soil Series	Hydric Inclusion*	Drainage	Percent Composition On-Site**
Houghton muck (Ho) †	--	Very poorly drained	9.2
Palms muck (Pa) †	--	Very poorly drained	0.6
Sable silty clay loam, 0-3% slopes (SaA) †	--	Poorly drained	24.7
Virgil silt loam, gravelly substratum 0-3% slopes (VwA)	Wetter soils	Somewhat poorly drained	45.9
Wacousta silty clay loam (Wa) †	--	Very poorly drained	19.5

* NRCS Wisconsin Hydric Soils List (2013)
**Source: Calculated using NRCS Web Soil Survey website (2013).
† NRCS Listed Hydric Soil

Precipitation

The wetland delineation was conducted during the middle part of the growing season, which tends to be a drier period due to less frequent precipitation events and increased evapotranspiration. Based on the data displayed in Table 2, the summer of 2013 was much wetter than normal (102%). In the two weeks prior to conducting field work, 1.66" of precipitation was recorded.

Table 2. Summary of Precipitation between April and June, 2013 in the Madison Area, Wisconsin.

Category	April	May	June
Recorded Precipitation	5.83	6.57	10.86
Average Monthly Precipitation	3.40	3.55	4.54
Amount Above/Below Average	+2.43	+3.02	+6.32

Precipitation values are measured in inches
Source: National Weather Service website – 2013 (Appendix D).

METHODOLOGY

Wetland boundaries were established based on a combination of the routine and comprehensive wetland delineation method as defined in the *Regional Supplement to the 1987 Corps of Engineers Wetland Delineation Manual: Northcentral and Northeast Regions* (NC/NE Supplement) (USACE ERDC, 2012).

Equipment & Materials Utilized:
Base Maps
NC/NE Supplement Data Forms
Compass
25-foot tape
Soil Auger
Sharp Shooter Spade
Munsell Soil Color Charts (Munsell Color, 2010)

Vegetation, soils and hydrology data were collected and recorded on NC/NE Supplement Data Forms (Appendix E) at a total of nine sample plots. These plots were chosen because NES felt they adequately covered and characterized the subject areas.

Vegetation

At each sample plot, the percent cover for each species within the vicinity of the plot was visually estimated and recorded on the NC/NE Supplement data forms. Herbaceous, shrub/sapling/vine and tree layers were measured within 5-foot, 15-foot and 30-foot radius plots, respectively. Dominant species were then determined by applying the 50/20 rule and Prevalence Index and their wetland indicator status was taken from *The National Wetland Plant List: 2013 wetland ratings* (Lichvar, 2013). After the indicators were applied, a decision regarding the dominance of hydrophytic vegetation was made.

Soils

At the sample plots, a soil pit was dug with a spade to a depth of at least 20", where possible. One plot could not to be excavated to that depth due to the presence of compacted soil. The presence and abundance of mottling, matrix color, and texture were then recorded for each of the soils found. The Munsell Soil Color Charts were used to determine the hue, value and chroma of all soils that were observed when moist.

The profiles were also observed to determine the presence of hydric indicators that are listed in the NC/NE Supplement. The presence or absence of these indicators was then used to determine if hydric soils exist at the sample plot.

Hydrology

Prior to conducting the on-site investigation, all available background data were reviewed to determine the presence of saturated soil conditions or standing water. If present, surface water depths were measured and recorded at each sample plot; however, if standing water was absent, the presence of free standing water and/or soil saturation within the excavated soil pit was measured. Soil pits are typically left open for at least one hour prior to recording data. In addition to measuring water depths, the site was investigated for other primary and secondary indicators listed on the data forms.

RESULTS

Site Description

Current Land Uses

The project area is located in a fallow area north of Femrite Drive and on the east and west sides of Dairy Drive. Several gravel roads and concrete pads remain from the business that was formerly on-site.

Water Features/Hydrology

Primary wetland hydrology indicators A1 (Surface Water), A2 (High Water Table), A3 (Saturation), C1 (Hydrogen Sulfide Odor) and/or C3 (Oxidized Rhizospheres along Living Roots) were present at the wetland plots during the investigation. Secondary wetland hydrology indicators D2 (Geomorphic Position) and D5 (FAC-Neutral Test) were also present.

Soils

Two wetland plots matched the A4 (Hydrogen Sulfide) and one plot matched the F6 (Redox Dark Surface) Hydric Soil Indicators.

One upland plot matched the A12 (Thick Dark Surface) Hydric Soil Indicator, but it was considered a relic due to the lack of wetland hydrology during an extremely wet period.

Plant Communities

Five communities (three upland and two wetland) were identified on-site (Table 3).

Table 3. Summary of Plant Communities.

Upland Communities	Wetland Communities
Fallow Field	Wet Meadow
Forest	
Meadow	

Findings

Wetland Communities

The delineation conducted by NES during a site visit on July 17, 2013 resulted in the identification of one wetland (Appendix F).

Wetland 1, a wet meadow (E2K), is 0.49 acre in size (Plots 2, 5 and 7). The wetland corresponds with the emergent wetland mapped by the Wisconsin Wetland Inventory.

Plot 2: Dominant vegetation is *Phalaris arundinacea*. The Dominance Test and Prevalence Index is 100% and 2.020. Surface water is 1 inch deep. Primary wetland hydrology indicators A1, A2, A3 & C3 and secondary indicators D2 & D5 are present. The soil matches the F6 NRCS Hydric Soil Indicator.

Plot 5: Dominant vegetation is *P. arundinacea*. The Dominance Test and Prevalence Index is 100% and 2.000. The water table is present at 13 inches and saturation is present at 10 inches below the surface. Primary wetland hydrology indicators A3 & C1 and secondary indicators D2 & D5 are present. The soil matches the A4 NRCS Hydric Soil Indicator.

Photo 1 – Wetland 1, looking west from Agriculture Drive.

Photo 2 – Wetland 1, looking east from Plot 5.

Plot 7: Dominant vegetation is *P. arundinacea*. The Dominance Test and Prevalence Index is 75% and 2.039. Surface water is 2 inches deep. Primary wetland hydrology indicators A1, A2, A3 & C1 and secondary indicators D2 & D5 are present. The soil matches the A4 NRCS Hydric Soil Indicator.

The wetland boundary was established based on wetland hydrology, hydric soil, topography and professional judgment.

Photo 3 – Wetland 1, looking south from NE corner of project area.

CONCLUSION

Wetland boundaries established on the property are NES' best estimate of their locations based upon the conditions and field indicators observed at the time of our site investigation. Our wetland boundaries are seldom changed; however, the regulating agencies (USACE, WDNR and other local governing units) decide their ultimate location. As a result, our wetland boundaries could be adjusted slightly during an agency review. Weather factors and the time of year reviewed are just two factors that could change a wetland's appearance and result in a boundary change. Because changes could occur, it is NES' policy to recommend to all our clients that they receive agency concurrence from both the WDNR and the USACE.

However, since Mr. Stautz is a Professional Wetland Delineator assured by the WDNR, he will not need WDNR concurrence. The WDNR has thoroughly reviewed his education, field experience and report preparation capabilities and accepted him into their program, which means automatic concurrence on any project in which he is the lead field investigator and report author. As part of the program requirements, however, he is still required to send a copy of the report to the WDNR in Madison. Unfortunately, the USACE does not yet have a similar program so we will send them a copy of the report to ensure they agree with the wetland boundary established by NES. Agency concurrence will also guarantee that this delineation is valid for the next five years.

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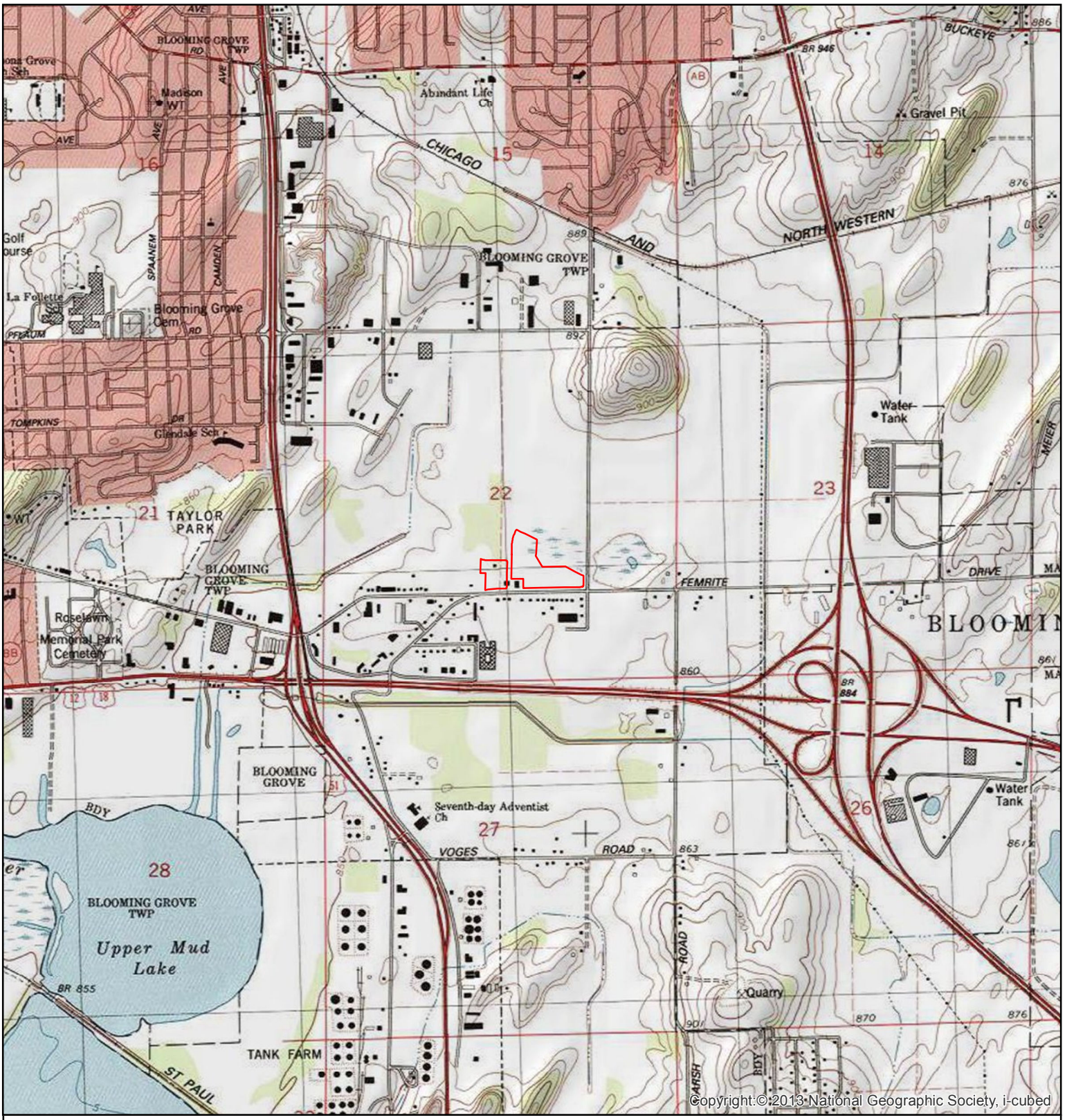
A

APPENDIX A

Site Location



Legend

Project Area (+/- 14.6 acres)

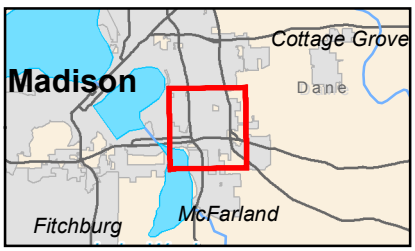
Located in part of the S 1/2,
Section 22, T7N, R10E,
City of Madison, Dane County,
Wisconsin

0 1,000 2,000
Feet

Document Path: Z:\Data\Jobs\Wetlands\Madison, City of\Fire Station 4\Maps\AppA.mxd

Appendix A
Site Location

City of Madison
Fire Station #14
Project No. 15220004
City of Madison, Dane County, Wisconsin



Extent of large view shown in red.

N

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August 6, 2013

B

APPENDIX B

Soil Survey of Dane County and Wisconsin Wetland Inventory

Legend

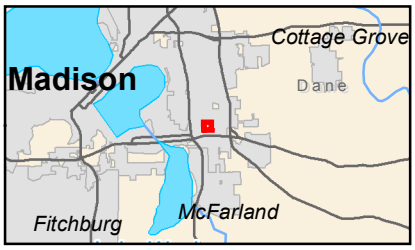
- Project Area (+/- 14.6 acres)
- Soil Map Unit
- Upland
- Wetland
- Filled or Drained Wetland

0 100 200

Feet

Appendix B
Soil Survey of Dane County and Wisconsin Wetland Inventory

City of Madison
Fire Station #14
Project No. 15220004
City of Madison, Dane County, Wisconsin



Extent of large view shown in red.

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August 6, 2013

C

APPENDIX C

Natural Resource Conservation Service Official Soil Series Descriptions

LOCATION HOUGHTON MI+IA IL IN MN WI

Established Series
Rev. LWB-WEF-RAB
06/2011

HOUGHTON SERIES

The Houghton series consists of very deep, very poorly drained soils formed in herbaceous organic materials more than 130 cm (51 inches) thick in depressions on lake plains, outwash plains, ground moraines, end moraines, and floodplains. Slope ranges from 0 to 2 percent. Mean annual precipitation is about 889 mm (35 inches), and mean annual temperature is about 10.0 degrees C (50 degrees F).

TAXONOMIC CLASS: Euic, mesic Typic Haplosaprists

TYPICAL PEDON: Houghton muck, on a level area in a cultivated field. (Colors are for moist soils unless otherwise stated.)

Oa1--0 to 23 cm (9 inches); black (N 2.5/) broken face and rubbed muck (sapric material); about 5 percent fiber, a trace rubbed; weak coarse subangular blocky structure; neutral [pH 7.0 in KCl]; abrupt smooth boundary.

Oa2--23 to 33 cm (9 to 13 inches); black (N 2.5/) broken face, very dark brown (7.5YR 2/2) rubbed muck (sapric material); about 5 percent fiber, a trace rubbed; weak medium granular structure; neutral [pH 7.0 in KCl]; abrupt smooth boundary.

Oa3--33 to 61 cm (13 to 24 inches); dark reddish brown (5YR 3/2) broken face, dark reddish brown (5YR 2/2) rubbed muck (sapric material); about 15 percent fiber, less than 5 percent rubbed; massive, breaking to thick platy fragments; neutral [pH 7.0 KCl]; abrupt smooth boundary.

Oa4--61 to 81 cm (24 to 32 inches); black (5YR 2/1) broken face and rubbed muck (sapric material); about 10 percent fiber, a trace rubbed; massive; about 1 percent woody fragments; neutral [pH 7.0 in KCl]; clear wavy boundary.

Oa5--81 to 122 cm (32 to 48 inches); dark reddish brown (5YR 2/2) broken face, black (5YR 2/1) rubbed muck (Sapric material); about 20 percent fiber, less than 10 percent rubbed; massive, breaking to thick platy fragments; neutral [pH 7.0 in KCl]; abrupt smooth boundary.

Oa6--122 to 203 cm (48 to 80 inches); dark reddish brown (5YR 2/2) broken face and rubbed muck (sapric material); about 10 percent fiber, less than 10 percent rubbed; massive; slightly sticky; about 15 percent mineral soil; neutral [pH 7.0 in KCl].

TYPE LOCATION: Clinton County, Michigan; about 3 miles northeast of the village of Bath; 200 feet north and 400 feet east of the southwest corner of sec. 12, T. 5 N., R. 1 W.; USGS Bath topographic quadrangle; lat. 42 degrees 49 minutes 43.4 seconds N. and long. 84 degrees 52 minutes 56.9 seconds W.; NAD 27.

RANGE IN CHARACTERISTICS:
Thickness of the organic material: more than 130 cm (51 inches)
Organic fibers: derived primarily from herbaceous plants, but some layers contain as much as 30 percent woody material
Woody fragment content: averages less than 15 percent by volume in the control section
Reaction: very strongly acid to slightly alkaline throughout

Oa horizon:
Hue: 5YR to 10YR, or is neutral
Value: 2, 2.5 or 3
Chroma: 0 to 3
Organic material: dominantly muck (sapric material), or to lesser extent mucky peat (hemic material) that has a combined thickness of less than 25 cm (10 inches) or peat (fibric material) that is less than 13 cm (5 inches) thick

Some pedons have coprogenous material or marly material below 130 cm (51 inches).

COMPETING SERIES: These are the Carlisle, Catden, Lena, Peteetneet, Saltese, and Semiahmoo series. Carlisle soils derived dominantly from woody materials and contain an average of 15 to 30 percent woody fragments in the control section. Lena soils contain carbonates throughout the control section. Peteetneet soils are not massive in the bottom tier. Saltese soils have lenses of diatomaceous earth and volcanic ash within a depth of 130 cm (51 inches). Semiahmoo soils are in areas with warm dry summers and mild moist winters, and typically are more acidic throughout the control section.

GEOGRAPHIC SETTING: Houghton soils are in closed depressions on lake plains, outwash plains, ground moraines, end moraines, and flood plains. Slope gradients are less than 2 percent. Houghton soils formed in herbaceous organic materials more than 130 cm (51 inches) thick. Mean annual precipitation ranges from 762 to 1067 mm (30 to 42 inches). Mean annual temperature ranges from 8.9 to 11.7 degrees C (48 to 53 degrees F).

GEOGRAPHICALLY ASSOCIATED SOILS: These are the Adrian, Edselton, Edwards, Moston, Muskego, Palms, and Willette soils. Edselton and Edwards soils are underlain by marly material at depths of 41 to 130 cm (16 to 51 inches). Moston, and Muskego soils are underlain by coprogenous material at depths of 41 to 130 cm (16 to 51 inches). Poorly or very poorly drained mineral soils are commonly associated along the margins of the bogs.

DRAINAGE AND SATURATED HYDRAULIC CONDUCTIVITY: Very poorly drained. Depth to the seasonal high water table ranges from 61 cm (2 feet) above the surface in ponded phases to 30 cm (1 foot) below the surface between September and June in normal years. Potential for surface runoff is very slow or ponded. Saturated hydraulic conductivity is moderately high or high. Permeability is moderately slow to moderately rapid.

USE AND VEGETATION: A considerable area of these soils is used for cropland or pasture. Common

crops are onions, lettuce, potatoes, celery, radishes, carrots, mint, and some corn. Native vegetation is primarily of marsh grasses, sedges, reeds, buttonbrush, and cattails, with some water-tolerant trees near the margins of the bogs.

DISTRIBUTION AND EXTENT: Mostly in MLRAs 95B, 98, 111B, and 111C, and to lesser extent in MLRAs 89, 95A, 96, 97, 99, 103, 104, 105, 108A, 108B, 108C, 110, 111A, 111C, 111D, and 115C in Michigan, Wisconsin, Indiana, Iowa, Minnesota, and Illinois. The series is of large extent.

MLRA SOIL SURVEY REGIONAL OFFICE (MO) RESPONSIBLE: Indianapolis, Indiana.

SERIES ESTABLISHED: Roscommon County, Michigan, 1924.

REMARKS: Diagnostic horizons and features recognized in this pedon are:
Muck (sapric material): from the surface to a depth of 203 cm (80 inches) (Oa1, Oa2, Oa3, Oa4, Oa5, Oa6 horizons).

ADDITIONAL DATA: Soil Interpretation Record - (MI0024, MI0291 (PONEED), MI0532 (SLOPING), MI0390 (MAAT>50), MI0383 (FREQUENTLY FLOODED).

National Cooperative Soil Survey
U.S.A.

LOCATION PALMS MI+IA IL IN MA MN NY PA VA WI

Established Series
Rev. LWB-WEF-DAG
08/2012

PALMS SERIES

The Palms series consist of very deep, very poorly drained soils formed in herbaceous organic materials 41 to 130 cm (16 to 51 inches) thick and the underlying loamy deposits in closed depressions on moraines, lake plains, till plains, outwash plains, and hillside seep areas, and on backswamps of flood plains. Slope ranges from 0 to 6 percent. Mean annual precipitation is about 889 mm (35 inches), and mean annual temperature is about 10.0 degrees C (50 degrees F).

TAXONOMIC CLASS: Loamy, mixed, euic, mesic Terric Haplosaprists

TYPICAL PEDON: Palms muck, on 1 percent slope under marsh vegetation at an elevation of 198 meters (648 feet) above mean sea level. (Colors are for moist soil unless otherwise stated.)

Oa1--0 to 36 cm (14 inches); black (10YR 2/1) broken face and rubbed muck (sapric material); about 5 percent fiber, less than 5 percent rubbed; moderate medium granular structure; slightly sticky; about 20 to 25 percent mineral material; slightly acid [pH 6.5 in water]; abrupt smooth boundary.

Oa2--36 to 71 cm (14 to 28 inches); black (10YR 2/1) broken face and rubbed muck (sapric material); about 5 percent fiber, less than 5 percent rubbed; massive parting to weak coarse subangular blocky structure; slightly sticky; 10 to 20 percent mineral material; strongly acid [pH 5.5 in water]; clear smooth boundary.

Oa3--71 to 89 cm (28 to 35 inches); black (N 2.5/) rubbed muck (sapric material); about 5 percent fiber, less than 5 percent rubbed; massive; slightly sticky; 10 to 20 percent mineral material; moderately acid [pH 6.0 in water]; abrupt smooth boundary. [Combined thickness of the Oa horizon is 41 to 130 cm (16 to 51 inches).]

Cg--89 to 203 cm (35 to 80 inches); gray (10YR 5/1) clay loam; massive; friable; common medium distinct dark yellowish brown (10YR 4/4) masses of oxidized iron in the matrix; neutral in upper part, slightly effervescent; moderately alkaline in lower part.

TYPE LOCATION: Gratiot County, Michigan; north of the flood plain of the Maple River and about 200 feet south of the upland; 1,420 feet south and 820 feet west of the northeast corner of sec. 27, T. 9 N., R. 2 W.; USGS Pompeli topographic quadrangle; lat. 43 degrees 8 minutes 31.3 seconds N. and long. 84 degrees 31 minutes 34.7 seconds W., NAD 27; UTM Zone 16, 701165 easting and 4779557 northing, NAD 83.

RANGE IN CHARACTERISTICS:
Depth to the loamy C horizon: 41 to 130 cm (16 to 51 inches)

Organic material: derived primarily from herbaceous plants, but some layers contain as much as 15 percent woody material

Surface tier (Oa1 or Oap horizon):
Hue: 5YR to 10YR, or is neutral
Value: 2, 2.5, or 3
Chroma: 0 to 2
Organic material: dominantly muck (sapric material), or less commonly mucky peat (hemic material)
Reaction: strongly acid to slightly alkaline

Subsurface and bottom tiers (Oa, Oe, or Oi horizons):
Hue: 5YR to 10YR, or is neutral
Value: 2 to 4
Chroma: 0 to 3
Organic material: some pedons have thin layers less than 25 cm (10 inches) thick of mucky peat (hemic material) or thin layers less than 13 cm (5 inches) thick of fibric material; some pedons have a thin layer of sedimentary peat above the C horizon.
Reaction: strongly acid to slightly alkaline, some pedons have carbonates

Some pedons have a thin A horizon above the C horizon.

C or Cg horizon:
Hue: 10YR to 5Y, 5GY, or is neutral
Value: 3 to 7
Chroma: 0 to 4
Texture: loamy very fine sand, sandy loam, fine sandy loam, loam, silt loam, silty clay loam, clay loam, or sandy clay loam, or the gravelly analogues of these textures; thin strata of fine sand, loamy sand, or silt in some pedons
Clay content: upper 30 cm (12 inches) averages between 10 and 35 percent clay
Rock fragment content: 0 to 25 percent gravel to stones
Reaction: moderately acid to moderately alkaline; some pedons contain carbonates

Sandy substratum, gravelly substratum, and overwash phases are recognized.

COMPETING SERIES: These are the Klossner, Linwood, Medo, Natchaug, Philbon, and Shalcar series. Klossner soils have A horizons directly below the organic matter that is more than 20 cm (8 inches) thick. Linwood soils formed mainly in woody fibers. Medo soils have less than 10 percent clay in the lower one third of the series control section. Natchaug soils are in areas where the mean annual precipitation is greater than 1092 mm (43 inches). Philbon soils have dominantly fibric and hemic material in the upper 30 cm (12 inches). Shalcar soils have a difference between mean annual summer and mean annual winter temperatures that is less than 26 degrees F.

GEOGRAPHIC SETTING: Palms soils are in closed depressions on lake plains, till plains, outwash plains, moraines, and hillside seep areas, and in backswamps on flood plains. Slope ranges from 0 to 6 percent. Palms soils formed herbaceous organic materials and the underlying loamy deposits. The soils on nearby uplands are generally loamy. Mean annual temperature ranges from 8.9 to 11.7 degrees C (48 to 53 degrees F). Mean

annual precipitation ranges from 762 to 1092 mm (30 to 43 inches). Frost-free period is 120 to 180 days. Elevation is 177 to 466 meters (580 to 1,530 feet) above mean sea level.

GEOGRAPHICALLY ASSOCIATED SOILS: The Houghton soils are the most common associate and are on similar landform positions. Poorly drained or very poorly drained loamy mineral soils are at the edges of the bogs and are adjacent to Palms soils.

DRAINAGE AND SATURATED HYDRAULIC CONDUCTIVITY: Very poorly drained. Depth to the top of an apparent seasonal high water table ranges from 30 cm (1 foot) above the surface to 30 cm (1 foot) below the surface between November and May in normal years. Potential for surface runoff is negligible. Saturated hydraulic conductivity is moderately high or high in the organic material and moderately high in the loamy material. Permeability is moderately slow to moderately rapid in the organic material and moderate or moderately slow in the loamy material.

USE AND VEGETATION: Most areas of this soil are in marsh vegetation of grasses, reeds, and sedges; and alder, aspen, willow, and dogwood. Some areas have been drained and are used for pasture, corn, and some truck crops.

DISTRIBUTION AND EXTENT: MLRAs 89, 95A, 95B, 97, 98, 99, 101, 102A, 103, 104, 105, 108A, 108B, 110, 111A, 111B, 111C, 111D, 115C, 127, 140, 142, 144A, 144B, and 145 in the southern parts of lower Michigan, Wisconsin, Illinois, Indiana, Iowa, Massachusetts, Minnesota, New York, and other northeastern states. The series is of large extent.

MLRA SOIL SURVEY REGIONAL OFFICE (MO) RESPONSIBLE: AMHERST, MASSACHUSETTS

SERIES ESTABLISHED: Sanilac County, Michigan; 1955.

REMARKS: Diagnostic horizons and features recognized in this pedon are:
Muck (sapric material) from the surface to a depth of 89 cm (35 inches) (Oa1, Oa2, and Oa3 horizons).
Terric feature: mineral material from a depth of 89 to 203 cm (35 to 80 inches) (Cg horizon).

ADDITIONAL DATA: Lab characterization data is available from the National Soil Survey Laboratory, Lincoln, NE.

National Cooperative Soil Survey
U.S.A.

LOCATION SABLE IL+IA IN WI

Established Series
Rev. JCD-KDH-AAC
02/2011

SABLE SERIES

The Sable series consists of very deep, poorly drained, moderately permeable soils formed in loess on nearly level broad summits of moraines and stream terraces. Slope ranges from 0 to 2 percent. Mean annual temperature is about 10.6 degrees C (51 degrees F)., and mean annual precipitation is about 889 mm (35 inches).

TAXONOMIC CLASS: Fine-silty, mixed, superactive, mesic Typic Endoaquolls

TYPICAL PEDON: Sable silty clay loam - nearly level in a cultivated field at an elevation of about 223 meters (732 feet) above mean sea level. (Colors are for moist soil unless otherwise stated.)

Ap--0 to 20 cm (0 to 8 inches); black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry; moderate fine and medium granular structure; firm; moderately acid; abrupt smooth boundary.

A--20 to 48 cm (8 to 19 inches); black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry; moderate very fine angular blocky structure; firm; few fine spherical dark reddish brown (5YR 3/2) very weakly cemented iron-manganese concretions throughout; slightly acid; clear smooth boundary. [Combined thickness of A horizon ranges from 25 to 51 cm (10 to 20 inches).]

AB--48 to 58 cm (19 to 23 inches); very dark gray (10YR 3/1) silty clay loam, grayish brown (10YR 5/2) dry; moderate fine angular blocky structure; firm; few faint very dark grayish brown (10YR 3/2) organic coatings on faces of peds; few fine spherical dark reddish brown (5YR 3/2) very weakly cemented iron-manganese concretions throughout; slightly acid; clear smooth boundary.[0 to 15 cm (0 to 6 inches) thick]

Bg--58 to 74 cm (23 to 29 inches); dark gray (10YR 4/1) silty clay loam; moderate fine and medium subangular blocky structure; firm; common faint very dark gray (10YR 3/1) organic coatings on faces of peds; common fine and medium spherical dark reddish brown (5YR 3/2) very weakly cemented iron-manganese concretions throughout; common medium distinct brown (10YR 5/3) masses of oxidized iron-manganese in the matrix; few medium faint dark grayish brown (10YR 4/2) iron depletions in the matrix; neutral; clear smooth boundary.

Btg1--74 to 97 cm (29 to 38 inches); grayish brown (2.5Y 5/2) silty clay loam; moderate medium and coarse subangular blocky structure; firm; few distinct dark gray (10YR 4/1) clay films on faces of peds; many fine and medium spherical dark reddish brown (5YR 3/2) very weakly cemented iron-manganese concretions throughout; many medium prominent yellowish brown (10YR 5/6) masses of oxidized iron in the matrix; neutral; clear wavy boundary.

Btg2--97 to 119 cm (38 to 47 inches); gray (N 5/0) silt loam; weak medium prismatic structure parting to weak medium and coarse angular blocky; firm; few distinct grayish brown (10YR 5/2) clay films on faces of prisms; common fine spherical dark reddish brown (5YR 3/2) very weakly cemented iron-manganese concretions throughout; many medium prominent yellowish brown (10YR 5/6) masses of oxidized iron in the matrix; slightly alkaline; gradual smooth boundary. [Combined thickness of the B horizon ranges from 33 to 117 cm (13 to 46 inches).]

Cg--119 to 152 cm (47 to 60 inches); gray (N 6/0) silt loam; massive; friable; many medium prominent yellowish brown (10YR 5/6) masses of oxidized iron in the matrix; slightly effervescent; slightly alkaline.

TYPE LOCATION: Warren County, Illinois; about 3 miles northwest of Roseville; 97 feet west and 1,281 feet south of the northeast corner, sec. 14, T. 9 N., R. 3 W.; USGS Kirkwood East topographic quadrangle; lat. 40 degrees, 46 minutes, 22.5 seconds N., long. 90 degrees, 41 minutes, 34.2 seconds W.; UTM Zone 15T 0694708 easting and 4516111 northing, NAD 83.

RANGE IN CHARACTERISTICS:
Depth to the base of the cambic horizon: 102 to 152 cm (40 to 60 inches)
Thickness of the mollic epipedon: 31 to 61 cm (12 to 24 inches) and extends into the upper part of the B horizon in some pedons.
Particle-size control section: averages between 27 and 35 percent clay
Average sand content in the series control section: commonly less than 5 percent, but ranges to 8 percent.
Depth to carbonates: greater than 102 cm (40 inches)
Mean annual soil temperature: 8.9 to 13.3 degrees C (48 to 56 degrees F)
Special features: Krotovina are common features in many pedons.

Ap or A horizon:
Hue: 10YR, 2.5Y, 5Y or n (neutral)
Value: 2 to 3
Chroma: 0 or 1
Texture: commonly silty clay loam, but in some pedons it is silt loam.
Clay content: less than 35 percent
Reaction: moderately acid to neutral

AB or BA horizon;
Hue; 10YR, 2.5Y, 5Y or N (neutral)
Value: 2 to 3
Chroma: 0 or 1
Texture: silty clay loam
Reaction: moderately acid to neutral

Btg, Bg, BC, and/or BCg horizons;
Hue: 10YR, 2.5Y, 5Y or N (neutral)
Value: 3 to 6
Chroma: 0 to 2
Texture: silty clay loam in the upper part and silty clay loam or silt loam in the lower part

Clay content: 24 to 35 percent
Reaction: moderately acid to neutral except that the lowest subhorizons in some pedons range to slightly alkaline.
Content of total phosphorous: lowest values in the upper part of the B horizon and is less than 400 ppm.

Cg horizon:
Hue: 10YR, 2.5Y, 5Y or N (neutral)
Value: 3 to 6
Chroma: 0 to 2
Texture: typically silt loam, but includes silty clay loam in the upper part in some pedons.
Clay content: 20 to 28 percent
Reaction: neutral to moderately alkaline
Other features: Some pedons do not have carbonates in the upper part of the Cg horizon.

An overwash phase is recognized where recent deposition from adjacent higher parts of the landscape has buried the original A horizon. A stratified substratum phase is also recognized. (see remarks.)

COMPETING SERIES: These are the Chalmers, Chetomba, Dolbee, Drummer, Dunham, Elpaso, Elvira, Garwin, Gillett Grove, Hartsburg, Madelia, Marcus, Mascoutah, Maxcreek, Maxfield, Maxmore, Ossian, Patton, Pella, Rushmore, and Wacousta series. Chalmers soils have less than 20 percent clay in the lower part of the series control section. Chetomba, Drummer, Dunham, Elpaso, Elvira, Gillett Grove, Maxcreek, Maxfield, Maxmore, Pella, and Rushmore soils average more than 8 percent sand in the lower part of the series control section. Dolbee soils formed in alluvium and have a less systematic increase or decrease in silt- and clay-size particles with depth. Garwin soils are higher in total phosphorus and organic phosphorus, contain less clay films and dark coatings on faces of prisms in the lower part of the B horizons, are lower in iron oxides in the lower part of the B and C horizons, and contain more total clay sized particles to a depth of 152 cm (60 inches). Hartsburg, Madelia, and Wacousta soils have carbonates within a depth of 102 cm (40 inches). Marcus average more than 35 percent clay in the surface layer. Mascoutah and Patton soils have a mean annual soil temperature of more than 13.3 degrees C (56 degrees F). Ossian soils have lower clay content in the upper 76 to 122 cm (2 1/2 to 4 feet) of the sola, have a less pronounced structural development in the B horizon, and in general have a less systematic increase or decrease in silt- and clay-size particles in the sola.

GEOGRAPHIC SETTING: Sable soils are on level or nearly level summits of loess-covered moraines and stream terraces. Typically, they are on broad interstream divides of till plains, and less commonly on unglaciated hills and on terraces. Slope gradients range from 0 to 2 percent. Sable soils formed entirely in loess. Mean annual temperature ranges from 7.8 to 12.2 degrees C (46 to 54 degrees F)., mean annual precipitation ranges from 760 to 1020 mm (30 to 40 inches), frost free days range from 140 to 180 days, and elevation ranges from 104 to 311 meters (340 to 1020 feet) above mean sea level.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the Denny, Ipava, Muscatune, Osco, and Tama soils. The poorly drained Denny soils are in shallow closed depressions and have an albic horizon and an argillic horizon. Also, they contain more than 35 percent clay in the particle-size control section. The somewhat poorly drained Ipava and Muscatune soils are commonly on narrow interstream divides, near the edges of broad divides, or on slightly higher or more sloping positions. The moderately well drained Osco soils and well drained Tama soils are on narrow or rounded crests and more sloping parts of the landscape.

DRAINAGE AND SATURATED HYDRAULIC CONDUCTIVITY: Poorly drained. Where drained, the depth to an apparent seasonal high water table is 15 cm (0.5 foot) above the surface to 31 cm (1.0 foot) below the surface at some time between January and May in most years. In the few remaining undisturbed areas, the depth to an apparent seasonal high water table is 15 cm (0.5 foot) above the surface to 15 cm (0.5 foot) below the surface at some time between November and June of most years. The potential for surface runoff is negligible. Saturated hydraulic conductivity is moderately high to high (4.23 to 14.11 micrometers per second). Permeability is moderate.

USE AND VEGETATION: Most areas are used to grow corn and soybeans. Some areas are used to grow small grain and meadow crops. Native vegetation is marsh grasses and sedges.

DISTRIBUTION AND EXTENT: These soils are in Illinois, Wisconsin, Iowa, and Indiana. Sable soils are extensive, over 608,000 acres have been correlated in MLRAs 95B, 104, 105, 108A, 108B, 110, 111D, and 115C.

MLRA SOIL SURVEY REGIONAL OFFICE (MO) RESPONSIBLE: Indianapolis, Indiana

SERIES ESTABLISHED: Livingston County, Illinois, 1938.

REMARKS: The overwash phase and the stratified substratum phase will be evaluated during the update of MLRA 108 to determine where best to correlate these soils.

Additional Data: For lab analysis refer to Soil Survey Nos. S57IL-94-l-(1-8) in SSIR-19. Lab data from the University of Illinois Pedology lab for an additional 35 pedons is available in the state office.
Diagnostic horizons and features recognized in this pedon are:
mollic epipedon -- the zone from the surface to a depth of 58 cm (23 inches) (Ap, A, and AB horizons);
cambic horizon -- the zone from 58 to 119 cm (23 to 47 inches) (Bg, Btg1, and Btg2 horizons);
Aquic conditions -- redox concentrations and/or depletions from the surface to a depth of 152 cm (60 inches) (assumed to extend to 203 cm (80 inches).

National Cooperative Soil Survey
U.S.A.

LOCATION VIRGIL IL+WI

Established Series
Rev. JCD-SKH-SLE
03/2011

VIRGIL SERIES

The Virgil series consists of very deep, somewhat poorly drained soils on outwash plains, stream terraces, or till plains. These soils formed in loess or other silty material and in the underlying loamy outwash or sandy loam till. Slope ranges from 0 to 6 percent. Mean annual air temperature is about 8.3 degrees C (47 degrees F). Mean annual precipitation is about 890 mm (35 inches).

TAXONOMIC CLASS: Fine-silty, mixed, superactive, mesic Udollic Endoaqualfs

TYPICAL PEDON: Virgil silt loam on a northeast facing, 1 percent slope in a cultivated field at an elevation of about 233 meters (765 feet) above mean sea level. (Colors are for moist soil unless otherwise stated.)

Ap--0 to 18 cm (0 to 7 inches); black (10YR 2/1) silt loam, grayish brown (10YR 5/2) dry; weak medium granular structure; friable; common fine roots; neutral; abrupt smooth boundary. [18 to 25 cm (7 to 10 inches) thick]

E--18 to 33 cm (7 to 13 inches); dark grayish brown (10YR 4/2) and grayish brown (10YR 5/2) silt loam, light brownish gray (10YR 6/2) dry; weak thin platy structure parting to moderate fine granular; friable; many fine roots; few faint black (10YR 2/1) organic coatings on faces of peds and on surfaces along root channels; few fine distinct brown (7.5YR 4/4) masses of oxidized iron-manganese in the matrix; strongly acid; clear smooth boundary. [5 to 20 cm (2 to 8 inches) thick]

Bt1--33 to 43 cm (13 to 17 inches); grayish brown (10YR 5/2) and brown (10YR 5/3) silty clay loam; moderate fine subangular blocky structure; firm; common fine roots; few faint dark grayish brown (10YR 4/2) clay films on faces of peds; common distinct light gray (10YR 7/2) (dry) clay depletions on faces of peds; few fine distinct black (10YR 2/1) iron-manganese concretions throughout; few fine distinct brown (7.5YR 4/4) masses of oxidized iron-manganese and few prominent strong brown (7.5YR 5/6) masses of oxidized iron in the matrix; strongly acid; clear smooth boundary.

Bt2--43 to 64 cm (17 to 25 inches); grayish brown (10YR 5/2) and brown (10YR 5/3) silty clay loam; moderate fine subangular blocky structure; firm; common fine roots; common faint dark grayish brown (10YR 4/2) and grayish brown (10YR 5/2) clay films on faces of peds; common faint light gray (10YR 7/2) (dry) clay depletions on faces of peds; few fine distinct black (10YR 2/1) iron-manganese concretions throughout; few fine distinct brown (7.5YR 4/4) masses of oxidized iron-manganese and prominent strong brown (7.5YR 5/6) masses of oxidized iron in the matrix; strongly acid; gradual smooth boundary.

Btg1--64 to 89 cm (25 to 35 inches); light brownish gray (2.5Y 6/2) silty clay loam; moderate fine and medium subangular blocky structure; firm; few fine roots; many faint grayish brown (2.5Y 5/2) clay films on faces of peds; few distinct light gray (10YR 7/2) (dry) clay depletions on faces of peds; many fine prominent black (10YR 2/1) iron-manganese concretions hroughout; common fine prominent strong brown (7.5YR 5/6 and 7.5YR 5/8) masses of oxidized iron in the matrix; strongly acid; clear smooth boundary.

Btg2--89 to 112 cm (35 to 44 inches); light brownish gray (2.5Y 6/2) silty clay loam; moderate medium and coarse subangular and angular blocky structure; firm; few fine roots; common faint grayish brown (2.5Y 5/2) clay films on faces of peds; few distinct light gray (10YR 7/2) (dry) clay depletions on faces of peds; many fine prominent black (10YR 2/1) iron-manganese nodules and concretions throughout; many medium prominent brown (7.5YR 4/4) masses of oxidized iron-manganese and strong brown (7.5YR 5/6) masses of oxidized iron in the matrix; moderately acid; clear smooth boundary.

Btg3--112 to 124 cm (44 to 49 inches); grayish brown (2.5Y 5/2) silty clay loam; weak medium and coarse angular blocky structure; firm; few fine roots; few prominent gray (N 5/) clay films on faces of peds; many fine prominent black (10YR 2/1) iron-manganese nodules and concretions throughout; many medium prominent brown (7.5YR 4/4) masses of oxidized iron-manganese and strong brown (7.5YR 5/6) masses of oxidized iron in the matrix; moderately acid; clear smooth boundary. [Combined thickness of the Bt and Btg horizons is 51 to 102 cm (20 to 40 inches)]

2Btg4--124 to 147 cm (49 to 58 inches); grayish brown (2.5Y 5/2) and light brownish gray (2.5Y 6/2) loam; weak coarse angular blocky structure; firm; few prominent dark gray (N 4/) clay films on faces of peds; few fine prominent black (10YR 2/1) iron-manganese concretions throughout; many medium prominent brown (7.5YR 4/4) masses of oxidized iron-manganese and strong brown (7.5YR 5/6) masses of oxidized iron in the matrix; neutral; gradual smooth boundary. [10 to 43 cm (4 to 17 inches) thick]

2C--147 to 152 cm (58 to 60 inches); brown (10YR 4/3) and dark yellowish brown (10YR 4/4) sandy loam; massive; friable; common fine distinct dark gray (10YR 4/1) and gray (10YR 5/1) iron depletions in the matrix; moderately alkaline.

TYPE LOCATION: Stephenson County, Illinois; about 1 mile south of Freeport; 1,346 feet east and 300 feet south of the northwest corner of sec. 8, T. 26 N., R. 8 E.; USGS Freeport East topographic quadrangle; lat. 42 degrees 16 minutes 20 seconds N., and long. 89 degrees 36 minutes 23 seconds W., UTM Zone 16T, 0285052 easting and 4683325 northing; NAD 83.

RANGE IN CHARACTERISTICS:
Thickness of the solum: typically 122 to 152 cm (48 to 60 inches) but ranges from 107 to 178 cm (42 to 70 inches).
Depth to the horizon with more than 40 percent sand: commonly 114 and 127 cm (45 and 50 inches), but ranges from 102 to 152 cm (40 to 60 inches).
Depth to carbonates: 114 to 178 cm (45 to 70 inches)
Particle-size control section (weighted average): 27 to 35 percent clay

A or Ap horizon:
Hue: 10YR

Value: 2 or 3
Chroma: 1 or 2
Texture: silt loam
Reaction: slightly acid to slightly alkaline

E or Eg horizon:
Hue: 10YR
Value: 4 to 6
Chroma: or 2
Texture: silt loam
Reaction: strongly acid to neutral
Other features: Some pedons have redoximorphic features.

Bt and/or Btg horizons:
Hue: 10YR, 2.5Y or 5Y
Value: 4 to 6
Chroma: 2 to 4
Texture: silty clay loam
Clay content: averages 27 to 35 percent
Sand content: averages less than 10 percent
Reaction: strongly acid to slightly acid, but some pedons range to slightly alkaline in the lower part.
Redoximorphic features have hue of 7.5YR, 10YR, or 2.5Y, value of 4 or 5, and chroma of 2 to 8.

2Bt, 2Btg, 2BC, and/or 2BCg horizons:
Hue: 10YR, 2.5Y or 5Y
Value: 4 to 6
Chroma: 2 to 8
Texture: loam, sandy loam, clay loam, silt loam or silty clay loam
Average sand content: 20 to 60 percent
Content of rock fragments: less than 10 percent
Redoximorphic features: It has redoximorphic features throughout. It typically has low chroma colors in the matrix and higher chroma in the redoximorphic features.
Reaction: moderately acid to slightly alkaline

2C or 2Cg horizon:
Hue: 10YR or 2.5Y
Value: 4 to 6
Chroma: 2 to 8
Texture: sandy loam, loam, sandy clay loam, loamy sand, clay loam, silt loam or is sandy loam till
Sand content: 20 to 80 percent
Content of rock fragments: less than 15 percent
Reaction: slightly acid to moderately alkaline

COMPETING SERIES: These are the Atterberry, Bethalto, Canoe, Curran, Emery, Franklin, Koszta, Millbrook, Mulvey, and Wauconda series. Atterberry, Bethalto, Canoe, and Koszta series average less than 20

percent sand in the lower part of the series control section. Curran soils average less than 27 percent clay in the middle part of the series control section. Emery soils do not have a layer in the lower part of the series control section that has more than 25 percent sand. Millbrook, Franklin, and Wauconda soils have horizons with more than 10 percent sand within a depth of 102 cm (40 inches). Mulvey soils average less than 15 percent clay and greater than 15 percent gravel in the lower part of the series control section.

GEOGRAPHIC SETTING: Virgil soils are nearly level or gently sloping low broad summits on outwash plains, stream terraces, and till plains. Slope ranges from 0 to 6 percent. These soils formed in 102 to 152 cm (40 to 60 inches) of loess or other silty sediments and in the underlying loamy outwash or sandy loam till. The dominant clay mineral in the loess is smectite, and in the outwash or till is illite. Summers are hot and winters are cold. Mean annual air temperature ranges from 6.7 to 12.2 degrees C (44 to 54 degrees F). Mean annual precipitation ranges from 760 to 1070 mm (30 to 42 inches). Frost-free days range from 120 to 190 days.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the Batavia, Drummer, Elburn, Emery, Harvard, Kendall, Millbrook, Plano, St. Charles, and Thorp soils. The well drained Batavia soils are on adjacent, slightly higher parts of the landscape. The poorly drained Drummer soils are on lower parts of the landscape and have a mollic epipedon. Elburn soils have a mollic epipedon and are on similar parts of the landscape nearby but generally are on broad landscape areas farther from the drainageways. Emery soils are on adjacent dissected till plains and average less than 20 percent sand in the lower part of the series control section. The well drained Harvard soils are on adjacent, slightly higher parts of the landscape and formed in loess less than 102 cm (40 inches) thick. Kendall soils are on similar parts of the landscape nearby but generally are adjacent to or nearer the drainageways and do not have a dark colored surface layer. Millbrook soils are on similar parts of the stream terraces and outwash plains where the loess is thinner. The well drained Plano soils have a mollic epipedon and are on adjacent, slightly higher parts of the landscape. The well drained St. Charles soils are on adjacent, slightly higher parts of the landscape and do not have dark colored surface layer. The poorly drained Thorp soils have a mollic epipedon and are on lower parts of the landscape.

DRAINAGE AND SATURATED HYDRAULIC CONDUCTIVITY: Somewhat poorly drained. An intermittent apparent high water table is at a depth of 31 to 61 cm (1.0 to 2.0 feet) below the surface in most years. Saturated hydraulic conductivity is moderately high or high (4.23 to 14.11 micrometers per second) in the upper part of the solum and high (14.11 to 42.34 micrometers per second) in the lower part. Permeability is moderate in the upper part of solum and ranges moderate to moderately rapid in the lower part. The potential for surface runoff is low to medium as related to slope.

USE AND VEGETATION: Most areas are cultivated. Corn, soybeans, small grain, and forages for hay are the principal crops. Native vegetation is mixed grasses and trees.

DISTRIBUTION AND EXTENT: Northern Illinois and southern Wisconsin. LRR's K and M, MLRA's 95A, 95B, 108A, 108B and 115C. The series is of moderate extent.

MLRA SOIL SURVEY REGIONAL OFFICE (MO) RESPONSIBLE: Indianapolis, Indiana

SERIES ESTABLISHED: Kendall County, Illinois, 1941.

REMARKS: A gravelly substratum phase is recognized. This soil will be investigated during MLRA update

activities. Possibly a new series will be developed.

Diagnostic horizons recognized in this pedon are:
Ochric epipedon -from a depth of 0 to 33 cm (0 to 13 inches) (Ap and E horizons)
Albic horizon--from a depth of 18 to 33 cm (7 to 13 inches) (E horizon)
Argillic horizon--from a depth of 33 to 150 cm (13 to 59 inches) (Bt1, Bt2, Btg1, Btg2, Btg3, 2Btg4, and 2C horizons)
Udic moisture regime; Mesic temperature regime.

National Cooperative Soil Survey
U.S.A.

LOCATION WACOUSTA IA+MN WI

Established Series
Rev. TEF-RJW-TWN
08/2007

WACOUSTA SERIES

The Wacousta series consists of very deep, very poorly drained soils formed in silty lacustrine sediments. These soils are in broad depressions and swales on till plains, moraines, and stream terraces. Slope ranges from 0 to 2 percent. Mean annual air temperature is about 8 degrees C. Mean annual precipitation is about 775 millimeters

TAXONOMIC CLASS: Fine-silty, mixed, superactive, mesic Typic Endoaquolls

TYPICAL PEDON: Wacousta silty clay loam, in a depression with a slope of less than 1 percent, in a cultivated field. (Colors are for moist soil unless otherwise stated.)

Ap--0 to 20 centimeters; black (N 2/0) silty clay loam, very dark gray (10YR 3/1) dry; weak fine and medium granular structure; friable; many fine and medium roots; neutral; abrupt smooth boundary.

A--20 to 43 centimeters; black (N 2/0) silty clay loam, dark gray (10YR 4/1) dry; weak medium subangular blocky structure; friable; many fine and medium roots; neutral; abrupt smooth boundary. (Combined thickness of the A horizon is 20 to 49 centimeters.)

Bg--43 to 64 centimeters; dark gray (5Y 4/1) silty clay loam; weak medium subangular blocky structure; friable; many fine and medium roots; common fine prominent strong brown (7.5YR 5/6) redoximorphic concentrations; neutral; clear smooth boundary. (5 to 15 centimeters thick)

Cg1--64 to 104 centimeters; gray (5Y 5/1) silt loam; massive; friable; common fine and medium roots; few fine rounded light gray (10YR 7/2) carbonate concretions; common medium prominent yellowish red (5YR 5/6) redoximorphic concentrations; slightly effervescent; slightly alkaline; clear smooth boundary.

Cg2--104 to 150 centimeters; gray (5Y 5/1) silt loam; massive; friable; few fine and medium roots; few fine black (10YR 2/1) iron-manganese concretions; few fine rounded light gray (10YR 7/2) carbonate concretions; common coarse prominent strong brown (7.5YR 5/6) redoximorphic concentrations; slightly effervescent; slightly alkaline; clear smooth boundary.

Cg3--150 to 200 centimeters; light olive gray (5Y 6/2) silt loam; massive; friable; thin strata of loam and sandy loam textured material at 152 to 170 centimeters; few fine and medium rounded light gray (10YR 7/2) carbonate concretions; common coarse prominent yellowish red (5YR 5/8) redoximorphic concentrations; strongly effervescent; moderately alkaline.

TYPE LOCATION: Major Land Resource Area (MLRA) 103-Central Iowa and Minnesota Till Prairies, Humboldt County, Iowa subset; located about 1,500 feet north and 150 feet east of the southwest corner of section 6, T. 92 N., R. 29 W.; USGS Bode topographic quadrangle; lat. 42 degrees 48 minutes 30 seconds N.

and long. 94 degrees 19 minutes 28 seconds W., NAD 83.

RANGE IN CHARACTERISTICS:
Thickness of the mollic epipedon--20 to 49 centimeters
Depth to carbonates--30 to 50 centimeters
Clay content of the particle-size control section (weighted average)--24 to 35 percent
Sand content of the particle-size control section (weighted average)--5 to 15 percent

Ap or A horizon:
Hue--10YR, 2.5Y, or is neutral
Value--2
Chroma--0 or 1
Texture--silty clay loam, silt loam, or mucky silt loam
Clay content--15 to 40 percent
Sand content--5 to 20 percent
Reaction--slightly acid to slightly alkaline

Maximum clay content is typically in the lower part of the A horizon or in the Bg horizon

Bg horizon:
Hue--5Y
Value--4 to 6
Chroma--1 or 2
Texture--silty clay loam, silty clay, clay loam, or silt loam
Clay content--15 to 45 percent
Sand content--5 to 45 percent
Reaction--neutral or slightly alkaline

Cg horizon:
Hue--5Y
Value--5 or 6
Chroma--1 or 2
Texture--silt loam or silty clay loam
Clay content--18 to 30 percent
Sand content--5 to 15 percent
Rock fragment content--0 percent
Reaction--slightly alkaline or moderately alkaline
Moist bulk density--1.30 g/cc to 1.40 g/cc

Some pedons have a 2Cg horizon below a depth of 150 centimeters with stratified textures of loam, silt loam, very fine sandy loam or clay loam

COMPETING SERIES: These are the Chalmers, Chetomba, Dolbee, Drummer, Dunham, Elpaso, Elvira, Garwin, Gillett Grove, Hartsburg, Madelia, Marcus, Mascoutah, Maxcreek, Maxfield, Maxmore, Ossian, Patton, Pella, Rushmore, and Sable series.
Chalmers--have clay content of 12 to 18 percent in the lower third of the series control section
Chetomba--have a sand content of more than 15 percent fine sand or coarser in the lower third of the series

control section
Dolbee--do not have carbonates within a depth of 125 centimeters
Drummer--do not have carbonates within a depth of 100 centimeters
Dunham--have a rock fragment content of 15 to 70 percent in the lower third of the series control section
Elpaso--do not have carbonates within a depth of 90 centimeters and have a rock fragment content of 1 to 10 percent in the lower third of the series control section
Elvira--do not have carbonates within a depth of 125 centimeters
Garwin--do not have carbonates within a depth of 125 centimeters
Gillett Grove--have a moist bulk density range of 1.6 g/cc to 1.8 g/cc in the lower third of the series control section
Hartsburg--have a sand content that averages less than 5 percent in the particle-size control section
Madelia--do not have carbonates within a depth of 50 centimeters
Marcus--do not have carbonates within a depth of 60 centimeters
Mascoutah--do not have carbonates within a depth of 100 centimeters
Maxfield--do not have carbonates within a depth of 100 centimeters
Maxcreek--do not have carbonates within a depth of 65 centimeters
Maxmore--have a moist bulk density range of 1.75 g/cc to 1.90 g/cc in the lower third of the series control section
Ossian--do not have carbonates within a depth of 100 centimeters
Patton--do not have carbonates within a depth of 100 centimeters
Pella--have stratified materials with a sand content that averages more than 10 percent in the lower third of the series control section
Rushmore--have a moist bulk density range of 1.6 g/cc to 1.8 g/cc in the lower third of the series control section
Sable--do not have carbonates within a depth of 100 centimeters

GEOGRAPHIC SETTING:
Parent material--silty lacustrine sediments
Landform--broad depressions and swales on till plains, moraines, and stream terraces
Slopes--0 to 2 percent
Elevation--200 to 400 meters above sea level
Mean annual air temperature--6 to 10 degrees C
Mean annual precipitation--585 to 965 millimeters
Frost-free period--150 to 200 days

GEOGRAPHICALLY ASSOCIATED SOILS: These are the Harps, Nicollet, Okoboji, and Webster soils.
Harps--are at slightly higher landscape positions on rims of depressions and have a sand content that averages 30 to 55 percent in the particle-size control section
Nicollet--are at higher landscape positions on slightly convex rises and have a sand content that averages 20 to 55 percent in the particle-size control section
Okoboji--are on landscape positions similar to that of the Wacousta soils and have a mollic epipedon 60 to 150 centimeters thick
Webster--are at slightly higher landscape positions on flats and have a sand content that averages more than 15 percent in the particle-size control section

DRAINAGE AND SATURATED HYDRAULIC CONDUCTIVITY:
Drainage class--very poorly drained--in undrained conditions, a frequently saturated zone occurs at the surface

to a depth of 0.3 meters during the wettest periods of years when precipitation is within one standard deviation of the 30 year mean of annual precipitation
Saturated hydraulic conductivity--1.00 to 10.00 micrometers per second
Ponding--frequently ponded for long duration

USE AND VEGETATION:
Where drained, these areas are cultivated. The principal crops are corn, soybeans, and small grain. The native vegetation is big bluestem, western wheatgrass, sedges, blue grama and other species of the tall grass prairie that are tolerant of excessive wetness.

DISTRIBUTION AND EXTENT:
Physiographic Division--Interior Plains
Physiographic Province--Central Lowland
Physiographic sections--Western lake section and Eastern lake section
MLRAs--Central Iowa and Minnesota Till Prairies (103) and Southern Wisconsin and Northern Illinois Drift Plain (95B)
LRR M;--central and north-central Iowa, south-central Minnesota, and southern Wisconsin
Extent--moderate

MLRA SOIL SURVEY REGIONAL OFFICE (MO) RESPONSIBLE: St. Paul, Minnesota

SERIES ESTABLISHED: Humboldt County, Iowa, 1958.

REMARKS:
Particle-size control section--the zone from a depth of 25 to 100 centimeters;
series control section--the zone from the surface of the soil to a depth of 150 centimeters.

Diagnostic horizons and features recognized in this pedon include:
mollic epipedon--the zone from the surface of the soil to a depth of 43 centimeters (Ap and A horizons);
cambic horizon--the zone from a depth of 43 to 64 centimeters (Bg horizon);
aquic moisture regime.

The type location was moved because the previous location had been disturbed.

Cation-exchange activity class is inferred from lab data from similar soils in the surrounding area.

Taxonomy version--Keys to Soil Taxonomy, tenth edition, 2006.

National Cooperative Soil Survey
U.S.A.

D

APPENDIX D

NOAA Online Precipitation Data for the Madison Area, Wisconsin

NOWData - NOAA Online Weather Data

Madison Area (ThreadEx Station)
Monthly Totals/Averages
Precipitation (inches)
Year: 2013

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
2013	2.87	2.41	2.41	5.83	6.57	10.86	1.66	-	-	-	-	-	32.61

This station's record may include data from more than one, possibly incompatible, locations. It reflects the longest available record for the Madison Area.

Official data and data for additional locations and years are available from the Regional Climate Centers and the National Climatic Data Center.

NOWData - NOAA Online Weather Data

Madison Area (ThreadEx Station)
Monthly Totals/Averages
Precipitation (inches)
Years: 1981-2010

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Average	1.23	1.45	2.19	3.40	3.55	4.54	4.18	4.22	3.13	2.40	2.39	1.75	34.42

This station's record may include data from more than one, possibly incompatible, locations. It reflects the longest available record for the Madison Area.

Official data and data for additional locations and years are available from the Regional Climate Centers and the National Climatic Data Center.

NOWData - NOAA Online Weather Data

Madison Area (ThreadEx Station)
Observed Daily Data
Month: Jul 2013

Day	MaxT	MinT	AvgT	HDD	CDD	Pcpn	Snow	Snwg
1	79	55	67.0	0	2	0.00	0.0	0
2	76	54	65.0	0	0	0.00	0.0	0
3	73	53	63.0	2	0	0.00	0.0	0
4	82	60	71.0	0	6	0.00	0.0	0
5	84	67	75.5	0	11	0.00	0.0	0
6	85	67	76.0	0	11	0.00	0.0	0
7	89	70	79.5	0	15	0.00	0.0	0
8	88	72	80.0	0	15	0.53	0.0	0
9	85	71	78.0	0	13	1.13	0.0	0
10	79	60	69.5	0	5	T	0.0	0
11	81	56	68.5	0	4	0.00	0.0	0
12	82	56	69.0	0	4	0.00	0.0	0
13	83	64	73.5	0	9	0.00	0.0	0
14	87	60	73.5	0	9	0.00	0.0	0
15	90	66	78.0	0	13	T	0.0	0
16	92	74	83.0	0	18	T	0.0	0
17	93	74	83.5	0	19	T	0.0	0
18	92	75	83.5	0	19	0.00	0.0	0
19	M	M	M	M	M	M	M	M
20	M	M	M	M	M	M	M	M
21	M	M	M	M	M	M	M	M
22	M	M	M	M	M	M	M	M
23	M	M	M	M	M	M	M	M
24	M	M	M	M	M	M	M	M
25	M	M	M	M	M	M	M	M
26	M	M	M	M	M	M	M	M
27	M	M	M	M	M	M	M	M
28	M	M	M	M	M	M	M	M
29	M	M	M	M	M	M	M	M
30	M	M	M	M	M	M	M	M
31	M	M	M	M	M	M	M	M
Smry	84.4	64.1	74.3	2	173	1.66	0.0	0.0

This station's record may include data from more than one, possibly incompatible, locations. It reflects the longest available record for the Madison Area.

Official data and data for additional locations and years are available from the Regional Climate Centers and the National Climatic Data Center.

E

APPENDIX E

Northcentral/Northeast Supplement Wetland Delineation Data Forms

WETLAND DETERMINATION DATA FORM - Northcentral and Northeast Region

Project/Site: Fire Station #14 **City/County:** Madison/Dane **Sampling Date:** 17-Jul-13

Applicant/Owner: City of Madison **State:** WI **Sampling Point:** 1

Investigator(s): Stautz/Anderson **Section, Township, Range:** **S.** 22 **T.** 7N **R.** 10E

Landform (hillslope, terrace, etc.): Footslope **Local relief (concave, convex, none):** convex **Slope:** 0.0 % / 0.0 °

Subregion (LRR or MLRA): LRR K **Lat.:** **Long.:** **Datum:**

Soil Map Unit Name: Houghton muck (Ho) **NWI classification:** UPL

Are climatic/hydrologic conditions on the site typical for this time of year? Yes ○ No ◉ **(If no, explain in Remarks.)**

Are Vegetation ☐ **, Soil** ☐ **, or Hydrology** ☐ **significantly disturbed?** **Are "Normal Circumstances" present?** Yes ◉ No ○

Are Vegetation ☐ **, Soil** ☐ **, or Hydrology** ☐ **naturally problematic?** **(If needed, explain any answers in Remarks.)**

Summary of Findings - Attach site map showing sampling point locations, transects, important features, etc

Hydrophytic Vegetation Present?	Yes ◉	No ○	
Hydric Soil Present?	Yes ◉	No ○	**Is the Sampled Area within a Wetland?** Yes ○ No ◉
Wetland Hydrology Present?	Yes ○	No ◉	

Remarks: (Explain alternative procedures here or in a separate report.)

Hydrologic conditions are not typical for this time of year (see hydrology remarks section). Although hydrophytic vegetation is dominant and hydric soil is present, the lack of wetland hydrology during a time when precipitation is 102% above normal indicates the sample plot is located in an upland fallow field.

Hydrology

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ☐ Surface Water (A1)
- ☐ High Water Table (A2)
- ☐ Saturation (A3)
- ☐ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Water-Stained Leaves (B9)
- ☐ Aquatic Fauna (B13)
- ☐ Marl Deposits (B15)
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Oxidized Rhizospheres along Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Thin Muck Surface (C7)
- ☐ Other (Explain in Remarks)

Secondary Indicators (minimum of 2 required)

- ☐ Surface Soil Cracks (B6)
- ☐ Drainage Patterns (B10)
- ☐ Moss Trim Lines (B16)
- ☐ Dry Season Water Table (C2)
- ☐ Crayfish Burrows (C8)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Stunted or Stressed Plants (D1)
- ☐ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☐ Microtopographic Relief (D4)
- ☑ FAC-neutral Test (D5)

Field Observations:

Surface Water Present?	Yes ○	No ◉	Depth (inches):	
Water Table Present?	Yes ○	No ◉	Depth (inches):	
Saturation Present? (includes capillary fringe)	Yes ◉	No ○	Depth (inches): 28	**Wetland Hydrology Present?** Yes ○ No ◉

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

Precipitation in the Madison Area for April-June was 102% above normal. 1.66" of precipitation were recorded in the two weeks prior to field work. The presence of only one secondary indicator at the sample plot does not provide evidence of wetland hydrology.

VEGETATION - Use scientific names of plants

Sampling Point: 1

	Absolute % Cover	Dominant Species?	Rel.Strat. Cover	Indicator Status
Tree Stratum (Plot size:)				
1. Populus tremuloides	0	☐	0.0%	FACU
2.	0	☐	0.0%	
3.	0	☐	0.0%	
4.	0	☐	0.0%	
5.	0	☐	0.0%	
6.	0	☐	0.0%	
7.	0	☐	0.0%	
	0		**= Total Cover**	
Sapling/Shrub Stratum (Plot size: 15')				
1. Acer negundo	10	☑	100.0%	FAC
2.	0	☐	0.0%	
3.	0	☐	0.0%	
4.	0	☐	0.0%	
5.	0	☐	0.0%	
6.	0	☐	0.0%	
7.	0	☐	0.0%	
	10		**= Total Cover**	
Herb Stratum (Plot size: 5')				
1. Phalaris arundinacea	100	☑	90.1%	FACW
2. Cirsium arvense	10	☐	9.0%	FACU
3. Rubus occidentalis	1	☐	0.9%	UPL
4.	0	☐	0.0%	
5.	0	☐	0.0%	
6.	0	☐	0.0%	
7.	0	☐	0.0%	
8.	0	☐	0.0%	
9.	0	☐	0.0%	
10.	0	☐	0.0%	
11.	0	☐	0.0%	
12.	0	☐	0.0%	
	111		**= Total Cover**	
Woody Vine Stratum (Plot size:)				
1.	0	☐	0.0%	
2.	0	☐	0.0%	
3.	0	☐	0.0%	
4.	0	☐	0.0%	
	0		**= Total Cover**	

Dominance Test worksheet:

Number of Dominant Species That are OBL, FACW, or FAC: 2 (A)

Total Number of Dominant Species Across All Strata: 2 (B)

Percent of dominant Species That Are OBL, FACW, or FAC: 100.0% (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:		
OBL species	0	x 1 =	0	
FACW species	100	x 2 =	200	
FAC species	10	x 3 =	30	
FACU species	10	x 4 =	40	
UPL species	1	x 5 =	5	
Column Totals:	121	(A)	275	(B)

Prevalence Index = B/A = 2.273

Hydrophytic Vegetation Indicators:

- ☐ **Rapid Test for Hydrophytic Vegetation**
- ☑ **Dominance Test is > 50%**
- ☑ **Prevalence Index is ≤3.0** [1]
- ☐ **Morphological Adaptations** [1] **(Provide supporting data in Remarks or on a separate sheet)**
- ☐ **Problematic Hydrophytic Vegetation** [1] **(Explain)**

[1] **Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.**

Definitions of Vegetation Strata:

Tree - Woody plants, 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/shrub - Woody plants less than 3 in. DBH and greater than 3.28 ft (1m) tall..

Herb - All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vine - All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? Yes ◉ No ○

Remarks: (Include photo numbers here or on a separate sheet.)

Dominant vegetation was determined through application of the 50/20 rule. Vegetation at the sample plot is hydrophytic.

*Indicator suffix = National status or professional decision assigned because Regional status not defined by FWS.

Soil

Sampling Point: 1

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)		%	Redox Features Color (moist)		%	Type [1]	Loc²	Texture	Remarks
0-13	10YR	2/1							Loam	
13-23	2.5Y	2.5/1							Clay Loam	
23-29	5Y	4/2		2.5Y	5/6	5%	C	M	Clay	

[1] Type: C=Concentration. D=Depletion. RM=Reduced Matrix, CS=Covered or Coated Sand Grains ²Location: PL=Pore Lining. M=Matrix

Hydric Soil Indicators:

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Stratified Layers (A5)
- ☐ Depleted Below Dark Surface (A11)
- ☑ Thick Dark Surface (A12)
- ☐ Sandy Muck Mineral (S1)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Dark Surface (S7) (LRR R, MLRA 149B)
- ☐ Polyvalue Below Surface (S8) (LRR R, MLRA 149B)
- ☐ Thin Dark Surface (S9) (LRR R, MLRA 149B)
- ☐ Loamy Mucky Mineral (F1) LRR K, L)
- ☐ Loamy Gleyed Matrix (F2)
- ☐ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)

Indicators for Problematic Hydric Soils : [3]

- ☐ 2 cm Muck (A10) (LRR K, L, MLRA 149B)
- ☐ Coast Prairie Redox (A16) (LRR K, L, R)
- ☐ 5 cm Mucky Peat or Peat (S3) (LRR K, L, R)
- ☐ Dark Surface (S7) (LRR K, L, M)
- ☐ Polyvalue Below Surface (S8) (LRR K, L)
- ☐ Thin Dark Surface (S9) (LRR K, L)
- ☐ Iron-Manganese Masses (F12) (LRR K, L, R)
- ☐ Piedmont Floodplain Soils (F19) (MLRA 149B)
- ☐ Mesic Spodic (TA6) (MLRA 144A, 145, 149B)
- ☐ Red Parent Material (F21)
- ☐ Very Shallow Dark Surface (TF12)
- ☐ Other (Explain in Remarks)

[3] Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: _____

Depth (inches): _____

Hydric Soil Present? Yes ◉ No ○

Remarks:

The soil at the sample plot matches the A12 Indicator (Thick Dark Surface) described in the Regional Supplement to the Army Corps of Engineers Wetland Delineation Manual: Northcentral and Northeast Regions (2012).

WETLAND DETERMINATION DATA FORM - Northcentral and Northeast Region

Project/Site: Fire Station #14 **City/County:** Madison/Dane **Sampling Date:** 17-Jul-13

Applicant/Owner: City of Madison **State:** WI **Sampling Point:** 2

Investigator(s): Stautz/Anderson **Section, Township, Range:** **S.** 22 **T.** 7N **R.** 10E

Landform (hillslope, terrace, etc.): Toeslope **Local relief (concave, convex, none):** concave **Slope:** 0.0 % / 0.0 °

Subregion (LRR or MLRA): LRR K **Lat.:** **Long.:** **Datum:**

Soil Map Unit Name: Houghton muck (Ho) **NWI classification:** E2H

Are climatic/hydrologic conditions on the site typical for this time of year? Yes ○ No ◉ **(If no, explain in Remarks.)**

Are Vegetation ☐ **, Soil** ☐ **, or Hydrology** ☐ **significantly disturbed?** **Are "Normal Circumstances" present?** Yes ◉ No ○

Are Vegetation ☐ **, Soil** ☐ **, or Hydrology** ☐ **naturally problematic?** **(If needed, explain any answers in Remarks.)**

Summary of Findings - Attach site map showing sampling point locations, transects, important features, etc

Hydrophytic Vegetation Present?	Yes ◉	No ○	
Hydric Soil Present?	Yes ◉	No ○	**Is the Sampled Area within a Wetland?** Yes ◉ No ○
Wetland Hydrology Present?	Yes ◉	No ○	

Remarks: (Explain alternative procedures here or in a separate report.)

Hydrologic conditions are not typical for this time of year (see hydrology remarks section). The sample plot is located in a wet meadow.

Hydrology

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ☑ Surface Water (A1)
- ☑ High Water Table (A2)
- ☑ Saturation (A3)
- ☐ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Water-Stained Leaves (B9)
- ☐ Aquatic Fauna (B13)
- ☐ Marl Deposits (B15)
- ☐ Hydrogen Sulfide Odor (C1)
- ☑ Oxidized Rhizospheres along Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Thin Muck Surface (C7)
- ☐ Other (Explain in Remarks)

Secondary Indicators (minimum of 2 required)

- ☐ Surface Soil Cracks (B6)
- ☐ Drainage Patterns (B10)
- ☐ Moss Trim Lines (B16)
- ☐ Dry Season Water Table (C2)
- ☐ Crayfish Burrows (C8)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Stunted or Stressed Plants (D1)
- ☑ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☐ Microtopographic Relief (D4)
- ☑ FAC-neutral Test (D5)

Field Observations:

Surface Water Present?	Yes ◉	No ○	Depth (inches): 1		
Water Table Present?	Yes ◉	No ○	Depth (inches): 0		
Saturation Present? (includes capillary fringe)	Yes ◉	No ○	Depth (inches): 0	**Wetland Hydrology Present?**	Yes ◉ No ○

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

Precipitation in the Madison Area for April-June was 102% above normal. 1.66" of precipitation were recorded in the two weeks prior to field work. The presence of four primary and two secondary indicators at the sample plot provides evidence of wetland hydrology.

VEGETATION - Use scientific names of plants

Sampling Point: 2

Tree Stratum (Plot size:)	Absolute % Cover	Dominant Species?	Rel.Strat. Cover	Indicator Status
1.	0	☐	0.0%	
2.	0	☐	0.0%	
3.	0	☐	0.0%	
4.	0	☐	0.0%	
5.	0	☐	0.0%	
6.	0	☐	0.0%	
7.	0	☐	0.0%	
	0		**= Total Cover**	
Sapling/Shrub Stratum (Plot size:)				
1.	0	☐	0.0%	
2.	0	☐	0.0%	
3.	0	☐	0.0%	
4.	0	☐	0.0%	
5.	0	☐	0.0%	
6.	0	☐	0.0%	
7.	0	☐	0.0%	
	0		**= Total Cover**	
Herb Stratum (Plot size: 5')				
1. Phalaris arundinacea	100	☑	99.0%	FACW
2. Cirsium arvense	1	☐	1.0%	FACU
3.	0	☐	0.0%	
4.	0	☐	0.0%	
5.	0	☐	0.0%	
6.	0	☐	0.0%	
7.	0	☐	0.0%	
8.	0	☐	0.0%	
9.	0	☐	0.0%	
10.	0	☐	0.0%	
11.	0	☐	0.0%	
12.	0	☐	0.0%	
	101		**= Total Cover**	
Woody Vine Stratum (Plot size:)				
1.	0	☐	0.0%	
2.	0	☐	0.0%	
3.	0	☐	0.0%	
4.	0	☐	0.0%	
	0		**= Total Cover**	

Dominance Test worksheet:

Number of Dominant Species That are OBL, FACW, or FAC: 1 (A)

Total Number of Dominant Species Across All Strata: 1 (B)

Percent of dominant Species That Are OBL, FACW, or FAC: 100.0% (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:		
OBL species	0	x 1 =	0	
FACW species	100	x 2 =	200	
FAC species	0	x 3 =	0	
FACU species	1	x 4 =	4	
UPL species	0	x 5 =	0	
Column Totals:	101	(A)	204	(B)

Prevalence Index = B/A = 2.020

Hydrophytic Vegetation Indicators:

- ☐ **Rapid Test for Hydrophytic Vegetation**
- ☑ **Dominance Test is > 50%**
- ☑ **Prevalence Index is ≤3.0** [1]
- ☐ **Morphological Adaptations** [1] **(Provide supporting data in Remarks or on a separate sheet)**
- ☐ **Problematic Hydrophytic Vegetation** [1] **(Explain)**

[1] **Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.**

Definitions of Vegetation Strata:

Tree - Woody plants, 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/shrub - Woody plants less than 3 in. DBH and greater than 3.28 ft (1m) tall..

Herb - All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vine - All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? Yes ◉ No ○

Remarks: (Include photo numbers here or on a separate sheet.)

Dominant vegetation was determined through application of the 50/20 rule. Vegetation at the sample plot is hydrophytic.

*Indicator suffix = National status or professional decision assigned because Regional status not defined by FWS.

Soil

Sampling Point: 2

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)		%	Redox Features Color (moist)		%	Type [1]	Loc²	Texture	Remarks
0-4	10YR	2/1		10YR	4/6	2%	C	PL	Loam	
4-20	10YR	2/1							Loam	
20-26	2.5Y	4/3							Sand	

[1] Type: C=Concentration. D=Depletion. RM=Reduced Matrix, CS=Covered or Coated Sand Grains ²Location: PL=Pore Lining. M=Matrix

Hydric Soil Indicators:

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Stratified Layers (A5)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Muck Mineral (S1)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Dark Surface (S7) (LRR R, MLRA 149B)
- ☐ Polyvalue Below Surface (S8) (LRR R, MLRA 149B)
- ☐ Thin Dark Surface (S9) (LRR R, MLRA 149B)
- ☐ Loamy Mucky Mineral (F1) LRR K, L)
- ☐ Loamy Gleyed Matrix (F2)
- ☐ Depleted Matrix (F3)
- ☑ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)

Indicators for Problematic Hydric Soils : [3]

- ☐ 2 cm Muck (A10) (LRR K, L, MLRA 149B)
- ☐ Coast Prairie Redox (A16) (LRR K, L, R)
- ☐ 5 cm Mucky Peat or Peat (S3) (LRR K, L, R)
- ☐ Dark Surface (S7) (LRR K, L, M)
- ☐ Polyvalue Below Surface (S8) (LRR K, L)
- ☐ Thin Dark Surface (S9) (LRR K, L)
- ☐ Iron-Manganese Masses (F12) (LRR K, L, R)
- ☐ Piedmont Floodplain Soils (F19) (MLRA 149B)
- ☐ Mesic Spodic (TA6) (MLRA 144A, 145, 149B)
- ☐ Red Parent Material (F21)
- ☐ Very Shallow Dark Surface (TF12)
- ☐ Other (Explain in Remarks)

[3] Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: _____

Depth (inches): _____

Hydric Soil Present? Yes ◉ No ○

Remarks:

The soil at the sample plot matches the F6 Indicator (Redox Dark Surface) described in the Regional Supplement to the Army Corps of Engineers Wetland Delineation Manual: Northcentral and Northeast Regions (2012).

WETLAND DETERMINATION DATA FORM - Northcentral and Northeast Region

Project/Site: Fire Station #14 **City/County:** Madison/Dane **Sampling Date:** 17-Jul-13

Applicant/Owner: City of Madison **State:** WI **Sampling Point:** 3

Investigator(s): Stautz/Anderson **Section, Township, Range: S.** 22 **T.** 7N **R.** 10E

Landform (hillslope, terrace, etc.): Footslope **Local relief (concave, convex, none):** flat **Slope:** 0.0 % / 0.0 °

Subregion (LRR or MLRA): LRR K **Lat.:** **Long.:** **Datum:**

Soil Map Unit Name: Sable silty clay loam, 0-3% slopes (SaA) **NWI classification:** UPL

Are climatic/hydrologic conditions on the site typical for this time of year? Yes ○ No ◉ **(If no, explain in Remarks.)**

Are Vegetation ☐ **, Soil** ☐ **, or Hydrology** ☐ **significantly disturbed?** **Are "Normal Circumstances" present?** Yes ◉ No ○

Are Vegetation ☐ **, Soil** ☐ **, or Hydrology** ☐ **naturally problematic?** **(If needed, explain any answers in Remarks.)**

Summary of Findings - Attach site map showing sampling point locations, transects, important features, etc

Hydrophytic Vegetation Present?	Yes ◉	No ○	
Hydric Soil Present?	Yes ○	No ◉	**Is the Sampled Area within a Wetland?** Yes ○ No ◉
Wetland Hydrology Present?	Yes ○	No ◉	

Remarks: (Explain alternative procedures here or in a separate report.)

Hydrologic conditions are not typical for this time of year (see hydrology remarks section). Although hydrophytic vegetation is dominant the lack of wetland hydrology and hydric soil indicates the sample plot is located in an upland forest.

Hydrology

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ☐ Surface Water (A1)
- ☐ High Water Table (A2)
- ☐ Saturation (A3)
- ☐ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Water-Stained Leaves (B9)
- ☐ Aquatic Fauna (B13)
- ☐ Marl Deposits (B15)
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Oxidized Rhizospheres along Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Thin Muck Surface (C7)
- ☐ Other (Explain in Remarks)

Secondary Indicators (minimum of 2 required)

- ☐ Surface Soil Cracks (B6)
- ☐ Drainage Patterns (B10)
- ☐ Moss Trim Lines (B16)
- ☐ Dry Season Water Table (C2)
- ☐ Crayfish Burrows (C8)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Stunted or Stressed Plants (D1)
- ☐ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☐ Microtopographic Relief (D4)
- ☐ FAC-neutral Test (D5)

Field Observations:

Surface Water Present?	Yes ○	No ◉	Depth (inches):	
Water Table Present?	Yes ○	No ◉	Depth (inches):	
Saturation Present? (includes capillary fringe)	Yes ○	No ◉	Depth (inches):	**Wetland Hydrology Present?** Yes ○ No ◉

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

Precipitation in the Madison Area for April-June was 102% above normal. 1.66" of precipitation were recorded in the two weeks prior to field work. No evidence of wetland hydrology was observed at the sample plot.

VEGETATION - Use scientific names of plants

Sampling Point: 3

	Absolute % Cover	Dominant Species?	Rel.Strat. Cover	Indicator Status
Tree Stratum (Plot size: 30')				
1. Salix nigra	40	☑	100.0%	OBL
2.	0	☐	0.0%	
3.	0	☐	0.0%	
4.	0	☐	0.0%	
5.	0	☐	0.0%	
6.	0	☐	0.0%	
7.	0	☐	0.0%	
	40		**= Total Cover**	
Sapling/Shrub Stratum (Plot size: 15')				
1. Acer negundo	60	☑	84.5%	FAC
2. Lonicera tatarica	10	☐	14.1%	FACU
3. Fraxinus pennsylvanica	1	☐	1.4%	FACW
4.	0	☐	0.0%	
5.	0	☐	0.0%	
6.	0	☐	0.0%	
7.	0	☐	0.0%	
	71		**= Total Cover**	
Herb Stratum (Plot size: 5')				
1. Alliaria petiolata	90	☑	89.1%	FACU
2. Leonurus cardiaca	1	☐	1.0%	UPL
3. Arctium minus	5	☐	5.0%	FACU
4. Parthenocissus quinquefolia	5	☐	5.0%	FACU
5.	0	☐	0.0%	
6.	0	☐	0.0%	
7.	0	☐	0.0%	
8.	0	☐	0.0%	
9.	0	☐	0.0%	
10.	0	☐	0.0%	
11.	0	☐	0.0%	
12.	0	☐	0.0%	
	101		**= Total Cover**	
Woody Vine Stratum (Plot size:)				
1.	0	☐	0.0%	
2.	0	☐	0.0%	
3.	0	☐	0.0%	
4.	0	☐	0.0%	
	0		**= Total Cover**	

Dominance Test worksheet:

Number of Dominant Species That are OBL, FACW, or FAC: 2 (A)

Total Number of Dominant Species Across All Strata: 3 (B)

Percent of dominant Species That Are OBL, FACW, or FAC: 66.7% (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:		
OBL species	40	x 1 =	40	
FACW species	1	x 2 =	2	
FAC species	60	x 3 =	180	
FACU species	110	x 4 =	440	
UPL species	1	x 5 =	5	
Column Totals:	212	(A)	667	(B)

Prevalence Index = B/A = 3.146

Hydrophytic Vegetation Indicators:

- ☐ **Rapid Test for Hydrophytic Vegetation**
- ☑ **Dominance Test is > 50%**
- ☐ **Prevalence Index is ≤3.0** [1]
- ☐ **Morphological Adaptations** [1] **(Provide supporting data in Remarks or on a separate sheet)**
- ☐ **Problematic Hydrophytic Vegetation** [1] **(Explain)**

[1] **Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.**

Definitions of Vegetation Strata:

Tree - Woody plants, 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/shrub - Woody plants less than 3 in. DBH and greater than 3.28 ft (1m) tall..

Herb - All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vine - All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? Yes ◉ No ○

Remarks: (Include photo numbers here or on a separate sheet.)

Dominant vegetation was determined through application of the 50/20 rule. Vegetation at the sample plot is hydrophytic.

*Indicator suffix = National status or professional decision assigned because Regional status not defined by FWS.

Soil

Sampling Point: 3

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)		%	Redox Features Color (moist)	%	Type [1]	Loc²	Texture	Remarks
0-14	10YR	2/1						Loamy Sand	
14-20	5YR	4/1	50%					Clay Loam	
14-20	N	2.5/1	30%					Clay	
14-20	10YR	4/2	20%					Sandy Clay Loam	

[1] Type: C=Concentration. D=Depletion. RM=Reduced Matrix, CS=Covered or Coated Sand Grains ²Location: PL=Pore Lining. M=Matrix

Hydric Soil Indicators:

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Stratified Layers (A5)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Muck Mineral (S1)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Dark Surface (S7) (LRR R, MLRA 149B)
- ☐ Polyvalue Below Surface (S8) (LRR R, MLRA 149B)
- ☐ Thin Dark Surface (S9) (LRR R, MLRA 149B)
- ☐ Loamy Mucky Mineral (F1) LRR K, L)
- ☐ Loamy Gleyed Matrix (F2)
- ☐ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)

Indicators for Problematic Hydric Soils : [3]

- ☐ 2 cm Muck (A10) (LRR K, L, MLRA 149B)
- ☐ Coast Prairie Redox (A16) (LRR K, L, R)
- ☐ 5 cm Mucky Peat or Peat (S3) (LRR K, L, R)
- ☐ Dark Surface (S7) (LRR K, L, M)
- ☐ Polyvalue Below Surface (S8) (LRR K, L)
- ☐ Thin Dark Surface (S9) (LRR K, L)
- ☐ Iron-Manganese Masses (F12) (LRR K, L, R)
- ☐ Piedmont Floodplain Soils (F19) (MLRA 149B)
- ☐ Mesic Spodic (TA6) (MLRA 144A, 145, 149B)
- ☐ Red Parent Material (F21)
- ☐ Very Shallow Dark Surface (TF12)
- ☐ Other (Explain in Remarks)

[3] Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: _____

Depth (inches): _____

Hydric Soil Present? Yes ○ No ◉

Remarks:

The soil at the sample plot does not meet any of the criteria described in the Regional Supplement to the Army Corps of Engineers Wetland Delineation Manual: Northcentral and Northeast Regions (2012).

WETLAND DETERMINATION DATA FORM - Northcentral and Northeast Region

Project/Site: Fire Station #14 **City/County:** Madison/Dane **Sampling Date:** 17-Jul-13

Applicant/Owner: City of Madison **State:** WI **Sampling Point:** 4

Investigator(s): Stautz/Anderson **Section, Township, Range:** **S.** 22 **T.** 7N **R.** 10E

Landform (hillslope, terrace, etc.): Footslope **Local relief (concave, convex, none):** convex **Slope:** 0.0 **%** / 0.0 °

Subregion (LRR or MLRA): LRR K **Lat.:** **Long.:** **Datum:**

Soil Map Unit Name: Houghton muck (Ho) **NWI classification:** UPL

Are climatic/hydrologic conditions on the site typical for this time of year? Yes ○ No ◉ **(If no, explain in Remarks.)**

Are Vegetation ☐ **, Soil** ☐ **, or Hydrology** ☐ **significantly disturbed?** **Are "Normal Circumstances" present?** Yes ◉ No ○

Are Vegetation ☐ **, Soil** ☐ **, or Hydrology** ☐ **naturally problematic?** **(If needed, explain any answers in Remarks.)**

Summary of Findings - Attach site map showing sampling point locations, transects, important features, etc

Hydrophytic Vegetation Present?	Yes ◉	No ○	
Hydric Soil Present?	Yes ○	No ◉	**Is the Sampled Area within a Wetland?** Yes ○ No ◉
Wetland Hydrology Present?	Yes ○	No ◉	

Remarks: (Explain alternative procedures here or in a separate report.)

Hydrologic conditions are not typical for this time of year (see hydrology remarks section). Although hydrophytic vegetation is dominant and hydric soil is present, the lack of wetland hydrology during a time when precipitation is 102% above normal indicates the sample plot is located in an upland fallow field.

Hydrology

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ☐ Surface Water (A1)
- ☐ High Water Table (A2)
- ☐ Saturation (A3)
- ☐ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Water-Stained Leaves (B9)
- ☐ Aquatic Fauna (B13)
- ☐ Marl Deposits (B15)
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Oxidized Rhizospheres along Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Thin Muck Surface (C7)
- ☐ Other (Explain in Remarks)

Secondary Indicators (minimum of 2 required)

- ☐ Surface Soil Cracks (B6)
- ☐ Drainage Patterns (B10)
- ☐ Moss Trim Lines (B16)
- ☐ Dry Season Water Table (C2)
- ☐ Crayfish Burrows (C8)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Stunted or Stressed Plants (D1)
- ☐ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☐ Microtopographic Relief (D4)
- ☑ FAC-neutral Test (D5)

Field Observations:

Surface Water Present?	Yes ○	No ◉	Depth (inches):	
Water Table Present?	Yes ○	No ◉	Depth (inches):	
Saturation Present? (includes capillary fringe)	Yes ○	No ◉	Depth (inches):	**Wetland Hydrology Present?** Yes ○ No ◉

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

Precipitation in the Madison Area for April-June was 102% above normal. 1.66" of precipitation were recorded in the two weeks prior to field work. The presence of only one secondary indicator at the sample plot does not provide evidence of wetland hydrology.

VEGETATION - Use scientific names of plants

Sampling Point: 4

	Absolute % Cover	Dominant Species?	Rel.Strat. Cover	Indicator Status
Tree Stratum (Plot size: 30')				
1. Acer negundo	20	☑	100.0%	FAC
2.	0	☐	0.0%	
3.	0	☐	0.0%	
4.	0	☐	0.0%	
5.	0	☐	0.0%	
6.	0	☐	0.0%	
7.	0	☐	0.0%	
	20		**= Total Cover**	
Sapling/Shrub Stratum (Plot size: 15')				
1. Acer negundo	5	☑	100.0%	FAC
2.	0	☐	0.0%	
3.	0	☐	0.0%	
4.	0	☐	0.0%	
5.	0	☐	0.0%	
6.	0	☐	0.0%	
7.	0	☐	0.0%	
	5		**= Total Cover**	
Herb Stratum (Plot size: 5')				
1. Phalaris arundinacea	100	☑	98.0%	FACW
2. Ambrosia trifida	1	☐	1.0%	FAC
3. Cirsium arvense	1	☐	1.0%	FACU
4.	0	☐	0.0%	
5.	0	☐	0.0%	
6.	0	☐	0.0%	
7.	0	☐	0.0%	
8.	0	☐	0.0%	
9.	0	☐	0.0%	
10.	0	☐	0.0%	
11.	0	☐	0.0%	
12.	0	☐	0.0%	
	102		**= Total Cover**	
Woody Vine Stratum (Plot size:)				
1.	0	☐	0.0%	
2.	0	☐	0.0%	
3.	0	☐	0.0%	
4.	0	☐	0.0%	
	0		**= Total Cover**	

Dominance Test worksheet:

Number of Dominant Species That are OBL, FACW, or FAC: 3 (A)

Total Number of Dominant Species Across All Strata: 3 (B)

Percent of dominant Species That Are OBL, FACW, or FAC: 100.0% (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:		
OBL species	0	x 1 =	0	
FACW species	100	x 2 =	200	
FAC species	26	x 3 =	78	
FACU species	1	x 4 =	4	
UPL species	0	x 5 =	0	
Column Totals:	127	(A)	282	(B)

Prevalence Index = B/A = 2.220

Hydrophytic Vegetation Indicators:

- ☐ **Rapid Test for Hydrophytic Vegetation**
- ☑ **Dominance Test is > 50%**
- ☑ **Prevalence Index is ≤3.0** [1]
- ☐ **Morphological Adaptations** [1] **(Provide supporting data in Remarks or on a separate sheet)**
- ☐ **Problematic Hydrophytic Vegetation** [1] **(Explain)**

[1] **Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.**

Definitions of Vegetation Strata:

Tree - Woody plants, 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/shrub - Woody plants less than 3 in. DBH and greater than 3.28 ft (1m) tall..

Herb - All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vine - All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? Yes ◉ No ○

Remarks: (Include photo numbers here or on a separate sheet.)

Dominant vegetation was determined through application of the 50/20 rule. Vegetation at the sample plot is hydrophytic.

*Indicator suffix = National status or professional decision assigned because Regional status not defined by FWS.

Soil

Sampling Point: 4

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	%	Redox Features Color (moist)	%	Type [1]	Loc²	Texture	Remarks
0-12	10YR 2/1						Sandy Loam	
12-20	2.5Y 4/2						Sand	

[1] Type: C=Concentration. D=Depletion. RM=Reduced Matrix, CS=Covered or Coated Sand Grains ²Location: PL=Pore Lining. M=Matrix

Hydric Soil Indicators:

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Stratified Layers (A5)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Muck Mineral (S1)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Dark Surface (S7) (LRR R, MLRA 149B)
- ☐ Polyvalue Below Surface (S8) (LRR R, MLRA 149B)
- ☐ Thin Dark Surface (S9) (LRR R, MLRA 149B)
- ☐ Loamy Mucky Mineral (F1) LRR K, L)
- ☐ Loamy Gleyed Matrix (F2)
- ☐ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)

Indicators for Problematic Hydric Soils : [3]

- ☐ 2 cm Muck (A10) (LRR K, L, MLRA 149B)
- ☐ Coast Prairie Redox (A16) (LRR K, L, R)
- ☐ 5 cm Mucky Peat or Peat (S3) (LRR K, L, R)
- ☐ Dark Surface (S7) (LRR K, L, M)
- ☐ Polyvalue Below Surface (S8) (LRR K, L)
- ☐ Thin Dark Surface (S9) (LRR K, L)
- ☐ Iron-Manganese Masses (F12) (LRR K, L, R)
- ☐ Piedmont Floodplain Soils (F19) (MLRA 149B)
- ☐ Mesic Spodic (TA6) (MLRA 144A, 145, 149B)
- ☐ Red Parent Material (F21)
- ☐ Very Shallow Dark Surface (TF12)
- ☐ Other (Explain in Remarks)

[3] Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: _____

Depth (inches): _____

Hydric Soil Present? Yes ○ No ◉

Remarks:

The soil at the sample plot does not meet any of the criteria described in the Regional Supplement to the Army Corps of Engineers Wetland Delineation Manual: Northcentral and Northeast Regions (2012).

WETLAND DETERMINATION DATA FORM - Northcentral and Northeast Region

Project/Site: Fire Station #14 **City/County:** Madison/Dane **Sampling Date:** 17-Jul-13

Applicant/Owner: City of Madison **State:** WI **Sampling Point:** 5

Investigator(s): Stautz/Anderson **Section, Township, Range: S.** 22 **T.** 7N **R.** 10E

Landform (hillslope, terrace, etc.): Toeslope **Local relief (concave, convex, none):** concave **Slope:** 0.0 % / 0.0 °

Subregion (LRR or MLRA): LRR K **Lat.:** **Long.:** **Datum:**

Soil Map Unit Name: Houghton muck (Ho) **NWI classification:** E2K

Are climatic/hydrologic conditions on the site typical for this time of year? Yes ○ No ◉ **(If no, explain in Remarks.)**

Are Vegetation ☐ **, Soil** ☐ **, or Hydrology** ☐ **significantly disturbed?** **Are "Normal Circumstances" present?** Yes ◉ No ○

Are Vegetation ☐ **, Soil** ☐ **, or Hydrology** ☐ **naturally problematic?** **(If needed, explain any answers in Remarks.)**

Summary of Findings - Attach site map showing sampling point locations, transects, important features, etc

Hydrophytic Vegetation Present?	Yes ◉	No ○	
Hydric Soil Present?	Yes ◉	No ○	**Is the Sampled Area within a Wetland?** Yes ◉ No ○
Wetland Hydrology Present?	Yes ◉	No ○	

Remarks: (Explain alternative procedures here or in a separate report.)

Hydrologic conditions are not typical for this time of year (see hydrology remarks section). The sample plot is located in a wet meadow.

Hydrology

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ☐ Surface Water (A1)
- ☐ High Water Table (A2)
- ☑ Saturation (A3)
- ☐ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Water-Stained Leaves (B9)
- ☐ Aquatic Fauna (B13)
- ☐ Marl Deposits (B15)
- ☑ Hydrogen Sulfide Odor (C1)
- ☐ Oxidized Rhizospheres along Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Thin Muck Surface (C7)
- ☐ Other (Explain in Remarks)

Secondary Indicators (minimum of 2 required)

- ☐ Surface Soil Cracks (B6)
- ☐ Drainage Patterns (B10)
- ☐ Moss Trim Lines (B16)
- ☐ Dry Season Water Table (C2)
- ☐ Crayfish Burrows (C8)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Stunted or Stressed Plants (D1)
- ☑ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☐ Microtopographic Relief (D4)
- ☑ FAC-neutral Test (D5)

Field Observations:

Surface Water Present?	Yes ○	No ◉	Depth (inches):		
Water Table Present?	Yes ◉	No ○	Depth (inches):	13	
Saturation Present? (includes capillary fringe)	Yes ◉	No ○	Depth (inches):	10	**Wetland Hydrology Present?** Yes ◉ No ○

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

Precipitation in the Madison Area for April-June was 102% above normal. 1.66" of precipitation were recorded in the two weeks prior to field work. The presence of two primary and two secondary indicators at the sample plot provides evidence of wetland hydrology.

VEGETATION - Use scientific names of plants

Sampling Point: 5

	Absolute % Cover	Dominant Species?	Rel.Strat. Cover	Indicator Status
Tree Stratum (Plot size:)				
1.	0	☐	0.0%	
2.	0	☐	0.0%	
3.	0	☐	0.0%	
4.	0	☐	0.0%	
5.	0	☐	0.0%	
6.	0	☐	0.0%	
7.	0	☐	0.0%	
	0		**= Total Cover**	
Sapling/Shrub Stratum (Plot size:)				
1.	0	☐	0.0%	
2.	0	☐	0.0%	
3.	0	☐	0.0%	
4.	0	☐	0.0%	
5.	0	☐	0.0%	
6.	0	☐	0.0%	
7.	0	☐	0.0%	
	0		**= Total Cover**	
Herb Stratum (Plot size: 5')				
1. Phalaris arundinacea	100	☑	100.0%	FACW
2.	0	☐	0.0%	
3.	0	☐	0.0%	
4.	0	☐	0.0%	
5.	0	☐	0.0%	
6.	0	☐	0.0%	
7.	0	☐	0.0%	
8.	0	☐	0.0%	
9.	0	☐	0.0%	
10.	0	☐	0.0%	
11.	0	☐	0.0%	
12.	0	☐	0.0%	
	100		**= Total Cover**	
Woody Vine Stratum (Plot size:)				
1.	0	☐	0.0%	
2.	0	☐	0.0%	
3.	0	☐	0.0%	
4.	0	☐	0.0%	
	0		**= Total Cover**	

Dominance Test worksheet:

Number of Dominant Species That are OBL, FACW, or FAC: 1 (A)

Total Number of Dominant Species Across All Strata: 1 (B)

Percent of dominant Species That Are OBL, FACW, or FAC: 100.0% (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:		
OBL species	0	x 1 =	0	
FACW species	100	x 2 =	200	
FAC species	0	x 3 =	0	
FACU species	0	x 4 =	0	
UPL species	0	x 5 =	0	
Column Totals:	100	(A)	200	(B)

Prevalence Index = B/A = 2.000

Hydrophytic Vegetation Indicators:

- ☐ **Rapid Test for Hydrophytic Vegetation**
- ☑ **Dominance Test is > 50%**
- ☑ **Prevalence Index is ≤3.0** [1]
- ☐ **Morphological Adaptations** [1] **(Provide supporting data in Remarks or on a separate sheet)**
- ☐ **Problematic Hydrophytic Vegetation** [1] **(Explain)**

[1] **Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.**

Definitions of Vegetation Strata:

Tree - Woody plants, 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/shrub - Woody plants less than 3 in. DBH and greater than 3.28 ft (1m) tall..

Herb - All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vine - All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? Yes ◉ No ○

Remarks: (Include photo numbers here or on a separate sheet.)

Dominant vegetation was determined through application of the 50/20 rule. Vegetation at the sample plot is hydrophytic.

*Indicator suffix = National status or professional decision assigned because Regional status not defined by FWS.

Soil

Sampling Point: 5

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)		%	Redox Features Color (moist)		%	Type [1]	Loc²	Texture	Remarks
0-9	10YR	3/1		10YR	3/6	1%	C	PL	Loam	
9-20	2.5Y	4/2	75%						Sand	
9-20	2.5Y	4/1	25%						Sand	

[1] Type: C=Concentration. D=Depletion. RM=Reduced Matrix, CS=Covered or Coated Sand Grains ²Location: PL=Pore Lining. M=Matrix

Hydric Soil Indicators:

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☑ Hydrogen Sulfide (A4)
- ☐ Stratified Layers (A5)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Muck Mineral (S1)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Dark Surface (S7) (LRR R, MLRA 149B)
- ☐ Polyvalue Below Surface (S8) (LRR R, MLRA 149B)
- ☐ Thin Dark Surface (S9) (LRR R, MLRA 149B)
- ☐ Loamy Mucky Mineral (F1) LRR K, L)
- ☐ Loamy Gleyed Matrix (F2)
- ☐ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)

Indicators for Problematic Hydric Soils : [3]

- ☐ 2 cm Muck (A10) (LRR K, L, MLRA 149B)
- ☐ Coast Prairie Redox (A16) (LRR K, L, R)
- ☐ 5 cm Mucky Peat or Peat (S3) (LRR K, L, R)
- ☐ Dark Surface (S7) (LRR K, L, M)
- ☐ Polyvalue Below Surface (S8) (LRR K, L)
- ☐ Thin Dark Surface (S9) (LRR K, L)
- ☐ Iron-Manganese Masses (F12) (LRR K, L, R)
- ☐ Piedmont Floodplain Soils (F19) (MLRA 149B)
- ☐ Mesic Spodic (TA6) (MLRA 144A, 145, 149B)
- ☐ Red Parent Material (F21)
- ☐ Very Shallow Dark Surface (TF12)
- ☐ Other (Explain in Remarks)

[3] Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: _____

Depth (inches): _____

Hydric Soil Present? Yes ◉ No ○

Remarks:

The soil at the sample plot matches the A4 Indicator (Hydrogen Sulfide) described in the Regional Supplement to the Army Corps of Engineers Wetland Delineation Manual: Northcentral and Northeast Regions (2012).

WETLAND DETERMINATION DATA FORM - Northcentral and Northeast Region

Project/Site: Fire Station #14 **City/County:** Madison/Dane **Sampling Date:** 17-Jul-13

Applicant/Owner: City of Madison **State:** WI **Sampling Point:** 6

Investigator(s): Stautz/Anderson **Section, Township, Range:** **S.** 22 **T.** 7N **R.** 10E

Landform (hillslope, terrace, etc.): Footslope **Local relief (concave, convex, none):** convex **Slope:** 0.0 **%** / 0.0 °

Subregion (LRR or MLRA): LRR K **Lat.:** **Long.:** **Datum:**

Soil Map Unit Name: Houghton muck (Ho) **NWI classification:** UPL

Are climatic/hydrologic conditions on the site typical for this time of year? Yes ○ No ◉ **(If no, explain in Remarks.)**

Are Vegetation ☐ **, Soil** ☐ **, or Hydrology** ☐ **significantly disturbed?** **Are "Normal Circumstances" present?** Yes ◉ No ○

Are Vegetation ☐ **, Soil** ☐ **, or Hydrology** ☐ **naturally problematic?** **(If needed, explain any answers in Remarks.)**

Summary of Findings - Attach site map showing sampling point locations, transects, important features, etc

Hydrophytic Vegetation Present?	Yes ◉	No ○	
Hydric Soil Present?	Yes ○	No ◉	**Is the Sampled Area within a Wetland?** Yes ○ No ◉
Wetland Hydrology Present?	Yes ○	No ◉	

Remarks: (Explain alternative procedures here or in a separate report.)

Hydrologic conditions are not typical for this time of year (see hydrology remarks section). Although hydrophytic vegetation is dominant and hydric soil is present, the lack of wetland hydrology during a time when precipitation is 102% above normal indicates the sample plot is located in an upland fallow field.

Hydrology

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ☐ Surface Water (A1)
- ☐ High Water Table (A2)
- ☐ Saturation (A3)
- ☐ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Water-Stained Leaves (B9)
- ☐ Aquatic Fauna (B13)
- ☐ Marl Deposits (B15)
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Oxidized Rhizospheres along Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Thin Muck Surface (C7)
- ☐ Other (Explain in Remarks)

Secondary Indicators (minimum of 2 required)

- ☐ Surface Soil Cracks (B6)
- ☐ Drainage Patterns (B10)
- ☐ Moss Trim Lines (B16)
- ☐ Dry Season Water Table (C2)
- ☐ Crayfish Burrows (C8)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Stunted or Stressed Plants (D1)
- ☐ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☐ Microtopographic Relief (D4)
- ☑ FAC-neutral Test (D5)

Field Observations:

Surface Water Present?	Yes ○	No ◉	Depth (inches):	
Water Table Present?	Yes ○	No ◉	Depth (inches):	
Saturation Present? (includes capillary fringe)	Yes ◉	No ○	Depth (inches): 25	**Wetland Hydrology Present?** Yes ○ No ◉

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

Precipitation in the Madison Area for April-June was 102% above normal. 1.66" of precipitation were recorded in the two weeks prior to field work. The presence of only one secondary indicator at the sample plot does not provide evidence of wetland hydrology.

VEGETATION - Use scientific names of plants

Sampling Point: 6

	Absolute % Cover	Dominant Species?	Rel.Strat. Cover	Indicator Status
Tree Stratum (Plot size:)				
1.	0	☐	0.0%	
2.	0	☐	0.0%	
3.	0	☐	0.0%	
4.	0	☐	0.0%	
5.	0	☐	0.0%	
6.	0	☐	0.0%	
7.	0	☐	0.0%	
	0		**= Total Cover**	
Sapling/Shrub Stratum (Plot size:)				
1.	0	☐	0.0%	
2.	0	☐	0.0%	
3.	0	☐	0.0%	
4.	0	☐	0.0%	
5.	0	☐	0.0%	
6.	0	☐	0.0%	
7.	0	☐	0.0%	
	0		**= Total Cover**	
Herb Stratum (Plot size: 5')				
1. Phalaris arundinacea	100	☑	90.9%	FACW
2. Cirsium arvense	10	☐	9.1%	FACU
3.	0	☐	0.0%	
4.	0	☐	0.0%	
5.	0	☐	0.0%	
6.	0	☐	0.0%	
7.	0	☐	0.0%	
8.	0	☐	0.0%	
9.	0	☐	0.0%	
10.	0	☐	0.0%	
11.	0	☐	0.0%	
12.	0	☐	0.0%	
	110		**= Total Cover**	
Woody Vine Stratum (Plot size:)				
1.	0	☐	0.0%	
2.	0	☐	0.0%	
3.	0	☐	0.0%	
4.	0	☐	0.0%	
	0		**= Total Cover**	

Dominance Test worksheet:

Number of Dominant Species That are OBL, FACW, or FAC: 1 (A)

Total Number of Dominant Species Across All Strata: 1 (B)

Percent of dominant Species That Are OBL, FACW, or FAC: 100.0% (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:		
OBL species	0	x 1 =	0	
FACW species	100	x 2 =	200	
FAC species	0	x 3 =	0	
FACU species	10	x 4 =	40	
UPL species	0	x 5 =	0	
Column Totals:	110	(A)	240	(B)

Prevalence Index = B/A = 2.182

Hydrophytic Vegetation Indicators:

- ☐ **Rapid Test for Hydrophytic Vegetation**
- ☑ **Dominance Test is > 50%**
- ☑ **Prevalence Index is ≤3.0** [1]
- ☐ **Morphological Adaptations** [1] **(Provide supporting data in Remarks or on a separate sheet)**
- ☐ **Problematic Hydrophytic Vegetation** [1] **(Explain)**

[1] **Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.**

Definitions of Vegetation Strata:

Tree - Woody plants, 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/shrub - Woody plants less than 3 in. DBH and greater than 3.28 ft (1m) tall..

Herb - All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vine - All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? Yes ◉ No ○

Remarks: (Include photo numbers here or on a separate sheet.)

Dominant vegetation was determined through application of the 50/20 rule. Vegetation at the sample plot is hydrophytic.

*Indicator suffix = National status or professional decision assigned because Regional status not defined by FWS.

Soil

Sampling Point: 6

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)		%	Redox Features Color (moist)	%	Type [1]	Loc²	Texture	Remarks
0-25	N	2.5/1						Loam	
25-28	2.5Y	5/3						Sand	
25-28	2.5Y	3/2						Sandy Loam	

[1] Type: C=Concentration. D=Depletion. RM=Reduced Matrix, CS=Covered or Coated Sand Grains ²Location: PL=Pore Lining. M=Matrix

Hydric Soil Indicators:

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Stratified Layers (A5)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Muck Mineral (S1)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Dark Surface (S7) (LRR R, MLRA 149B)
- ☐ Polyvalue Below Surface (S8) (LRR R, MLRA 149B)
- ☐ Thin Dark Surface (S9) (LRR R, MLRA 149B)
- ☐ Loamy Mucky Mineral (F1) LRR K, L)
- ☐ Loamy Gleyed Matrix (F2)
- ☐ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)

Indicators for Problematic Hydric Soils : [3]

- ☐ 2 cm Muck (A10) (LRR K, L, MLRA 149B)
- ☐ Coast Prairie Redox (A16) (LRR K, L, R)
- ☐ 5 cm Mucky Peat or Peat (S3) (LRR K, L, R)
- ☐ Dark Surface (S7) (LRR K, L, M)
- ☐ Polyvalue Below Surface (S8) (LRR K, L)
- ☐ Thin Dark Surface (S9) (LRR K, L)
- ☐ Iron-Manganese Masses (F12) (LRR K, L, R)
- ☐ Piedmont Floodplain Soils (F19) (MLRA 149B)
- ☐ Mesic Spodic (TA6) (MLRA 144A, 145, 149B)
- ☐ Red Parent Material (F21)
- ☐ Very Shallow Dark Surface (TF12)
- ☐ Other (Explain in Remarks)

[3] Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: _____

Depth (inches): _____

Hydric Soil Present? Yes ○ No ◉

Remarks:

The soil at the sample plot does not meet any of the criteria described in the Regional Supplement to the Army Corps of Engineers Wetland Delineation Manual: Northcentral and Northeast Regions (2012).

WETLAND DETERMINATION DATA FORM - Northcentral and Northeast Region

Project/Site: Fire Station #14 **City/County:** Madison/Dane **Sampling Date:** 17-Jul-13

Applicant/Owner: City of Madison **State:** WI **Sampling Point:** 7

Investigator(s): Stautz/Anderson **Section, Township, Range:** **S.** 22 **T.** 7N **R.** 10E

Landform (hillslope, terrace, etc.): Toeslope **Local relief (concave, convex, none):** concave **Slope:** 0.0 % / 0.0 °

Subregion (LRR or MLRA): LRR K **Lat.:** **Long.:** **Datum:**

Soil Map Unit Name: Houghton muck (Ho) **NWI classification:** E2K

Are climatic/hydrologic conditions on the site typical for this time of year? Yes ○ No ◉ **(If no, explain in Remarks.)**

Are Vegetation ☐ **, Soil** ☐ **, or Hydrology** ☐ **significantly disturbed?** **Are "Normal Circumstances" present?** Yes ◉ No ○

Are Vegetation ☐ **, Soil** ☐ **, or Hydrology** ☐ **naturally problematic?** **(If needed, explain any answers in Remarks.)**

Summary of Findings - Attach site map showing sampling point locations, transects, important features, etc

Hydrophytic Vegetation Present?	Yes ◉	No ○	
Hydric Soil Present?	Yes ◉	No ○	**Is the Sampled Area within a Wetland?** Yes ◉ No ○
Wetland Hydrology Present?	Yes ◉	No ○	

Remarks: (Explain alternative procedures here or in a separate report.)

Hydrologic conditions are not typical for this time of year (see hydrology remarks section). The sample plot is located in a wet meadow.

Hydrology

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ☑ Surface Water (A1)
- ☑ High Water Table (A2)
- ☑ Saturation (A3)
- ☐ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Water-Stained Leaves (B9)
- ☐ Aquatic Fauna (B13)
- ☐ Marl Deposits (B15)
- ☑ Hydrogen Sulfide Odor (C1)
- ☐ Oxidized Rhizospheres along Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Thin Muck Surface (C7)
- ☐ Other (Explain in Remarks)

Secondary Indicators (minimum of 2 required)

- ☐ Surface Soil Cracks (B6)
- ☐ Drainage Patterns (B10)
- ☐ Moss Trim Lines (B16)
- ☐ Dry Season Water Table (C2)
- ☐ Crayfish Burrows (C8)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Stunted or Stressed Plants (D1)
- ☑ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☐ Microtopographic Relief (D4)
- ☑ FAC-neutral Test (D5)

Field Observations:

Surface Water Present?	Yes ◉	No ○	Depth (inches):	2	
Water Table Present?	Yes ◉	No ○	Depth (inches):	0	
Saturation Present? (includes capillary fringe)	Yes ◉	No ○	Depth (inches):	0	**Wetland Hydrology Present?** Yes ◉ No ○

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

Precipitation in the Madison Area for April-June was 102% above normal. 1.66" of precipitation were recorded in the two weeks prior to field work. The presence of four primary and two secondary indicators at the sample plot provides evidence of wetland hydrology.

VEGETATION - Use scientific names of plants

Sampling Point: 7

	Absolute % Cover	Dominant Species?	Rel.Strat. Cover	Indicator Status
Tree Stratum (Plot size:)				
1.	0	☐	0.0%	
2.	0	☐	0.0%	
3.	0	☐	0.0%	
4.	0	☐	0.0%	
5.	0	☐	0.0%	
6.	0	☐	0.0%	
7.	0	☐	0.0%	
	0	**= Total Cover**		
Sapling/Shrub Stratum (Plot size:)				
1.	0	☐	0.0%	
2.	0	☐	0.0%	
3.	0	☐	0.0%	
4.	0	☐	0.0%	
5.	0	☐	0.0%	
6.	0	☐	0.0%	
7.	0	☐	0.0%	
	0	**= Total Cover**		
Herb Stratum (Plot size: 5')				
1. Phalaris arundinacea	100	☑	98.0%	FACW
2. Cirsium arvense	2	☐	2.0%	FACU
3.	0	☐	0.0%	
4.	0	☐	0.0%	
5.	0	☐	0.0%	
6.	0	☐	0.0%	
7.	0	☐	0.0%	
8.	0	☐	0.0%	
9.	0	☐	0.0%	
10.	0	☐	0.0%	
11.	0	☐	0.0%	
12.	0	☐	0.0%	
	102	**= Total Cover**		
Woody Vine Stratum (Plot size:)				
1.	0	☐	0.0%	
2.	0	☐	0.0%	
3.	0	☐	0.0%	
4.	0	☐	0.0%	
	0	**= Total Cover**		

Dominance Test worksheet:

Number of Dominant Species That are OBL, FACW, or FAC: 1 (A)

Total Number of Dominant Species Across All Strata: 1 (B)

Percent of dominant Species That Are OBL, FACW, or FAC: 100.0% (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:		
OBL species	0	x 1 =	0	
FACW species	100	x 2 =	200	
FAC species	0	x 3 =	0	
FACU species	2	x 4 =	8	
UPL species	0	x 5 =	0	
Column Totals:	102	(A)	208	(B)

Prevalence Index = B/A = 2.039

Hydrophytic Vegetation Indicators:

- ☐ **Rapid Test for Hydrophytic Vegetation**
- ☑ **Dominance Test is > 50%**
- ☑ **Prevalence Index is ≤3.0** [1]
- ☐ **Morphological Adaptations** [1] **(Provide supporting data in Remarks or on a separate sheet)**
- ☐ **Problematic Hydrophytic Vegetation** [1] **(Explain)**

[1] **Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.**

Definitions of Vegetation Strata:

Tree - Woody plants, 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/shrub - Woody plants less than 3 in. DBH and greater than 3.28 ft (1m) tall..

Herb - All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vine - All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? Yes ◉ No ○

Remarks: (Include photo numbers here or on a separate sheet.)

Dominant vegetation was determined through application of the 50/20 rule. Vegetation at the sample plot is hydrophytic.

*Indicator suffix = National status or professional decision assigned because Regional status not defined by FWS.

Soil

Sampling Point: 7

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)		%	Redox Features Color (moist)	%	Type [1]	Loc²	Texture	Remarks
0-11	10YR	2.5/1						Loam	
11-20	2.5Y	4/2	80%					Sandy Clay Loam	
11-20	2.5Y	3/2	20%					Sandy Loam	

[1] Type: C=Concentration. D=Depletion. RM=Reduced Matrix, CS=Covered or Coated Sand Grains ²Location: PL=Pore Lining. M=Matrix

Hydric Soil Indicators:

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☑ Hydrogen Sulfide (A4)
- ☐ Stratified Layers (A5)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Muck Mineral (S1)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Dark Surface (S7) (LRR R, MLRA 149B)
- ☐ Polyvalue Below Surface (S8) (LRR R, MLRA 149B)
- ☐ Thin Dark Surface (S9) (LRR R, MLRA 149B)
- ☐ Loamy Mucky Mineral (F1) LRR K, L)
- ☐ Loamy Gleyed Matrix (F2)
- ☐ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)

Indicators for Problematic Hydric Soils : [3]

- ☐ 2 cm Muck (A10) (LRR K, L, MLRA 149B)
- ☐ Coast Prairie Redox (A16) (LRR K, L, R)
- ☐ 5 cm Mucky Peat or Peat (S3) (LRR K, L, R)
- ☐ Dark Surface (S7) (LRR K, L, M)
- ☐ Polyvalue Below Surface (S8) (LRR K, L)
- ☐ Thin Dark Surface (S9) (LRR K, L)
- ☐ Iron-Manganese Masses (F12) (LRR K, L, R)
- ☐ Piedmont Floodplain Soils (F19) (MLRA 149B)
- ☐ Mesic Spodic (TA6) (MLRA 144A, 145, 149B)
- ☐ Red Parent Material (F21)
- ☐ Very Shallow Dark Surface (TF12)
- ☐ Other (Explain in Remarks)

[3] Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: _____

Depth (inches): _____

Hydric Soil Present? Yes ◉ No ○

Remarks:

The soil at the sample plot matches the A4 Indicator (Hydrogen Sulfide) described in the Regional Supplement to the Army Corps of Engineers Wetland Delineation Manual: Northcentral and Northeast Regions (2012).

WETLAND DETERMINATION DATA FORM - Northcentral and Northeast Region

Project/Site: Fire Station #14 **City/County:** Madison/Dane **Sampling Date:** 17-Jul-13

Applicant/Owner: City of Madison **State:** WI **Sampling Point:** 8

Investigator(s): Stautz/Anderson **Section, Township, Range:** **S.** 22 **T.** 7N **R.** 10E

Landform (hillslope, terrace, etc.): Undulating **Local relief (concave, convex, none):** flat **Slope:** 0.0 **%** / 0.0 °

Subregion (LRR or MLRA): LRR K **Lat.:** **Long.:** **Datum:**

Soil Map Unit Name: Virgil silt loam, gravelly substratum, 0-3% slopes (VwA) **NWI classification:** UPL

Are climatic/hydrologic conditions on the site typical for this time of year? Yes ○ No ◉ **(If no, explain in Remarks.)**

Are Vegetation ☐ **, Soil** ☐ **, or Hydrology** ☐ **significantly disturbed?** **Are "Normal Circumstances" present?** Yes ◉ No ○

Are Vegetation ☐ **, Soil** ☐ **, or Hydrology** ☐ **naturally problematic?** **(If needed, explain any answers in Remarks.)**

Summary of Findings - Attach site map showing sampling point locations, transects, important features, etc

Hydrophytic Vegetation Present?	Yes ○ No ◉	**Is the Sampled Area within a Wetland?**	Yes ○ No ◉
Hydric Soil Present?	Yes ○ No ◉		
Wetland Hydrology Present?	Yes ○ No ◉		

Remarks: (Explain alternative procedures here or in a separate report.)

Hydrologic conditions are not typical for this time of year (see hydrology remarks section). The sample plot is located in an upland meadow.

Hydrology

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ☐ Surface Water (A1)
- ☐ High Water Table (A2)
- ☐ Saturation (A3)
- ☐ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Water-Stained Leaves (B9)
- ☐ Aquatic Fauna (B13)
- ☐ Marl Deposits (B15)
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Oxidized Rhizospheres along Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Thin Muck Surface (C7)
- ☐ Other (Explain in Remarks)

Secondary Indicators (minimum of 2 required)

- ☐ Surface Soil Cracks (B6)
- ☐ Drainage Patterns (B10)
- ☐ Moss Trim Lines (B16)
- ☐ Dry Season Water Table (C2)
- ☐ Crayfish Burrows (C8)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Stunted or Stressed Plants (D1)
- ☐ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☐ Microtopographic Relief (D4)
- ☐ FAC-neutral Test (D5)

Field Observations:

Surface Water Present?	Yes ○	No ◉	Depth (inches):	
Water Table Present?	Yes ○	No ◉	Depth (inches):	
Saturation Present? (includes capillary fringe)	Yes ○	No ◉	Depth (inches):	**Wetland Hydrology Present?** Yes ○ No ◉

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

Precipitation in the Madison Area for April-June was 102% above normal. 1.66" of precipitation were recorded in the two weeks prior to field work. No evidence of wetland hydrology was observed at the sample plot.

VEGETATION - Use scientific names of plants

Sampling Point: 8

	Absolute % Cover	Dominant Species?	Rel.Strat. Cover	Indicator Status
Tree Stratum (Plot size:)				
1.	0	☐	0.0%	
2.	0	☐	0.0%	
3.	0	☐	0.0%	
4.	0	☐	0.0%	
5.	0	☐	0.0%	
6.	0	☐	0.0%	
7.	0	☐	0.0%	
	0		**= Total Cover**	
Sapling/Shrub Stratum (Plot size:)				
1.	0	☐	0.0%	
2.	0	☐	0.0%	
3.	0	☐	0.0%	
4.	0	☐	0.0%	
5.	0	☐	0.0%	
6.	0	☐	0.0%	
7.	0	☐	0.0%	
	0		**= Total Cover**	
Herb Stratum (Plot size: 5')				
1. Elymus repens	5	☐	4.4%	FACU
2. Poa pratensis	100	☑	88.5%	FACU
3. Phalaris arundinacea	1	☐	0.9%	FACW
4. Lotus corniculatus	5	☐	4.4%	FACU
5. Solidago canadensis	2	☐	1.8%	FACU
6.	0	☐	0.0%	
7.	0	☐	0.0%	
8.	0	☐	0.0%	
9.	0	☐	0.0%	
10.	0	☐	0.0%	
11.	0	☐	0.0%	
12.	0	☐	0.0%	
	113		**= Total Cover**	
Woody Vine Stratum (Plot size:)				
1.	0	☐	0.0%	
2.	0	☐	0.0%	
3.	0	☐	0.0%	
4.	0	☐	0.0%	
	0		**= Total Cover**	

Dominance Test worksheet:

Number of Dominant Species That are OBL, FACW, or FAC: 0 (A)

Total Number of Dominant Species Across All Strata: 1 (B)

Percent of dominant Species That Are OBL, FACW, or FAC: 0.0% (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:		
OBL species	0	x 1 =	0	
FACW species	1	x 2 =	2	
FAC species	0	x 3 =	0	
FACU species	112	x 4 =	448	
UPL species	0	x 5 =	0	
Column Totals:	113	(A)	450	(B)

Prevalence Index = B/A = 3.982

Hydrophytic Vegetation Indicators:

- ☐ **Rapid Test for Hydrophytic Vegetation**
- ☐ **Dominance Test is > 50%**
- ☐ **Prevalence Index is ≤3.0** [1]
- ☐ **Morphological Adaptations** [1] **(Provide supporting data in Remarks or on a separate sheet)**
- ☐ **Problematic Hydrophytic Vegetation** [1] **(Explain)**

[1] **Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.**

Definitions of Vegetation Strata:

Tree - Woody plants, 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/shrub - Woody plants less than 3 in. DBH and greater than 3.28 ft (1m) tall..

Herb - All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vine - All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? Yes ○ No ◉

Remarks: (Include photo numbers here or on a separate sheet.)

Dominant vegetation was determined through application of the 50/20 rule. Vegetation at the sample plot is not hydrophytic.

*Indicator suffix = National status or professional decision assigned because Regional status not defined by FWS.

Soil

Sampling Point: 8

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)		%	Redox Features Color (moist)	%	Type [1]	Loc²	Texture	Remarks
0-7	2.5Y	3/2						Sandy Loam	
7-18	10YR	4/4						Sandy Clay Loam	gravel
18+								Compacted Soil	

[1] Type: C=Concentration. D=Depletion. RM=Reduced Matrix, CS=Covered or Coated Sand Grains ²Location: PL=Pore Lining. M=Matrix

Hydric Soil Indicators:

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Stratified Layers (A5)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Muck Mineral (S1)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Dark Surface (S7) (LRR R, MLRA 149B)
- ☐ Polyvalue Below Surface (S8) (LRR R, MLRA 149B)
- ☐ Thin Dark Surface (S9) (LRR R, MLRA 149B)
- ☐ Loamy Mucky Mineral (F1) LRR K, L)
- ☐ Loamy Gleyed Matrix (F2)
- ☐ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)

Indicators for Problematic Hydric Soils : [3]

- ☐ 2 cm Muck (A10) (LRR K, L, MLRA 149B)
- ☐ Coast Prairie Redox (A16) (LRR K, L, R)
- ☐ 5 cm Mucky Peat or Peat (S3) (LRR K, L, R)
- ☐ Dark Surface (S7) (LRR K, L, M)
- ☐ Polyvalue Below Surface (S8) (LRR K, L)
- ☐ Thin Dark Surface (S9) (LRR K, L)
- ☐ Iron-Manganese Masses (F12) (LRR K, L, R)
- ☐ Piedmont Floodplain Soils (F19) (MLRA 149B)
- ☐ Mesic Spodic (TA6) (MLRA 144A, 145, 149B)
- ☐ Red Parent Material (F21)
- ☐ Very Shallow Dark Surface (TF12)
- ☐ Other (Explain in Remarks)

[3] Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: _____

Depth (inches): _____

Hydric Soil Present? Yes ○ No ◉

Remarks:

The presence of a compacted soil layer at 18" did not allow the observation of a complete soil profile. The soil at the sample plot does not meet any of the criteria described in the Regional Supplement to the Army Corps of Engineers Wetland Delineation Manual: Northcentral and Northeast Regions (2012).

WETLAND DETERMINATION DATA FORM - Northcentral and Northeast Region

Project/Site: Fire Station #14 **City/County:** Madison/Dane **Sampling Date:** 17-Jul-13

Applicant/Owner: City of Madison **State:** WI **Sampling Point:** 9

Investigator(s): Stautz/Anderson **Section, Township, Range:** **S.** 22 **T.** 7N **R.** 10E

Landform (hillslope, terrace, etc.): **Local relief (concave, convex, none):** **Slope:** 0.0 % / 0.0 °

Subregion (LRR or MLRA): LRR K **Lat.:** **Long.:** **Datum:**

Soil Map Unit Name: Virgil silt loam, gravelly substratum, 0-3% slopes (VwA) **NWI classification:** UPL

Are climatic/hydrologic conditions on the site typical for this time of year? Yes ○ No ◉ **(If no, explain in Remarks.)**

Are Vegetation ☐ **, Soil** ☐ **, or Hydrology** ☐ **significantly disturbed?** **Are "Normal Circumstances" present?** Yes ◉ No ○

Are Vegetation ☐ **, Soil** ☐ **, or Hydrology** ☐ **naturally problematic?** **(If needed, explain any answers in Remarks.)**

Summary of Findings - Attach site map showing sampling point locations, transects, important features, etc

Hydrophytic Vegetation Present?	Yes ○	No ◉	
Hydric Soil Present?	Yes ○	No ◉	**Is the Sampled Area within a Wetland?** Yes ○ No ◉
Wetland Hydrology Present?	Yes ○	No ◉	

Remarks: (Explain alternative procedures here or in a separate report.)

Hydrologic conditions are not typical for this time of year (see hydrology remarks section). The sample plot is located in an upland meadow.

Hydrology

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ☐ Surface Water (A1)
- ☐ High Water Table (A2)
- ☐ Saturation (A3)
- ☐ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Water-Stained Leaves (B9)
- ☐ Aquatic Fauna (B13)
- ☐ Marl Deposits (B15)
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Oxidized Rhizospheres along Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Thin Muck Surface (C7)
- ☐ Other (Explain in Remarks)

Secondary Indicators (minimum of 2 required)

- ☐ Surface Soil Cracks (B6)
- ☐ Drainage Patterns (B10)
- ☐ Moss Trim Lines (B16)
- ☐ Dry Season Water Table (C2)
- ☐ Crayfish Burrows (C8)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Stunted or Stressed Plants (D1)
- ☐ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☐ Microtopographic Relief (D4)
- ☐ FAC-neutral Test (D5)

Field Observations:

Surface Water Present?	Yes ○	No ◉	Depth (inches):	
Water Table Present?	Yes ○	No ◉	Depth (inches):	
Saturation Present? (includes capillary fringe)	Yes ○	No ◉	Depth (inches):	**Wetland Hydrology Present?** Yes ○ No ◉

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

Precipitation in the Madison Area for April-June was 102% above normal. 1.66" of precipitation were recorded in the two weeks prior to field work. No evidence of wetland hydrology was observed at the sample plot.

VEGETATION - Use scientific names of plants

Sampling Point: 9

	Absolute % Cover	Dominant Species?	Rel.Strat. Cover	Indicator Status
Tree Stratum (Plot size:)				
1.	0	☐	0.0%	
2.	0	☐	0.0%	
3.	0	☐	0.0%	
4.	0	☐	0.0%	
5.	0	☐	0.0%	
6.	0	☐	0.0%	
7.	0	☐	0.0%	
	0		**= Total Cover**	
Sapling/Shrub Stratum (Plot size:)				
1.	0	☐	0.0%	
2.	0	☐	0.0%	
3.	0	☐	0.0%	
4.	0	☐	0.0%	
5.	0	☐	0.0%	
6.	0	☐	0.0%	
7.	0	☐	0.0%	
	0		**= Total Cover**	
Herb Stratum (Plot size: 5')				
1. Dipsacus fullonum	2	☐	1.6%	FACU
2. Poa pratensis	90	☑	73.8%	FACU
3. Solidago canadensis	20	☐	16.4%	FACU
4. Cirsium arvense	10	☐	8.2%	FACU
5.	0	☐	0.0%	
6.	0	☐	0.0%	
7.	0	☐	0.0%	
8.	0	☐	0.0%	
9.	0	☐	0.0%	
10.	0	☐	0.0%	
11.	0	☐	0.0%	
12.	0	☐	0.0%	
	122		**= Total Cover**	
Woody Vine Stratum (Plot size:)				
1.	0	☐	0.0%	
2.	0	☐	0.0%	
3.	0	☐	0.0%	
4.	0	☐	0.0%	
	0		**= Total Cover**	

Dominance Test worksheet:

Number of Dominant Species That are OBL, FACW, or FAC: 0 (A)

Total Number of Dominant Species Across All Strata: 1 (B)

Percent of dominant Species That Are OBL, FACW, or FAC: 0.0% (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:		
OBL species	0	x 1 =	0	
FACW species	0	x 2 =	0	
FAC species	0	x 3 =	0	
FACU species	122	x 4 =	488	
UPL species	0	x 5 =	0	
Column Totals:	122	(A)	488	(B)

Prevalence Index = B/A = 4.000

Hydrophytic Vegetation Indicators:

- ☐ **Rapid Test for Hydrophytic Vegetation**
- ☐ **Dominance Test is > 50%**
- ☐ **Prevalence Index is ≤3.0** [1]
- ☐ **Morphological Adaptations** [1] **(Provide supporting data in Remarks or on a separate sheet)**
- ☐ **Problematic Hydrophytic Vegetation** [1] **(Explain)**

[1] **Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.**

Definitions of Vegetation Strata:

Tree - Woody plants, 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/shrub - Woody plants less than 3 in. DBH and greater than 3.28 ft (1m) tall..

Herb - All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vine - All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? Yes ○ No ◉

Remarks: (Include photo numbers here or on a separate sheet.)

Dominant vegetation was determined through application of the 50/20 rule. Vegetation at the sample plot is not hydrophytic.

*Indicator suffix = National status or professional decision assigned because Regional status not defined by FWS.

Soil

Sampling Point: 9

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)		%	Redox Features Color (moist)		%	Type [1]	Loc²	Texture	Remarks
0-5	2.5Y	3/3							Clay Loam	
5-16	10YR	4/3							Clay Loam	
16-20	10YR	4/6		7.5YR	5/6	2%	C	M	Clay Loam	

[1] Type: C=Concentration. D=Depletion. RM=Reduced Matrix, CS=Covered or Coated Sand Grains ²Location: PL=Pore Lining. M=Matrix

Hydric Soil Indicators:

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Stratified Layers (A5)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Muck Mineral (S1)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Dark Surface (S7) (LRR R, MLRA 149B)
- ☐ Polyvalue Below Surface (S8) (LRR R, MLRA 149B)
- ☐ Thin Dark Surface (S9) (LRR R, MLRA 149B)
- ☐ Loamy Mucky Mineral (F1) LRR K, L)
- ☐ Loamy Gleyed Matrix (F2)
- ☐ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)

Indicators for Problematic Hydric Soils : [3]

- ☐ 2 cm Muck (A10) (LRR K, L, MLRA 149B)
- ☐ Coast Prairie Redox (A16) (LRR K, L, R)
- ☐ 5 cm Mucky Peat or Peat (S3) (LRR K, L, R)
- ☐ Dark Surface (S7) (LRR K, L, M)
- ☐ Polyvalue Below Surface (S8) (LRR K, L)
- ☐ Thin Dark Surface (S9) (LRR K, L)
- ☐ Iron-Manganese Masses (F12) (LRR K, L, R)
- ☐ Piedmont Floodplain Soils (F19) (MLRA 149B)
- ☐ Mesic Spodic (TA6) (MLRA 144A, 145, 149B)
- ☐ Red Parent Material (F21)
- ☐ Very Shallow Dark Surface (TF12)
- ☐ Other (Explain in Remarks)

[3] Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: _____

Depth (inches): _____

Hydric Soil Present? Yes ○ No ◉

Remarks:

The soil at the sample plot does not meet any of the criteria described in the Regional Supplement to the Army Corps of Engineers Wetland Delineation Manual: Northcentral and Northeast Regions (2012).

F

APPENDIX F

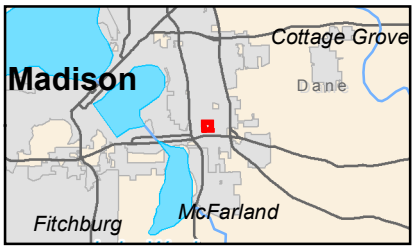
Site Survey

Legend

- Sample Plot
- Project Area (+/- 14.6 acres)
- Wetland (+/-0.49 acre)

Appendix F
Site Survey

City of Madison
Fire Station #14
Project No. 15220004
City of Madison, Dane County, Wisconsin



Extent of large view shown in red.

0 100 200
Feet

N

NES ECOLOGICAL SERVICES
A Division of Robert E. Lee & Associates, Inc.

Document Path: Z:\Data\Jobs\Wetlands\Madison, City of\Fire Station 4\Maps\AppF.mxd

August 6, 2013

CGC, Inc.

Construction • Geotechnical
Consulting Engineering/Testing

August 9, 2013
C13064-7

Mr. Randy Wiesner
City Engineering, Management Section
210 Martin Luther King Jr. Blvd, Room 115
Madison, WI 53703

Re: Preliminary Geotechnical Exploration Report
Proposed Fire Station No. 14 & Fire Training Facility
Femrite Drive and Dairy Drive
Madison, Wisconsin

Dear Mr. Wiesner:

Construction • Geotechnical Consultants, Inc. (CGC) has completed the *preliminary* geotechnical exploration program for the proposed Fire Station No. 14 and Fire Training Facility. The purpose of this exploration program was to evaluate the subsurface conditions within the five parcels being considered for purchase by the City for this project and to provide preliminary geotechnical recommendations regarding site preparation, foundation, floor slab, and pavement design/construction, as well as stormwater infiltration potential. We are sending you one paper copy of this report and can provide a paper copy upon request.

PROJECT DESCRIPTION

We understand that five parcels along Femrite Drive and Dairy Drive in the World Dairy Center are being considered to house Fire Station No. 14 and Fire Training Facilities. The project potentially will include the following components, with a brief description, as available:

- Fire Station No. 14, which would be a slab-on-grade (no basement) building with masonry and steel stud construction,
- Classroom and Administrative space, which would be similar construction to the fire station,
- Burn Training Structure consisting of a three-story concrete structure, and
- Physical Fitness Training Building of unspecified building type and structural system.

The locations, elevations, loads of the structures have not been determined at this time, although buildings will likely not be located near the high-pressure gas line easement traversing along the southern to middle portions of the area. Associated with these structures would be pavement areas for both light-duty and heavy-duty traffic loading. Stormwater management areas will also be incorporated into the development.

SITE CONDITIONS

The proposed project area involves five parcels located north of Femrite Drive and east and west of Dairy Drive. The two lots west of Dairy Drive (3202 and 3218 Dairy Drive) are vacant grass-covered sites that extend from Prairie Dock Drive to Femrite Drive that generally have flat to gently-sloping site grades. An east-west running

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drainage ditch exists between these lots, as well as long the east property line. The three parcels east of Dairy Drive (3101 and 3201 Dairy Drive and 5152 Femrite Drive) form an essentially 'L-shaped' area that extends from Blazing Star Drive south to Femrite Drive and then east to Agriculture Drive. A small parcel exists at the northeast corner of Dairy Drive and Femrite Drive that contains an occupied single-story structure with related parking area that is not included in the project area. The north and east legs of the L-shaped parcel are bounded by a wetland, which is owned by the City. The area east of Dairy Drive is a mixture of grass-covered land in the northern and southern portions, with moderately to heavily-wooded land adjacent to the wetland and fairly widespread on the 3201 Dairy Drive parcel. Site grades appear to slope down gently to the east. The parcels at 3101 Dairy Drive and 5152 Femrite Drive do not appear to have been previously developed, but the parcel at 3201 Dairy Drive includes an asphalt drive off of Femrite Drive and evidence that previous structures existed, but have been demolished; there is also evidence that some grading (cutting and filling) has occurred on the 3201 Dairy Drive property. A 50-ft wide easement for a large high pressure gas line traverses the south end of the 5152 Femrite Drive and 3201 Dairy Drive properties and the north end of the 3218 Dairy Drive property.

SUBSURFACE CONDITIONS

Subsurface conditions on site were explored by drilling a total of 20 Standard Penetration Test (SPT) soil borings to planned depths of 10 to 30 ft below existing site grades at locations selected by the City of Madison and located in the field by Burse Survey and Engineering (Burse). Note that Boring 3 was offset 75 ft east due to a fallen tree blocking the path to the boring, and this boring was extended to 35 ft due to very loose to loose soil conditions at 30 ft. Boring 5 was also offset 10 ft east due to downed tree blocking the path to the boring. The borings were drilled on July 22 through 25, 2013 by Badger State Drilling (under subcontract to CGC) using ATV-mounted CME-750 and truck-mounted D-120 rotary drill rigs equipped with hollow-stem augers, mud rotary equipment and automatic SPT hammers. The boring locations are shown in plan on the Soil Boring Location Map attached in Appendix B. Ground surface elevations at the boring locations were surveyed by Burse.

The subsurface profiles at the boring locations varied somewhat at shallow depths due to previous site grading, but the profiles were fairly similar with depth. A generalized soil profile included the following strata, in descending order:

- 4 to 18 in. of ***topsoil/topsoil fill***, except in Borings 8, 9 and 13 where topsoil was absent at the surface; over

- 1 to 5.5 ft of ***fill*** or ***possible fill*** in Borings 8, 9, 10, 13 through 18 and 20 consisting of loose to medium dense sand with variable silt, clay and gravel content or soft to very stiff silty to lean clay with topsoil and wood/roots in some locations; followed by

- 1.5 to 5.5 ft of soft to hard ***lean clay*** with variable sand content or loose to medium dense ***clayey sand***; this layer was not encountered in Borings 2, 8, 9 and 10; followed by

- Very loose to dense ***sand*** with variable silt content and scattered silt seams or ***sandy silt*** to the maximum depth explored.

As exceptions to the above profile, 1-ft thick clay layers were encountered between sand layers in Borings 2 and 3. Additionally, 3.5-ft thick ***probable buried topsoil layers*** were encountered below the fill in Borings 8 and 9. The organic content (as measured by loss-on-ignition) on the buried topsoil layer ranged from 6.5% to 9.1%, where soils with loss on ignition exceeding 4% are considered organic.

The shallow clay layer ranged from soft to very stiff, with moisture contents that ranging from 17.0% to 29.5% on representative samples.

Groundwater was encountered in the borings during or shortly after drilling at 3.5 to 8.5 ft below existing site grades. Groundwater was generally shallowest on the eastern end of the area and slightly deeper to the west. Groundwater levels can be expected to fluctuate with seasonal variations in precipitation, infiltration, evapotranspiration, the level of nearby streams and lakes, the pumping rate of nearby wells and other factors. A more detailed description of the site soil and groundwater conditions is presented on the Soil Boring Logs attached in Appendix B.

DISCUSSION AND PRELIMINARY RECOMMENDATIONS

Subject to the limitations described below and based on the subsurface exploration, it is our opinion that these sites are generally suitable for the proposed construction and that structures can likely be supported by conventional spread footing foundations. However, the following soil issues exist at the site that will impact foundation, floor slab and pavement design and construction:

- Widespread presence of very loose to loose sands;
- Scattered areas of soft to medium stiff clay;
- Existing fill and buried topsoil in some areas; and
- Shallow groundwater table;

The extent to which the above soil conditions will impact building and pavement design and the strategies that can be used to address the soil issues will depend on the following:

- Building location and elevation;
- Foundation and floor slab loads; and
- Pavement grades and traffic loads.

With the above soil conditions and as of yet unknown building and pavement information in mind, our *preliminary* geotechnical recommendations regarding site preparation, foundation, floor slab, and stormwater infiltration design/construction are presented in the following subsections. Additional information regarding the conclusions and reeommendations presented in this report is discussed in Appendix C.

1. Site Preparation

We recommend that the topsoil/vegetation and pavement be stripped/removed at least 10 ft beyond the proposed construction areas, including areas required for cuts and fills beyond building footprints or pavement limits. The topsoil can be stockpiled on-site and re-used as fill in landscaped areas. Trees and tree roots should be removed in conjunction with topsoil stripping. Topsoil thicknesses varied from 0 to 18 in. the borings, but thicker topsoil deposits could be encountered due to previous grading activities.

Where areas containing fill (e.g, on the two parcels east of Dairy Drive and the large parcel at the northeast corner of Dairy Drive and Femrite Drive) fall within building footprints, we recommend that follow-up soil borings and/or test pits be completed to better determine the extent and composition of the fill. Although the fill will likely need to be removed below foundations, suitably firm, non-organic fill may be able to remain in-place below floor slab areas. *Note that 3.5 ft of buried topsoil was encountered below 2.5 to 5.5 ft of fill in Borings 8 and 9. If these areas will be within building footprints, we recommend that the fill and buried topsoil be undercut/removed during the initial site preparation, as the buried topsoil is considered unacceptable for foundation and floor slab support.*

Remnants of former buildings (slabs, foundations, foundation walls, abandoned utilities, etc.) that are located within planned building areas should be removed, with grade restored with granular backfill compacted to at least 95% compaction based on modified Proctor methods (ASTM D1557). Old foundations and slabs can potentially remain in-place in landscape and pavement areas provided slabs are broken up to allow drainage, are at least 2 ft below the bottom of the base course layer in the pavement section and do not interfere with new utility installation.

Prior to fill placement (where needed) or where the site is at-grade, the soils exposed below the topsoil should be carefully checked for soft/yielding areas by proof-rolling with a loaded tri-axle dump truck or other large rubber-tired piece of construction equipment (e.g., loaded scraper, off-road dump truck or front-end loader). If soft/yielding areas are encountered, these areas should be undercut and replaced with compacted granular backfill compacted to at least 95% compaction based on modified Proctor methods (ASTM D1557). Alternatively, 3-in. dense graded base can be used to stabilize soft clay subgrades and/or to restore grades in undercut areas. If groundwater is encountered at the bottom of the undercut, a 6 to 12 in. thick layer of compacted crushed clear stone will likely be required to stabilize the soils prior to subsequent granular fill placement. If the clear stone layer exceeds 12 in., the stone layer should be overlain by a non-woven geotextile fabric (e.g., Mirafi 160N or equivalent) to prevent migration of soil into the clear stone.

As an alternative to undercutting/stabilization in pavement areas, the shallow clayey soils could potentially be aerated (dried) and then recompacted to create a stable platform for fill placement. However, drying and recompacting is highly weather dependent and could require multiple cycles of drying and recompacting to create an adequate subgrade. Lime stabilization could also be eonsidered for improving the soft clay soils. We can provide additional details, if needed, but we recommend that the project budget include a generous contingency and schedule for improving, stabilizing or undercutting/replacing the soils within proposed buildings and parking lots.

Fill placement (where required) to establish grades can then proceed. We recommend using granular soils (i.e.,

compact in most weather conditions. The shallow clay soils, as well as the slightly deeper sands that contained significant silt and clay are not recommended as structural fill within the building because moisture conditioning will be required to achieve desired compaction levels, which could delay construction progress. Clay/silt soils may be used as fill in landscaped areas or in the lower portion of deeper fills in pavement areas provided the soils are adequately dried back to facilitate compaction. We recommend that fill/backfill be compacted to at least 95% compaction (ASTM D1557) in accordance with our Recommended Compacted Fill Specifications presented in Appendix D. Periodic field density tests should be taken by CGC staff within the fill/backfill to document the adequacy of compactive effort.

Based on the presence of slightly to moderately compressible soft to medium stiff clay and very loose to loose sands across the site, if site grades will be raised by more than about 1 to 2 ft, we recommend that the fill be placed to the floor slab subgrade elevation or pavement subgrade elevation early in the construction sequence to allow the clay soils to mostly consolidate under the weight of the fill prior to beginning building construction. (Note that settlement of the very loose to loose sands will also occur under the weight of the new fill, but settlement of sand will occur more quickly than consolidation of clay soils, so as long as fill placement occurs early in the eonstruction sequence, settlement of the sands should occur prior to beginning building construction.) If thicker fills are expected a time-delay (i.e., on the order of several weeks to a few months) between fill placement and beginning building construction may be required. We can provide additional details as the project details develop and after supplemental borings are completed.

2. Preliminary Foundation Design

Based on the preliminary soil borings, it is our opinion that proposed structures can generally be supported on reinforced concrete spread footing foundations proportioned using a fairly low bearing pressure. The allowable bearing pressure will be limited by the very loose to loose sands and soft to medium stiff soils and may necessitate undercutting in some locations. (As noted above, we have assumed that the buried topsoil layer in Borings 8 and 9 will be undercut and replaced with compacted granular backfill.) Where high foundation loads exist, the bearing pressure could be increased by using an intermediate foundation system such as rammed aggregate piers (RAPs) or a mat foundation could be used to distribute the loads over a larger area resulting in a low overall foundation contact pressure. Another strategy to potentially increase the bearing pressure in the loose sands would be to conduct pressuremeter testing during a supplemental drilling phase, which has been shown on numerous projects in the Madison area to increase the bearing pressure in granular soils compared to conventional methods based solely on SPT blow counts (N-values). We can provide additional details about alternative foundation support systems and follow-up pressuremeter testing, if needed.

In general, the soils on the three lots east of Dairy Drive were relatively looser/softer than the on the two sites west of Dairy Drive. Assuming that unsuitable soils will be undercut below foundations, a relatively low bearing pressure in the range of 1,000 to 2,000 psf will likely feasible on the sites east of Dairy Drive, with a slightly higher bearing pressure range of 2,000 to 3,000 psf possible on the two sites west of Dairy Drive, as the clays are slightly stiffer and sands are slightly denser. The bearing pressure on the east end of the site can likely be increased if site grades are raised such that the footings bear on at least 2 ft of well-compacted granular fill over firm/stable natural soils. Additional parameters should be used for foundation design:

- Minimum foundation widths:
  - -- Continuous wall footings: 18 in.
  - -- Column pad footings: 30 in.

- Minimum footing depths:
  - -- Exterior/perimeter footings: 4 ft
  - -- Interior footings: no minimum requirement

Undercutting below footing grade will be required where very loose/disturbed sands or silts or native clays with pocket penetrometer readings (an estimate of the unconfined compressive strength of cohesive soils) of less than 0.5 tsf for a 1,000 psf bearing pressure to 1.5 tsf for a 3,000 psf bearing pressure are encountered at or slightly below footing grade. Such soils were located in numerous borings. Where undercutting is required, the base of the undercut excavation should be widened beyond the footing edges at least 0.5 ft in each direction for each foot of undercut depth for stress distribution purposes. Undercut depths are difficult to determine without more specific building locations and elevations, but undercut depths could be on the order of 3 to 8.5 ft below existing site grades.

Assuming that the bottom of the undercut is above the groundwater table, footing grade can be restored with granular backfill compacted to at least 95% (ASTM D1557). Alternatively, 3-in. dense graded base could be placed/compacted to re-establish footing grade. Where the base of the undercut extends near or below the water table, the soils at the bottom of the excavation should be stabilized with a 6 to 12 in. layer of compacted crushed clear stone. If the clear stone layer exceeds 12 in., the stone layer should be covered in a non-woven geotextile fabric (e.g., Mirafi 160N or equivalent). CGC should be present during footing excavations to check whether subgrades are satisfactory for the design bearing pressure and to advise on corrective measures, where necessary.

Based on the presence of shallow groundwater at this site, dewatering will likely be required in advance of and during some footing excavations, especially on the sites east of Dairy Drive where the undercut or footing excavations may extend near to a few feet below the water table. For groundwater drawdowns of less than 1 to 2 ft, dewatering can likely be controlled using pumps operating from filtered sump pits. Groundwater drawdowns of more than 1 to 2 ft typically require deep wells or closely-spaced well points. A stone layer may be required at the bottom of the excavation to stabilize the expected very moist to wet soil, and *supplemental* dewatering can be completed with submersible pumps operating from the stone layer.

We recommend using a smooth-edged backhoe bucket for footing excavations. Additionally, granular soils exposed at footing grade should be recompacted with a large vibratory plate compactor prior to formwork/concrete placement to densify soils loosened during the excavation process. Soils potentially suseeptible to disturbance from compaction (e.g., silty or clayey soils) should be hand trimmed. Provided the foundation design/construction recommendations discussed above are followed, we estimate that total and differential settlements should be on the order of 1.0 and 0.5 in., respectively.

3. Floor Slabs

We anticipate that the soils exposed at floor slab subgrade within the building areas will consist of native clays or sands and granular fill where grades will be raised. In our opinion, the soft to medium stiff clays are considered marginal for slab support and will likely require partial undercutting and stabilization during slab preparation if not already completed during earlier site preparation activities. Prior to slab construction, the subgrades should be thoroughly proof-rolled/recompacted as described in the Site Preparation section of this report to densify soils that may become disturbed or loosened during construction activities. Areas that do not proof-roll satisfactorily or that remain loose after recompaction should be undercut and replaced with compacted 3-in. dense graded base or granular fill. The design subgrade modulus is based on a recompacted subgrade such that non-yielding conditions are developed. To serve as a capillary break, the final 4 to 6 in. of soil placed below the slab should consist of well-graded sand or gravel with no more than 5 percent by weight passing a No. 200 U.S. standard sieve. A subgrade modulus of 100 pci may be used for slab design on adequately stabilized native clay or recompacted sand fill. Note that some structural engineers require a 4 to 6 in. layer of dense graded base (e.g., 1.25-in. crushed aggregate base course) below the slab to increase the subgrade modulus. If 6 in. of dense graded base is included below the floor slab, the subgrade modulus can be increased to 150 pci. Fill and base layer material below the floor slab should be placed as described in the Site Preparation section of this report. To further minimize the potential for moisture migration, a 15-mil plastic vapor barrier can be also be utilized below the slab. The slab should be structurally separate from the foundations and have construction joints and reinforcement for crack control.

Note that in areas of high slab loads more extensive undercutting/replacement may be required to minimize long-term settlement from the higher slab loads. We recommend that if higher slab loads are anticipated, these areas be carefully explored with follow-up soil borings/test pits to better evaluate the ability of the soils to support the higher slab loads or determine remedial measures.

4. Seismic Design Category

As discussed above, the granular soils on the three sites east of Dairy Drive are slightly looser than the granular soils on the two sites west of Dairy Drive. East of Dairy Drive it is our opinion that the average soil/rock properties in the upper 100 ft of the site (based on SPT blow counts (N-values) of less than 15 blows/ft, on average, in the granular soils underlying the site) may be characterized as a soft soil profile. This characterization would place the site in Site Class E for seismic design according to the International Building Code (see Table 1613.5.2). The average SPT blow counts in the granular soils west of Dairy Drive generally exceed 15 blows/ft, which would classify the site as having a stiff soil profile with Site Class D.

5. Preliminary Pavement Design

We anticipate that the subgrade soils within the pavement areas will likely consist of native or fill soils that include significant areas of marginal soft to stiff cohesive soils or variable fill soils. Where grades are raised, pavement subgrades may consist of newly-placed granular fill soils. Pavement subgrades should be proof-rolled with a loaded tri-axle dump truck, as described in the Site Preparation section of this report, and stabilized as needed with 3-in. dense graded base or replaced with compacted granular fill.

As discussed in the Site Preparation section of this report, the presence of marginal shallow soils across the site will likely either necessitate an extensive program of drying/recompacting the native clays or partially undercutting the soft soils and restoring grade with 3-in. dense graded base, perhaps in combination with triaxial or biaxial geogrid. For budgetary purposes, we recommend that a contingency for a stabilization layer consisting of triaxial or biaxial geogrid (Tensar TX-5 or BX-1100 or equivalent) and 8 to 12 in. of 3-in. dense graded base be included. (Note that if standing water exists at the surface, the 3-in. dense graded base will likely need to be substituted with 3-in. clear stone.) If the soil conditions prove to be better than anticipated, the stabilization can be reduced or potentially eliminated, but if the soil conditions are worse, the stabilization section may need to be increased. We assume that the portions of the parking lot used primarily as automobile parking will experience light to moderate traffic loads (e.g., 1 to 5 equivalent 18-kip single-axle loads per day - ESALs), and the drive lanes used to access the loading docks will experience heavier traffic loads (of up to about 10 ESALs). The variable clay soils will control the pavement thickness design. Accordingly, the pavement sections tabulated below were selected assuming a CBR of approximately 0.5 to 1.0 for the native clays that improves to 3 to 5 with the inclusion of a stabilization layer and a design life of 20 years.

TABLE 1
RECOMMENDED PAVEMENT SECTIONS

Material	Thickness (in.)		WDOT Specification[1]
	Car Parking/Drives (1 to 5 ESALs)	Truck Drives (< 10 ESALs)	
Bituminous upper layer	1.75	1.75	Section 460, Table 460-1, 12.5 mm
Bituminous lower layer	1.75	2.25	Section 460, Table 460-1, 19.0 mm
Dense graded base	10.0	12.0	Sections 301 and 305, 31.5mm and 75mm
Stabilization Layer (4)	8.0	12.0	Section 305, 75 mm
Geogrid Reinforcement	Possibly	Yes	Tensar TX-5 or BX-1100
TOTAL THICKNESS	21.5	28.0	

Notes:

1. Wisconsin DOT *Standard Specifications for Highway and Structure Construction*, latest edition, including supplemental specifications, but excluding Section 460.3.2 relating layer thickness to aggregate size.

2. Compaction requirements:
   - Bituminous concrete: Refer to Section 460-3.
   - Base course: Refer to Section 301.3.4.2, Standard Compaction

3. Mixture Type E-0.3 bituminous pavement is recommended for car parking and drives and E-1 is recommended for truck drives; refer to Section 460, Table 460-2 of the *Standard Specifications.*

4. Stone stabilization may be reduced or deleted if subgrades proof-roll satisfactory during pavement subgrade preparation. Alternatively, the stone stabilization layer may need to be increased if very soft soil conditions are encountered.

Where pavement areas will experience heavier concentrated loads from fire trucks and related equipment, we recommend that rigid concrete pavement be used in pavement areas. Similarly, we recommend that dumpster pads or loading dock pads be constructed of concrete pavement. We recommend that rigid concrete pavement be designed using a subgrade modulus of 100pci, which assumes that concrete pavement will be underlain by a minimum of 6 in. of well-compacted dense graded base over a firm (adequately proof-rolled) subgrade. Depending on actual traffic loads, concrete pavement thickness is typically 6 to 9 in., and we recommend a minimum concrete pavement thickness of 6 in.

Note that if traffic volumes are greater than those assumed, CGC should be allowed to review the recommended pavement section and adjust them accordingly. The pavement design assumes a stable/non-yielding subgrade and a regular program of preventative maintenance. Alternative pavement designs may prove applicable and should be reviewed by CGC. If there is a delay between subgrade preparation and placing the base course, the subgrade should be recompacted.

6. Stormwater Infiltration Potential

Based on the soil borings, it is our opinion that this site will have very limited stormwater infiltration potential due to the generally shallow groundwater, as well as shallow silty clay loam soils that generally extended below the topsoil to near the groundwater depth in many locations. The natural clay also generally had redoximorphic features (redox or mottling), which indicates seasonal or past saturation and is considered a limiting layer to stormwater infiltration. According to NR151.12, this site may qualify as "exempted" based on estimated infiltration rates of less than 0.6 in./hr. The site may also be classified "excluded" based on less than 3 ft below of separation between the bottom of the infiltration basin and the high water level (or redox in the clay). In some areas sand soils with relatively high permeability had scattered silt loam seams, which will limit the infiltration rate.

having an infiltration rate greater than or equal to the design infiltration rate. Another strategy that could be implemented for sand soils with scattered silt loam seams would be to thoroughly mix the soil to break up the silt loam seams down to the groundwater level such that the mixed soil would have a particle size distribution and infiltration rate that would likely approach sandy loam or loamy sand. We recommend that gradations on samples of the mixed soil be completed during construction to document that the mixed soil has an appropriate gradation for the design infiltration rate.

The following parameters should be considered for design of infiltration features:

Infiltration Potential: The following infiltration parameters were estimated using Table 2 of the WDNR Conservation Practice Standard 1002, *Site Evaluation for Storm Water Infiltration*. The estimated infiltration rates are as follows:

- Silty clay loam 0.04 in./hr
- Silt loam 0.13 in./hr
- Loam 0.24 in./hr
- Sandy loam 0.5 in./hr
- Loamy sand 1.63 in./hr
- Sand 3.6 in./hr

Note that the infiltration rates should be considered very approximate. The Wisconsin Department of Safety and Professional Services soil evaluation forms for the borings are included in Appendix E.

Groundwater: Groundwater was encountered in the borings during or shortly after drilling at 3.5 to 8.5 ft below existing site grades. Redoximorphic features were also encountered in most of the shallow natural clays, which indicates seasonal or past saturation at levels above the water table. Groundwater levels should be expected to vary, as previously discussed.

Bedrock: Bedrock was not encountered in the borings to maximum depth explored.

During construction of the proposed buildings, pavement and related site work, appropriate erosion control should be provided to prevent eroded soil from contaminating the infiltration areas. Where appropriate, the basin design should include pretreatment to remove fine-grained soils (silt/clay) from stormwater prior to entering the infiltration area. Additionally, a regular maintenance plan should be developed to remove silt/clay soils that may accumulate in the bottom of the infiltration basin over time. Failure to adequately control fine-grained soils from entering the infiltration area or failure to regularly remove fine-grained soils that accumulate at the base of the infiltration basin will likely cause the basin to fail. Refer to WDNR Conservation Praetice Standard 1002 and NR 151 for additional information.

CONSTRUCTION CONSIDERATIONS

Due to variations in weather, construction methods and other factors, specific construction problems are difficult to predict. Soil related difficulties that could be encountered on the site are discussed below:

- Due to the potentially sensitive nature of the on-site soils, we recommend that final site grading activities be completed during dry weather, if possible. Construction traffic should be avoided on prepared subgrades to minimize potential disturbance.

- Earthwork construction during the early spring or late fall could be complicated as a result of wet weather and freezing temperatures. During cold weather, exposed subgrades should be protected from freezing before and after footing construction. Fill should never be placed while frozen or on frozen ground.

- Excavations extending greater than 4 ft in depth below the existing ground surface should be sloped or braced in accordance with current OSHA standards.

- Based on observations made during the field exploration, groundwater infiltration into footing, undercut and utility excavations should be expected, and dewatering strategies were previously discussed. Additional water accumulating at the base of excavations as a result of precipitation or seepage should be controlled and quickly removed using pumps operating from filtered sump pits.

RECOMMENDED CONSTRUCTION MONITORING

The quality of the foundation, floor slab and pavement subgrades will be largely determined by the level of care exercised during site development. To check that earthwork and foundation construction proceeds in accordance with our recommendations, the following operations should be monitored by CGC:

- Topsoil stripping/subgrade proof-rolling within the construction areas;
- Fill/backfill placement and compaction;
- Foundation excavation/subgrade preparation; and
- Concrete placement.

SUPPLEMENTAL GEOTECHNICAL EXPLORATION

The preliminary soil borings were intended to provide an overview of the soil conditions across the sites and identify potential geotechnical concerns, such as the widespread very loose to loose sands, areas of marginal clay, areas with buried topsoil and shallow groundwater. Supplemental soil borings are recommended to provide more specific geotechnical recommendations as the project progresses and the locations and elevations of the building, pavement and stormwater management areas are determined. We would be happy to provide additional details and develop a supplemental geotechnical scope at the appropriate time.

* * * * *

It has been a pleasure to serve you on this project. If you have any questions or need additional consultation, please contact us.

Sincerely,

CGC, Inc.

David A. Staab, P.E., LEED AP
Consulting Professional

William W. Wuellner, P.E.
Senior Geotechnical Engineer

Encl:
Appendix A - Field Exploration
Appendix B - Soil Boring Location Map
Logs of Test Borings (20)
Log of Test Boring-General Notes
Unified Soil Classification System
Appendix C - Document Qualifications
Appendix D - Recommended Compacted Fill Specifications
Appendix E - Perimeter Drain Details
Appendix F - Wisconsin Dept. of Safety and Professional Services – Soil Evaluation Forms (20 Borings)

APPENDIX A

FIELD EXPLORATION

APPENDIX A

FIELD EXPLORATION

A total of 20 Standard Penetration Test (SPT) soil borings were drilled to planned depths of 10 to 30 ft below existing site grades at locations selected by the City of Madison and located in the field by Burse Survey and Engineering (Burse). Note that Boring 3 was offset 75 ft east due to a fallen tree blocking the path to the boring, and this boring was extended to 35 ft due to very loose to loose soil conditions at 30 ft. Also, Boring 5 was offset 10 ft east due to downed tree blocking the path to the boring. The borings were drilled on July 22 through 25, 2013 by Badger State Drilling (under subcontract to CGC) using ATV-mounted CME-750 and truck-mounted D-120 rotary drill rigs equipped with hollow-stem augers, mud rotary equipment and automatic SPT hammers. The boring locations are shown in plan on the Soil Boring Location Map attached in Appendix B. Ground surface elevations at the boring locations were surveyed by Burse.

In each boring, soil samples were obtained at 2.5 foot intervals to a depth of 10 ft and at 5 ft intervals thereafter. The soil samples were obtained in general accordance with specifications for standard penetration testing, ASTM D 1586. The specific procedures used for drilling and sampling are described below.

1. Boring Procedures between Samples

   The boring is extended downward, between samples, by a hollow-stem auger.

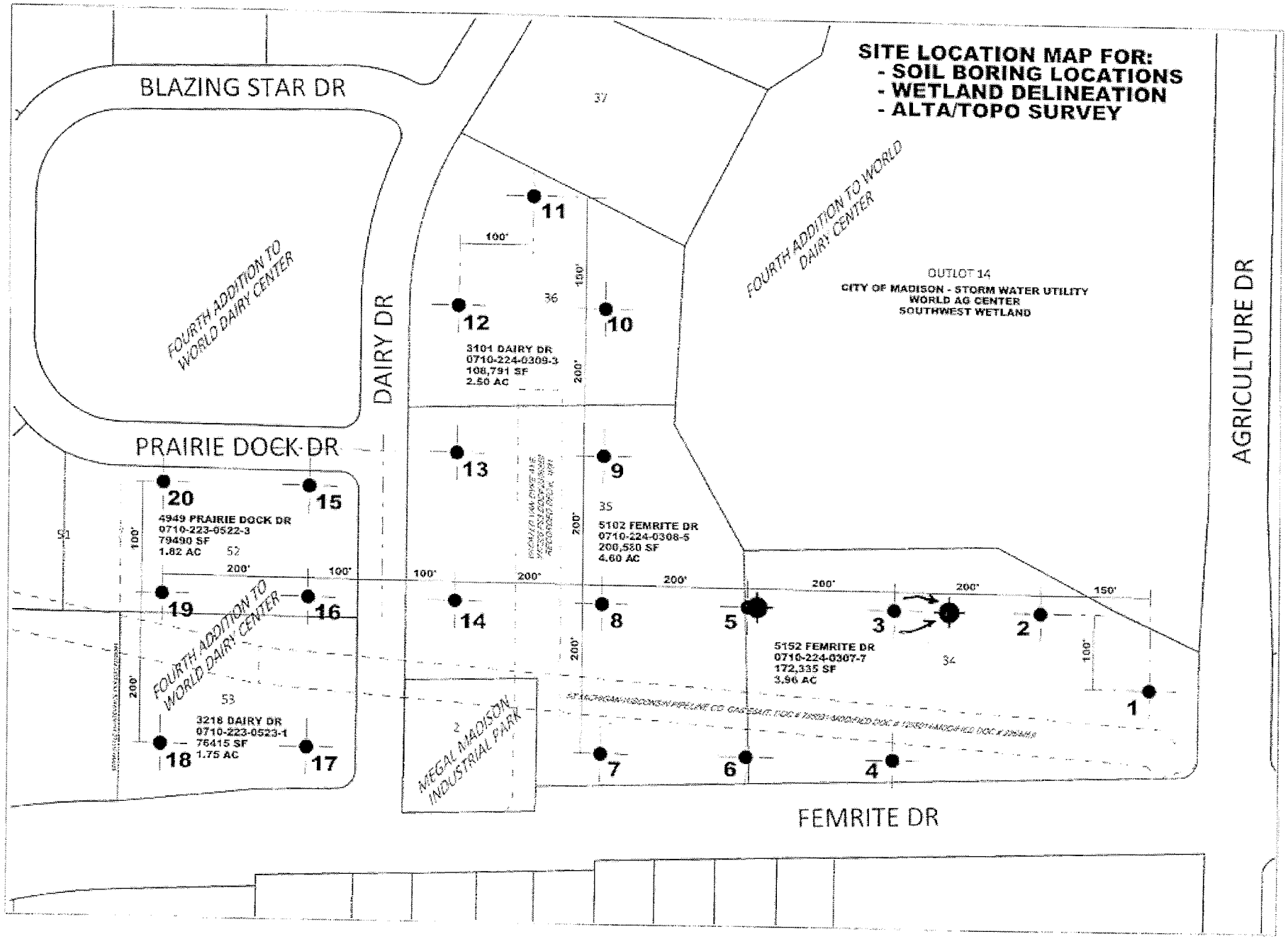
2. Standard Penetration Test and Split-Barrel Sampling of Soils
   (ASTM Designation: D 1586)

   This method consists of driving a 2-inch outside diameter split-barrel sampler using a 140-pound weight falling freely through a distance of 30 inches. The sampler is first seated 6 inches into the material to be sampled and then driven 12 inches. The number of blows required to drive the sampler the final 12 inches is recorded on the log of borings and is known as the Standard Penetration Resistance.

During the field exploration, the driller visually classified the soil and prepared a field log. *Field screening of the soil samples for possible environmental contaminants was not conducted by the drillers as environmental site assessment activities were not part of CGC's work scope.* Water level observations were made in each boring during and after drilling and are shown at the bottom of each boring log. Upon completion of drilling, the borings were backfilled with bentonite (where required) to satisfy WDNR regulations and the soil samples were delivered to our laboratory for visual elassification and laboratory testing. The soil samples were visually classified by a geotechnical engineer using the Unified Soil Classification System. The final logs prepared by the engineer and a description of the Unified Soil Classification System are presented in Appendix B.

APPENDIX B

SOIL BORING LOCATION MAP
LOGS OF TEST BORINGS (20)
LOG OF TEST BORING - GENERAL NOTES
UNIFIED SOIL CLASSIFICATION SYSTEM



Legend

Denotes Boring Location and Number

Scale: Unknown.

Notes

1. Borings drilled by Badger State Drilling on July 22 through 25, 2013.
2. Base map prepared by City of Madison.
3. Boring locations are approximate.

Job No. C13064-7		**SOIL BORING LOCATION MAP** Proposed Fire Station No. 14 & Fire Training Center Femrite Drive and Dairy Drive Madison, WI
Date: 08/2013	CGC, Inc.	

CGC Inc.

LOG OF TEST BORING

Project **Proposed Fire Station #14 & Fire Training Site**
Femrite Drive and Dairy Drive
Location **Madison, Wisconsin**

Boring No. **1**
Surface Elevation (ft) **859.8**
Job No. **C13064-7**
Sheet **1** of **1**

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SAMPLE No.	TYPE	Rec (in.)	Moist	N	Depth (ft)	VISUAL CLASSIFICATION and Remarks	qu (qa) (tsf)	W	LL	PL	LI
						13 in.± Clayey TOPSOIL (OL)					
1		6	M	4		Medium Stiff to Stiff, Light Green-Gray/Brown (Mottled) Lean CLAY, Trace Sand (CL) USDA: 10YR 5/1 Silty Clay Loam (Redox: C2F 10YR 6/6)	(1.0)	26.3			
2		8	W	4	5	Very Loose to Loose, Brown Fine to Medium SAND, Trace to Little Silt, Trace Gravel (SP/SP-SM) USDA: 10YR 5/3 Sand					
3		10	W	4							
4		7	W	5	10	Loose, Gray Fine SAND, Some Silt, Little to Some Gravel (SM) USDA: 10YR 5/2 Sandy Loam					
5		10	W	6	15	Loose to Medium Dense, Gray Fine to Medium SAND, Trace to Little Silt, Trace Gravel (SP/SP-SM) USDA: 10YR 5/2 Sand					
6		12	W	12	20						
7		10	W	10	25	Scattered Silt (Silt Loam) Seams Near 25 ft					
8		18	W	21	30	End of Boring at 30 ft Borehole Backfilled with bentonite chips and slurry					
					35						

WATER LEVEL OBSERVATIONS

	While Drilling	Upon Completion of Drilling
Time After Drilling		
Depth to Water	▽ 3.5'	▼
Depth to Cave in		

The stratification lines represent the approximate boundary between soil types and the transition may be gradual.

GENERAL NOTES

Start **7/23/13** End **7/23/13**
Driller **BSD** Chief **KD** Rig **CME-750**
Logger **JM** Editor **DAS**
Drill Method **2.25" HSA; 10'-30' 0-10';**
3-7/8" RB/DM; Autohammer

CGC Inc.

LOG OF TEST BORING

Project **Proposed Fire Station #14 & Fire Training Site**
Femrite Drive and Dairy Drive
Location **Madison, Wisconsin**

Boring No. **2**
Surface Elevation (ft) **859.9**
Job No. **C13064-7**
Sheet **1** of **1**

2921 Perry Street, Madison, WI 53713 (608) 288-4100, FAX (608) 288-7887

SAMPLE No.	TYPE	Rec (in.)	Moist	N	Depth (ft)	VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES qu (qa) (tsf)	W	LL	PL	LI
						15 in.± Clayey TOPSOIL (OL)					
1		9	M	5		Loose, Brown Fine to Medium SAND, Trace to Little Silt, Trace Gravel (SP/SP-SM) USDA: 10YR 5/3 Sand					
2		10	W	6	5						
3		18	W	4							
4		18	W	5	10						
5		9	W	7	15	Loose, Gray Sandy SILT, Scattered Sand Seams (ML) USDA: 10YR 5/2 Loam					
6		18	W	11	20	Soft, Gray Silty CLAY, Trace Sand, Scattered Sand Seams (CL-ML) USDA: 10YR 5/2 Silty Clay	(0.25-0.5)	24.2			
						Medium Dense, Gray Fine to Coarse SAND, Trace to Little Silt, Little to Some Gravel (SP/SP-SM) USDA: 10YR 5/2 Sand					
7		3	W	27	25	Medium Dense, Gray-Brown Fine to Medium SAND, Trace to Little Silt, Trace Gravel (SP/SP-SM) USDA: 10YR 5/2 Sand					
8		6	W	18	30	End of Boring at 30 ft					
						Borehole Backfilled with bentonite chips and slurry					
					35						

WATER LEVEL OBSERVATIONS

While Drilling ▽ **3.5'** Upon Completion of Drilling _____
Time After Drilling _____
Depth to Water _____ ▼
Depth to Cave in _____

The stratification lines represent the approximate boundary between soil types and the transition may be gradual.

GENERAL NOTES

Start **7/23/13** End **7/23/13**
Driller **BSD** Chief **KD** Rig **CME-750**
Logger **JM** Editor **DAS**
Drill Method **2.25" HSA; 0'-6' 3-7/8" RB/DM 6'-30'; Autohammer**

CGC Inc.

LOG OF TEST BORING

Project **Proposed Fire Station #14 & Fire Training Site**
Femrite Drive and Dairy Drive
Location **Madison, Wisconsin**

Boring No. **3**
Surface Elevation (ft) **861.0**
Job No. **C13064-7**
Sheet **1** of **1**

2921 Perry Street, Madison, WI 53713 (608) 288-4100, FAX (608) 288-7887

SAMPLE No.	TYPE	Rec (in.)	Moist	N	Depth (ft)	VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES qu (qa) (tsf)	W	LL	PL	LI
						15 in.± Clayey TOPSOIL (OL)					
1		5	M	5		Stiff to Very Stiff, Light Green-Gray/Brown (Mottled) Lean CLAY, Little to Some Sand (CL) USDA: 10YR 5/1 Silty Clay Loam (Redox: C2F 10YR 6/6)	(2.0)				
2		10	W	8	5						
3		14	W	9		Very Loose to Loose, Light Brown Fine to Medium SAND, Trace to Little Silt, Little Gravel (SP/SP-SM) USDA: 10YR 6/3 Sand Scattered Silt (Silt Loam) Seams near 10 ft					
4		6	W	4	10						
5		12	W	4	15	Very Loose to Loose, Brown/Gray Fine SAND, Little to Some Silt (SP-SM/SM) USDA: 10YR 4/2 Sandy Loam					
6		14	W	7	20	Loose, Gray Silty Fine SAND, Trace Gravel, Scattered Silt Seams (SM) USDA: 10YR 5/2 Sandy Loam, Scattered Silt Loam Seams					
7		14	W	7	25	Loose, Brown/Gray Fine SAND, Little to Some Silt (SP-SM/SM) USDA: 10YR 4/2 Sandy Loam					
8		18	W	4	30	Stiff, Brown/Gray Lean CLAY, Trace Sand, Scattered Sand Seams (CL) USDA: 10YR 5/3 Silty Clay Loam	(1.75)				
9		14	W	11	35	Very Loose to Loose, Gray Fine SAND, Some Silt, Little to Some Gravel, Scattered Silt Seams (SM) USDA: 10YR 5/2 Sandy Loam, Scattered Silt Loam Seams					
						Medium Dense, Gray Fine SAND, Trace to Little Silt (SP/SP-SM) USDA: 10YR 5/2 Fine Sand					
					40	End of Boring at 35 ft Borehole Backfilled with bentonite chips and slurry					
					45	Boring offset 75 ft to the east of staked location (downed tree blocking path).					
					50						

WATER LEVEL OBSERVATIONS

While Drilling ▽ **3.5'** Upon Completion of Drilling _____
Time After Drilling _____
Depth to Water _____
Depth to Cave in _____

The stratification lines represent the approximate boundary between soil types and the transition may be gradual.

GENERAL NOTES

Start **7/23/13** End **7/23/13**
Driller **BSD** Chief **KD** Rig **CME-750**
Logger **JM** Editor **DAS**
Drill Method **2.25" HSA; 10'-30' 0-10';**
3-7/8" RB/DM; Autohammer

CGC Inc.

LOG OF TEST BORING

Project **Proposed Fire Station #14 & Fire Training Site**
Femrite Drive and Dairy Drive
Location **Madison, Wisconsin**

Boring No. **4**
Surface Elevation (ft) **862.0**
Job No. **C13064-7**
Sheet **1** of **1**

2921 Perry Street, Madison, WI 53713 (608) 288-4100, FAX (608) 288-7887

SAMPLE No.	TYPE	Rec (in.)	Moist	N	Depth (ft)	VISUAL CLASSIFICATION and Remarks	qu (qa) (tsf)	W	LL	PL	LI
						13 in.± Clayey TOPSOIL (OL)					
1		18	M	7		Very Stiff, Gray/Brown (Mottled) Lean CLAY, Trace Sand (CL)	(2.25-2.5)				
						USDA: 10YR 5/1 Silty Clay Loam (Redox: C2D 10YR 6/6)					
2		18	M	6	5	Loose, Light Brown to Brown Fine to Medium SAND, Trace to Little Silt, Trace Gravel (SP/SP-SM)					
						USDA: 10YR 5/3, 6/3 Sand					
3		18	W	4							
4		18	W	4							
					10	End of Boring at 10 ft					
						Borehole Backfilled with bentonite chips					
					15						
					20						
					25						
					30						
					35						

WATER LEVEL OBSERVATIONS

While Drilling ▽ 6.0' Upon Completion of Drilling ____
Time After Drilling ____ ____ ____ 15 min.
Depth to Water ____ ____ ____ 5.5' ▼
Depth to Cave in ____ ____ ____ 6.0'

The stratification lines represent the approximate boundary between soil types and the transition may be gradual.

GENERAL NOTES

Start **7/25/13** End **7/25/13**
Driller **BSD** Chief **DC** Rig **CME-750**
Logger **JM** Editor **DAS**
Drill Method **2.25" HSA; Autohammer**

CGC Inc.

LOG OF TEST BORING

Project **Proposed Fire Station #14 & Fire Training Site**
Femrite Drive and Dairy Drive
Location **Madison, Wisconsin**

Boring No. **5**
Surface Elevation (ft) **860.2**
Job No. **C13064-7**
Sheet **1** of **2**

2921 Perry Street, Madison, WI 53713 (608) 288-4100, FAX (608) 288-7887

SAMPLE						VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES				
No.	TYPE	Rec (in.)	Moist	N	Depth (ft)		qu (qa) (tsf)	W	LL	PL	LI
						13 in.± Clayey TOPSOIL (OL)					
1		4	M	4		Soft to Medium Stiff, Gray-Brown Lean CLAY, Some Sand, Scattered Sand Seams (CL) USDA: 10YR 4/2 Silty Clay Loam	(0.5)	17.0			
2		10	W	8	5	Very Loose to Loose, Brown Fine to Medium SAND, Trace to Little Silt, Trace Gravel, Scattered Silt Seams (SP/SP-SM) USDA: 10YR 5/3 Sand, Scattered Silt Loam Seams					
3		12	W	2							
4		8	W	6	10	Color Change to Dark Brown (10YR 3/3) near 7.5 ft					
5		10	W	5	15						
6		7	W	8	20	Color Change to Gray (10YR 5/2) near 20 ft)					
7		7	W	31	25	Dense, Gray Silty Fine SAND, Trace Gravel (SM) USDA: 10YR 5/2 Sandy Loam					
8		10	W	15	30	Medium Dense, Gray Fine SAND, Trace to Little Silt (SP/SP-SM) USDA: 10YR 5/2 Fine Sand					
					35	End of Boring at 30 ft Borehole Backfilled with bentonite chips and slurry Boring offset 10 ft east from staked location					

WATER LEVEL OBSERVATIONS

While Drilling ▽ 3.5'	Upon Completion of Drilling			
Time After Drilling				
Depth to Water				▼
Depth to Cave in				

The stratification lines represent the approximate boundary between soil types and the transition may be gradual.

GENERAL NOTES

Start **7/23/13** End **7/23/13**
Driller **BSD** Chief **KD** Rig **CME-750**
Logger **JM** Editor **DAS**
Drill Method **2.25" HSA; Autohammer**

CGC Inc.

LOG OF TEST BORING

Project **Proposed Fire Station #14 & Fire Training Site**
Femrite Drive and Dairy Drive
Location **Madison, Wisconsin**

Boring No. **6**
Surface Elevation (ft) **861.5**
Job No. **C13064-7**
Sheet **1** of **1**

2921 Perry Street, Madison, WI 53713 (608) 288-4100, FAX (608) 288-7887

SAMPLE					VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES				
No.	TYPE	Rec (in.)	Moist	N	Depth (ft)		qu (qa) (tsf)	W	LL	PL	LI
						13 in.± Clayey TOPSOIL (OL)					
1		8	M	5		Stiff, Light Green-Gray/Brown (Mottled) Lean CLAY, Trace Sand (CL) USDA: 10YR 5/1 Silty Clay Loam (Redox: C2D 10YR 6/6)	(1.5-1.75)	27.4			
2		18	M	5				15.3			2.1
3		12	W	6	5	Loose, Dark Gray Clayey Fine SAND, Trace Organics (SC) USDA: 10YR 3/1 Sandy Clay Loam					
4		18	W	4		Loose, Gray/Brown Fine to Medium SAND, Trace to Little Silt, Trace Gravel (SP/SP-SM) USDA: 10YR 5/2 Sand					
					10	End of Boring at 10 ft					
						Borehole Backfilled with bentonite chips					
					15						
					20						
					25						
					30						
					35						

WATER LEVEL OBSERVATIONS

While Drilling ▽ **6.0'** Upon Completion of Drilling _____
Time After Drilling _____ _____ _____ **15 min.**
Depth to Water _____ _____ _____ **5.8'** ▼
Depth to Cave in _____ _____ _____ **6.0'**

The stratification lines represent the approximate boundary between soil types and the transition may be gradual.

GENERAL NOTES

Start **7/25/13** End **7/25/13**
Driller **BSD** Chief **DC** Rig **CME-750**
Logger **JM** Editor **DAS**
Drill Method **2.25" HSA; Autohammer**

CGC Inc.

LOG OF TEST BORING

Project **Proposed Fire Station #14 & Fire Training Site**
Femrite Drive and Dairy Drive
Location **Madison, Wisconsin**

Boring No. **7**
Surface Elevation (ft) **862.2**
Job No. **C13064-7**
Sheet **1** of **1**

2921 Perry Street, Madison, WI 53713 (608) 288-4100, FAX (608) 288-7887

SAMPLE No.	Type	Rec (in.)	Moist	N	Depth (ft)	VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES qu (qa) (tsf)	W	LL	PL	LI
						12 in.± Clayey TOPSOIL (OL)					
1		8	M	8		Very Stiff, Gray/Brown (Mottled) Lean CLAY, Trace Sand (CL)	(2.0-2.75)				
						USDA: 10YR 5/2 Silty Clay Loam (Redox: C2D 10YR 6/6)					
2		3	M	8							
					5	Loose, Brown Fine to Medium SAND, Trace to Little Silt, Trace Gravel, Scattered Silt Seams in Upper Part of Layer (SP/SP-SM)					
3		12	W	6		USDA: 10YR 5/3 Sand, Scattered Silt Loam Seams					
4		18	W	6							
					10	End of Boring at 10 ft					
						Borehole Backfilled with bentonite chips					
					15						
					20						
					25						
					30						
					35						

WATER LEVEL OBSERVATIONS

While Drilling ▽ 6.0'	Upon Completion of Drilling			
Time After Drilling				15 min.
Depth to Water				6.0' ▼
Depth to Cave in				7.0'

The stratification lines represent the approximate boundary between soil types and the transition may be gradual.

GENERAL NOTES

Start **7/25/13** End **7/25/13**
Driller **BSD** Chief **DC** Rig **CME-750**
Logger **JM** Editor **DAS**
Drill Method **2.25" HSA; Autohammer**

CGC Inc.

LOG OF TEST BORING

Project **Proposed Fire Station #14 & Fire Training Site**
Femrite Drive and Dairy Drive
Location **Madison, Wisconsin**

Boring No. **8**
Surface Elevation (ft) **863.8**
Job No. **C13064-7**
Sheet **1** of **1**

2921 Perry Street, Madison, WI 53713 (608) 288-4100, FAX (608) 288-7887

SAMPLE						VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES				
No.	TYPE	Rec (in.)	Moist	N	Depth (ft)		qu (qa) (tsf)	W	LL	PL	LI
1		18	M	15		FILL: Medium Dense, Tan Fine to Medium Sand, Some Silt and Gravel USDA: FILL - 2.5Y 5/3 Sandy Loam					
2		10	M	5	5	FILL: Soft to Medium Stiff, Dark Gray/Gray Lean Clay, Little to Some Sand, Trace Organics USDA: FILL - 10YR 3/1, 5/2 Silty Clay Loam	(0.5)	15.4			
3		8	M	5		Medium Stiff, Dark Gray/Black Organic CLAY (OL - Probable Buried Topsoil) USDA: 10YR 2/1 Silty Clay Loam	(1.0)	26.6			9.1
4		18	W	10	10	Very Loose to Loose, Brown Fine to Medium SAND, Trace to Little Silt, Trace Gravel (SP/SP-SM) USDA: 10YR 5/3 Sand					
5		5	W	2	15						
6		3	W	4	20						
7		12	W	14	25	Medium Dense, Brown Fine SAND, Trace to Little Silt (SP/SP-SM) USDA: 10YR 5/3 Fine Sand					
8		8	W	21	30	Medium Dense, Gray-Brown Fine to Medium SAND, Trace to Little Silt, Trace Gravel (SP/SP-SM) USDA: 10YR 5/2 Sand					
					35	End of Boring at 30 ft Borehole Backfilled with bentonite chips and slurry					

WATER LEVEL OBSERVATIONS

While Drilling ▽ **8.0'** Upon Completion of Drilling _____
Time After Drilling _____
Depth to Water _____ ▼
Depth to Cave in _____

The stratification lines represent the approximate boundary between soil types and the transition may be gradual.

GENERAL NOTES

Start **7/22/13** End **7/22/13**
Driller **BSD** Chief **DC** Rig **CME-750**
Logger **JM** Editor **DAS**
Drill Method **2.25" HSA; 0-10'; 3-7/8"**
RB/DM; Autohammer

CGC Inc.

LOG OF TEST BORING

Project **Proposed Fire Station #14 & Fire Training Site**
Femrite Drive and Dairy Drive
Location **Madison, Wisconsin**

Boring No. **9**
Surface Elevation (ft) **863.5**
Job No. **C13064-7**
Sheet **1** of **1**

2921 Perry Street, Madison, WI 53713 (608) 288-4100, FAX (608) 288-7887

SAMPLE No.	TYPE	Rec (in.)	Moist	N	Depth (ft)	VISUAL CLASSIFICATION and Remarks	qu (qa) (tsf)	W	LL	PL	LI
						FILL: Medium Dense, Tan Fine to Medium Sand, Some Silt and Gravel USDA: FILL - 2.5Y 5/3 Sandy Loam					
1	■	18	M	17							
						Loose, Dark Gray/Black Organic Clayey SILT (OL - Probable Buried Topsoil) USDA: 10YR 2/1 Silt Loam					
2	■	15	M	5	5			19.3			6.5
						Very Loose to Medium Dense, Brown Fine to Medium SAND, Trace to Little Silt, Trace Gravel (SP/SP-SM) USDA: 10YR 5/3 Sand					
3	■	10	W	10							
4	■	12	W	8	10						
5	■	18	W	3	15	Grades to Fine Sand near 15 ft					
6	■	3	W	10	20						
7	■	4	W	27	25						
8	■	12	W	9	30	End of Boring at 30 ft Borehole Backfilled with bentonite chips and slurry					
					35						

WATER LEVEL OBSERVATIONS

While Drilling ▽ **6.0'** Upon Completion of Drilling _____
Time After Drilling _____
Depth to Water _____ ▼
Depth to Cave in _____

The stratification lines represent the approximate boundary between soil types and the transition may be gradual.

GENERAL NOTES

Start **7/23/13** End **7/23/13**
Driller **BSD** Chief **KD** Rig **CME-750**
Logger **JM** Editor **DAS**
Drill Method **2.25" HSA; 0-15'; 3-7/8" RB/DM 15'-30'; Autohammer**

CGC Inc.

LOG OF TEST BORING

Project **Proposed Fire Station #14 & Fire Training Site**
Femrite Drive and Dairy Drive
Location **Madison, Wisconsin**

Boring No. **10**
Surface Elevation (ft) **860.4**
Job No. **C13064-7**
Sheet **1** of **1**

2921 Perry Street, Madison, WI 53713 (608) 288-4100, FAX (608) 288-7887

SAMPLE No.	TYPE	Rec (in.)	Moist	N	Depth (ft)	VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES qu (qa) (tsf)	W	LL	PL	LI
						14 in.± Clayey TOPSOIL (OL)					
1		6	M	7		Loose, Gray Fine to Medium SAND, Some Silt, Trace Clay and Gravel (SM - Possible Fill) USDA: 10YR 5/1 Sandy Loam					
2		6	W	5	5	Very Loose to Loose, Brown Fine to Medium SAND, Trace to Little Silt, Trace Gravel (SP/SP-SM) USDA: 10YR 5/3 Sand					
3		12	W	3							
4		8	W	4	10	Color Change to Dark Brown (10YR 3/3) with Scattered Silt Seams near 7.5 ft					
5		10	W	4	15	Very Loose to Loose, Gray Fine SAND, Trace to Little Silt (SP/SP-SM) USDA: 10YR 5/2 Fine Sand					
6		9	W	9	20	Loose, Gray Fine SAND, Some Silt, Trace Gravel (SM) USDA: 10YR 5/2 Sandy Loam					
7		14	W	10	25	Loose, Gray Fine SAND, Trace to Little Silt (SP/SP-SM) USDA: 10YR 5/2 Fine Sand					
8		12	W	8	30	Scattered Silt Seams near 30 ft					
						End of Boring at 30 ft					
					35	Borehole Backfilled with bentonite chips and slurry					

WATER LEVEL OBSERVATIONS

While Drilling ▽ **6.0'** Upon Completion of Drilling _____
Time After Drilling _____
Depth to Water _____ ▼
Depth to Cave in _____

The stratification lines represent the approximate boundary between soil types and the transition may be gradual.

GENERAL NOTES

Start **7/24/13** End **7/24/13**
Driller **BSD** Chief **KD** Rig **CME-750**
Logger **JM** Editor **DAS**
Drill Method **2.25" HSA; 0-10'; 3-7/8" RB/DM; Autohammer**

CGC Inc.

LOG OF TEST BORING

Project **Proposed Fire Station #14 & Fire Training Site**
Femrite Drive and Dairy Drive
Location **Madison, Wisconsin**

Boring No. **11**
Surface Elevation (ft) **861.2**
Job No. **C13064-7**
Sheet **1** of **1**

2921 Perry Street, Madison, WI 53713 (608) 288-4100, FAX (608) 288-7887

SAMPLE						VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES				
No.	TYPE	Rec (in.)	Moist	N	Depth (ft)		qu (qa) (tsf)	W	LL	PL	LI
						15 in.± Clayey TOPSOIL (OL)					
1		12	M	7		Medium Stiff to Very Stiff, Light Green-Gray/Brown (Mottled) Lean CLAY, Trace Sand and Organics (CL)	(2.5)				
2		8	M	3	5	USDA: 10YR 5/1 Silty Clay Loam (Redox: C2D 10YR 6/6)	(0.5-1.0)	20.4			
3		11	W	7		Scattered Sand Seams near 5 ft					
4		10	W	3	10	Very Loose to Loose, Brown Fine to Medium SAND, Trace to Little Silt, Trace Gravel (SP/SP-SM) USDA: 10YR 5/3 Sand					
5		6	W	9	15	Loose, Brown/Gray Fine SAND, Trace to Little Silt (SP/SP-SM) USDA: 10YR 5/3 Fine Sand					
6		5	W	3	20	Very Loose to Medium Dense, Brown Fine to Medium SAND, Trace to Little Silt, Trace Gravel (SP/SP-SM) USDA: 10YR 5/3 Sand					
7		9	W	14	25						
8		15	W	16	30	Medium Dense, Gray Sandy SILT, Scattered Sand Seams (ML) USDA: 10YR 5/2 Loam					
					35	End of Boring at 30 ft Borehole Backfilled with bentonite chips and slurry					

WATER LEVEL OBSERVATIONS

	While Drilling	Upon Completion of Drilling		
Time After Drilling				
Depth to Water	▽ 6.0'			▼
Depth to Cave in				

The stratification lines represent the approximate boundary between soil types and the transition may be gradual.

GENERAL NOTES

Start **7/24/13** End **7/24/13**
Driller **BSD** Chief **KD** Rig **CME-750**
Logger **JM** Editor **DAS**
Drill Method **2.25" HSA; 0-10'; 3-7/8"**
RB/DM 10'30'; Autohammer

LOG OF TEST BORING

CGC Inc.

Project **Proposed Fire Station #14 & Fire Training Site**
Femrite Drive and Dairy Drive
Location **Madison, Wisconsin**

Boring No. **12**
Surface Elevation (ft) **863.2**
Job No. **C13064-7**
Sheet **1** of **1**

2921 Perry Street, Madison, WI 53713 (608) 288-4100, FAX (608) 288-7887

SAMPLE No.	TYPE	Rec (in.)	Moist	N	Depth (ft)	VISUAL CLASSIFICATION and Remarks	qu (qa) (tsf)	W	LL	PL	LI
						12 in.± Clayey TOPSOIL (OL)					
1		10	M	9		Very Stiff, Light Green-Gray/Brown (Mottled) Lean CLAY, Trace Sand (CL) USDA: 10YR 5/1 Silty Clay Loam (Redox: C2F 10YR 6/6)	(3.0)				
2		16	M	5	5	Loose, Brown Fine to Medium SAND, Trace to Little Silt, Trace Gravel (SP/SP-SM) USDA: 10YR 5/3 Sand					
3		12	W	5							
4		14	W	8	10						
5		12	W	5	15	3 in. Stiff, Gray/Brown Lean Clay Seam near 15 ft	(1.0-1.5)				
6		12	W	15	20	Medium Dense, Gray Fine SAND, Trace to Little Silt (SP/SP-SM) USDA: 10YR 5/2 Fine Sand					
7		16	W	15	25						
8		14	W	23	30						
					35	End of Boring at 30 ft Borehole Backfilled with bentonite chips and slurry					

WATER LEVEL OBSERVATIONS

While Drilling ▽ **6.0'** Upon Completion of Drilling _____
Time After Drilling _____
Depth to Water _____ ▼
Depth to Cave in _____

The stratification lines represent the approximate boundary between soil types and the transition may be gradual.

GENERAL NOTES

Start **7/24/13** End **7/24/13**
Driller **BSD** Chief **KD** Rig **CME-750**
Logger **JM** Editor **DAS**
Drill Method **2.25" HSA; 0-10'; 3-7/8" RB/DM 10'-30'; Autohammer**

LOG OF TEST BORING

CGC Inc.

Project **Proposed Fire Station #14 & Fire Training Site**
Femrite Drive and Dairy Drive
Location **Madison, Wisconsin**

Boring No. **13**
Surface Elevation (ft) **862.2**
Job No. **C13064-7**
Sheet **1** of **1**

2921 Perry Street, Madison, WI 53713 (608) 288-4100, FAX (608) 288-7887

SAMPLE No.	TYPE	Rec (in.)	Moist	N	Depth (ft)	VISUAL CLASSIFICATION and Remarks	qu (qa) (tsf)	W	LL	PL	LI
						12 in.± Sand and Gravel FILL					
1		5	M	8		Stiff to Very Stiff, Light Green-Gray/Brown (Mottled) Lean CLAY, Trace Sand (CL - Possible Fill in Upper Few Feet of Layer)	(3.5)				
2		18	M	8	5	USDA: 10YR 5/1 Silty Clay Loam (Redox: C2D 10YR 6/6)	(1.0-1.5)	29.5			
3		18	W	4		Very Loose to Loose, Brown Fine to Medium SAND, Trace to Little Silt, Trace Gravel (SP/SP-SM)					
4		18	W	4	10	USDA: 10YR 5/3 Sand					
5		3	W	4	15						
6		12	W	17	20	Medium Dense, Gray Fine SAND, Trace to Little Silt (SP/SP-SM) USDA: 10YR 5/2 Fine Sand					
7		12	W	27	25	Medium Dense, Brown Fine to Coarse SAND, Trace to Little Silt, Trace Gravel (SP/SP-SM) USDA: 10YR 5/3 Sand					
8		4	W	14	30	End of Boring at 30 ft Borehole backfilled with bentonite chips and slurry					
					35						

WATER LEVEL OBSERVATIONS

While Drilling ▽ 6.0' Upon Completion of Drilling _____
Time After Drilling _____
Depth to Water _____ ▼
Depth to Cave in _____

The stratification lines represent the approximate boundary between soil types and the transition may be gradual.

GENERAL NOTES

Start **7/22/13** End **7/22/13**
Driller **BSD** Chief **DC** Rig **CME-750**
Logger **JM** Editor **DAS**
Drill Method **2.25" HSA; 0-10'; 3-7/8" RB/DM 10'-30'; Autohammer**

CGC Inc.

LOG OF TEST BORING

Project **Proposed Fire Station #14 & Fire Training Site**
Femrite Drive and Dairy Drive
Location **Madison, Wisconsin**

Boring No. **14**
Surface Elevation (ft) **865.0**
Job No. **C13064-7**
Sheet **1** of **1**

2921 Perry Street, Madison, WI 53713 (608) 288-4100, FAX (608) 288-7887

SAMPLE No.	TYPE	Rec (in.)	Moist	N	Depth (ft)	VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES qu (qa) (tsf)	W	LL	PL	LI
						8 in.± Sandy TOPSOIL FILL (OL)					
1		12	M	12		FILL: Very Stiff, Brown/Gray Lean Clay, Trace to Little Sand USDA: FILL-10YR 4/3 Silty Clay Loam	(3.75-4.0)				
2		12	M	8	5	Stiff to Very Stiff, Gray/Brown (Mottled) Lean CLAY, Trace Sand (CL) USDA: 10YR 5/2 Silty Clay Loam (Redox: C2D 10YR 6/6)	(2.0-2.5)				
3		18	M	8			(1.0-1.5)	24.7			
4		6	W	4	10	Very Loose to Medium Dense, Brown Fine to Medium SAND, Trace to Little Silt, Trace Gravel (SP/SP-SM) USDA: 10YR 5/3 Sand					
5		18	W	4	15	Grades to Fine Sand near 15 ft					
6		6	W	2	20						
7		8	W	12	25						
8		18	W	20	30	End of Boring at 30 ft Borehole Backfilled with bentonite chips and slurry					
					35						

WATER LEVEL OBSERVATIONS

While Drilling ▽ **8.5'** Upon Completion of Drilling _____
Time After Drilling _____
Depth to Water _____ ▼
Depth to Cave in _____

The stratification lines represent the approximate boundary between soil types and the transition may be gradual.

GENERAL NOTES

Start **7/22/13** End **7/22/13**
Driller **BSD** Chief **DC** Rig **CME-750**
Logger **JM** Editor **DAS**
Drill Method **2.25" HSA; 0-10'; 3-7/8" RB/DM 10'-30'; Autohammer**

CGC Inc.

LOG OF TEST BORING

Project **Proposed Fire Station #14 & Fire Training Site**
Femrite Drive and Dairy Drive
Location **Madison, Wisconsin**

Boring No. **15**
Surface Elevation (ft) **863.6**
Job No. **C13064-7**
Sheet **1** of **1**

2921 Perry Street, Madison, WI 53713 (608) 288-4100, FAX (608) 288-7887

SAMPLE						VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES				
No.	TYPE	Rec (in.)	Moist	N	Depth (ft)		qu (qa) (tsf)	W	LL	PL	LI
						18 in.± Clayey TOPSOIL FILL(OL)					
1		13	M	16		FILL: Stiff, Dark Gray-Brown Silty Clay, Intermixed with Topsoil, Scattered Wood/Roots	(1.5-2.0)				
2		14	M	6	5	USDA: FILL-10YR 3/2 Silty Clay Very Stiff, Light Green-Gray/Brown (Mottled) Lean CLAY, Trace Sand (CL)	(2.0-2.5)				
3		12	M/W	8		USDA: 10YR 5/1 Silty Clay Loam (Redox: C2F 10YR 6/6)					
4		17	W	15	10	Loose to Medium Dense, Brown Fine to Medium SAND, Trace to Little Silt, Trace Gravel (SP/SP-SM) USDA: 10YR 5/3 Sand					
5		8	W	11	15						
6		6	W	16	20	Loose to Dense, Gray Fine SAND, Trace to Little Silt (SP/SP-SM) USDA: 10YR 5/2 Fine Sand					
7		12	W	7	25						
8		9	W	32	30						
						End of Boring at 30 ft Borehole Backfilled with bentonite chips and slurry					
					35						

WATER LEVEL OBSERVATIONS

While Drilling ▽ **8.5'** Upon Completion of Drilling _____
Time After Drilling _____
Depth to Water _____ ▼
Depth to Cave in _____

The stratification lines represent the approximate boundary between soil types and the transition may be gradual.

GENERAL NOTES

Start **7/22/13** End **7/22/13**
Driller **BSD** Chief **KD** Rig **CME-750**
Logger **JM** Editor **DAS**
Drill Method **2.25" HSA; 0-10'; 3-7/8" RB/DM 10'-30'; Autohammer**

CGC Inc.

LOG OF TEST BORING

Project **Proposed Fire Station #14 & Fire Training Site**
Femrite Drive and Dairy Drive
Location **Madison, Wisconsin**

Boring No. **16**
Surface Elevation (ft) **863.3**
Job No. **C13064-7**
Sheet **1** of **1**

2921 Perry Street, Madison, WI 53713 (608) 288-4100, FAX (608) 288-7887

SAMPLE No.	TYPE	Rec (in.)	Moist	N	Depth (ft)	VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES qu (qa) (tsf)	W	LL	PL	LI
						9 in.± Clayey TOPSOIL FILL (OL)					
1		18	M	14		FILL: Medium Dense, Orange-Brown Fine Sand, Little to Some Silt USDA: FILL - 10YR 5/6 Sandy Loam					
2		18	M	7	5	Very Stiff, Light Green-Gray/Brown (Mottled) Lean CLAY, Little to Some Sand (CL) USDA: 10YR 5/1 Silty Clay Loam (Redox: C2F 10YR 6/6)	(2.25-2.5)				
3		16	M/W	7							
4		15	W	7	10	Loose, Gray/Brown Fine to Medium SAND, Trace to Little Silt, Trace Gravel (SP/SP-SM) USDA: 10YR 5/2, 5/3 Sand					
5		18	W	10	15						
6		7	W	9	20	Loose, Gray Sandy SILT, Scattered Sand Seams (ML) USDA: 10YR 5/2 Loam					
7		5	W	19	25	Medium Dense, Gray Fine SAND, Trace to Little Silt (SP/SP-SM) USDA: 10YR 5/2 Fine Sand					
8		12	W	30	30	End of Boring at 30 ft Borehole Backfilled with bentonite chips and slurry					
					35						

WATER LEVEL OBSERVATIONS

While Drilling ▽ **8.5'** Upon Completion of Drilling _____
Time After Drilling _____
Depth to Water _____ ▼
Depth to Cave in _____

The stratification lines represent the approximate boundary between soil types and the transition may be gradual.

GENERAL NOTES

Start **7/22/13** End **7/22/13**
Driller **BSD** Chief **KD** Rig **D-120**
Logger **JM** Editor **DAS**
Drill Method **2.25" HSA; 0-10'; 3-7/8" RB/DM 10'-30'; Autohammer**

CGC Inc.

LOG OF TEST BORING

Project **Proposed Fire Station #14 & Fire Training Site**
Femrite Drive and Dairy Drive
Location **Madison, Wisconsin**

Boring No. **17**
Surface Elevation (ft) **864.3**
Job No. **C13064-7**
Sheet **1** of **1**

2921 Perry Street, Madison, WI 53713 (608) 288-4100, FAX (608) 288-7887

SAMPLE No.	TYPE	Rec (in.)	Moist	N	Depth (ft)	VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES qu (qa) (tsf)	W	LL	PL	LI
						4 in.± Clayey TOPSOIL FILL (OL)					
1		6	M	12		FILL: Medium Dense, Gray/Brown Clayey Fine to Medium Sand					
						USDA: FILL - 10YR 5/2, 4/3 Sandy Clay Loam					
2		12	M	7		Very Stiff, Light Green-Gray/Brown (Mottled) Lean CLAY, Some Sand (CL)	(2.0-2.5)				
					5	USDA: 10YR 5/1 Silty Clay Loam (Redox: C2F 10YR 6/6)					
3		16	W	8		Loose, Gray Fine to Medium SAND, Some Silt, Trace Clay (SM)					
						USDA: 10YR 5/2 Sandy Loam					
4		18	W	11		Medium Dense, Brown Fine to Medium SAND, Trace to Little Silt, Trace Gravel (SP/SP-SM)					
					10	USDA: 10YR 5/3 Sand					
5		7	W	13							
					15						
6		8	W	12							
					20						
7		10	W	15		Grades to Fine Sand near 25 ft					
					25						
8		13	W	25							
					30	End of Boring at 30 ft					
						Borehole Backfilled with bentonite chips and slurry					
					35						

WATER LEVEL OBSERVATIONS

While Drilling ▽ 6.0'	Upon Completion of Drilling			
Time After Drilling				
Depth to Water				▼
Depth to Cave in				

The stratification lines represent the approximate boundary between soil types and the transition may be gradual.

GENERAL NOTES

Start **7/24/13** End **7/24/13**
Driller **BSD** Chief **KD** Rig **CME-750**
Logger **JM** Editor **DAS**
Drill Method **2.25" HSA; 0-10'; 3-7/8" RB/DM 10'-30'; Autohammer**

CGC Inc.

LOG OF TEST BORING

Project **Proposed Fire Station #14 & Fire Training Site**
Femrite Drive and Dairy Drive
Location **Madison, Wisconsin**

Boring No. **18**
Surface Elevation (ft) **863.8**
Job No. **C13064-7**
Sheet **1** of **1**

2921 Perry Street, Madison, WI 53713 (608) 288-4100, FAX (608) 288-7887

SAMPLE No.	TYPE	Rec (in.)	Moist	N	Depth (ft)	VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES qu (qa) (tsf)	W	LL	PL	LI
						4 in.± Clayey TOPSOIL FILL (OL)					
1		10	M	13		FILL: Very Stiff, Brown/Gray Lean Clay, Little to Some Gravel, Trace to Little Sand	(2.5)				
						USDA: FILL-10YR 4/3 Silty Clay Loam					
2		12	M	8		Medium Stiff to Stiff, Light Green-Gray/Brown (Mottled) Lean CLAY, Trace Sand (CL)	(1.5)				
					5						
3		16	M/W	3		USDA: 10YR 5/1 Silty Clay Loam (Redox: C2D 10YR 6/6)	(0.5)	28.3			
4		13	W	15		Loose to Medium Dense, Brown Fine to Medium SAND, Trace to Little Silt, Trace Gravel (SP/SP-SM)					
					10	USDA: 10YR 5/3 Sand					
5		7	W	8							
					15						
6		14	W	15							
					20						
7		9	W	10		Grades to Fine Sand near 25 ft					
					25						
8		11	W	22		Scattered Silty Sand Seams near 30 ft					
					30	End of Boring at 30 ft					
						Borehole Backfilled with bentonite chips and slurry					
					35						

WATER LEVEL OBSERVATIONS

While Drilling ▽ **8.5'** Upon Completion of Drilling _____
Time After Drilling _____
Depth to Water _____ ▼
Depth to Cave in _____

The stratification lines represent the approximate boundary between soil types and the transition may be gradual.

GENERAL NOTES

Start **7/24/13** End **7/24/13**
Driller **BSD** Chief **KD** Rig **CME-750**
Logger **JM** Editor **DAS**
Drill Method **2.25" HSA; 0-10'; 3-7/8"**
RB/DM 10'-30'; Autohammer

CGC Inc.

LOG OF TEST BORING

Project **Proposed Fire Station #14 & Fire Training Site**
Femrite Drive and Dairy Drive
Location **Madison, Wisconsin**

Boring No. **19**
Surface Elevation (ft) **863.2**
Job No. **C13064-7**
Sheet **1** of **1**

2921 Perry Street, Madison, WI 53713 (608) 288-4100, FAX (608) 288-7887

SAMPLE No.	TYPE	Rec (in.)	Moist	N	Depth (ft)	VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES qu (qa) (tsf)	W	LL	PL	LI
						5 in.± Clayey TOPSOIL (OL)					
1		10	M	11		Very Stiff, Brown (Mottled) Lean CLAY, Trace Sand USDA: 10YR 4/4 Silty Clay Loam	(3.5)				
2		10	M	5	5	(Redox: C2D 10YR 6/6)					
3		15	W	13		Loose, Gray Fine to Medium SAND, Some Silt, Little Clay, Scattered Soft Clay Seams (SM) USDA: 10YR 4/3 Sandy Loam, Silty Clay Loam Seams					
4		12	W	8	10	Loose to Medium Dense, Brown Fine to Medium SAND, Trace to Little Silt, Trace Gravel (SP/SP-SM) USDA: 10YR 5/3 Sand					
5		3	W	18	15						
6		5	W	10	20	Color Changes to Gray near 20 ft					
7		10	W	14	25						
8		4	W	16	30	End of Boring at 30 ft Borehole Backfilled with bentonite chips and slurry					
					35						

WATER LEVEL OBSERVATIONS

While Drilling ▽ **6.0'** Upon Completion of Drilling _____
Time After Drilling _____
Depth to Water _____ ▼
Depth to Cave in _____

The stratification lines represent the approximate boundary between soil types and the transition may be gradual.

GENERAL NOTES

Start **7/24/13** End **7/24/13**
Driller **BSD** Chief **KD** Rig **CME-750**
Logger **JM** Editor **DAS**
Drill Method **2.25" HSA; 0-10'; 3-7/8"**
RB/DM 10'-30'; Autohammer

CGC Inc.

LOG OF TEST BORING

Project **Proposed Fire Station #14 & Fire Training Site**
Femrite Drive and Dairy Drive
Location **Madison, Wisconsin**

Boring No. **20**
Surface Elevation (ft) **864.4**
Job No. **C13064-7**
Sheet **1** of **1**

2921 Perry Street, Madison, WI 53713 (608) 288-4100, FAX (608) 288-7887

SAMPLE No.	TYPE	Rec (in.)	Moist	N	Depth (ft)	VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES qu (qa) (tsf)	W	LL	PL	LI
						8 in.± Clayey TOPSOIL FILL (OL)					
1		16	M	17		FILL: Medium Dense, Brown Fine to Medium Sand, Some Silt and Gravel, Intermixed with Clay					
						USDA: 10YR 4/3 Sandy Loam with Silty Clay Loam					
2		9	M	11			(4.5+)				
					5	Hard, Brown (Mottled) Lean CLAY, Trace Sand					
3		10	M	6		USDA: 10 YR 4/4 Silty Clay Loam (C2D 10YR 6/6)					
						Loose to Medium Dense, Brown Fine to Medium					
4		15	W	17		SAND, Trace Silt, Clay and Gravel, Scattered Silt Seams (SP/SP-SM)					
					10	USDA: 10YR 5/3 Sand to Loamy Sand, Silt Loam Seams					
						Medium Dense, Brown Fine to Medium SAND, Trace to Little Silt, Trace Gravel (SP/SP-SM)					
5		18	W	11		USDA: 10YR 5/3 Sand					
					15						
6		5	W	11		Medium Dense, Gray Fine SAND, Some Silt, Trace Gravel (SM)					
					20	USDA: 10YR 5/2 Sandy Loam					
7		16	W	18							
					25						
8		12	W	26		Scattered Silty Sand Seams near 30 ft					
					30	End of Boring at 30 ft					
						Borehole Backfilled with bentonite chips and slurry					
					35						

WATER LEVEL OBSERVATIONS

While Drilling ▽ **8.5'** Upon Completion of Drilling _____
Time After Drilling _____
Depth to Water _____
Depth to Cave in _____

The stratification lines represent the approximate boundary between soil types and the transition may be gradual.

GENERAL NOTES

Start **7/22/13** End **7/22/13**
Driller **BSD** Chief **KD** Rig **D-120**
Logger **JM** Editor **DAS**
Drill Method **2.25" HSA; 0-10'; 3-7/8" RB/DM 10'-30'; Autohammer**

APPENDIX C

DOCUMENT QUALIFICATIONS

APPENDIX C
DOCUMENT QUALIFICATIONS

I. GENERAL RECOMMENDATIONS/LIMITATIONS

CGC, Inc. should be provided the opportunity for a general review of the final design and specifications to confirm that earthwork and foundation requirements have been properly interpreted in the design and specifications. CGC should be retained to provide soil engineering services during excavation and subgrade preparation. This will allow us to observe that construction proceeds in complianee with the design concepts, specifieations and recommendations, and also will allow design changes to be made in the event that subsurface conditions differ from those anticipated prior to the start of construction. CGC does not assume responsibility for compliance with the recommendations in this report unless we are retained to provide construction testing and observation services.

This report has been prepared in accordance with generally accepted soil and foundation engineering practices and no other warranties are expressed or implied. The opinions and recommendations submitted in this report are based on interpretation of the subsurface information revealed by the test borings indicated on the location plan. The report does not reflect potential variations in subsurface conditions between or beyond these borings. Therefore, variations in soil conditions can be expected between the boring locations and fluctuations of groundwater levels may occur with time. The nature and extent of the variations may not become evident until eonstruction.

II. IMPORTANT INFORMATION ABOUT YOUR GEOTECHNICAL ENGINEERING REPORT

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical engineering study conducted for a civil engineer may not fulfill the needs of a construction contractor or even another civil engineer. Because each geotechnical engineering study is unique, each geotechnical engineering report is unique, prepared *solely* for the client. *No one except you* should rely on your geotechnical engineering report without first conferring with the geotechnical engineer who prepared it. *And no one - not even you* - should apply the report for any purpose or project except the one originally contemplated.

Serious problems have occurred because those relying on a geotechnical engineering report did not read it all. Do not rely on an executive summary. Do not read selected elements only.

A GEOTECHNICAL ENGINEERING REPORT IS BASED ON A UNIQUE SET OF PROJECT-SPECIFIC FACTORS

Geotechnical engineers consider a number of unique, project-specific factors when establishing the scope of a study. Typical factors include: the client's goals, objectives, and risk management preferences; the general nature of the structure involved, its size, and configuration; the location of the structure on the site; and other planned or existing site improvements, such as access roads, parking lots, and underground utilities. Unless the geotechnical engineer who conducted the study specifically indicates otherwise, *do not rely on a geotechnical engineering report* that was:

- not prepared for you,
- not prepared for your project,
- not prepared for the specific site explored, or
- completed before important project changes were made.

Typical changes that can erode the reliability of an existing geotechnical report include those that affect:

- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light industrial plant to a refrigerated warehouse,
- elevation, configuration, location, orientation, or weight of the proposed structure,
- composition of the design team, or project ownership.

As a general rule, , *always* inform your geotechnical engineer of project changes - even minor ones - and request an assessment of their impact. *CGC cannot accept responsibility or liability for problems that occur because our reports do not consider developments of which we were not Informed.*

SUBSURFACE CONDITIONS CAN CHANGE

A geotechnical engineering report is based on conditions that existed at the time the study was performed. *Do not rely on a geotechnical engineering report* whose adequacy may have been affected by: the passage of time; by man-made events, such as construction on or adjacent to the site; or by natural events, such as floods, earthquakes, or groundwater fluctuations. *Always* contact the geotechnical engineer before applying the report to determine if it is still reliable. A minor amount of additional testing or analysis could prevent major problems.

MOST GEOTECHNICAL FINDINGS ARE PROFESSIONAL OPINION

Site exploration identifies subsurface conditions only at those points where surface tests are conducted or samples are taken. Geotechnical engineers review field and laboratory data and then apply their professional judgement to render an opinion about subsurface conditions throughout the site. Actual subsurface conditions may differ - sometimes significantly - from those indicated in your report. Retaining the geotechnical engineer who developed your report to provide construction observation is the most effective method of managing the risks associated with unanticipated conditions.

A REPORT'S RECOMMENDATIONS ARE NOT FINAL

Do not over-rely on the construction recommendations included in your report. *Those recommendations are not final,* because geotechnical engineers develop them principally from judgement and opinion, geotechnical engineers can finalize their recommendations only by observing actual subsurface eonditions revealed during construction. *CGC cannot assume responsibility or liability for the report's recommendations if we do not perform construction observation.*

A GEOTECHNICAL ENGINEERING REPORT IS SUBJECT TO MISINTERPRETATION

Other design team members' misinterpretation of geotechnical engineering reports has resulted in costly problems. Lower that risk by having your geotechnical engineer confer with appropriate members of the design team after submitting the report. Also retain your geotechnical engineer to review pertinent elements of the design team's plans and specifications. Contractors ean also misinterpret a geotechnical engineering report. Reduce that risk by having CGC participate in prebid and preconstruction conferences, and by providing construction observation.

DO NOT REDRAW THE ENGINEER'S LOGS

Geotechnical engineers prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. To prevent errors or omissions, the logs included in a geotechnical engineering report should *never* be redrawn for inclusion in architectural or other design drawings. Only photographic or electronic reproduction is acceptable, *but recognize that separating logs from the report can elevate risk.*

GIVE CONTRACTORS A COMPLETE REPORT AND GUIDANCE

Some owners and design professionals mistakenly believe they can make contractors liable for unanticipated subsurface conditions by limiting what they provide for bid preparation. To help prevent costly problems, give contractors the complete geotechnical engineering report, *but* preface it with a clearly written letter of transmittal. In that letter, advise contractors that the report was not prepared for purposes of bid development and that the report's accuracy is limited; encourage them to confer with the geotechnical engineer who prepared the report (a modest fee may be required) and/or to conduct additional study to obtain the specific types of information they need or prefer. A prebid conference can also be valuable. *Be sure contractors have sufficient time* to perform additional study. Only then might you be in a position to give contractors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

READ RESPONSIBILITY PROVISIONS CLOSELY

Some clients, design professionals, and contractors do not recognize that geotechnical engineering is far less exact than other engineering disciplines. This lack of understanding has created unrealistic expectations that have led to disappointments, claims, and disputes. To help reduce such risks, geotechnical engineers commonly include a variety of explanatory provisions in their reports. Sometimes labeled "limitations," many of these provisions indicate where geotechnical engineer's responsibilities begin and end, to help others recognize their own responsibilities and risks. Read these provisions closely. Ask questions. Your geotechnical engineer should respond fully and frankly.

GEOENVIRONMENTAL CONCERNS ARE NOT COVERED

The equipment, techniques, and personnel used to perform a *geoenvironmental* study differ significantly from those used to perform a *geotechnical* study. For that reason, a geotechnical engineering report does not usually relate any geoenvironmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated environmental problems have led to numerous project failures.* If you have not yet obtained your own geoenvironmental information, ask your geotechnical consultant for risk management guidance. *Do not rely on an environmental report prepared for someone else.*

OBTAIN PROFESSIONAL ASSISTANCE TO DEAL WITH MOLD

Diverse strategies can be applied during building design, construction, operation, and maintenance to prevent significant amounts of mold from growing on indoor surfaces. To be effective, all such strategies should be devised for the *express purpose* of mold prevention, integrated into a comprehensive plan, and executed with diligent oversight by a professional mold prevention consultant. Because just a small amount of water or moisture can lead to the development of severe mold infestations, a number of mold prevention strategies focus on keeping building surfaces dry. While groundwater, water infiltration, and similar issues may have been addressed as part of the geotechnical engineering study whose findings are conveyed in this report, the geotechnical engineer in charge of this project is not a mold prevention consultant; ***none of the services performed in connection with the geotechnical engineer's study were designed or conducted for the purpose of mold prevention. Proper implementation of the recommendations conveyed in this report will not of itself be sufficient to prevent mold from growing in or on the structure involved.***

RELY ON YOUR GEOTECHNICAL ENGINEER FOR ADDITIONAL ASSISTANCE

Membership in ASFE exposes geotechnical engineers to a wide array of risk management techniques that can be of genuine benefit for everyone involved with a construction project. Confer with CGC, a member of ASFE, for more information.

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ASFE/The Best People on Earth
881 Colesville Road, Suite G 106
Silver Spring, MD 20910

APPENDIX D

RECOMMENDED COMPACTED FILL SPECIFICATIONS

APPENDIX D

CGC, INC.

RECOMMENDED COMPACTED FILL SPECIFICATIONS

General Fill Materials

Proposed fill shall contain no vegetation, roots, topsoil, peat, ash, wood or any other non-soil material which by decomposition might cause settlement. Also, fill shall never be placed while frozen or on frozen surfaces. Rock, stone or broken concrete greater than 6 in. in the largest dimension shall not be placed within 10 ft of the building area. Fill used greater than 10 ft beyond the building limits shall not contain rock, boulders or concrete pieces greater than a 2 sq ft area and shall not be placed within the final 2 ft of finish subgrade or in designated utility construction areas. Fill containing rock, boulders or concrete pieces should include sufficient finer material to fill voids among the larger fragments.

Special Fill Materials

In certain cases, special fill materials may be required for specific purposes, such as stabilizing subgrades, backfilling undercut excavations or filling behind retaining walls. For reference, WisDOT gradation specifications for various types of granular fill are attached in Table 1.

Placement Method

The approved fill shall be placed, spread and leveled in layers generally not exceeding 10 in. in thickness before compaction. The fill shall be placed at moisture content capable of achieving the desired compaction level. For clay soils or granular soils containing an appreciable amount of cohesive fines, moisture conditioning will likely be required.

It is the Contractor's responsibility to provide all necessary compaction equipment and other grading equipment that may be required to attain the specified compaction. Hand-guided vibratory or tamping compactors will be required whenever fill is placed adjacent to walls, footings, columns or in confined areas.

Compaction Specifications

Maximum dry density and optimum moisture content of the fill soil shall be determined in accordance with modified Proctor methods (ASTM D1557). The recommended field compaction as a percentage of the maximum dry density is shown in Table 2. Note that these compaction guidelines would generally not apply to coarse gravel/stone fill. Instead, a method specification would apply (e.g., compact in thin lifts with a vibratory compactor until no further consolidation is evident).

Testing Procedures

Representative samples of proposed fill shall be submitted to CGC, Inc. for optimum moisture-maximum density determination (ASTM D1557) prior to the start of fill placement. The sample size should be approximately 50 lb.

CGC, Inc. shall be retained to perform field density tests to determine the level of compaction being achieved in the fill. The tests shall generally be conducted on each lift at the beginning of fill placement and at a frequency mutually agreed upon by the project team for the remainder of the project.

Table 1
Gradation of Special Fill Materials

Material	WisDOT Section 311	WisDOT Section 312	WisDOT Section 305			WisDOT Section 209		WisDOT Section 210
	Breaker Run	Select Crushed Material	3-in. Dense Graded Base	1 1/4-in. Dense Graded Base	3/4-in. Dense Graded Base	Grade 1 Granular Backfill	Grade 2 Granular Backfill	Structure Backfill
Sieve Size	Percent Passing by Weight							
6 in.	100							
5 in.		90-100						
3 in.			90-100					100
1 1/2 in.		20-50	60-85					
1 1/4 in.				95-100				
1 in.					100			
3/4 in.			40-65	70-93	95-100			
3/8 in.				42-80	50-90			
No. 4			15-40	25-63	35-70	100 (2)	100 (2)	25-100
No. 10		0-10	10-30	16-48	15-55	75 (2)		
No. 40			5-20	8-28	10-35	15 (2)	30 (2)	
No. 200			2-12	2-12	5-15	8 (2)	15 (2)	15 (2)

Notes:

1. Reference: Wisconsin Department of Transportation *Standard Specifications for Highway and Structure Construction.*
2. Percentage applies to the material passing the No. 4 sieve, not the entire sample.
3. Per WisDOT specifications, both breaker run and select crushed material can include concrete that is 'substantially free of steel, building materials and other deleterious material'.

Table 2
Compaction Guidelines

Area	Percent Compaction (1)	
	Clay/Silt	Sand/Gravel
Within 10 ft of building lines		
Footing bearing soils	93 - 95	95
Under floors, steps and walks		
- Lightly loaded floor slab	90	90
- Heavily loaded floor slab and thicker fill zones	92	95
Beyond 10 ft of building lines		
Under walks and pavements		
- Less than 3 ft below subgrade	92	95
- Greater than 3 ft below subgrade	90	90
Landscaping	85	90

Notes:

1. Based on Modified Proctor Dry Density (ASTM D 1557)

APPENDIX E

TYPICAL PERIMETER DRAIN DETAILS

General Notes

1. This system's primary function is to intercept infiltrating surface water. These Alternates are not appropriate for use in situations of high groundwater (i.e., cases where the water table approaches floor slab elevation).

2. Grade surface cap to slope away from structure.

3. Exterior surface of walls below grade should be damp-proofed.

4. A plastic vapor barrier should be installed below the slab.

5. Recommended types of drain pipes:

Specification	Description
ASTM D2729	Polyvinyl Chloride (PVC) Drain Pipe
ASTM F405	Corrugated Polyethylene Drain Pipe
ASTM D2852	Styrene-Rubber Plastic Drain Pipe
AASHTO M136	Corrugated Metal Underdrain Pipe

6. Minimum slope of drain pipes should be 2 in. per 100 lin ft.

7. Place drain pipe below basement floor level and orient the perforations toward the bottom.

8. Clean-outs should be provided to service the pipe.

9. Collected field water should be discharged to a sump, storm sewer or drainage field.

10. The geotextile for Alternative Nos. 2 and 3 may be eliminated if filter requirements are satisfied between the wall and pipe backfill, as well as between backfill materials and natural soils.

11. Pipe backfill materials should satisfy filter requirements for the slot width or hole diameter of the perforated pipe.

12. Care should be taken during backfilling not to damage the integrity of the system. For compaction requirements, refer to geotechnical report.

13. Pipe, geotextile, and geocomposite should be installed according to manufacturer specifications.

General Notes

1. This system's primary function is to intercept infiltrating surface water. These Alternates are not appropriate for use in situations of high groundwater (i.e., cases where the water table approaches floor slab elevation).

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12. Care should be taken during backfilling not to damage the integrity of the system. For compaction requirements, refer to geotechnical report.

13. Pipe, geotextile, and geocomposite should be installed according to manufacturer specifications.

APPENDIX F

WISCONSIN DEPARTMENT OF SAFETY & PROFESSIONAL SERVICES
SOIL EVALUATION FORMS (20 Borings)

Wisconsin Department of Safety & Professional Development

SOIL EVALUATION - STORM

in accordance with Comm 82.365 & 85, Wis. Adm. Code

Attach complete site plan on paper not less than 8 1/2 x 11 inches in size. Plan must include, but not limited to: vertical and horizontal reference point (BM), direction and percent slope, scale or dimensions, north arrow, and BM referenced to nearest road.

Please print all information.

Personal information you provide may be used for secondary purposes (Privacy Law, s.15.04 (1) (m)).

County	
Dane	
Parcel I.D.	071022403077
Review by	Date

Property Owner	Property Location
FHB Investments, LLC	Govt. Lot 1/4 SE 1/4 S 22 T 07 N R 10 E
Property Owner's Mailing Address	Lot # 34 / Block # / Subd. Name or CSM# 4th Addition of World Dairy Center
1830 Meadow Lane, Suite A	
City: Pewaukee / State: WI / Zip Code: 53072 / Phone Number:	[X] City [ ] Village [ ] Town / Nearest Road: 5152 Femrite Dr.
	Madison

Drainage area _____ [ ] sq. ft. [ ] acres

Optional:

Test Site Suitable for (check all that apply)

[ ] Irrigation [ ] Bioretention trench [ ] Trench(es)

[ ] Rain Garden [ ] Grassed Swale [ ] Reuse

[ ] Infiltration trench [ ] SDS (>15' wide) [ ] Other _____

Hydraulic Application Test Method

[X] Morphological Evaluation

[ ] Double-Ring Infiltrometer

[ ] Other (Specify)_____

1 Obs. # [X] Boring [ ] Pit Ground Surface Elev. 859.8 ft Depth to limiting factor 13, 42 in.

Horizon	Depth in.	Dominant Color Munsell	Redox Description Qu. Sz. Cont. Color	Texture	Structure Gr. Sz. Sh.	Consistence	Boundary	% Rock Frag.	Hydraulic App. Rate Inches/Hr
1	0 - 13	10YR 2/1	None	SiCL	1msbk	mvfr	as	<5	0.04
2	13 - 42	10 YR 5/1	C2F 10YR6/6	SiCL	1msbk	mvfr	gs	<5	0.04
3	42 - 102	10 YR 5/3	None	S	0sg	ml	gs	<5	3.6
4	102 - 162	10 YR 5/2	None	SL	1msbk	mvfr	gs	10 - 15	0.5
5	162 - 360	10 YR 5/2	None	S	0sg	ml		<5	3.6
		Groundwater was encountered in boring at 42 in. below existing grade.							

2 Obs. # [X] Boring [ ] Pit Ground Surface Elev. 859.9 ft Depth to limiting factor 42 in.

Horizon	Depth in.	Dominant Color Munsell	Redox Description Qu. Sz. Cont. Color	Texture	Structure Gr. Sz. Sh.	Consistence	Boundary	% Rock Frag.	Hydraulic App. Rate Inches/Hr
1	0 - 15	10YR 2/1	None	SiCL	1msbk	mvfr	as	<5	0.04
2	15 - 162	10 YR 5/3	None	S	0sg	ml	gs	<5	3.6
3	162 - 216	10 YR 5/2	None	L	0m	mvfr	gs	<5	0.24
4	216 - 228	10 YR 5/2	None	SiC	1msbk	mvfr	gs	<5	0.07
5	228 - 282	10 YR 5/2	None	S	0sg	ml	gs	10-15	3.6
6	282 - 360	10 YR 5/2	None	S	0sg	ml		<5	3.6
		Groundwater was encountered in boring at 42 in. below existing grade.							

CST/PSS Name (Please Print)	Signature	CST/PSS Number
David Staab	David Staab	1042602
Address	**Date Evaluation Conducted**	**Telephone Number**
3911 Mineral Point Road	7/25/2013	608/288-4100

3 Obs. # [X] Boring [ ] Pit Ground Surface Elev. 861.0 ft Depth to limiting factor 15, 42 in.

Horizon	Depth in.	Dominant Color Munsell	Redox Description Qu. Sz. Cont. Color	Texture	Structure Gr. Sz. Sh.	Consistence	Boundary	% Rock Frag.	Hydraulic App. Rate Inches/Hr
1	0 - 15	10YR 2/1	None	SiCL	1msbk	mvfr	as	<5	0.04
2	15 - 42	10 YR 5/1	C2F 10YR6/6	SiCL	1msbk	mvfr	gs	<5	0.04
3	42 - 162	10 YR 6/3	None	S, SiL	0sg	ml	gs	10 - 15	0.13
4	162 - 222	10 YR 4/2	None	SL	1msbk	mvfr	gs	<5	0.5
5	222 - 282	10 YR 5/2	None	SL, SiL	1msbk	mvfr	gs	<5	0.13
6	282 - 342	10 YR 4/2	None	SL	1msbk	mvfr	gs	<5	0.5
7	342 - 354	10 YR 5/3	None	SiCL	1msbk	mvfr	gs	<5	0.04
8	354 - 402	10 YR 5/2	None	SL, SiL	1msbk	mvfr	gs	10 - 15	0.13
9	402 - 420	10 YR 5/2	None	FS	0sg	ml		<5	0.5
	Groundwater was encountered in boring at 42 in. below existing grade.								

4 Obs. # [X] Boring [ ] Pit Ground Surface Elev. 862.0 ft Depth to limiting factor 13, 66 in.

Horizon	Depth in.	Dominant Color Munsell	Redox Description Qu. Sz. Cont. Color	Texture	Structure Gr. Sz. Sh.	Consistence	Boundary	% Rock Frag.	Hydraulic App. Rate Inches/Hr
1	0 - 13	10YR 2/1	None	SiCL	1msbk	mvfr	as	<5	0.04
2	13 - 36	10 YR 5/1	None	SiCL	1msbk	mvfr	gs	<5	0.04
3	36 - 120	10 YR 5/3, 6/3	None	S	0sg	ml		<5	3.6
		Groundwater was encountered in boring at 66 in. below existing grade.							

5 Obs. # [X] Boring [ ] Pit Ground Surface Elev. 860.2 ft Depth to limiting factor 42 in.

Horizon	Depth in.	Dominant Color Munsell	Redox Description Qu. Sz. Cont. Color	Texture	Structure Gr. Sz. Sh.	Consistence	Boundary	% Rock Frag.	Hydraulic App. Rate Inches/Hr
1	0 - 13	10YR 2/1	None	SiCL	1msbk	mvfr	as	<5	0.04
2	13 - 42	10 YR 4/2	None	SiCL	1msbk	mvfr	gs	<5	0.04
3	42 - 282	10 YR 5/3, 3/3, 5/2	None	S, SiL	0sg	ml	gs	<5	0.13
4	282 - 342	10 YR 5/2	None	SL	1msbk	mvfr	gs	<5	0.5
5	342 - 360	10 YR 5/2	None	FS	0sg	ml		<5	0.5
		Groundwater was encountered in boring at 42 in. below existing grade.							

Property Owner FMB Investments, LLC Parcel ID# 71022403077 Page 3 of 3

6 Obs. # [X] Boring [ ] Pit Ground Surface Elev. 861.5 ft Depth to limiting factor 70 in.

Horizon	Depth in.	Dominant Color Munsell	Redox Description Qu. Sz. Cont. Color	Texture	Structure Gr. Sz. Sh.	Consistence	Boundary	% Rock Frag.	Hydraulic App. Rate Inches/Hr
1	0 - 13	10YR 2/1	None	SiCL	1msbk	mvfr	as	<5	0.04
2	13 - 42	10 YR 5/1	C2D 10 YR 6/6	SiCL	1msbk	mvfr	gs	<5	0.04
3	42 - 54	10 YR 3/1	None	SCL	0m	mvfr	gs	<5	0.11
4	54 - 120	10 YR 5/2	None	S	0sg	ml		<5	3.6
		Groundwater was encountered in boring at 70 in. below existing grade.							

Obs. # [ ] Boring [ ] Pit Ground Surface Elev. _____ ft Depth to limiting factor _____ in.

Horizon	Depth in.	Dominant Color Munsell	Redox Description Qu. Sz. Cont. Color	Texture	Structure Gr. Sz. Sh.	Consistence	Boundary	% Rock Frag.	Hydraulic App. Rate Inches/Hr

Obs. # [ ] Boring [ ] Pit Ground Surface Elev. _____ ft Depth to limiting factor _____ in.

Horizon	Depth in.	Dominant Color Munsell	Redox Description Qu. Sz. Cont. Color	Texture	Structure Gr. Sz. Sh.	Consistence	Boundary	% Rock Frag.	Hydraulic App. Rate Inches/Hr

Wisconsin Department of Safety & Professional Development

SOIL EVALUATION - STORM

in accordance with Comm 82.365 & 85, Wis. Adm. Code

Attach complete site plan on paper not less than 8 1/2 x 11 inches in size. Plan must include, but not limited to: vertical and horizontal reference point (BM), direction and percent slope, scale or dimensions, north arrow, and BM referenced to nearest road.

Please print all information.

Personal information you provide may be used for secondary purposes (Privacy Law, s.15.04 (1) (m)).

County	
Dane	
Parcel I.D.	071022403093, 071022403085
Review by	Date

Property Owner	Property Location
FHB Investments, LLC	Govt. Lot 1/4 SE 1/4 S 22 T 07 N R 10 E
Property Owner's Mailing Address	**Lot #** / **Block #** / **Subd. Name or CSM#**
1830 Meadow Lane, Suite A	35,36 — 4th Addition of World Dairy Center
City / **State** / **Zip Code** / **Phone Number**	[X] City [ ] Village [ ] Town — **Nearest Road**
Pewaukee / WI / 53072	Madison — 3101 and 3201 Dairy Drive

Drainage area _____ [ ] sq. ft. [ ] acres

Optional:

Test Site Suitable for (check all that apply)

[ ] Irrigation [ ] Bioretention trench [ ] Trench(es)

[ ] Rain Garden [ ] Grassed Swale [ ] Reuse

[ ] Infiltration trench [ ] SDS (>15' wide) [ ] Other _____

Hydraulic Application Test Method

[X] Morphological Evaluation

[ ] Double-Ring Infiltrometer

[ ] Other (Specify)_____

7 Obs. # [X] Boring [ ] Pit Ground Surface Elev. 862.2 ft Depth to limiting factor 12, 72 in.

Horizon	Depth in.	Dominant Color Munsell	Redox Description Qu. Sz. Cont. Color	Texture	Structure Gr. Sz. Sh.	Consistence	Boundary	% Rock Frag.	Hydraulic App. Rate Inches/Hr
1	0 - 12	10YR 2/1	None	SiCL	1msbk	mvfr	as	<5	0.04
2	12 - 36	10 YR 5/2	C2D 10YR6/6	SiCL	1msbk	mvfr	gs	<5	0.04
3	36 - 120	10 YR 5/3	None	S, SiL	0sg	ml		<5	0.13
		Groundwater was encountered in boring at 72 in. below existing grade.							

8 Obs. # [X] Boring [ ] Pit Ground Surface Elev. 863.8 ft Depth to limiting factor 96 in.

Horizon	Depth in.	Dominant Color Munsell	Redox Description Qu. Sz. Cont. Color	Texture	Structure Gr. Sz. Sh.	Consistence	Boundary	% Rock Frag.	Hydraulic App. Rate Inches/Hr
1	0 - 36	2.5 Y 5/3	None	Fill - SL	Variable	Variable	as	20 - 30	0.5
2	36 - 66	10 YR 3/1, 5/2	None	Fill - SiCL	Variable	Variable	as	<5	0.04
3	66 - 108	10 YR 2/1	None	SiCL	1msbk	mvfr	gs	<5	0.04
4	108 - 282	10 YR 5/3	None	S	0sg	ml	gs	<5	3.6
5	282 - 342	10 YR 5/3	None	FS	0sg	ml	gs	<5	0.5
6	342 - 360	10 YR 5/2	None	S	0sg	ml		<5	3.6
		Groundwater was encountered in boring at 96 in. below existing grade.							

CST/PSS Name (Please Print)	Signature	CST/PSS Number
David Staab	David Staab	1042602
Address	**Date Evaluation Conducted**	**Telephone Number**
3911 Mineral Point Road	7/25/2013	608/288-4100

9 Obs. # [X] Boring [ ] Pit Ground Surface Elev. 863.5 ft Depth to limiting factor 72 in.

Horizon	Depth in.	Dominant Color Munsell	Redox Description Qu. Sz. Cont. Color	Texture	Structure Gr. Sz. Sh.	Consistence	Boundary	% Rock Frag.	Hydraulic App. Rate Inches/Hr
1	0 - 30	2.5 Y 5/3	None	Fill - SL	Variable	Variable	as	20 - 30	0.5
2	30 - 72	10YR 2/1	None	SiL	1msbk	mvfr	as	<5	0.13
3	72 - 360	10 YR 5/3	None	S	0sg	ml		<5	3.6
	Groundwater was encountered in boring at 72 in. below existing grade.								

10 Obs. # [X] Boring [ ] Pit Ground Surface Elev. 860.4 ft Depth to limiting factor 72 in.

Horizon	Depth in.	Dominant Color Munsell	Redox Description Qu. Sz. Cont. Color	Texture	Structure Gr. Sz. Sh.	Consistence	Boundary	% Rock Frag.	Hydraulic App. Rate Inches/Hr
1	0 - 14	10 YR 2/1	None	SiCL	1msbk	mvfr	as	<5	0.04
2	14 - 42	10 YR 5/1	None	SL	1msbk	mvfr	gs	<5	0.5
3	42 - 162	10 YR 5/3, 3/3	None	S, SiL	0sg	ml	gs	<5	0.13
4	162 - 222	10 YR 5/2	None	FS	0sg	ml	gs	<5	0.5
5	222 - 282	10 YR 5/2	None	SL	1msbk	mvfr	gs	<5	0.5
6	282 - 360	10 YR 5/2	None	FS	0sg	ml		<5	0.5
		Groundwater was encountered in boring at 72 in. below existing grade.							

11 Obs. # [X] Boring [ ] Pit Ground Surface Elev. 861.2 ft Depth to limiting factor 72 in.

Horizon	Depth in.	Dominant Color Munsell	Redox Description Qu. Sz. Cont. Color	Texture	Structure Gr. Sz. Sh.	Consistence	Boundary	% Rock Frag.	Hydraulic App. Rate Inches/Hr
1	0 - 15	10 YR 2/1	None	SiCL	1msbk	mvfr	as	<5	0.04
2	15 - 72	10 YR 5/1	C2D 10YR6/6	SiCL	1msbk	mvfr	gs	<5	0.04
3	72 - 162	10 YR 5/3	None	S	0sg	ml	gs	<5	3.6
4	162 - 222	10 YR 5/3	None	FS	0sg	ml	gs	<5	0.5
5	222 - 342	10 YR 5/3	None	S	0sg	ml	gs	<5	3.6
6	342 - 360	10 YR 5/2	None	L	1msbk	mvfr		<5	0.24
		Groundwater was encountered in boring at 72 in. below existing grade.							

12 Obs. # [X] Boring [ ] Pit Ground Surface Elev. 863.2 ft Depth to limiting factor 12, 72 in.

Horizon	Depth in.	Dominant Color Munsell	Redox Description Qu. Sz. Cont. Color	Texture	Structure Gr. Sz. Sh.	Consistence	Boundary	% Rock Frag.	Hydraulic App. Rate Inches/Hr
1	0 - 12	10YR 2/1	None	SiCL	1msbk	mvfr	as	<5	0.04
2	12 - 42	10 YR 5/1	C2F 10 YR 6/6	SiCL	1msbk	mvfr	gs	<5	0.04
3	42 - 222	10 YR 5/3	None	S	0sg	ml	gs	<5	3.6
4	222 - 360	10 YR 5/2	None	FS	0sg	ml		<5	0.5
		Groundwater was encountered in boring at 72 in. below existing grade.							

13 Obs. # [X] Boring [ ] Pit Ground Surface Elev. 862.2 ft Depth to limiting factor 12, 72 in.

Horizon	Depth in.	Dominant Color Munsell	Redox Description Qu. Sz. Cont. Color	Texture	Structure Gr. Sz. Sh.	Consistence	Boundary	% Rock Frag.	Hydraulic App. Rate Inches/Hr
1	0 - 12	10YR 2/1	None	SiCL	1msbk	mvfr	as	<5	0.04
2	12 - 66	10 YR 5/1	C2D 10 YR 6/6	SiCL	1msbk	mvfr	gs	<5	0.04
3	66 - 216	10 YR 5/3	None	S	0sg	ml	gs	<5	3.6
4	216 - 270	10 YR 5/2	None	FS	0sg	ml	gs	<5	0.5
5	270 - 360	10 YR 5/3	None	S	0sg	ml			3.6
		Groundwater was encountered in boring at 72 in. below existing grade.							

14 Obs. # [X] Boring [ ] Pit Ground Surface Elev. 865.0 ft Depth to limiting factor 42, 102 in.

Horizon	Depth in.	Dominant Color Munsell	Redox Description Qu. Sz. Cont. Color	Texture	Structure Gr. Sz. Sh.	Consistence	Boundary	% Rock Frag.	Hydraulic App. Rate Inches/Hr
1	0 - 8	10YR 2/1	None	SCL - Fill	Variable	Variable	as	<5	0.11
2	8 - 42	10 YR 4/3	None	SiCL- Fill	Variable	Variable	gs	<5	0.04
3	42 - 84	10 YR 5/2	C2D 10YR6/6	SiCL	1msbk	mvfr	gs	<5	0.04
4	84 - 360	10 YR 5/3	None	S	0sg	ml		<5	3.6
		Groundwater was encountered in boring at 102 in. below existing grade.							

Wisconsin Department of Safety & Professional Development

SOIL EVALUATION - STORM

in accordance with Comm 82.365 & 85, Wis. Adm. Code

Attach complete site plan on paper not less than 8 1/2 x 11 inches in size. Plan must include, but not limited to: vertical and horizontal reference point (BM), direction and percent slope, scale or dimensions, north arrow, and BM referenced to nearest road.

Please print all information.

Personal information you provide may be used for secondary purposes (Privacy Law, s.15.04 (1) (m)).

County: Dane

Parcel I.D.: 071022305223, 071022305231

Review by: Date:

Property Owner

FHB Investments, LLC

Property Location

Govt. Lot: 1/4 SE 1/4 S 22 T 07 N R 10 E

Property Owner's Mailing Address

1830 Meadow Lane, Suite A

Lot #: 51, 52 & 53 Block #: Subd. Name or CSM#: 4th Addition of World Dairy Center

City	State	Zip Code	Phone Number
Pewaukee	WI	53072	

[X] City [ ] Village [ ] Town Nearest Road: 3202 & 3218 Dairy Drive

Madison

Drainage area _____ [ ] sq. ft. [ ] acres

Optional:

Test Site Suitable for (check all that apply)

[ ] Irrigation [ ] Bioretention trench [ ] Trench(es)

[ ] Rain Garden [ ] Grassed Swale [ ] Reuse

[ ] Infiltration trench [ ] SDS (>15' wide) [ ] Other _____

Hydraulic Application Test Method

[X] Morphological Evaluation

[ ] Double-Ring Infiltrometer

[ ] Other (Specify)_____

15 Obs. # [X] Boring [ ] Pit Ground Surface Elev. 863.6 ft Depth to limiting factor 36, 102 in.

Horizon	Depth in.	Dominant Color Munsell	Redox Description Qu. Sz. Cont. Color	Texture	Structure Gr. Sz. Sh.	Consistence	Boundary	% Rock Frag.	Hydraulic App. Rate Inches/Hr
1	0 - 18	10YR 2/1	None	Fill - SiCL	Variable	Variable	as	<5	0.04
2	18 - 36	10 YR 3/2	None	Fill - SiC	Variable	Variable	gs	<5	0.07
3	36 - 72	10 YR 5/1	C2F 10YR6/6	SiCL	1msbk	mvfr	gs	<5	0.04
4	72 - 222	10 YR 5/3	None	S	0sg	ml	gs	<5	3.6
5	222 - 360	10 YR 5/2	None	FS	0sg	ml		<5	0.5
		Groundwater was encountered in boring at 102 in. below existing grade.							

16 Obs. # [X] Boring [ ] Pit Ground Surface Elev. 863.3 ft Depth to limiting factor 42,102 in.

Horizon	Depth in.	Dominant Color Munsell	Redox Description Qu. Sz. Cont. Color	Texture	Structure Gr. Sz. Sh.	Consistence	Boundary	% Rock Frag.	Hydraulic App. Rate Inches/Hr
1	0 - 9	10YR 2/1	None	Fill - SiCL	Variable	Variable	as	<5	0.04
2	9 - 42	10 YR 5/6	None	Fill - SL	Variable	Variable	gs	<5	0.5
3	42 - 72	10 YR 5/1	C2F 10YR6/6	SiCL	1msbk	mvfr	gs	<5	0.04
4	72 - 222	10 YR 5/2, 5/3	None	S	0sg	ml	gs	<5	3.6
5	222 - 282	10 YR 5/2	None	L	0m	mvfr	gs	<5	0.24
6	282 - 360	10 YR 5/2	None	FS	0sg	ml		<5	3.6
		Groundwater was encountered in boring at 102 in. below existing grade.							

CST/PSS Name (Please Print)	Signature	CST/PSS Number
David Staab	David Staab	1042602
Address	**Date Evaluation Conducted**	**Telephone Number**
3911 Mineral Point Road	7/25/2013	608/288-4100

17 Obs. # [X] Boring [ ] Pit Ground Surface Elev. 864.3 ft Depth to limiting factor 42, 72 in.

Horizon	Depth in.	Dominant Color Munsell	Redox Description Qu. Sz. Cont. Color	Texture	Structure Gr. Sz. Sh.	Consistence	Boundary	% Rock Frag.	Hydraulic App. Rate Inches/Hr
1	0 - 4	10YR 2/1	None	Fill - SiCL	Variable	Variable	as	<5	0.04
2	4 - 42	10 YR 5/2, 4/3	None	Fill - SCL	Variable	Variable	gs	<5	0.11
3	42 - 72	10 YR 5/1	C2F 10YR6/6	SiCL	1msbk	mvfr	gs	<5	0.04
4	72 - 102	10 YR 5/2	None	SL	1msbk	mvfr	gs	<5	0.5
5	102 - 360	10 YR 5/3	None	S	0m	mvfr	gs	<5	3.6
	Groundwater was encountered in boring at 72 in. below existing grade.								

18 Obs. # [X] Boring [ ] Pit Ground Surface Elev. 863.8 ft Depth to limiting factor 36, 102 in.

Horizon	Depth in.	Dominant Color Munsell	Redox Description Qu. Sz. Cont. Color	Texture	Structure Gr. Sz. Sh.	Consistence	Boundary	% Rock Frag.	Hydraulic App. Rate Inches/Hr
1	0 - 4	10YR 2/1	None	Fill - SiCL	Variable	Variable	as	<5	0.04
2	4 - 36	10 YR 4/3	None	Fill - SiCL	Variable	Variable	gs	10 - 15	0.04
3	36 - 102	10 YR 5/1	C2F 10YR6/6	SiCL	1msbk	mvfr	gs	<5	0.04
5	102 - 360	10 YR 5/3	None	S	0m	mvfr		<5	3.6
		Groundwater was encountered in boring at 102 in. below existing grade.							

19 Obs. # [X] Boring [ ] Pit Ground Surface Elev. 863.2 ft Depth to limiting factor 5, 72 in.

Horizon	Depth in.	Dominant Color Munsell	Redox Description Qu. Sz. Cont. Color	Texture	Structure Gr. Sz. Sh.	Consistence	Boundary	% Rock Frag.	Hydraulic App. Rate Inches/Hr
1	0 - 5	10YR 2/1	None	SiCL	1msbk	mvfr	as	<5	0.04
2	5 - 42	10 YR 4/4	C2D 10YR6/6	SiCL	1msbk	mvfr	gs	<5	0.04
3	42 - 72	10 YR 4/3	None	SL, SiCL	1msbk	mvfr	gs	<5	0.04
4	72 - 360	10 YR 5/3	None	S	0sg	ml		<5	3.6
		Groundwater was encountered in boring at 72 in. below existing grade.							

Property Owner FMB Investments, LLC Parcel ID# 071022305223, 071022305231 Page 3 of 3

20 Obs. # [X] Boring [ ] Pit Ground Surface Elev. 864.4 ft Depth to limiting factor 36, 102 in.

Horizon	Depth in.	Dominant Color Munsell	Redox Description Qu. Sz. Cont. Color	Texture	Structure Gr. Sz. Sh.	Consistence	Boundary	% Rock Frag.	Hydraulic App. Rate Inches/Hr
1	0 - 8	10YR 2/1	None	Fill - SiCL	Variable	Variable	as	<5	0.04
2	8 - 36	10 YR 4/3	None	Fill - SL/SiCL	Variable	Variable	gs	20 - 25	0.04
3	36 - 54	10 YR 4/4	C2D 10YR6/6	SiCL	1msbk	mvfr	gs	<5	0.04
4	54 - 102	10 YR 5/3	None	S/LS/SiL	0sg	ml	gs	<5	0.13
5	102 - 222	10 YR 5/3	None	S	0sg	ml	gs	<5	3.6
6	222 - 240	10 YR 5/2	None	SL	1msbk	mvfr		<5	0.5
		Groundwater was encountered in boring at 102 in. below existing grade.							

Obs. # [ ] Boring [ ] Pit Ground Surface Elev. _____ ft Depth to limiting factor _____ in.

Horizon	Depth in.	Dominant Color Munsell	Redox Description Qu. Sz. Cont. Color	Texture	Structure Gr. Sz. Sh.	Consistence	Boundary	% Rock Frag.	Hydraulic App. Rate Inches/Hr

Obs. # [ ] Boring [ ] Pit Ground Surface Elev. _____ ft Depth to limiting factor _____ in.

Horizon	Depth in.	Dominant Color Munsell	Redox Description Qu. Sz. Cont. Color	Texture	Structure Gr. Sz. Sh.	Consistence	Boundary	% Rock Frag.	Hydraulic App. Rate Inches/Hr

CGC, Inc.

Construction • Geotechnical
Consulting Engineering/Testing

July 13, 2017
C17051-15

Mr. Jon Evans, P.E., LEED AP-BD&C
Building Design Project Manager
Department of Public Works
Engineering Division
City-County Building, Room 115
210 Martin Luther King Jr. Blvd
Madison, WI 53703

Re: Geotechnical Exploration Report
Proposed Fire Station No. 14
3201 Dairy Drive
City of Madison, Dane County, Wisconsin

Dear Mr. Evans:

Construction • Geotechnical Consultants, Inc. (CGC) has completed the geotechnical exploration program for the proposed Fire Station No. 14 on Dairy Drive. The purpose of this exploration program was to evaluate the subsurface conditions within the planned construction area and to provide geotechnical recommendations regarding site preparation, foundation, floor slab and pavement design/construction. We are sending you one paper copy of this report and can provide a paper copy upon request.

PROJECT DESCRIPTION AND SITE CONDITIONS

We understand that Fire Station No. 14 is proposed for a vacant parcel on the east side of Dairy Drive, across from the intersection with Prairie Dock Drive. Most of the site is moderately to heavily-wooded, and site topography generally slopes down gently to the east. Based on a topographic site plan showing 1-ft contour lines, which was provided to us by OPN Architects, current site grades within the planned construction area range between approximately EL 862 and 865 ft.

Based on aerial photos dating back to the years 1995, 2000 and 2005, the site has been previously developed. A building can be identified in north portion of the site, with a greenhouse or similar structure extending into the center of the site. Apparent drives existed to the west and south of the previous structures. There is also evidence that some grading (cutting and filling) has occurred on the property. A 50-ft wide easement for a large high-pressure gas line traverses the south end of parcel.

The new fire station is proposed to be a one-story, slab-on-grade building with partial mezzanine. Finish first floor elevation is (tentatively) planned at EL 866.25 ft. Paved drives and parking areas are planned surrounding the new building. Structural loads have not been provided to us, be we expect loads resulting from the masonry and structural steel construction to be moderate to heavy. Previous fire

2921 Perry Street, Madison WI 53713
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stations of similar size have had maximum wall loads of 6 to 10 kips/ft and maximum column loads of 150 to 200 kips. Maximum floor slab live loads are anticipated to be 125 psf. Pavement areas are anticipated to be subjected to both light-duty and heavy-duty traffic loading.

SUBSURFACE CONDITIONS

Subsurface conditions within the proposed building footprint were explored by drilling five Standard Penetration Test (SPT) soil borings (labeled B-1A through B-5A) to planned depths of 30 ft below existing site grades. The boring locations were selected and field-staked by City of Madison personnel. The borings were drilled on June 27 and 28, 2017 by Badger State Drilling (under subcontract to CGC) using an ATV-mounted D-50 rotary drill rig equipped with hollow-stem augers, mud rotary equipment and an automatic SPT hammer. Ground surface elevations at the boring locations were interpolated by CGC using a topographic site plan (showing 1-ft contour lines), which was provided to us by OPN Architect, and should therefore be considered approximate.

In addition to the five borings recently performed within the building footprint, we have also included six previous SPT soil borings in our evaluation of the site. The six previous borings (labeled B-8 through B-10 and B-12 through B-14) are located in the vicinity of the proposed building, and were performed from July 22 to 24, 2013 by Badger State Drilling (under subcontract to CGC) to planned depths of 30 ft below site grades for a preliminary study of the site.

Specific procedures used for drilling and sampling are described in Appendix A, and the recent and previous boring locations are shown in plan on the Soil Boring Location Exhibit attached in Appendix B.

The subsurface profiles at the boring locations varied somewhat at shallow depths due to previous site development and grading, but the profiles were fairly similar with depth. The following strata were typically encountered (in descending order):

- About 8 to 14 in. of ***topsoil/topsoil fill*** in about half of the borings; over
- About 2.3 to 6 ft of ***fill*** or ***possible fill*** in most borings, consisting primarily of soft to very stiff clay with variable sand and gravel contents as well as occasional organic inclusions (roots and other organic matter), and secondarily of medium dense sand with considerable silt and gravel contents; followed by
- About 1.5 to 3.5 ft of natural, soft to very stiff ***lean to silty clay*** with varying sand content and very loose to loose ***clayey sand*** in most borings; and/or
- Very loose to medium dense ***sand*** with variable silt and gravel contents to the maximum depths explored in all borings.

Instead of *topsoil*, about 4 and 12 in. of ***sand/gravel surface*** was encountered in Borings 3A and 13, respectively, while borings 4A, 5A, 8 and 9 did not contain either. The *fill/possible fill* layer was not present in Boring 12, which featured a profile of topsoil over apparent natural clay that was underlain by natural sand strata. Conversely, *natural clays* were apparently missing in Borings 1A and 8 through 10. However, approximately 3.5-ft thick ***probable buried topsoil layers*** were encountered below the fill in Borings 8 and 9. The organic content (as measured by loss-on-ignition) on the buried topsoil layer ranged from 6.5% to 9.1%, where soils with loss on ignition exceeding 4% are considered organic. The shallow clays (fill and natural) were soft to very stiff, with moisture contents ranging from 14.9% to 29.5% in representative samples. Some of the on-site cohesive soils should therefore be considered slightly to moderately compressible. Possible clay fill samples obtained from Borings 1A and 4A containing apparent organic pockets had overall organic contents between 2.6% and 3.4%.

Groundwater was encountered in the borings during drilling at about 6 to 8.5 ft below site grades (corresponding to approximately EL 854.4 to 857.5 ft). Groundwater levels can be expected to fluctuate with seasonal variations in precipitation, infiltration, evapotranspiration, the level of nearby streams and lakes, the pumping rate of nearby wells and other factors. A more detailed description of the site soil and groundwater conditions is presented on the Soil Boring Logs attached in Appendix B, which also contain the laboratory test results.

DISCUSSION AND RECOMMENDATIONS

Subject to the limitations discussed below and based on the subsurface exploration, it is our opinion that the site is generally suitable for construction. *However, based on the presence of fairly deep, very loose sands within large portions of proposed building footprint, a conventional spread footing foundation system at a typical design bearing pressure is likely not feasible for most of the planned building, as adequate undercutting/replacement of marginal soils will likely be impractical due to shallow groundwater.* In our opinion, suitable foundation support will require ground improvement with rammed aggregate piers (RAPs) or supporting the building on deep foundations such as helical piers. Alternatively, conventional spread footings could potentially be designed for a low bearing pressure, provided that a partial undercut will be included below footings and the structure can tolerate settlement that may slightly exceed typical levels.

Accordingly, our recommendations for site preparation, foundation, floor slab and pavement design/construction along with our assessment of the site class for seismic design are presented in the following subsections. Additional information regarding the conclusions and recommendations presented in this report is discussed in Appendix C.

1. Site Preparation

We recommend that the topsoil be stripped at least 10 ft beyond the proposed construction areas, including areas required for fill beyond the building footprint or pavement limits. The topsoil can be

stockpiled on-site and re-used as fill in landscaped areas. As noted above, topsoil ranged from 8 to 14 in. thick in the borings, but variable topsoil thicknesses may be encountered between boring locations due to previous development and grading activities. Brush, trees and tree roots should be removed from the construction areas in conjunction with topsoil stripping, and we recommend that remnants of the previous development (including utilities that are no longer in use) be removed in their entirety within the proposed building footprint. Where structures are removed, the soils at the base of the excavation should be checked for suitability prior to backfilling with engineered granular backfill. Remnants of previous structures can potentially remain in-place below new pavement areas assuming the former structures are at least 2 ft below proposed base course grades, and the former structures do not interfere with new utility construction. Old floor slabs should be broken up to allow drainage.

After topsoil stripping and where existing structures have been removed (if any), we recommend that the exposed soils in areas to remain at-grade or requiring fill be proof-rolled with a heavy piece of rubber-tire construction equipment, such as a loaded tri-axle dump truck, to check for soft/yielding areas. Granular soils exposed should be proof-compacted using a vibratory smooth-drum roller. If loose or soft/yielding areas are encountered or zones remain loose after recompaction, these areas should be undercut and replaced with granular backfill compacted to at least 95% compaction based on modified Proctor methods (ASTM D1557) in accordance with the Recommended Compacted Fill Specifications contained in Appendix D. Alternatively, 3-in. dense graded base (DGB) that is placed in loose lifts of 10 in. (or less) and compacted until deflection ceases can be used to restore grades in undercut areas. *Note that the shallow soils below the topsoil generally consist of marginal cohesive soils (natural and fill) that contain variable organic content, unstable soils or soils with elevated organic content. Therefore, partial undercutting/replacement of these layers may be required within pavement areas, with partial to complete undercutting/replacement required within the building footprint, which is discussed in more detail in the Foundation Design and Floor Slab sections of this report. We recommend that the budget include a generous contingency for soil correction.*

Fill placement to establish building and pavement grades can then proceed. We recommend using granular soils (i.e., sands/gravels) as structural fill within the building envelope and upper 2 to 3 ft in pavement areas because these soils are relatively easy to place and compact in most weather conditions, compared to fine-grained and cohesive soils. Clay/silt soils excavated on-site are not recommended as structural fill because moisture conditioning will generally be required to achieve desired compaction levels, which is highly weather dependent (i.e., warm, windy and dry conditions) and could potentially delay construction progress. Clay/silt soils are best used as fill in landscaping or potentially as lower lifts in pavement areas provided the moisture contents can be sufficiently lowered from the natural states to facilitate compaction efforts. We recommend that structural fill/backfill be compacted to at least 95% compaction based on modified Proctor methods (ASTM D1557) following Appendix D guidelines. Periodic field density tests should be taken by CGC staff within the fill/backfill to document the adequacy of compactive effort.

We understand that fill heights may be on the order of 1 to 4 ft to establish floor slab subgrades within the building footprint, and site grades within surrounding pavement areas are anticipated to be adjusted accordingly. *Given the presence of slightly to moderately compressible cohesive soils within most of the site, we recommend a minimum time delay of approximately 2 to 4 weeks between fill placement and beginning footing construction to allow the compressive soils to largely consolidate and settle under the weight of the new fill and reduce post-construction settlement to typically tolerable levels.* The required time delay can potentially be reduced or eliminated if cohesive soils are partially or completely undercut and replaced within the building footprint. Settlement platforms (see detail in Appendix E) or monitoring points should be established in the areas of the building where settlement due to the weight of the new fill is a concern. The settlement monitoring points should be surveyed immediately after the full height of the fill reaches the floor slab subgrade elevation, and twice per week until three consecutive sets or survey readings indicate that settlement has ceased. The normal construction sequence can begin after the settlement data indicates that settlement has largely ceased. We can provide additional details upon request.

2. Foundation Design

A. Undercutting and Replacement of Soils Unsuitable for Foundation Support

Assuming finish first floor elevation of the proposed building at EL 866.25 ft and footing grades on the order of 2 to 5 ft below finish first floor elevation, we anticipate footings to bear within newly-placed engineered granular fill/backfill after undercutting (removal) of the existing fill and soft cohesive soils, which are considered unacceptable for foundation support. Undercut depths are expected to extend about 3.5 to 6 ft below grade, and potentially 8.5 ft below existing grade near Boring 4A. Very loose to loose sands extend to depths between about 8 and 22 ft below current site grades, which will limit the allowable bearing pressure. Fairly deep marginal soils (especially in southern portions of the proposed building) in conjunction with the relatively shallow groundwater table are expected to render extensive undercutting and replacement operations impractical, but a conventional spread footing foundation system could potentially be utilized by implementing a low bearing pressure and the following additional parameters for foundation design:

- Maximum net allowable bearing pressure
  (assuming undercutting of existing fill and soft clays): 1,000 psf

- Minimum foundation widths:
  - Continuous wall footings: 18 in.
  - Column pad footings: 30 in.

- Minimum footing depths:
  - Exterior/perimeter footings: 4 ft
  - Interior footings: no minimum requirement

Note that undercut depths may potentially increase if marginal soils are encountered at the bottom of undercut excavations. A CGC field representative should be present on-site during footing and undercut excavations to carefully check the subgrade soils for footing support suitability, and advise on corrective measures, if necessary. We recommend using a smooth-edged backhoe bucket for footing excavations. Additionally, granular soils exposed at footing grade and at the bottom of undercut excavations (that are at least 2 ft above the water table) should be thoroughly recompacted with a large vibratory plate compactor or an excavator-mounted hoe-pack prior to formwork/concrete placement or backfilling to densify soils loosened during the excavation process. Soils potentially susceptible to disturbance from compaction (e.g. silty or clayey soils or soils with elevated water content) should be hand-trimmed.

Where the bottom of undercut excavations extend near the water table, appropriate dewatering measures should be implemented, as determined by the contractor, to lower the water table at least 2 ft below the bottom of the excavation. Very moist to wet soils should be stabilized with a 6 to 12 in. thick layer of crushed clear stone that is compacted into the subgrade. If the stone layer exceeds 12 in., non-woven geotextile fabric (e.g., Mirafi 160N, or equivalent) should be utilized to envelop the stone layer in order to prevent migration of fines into the void spaces of the stone layer. Where undercutting is required, the base of the undercut excavation should be widened beyond the footing edges at least 0.5 ft in each direction for each foot of undercut depth for stress distribution purposes. In order to re-establish footing grade, we recommend using granular soils (i.e., sands/gravels) as backfill, that are compacted to at least 95% compaction based on modified Proctor methods (ASTM D1557) following Appendix D guidelines. Alternatively, well-compacted 3-in. DGB can be used to restore grades in undercut areas. OSHA slope guidelines should be followed if workers need to enter excavations.

Provided the foundation design/construction recommendations discussed above are followed (including undercutting/replacement of unsuitable soils and early fill placement), we estimate that total and differential settlements should be on the order of 1.0 to 1.3 and 0.5 to 0.7 in., respectively.

B. Rammed Aggregate Pier Supported Spread Footing Foundation

In our opinion, a proprietary system known as rammed aggregate piers (RAPs or Geopiers™) designed and installed by Ground Improvement Engineering (GIE; formerly Geopier™ Foundation Company) would be a possible system to support the proposed structure. This system is not a pile foundation, but instead essentially stiffens the softer clays and loose sands to a sufficient depth below foundation grade such that a conventional foundation and slab system at a typical bearing pressure is feasible while limiting settlements to typically tolerable levels. Structure loads will generally be concentrated on the perimeter wall footings and exterior/interior column pads, with lower loads anticipated to be distributed more uniformly across the floor slab. Based on the expected, fairly concentrated load distribution, we anticipate that ground improvement elements (RAPs) would be installed in a fairly dense grid pattern below the structure footings in order to limit total settlement to about 1 inch. We do not anticipate RAPs to be required below floor slabs unless high floor slab loads exist, although undercutting/replacement of

unsuitable fill and cohesive soils will be required, as discussed previously and in the Floor Slab section of this report. The use of RAPs in floor slab areas would likely reduce the need for undercutting/ replacement in floor slab areas.

Due to collapsible soils, we expect that a displacement system will be required to construct the piers. This system involves inserting a hollow mandrel to a specified depth (depending on soil conditions and building loads) at which point stone is introduced through the mandrel, which is compacted through a combination of down pressure and oscillations as the mandrel is systematically raised and lowered. The installation process not only creates a relatively strong and rigid aggregate pier but also improves the strength and compressibility properties of the soil around the pier. Based on preliminary discussions with GIE, we expect that RAPs will be installed after fill placement to establish floor slab subgrades. As discussed earlier, a time delay of a few weeks will be required after fill placement to allow the soils to partially consolidate under the weight of the new fill. During this time, settlement will be monitored to determine when settlement due to the new fill has largely ceased and foundation construction can begin. Full-time inspection is recommended during RAP installation to document their construction according to design requirements.

In our opinion and based on preliminary review by GIE, RAP-supported footings could be designed for a maximum net allowable soil bearing pressure of about 4,000 psf. The maximum allowable bearing pressure for footings bearing on RAPs will need to be confirmed by Ground Improvement Engineering once additional project information becomes available. RAPs have been used successfully on many projects in Wisconsin with similar soil conditions. Rammed aggregate piers can be bid as an alternative to undercutting the fill and soft clays (and use a low bearing pressure) or using helical piers for building support, with foundation design included in the package.

C. Helical Pier Supported Spread Footing Foundation

As an alternative to undercutting/replacement and RAPs, it is our opinion that the building foundations can be supported on helical piers that extend through the very loose sands, and bear within the underlying medium dense sands. Helical pier capacity will vary depending on the number and size of helices, depth of installation and bearing stratum. Floor slabs would likely be supported in a conventional fashion, as previously described.

Note that in order to gather more subsurface information for helical pier design, we recommend performing at least one more boring within the building footprint. The additional boring should extend at least 50 to 75 ft below current site grades in order to reach denser soil more suitable to develop higher helical pier capacities. If desired, we can provide additional details and develop a supplemental geotechnical scope at the appropriate time.

3. Seismic Site Class

In our opinion, the average soil properties in the upper 100 ft of the site (based on SPT blow counts "N-values" of less than 15 blows/ft, on average) can be characterized as a soft soil profile. This characterization would place the site in Class E for seismic design according to International Building Code (see Table 1613.5.2).

4. Floor Slab

The floor slab subgrade soils are expected to consist mainly of newly-placed engineered granular fill/backfill over soft to very stiff cohesive soils (natural or existing fill). (Note that due to anticipated light floor loads, we do not expect that the floor slabs will require support by RAPs or helical piers, although partial undercutting of existing fill/possible fill soils and lower strength natural soils will likely be required.) Prior to slab construction, the subgrade soils should be thoroughly proof-rolled/recompacted to densify soils that may become disturbed or loosened during construction activities. Areas of disturbed soil or where soils remain loose after recompaction should be undercut and replaced with compacted 3-in. DGB or granular fill. *As mentioned previously, some of the shallow fill/possible fill cohesive soils are considered marginal to unsuitable for direct slab support, and some undercutting/stabilization will likely be required within slab areas during general site grading prior to new fill placement to establish finish floor elevation. Undercut depths could be on the order of 2 to 4 ft (potentially deeper) within floor slab areas.*

To act as a capillary break, we recommend including a minimum 4 to 6-in. thick layer of well-graded sand/gravel with less than 5% passing the No. 200 U.S. standard sieve below the floor slab. To further minimize the potential for moisture migration through the slab, a plastic vapor barrier can also be utilized below the slab. Fill and base layer material below the floor slab should be placed as described in the Site Preparation section of this report. A subgrade modulus of 100 pci may be used for slab design on the sand/gravel layer above a firm or stabilized subgrade. The design subgrade modulus is based on a recompacted subgrade such that non-yielding conditions are developed. Note that some structural engineers require a 4 to 6-in. layer of DGB, such as 1¼-in. DGB, below the slab to increase the subgrade modulus immediately below the slab. If 6 in. of DGB is included below the floor slab, the subgrade modulus can be increased to 150 pci. The slab should be structurally separated from the foundations with a compressible filler and have construction joints and reinforcement for crack control.

5. Pavement Design

Pavement within at-grade parking areas and drives is anticipated to be constructed on a variety of soils, including newly-placed engineered granular fill, natural and/or existing fill granular soils and natural and/or existing fill cohesive/fine-grained soils. Subgrades should be prepared, as described in the Site Preparation section of this report, with undercutting/stabilization completed to develop suitable subgrades, where needed. *Due to the variable fill expected at pavement subgrades in some portions of*

the site, we recommend that the budget include a generous contingency for subgrade undercutting/ stabilization. For budgeting purposes, we recommend including an allowance for 12 in. of additional coarse aggregate (e.g., 3-in. DGB) over biaxial geogrid within about 50% of the pavement area. The need for undercutting below the pavement section will likely be reduced when site grades are raised at least 2 ft above existing grade with high quality granular fill.

We anticipate that some asphalt pavement within parking lots will be exposed to primarily automobile traffic with less than one 18-kip equivalent single axle load (ESAL) per day. In view of this, we have assumed Traffic Class I following Wisconsin Asphalt Pavement Association (WAPA) recommendations for parking areas and driveways that are mainly used by light passenger vehicles. However, main sections of driveways are likely to experience heavier traffic loads due to truck traffic. For pavement areas where trucks will routinely travel, we have assumed a traffic load of less than 20 ESALs per day and Traffic Class II according to WAPA. We have also included a heavy duty pavement section where higher truck traffic loads including heavy fire truck traffic (up to 50 ESALs per day) are expected. The pavement sections summarized in Table 1 below were selected assuming a Soil Support Value "SSV" of 4.0 for a firm or adequately stabilized subgrade and a design life of 20 years.

TABLE 1 – Recommended Pavement Sections

Material	Thicknesses (in.)			WDOT Specification[1]
	Traffic Class I (Light Duty)	Traffic Class II (Medium Duty)	Traffic Class III (Heavy Duty)	
Bituminous Upper Layer[2,3]	1.5	1.75	2.0	Section 460, Table 460-1, 9.5 mm (light duty), 12.5 mm (medium and heavy duty)
Bituminous Lower Layer[2,3]	2.0	2.25	3.0	Section 460, Table 460-1, 12.5 mm (light duty), 19 mm (medium and heavy duty)
Dense Graded Base Course[2,4]	8.0	10.0	12.0	Sections 301 and 305, 3 in. and 1¼ in.
Total Thickness	**11.5**	**14.0**	**17.0**	

Notes:

1. Wisconsin DOT *Standard Specifications for Highway and Structure Construction*, latest edition, including supplemental specifications, and Wisconsin Asphalt Pavement Association *2016 Asphalt Pavement Design Guide*.

2. Compaction requirements:
   - Bituminous concrete: Refer to Section 460-3.
   - Base course: Refer to Section 301.3.4.2, Standard Compaction

3. Mixture Type LT bituminous; refer to Section 460, Table 460-2 of the *Standard Specifications*. Mixture type MT is recommended in heavy duty traffic areas. Note that an "H Grade" asphalt surface layer is recommended where there will be slow moving heavy truck traffic making turning movements.

4. The upper 4 in. should consist of 1¼-in. DGB; the bottom part of the layer can consist of 3-in. DGB.

Note that if traffic volumes are greater than those assumed, CGC should be allowed to review the recommended pavement sections and adjust them accordingly. The pavement design assumes a stable/non-yielding subgrade which will be evaluated using proof-rolling techniques. *As mentioned above, where pavement construction occurs fairly close to existing site grades, a stabilization layer that is underlain by a biaxial geogrid may potentially be required below the pavement sections summarized in Table 1 in order to develop suitable pavement subgrades on the existing fill soils.* Alternative pavement designs may prove acceptable and should be reviewed by CGC. If there is a delay between subgrade preparation and placing the base course, the subgrade should be recompacted.

Where concrete pavement may be used, such as in pavement areas subjected to concentrated wheel loads (e.g., dumpster pads, aprons around the apparatus bay, etc.), we recommend that the concrete pavement should be at least 6-in. thick (thicker concrete may be required within areas of heavy traffic loads due to fire trucks), be underlain by at least 6 in. of DGB and contain mesh reinforcement for crack control. Concrete slabs underlain by a minimum 6-in. thick dense graded base layer over a firm or stabilized subgrade can be designed utilizing a subgrade modulus of 150 pci. Note that a thicker pavement section (more than 6 in. of concrete) may be required depending on pavement loads, which should be evaluated by a structural engineer.

CONSTRUCTION CONSIDERATIONS

Due to variations in weather, construction methods and other factors, specific construction problems are difficult to predict. Soil related difficulties that could be encountered on the site are discussed below:

- Due to the potentially sensitive nature of some of the on-site soils, we recommend that final site grading activities be completed during dry weather, if possible. Construction traffic should be avoided on prepared subgrades to minimize potential disturbance.

- Contingencies in the project budget for subgrade stabilization with coarse aggregate in pavement and floor slab areas should be increased if the project schedule requires that work proceed during adverse weather conditions.

- Earthwork construction during the early spring or late fall could be complicated as a result of wet weather and freezing temperatures. During cold weather, exposed subgrades should be protected from freezing before and after footing construction. Fill should never be placed while frozen or on frozen ground.

- Excavations extending greater than 4 ft in depth below the existing ground surface should be sloped or braced in accordance with current OSHA standards.

- Based on observations made during the field exploration, we generally do not anticipate groundwater to be encountered during footing excavations. However, groundwater could be encountered at the base of undercut excavations that requires dewatering measures to lower the water during construction activities. Additionally, water accumulating at the base of excavations as a result of precipitation or seepage should be quickly removed, with dewatering means and methods the contractor's responsibility.

RECOMMENDED CONSTRUCTION MONITORING

The quality of the foundation, floor slab and pavement subgrades will be largely determined by the level of care exercised during site development. To check that earthwork and foundation construction proceeds in accordance with our recommendations, the following operations should be monitored by CGC:

- Topsoil stripping/subgrade proof-rolling;
- Fill/backfill placement and compaction;
- RAP or helical pier installation;
- Foundation excavation/subgrade preparation; and
- Concrete placement.

* * * * *

It has been a pleasure to serve you on this project. If you have any questions or need additional consultation, please contact us.

Sincerely,

CGC, Inc.

Tim F. Gassenheimer, E.I.T.
Staff Engineer

David A. Staab, P.E., LEED AP
Senior Consulting Professional

Encl: Appendix A - Field Exploration
Appendix B - Soil Boring Location Exhibit
Logs of Recent Test Borings (5)
Logs of Previous Test Borings (6)
Particle Size Distribution Test Reports (2)
Log of Test Boring-General Notes
Unified Soil Classification System
Appendix C - Document Qualifications
Appendix D - Recommended Compacted Fill Specifications
Appendix E - Settlement Platform

APPENDIX A

FIELD EXPLORATION REPORT

APPENDIX A

FIELD EXPLORATION

Subsurface conditions within the proposed building footprint were explored by drilling five Standard Penetration Test (SPT) soil borings (labeled B-1A through B-5A) to planned depths of 30 ft below existing site grades. The boring locations were selected and field-staked by City of Madison personnel. The borings were drilled on June 27 and 28, 2017 by Badger State Drilling (under subcontract to CGC) using an ATV-mounted D-50 rotary drill rig equipped with hollow-stem augers, mud rotary equipment and an automatic SPT hammer. Ground surface elevations at the boring locations were interpolated by CGC using a topographic site plan (showing 1-ft contour lines), which was provided to us by OPN Architect, and should therefore be considered approximate.

In addition to the five borings recently performed within the building footprint, we have also included six previous SPT soil borings in our evaluation of the site. The six previous borings (labeled B-8 through B-10 and B-12 through B-14) are located in the vicinity of the proposed building, and were performed from July 22 to 24, 2013 by Badger State Drilling (under subcontract to CGC) to planned depths of 30 ft below site grades for a preliminary study of the site.

In the previous borings, soil samples were obtained at 2.5 foot intervals to a depth of 10 ft and at 5 ft intervals thereafter. To better explore the extent of very loose sands, the recent borings were samples at 2.5 foot intervals to a depth of 20 ft and at 5 ft intervals thereafter. The soil samples were obtained in general accordance with specifications for standard penetration testing, ASTM D 1586. The specific procedures used for drilling and sampling are described below.

1. Boring Procedures between Samples

   The boring is extended downward, between samples, by a hollow-stem auger.

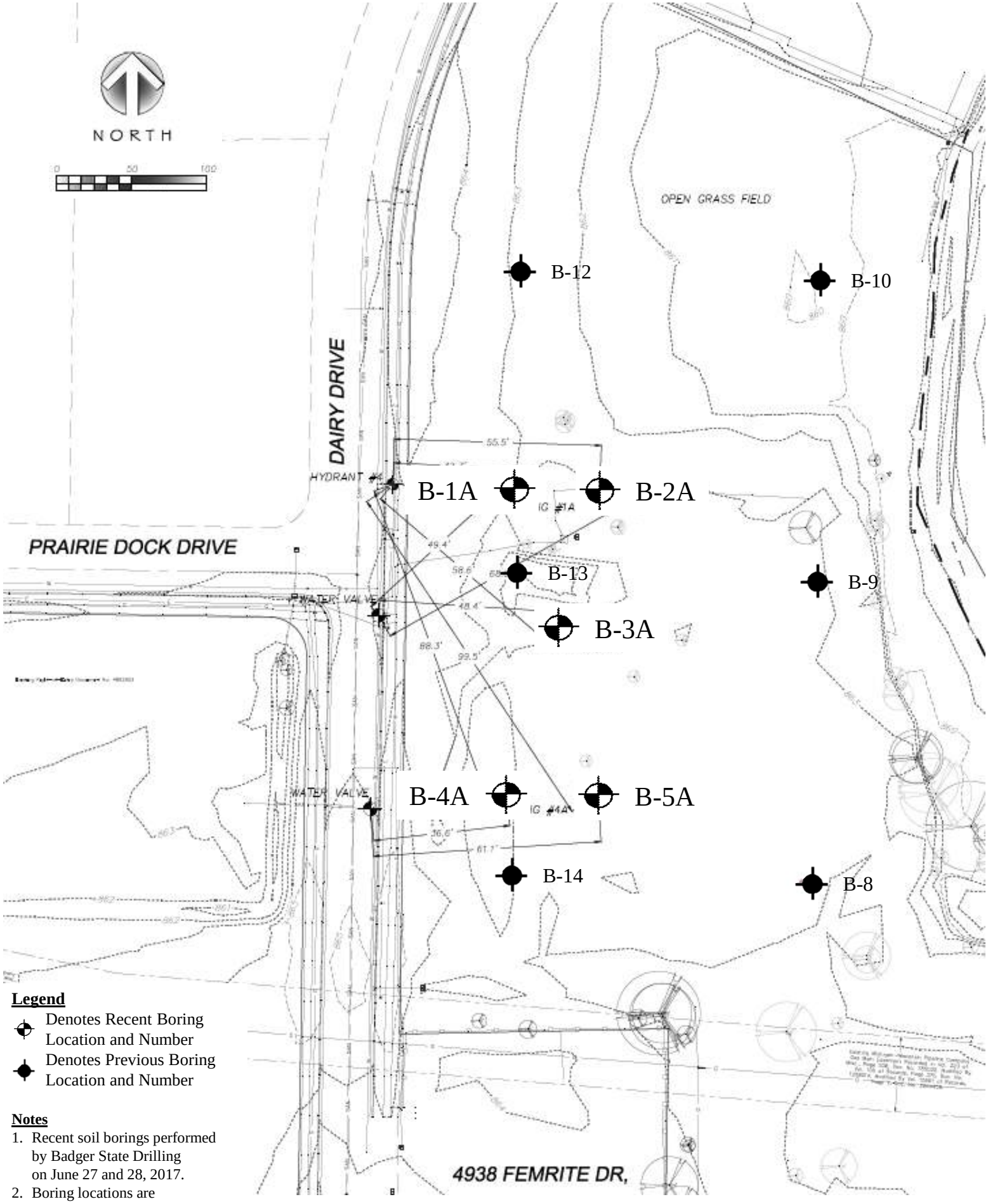
2. Standard Penetration Test and Split-Barrel Sampling of Soils
   (ASTM Designation: D 1586)

   This method consists of driving a 2-inch outside diameter split-barrel sampler using a 140-pound weight falling freely through a distance of 30 inches. The sampler is first seated 6 inches into the material to be sampled and then driven 12 inches. The number of blows required to drive the sampler the final 12 inches is recorded on the log of borings and is known as the Standard Penetration Resistance.

During the field exploration, the driller visually classified the soil and prepared a field log. *Field screening of the soil samples for possible environmental contaminants was not conducted by the drillers as environmental site assessment activities were not part of CGC's work scope.* Water level observations were made in each boring during and after drilling and are shown at the bottom of each boring log. Upon completion of drilling, the borings were backfilled with bentonite to satisfy WDNR regulations, and the soil samples were delivered to our laboratory for visual classification and laboratory testing. The soil samples were visually classified by a geotechnical engineer using the Unified Soil Classification System. The final logs prepared by the engineer, including laboratory test results, a boring location map, and a description of the Unified Soil Classification System are presented in Appendix B.

APPENDIX B

SOIL BORING LOCATION EXHIBIT
LOGS OF RECENT TEST BORINGS (5)
LOGS OF PREVIOUS TEST BORINGS (6)
PARTICLE SIZE DISTRIBUTION TEST REPORTS (2)
LOG OF TEST BORING – GENERAL NOTES
UNIFIED SOIL CLASSIFICATION SYSTEM



Legend

- Denotes Recent Boring Location and Number
- Denotes Previous Boring Location and Number

Notes

1. Recent soil borings performed by Badger State Drilling on June 27 and 28, 2017.
2. Boring locations are approximate.
3. Base map was provided by OPN Architects.

Job No.: C17051-15 **Date:** 7/2017	CGC, Inc.	**SOIL BORING LOCATION EXHIBIT** **Proposed Fire Station No. 14** **3201 Dairy Drive** **City of Madison, Dane Co., WI**

CGC Inc.

LOG OF TEST BORING

Project **Proposed Fire Station No. 14**
3201 Dairy Drive
Location **City of Madison, Dane Co., WI**

Boring No. **1A**
Surface Elevation (ft) **± 863.0**
Job No. **C17051-15**
Sheet **1** of **1**

2921 Perry Street, Madison, WI 53713 (608) 288-4100, FAX (608) 288-7887

SAMPLE No.	TYPE	Rec (in.)	Moist	N	Depth (ft)	VISUAL CLASSIFICATION and Remarks	qu (qa) (tsf)	W	LL	PL	LI
						± 8 in. TOPSOIL (OL)					
1		12	M	5		Soft to Medium Stiff, Gray/Brown (Lightly Mottled) Lean CLAY, Little to Some Sand, Trace Gravel, Scattered Dark Gray Organic Pockets (CL - Possible Fill)	(0.75-1.0)	23.3			2.6
2		18	M	4			(0.25)	28.5			
					5	Sand and Gravel Contents Slightly Decreasing With Depth					
3		16	W	4	▽	Loose, Tan Fine to Coarse SAND, Little Gravel, Trace to Little Silt, Scattered Cobbles/Boulders (SP)					
4		18	W	9		Silt Content Slightly Increasing with Depth					
					10						
5		8	W	16		Medium Dense, Gray Fine to Medium SAND, Little Silt, Trace Gravel, Scattered Cobbles/Boulders (SP-SM)					
6		10	W	20							
					15						
7		10	W	21		Medium Dense, Gray Fine to Medium SAND, Some Silt, Trace Gravel, Scattered Cobbles/Boulders (SM)					
8		12	W	19							
					20						
9		8	W	29		Scattered Silt Seams near 23.5 ft					
					25						
10		10	W	24							
					30	End of Boring at 30 ft Borehole Backfilled with Bentonite Chips					
					35						

WATER LEVEL OBSERVATIONS

While Drilling ▽ **6.0'** Upon Completion of Drilling _____
Time After Drilling _____
Depth to Water _____ ▼
Depth to Cave in _____

The stratification lines represent the approximate boundary between soil types and the transition may be gradual.

GENERAL NOTES

Start **6/28/17** End **6/28/17**
Driller **BSD** Chief **MC** Rig **D-50**
Logger **MG/CD** Editor **TFG**
Drill Method **4.25" HSA (0-10') / MR (10-30'); Autohammer**

CGC Inc.

LOG OF TEST BORING

Project **Proposed Fire Station No. 14**
3201 Dairy Drive
Location **City of Madison, Dane Co., WI**

Boring No. **2A**
Surface Elevation (ft) **± 863.0**
Job No. **C17051-15**
Sheet **1** of **1**

2921 Perry Street, Madison, WI 53713 (608) 288-4100, FAX (608) 288-7887

SAMPLE						VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES				
No.	TYPE	Rec (in.)	Moist	N	Depth (ft)		qu (qa) (tsf)	W	LL	PL	LI
						± 8 in. TOPSOIL (OL)					
1		14	M	8		Stiff, Gray/Brown (Lightly Mottled) Lean CLAY, Little Sand, Trace Gravel, Scattered Dark Gray Organic Pockets and Roots (CL - Possible Fill)	(1.75-2.0)	25.0			
2		18	M	6	5	Soft to Medium Stiff, Gray Lean to Silty CLAY, Some Sand (CL/CL-ML)	(0.25-0.75)	14.9	20	13	
3		14	W	4		Very Loose, Tan Fine to Coarse SAND, Little Gravel, Trace Silt, Scattered Cobbles/Boulders (SP)					
4		6	W	2	10	Scattered Clay Seams near 8.5 ft					
5		16	W	15		Medium Dense, Gray Fine to Medium SAND, Some Silt, Trace Gravel, Scattered Cobbles/Boulders (SM)					
6		8	W	11	15	P200 (Sample 6): 15.0%		24.2			
7		12	W	20							
8		10	W	11	20						
9		8	W	12	25	Medium Dense, Gray Fine to Coarse SAND, Some Gravel, Little Silt, Scattered Cobbles/Boulders (SP-SM)					
10		10	W	17	30	Medium Dense, Grayish Brown Fine to Medium SAND, Some Silt, Trace Gravel, Scattered Cobbles/Boulders (SM)					
						End of Boring at 30 ft					
					35	Borehole Backfilled with Bentonite Chips					

WATER LEVEL OBSERVATIONS

While Drilling ▽ **6.0'** Upon Completion of Drilling _____
Time After Drilling _____
Depth to Water _____ ▼
Depth to Cave in _____

The stratification lines represent the approximate boundary between soil types and the transition may be gradual.

GENERAL NOTES

Start **6/28/17** End **6/28/17**
Driller **BSD** Chief **MC** Rig **D-50**
Logger **MG/CD** Editor **TFG**
Drill Method **4.25" HSA (0-10') / MR (10-30'); Autohammer**

CGC Inc.

LOG OF TEST BORING

Project **Proposed Fire Station No. 14**
3201 Dairy Drive
Location **City of Madison, Dane Co., WI**

Boring No. **3A**
Surface Elevation (ft) **± 862.0**
Job No. **C17051-15**
Sheet **1** of **1**

2921 Perry Street, Madison, WI 53713 (608) 288-4100, FAX (608) 288-7887

SAMPLE						VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES				
No.	TYPE	Rec (in.)	Moist	N	Depth (ft)		qu (qa) (tsf)	W	LL	PL	LI
						± 4 in. GRAVEL SURFACE					
1		14	M	8		Very Stiff, Gray/Brown (Lightly Mottled) Lean CLAY, Little Sand, Trace Gravel, Scattered Dark Gray Organic Pockets and Roots (CL - Possible Fill)	(2.0-2.25)	25.5			
2		12	M	7	5	Soft to Medium Stiff, Gray/Brown (Lightly Mottled) Sandy Lean CLAY, Trace Gravel (CL)	(0.25-0.75)	17.7			
3		18	W	2		Very Loose, Gray Silty Fine SAND, Layered with Tan Fine to Medium SAND, Little to Some Silt, Trace to Little Gravel (SM)					
4		16	W	2	10	Very Loose to Loose, Gray Fine to Medium SAND, Little Silt and Gravel, Scattered Cobbles/Boulders (SP-SM)					
5		16	W	7							
6		10	W	6	15						
7		18	W	22		Medium Dense, Gray Silty Fine SAND, Trace Gravel, Scattered Less Silty Fine to Medium Sand Seams (SM)					
8		12	W	9	20	Loose to Medium Dense, Gray Fine to Medium SAND, Little Silt, Trace Gravel, Scattered Cobbles/Boulders (SP-SM)					
9		14	W	23	25						
10		12	W	30	30	End of Boring at 30 ft Borehole Backfilled with Bentonite Chips					
					35						

WATER LEVEL OBSERVATIONS

While Drilling ▽ **6.0'** Upon Completion of Drilling _____
Time After Drilling _____
Depth to Water _____ ▼
Depth to Cave in _____

The stratification lines represent the approximate boundary between soil types and the transition may be gradual.

GENERAL NOTES

Start **6/27/17** End **6/28/17**
Driller **BSD** Chief **MC** Rig **D-50**
Logger **MG/CD** Editor **TFG**
Drill Method **4.25" HSA (0-10') / MR (10-30'); Autohammer**

CGC Inc.

LOG OF TEST BORING

Project **Proposed Fire Station No. 14**
3201 Dairy Drive
Location **City of Madison, Dane Co., WI**

Boring No. **4A**
Surface Elevation (ft) **± 864.0**
Job No. **C17051-15**
Sheet **1** of **1**

2921 Perry Street, Madison, WI 53713 (608) 288-4100, FAX (608) 288-7887

SAMPLE						VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES				
No.	TYPE	Rec (in.)	Moist	N	Depth (ft)		qu (qa) (tsf)	W	LL	PL	LI
						FILL: Dark Gray Silty Clay, Some Sand, Little Gravel, Trace Organics, Scattered Roots (Possible Tospoil Fill)					
1	■	12	M	10			(-)	16.8			3.4
2	■	8	M	7		FILL: Medium Stiff to Stiff, Gray/Tan/Reddish Brown Lean to Silty Clay, Some Sand, Trace Gravel, Numerous Roots	(0.5-1.25)	17.5			
3	■	10	M	4	5	Very Loose to Loose, Gray Clayey Fine to Medium SAND, Scattered Lean Clay Seams (SC)		16.7			
4	■	12	W	6		Loose, Tan Fine to Coarse SAND, Little Gravel, Trace Silt, Scattered Cobbles/Boulders (SP)					
5	■	8	W	3	10	Very Loose, Tan Fine to Medium SAND, Trace to Little Silt and Gravel, Scattered Cobbles/Boulders (SP/SP-SM)					
6	■	10	W	2		P200 (Sample 6): 2.5%		22.3			
7	■	14	W	4	15	Grading Gray/Gravel Content Slightly Increasing with Depth					
8	■	10	W	2							
9	■	12	W	13	20	Medium Dense, Tan Fine to Medium SAND, Some Silt, Trace Gravel, Scattered Cobbles/Boulders (SM)					
10	■	12	W	18	25						
					30	End of Boring at 30 ft Borehole Backfilled with Bentonite Chips					
					35						

WATER LEVEL OBSERVATIONS

While Drilling ▽ **8.5'** Upon Completion of Drilling _____
Time After Drilling _____
Depth to Water _____ ▼
Depth to Cave in _____

The stratification lines represent the approximate boundary between soil types and the transition may be gradual.

GENERAL NOTES

Start **6/27/17** End **6/27/17**
Driller **BSD** Chief **MC** Rig **D-50**
Logger **MG/CD** Editor **TFG**
Drill Method **4.25" HSA (0-10') / MR (10-30'); Autohammer**

CGC Inc.

LOG OF TEST BORING

Project **Proposed Fire Station No. 14**
3201 Dairy Drive
Location **City of Madison, Dane Co., WI**

Boring No. **5A**
Surface Elevation (ft) **± 863.5**
Job No. **C17051-15**
Sheet **1** of **1**

2921 Perry Street, Madison, WI 53713 (608) 288-4100, FAX (608) 288-7887

SAMPLE						VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES				
No.	TYPE	Rec (in.)	Moist	N	Depth (ft)		qu (qa) (tsf)	W	LL	PL	LI
						FILL: Stiff, Gray/Dark Gray/Brown Lean Clay, Some Sand, Scattered Roots					
1	■	10	M	6			(1.25-1.75)	22.0			
2	■	12	M	9	5	Stiff, Gray/Brown (Lightly Mottled) Sandy Lean CLAY, Trace Gravel (CL)	(1.5-1.75)	16.4			
3	■	12	W	5		Loose, Tan Fine to Medium SAND, Trace Silt and Gravel, Scattered Cobbles/Boulders (SP)					
4	■	10	W	2	10	Very Loose, Tan Fine to Medium SAND, Little Silt and Gravel, Scattered Cobbles/Boulders (SP-SM)					
5	■	12	W	3		Very Loose, Gray Fine to Medium SAND, Some Silt, Trace Gravel and Organics, Scattered Tan Less Silty Seams and Cobbles/Boulders (SM)					
6	■	10	W	2	15						
7	■	10	W	5		Very Loose to Loose, Gray Fine to Medium SAND, Little Silt and Gravel, Scattered Cobbles/Boulders (SP-SM)					
8	■	8	W	2	20						
9	■	12	W	19	25	Medium Dense, Gray Fine to Medium SAND, Some Gravel, Little Silt, Scattered Silt Seams and Cobbles/Boulders (SP-SM)					
10	■	12	W	21	30	Medium Dense, Gray Fine to Medium SAND, Some Silt, Little Gravel, Scattered Cobbles/Boulders (SM)					
						End of Boring at 30 ft Borehole Backfilled with Bentonite Chips					
					35						

WATER LEVEL OBSERVATIONS

While Drilling ▽ **8.5'** Upon Completion of Drilling _____
Time After Drilling _____
Depth to Water _____ ▼
Depth to Cave in _____

The stratification lines represent the approximate boundary between soil types and the transition may be gradual.

GENERAL NOTES

Start **6/27/17** End **6/27/17**
Driller **BSD** Chief **MC** Rig **D-50**
Logger **MG/CD** Editor **TFG**
Drill Method **4.25" HSA (0-10') / MR (10-30'); Autohammer**

CGC Inc.

LOG OF TEST BORING

Project **Proposed Fire Station #14 & Fire Training Site**
Femrite Drive and Dairy Drive
Location **Madison, Wisconsin**

Boring No. **8**
Surface Elevation (ft) **863.8**
Job No. **C13064-7**
Sheet **1** of **1**

2921 Perry Street, Madison, WI 53713 (608) 288-4100, FAX (608) 288-7887

SAMPLE						VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES				
No.	TYPE	Rec (in.)	Moist	N	Depth (ft)		qu (qa) (tsf)	W	LL	PL	LI
1		18	M	15		FILL: Medium Dense, Tan Fine to Medium Sand, Some Silt and Gravel USDA: FILL - 2.5Y 5/3 Sandy Loam					
2		10	M	5	5	FILL: Soft to Medium Stiff, Dark Gray/Gray Lean Clay, Little to Some Sand, Trace Organics USDA: FILL - 10YR 3/1, 5/2 Silty Clay Loam	(0.5)	15.4			
3		8	M	5		Medium Stiff, Dark Gray/Black Organic CLAY (OL - Probable Buried Topsoil) USDA: 10YR 2/1 Silty Clay Loam	(1.0)	26.6			9.1
4		18	W	10	10	Very Loose to Loose, Brown Fine to Medium SAND, Trace to Little Silt, Trace Gravel (SP/SP-SM) USDA: 10YR 5/3 Sand					
5		5	W	2	15						
6		3	W	4	20						
7		12	W	14	25	Medium Dense, Brown Fine SAND, Trace to Little Silt (SP/SP-SM) USDA: 10YR 5/3 Fine Sand					
8		8	W	21	30	Medium Dense, Gray-Brown Fine to Medium SAND, Trace to Little Silt, Trace Gravel (SP/SP-SM) USDA: 10YR 5/2 Sand					
					35	End of Boring at 30 ft Borehole Backfilled with bentonite chips and slurry					

WATER LEVEL OBSERVATIONS

While Drilling ▽ **8.0'** Upon Completion of Drilling _____
Time After Drilling _____
Depth to Water _____ ▼
Depth to Cave in _____

The stratification lines represent the approximate boundary between soil types and the transition may be gradual.

GENERAL NOTES

Start **7/22/13** End **7/22/13**
Driller **BSD** Chief **DC** Rig **CME-750**
Logger **JM** Editor **DAS**
Drill Method **2.25" HSA; 0-10'; 3-7/8"**
RB/DM; Autohammer

CGC Inc.

LOG OF TEST BORING

Project **Proposed Fire Station #14 & Fire Training Site**
Femrite Drive and Dairy Drive
Location **Madison, Wisconsin**

Boring No. **9**
Surface Elevation (ft) **863.5**
Job No. **C13064-7**
Sheet **1** of **1**

2921 Perry Street, Madison, WI 53713 (608) 288-4100, FAX (608) 288-7887

SAMPLE No.	TYPE	Rec (in.)	Moist	N	Depth (ft)	VISUAL CLASSIFICATION and Remarks	qu (qa) (tsf)	W	LL	PL	LI
						FILL: Medium Dense, Tan Fine to Medium Sand, Some Silt and Gravel USDA: FILL - 2.5Y 5/3 Sandy Loam					
1	■	18	M	17							
						Loose, Dark Gray/Black Organic Clayey SILT (OL - Probable Buried Topsoil) USDA: 10YR 2/1 Silt Loam					
2	■	15	M	5	5			19.3			6.5
						Very Loose to Medium Dense, Brown Fine to Medium SAND, Trace to Little Silt, Trace Gravel (SP/SP-SM) USDA: 10YR 5/3 Sand					
3	■	10	W	10							
4	■	12	W	8	10						
5	■	18	W	3	15	Grades to Fine Sand near 15 ft					
6	■	3	W	10	20						
7	■	4	W	27	25						
8	■	12	W	9	30	End of Boring at 30 ft Borehole Backfilled with bentonite chips and slurry					
					35						

WATER LEVEL OBSERVATIONS

While Drilling ▽ **6.0'** Upon Completion of Drilling _____
Time After Drilling _____
Depth to Water _____ ▼
Depth to Cave in _____

The stratification lines represent the approximate boundary between soil types and the transition may be gradual.

GENERAL NOTES

Start **7/23/13** End **7/23/13**
Driller **BSD** Chief **KD** Rig **CME-750**
Logger **JM** Editor **DAS**
Drill Method **2.25" HSA; 0-15'; 3-7/8" RB/DM 15'-30'; Autohammer**

CGC Inc.

LOG OF TEST BORING

Project **Proposed Fire Station #14 & Fire Training Site**
Femrite Drive and Dairy Drive
Location **Madison, Wisconsin**

Boring No. **10**
Surface Elevation (ft) **860.4**
Job No. **C13064-7**
Sheet **1** of **1**

2921 Perry Street, Madison, WI 53713 (608) 288-4100, FAX (608) 288-7887

SAMPLE No.	TYPE	Rec (in.)	Moist	N	Depth (ft)	VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES qu (qa) (tsf)	W	LL	PL	LI
						14 in.± Clayey TOPSOIL (OL)					
1		6	M	7		Loose, Gray Fine to Medium SAND, Some Silt, Trace Clay and Gravel (SM - Possible Fill) USDA: 10YR 5/1 Sandy Loam					
2		6	W	5	5	Very Loose to Loose, Brown Fine to Medium SAND, Trace to Little Silt, Trace Gravel (SP/SP-SM) USDA: 10YR 5/3 Sand					
3		12	W	3							
4		8	W	4	10	Color Change to Dark Brown (10YR 3/3) with Scattered Silt Seams near 7.5 ft					
5		10	W	4	15	Very Loose to Loose, Gray Fine SAND, Trace to Little Silt (SP/SP-SM) USDA: 10YR 5/2 Fine Sand					
6		9	W	9	20	Loose, Gray Fine SAND, Some Silt, Trace Gravel (SM) USDA: 10YR 5/2 Sandy Loam					
7		14	W	10	25	Loose, Gray Fine SAND, Trace to Little Silt (SP/SP-SM) USDA: 10YR 5/2 Fine Sand					
8		12	W	8	30	Scattered Silt Seams near 30 ft					
						End of Boring at 30 ft					
					35	Borehole Backfilled with bentonite chips and slurry					

WATER LEVEL OBSERVATIONS

While Drilling ▽ **6.0'** Upon Completion of Drilling _____
Time After Drilling _____
Depth to Water _____ ▼
Depth to Cave in _____

The stratification lines represent the approximate boundary between soil types and the transition may be gradual.

GENERAL NOTES

Start **7/24/13** End **7/24/13**
Driller **BSD** Chief **KD** Rig **CME-750**
Logger **JM** Editor **DAS**
Drill Method **2.25" HSA; 0-10'; 3-7/8" RB/DM; Autohammer**

LOG OF TEST BORING

CGC Inc.

Project **Proposed Fire Station #14 & Fire Training Site**
Femrite Drive and Dairy Drive
Location **Madison, Wisconsin**

Boring No. **12**
Surface Elevation (ft) **863.2**
Job No. **C13064-7**
Sheet **1** of **1**

2921 Perry Street, Madison, WI 53713 (608) 288-4100, FAX (608) 288-7887

SAMPLE No.	TYPE	Rec (in.)	Moist	N	Depth (ft)	VISUAL CLASSIFICATION and Remarks	qu (qa) (tsf)	W	LL	PL	LI
						12 in.± Clayey TOPSOIL (OL)					
1		10	M	9		Very Stiff, Light Green-Gray/Brown (Mottled) Lean CLAY, Trace Sand (CL) USDA: 10YR 5/1 Silty Clay Loam (Redox: C2F 10YR 6/6)	(3.0)				
2		16	M	5	5	Loose, Brown Fine to Medium SAND, Trace to Little Silt, Trace Gravel (SP/SP-SM) USDA: 10YR 5/3 Sand					
3		12	W	5							
4		14	W	8	10						
5		12	W	5	15	3 in. Stiff, Gray/Brown Lean Clay Seam near 15 ft	(1.0-1.5)				
6		12	W	15	20	Medium Dense, Gray Fine SAND, Trace to Little Silt (SP/SP-SM) USDA: 10YR 5/2 Fine Sand					
7		16	W	15	25						
8		14	W	23	30						
					35	End of Boring at 30 ft Borehole Backfilled with bentonite chips and slurry					

WATER LEVEL OBSERVATIONS

While Drilling ▽ **6.0'** Upon Completion of Drilling _____
Time After Drilling _____
Depth to Water _____ ▼
Depth to Cave in _____

The stratification lines represent the approximate boundary between soil types and the transition may be gradual.

GENERAL NOTES

Start **7/24/13** End **7/24/13**
Driller **BSD** Chief **KD** Rig **CME-750**
Logger **JM** Editor **DAS**
Drill Method **2.25" HSA; 0-10'; 3-7/8" RB/DM 10'-30'; Autohammer**

LOG OF TEST BORING

CGC Inc.

Project **Proposed Fire Station #14 & Fire Training Site**
Femrite Drive and Dairy Drive
Location **Madison, Wisconsin**

Boring No. **13**
Surface Elevation (ft) **862.2**
Job No. **C13064-7**
Sheet **1** of **1**

2921 Perry Street, Madison, WI 53713 (608) 288-4100, FAX (608) 288-7887

SAMPLE No.	TYPE	Rec (in.)	Moist	N	Depth (ft)	VISUAL CLASSIFICATION and Remarks	qu (qa) (tsf)	W	LL	PL	LI
						12 in.± Sand and Gravel FILL					
1		5	M	8		Stiff to Very Stiff, Light Green-Gray/Brown (Mottled) Lean CLAY, Trace Sand (CL - Possible Fill in Upper Few Feet of Layer)	(3.5)				
2		18	M	8	5	USDA: 10YR 5/1 Silty Clay Loam (Redox: C2D 10YR 6/6)	(1.0-1.5)	29.5			
3		18	W	4		Very Loose to Loose, Brown Fine to Medium SAND, Trace to Little Silt, Trace Gravel (SP/SP-SM)					
4		18	W	4	10	USDA: 10YR 5/3 Sand					
5		3	W	4	15						
6		12	W	17	20	Medium Dense, Gray Fine SAND, Trace to Little Silt (SP/SP-SM) USDA: 10YR 5/2 Fine Sand					
7		12	W	27	25	Medium Dense, Brown Fine to Coarse SAND, Trace to Little Silt, Trace Gravel (SP/SP-SM) USDA: 10YR 5/3 Sand					
8		4	W	14	30	End of Boring at 30 ft Borehole backfilled with bentonite chips and slurry					
					35						

WATER LEVEL OBSERVATIONS

While Drilling ▽ 6.0' Upon Completion of Drilling _____
Time After Drilling _____
Depth to Water _____ ▼
Depth to Cave in _____

The stratification lines represent the approximate boundary between soil types and the transition may be gradual.

GENERAL NOTES

Start **7/22/13** End **7/22/13**
Driller **BSD** Chief **DC** Rig **CME-750**
Logger **JM** Editor **DAS**
Drill Method **2.25" HSA; 0-10'; 3-7/8" RB/DM 10'-30'; Autohammer**

CGC Inc.

LOG OF TEST BORING

Project **Proposed Fire Station #14 & Fire Training Site**
Femrite Drive and Dairy Drive
Location **Madison, Wisconsin**

Boring No. **14**
Surface Elevation (ft) **865.0**
Job No. **C13064-7**
Sheet **1** of **1**

2921 Perry Street, Madison, WI 53713 (608) 288-4100, FAX (608) 288-7887

SAMPLE No.	TYPE	Rec (in.)	Moist	N	Depth (ft)	VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES qu (qa) (tsf)	W	LL	PL	LI
						8 in.± Sandy TOPSOIL FILL (OL)					
1		12	M	12		FILL: Very Stiff, Brown/Gray Lean Clay, Trace to Little Sand USDA: FILL-10YR 4/3 Silty Clay Loam	(3.75-4.0)				
2		12	M	8	5	Stiff to Very Stiff, Gray/Brown (Mottled) Lean CLAY, Trace Sand (CL) USDA: 10YR 5/2 Silty Clay Loam (Redox: C2D 10YR 6/6)	(2.0-2.5)				
3		18	M	8			(1.0-1.5)	24.7			
4		6	W	4	10	Very Loose to Medium Dense, Brown Fine to Medium SAND, Trace to Little Silt, Trace Gravel (SP/SP-SM) USDA: 10YR 5/3 Sand					
5		18	W	4	15	Grades to Fine Sand near 15 ft					
6		6	W	2	20						
7		8	W	12	25						
8		18	W	20	30	End of Boring at 30 ft Borehole Backfilled with bentonite chips and slurry					
					35						

WATER LEVEL OBSERVATIONS

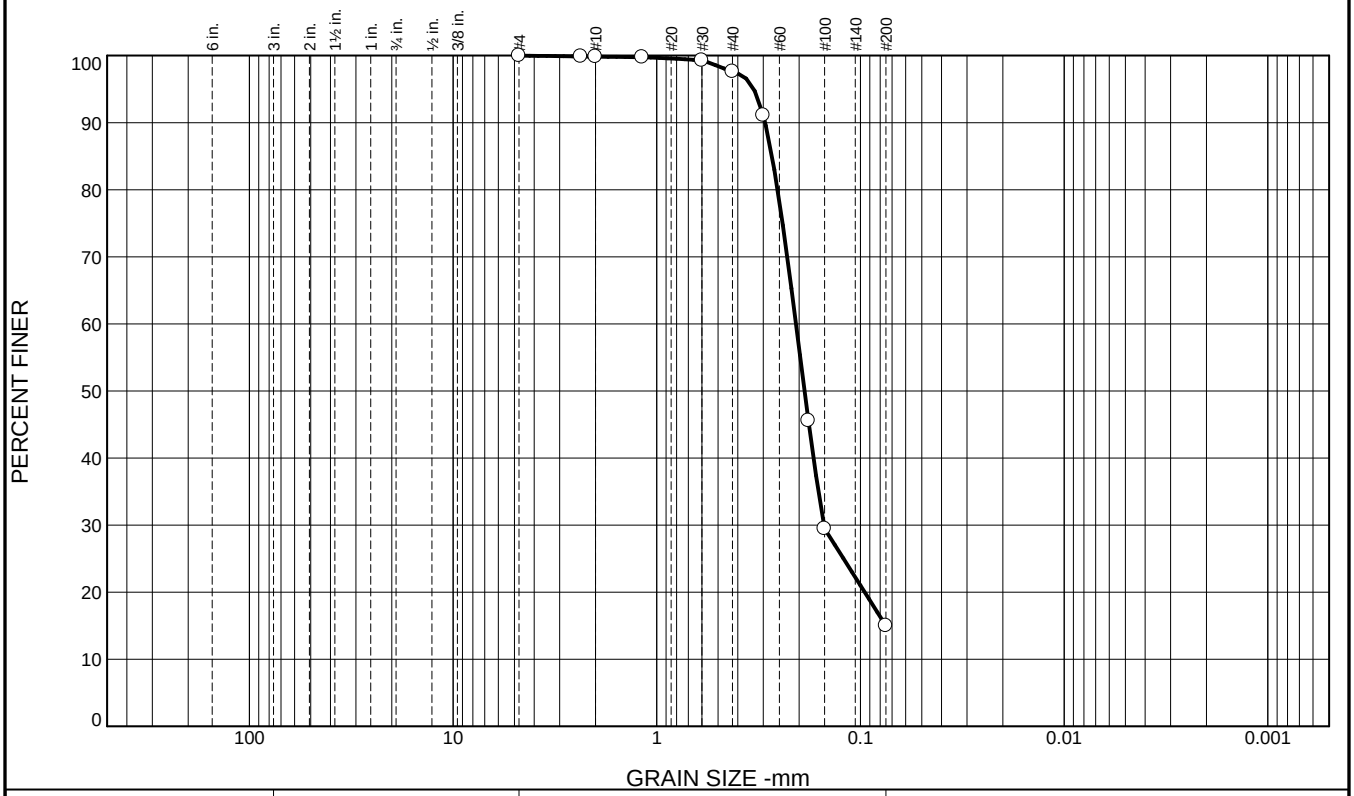
While Drilling ▽ **8.5'** Upon Completion of Drilling _____
Time After Drilling _____
Depth to Water _____ ▼
Depth to Cave in _____

The stratification lines represent the approximate boundary between soil types and the transition may be gradual.

GENERAL NOTES

Start **7/22/13** End **7/22/13**
Driller **BSD** Chief **DC** Rig **CME-750**
Logger **JM** Editor **DAS**
Drill Method **2.25" HSA; 0-10'; 3-7/8" RB/DM 10'-30'; Autohammer**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.2	2.2	82.6	15.0	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#8	99.9		
#10	99.8		
#16	99.8		
#30	99.3		
#40	97.6		
#50	91.1		
#80	45.5		
#100	29.5		
#200	15.0		

* (no specification provided)

Material Description

Brown Fine Sand, Some Silt

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 0.2938 D_{85}= 0.2718 D_{60}= 0.2073
D_{50}= 0.1881 D_{30}= 0.1511 D_{15}= 0.0751
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO=

Remarks

Sample Number: B-2A, S-6

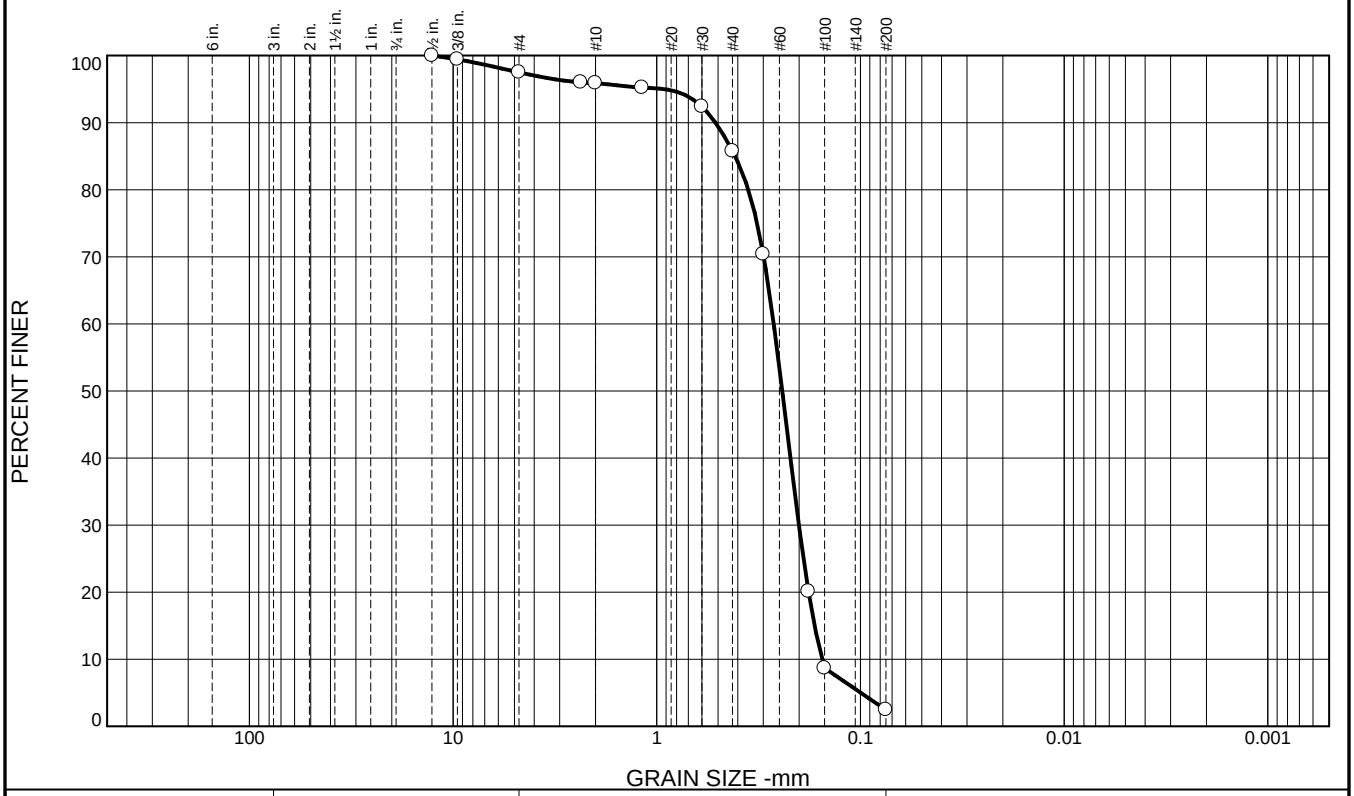
Date: 7/5/17

CGC,Inc.

Client: City of Madison - Public Works
Project: Fire Station No. 14
Dairy Drive, Madison
Project No: C17051-15 **Figure**

Tested By: DRW **Checked By:** TFG

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	2.5	1.6	10.1	83.3	2.5	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1/2	100.0		
3/8	99.4		
#4	97.5		
#8	96.0		
#10	95.9		
#16	95.2		
#30	92.4		
#40	85.8		
#50	70.4		
#80	20.1		
#100	8.7		
#200	2.5		

* (no specification provided)

Material Description

Brown Fine to Medium Sand, Trace Silt and Gravel

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 0.5150 D_{85}= 0.4128 D_{60}= 0.2665
D_{50}= 0.2420 D_{30}= 0.2005 D_{15}= 0.1680
D_{10}= 0.1542 C_u= 1.73 C_c= 0.98

Classification

USCS= SP AASHTO=

Remarks

Sample Number: B-4A, S-6

Date: 7/5/17

CGC,Inc.

Client: City of Madison - Public Works
Project: Fire Station No. 14
Dairy Drive, Madison
Project No: C17051-15 **Figure**

Tested By: DRW **Checked By:** TFG

CGC, Inc.

LOG OF TEST BORING
General Notes

DESCRIPTIVE SOIL CLASSIFICATION

Grain Size Terminology

Soil Fraction	Particle Size	U.S. Standard Sieve Size
Boulders	Larger than 12"	Larger than 12"
Cobbles	3" to 12"	3" to 12"
Gravel: Coarse	¾" to 3"	¾" to 3"
Fine	4.76 mm to ¾"	#4 to ¾"
Sand: Coarse	2.00 mm to 4.76 mm	#10 to #4
Medium	0.42 to mm to 2.00 mm	#40 to #10
Fine	0.074 mm to 0.42 mm	#200 to #40
Silt	0.005 mm to 0.074 mm	Smaller than #200
Clay	Smaller than 0.005 mm	Smaller than #200

Plasticity characteristics differentiate between silt and clay.

General Terminology

Physical Characteristics
Color, moisture, grain shape, fineness, etc.
Major Constituents
Clay, silt, sand, gravel
Structure
Laminated, varved, fibrous, stratified, cemented, fissured, etc.
Geologic Origin
Glacial, alluvial, eolian, residual, etc.

Relative Density

Term	"N" Value
Very Loose	0 - 4
Loose	4 - 10
Medium Dense	10 - 30
Dense	30 - 50
Very Dense	Over 50

Relative Proportions Of Cohesionless Soils

Proportional Term	Defining Range by Percentage of Weight
Trace	0% - 5%
Little	5% - 12%
Some	12% - 35%
And	35% - 50%

Consistency

Term	q_u-tons/sq. ft
Very Soft	0.0 to 0.25
Soft	0.25 to 0.50
Medium	0.50 to 1.0
Stiff	1.0 to 2.0
Very Stiff	2.0 to 4.0
Hard	Over 4.0

Organic Content by Combustion Method

Soil Description	Loss on Ignition
Non Organic	Less than 4%
Organic Silt/Clay	4 – 12%
Sedimentary Peat	12% - 50%
Fibrous and Woody Peat	More than 50%

Plasticity

Term	Plastic Index
None to Slight	0 - 4
Slight	5 - 7
Medium	8 - 22
High to Very High	Over 22

The penetration resistance, N, is the summation of the number of blows required to effect two successive 6" penetrations of the 2" split-barrel sampler. The sampler is driven with a 140 lb. weight falling 30" and is seated to a depth of 6" before commencing the standard penetration test.

SYMBOLS

Drilling and Sampling

CS – Continuous Sampling
RC – Rock Coring: Size AW, BW, NW, 2"W
RQD – Rock Quality Designation
RB – Rock Bit/Roller Bit
FT – Fish Tail
DC – Drove Casing
C – Casing: Size 2 ½", NW, 4", HW
CW – Clear Water
DM – Drilling Mud
HSA – Hollow Stem Auger
FA – Flight Auger
HA – Hand Auger
COA – Clean-Out Auger
SS - 2" Dia. Split-Barrel Sample
2ST – 2" Dia. Thin-Walled Tube Sample
3ST – 3" Dia. Thin-Walled Tube Sample
PT – 3" Dia. Piston Tube Sample
AS – Auger Sample
WS – Wash Sample
PTS – Peat Sample
PS – Pitcher Sample
NR – No Recovery
S – Sounding
PMT – Borehole Pressuremeter Test
VS – Vane Shear Test
WPT – Water Pressure Test

Laboratory Tests

q_a – Penetrometer Reading, tons/sq ft
q_a – Unconfined Strength, tons/sq ft
W – Moisture Content, %
LL – Liquid Limit, %
PL – Plastic Limit, %
SL – Shrinkage Limit, %
LI – Loss on Ignition
D – Dry Unit Weight, lbs/cu ft
pH – Measure of Soil Alkalinity or Acidity
FS – Free Swell, %

Water Level Measurement

▽ - Water Level at Time Shown
NW – No Water Encountered
WD – While Drilling
BCR – Before Casing Removal
ACR – After Casing Removal
CW – Cave and Wet
CM – Caved and Moist

Note: Water level measurements shown on the boring logs represent conditions at the time indicated and may not reflect static levels, especially in cohesive soils.

CGC, Inc.

Madison - Milwaukee

Unified Soil Classification System

UNIFIED SOIL CLASSIFICATION AND SYMBOL CHART

COARSE-GRAINED SOILS (more than 50% of material is larger than No. 200 sieve size)			
GRAVELS More than 50% of coarse fraction larger than No. 4 sieve size	Clean Gravels (Less than 5% fines)		
		GW	Well-graded gravels, gravel-sand mixtures, little or no fines
		GP	Poorly-graded gravels, gravel-sand mixtures, little or no fines
	Gravels with fines (More than 12% fines)		
		GM	Silty gravels, gravel-sand-silt mixtures
		GC	Clayey gravels, gravel-sand-clay mixtures
SANDS 50% or more of coarse fraction smaller than No. 4 sieve size	Clean Sands (Less than 5% fines)		
		SW	Well-graded sands, gravelly sands, little or no fines
		SP	Poorly graded sands, gravelly sands, little or no fines
	Sands with fines (More than 12% fines)		
		SM	Silty sands, sand-silt mixtures
		SC	Clayey sands, sand-clay mixtures
FINE-GRAINED SOILS (50% or more of material is smaller than No. 200 sieve size.)			
SILTS AND CLAYS Liquid limit less than 50%		ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity
		CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
		OL	Organic silts and organic silty clays of low plasticity
SILTS AND CLAYS Liquid limit 50% or greater		MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts
		CH	Inorganic clays of high plasticity, fat clays
		OH	Organic clays of medium to high plasticity, organic silts
HIGHLY ORGANIC SOILS		PT	Peat and other highly organic soils

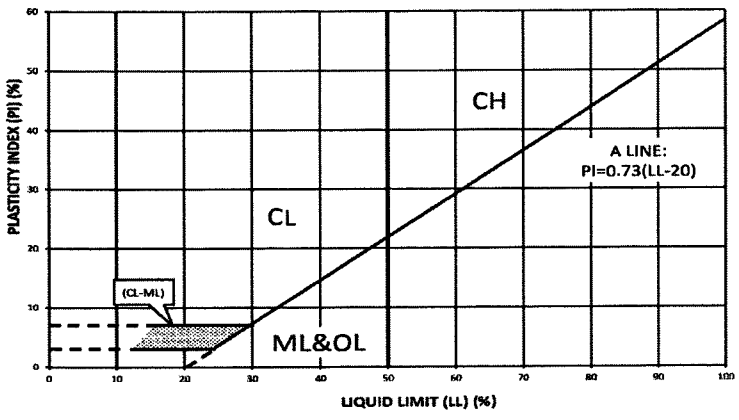
LABORATORY CLASSIFICATION CRITERIA

GW	$C_u = \frac{D_{60}}{D_{10}}$ greater than 4; $C_C = \frac{D_{30}}{D_{10} \times D_{60}}$ between 1 and 3	
GP	Not meeting all gradation requirements for GW	
GM	Atterberg limts below "A" line or P.I. less than 4	Above "A" line with P.I. between 4 and 7 are borderline cases requiring use of dual symbols
GC	Atterberg limts above "A" line or P.I. greater than 7	
SW	$C_u = \frac{D_{60}}{D_{10}}$ greater than 4; $C_C = \frac{D_{30}}{D_{10} \times D_{60}}$ between 1 and 3	
SP	Not meeting all gradation requirements for GW	
SM	Atterberg limits below "A" line or P.I. less than 4	Limits plotting in shaded zone with P.I. between 4 and 7 are borderline cases requiring use of dual symbols
SC	Atterberg limits above "A" line with P.I. greater than 7	

Determine percentages of sand and gravel from grain-size curve. Depending on percentage of fines (fraction smaller than No. 200 sieve size), coarse-grained soils are classified as follows:

Less than 5 percent ..... GW, GP, SW, SP
More than 12 percent ..... GM, GC, SM, SC
5 to 12 percent ..... Borderline cases requiring dual symbols

PLASTICITY CHART



APPENDIX C

DOCUMENT QUALIFICATIONS

APPENDIX C
DOCUMENT QUALIFICATIONS

I. GENERAL RECOMMENDATIONS/LIMITATIONS

CGC, Inc. should be provided the opportunity for a general review of the final design and specifications to confirm that earthwork and foundation requirements have been properly interpreted in the design and specifications. CGC should be retained to provide soil engineering services during excavation and subgrade preparation. This will allow us to observe that construction proceeds in compliance with the design concepts, specifications and recommendations, and also will allow design changes to be made in the event that subsurface conditions differ from those anticipated prior to the start of construction. CGC does not assume responsibility for compliance with the recommendations in this report unless we are retained to provide construction testing and observation services.

This report has been prepared in accordance with generally accepted soil and foundation engineering practices and no other warranties are expressed or implied. The opinions and recommendations submitted in this report are based on interpretation of the subsurface information revealed by the test borings indicated on the location plan. The report does not reflect potential variations in subsurface conditions between or beyond these borings. Therefore, variations in soil conditions can be expected between the boring locations and fluctuations of groundwater levels may occur with time. The nature and extent of the variations may not become evident until construction.

II. IMPORTANT INFORMATION ABOUT YOUR GEOTECHNICAL ENGINEERING REPORT

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes. While you cannot eliminate all such risks, you can manage them. The following information is provided to help.

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical engineering study conducted for a civil engineer may not fulfill the needs of a construction contractor or even another civil engineer. Because each geotechnical engineering study is unique, each geotechnical engincering report is unique, prepared *solely* for the client. *No one except you* should rely on your geotechnical engineering report without first conferring with the geotechnical engineer who prepared it. *And no one - not even you* - should apply the report for any purpose or project except the one originally contemplated.

READ THE FULL REPORT

Serious problems have occurred because those relying on a geotechnical engineering report did not read it all. Do not rely on an executive summary. Do not read selected elements only.

A GEOTECHNICAL ENGINEERING REPORT IS BASED ON A UNIQUE SET OF PROJECT-SPECIFIC FACTORS

Geotechnical engineers consider a number of unique, project-specific factors when establishing the scope of a study. Typical factors include: the client's goals, objectives, and risk management preferences; the general nature of the structure involved, its size, and configuration; the location of the structure on the site; and other planned or existing site improvements, such as access roads, parking lots, and underground utilities. Unless the geotechnical engineer who conducted the study specifically indicates otherwise, *do not rely on a geotechnical engineering report* that was:

- not prepared for you,
- not prepared for your project,
- not prepared for the specific site explored, or
- completed before important project changes were made.

Typical changes that can erode the reliability of an existing geotechnical report include those that affect:

- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light industrial plant to a refrigerated warehouse,
- elevation, configuration, location, orientation, or weight of the proposed structure,
- composition of the design team, or project ownership.

As a general rule, *always* inform your geotechnical engineer of project changes - even minor ones - and request an assessment of their impact. *CGC cannot accept responsibility or liability for problems that occur because our reports do not consider developments of which we were not informed.*

SUBSURFACE CONDITIONS CAN CHANGE

A geotechnical engineering report is based on conditions that existed at the time the geotechnical engineer performed the study. *Do not rely on a geotechnical engineering report* whose adequacy may have been affected by: the passage of time; by man-made events, such as construction on or adjacent to the site; or by natural events, such as floods, earthquakes, or groundwater fluctuations. *Always* contact the geotechnical engineer before applying the report to determine if it is still reliable. A minor amount of additional testing or analysis could prevent major problems.

MOST GEOTECHNICAL FINDINGS ARE PROFESSIONAL OPINION

Site exploration identifies subsurface conditions only at those points where subsurface tests are conducted or samples are taken. Geotechnical engineers review field and laboratory data and then apply their professional judgement to render an opinion about subsurface conditions throughout the site. Actual subsurface conditions may differ - sometimes significantly - from those indicated in your report. Retaining the geotechnical engineer who developed your report to provide construction observation is the most

effective method of managing the risks associated with unanticipated conditions.

A REPORT'S RECOMMENDATIONS ARE NOT FINAL

Do not over-rely on the confirmation-dependent recommendations included in your report. *Those confirmation-dependent recommendations are not final*, because geotechnical engineers develop them principally from judgement and opinion. Geotechnical engineers can finalize their recommendations *only* by observing actual subsurface conditions revealed during construction. *CGC cannot assume responsibility or liability for the report's confirmation-dependent recommendations if we do not perform the geotechnical-construction observation required to confirm the recommendations' applicability.*

A GEOTECHNICAL ENGINEERING REPORT IS SUBJECT TO MISINTERPRETATION

Other design team members' misinterpretation of geotechnical engineering reports has resulted in costly problems. Confront that risk by having your geotechnical engineer confer with appropriate members of the design team after submitting the report. Also retain your geotechnical engineer to review pertinent elements of the design team's plans and specifications. Constructors can also misinterpret a geotechnical engineering report. Confront that risk by having CGC participate in prebid and preconstruction conferences, and by providing geotechnical construction observation.

DO NOT REDRAW THE ENGINEER'S LOGS

Geotechnical engineers prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. To prevent errors or omissions, the logs included in a geotechnical engineering report should *never* be redrawn for inclusion in architectural or other design drawings. Only photographic or electronic reproduction is acceptable, *but recognize that separating logs from the report can elevate risk.*

GIVE CONSTRUCTORS A COMPLETE REPORT AND GUIDANCE

Some owners and design professionals mistakenly believe they can make constructors liable for unanticipated subsurface conditions by limiting what they provide for bid preparation. To help prevent costly problems, give constructors the complete geotechnical engineering report, *but* preface it with a clearly written letter of transmittal. In that letter, advise constructors that the report was not prepared for purposes of bid development and that the report's accuracy is limited; encourage them to confer with the geotechnical engineer who prepared the report (a modest fee may be required) and/or to conduct additional study to obtain the specific types of information they need or prefer. A prebid conference can also be valuable. *Be sure constructors have sufficient time* to perform additional study. Only then might you be in a position to give constructors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

READ RESPONSIBILITY PROVISIONS CLOSELY

Some clients, design professionals, and constructors do not recognize that geotechnical engineering is far less exact than other engineering disciplines. This lack of understanding has created unrealistic expectations that have led to disappointments, claims, and disputes. To help reduce the risk of such outcomes, geotechnical engineers commonly include a variety of explanatory provisions in their reports. Sometimes labeled "limitations," many of these provisions indicate where geotechnical engineer's responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

ENVIRONMENTAL CONCERNS ARE NOT COVERED

The equipment, techniques, and personnel used to perform an *environmental* study differ significantly from those used to perform a *geotechnical* study. For that reason, a geotechnical engineering report does not usually relate any environmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated environmental problems have led to numerous project failures.* If you have not yet obtained your own environmental information, ask your geotechnical consultant for risk management guidance. *Do not rely on an environmental report prepared for someone else.*

OBTAIN PROFESSIONAL ASSISTANCE TO DEAL WITH MOLD

Diverse strategies can be applied during building design, construction, operation, and maintenance to prevent significant amounts of mold from growing on indoor surfaces. To be effective, all such strategies should be devised for the *express purpose* of mold prevention, integrated into a comprehensive plan, and executed with diligent oversight by a professional mold prevention consultant. Because just a small amount of water or moisture can lead to the development of severe mold infestations, many mold prevention strategies focus on keeping building surfaces dry. While groundwater, water infiltration, and similar issues may have been addressed as part of the geotechnical engineering study whose findings are conveyed in this report, the geotechnical engineer in charge of this project is not a mold prevention consultant; ***none of the services performed in connection with the geotechnical engineer's study were designed or conducted for the purpose of mold prevention. Proper implementation of the recommendations conveyed in this report will not of itself be sufficient to prevent mold from growing in or on the structure involved.***

RELY ON YOUR GEOTECHNICAL ENGINEER FOR ADDITIONAL ASSISTANCE

Membership in the Geotechnical Business Council (GBC) of Geoprofessional Business Association exposes geotechnical engineers to a wide array of risk confrontation techniques that can be of genuine benefit for everyone involved with a construction project. Confer with CGC, a member of GBC, for more information.

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Geotechnical Business Council
of the Geoprofessional Business Association
8811 Colesville Road, Suite G 106
Silver Spring, MD 20910

APPENDIX D

RECOMMENDED COMPACTED FILL SPECIFICATIONS

APPENDIX D

CGC, INC.

RECOMMENDED COMPACTED FILL SPECIFICATIONS

General Fill Materials

Proposed fill shall contain no vegetation, roots, topsoil, peat, ash, wood or any other non-soil material which by decomposition might cause settlement. Also, fill shall never be placed while frozen or on frozen surfaces. Rock, stone or broken concrete greater than 6 in. in the largest dimension shall not be placed within 10 ft of the building area. Fill used greater than 10 ft beyond the building limits shall not contain rock, boulders or concrete pieces greater than a 2 sq ft area and shall not be placed within the final 2 ft of finish subgrade or in designated utility construction areas. Fill containing rock, boulders or concrete pieces should include sufficient finer material to fill voids among the larger fragments.

Special Fill Materials

In certain cases, special fill materials may be required for specific purposes, such as stabilizing subgrades, backfilling undercut excavations or filling behind retaining walls. For reference, WisDOT gradation specifications for various types of granular fill are attached in Table 1.

Placement Method

The approved fill shall be placed, spread and leveled in layers generally not exceeding 10 in. in thickness before compaction. The fill shall be placed at moisture content capable of achieving the desired compaction level. For clay soils or granular soils containing an appreciable amount of cohesive fines, moisture conditioning will likely be required.

It is the Contractor's responsibility to provide all necessary compaction equipment and other grading equipment that may be required to attain the specified compaction. Hand-guided vibratory or tamping compactors will be required whenever fill is placed adjacent to walls, footings, columns or in confined areas.

Compaction Specifications

Maximum dry density and optimum moisture content of the fill soil shall be determined in accordance with modified Proctor methods (ASTM D1557). The recommended field compaction as a percentage of the maximum dry density is shown in Table 2. Note that these compaction guidelines would generally not apply to coarse gravel/stone fill. Instead, a method specification would apply (e.g., compact in thin lifts with a vibratory compactor until no further consolidation is evident).

Testing Procedures

Representative samples of proposed fill shall be submitted to CGC, Inc. for optimum moisture-maximum density determination (ASTM D1557) prior to the start of fill placement. The sample size should be approximately 50 lb.

CGC, Inc. shall be retained to perform field density tests to determine the level of compaction being achieved in the fill. The tests shall generally be conducted on each lift at the beginning of fill placement and at a frequency mutually agreed upon by the project team for the remainder of the project.

Table 1
Gradation of Special Fill Materials

Material	WisDOT Section 311	WisDOT Section 312	WisDOT Section 305			WisDOT Section 209		WisDOT Section 210
	Breaker Run	Select Crushed Material	3-in. Dense Graded Base	1 1/4-in. Dense Graded Base	3/4-in. Dense Graded Base	Grade 1 Granular Backfill	Grade 2 Granular Backfill	Structure Backfill
Sieve Size	Percent Passing by Weight							
6 in.	100							
5 in.		90-100						
3 in.			90-100					100
1 1/2 in.		20-50	60-85					
1 1/4 in.				95-100				
1 in.					100			
3/4 in.			40-65	70-93	95-100			
3/8 in.				42-80	50-90			
No. 4			15-40	25-63	35-70	100 (2)	100 (2)	25-100
No. 10		0-10	10-30	16-48	15-55			
No. 40			5-20	8-28	10-35	75 (2)		
No. 100						15 (2)	30 (2)	
No. 200			2-12	2-12	5-15	8 (2)	15 (2)	15 (2)

Notes:

1. Reference: Wisconsin Department of Transportation *Standard Specifications for Highway and Structure Construction.*
2. Percentage applies to the material passing the No. 4 sieve, not the entire sample.
3. Per WisDOT specifications, both breaker run and select crushed material can include concrete that is 'substantially free of steel, building materials and other deleterious material'.

Table 2
Compaction Guidelines

Area	Percent Compaction (1)	
	Clay/Silt	Sand/Gravel
Within 10 ft of building lines		
Footing bearing soils	93 - 95	95
Under floors, steps and walks		
- Lightly loaded floor slab	90	90
- Heavily loaded floor slab and thicker fill zones	92	95
Beyond 10 ft of building lines		
Under walks and pavements		
- Less than 2 ft below subgrade	92	95
- Greater than 2 ft below subgrade	90	90
Landscaping	85	90

Notes:

1. Based on Modified Proctor Dry Density (ASTM D 1557)

APPENDIX E

SETTLEMENT PLATFORM

Settlement Platform Instructions

Settlement platforms will be placed as close to the bottom of the fill as is practical. The surface upon which the settlement platform should rest must be cleaned off to a flat compacted surface. The settlement platform should then be placed in this surface and backfill should be placed over the top of the settlement platform to a depth of at least two feet.

Initial elevations should be taken on the top of the first section of the pipe riser. These should be referenced to the elevation at the platform so that all future additional lengths of riser pipe can be referenced to the elevation of the platform.

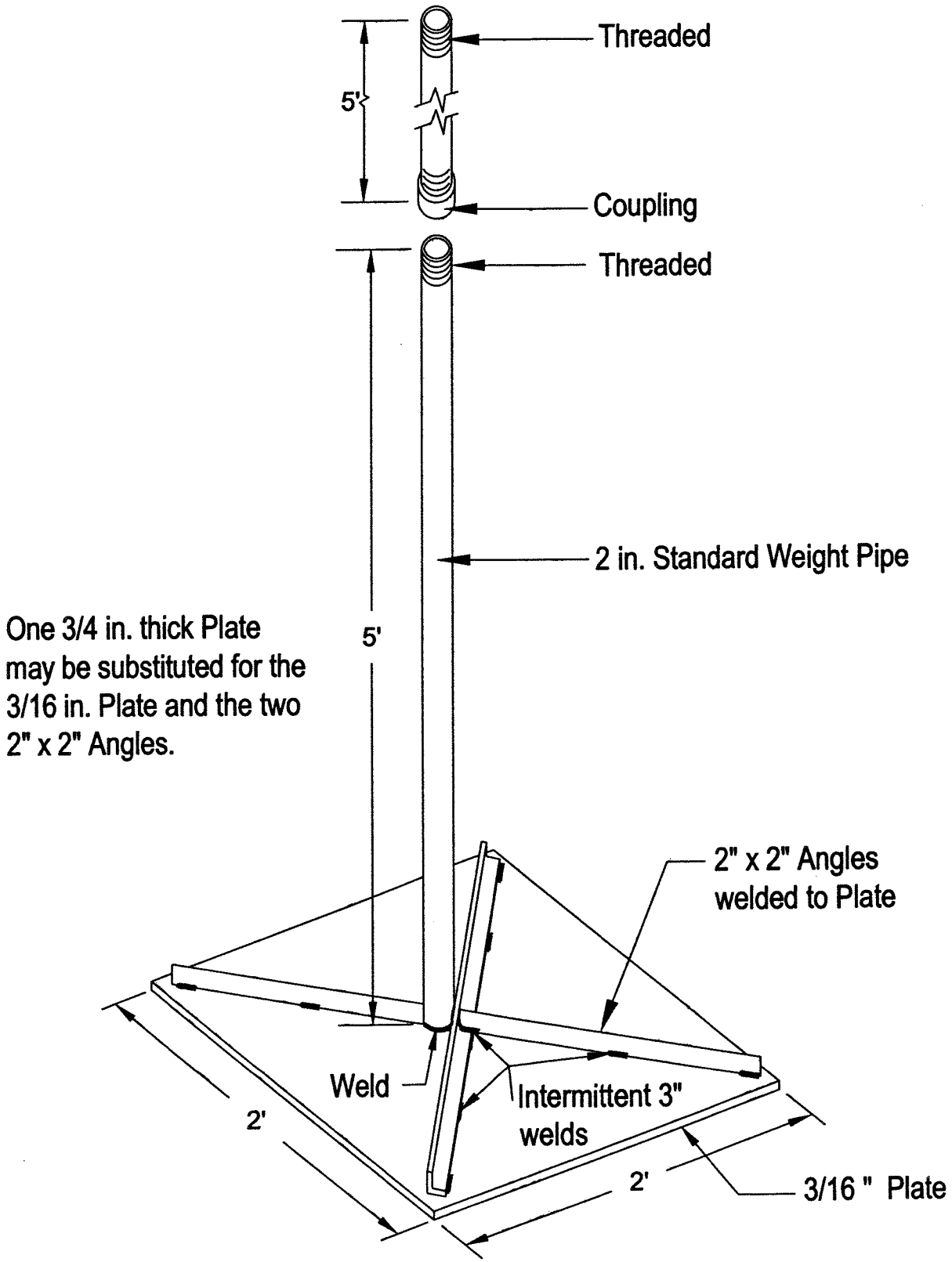
The settlement platform locations should be guarded with tall stakes driven into the fill marked with red flags. No equipment should be permitted to operate closer than three feet from the riser pipes. As each layer of fill is being added to the area, fill should be carefully placed around the riser pipe to an elevation slightly above the surrounding area. The vibrating compactor then should be moved to within a foot or so of the riser pipe with care being taken so as to avoid disturbance of the riser pipe. If necessary, hand compacting equipment should be used to avoid damage to the riser pipe.

When settlement platform readings are taken, the elevation of nearby fill should also be taken.

The elevation at the settlement platform and the nearby fill should be observed at least once each week, and during the period that fill is being placed in the vicinity of the platform, these elevations should be obtained daily. All elevation data should be plotted according to time, with one graph prepared per settlement platform. The plotting should contain the time scale along the abscissa and the vertical scale should be height of fill shown going upward from the middle of the paper, and the settlement of the settlement platforms should be plotted downward from the middle of the paper. The time sale should include both the actual calendar date and also the number of days since the platform was installed.

The benchmark to be used in reading the various settlement platforms should be well away from the proposed excavation or filling areas.

If damage occurs to any settlement platform riser pipe, it is suggested that the pipe be repaired as quickly as possible and the readings continued. The adjustment of these readings can be made, considering that settlement rate during the period of damage was uniform.



CGC, Inc.	Typical Detail Settlement Platform

CGC, Inc.

Construction • Geotechnical
Consulting Engineering/Testing

August 7, 2017
C17051-18

Mr. Jon Evans, P.E., LEED AP-BD&C
Building Design Project Manager
Department of Public Works
Engineering Division
City-County Building, Room 115
210 Martin Luther King Jr. Blvd
Madison, WI 53703

Re: Addendum to Geotechnical Exploration Report
Proposed Fire Station No. 14
3201 Dairy Drive
City of Madison, Dane County, Wisconsin

Dear Mr. Evans:

As requested, Construction • Geotechnical Consultants, Inc. (CGC) arranged for geophysical testing to further evaluate the subsurface conditions as it relates to seismic site class. The recommendations in other sections of our report (Report C17051-15, dated July 14, 2017) completed for this project are still current. We are sending you an electronic copy of this report and can provide a paper copy upon request.

GEI Consultants, Inc. (GEI) (under subcontract to CGC) completed a Refraction Micro-Tremor (ReMi) survey on July 28, 2017 in order to estimate the shear wave velocity profile within the upper 100 ft of the site. The findings of their geophysical survey indicated that the shear wave velocity profile was fairly low in the upper approximately 20 ft of the site, which is consistent with the findings of the previously-completed soil borings on this site that encountered loose sands to approximately 20 ft below existing grade. The ReMi survey indicates that the density of the soil increases with depth (based on increased shear wave velocity), with a noticeable increase in shear wave velocity near 85 ft, which is generally consistent with very dense soil. Based on the ReMi survey, the average shear wave velocity in the upper 100 ft of the site was determined to be 1,076 feet per second. GEI's report is attached for additional information on the test methods, results and conclusions.

In our opinion, based on the average shear wave velocity of 1,076 feet per second in the upper 100 ft of the site, the average soil properties in the upper 100 ft of the site can be characterized as a stiff soil profile. This characterization would classify the site as **Site Class D** for seismic design according to International Building Code (see Table 1613.5.2).

2921 Perry Street, Madison WI 53713
Telephone: 608/288-4100
FAX: 608/288-7887

* * * * *

We trust that this report satisfies the current needs of this project. If you have any questions or need additional consultation, please contact us.

Sincerely,

CGC, Inc.

David A. Staab, P.E., LEED AP
Senior Consulting Professional

Encl: Appendix A - GEI Report, Date August 3, 2017

APPENDIX A

GEI REPORT (Project No. 1703284), DATED AUGUST 3, 2017

GEI Consultants

Consulting Engineers and Scientists

August 3, 2017
GEI Project No. 1703284

VIA EMAIL: *dstaab@cgcinc.net*

David A. Staab, P.E., LEED AP
CGC, Inc.
2921 Perry Street
Madison, WI 53713

RE: Seismic Site Classification at the Proposed Madison Fire Station, Madison, Wisconsin

Dear Mr. Staab:

We are pleased to present the following report on the seismic testing that we performed in accordance with our agreement.

Introduction

GEI Consultants, Inc. (GEI) was instructed by CGC, Inc. to perform a Refraction Micro-tremor (ReMi) survey for seismic site classification at the site for the proposed Madison Fire Station at 3201 Dairy Drive in Madison, Wisconsin. GEI performed the ReMi measurements at the above-referenced site on Friday, July 28, 2017.

Test Results

To characterize the shear wave velocity characteristics of the subsurface profile, GEI conducted a ReMi survey within the development area in the locations shown on Figure No. 1. The ReMi method is described in Louie, 2001 ((Louie, J, N., 2001, Faster, Better: Shear-wave Velocity to 100 Meters Depth from Refraction Microtremor Arrays: Bulletin of the Seismological Society of America, v. 91, p. 347-364). The method uses standard seismic P-wave recording equipment and ambient noise to produce average one-dimensional shear-wave profiles.

The survey line laid out for this work employed a total of 24 geophones spaced at 10 foot centers. Data was recorded in 20 second samples, with a 2-millisecond sampling rate per channel, utilizing a Geometrics 24 channel "Geode" seismograph and 4.5 Hz. geophones.

GEI Consultants, Inc.
400 N. Lakeview Parkway, Suite 140, Vernon Hills, IL 60061
847.984.3401 fax: 847.984.3532

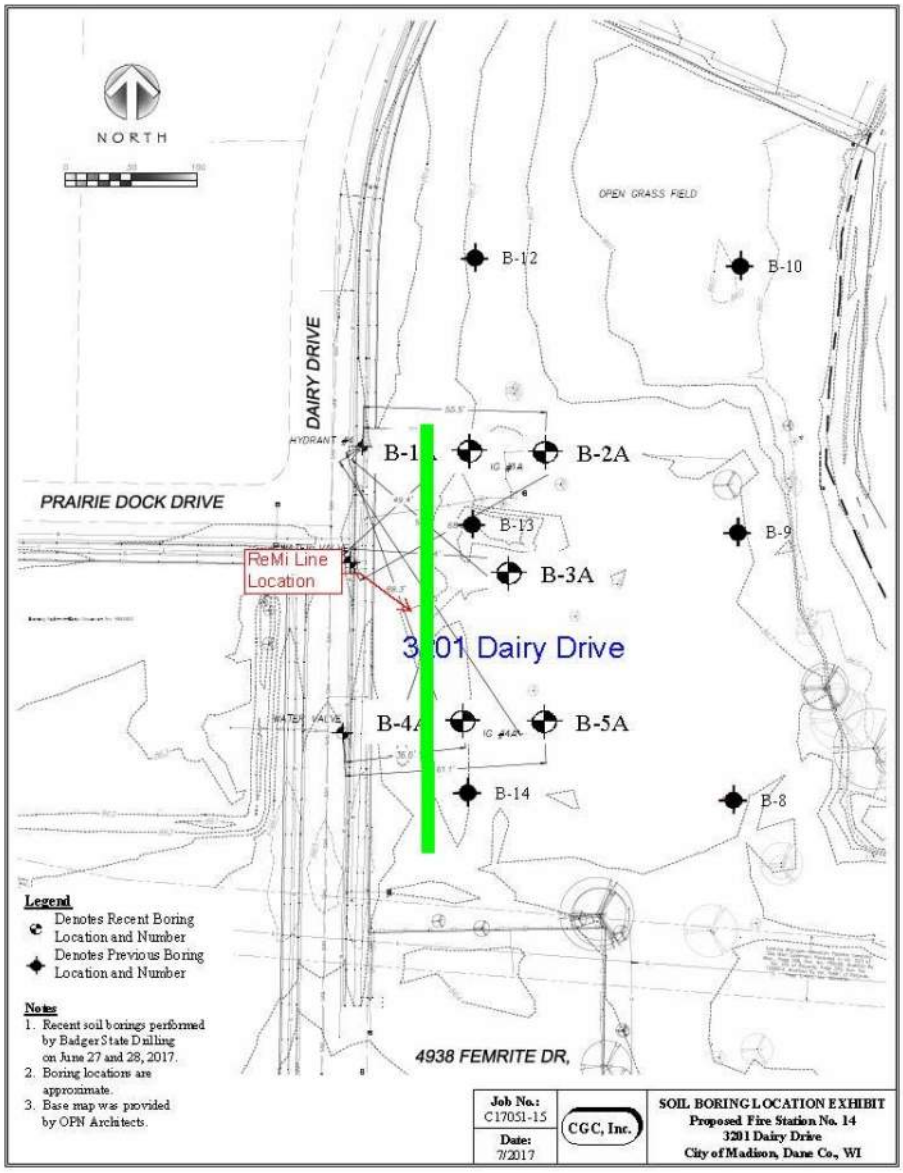


Figure No. 1

Background vibrations from vehicle traffic on the adjacent road were measured and employed in a wave-field transformation data processing technique to permit interpretation of the shear wave velocity profile using the ReMi "V-Spect" Computer program, developed by Optim Software. The resulting profile, presented in Figure No. 2, represents the average shear wave velocity profile over the length of the array. However, it should be noted that the actual profile varies from point to point over the extent of the array.

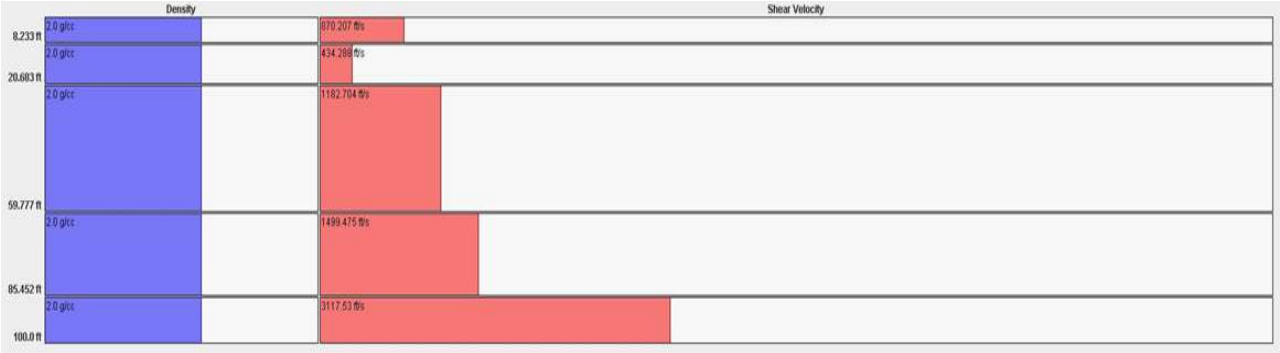


Figure No. 2

In general, the shear wave velocity was found to be relatively low within the upper 20 feet of the subsurface profile, with a gradual increase to a depth of about 85 feet. Below 85 feet a relatively high shear wave velocity, consistent with very dense soil, was interpreted from the results. This is consistent with the results of soil test borings drilled on the site, which were provided for our review.

Conclusion

The average shear wave velocity to a depth of 100 feet determined from this test was 1076 feet per second. This value is consistent with the characteristics of Seismic Site Class D as defined by the International Building Code.

We thank you for this opportunity to provide our services to CGC, Inc. If you have any questions regarding the contents of this report, please do not hesitate to contact us at 847-984-3401.

Respectfully,

GEI CONSULTANTS, INC.

Sean B. Brady
Senior Instrumentation Specialist

Bernard H. Hertlein, FACI, M. ASCE, M.GI
Senior Consultant

SBB:nls

CGC, Inc.

Construction • Geotechnical
Consulting Engineering/Testing

September 26, 2017
C17051-15

Mr. Jon Evans, P.E., LEED AP-BD&C
Building Design Project Manager
Department of Public Works
Engineering Division
City-County Building, Room 115
210 Martin Luther King Jr. Blvd
Madison, WI 53703

Re: Supplemental Geotechnical Exploration Report
Proposed Fire Station No. 14 – Helical Pier Alternative
3201 Dairy Drive
City of Madison, Dane County, Wisconsin

Dear Mr. Evans:

Construction • Geotechnical Consultants, Inc. (CGC) has completed the supplemental geotechnical exploration program for the proposed Fire Station No. 14 on Dairy Drive. The purpose of this exploration program was to evaluate the deeper subsurface conditions within the planned construction area and to provide geotechnical recommendations regarding helical pier design/construction. We are sending you an electronic copy of this report and we can provide a paper copy upon request.

PROJECT DESCRIPTION AND SITE CONDITIONS

We understand that Fire Station No. 14 is proposed for a vacant parcel on the east side of Dairy Drive, across from the intersection with Prairie Dock Drive. A geotechnical report including recommendations regarding site preparation, foundation, floor slab and pavement design/construction along with our assessment of the site class for seismic design was issued by us on July 13, 2017. A geophysical investigation of the site was conducted thereafter to more accurately determine (and improve) the site class for seismic design of the planned building, which was included in a report dated August 7, 2017.

Since our initial foundation recommendations included intermediate to deep foundations due to very loose sands extending fairly deep below the ground surface on this site, but previous borings were only performed to depths of 30 ft below current site grades, one additional boring (Boring 6A) was performed within the planned building footprint to gather more information for helical pier design.

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SUBSURFACE CONDITIONS

Subsurface conditions were explored for this study by drilling one Standard Penetration Test (SPT) soil boring (labeled B-6A) to a planned depth of 90 ft below the ground surface. However, the boring was stopped at 70 ft after encountering about 13 ft of very dense soil. The boring location was selected and field-staked by CGC. The boring was drilled on September 21, 2017 by Badger State Drilling (under subcontract to CGC) using an ATV-mounted D-50 rotary drill rig equipped with hollow-stem augers, mud rotary equipment and an automatic SPT hammer. The ground surface elevations at the boring location was interpolated by CGC using a topographic site plan (showing 1-ft contour lines), which was provided to us by OPN Architect, and should therefore be considered approximate.

In addition to the deep boring recently performed within the building footprint, we have also included five SPT soil borings that were performed earlier this summer within the building footprint (labeled B-1A through B-5A) and six previous soil borings located in the vicinity of the proposed building in our evaluation of the site. Specific procedures used for drilling and sampling are described in Appendix A, and the recent and previous boring locations are shown in plan on the Soil Boring Location Exhibit attached in Appendix B.

The subsurface profiles at the boring locations varied somewhat at shallow depths due to previous site development and grading, but the profiles were fairly similar with depth. The following strata were typically encountered (in descending order):

- About 8 to 14 in. of ***topsoil/topsoil fill*** in about half of the borings; over
- About 2.3 to 6 ft of ***fill*** or ***possible fill*** in most borings, consisting primarily of soft to very stiff clay with variable sand and gravel contents as well as occasional organic inclusions (roots and other organic matter), and secondarily of medium dense sand with considerable silt and gravel contents; followed by
- About 1.5 to 3.5 ft of natural, soft to very stiff ***lean to silty clay*** with varying sand content and very loose to loose ***clayey sand*** in most borings; and/or
- Very loose to medium dense (with isolated dense zones) ***sand*** with variable silt and gravel contents to the maximum depths explored in most borings/to about 37 ft below the ground surface in B-6A; underlain by
- About 15 ft of cohesive/fine-grained strata, consisting of loose to medium dense ***sandy silt*** and stiff to very stiff ***lean to fat clay*** that extended to a depth of approximately 52 ft in Boring 6A; over

- Medium dense to very dense ***sand*** with typically considerable silt and gravel contents and scattered cobbles/boulders to the termination depth of 70 ft in Boring 6A. Note that the sand became very dense about 57 ft below existing grade.

Exceptions to the above profile include the following: Instead of *topsoil*, about 4 and 12 in. of ***sand/gravel surface*** was encountered in Borings 3A and 13, respectively, while borings 4A, 5A, 8 and 9 did not contain either. The *fill/possible fill* layer was not present in Boring 12, which featured a profile of topsoil over apparent natural clay that was underlain by natural sand strata. Conversely, *natural clays* were apparently missing in Borings 1A and 8 through 10. However, approximately 3.5-ft thick ***probable buried topsoil layers*** were encountered below the fill in Borings 8 and 9. The organic content (as measured by loss-on-ignition) of the buried topsoil layer ranged from 6.5% to 9.1%, with soils with loss on ignition exceeding 4% being considered organic. The shallow clays (fill and natural) were soft to very stiff, with moisture contents ranging from 14.9% to 29.5% in representative samples. Some of the on-site cohesive soils should therefore be considered slightly to moderately compressible. Possible clay fill samples obtained from Borings 1A and 4A containing apparent organic pockets had overall organic contents between 2.6% and 3.4%.

Groundwater was encountered in the borings during drilling at about 6 to 8.5 ft below site grades (corresponding to approximately EL 854.4 to 857.5 ft). Groundwater levels can be expected to fluctuate with seasonal variations in precipitation, infiltration, evapotranspiration, the level of nearby streams and lakes, the pumping rate of nearby wells and other factors. A more detailed description of the site soil and groundwater conditions is presented on the Soil Boring Logs attached in Appendix B, which also contain the laboratory test results.

DISCUSSION AND RECOMMENDATIONS

Subject to the limitations discussed below and based on the subsurface exploration, it is our opinion that the site is generally suitable for construction. *However, based on the presence of fairly deep, very loose sands within large portions of the proposed building footprint, a conventional spread footing foundation system at a typical design bearing pressure is likely not feasible for most of the planned building, as adequate undercutting/replacement of marginal soils will likely be impractical due to shallow groundwater.* In our opinion, suitable foundation support will require ground improvement with rammed aggregate piers (RAPs), which was discussed in detail in or previous report. Alternatively, the building could be supported on deep foundations such as helical piers, which was only briefly discussed previously because subsurface information was not sufficient for helical pier design recommendations at that point. More detailed recommendations for helical pier design/construction are included in the following paragraphs. Additional information regarding the conclusions and recommendations presented in this report is discussed in Appendix C.

Helical Piers

In our opinion, the proposed building can be supported on helical piers that extend through the existing fill, marginal shallow clay/clayey sand, very loose sand and underlying silt/clay strata, and bear within the medium dense to very dense sand layers that were encountered below a depth of approximately 52 ft in Boring 6A. The soil parameters included in Table I should be used for helical pier design.

Helical pier capacity will vary depending on the number and size of helices, depth of installation and bearing stratum. Utilizing the parameters summarized in Table I, we used the commercially available software HeliCap®, produced by Hubbell Power Systems, to develop *preliminary* helical pier capacity estimates for a three-helix configuration (10 in., 12 in. and 14 in.) on a larger diameter circular shaft. In general, we estimate that *ultimate* helical pier capacities (in compression) ranging from about 100 to 180 kips can be developed for 50 to 60-ft long helical piers (below the bottom of foundation grade). Note that the helical pier capacity at these higher loads appears to be limited by the structural capacity of the helices and not from the geotechnical capacity of the soils. We anticipate that helical piers will encounter refusal shortly after reaching the very dense sand strata (below about 57 ft in Boring 6A). *The helical pier depths and capacities should be considered approximate and, since helical piers are proprietary, the helical pier installer should determine the helix configuration and depth necessary to satisfy project requirements.*

The installation torque is correlated with capacity, although static load tests can also be completed to confirm the ultimate and allowable capacities. A minimum factor of safety of 2.0 to 3.0 is generally used for helical pier design. If a factor of safety of 2.0 is used to determine the allowable helical pier capacity, we recommend that at least one static load test be performed to confirm the helical pier design satisfies the project requirements. Static load tests should be performed on piers installed to similar installation depths and torques as production piers. Additionally, the torque of each pier should be monitored during installation to document that each pier is torqued to the minimum torque established by the static load tests or empirical correlations to ultimate capacity. If static load tests are not performed, we recommend using a minimum factor of safety of 2.5 to 3.0 in determining the allowable capacity, and the installation torque of each pier should be monitored, which is empirically correlated to the ultimate capacity. *Since there are multiple proprietary helical pier systems, it is the responsibility of the contractor to determine that their selected helical pier configuration, installation procedures and termination criteria satisfy the project requirements.*

TABLE 1

Recommended Soil Parameters for Helical Pier Foundations

Proposed Fire Station No. 14, 3201 Dairy Drive, Madison, WI

Soil Layer	Cohesive FILL / Possible Fill and Natural CLAY to Clayey SAND		Very Loose to Medium Dense SAND		Medium Dense SAND with variable Silt and Gravel Contents		Medium Dense Sandy SILT		Stiff to Very Stiff Lean to Fat CLAY		Loose Sandy SILT		Medium Dense SAND		Very Dense SAND, Some Silt and Gravel	
Approximate Depth	**Top**	**Bottom**	**Top**	**Bottom**	**Top**	**Bottom**	**Top**	**Bottom**	**Top**	**Bottom**	**Top**	**Bottom**	**Top**	**Bottom**	**Top**	**Bottom**
Boring 1A	0 ft	6 ft	6 ft	11 ft	11 ft	30 ft (1)										
Boring 2A	0 ft	6 ft	6 ft	11 ft	11 ft	30 ft (1)										
Boring 3A	0 ft	6 ft	6 ft	16 ft	16 ft	30 ft (1)										
Boring 4A	0 ft	8.5 ft	8.5 ft	22 ft	22 ft	30 ft (1)										
Boring 5A	0 ft	6 ft	6 ft	22 ft	22 ft	30 ft (1)										
Boring 6A	0 ft	5.5 ft	5.5 ft	17 ft	17 ft	37 ft	37 ft	42 ft	42 ft	47 ft	47 ft	52 ft	52 ft	57 ft	57 ft	70 ft (1)
Boring 13	0 ft	5.5 ft	5.5 ft	18 ft	18 ft	30 ft (1)										
Boring 14	0 ft	7 ft	7 ft	22 ft	22 ft	30 ft (1)										
Estimated Soil Parameters (2)																
Short-term Loading Conditions																
Angle of internal friction, ϕ	**0** degrees		**26** degrees		**32** degrees		**30** degrees		**0** degrees		**28** degrees		**32** degrees		**38** degrees	
Cohesion	**750** lb/sq ft		**0** lb/sq ft		**0** lb/sq ft		**0** lb/sq ft		**1500** lb/sq ft		**0** lb/sq ft		**0** lb/sq ft		**0** lb/sq ft	
Long-term Loading Conditions																
Angle of internal friction, ϕ	**25** degrees		**26** degrees		**32** degrees		**30** degrees		**25** degrees		**28** degrees		**32** degrees		**36** degrees	
Cohesion	**30** lb/sq ft		**0** lb/sq ft		**0** lb/sq ft		**0** lb/sq ft		**30** lb/sq ft		**0** lb/sq ft		**0** lb/sq ft		**0** lb/sq ft	
Moist unit weight	**120** lb/cu ft		**110** lb/cu ft		**120** lb/cu ft		**120** lb/cu ft		**120** lb/cu ft		**115** lb/cu ft		**120** lb/cu ft		**125** lb/cu ft	
Submerged unit weight	**125** lb/cu ft		**120** lb/cu ft		**130** lb/cu ft		**130** lb/cu ft		**125** lb/cu ft		**125** lb/cu ft		**130** lb/cu ft		**135** lb/cu ft	
Buoyant unit weight	**63** lb/cu ft		**58** lb/cu ft		**68** lb/cu ft		**68** lb/cu ft		**63** lb/cu ft		**63** lb/cu ft		**68** lb/cu ft		**73** lb/cu ft	
Earth pressure coefficients																
Active, Ka	**1.00**		**0.39**		**0.31**		**0.33**		**1.00**		**0.36**		**0.31**		**0.24**	
Passive, Kp	**1.00**		**2.56**		**3.25**		**3.00**		**1.00**		**2.77**		**3.25**		**4.20**	

Notes:

(1) End of boring.

(2) Does not include factor of safety.

Other helical pier considerations include the following:

- *Prospective helical pier contractors should be aware of the presence of possible buried concrete within the surficial fill soils (or other remnants of the former development) and very dense zones or possible cobbles and boulders within the predominantly very loose to medium dense natural sand strata, that may impact helical pier installation.* The helical pier installer should have provisions to deal with the presence of potential obstructions. If obstructions are encountered, removing obstructions with an excavator would be one method to deal with the obstructions. Using smaller diameter helix configuration may also assist in the installation process but may require deeper piers to develop capacity.

- The existing fill, marginal shallow clay/clayey sand and very loose sand layers have relatively low lateral capacity. As such, round helical pier shafts, which have higher resistance to buckling, are recommended over square shafts. A buckling analysis should be completed to check that the pier shaft has adequate buckling resistance.

- Portions of the existing fill soils could potentially contain contaminants that may represent an increase in corrosion potential for the steel helical pier shafts. We therefore recommend that measures be taken to protect the helical pier shafts from corrosion, such as with a corrosion-resistant coating, or by increasing the thickness of the steel shafts to account for section loss due to corrosive soils. The final helical pier design should take into account the potentially corrosive nature of some of the soils at this site.

- Pile caps along the perimeter of the building should be located a minimum of 4 ft below finish grade for frost protection.

- We recommend helical pier installation, pile cap subgrade preparation and concrete placement be monitored by CGC.

As discussed in the initial geotechnical report, since floor slab loads are expected to be fairly light, we anticipate that the floor slab will be a conventional concrete slab-on-grade. Note, however, that undercutting/replacement of some of the shallow fill and natural soils will likely be required to develop a suitable subgrade for slab support. Although structural slab support on helical piers could be considered, we anticipate a conventional slab-on-grade with undercutting/replacement will be economically favorable to a structural slab. We can provide additional information, if needed.

* * * * *

It has been a pleasure to serve you on this project. If you have any questions or need additional consultation, please contact us.

Sincerely,

CGC, Inc.

Tim F. Gassenheimer, E.I.T.
Staff Engineer

David A. Staab, P.E., LEED AP
Senior Consulting Professional

Encl: Appendix A - Field Exploration
Appendix B - Soil Boring Location Exhibit
Log of Recent Test Boring (1)
Logs of Previous Test Borings – June 2017 (5)
Logs of Previous Test Borings – July 2013 (6)
Log of Test Boring-General Notes
Unified Soil Classification System
Appendix C - Document Qualifications

APPENDIX A

FIELD EXPLORATION REPORT

APPENDIX A

FIELD EXPLORATION

Subsurface conditions were explored for this study by drilling one Standard Penetration Test (SPT) soil boring (labeled B-6A) to a planned depth of 90 ft below the ground surface. However, the boring was stopped at 70 ft after encountering about 13 ft of very dense soil. The boring location was selected and field-staked by CGC. The boring was drilled on September 21, 2017 by Badger State Drilling (under subcontract to CGC) using an ATV-mounted D-50 rotary drill rig equipped with hollow-stem augers, mud rotary equipment and an automatic SPT hammer. The ground surface elevations at the boring location was interpolated by CGC using a topographic site plan (showing 1-ft contour lines), which was provided to us by OPN Architect, and should therefore be considered approximate.

In addition to the deep boring recently performed within the building footprint, we have also included five SPT soil borings that were performed earlier this summer within the building footprint (labeled B-1A through B-5A) and six previous soil borings located in the vicinity of the proposed building in our evaluation of the site.

In the previous borings, soil samples were obtained at 2.5-foot intervals to a depth of 10 ft and at 5 ft intervals thereafter. To better explore the extent of very loose sands, most of the the recent borings were samples at 2.5-foot intervals to a depth of 20 ft and at 5 ft intervals thereafter. The soil samples were obtained in general accordance with specifications for standard penetration testing, ASTM D 1586. The specific procedures used for drilling and sampling are described below.

1. Boring Procedures between Samples

   The boring is extended downward, between samples, by a hollow-stem auger.

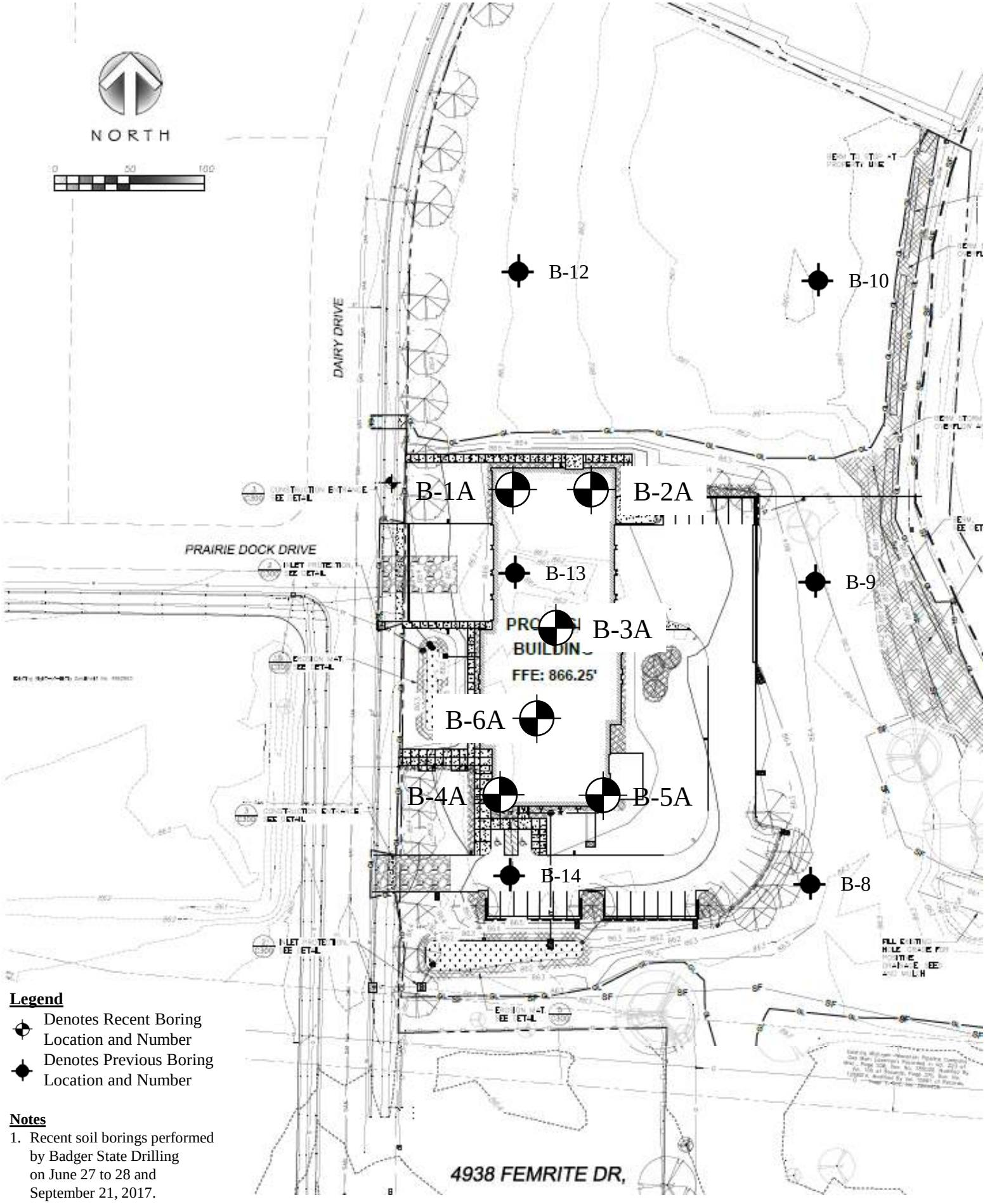
2. Standard Penetration Test and Split-Barrel Sampling of Soils
   (ASTM Designation: D 1586)

   This method consists of driving a 2-inch outside diameter split-barrel sampler using a 140-pound weight falling freely through a distance of 30 inches. The sampler is first seated 6 inches into the material to be sampled and then driven 12 inches. The number of blows required to drive the sampler the final 12 inches is recorded on the log of borings and is known as the Standard Penetration Resistance.

During the field exploration, the driller visually classified the soil and prepared a field log. *Field screening of the soil samples for possible environmental contaminants was not conducted by the drillers as environmental site assessment activities were not part of CGC's work scope.* Water level observations were made in each boring during and after drilling and are shown at the bottom of each boring log. Upon completion of drilling, the borings were backfilled with bentonite to satisfy WDNR regulations, and the soil samples were delivered to our laboratory for visual classification and laboratory testing. The soil samples were visually classified by a geotechnical engineer using the Unified Soil Classification System. The final logs prepared by the engineer, including laboratory test results, a boring location map, and a description of the Unified Soil Classification System are presented in Appendix B.

APPENDIX B

SOIL BORING LOCATION EXHIBIT
LOGS OF TEST BORINGS (1)
LOG OF PREVIOUS TEST BORINGS – JUNE 2017 (5)
LOG OF PREVIOS TEST BORINGS – JULY 2013 (6)
LOG OF TEST BORING – GENERAL NOTES
UNIFIED SOIL CLASSIFICATION SYSTEM



Legend

- Denotes Recent Boring Location and Number
- Denotes Previous Boring Location and Number

Notes

1. Recent soil borings performed by Badger State Drilling on June 27 to 28 and September 21, 2017.
2. Boring locations are approximate.
3. Base map was provided by OPN Architects.

Job No.: C17051-15	**CGC, Inc.**	**SOIL BORING LOCATION EXHIBIT**
Date: 09/2017		**Proposed Fire Station No. 14**
		3201 Dairy Drive
		City of Madison, Dane Co., WI

CGC Inc.

LOG OF TEST BORING

Project **Proposed Fire Station No. 14**
3201 Dairy Drive
Location **City of Madison, Dane Co., WI**

Boring No. **6A**
Surface Elevation (ft) **± 864.0**
Job No. **C17051-15**
Sheet **1** of **2**

2921 Perry Street, Madison, WI 53713 (608) 288-4100, FAX (608) 288-7887

SAMPLE No.	TYPE	Rec (in.)	Moist	N	Depth (ft)	VISUAL CLASSIFICATION and Remarks	qu (qa) (tsf)	W	LL	PL	LI
						± 6 in. TOPSOIL FILL with Gravel (OL - Fill)					
1	■	18	M	8		Very Stiff, Gray/Brown (Mottled) Lean CLAY, Trace Sand (CL)	(3.0-3.5)				
2	■	18	M	8		Loose, Gray Clayey Fine to Medium SAND, Scattered Less Clayey Seams (SC)					
3	■	12	M/W	7	5	Very Loose to Loose, Tan Fine to Medium SAND, Trace Silt and Gravel (SP)					
4	■	12	W	2	▽						
5	■	10	W	6	10	*Grading Gray near 13.5 ft*					
6	■	12	W	32	15	Medium Dense to Dense, Gray Fine SAND, Some Silt, Trace Gravel (SM)					
7	■	12	W	16	20						
8	■	10	W	6	25	Loose, Grayish Brown Fine to Medium SAND, Little Silt, Trace Gravel (SP-SM)					
9	■	12	W	16	30	Medium Dense, Gray Fine to Medium SAND, Some Silt, Trace Gravel (SM)					
					35						

WATER LEVEL OBSERVATIONS

While Drilling ▽ **8.5'** Upon Completion of Drilling _____
Time After Drilling _____
Depth to Water _____ ▼
Depth to Cave in _____

The stratification lines represent the approximate boundary between soil types and the transition may be gradual.

GENERAL NOTES

Start **9/21/17** End **9/21/17**
Driller **BSD** Chief **KD** Rig **D-50**
Logger **DB** Editor **TFG**
Drill Method **2.25" HSA (0-10') / MR (10-70'); Autohammer**

CGC Inc.

LOG OF TEST BORING

Project **Proposed Fire Station No. 14**
3201 Dairy Drive
Location **City of Madison, Dane Co., WI**

Boring No. **6A**
Surface Elevation **± 864.0**
Job No. **C17051-15**
Sheet **2** of **2**

2921 PERRY STREET, MADISON, WIS. 53713 (608) 288-4100, FAX (608) 288-7887

SAMPLE No.	TYPE	Rec (in.)	Moist	N	Depth (ft)	VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES qu (qa) (tsf)	W	LL	PL	LI
						Medium Dense, Gray Sandy SILT, Scattered Lean to Fat Clay Seams (ML)					
10		12	W	17	40						
						Stiff to Very Stiff, Gray Lean to Fat CLAY, Trace Sand (CL/CH)					
11		18	W	17	45		(1.5-3.5)				
						Loose, Gray Sandy SILT, Scattered Lean to Fat Clay Seams (ML)					
12		18	W	6	50						
						Medium Dense, Grayish Brown Fine to Medium SAND, Little Silt, Trace Gravel (SP-SM)					
13		18	W	24	55						
						Very Dense, Gray Fine to Medium SAND, Some Silt and Gravel, Scattered Cobbles/Boulders (SM)					
14		12	W	54	60						
15		12	W	92	65						
16		10	W	50/2"	70	*Drove Stone, Possible Top of Bedrock near 68.5 ft* *Split-Spoon Refusal at 69.2 ft*					
						End of Boring at 70 ft Borehole Backfilled with Bentonite Chips					

CGC Inc.

LOG OF TEST BORING

Project **Proposed Fire Station No. 14**
3201 Dairy Drive
Location **City of Madison, Dane Co., WI**

Boring No. **1A**
Surface Elevation (ft) **± 863.0**
Job No. **C17051-15**
Sheet **1** of **1**

2921 Perry Street, Madison, WI 53713 (608) 288-4100, FAX (608) 288-7887

SAMPLE No.	TYPE	Rec (in.)	Moist	N	Depth (ft)	VISUAL CLASSIFICATION and Remarks	qu (qa) (tsf)	W	LL	PL	LI
						± 8 in. TOPSOIL (OL)					
1		12	M	5		Soft to Medium Stiff, Gray/Brown (Lightly Mottled) Lean CLAY, Little to Some Sand, Trace Gravel, Scattered Dark Gray Organic Pockets (CL - Possible Fill)	(0.75-1.0)	23.3			2.6
2		18	M	4			(0.25)	28.5			
					5	Sand and Gravel Contents Slightly Decreasing With Depth					
3		16	W	4	▽	Loose, Tan Fine to Coarse SAND, Little Gravel, Trace to Little Silt, Scattered Cobbles/Boulders (SP)					
4		18	W	9		Silt Content Slightly Increasing with Depth					
					10						
5		8	W	16		Medium Dense, Gray Fine to Medium SAND, Little Silt, Trace Gravel, Scattered Cobbles/Boulders (SP-SM)					
6		10	W	20							
					15						
7		10	W	21		Medium Dense, Gray Fine to Medium SAND, Some Silt, Trace Gravel, Scattered Cobbles/Boulders (SM)					
8		12	W	19							
					20						
9		8	W	29		Scattered Silt Seams near 23.5 ft					
					25						
10		10	W	24							
					30	End of Boring at 30 ft Borehole Backfilled with Bentonite Chips					
					35						

WATER LEVEL OBSERVATIONS

While Drilling ▽ **6.0'** Upon Completion of Drilling _____
Time After Drilling _____
Depth to Water _____ ▼
Depth to Cave in _____

The stratification lines represent the approximate boundary between soil types and the transition may be gradual.

GENERAL NOTES

Start **6/28/17** End **6/28/17**
Driller **BSD** Chief **MC** Rig **D-50**
Logger **MG/CD** Editor **TFG**
Drill Method **4.25" HSA (0-10') / MR (10-30'); Autohammer**

CGC Inc.

LOG OF TEST BORING

Project **Proposed Fire Station No. 14**
3201 Dairy Drive
Location **City of Madison, Dane Co., WI**

Boring No. **2A**
Surface Elevation (ft) **± 863.0**
Job No. **C17051-15**
Sheet **1** of **1**

2921 Perry Street, Madison, WI 53713 (608) 288-4100, FAX (608) 288-7887

SAMPLE						VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES				
No.	TYPE	Rec (in.)	Moist	N	Depth (ft)		qu (qa) (tsf)	W	LL	PL	LI
						± 8 in. TOPSOIL (OL)					
1		14	M	8		Stiff, Gray/Brown (Lightly Mottled) Lean CLAY, Little Sand, Trace Gravel, Scattered Dark Gray Organic Pockets and Roots (CL - Possible Fill)	(1.75-2.0)	25.0			
2		18	M	6	5	Soft to Medium Stiff, Gray Lean to Silty CLAY, Some Sand (CL/CL-ML)	(0.25-0.75)	14.9	20	13	
3		14	W	4		Very Loose, Tan Fine to Coarse SAND, Little Gravel, Trace Silt, Scattered Cobbles/Boulders (SP)					
4		6	W	2	10	Scattered Clay Seams near 8.5 ft					
5		16	W	15		Medium Dense, Gray Fine to Medium SAND, Some Silt, Trace Gravel, Scattered Cobbles/Boulders (SM)					
6		8	W	11	15	P200 (Sample 6): 15.0%		24.2			
7		12	W	20							
8		10	W	11	20						
9		8	W	12	25	Medium Dense, Gray Fine to Coarse SAND, Some Gravel, Little Silt, Scattered Cobbles/Boulders (SP-SM)					
10		10	W	17	30	Medium Dense, Grayish Brown Fine to Medium SAND, Some Silt, Trace Gravel, Scattered Cobbles/Boulders (SM)					
						End of Boring at 30 ft					
					35	Borehole Backfilled with Bentonite Chips					

WATER LEVEL OBSERVATIONS

While Drilling ▽ **6.0'** Upon Completion of Drilling _____
Time After Drilling _____
Depth to Water _____ ▼
Depth to Cave in _____

The stratification lines represent the approximate boundary between soil types and the transition may be gradual.

GENERAL NOTES

Start **6/28/17** End **6/28/17**
Driller **BSD** Chief **MC** Rig **D-50**
Logger **MG/CD** Editor **TFG**
Drill Method **4.25" HSA (0-10') / MR (10-30'); Autohammer**

CGC Inc.

LOG OF TEST BORING

Project **Proposed Fire Station No. 14**
3201 Dairy Drive
Location **City of Madison, Dane Co., WI**

Boring No. **3A**
Surface Elevation (ft) **± 862.0**
Job No. **C17051-15**
Sheet **1** of **1**

2921 Perry Street, Madison, WI 53713 (608) 288-4100, FAX (608) 288-7887

SAMPLE						VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES				
No.	TYPE	Rec (in.)	Moist	N	Depth (ft)		qu (qa) (tsf)	W	LL	PL	LI
						± 4 in. GRAVEL SURFACE					
1		14	M	8		Very Stiff, Gray/Brown (Lightly Mottled) Lean CLAY, Little Sand, Trace Gravel, Scattered Dark Gray Organic Pockets and Roots (CL - Possible Fill)	(2.0-2.25)	25.5			
2		12	M	7	5	Soft to Medium Stiff, Gray/Brown (Lightly Mottled) Sandy Lean CLAY, Trace Gravel (CL)	(0.25-0.75)	17.7			
3		18	W	2		Very Loose, Gray Silty Fine SAND, Layered with Tan Fine to Medium SAND, Little to Some Silt, Trace to Little Gravel (SM)					
4		16	W	2	10	Very Loose to Loose, Gray Fine to Medium SAND, Little Silt and Gravel, Scattered Cobbles/Boulders (SP-SM)					
5		16	W	7							
6		10	W	6	15						
7		18	W	22		Medium Dense, Gray Silty Fine SAND, Trace Gravel, Scattered Less Silty Fine to Medium Sand Seams (SM)					
8		12	W	9	20	Loose to Medium Dense, Gray Fine to Medium SAND, Little Silt, Trace Gravel, Scattered Cobbles/Boulders (SP-SM)					
9		14	W	23	25						
10		12	W	30	30	End of Boring at 30 ft Borehole Backfilled with Bentonite Chips					
					35						

WATER LEVEL OBSERVATIONS

While Drilling ▽ **6.0'** Upon Completion of Drilling _____
Time After Drilling _____
Depth to Water _____ ▼
Depth to Cave in _____

The stratification lines represent the approximate boundary between soil types and the transition may be gradual.

GENERAL NOTES

Start **6/27/17** End **6/28/17**
Driller **BSD** Chief **MC** Rig **D-50**
Logger **MG/CD** Editor **TFG**
Drill Method **4.25" HSA (0-10') / MR (10-30'); Autohammer**

CGC Inc.

LOG OF TEST BORING

Project **Proposed Fire Station No. 14**
3201 Dairy Drive
Location **City of Madison, Dane Co., WI**

Boring No. **4A**
Surface Elevation (ft) **± 864.0**
Job No. **C17051-15**
Sheet **1** of **1**

2921 Perry Street, Madison, WI 53713 (608) 288-4100, FAX (608) 288-7887

SAMPLE						VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES				
No.	TYPE	Rec (in.)	Moist	N	Depth (ft)		qu (qa) (tsf)	W	LL	PL	LI
						FILL: Dark Gray Silty Clay, Some Sand, Little Gravel, Trace Organics, Scattered Roots (Possible Tospoil Fill)					
1	■	12	M	10			(-)	16.8			3.4
2	■	8	M	7		FILL: Medium Stiff to Stiff, Gray/Tan/Reddish Brown Lean to Silty Clay, Some Sand, Trace Gravel, Numerous Roots	(0.5-1.25)	17.5			
3	■	10	M	4	5	Very Loose to Loose, Gray Clayey Fine to Medium SAND, Scattered Lean Clay Seams (SC)		16.7			
4	■	12	W	6		Loose, Tan Fine to Coarse SAND, Little Gravel, Trace Silt, Scattered Cobbles/Boulders (SP)					
5	■	8	W	3	10	Very Loose, Tan Fine to Medium SAND, Trace to Little Silt and Gravel, Scattered Cobbles/Boulders (SP/SP-SM)					
6	■	10	W	2		P200 (Sample 6): 2.5%		22.3			
7	■	14	W	4	15	Grading Gray/Gravel Content Slightly Increasing with Depth					
8	■	10	W	2							
9	■	12	W	13	20	Medium Dense, Tan Fine to Medium SAND, Some Silt, Trace Gravel, Scattered Cobbles/Boulders (SM)					
10	■	12	W	18	25						
					30	End of Boring at 30 ft Borehole Backfilled with Bentonite Chips					
					35						

WATER LEVEL OBSERVATIONS

While Drilling ▽ **8.5'** Upon Completion of Drilling _____
Time After Drilling _____
Depth to Water _____ ▼
Depth to Cave in _____

The stratification lines represent the approximate boundary between soil types and the transition may be gradual.

GENERAL NOTES

Start **6/27/17** End **6/27/17**
Driller **BSD** Chief **MC** Rig **D-50**
Logger **MG/CD** Editor **TFG**
Drill Method **4.25" HSA (0-10') / MR (10-30'); Autohammer**

CGC Inc.

LOG OF TEST BORING

Project **Proposed Fire Station No. 14**
3201 Dairy Drive
Location **City of Madison, Dane Co., WI**

Boring No. **5A**
Surface Elevation (ft) **± 863.5**
Job No. **C17051-15**
Sheet **1** of **1**

2921 Perry Street, Madison, WI 53713 (608) 288-4100, FAX (608) 288-7887

SAMPLE						VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES				
No.	TYPE	Rec (in.)	Moist	N	Depth (ft)		qu (qa) (tsf)	W	LL	PL	LI
						FILL: Stiff, Gray/Dark Gray/Brown Lean Clay, Some Sand, Scattered Roots					
1	■	10	M	6			(1.25-1.75)	22.0			
2	■	12	M	9	5	Stiff, Gray/Brown (Lightly Mottled) Sandy Lean CLAY, Trace Gravel (CL)	(1.5-1.75)	16.4			
3	■	12	W	5		Loose, Tan Fine to Medium SAND, Trace Silt and Gravel, Scattered Cobbles/Boulders (SP)					
4	■	10	W	2	10	Very Loose, Tan Fine to Medium SAND, Little Silt and Gravel, Scattered Cobbles/Boulders (SP-SM)					
5	■	12	W	3		Very Loose, Gray Fine to Medium SAND, Some Silt, Trace Gravel and Organics, Scattered Tan Less Silty Seams and Cobbles/Boulders (SM)					
6	■	10	W	2	15						
7	■	10	W	5		Very Loose to Loose, Gray Fine to Medium SAND, Little Silt and Gravel, Scattered Cobbles/Boulders (SP-SM)					
8	■	8	W	2	20						
9	■	12	W	19	25	Medium Dense, Gray Fine to Medium SAND, Some Gravel, Little Silt, Scattered Silt Seams and Cobbles/Boulders (SP-SM)					
10	■	12	W	21	30	Medium Dense, Gray Fine to Medium SAND, Some Silt, Little Gravel, Scattered Cobbles/Boulders (SM)					
						End of Boring at 30 ft Borehole Backfilled with Bentonite Chips					
					35						

WATER LEVEL OBSERVATIONS

While Drilling ▽ **8.5'** Upon Completion of Drilling _____
Time After Drilling _____
Depth to Water _____ ▼
Depth to Cave in _____

The stratification lines represent the approximate boundary between soil types and the transition may be gradual.

GENERAL NOTES

Start **6/27/17** End **6/27/17**
Driller **BSD** Chief **MC** Rig **D-50**
Logger **MG/CD** Editor **TFG**
Drill Method **4.25" HSA (0-10') / MR (10-30'); Autohammer**

CGC Inc.

LOG OF TEST BORING

Project **Proposed Fire Station #14 & Fire Training Site**
Femrite Drive and Dairy Drive
Location **Madison, Wisconsin**

Boring No. **8**
Surface Elevation (ft) **863.8**
Job No. **C13064-7**
Sheet **1** of **1**

2921 Perry Street, Madison, WI 53713 (608) 288-4100, FAX (608) 288-7887

SAMPLE						VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES				
No.	TYPE	Rec (in.)	Moist	N	Depth (ft)		qu (qa) (tsf)	W	LL	PL	LI
1		18	M	15		FILL: Medium Dense, Tan Fine to Medium Sand, Some Silt and Gravel USDA: FILL - 2.5Y 5/3 Sandy Loam					
2		10	M	5	5	FILL: Soft to Medium Stiff, Dark Gray/Gray Lean Clay, Little to Some Sand, Trace Organics USDA: FILL - 10YR 3/1, 5/2 Silty Clay Loam	(0.5)	15.4			
3		8	M	5		Medium Stiff, Dark Gray/Black Organic CLAY (OL - Probable Buried Topsoil) USDA: 10YR 2/1 Silty Clay Loam	(1.0)	26.6			9.1
4		18	W	10	10	Very Loose to Loose, Brown Fine to Medium SAND, Trace to Little Silt, Trace Gravel (SP/SP-SM) USDA: 10YR 5/3 Sand					
5		5	W	2	15						
6		3	W	4	20						
7		12	W	14	25	Medium Dense, Brown Fine SAND, Trace to Little Silt (SP/SP-SM) USDA: 10YR 5/3 Fine Sand					
8		8	W	21	30	Medium Dense, Gray-Brown Fine to Medium SAND, Trace to Little Silt, Trace Gravel (SP/SP-SM) USDA: 10YR 5/2 Sand					
					35	End of Boring at 30 ft Borehole Backfilled with bentonite chips and slurry					

WATER LEVEL OBSERVATIONS

While Drilling ▽ **8.0'** Upon Completion of Drilling _____
Time After Drilling _____
Depth to Water _____ ▼
Depth to Cave in _____

The stratification lines represent the approximate boundary between soil types and the transition may be gradual.

GENERAL NOTES

Start **7/22/13** End **7/22/13**
Driller **BSD** Chief **DC** Rig **CME-750**
Logger **JM** Editor **DAS**
Drill Method **2.25" HSA; 0-10'; 3-7/8"**
RB/DM; Autohammer

CGC Inc.

LOG OF TEST BORING

Project **Proposed Fire Station #14 & Fire Training Site**
Femrite Drive and Dairy Drive
Location **Madison, Wisconsin**

Boring No. **9**
Surface Elevation (ft) **863.5**
Job No. **C13064-7**
Sheet **1** of **1**

2921 Perry Street, Madison, WI 53713 (608) 288-4100, FAX (608) 288-7887

SAMPLE No.	TYPE	Rec (in.)	Moist	N	Depth (ft)	VISUAL CLASSIFICATION and Remarks	qu (qa) (tsf)	W	LL	PL	LI
						FILL: Medium Dense, Tan Fine to Medium Sand, Some Silt and Gravel USDA: FILL - 2.5Y 5/3 Sandy Loam					
1	■	18	M	17							
						Loose, Dark Gray/Black Organic Clayey SILT (OL - Probable Buried Topsoil) USDA: 10YR 2/1 Silt Loam					
2	■	15	M	5	5			19.3			6.5
						Very Loose to Medium Dense, Brown Fine to Medium SAND, Trace to Little Silt, Trace Gravel (SP/SP-SM) USDA: 10YR 5/3 Sand					
3	■	10	W	10							
4	■	12	W	8	10						
5	■	18	W	3	15	Grades to Fine Sand near 15 ft					
6	■	3	W	10	20						
7	■	4	W	27	25						
8	■	12	W	9	30	End of Boring at 30 ft Borehole Backfilled with bentonite chips and slurry					
					35						

WATER LEVEL OBSERVATIONS

While Drilling ▽ **6.0'** Upon Completion of Drilling _____
Time After Drilling _____
Depth to Water _____ ▼
Depth to Cave in _____

The stratification lines represent the approximate boundary between soil types and the transition may be gradual.

GENERAL NOTES

Start **7/23/13** End **7/23/13**
Driller **BSD** Chief **KD** Rig **CME-750**
Logger **JM** Editor **DAS**
Drill Method **2.25" HSA; 0-15'; 3-7/8" RB/DM 15'-30'; Autohammer**

CGC Inc.

LOG OF TEST BORING

Project **Proposed Fire Station #14 & Fire Training Site**
Femrite Drive and Dairy Drive
Location **Madison, Wisconsin**

Boring No. **10**
Surface Elevation (ft) **860.4**
Job No. **C13064-7**
Sheet **1** of **1**

2921 Perry Street, Madison, WI 53713 (608) 288-4100, FAX (608) 288-7887

SAMPLE No.	TYPE	Rec (in.)	Moist	N	Depth (ft)	VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES qu (qa) (tsf)	W	LL	PL	LI
						14 in.± Clayey TOPSOIL (OL)					
1		6	M	7		Loose, Gray Fine to Medium SAND, Some Silt, Trace Clay and Gravel (SM - Possible Fill) USDA: 10YR 5/1 Sandy Loam					
2		6	W	5	5	Very Loose to Loose, Brown Fine to Medium SAND, Trace to Little Silt, Trace Gravel (SP/SP-SM) USDA: 10YR 5/3 Sand					
3		12	W	3							
4		8	W	4	10	Color Change to Dark Brown (10YR 3/3) with Scattered Silt Seams near 7.5 ft					
5		10	W	4	15	Very Loose to Loose, Gray Fine SAND, Trace to Little Silt (SP/SP-SM) USDA: 10YR 5/2 Fine Sand					
6		9	W	9	20	Loose, Gray Fine SAND, Some Silt, Trace Gravel (SM) USDA: 10YR 5/2 Sandy Loam					
7		14	W	10	25	Loose, Gray Fine SAND, Trace to Little Silt (SP/SP-SM) USDA: 10YR 5/2 Fine Sand					
8		12	W	8	30	Scattered Silt Seams near 30 ft					
						End of Boring at 30 ft					
					35	Borehole Backfilled with bentonite chips and slurry					

WATER LEVEL OBSERVATIONS

While Drilling ▽ **6.0'** Upon Completion of Drilling _____
Time After Drilling _____
Depth to Water _____ ▼
Depth to Cave in _____

The stratification lines represent the approximate boundary between soil types and the transition may be gradual.

GENERAL NOTES

Start **7/24/13** End **7/24/13**
Driller **BSD** Chief **KD** Rig **CME-750**
Logger **JM** Editor **DAS**
Drill Method **2.25" HSA; 0-10'; 3-7/8" RB/DM; Autohammer**

LOG OF TEST BORING

CGC Inc.

Project **Proposed Fire Station #14 & Fire Training Site**
Femrite Drive and Dairy Drive
Location **Madison, Wisconsin**

Boring No. **12**
Surface Elevation (ft) **863.2**
Job No. **C13064-7**
Sheet **1** of **1**

2921 Perry Street, Madison, WI 53713 (608) 288-4100, FAX (608) 288-7887

SAMPLE No.	TYPE	Rec (in.)	Moist	N	Depth (ft)	VISUAL CLASSIFICATION and Remarks	qu (qa) (tsf)	W	LL	PL	LI
						12 in.± Clayey TOPSOIL (OL)					
1		10	M	9		Very Stiff, Light Green-Gray/Brown (Mottled) Lean CLAY, Trace Sand (CL) USDA: 10YR 5/1 Silty Clay Loam (Redox: C2F 10YR 6/6)	(3.0)				
2		16	M	5	5	Loose, Brown Fine to Medium SAND, Trace to Little Silt, Trace Gravel (SP/SP-SM) USDA: 10YR 5/3 Sand					
3		12	W	5							
4		14	W	8	10						
5		12	W	5	15	3 in. Stiff, Gray/Brown Lean Clay Seam near 15 ft	(1.0-1.5)				
6		12	W	15	20	Medium Dense, Gray Fine SAND, Trace to Little Silt (SP/SP-SM) USDA: 10YR 5/2 Fine Sand					
7		16	W	15	25						
8		14	W	23	30						
					35	End of Boring at 30 ft Borehole Backfilled with bentonite chips and slurry					

WATER LEVEL OBSERVATIONS

While Drilling ▽ **6.0'** Upon Completion of Drilling _____
Time After Drilling _____
Depth to Water _____ ▼
Depth to Cave in _____

The stratification lines represent the approximate boundary between soil types and the transition may be gradual.

GENERAL NOTES

Start **7/24/13** End **7/24/13**
Driller **BSD** Chief **KD** Rig **CME-750**
Logger **JM** Editor **DAS**
Drill Method **2.25" HSA; 0-10'; 3-7/8" RB/DM 10'-30'; Autohammer**

LOG OF TEST BORING

CGC Inc.

Project **Proposed Fire Station #14 & Fire Training Site**
Femrite Drive and Dairy Drive
Location **Madison, Wisconsin**

Boring No. **13**
Surface Elevation (ft) **862.2**
Job No. **C13064-7**
Sheet **1** of **1**

2921 Perry Street, Madison, WI 53713 (608) 288-4100, FAX (608) 288-7887

SAMPLE No.	TYPE	Rec (in.)	Moist	N	Depth (ft)	VISUAL CLASSIFICATION and Remarks	qu (qa) (tsf)	W	LL	PL	LI
						12 in.± Sand and Gravel FILL					
1		5	M	8		Stiff to Very Stiff, Light Green-Gray/Brown (Mottled) Lean CLAY, Trace Sand (CL - Possible Fill in Upper Few Feet of Layer)	(3.5)				
2		18	M	8	5	USDA: 10YR 5/1 Silty Clay Loam (Redox: C2D 10YR 6/6)	(1.0-1.5)	29.5			
3		18	W	4		Very Loose to Loose, Brown Fine to Medium SAND, Trace to Little Silt, Trace Gravel (SP/SP-SM)					
4		18	W	4	10	USDA: 10YR 5/3 Sand					
5		3	W	4	15						
6		12	W	17	20	Medium Dense, Gray Fine SAND, Trace to Little Silt (SP/SP-SM) USDA: 10YR 5/2 Fine Sand					
7		12	W	27	25	Medium Dense, Brown Fine to Coarse SAND, Trace to Little Silt, Trace Gravel (SP/SP-SM) USDA: 10YR 5/3 Sand					
8		4	W	14	30	End of Boring at 30 ft Borehole backfilled with bentonite chips and slurry					
					35						

WATER LEVEL OBSERVATIONS

While Drilling ▽ 6.0' Upon Completion of Drilling _____
Time After Drilling _____
Depth to Water _____ ▼
Depth to Cave in _____

The stratification lines represent the approximate boundary between soil types and the transition may be gradual.

GENERAL NOTES

Start **7/22/13** End **7/22/13**
Driller **BSD** Chief **DC** Rig **CME-750**
Logger **JM** Editor **DAS**
Drill Method **2.25" HSA; 0-10'; 3-7/8" RB/DM 10'-30'; Autohammer**

CGC Inc.

LOG OF TEST BORING

Project **Proposed Fire Station #14 & Fire Training Site**
Femrite Drive and Dairy Drive
Location **Madison, Wisconsin**

Boring No. **14**
Surface Elevation (ft) **865.0**
Job No. **C13064-7**
Sheet **1** of **1**

2921 Perry Street, Madison, WI 53713 (608) 288-4100, FAX (608) 288-7887

SAMPLE No.	TYPE	Rec (in.)	Moist	N	Depth (ft)	VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES qu (qa) (tsf)	W	LL	PL	LI
						8 in.± Sandy TOPSOIL FILL (OL)					
1		12	M	12		FILL: Very Stiff, Brown/Gray Lean Clay, Trace to Little Sand USDA: FILL-10YR 4/3 Silty Clay Loam	(3.75-4.0)				
2		12	M	8	5	Stiff to Very Stiff, Gray/Brown (Mottled) Lean CLAY, Trace Sand (CL) USDA: 10YR 5/2 Silty Clay Loam (Redox: C2D 10YR 6/6)	(2.0-2.5)				
3		18	M	8			(1.0-1.5)	24.7			
4		6	W	4	10	Very Loose to Medium Dense, Brown Fine to Medium SAND, Trace to Little Silt, Trace Gravel (SP/SP-SM) USDA: 10YR 5/3 Sand					
5		18	W	4	15	Grades to Fine Sand near 15 ft					
6		6	W	2	20						
7		8	W	12	25						
8		18	W	20	30	End of Boring at 30 ft Borehole Backfilled with bentonite chips and slurry					
					35						

WATER LEVEL OBSERVATIONS

While Drilling ▽ **8.5'** Upon Completion of Drilling _____
Time After Drilling _____
Depth to Water _____ ▼
Depth to Cave in _____

The stratification lines represent the approximate boundary between soil types and the transition may be gradual.

GENERAL NOTES

Start **7/22/13** End **7/22/13**
Driller **BSD** Chief **DC** Rig **CME-750**
Logger **JM** Editor **DAS**
Drill Method **2.25" HSA; 0-10'; 3-7/8" RB/DM 10'-30'; Autohammer**

CGC, Inc.

LOG OF TEST BORING
General Notes

DESCRIPTIVE SOIL CLASSIFICATION

Grain Size Terminology

Soil Fraction	Particle Size	U.S. Standard Sieve Size
Boulders	Larger than 12"	Larger than 12"
Cobbles	3" to 12"	3" to 12"
Gravel: Coarse	¾" to 3"	¾" to 3"
Fine	4.76 mm to ¾"	#4 to ¾"
Sand: Coarse	2.00 mm to 4.76 mm	#10 to #4
Medium	0.42 to mm to 2.00 mm	#40 to #10
Fine	0.074 mm to 0.42 mm	#200 to #40
Silt	0.005 mm to 0.074 mm	Smaller than #200
Clay	Smaller than 0.005 mm	Smaller than #200

Plasticity characteristics differentiate between silt and clay.

General Terminology

Physical Characteristics
Color, moisture, grain shape, fineness, etc.
Major Constituents
Clay, silt, sand, gravel
Structure
Laminated, varved, fibrous, stratified, cemented, fissured, etc.
Geologic Origin
Glacial, alluvial, eolian, residual, etc.

Relative Density

Term	"N" Value
Very Loose	0 - 4
Loose	4 - 10
Medium Dense	10 - 30
Dense	30 - 50
Very Dense	Over 50

Relative Proportions Of Cohesionless Soils

Proportional Term	Defining Range by Percentage of Weight
Trace	0% - 5%
Little	5% - 12%
Some	12% - 35%
And	35% - 50%

Consistency

Term	q_u-tons/sq. ft
Very Soft	0.0 to 0.25
Soft	0.25 to 0.50
Medium	0.50 to 1.0
Stiff	1.0 to 2.0
Very Stiff	2.0 to 4.0
Hard	Over 4.0

Organic Content by Combustion Method

Soil Description	Loss on Ignition
Non Organic	Less than 4%
Organic Silt/Clay	4 – 12%
Sedimentary Peat	12% - 50%
Fibrous and Woody Peat	More than 50%

Plasticity

Term	Plastic Index
None to Slight	0 - 4
Slight	5 - 7
Medium	8 - 22
High to Very High	Over 22

The penetration resistance, N, is the summation of the number of blows required to effect two successive 6" penetrations of the 2" split-barrel sampler. The sampler is driven with a 140 lb. weight falling 30" and is seated to a depth of 6" before commencing the standard penetration test.

SYMBOLS

Drilling and Sampling

CS – Continuous Sampling
RC – Rock Coring: Size AW, BW, NW, 2"W
RQD – Rock Quality Designation
RB – Rock Bit/Roller Bit
FT – Fish Tail
DC – Drove Casing
C – Casing: Size 2 ½", NW, 4", HW
CW – Clear Water
DM – Drilling Mud
HSA – Hollow Stem Auger
FA – Flight Auger
HA – Hand Auger
COA – Clean-Out Auger
SS - 2" Dia. Split-Barrel Sample
2ST – 2" Dia. Thin-Walled Tube Sample
3ST – 3" Dia. Thin-Walled Tube Sample
PT – 3" Dia. Piston Tube Sample
AS – Auger Sample
WS – Wash Sample
PTS – Peat Sample
PS – Pitcher Sample
NR – No Recovery
S – Sounding
PMT – Borehole Pressuremeter Test
VS – Vane Shear Test
WPT – Water Pressure Test

Laboratory Tests

q_a – Penetrometer Reading, tons/sq ft
q_a – Unconfined Strength, tons/sq ft
W – Moisture Content, %
LL – Liquid Limit, %
PL – Plastic Limit, %
SL – Shrinkage Limit, %
LI – Loss on Ignition
D – Dry Unit Weight, lbs/cu ft
pH – Measure of Soil Alkalinity or Acidity
FS – Free Swell, %

Water Level Measurement

▽ - Water Level at Time Shown
NW – No Water Encountered
WD – While Drilling
BCR – Before Casing Removal
ACR – After Casing Removal
CW – Cave and Wet
CM – Caved and Moist

Note: Water level measurements shown on the boring logs represent conditions at the time indicated and may not reflect static levels, especially in cohesive soils.

CGC, Inc.

Madison - Milwaukee

Unified Soil Classification System

UNIFIED SOIL CLASSIFICATION AND SYMBOL CHART

COARSE-GRAINED SOILS (more than 50% of material is larger than No. 200 sieve size)			
GRAVELS More than 50% of coarse fraction larger than No. 4 sieve size	Clean Gravels (Less than 5% fines)	GW	Well-graded gravels, gravel-sand mixtures, little or no fines
		GP	Poorly-graded gravels, gravel-sand mixtures, little or no fines
	Gravels with fines (More than 12% fines)	GM	Silty gravels, gravel-sand-silt mixtures
		GC	Clayey gravels, gravel-sand-clay mixtures
SANDS 50% or more of coarse fraction smaller than No. 4 sieve size	Clean Sands (Less than 5% fines)	SW	Well-graded sands, gravelly sands, little or no fines
		SP	Poorly graded sands, gravelly sands, little or no fines
	Sands with fines (More than 12% fines)	SM	Silty sands, sand-silt mixtures
		SC	Clayey sands, sand-clay mixtures
FINE-GRAINED SOILS (50% or more of material is smaller than No. 200 sieve size.)			
SILTS AND CLAYS Liquid limit less than 50%		ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity
		CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
		OL	Organic silts and organic silty clays of low plasticity
SILTS AND CLAYS Liquid limit 50% or greater		MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts
		CH	Inorganic clays of high plasticity, fat clays
		OH	Organic clays of medium to high plasticity, organic silts
HIGHLY ORGANIC SOILS		PT	Peat and other highly organic soils

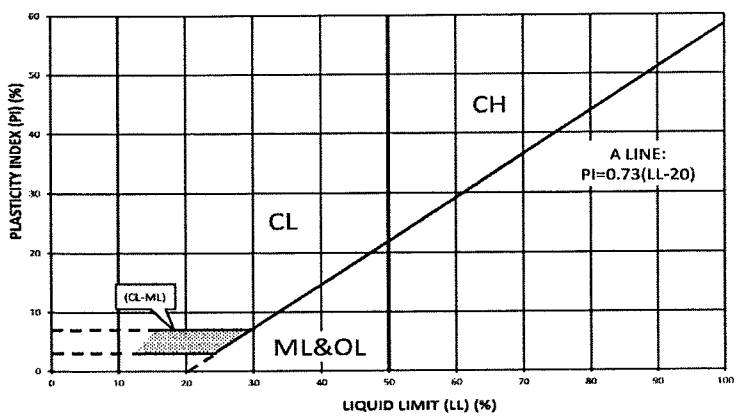
LABORATORY CLASSIFICATION CRITERIA

GW	$C_u = \frac{D_{60}}{D_{10}}$ greater than 4; $C_C = \frac{D_{30}}{D_{10} \times D_{60}}$ between 1 and 3	
GP	Not meeting all gradation requirements for GW	
GM	Atterberg limts below "A" line or P.I. less than 4	Above "A" line with P.I. between 4 and 7 are borderline cases requiring use of dual symbols
GC	Atterberg limts above "A" line or P.I. greater than 7	
SW	$C_u = \frac{D_{60}}{D_{10}}$ greater than 4; $C_C = \frac{D_{30}}{D_{10} \times D_{60}}$ between 1 and 3	
SP	Not meeting all gradation requirements for GW	
SM	Atterberg limits below "A" line or P.I. less than 4	Limits plotting in shaded zone with P.I. between 4 and 7 are borderline cases requiring use of dual symbols
SC	Atterberg limits above "A" line with P.I. greater than 7	

Determine percentages of sand and gravel from grain-size curve. Depending on percentage of fines (fraction smaller than No. 200 sieve size), coarse-grained soils are classified as follows:

Less than 5 percent ..... GW, GP, SW, SP
More than 12 percent ..... GM, GC, SM, SC
5 to 12 percent ..... Borderline cases requiring dual symbols

PLASTICITY CHART



APPENDIX C

DOCUMENT QUALIFICATIONS

APPENDIX C
DOCUMENT QUALIFICATIONS

I. GENERAL RECOMMENDATIONS/LIMITATIONS

CGC, Inc. should be provided the opportunity for a general review of the final design and specifications to confirm that earthwork and foundation requirements have been properly interpreted in the design and specifications. CGC should be retained to provide soil engineering services during excavation and subgrade preparation. This will allow us to observe that construction proceeds in compliance with the design concepts, specifications and recommendations, and also will allow design changes to be made in the event that subsurface conditions differ from those anticipated prior to the start of construction. CGC does not assume responsibility for compliance with the recommendations in this report unless we are retained to provide construction testing and observation services.

This report has been prepared in accordance with generally accepted soil and foundation engineering practices and no other warranties are expressed or implied. The opinions and recommendations submitted in this report are based on interpretation of the subsurface information revealed by the test borings indicated on the location plan. The report does not reflect potential variations in subsurface conditions between or beyond these borings. Therefore, variations in soil conditions can be expected between the boring locations and fluctuations of groundwater levels may occur with time. The nature and extent of the variations may not become evident until construction.

II. IMPORTANT INFORMATION ABOUT YOUR GEOTECHNICAL ENGINEERING REPORT

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes. While you cannot eliminate all such risks, you can manage them. The following information is provided to help.

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical engineering study conducted for a civil engineer may not fulfill the needs of a construction contractor or even another civil engineer. Because each geotechnical engineering study is unique, each geotechnical engineering report is unique, prepared *solely* for the client. *No one except you* should rely on your geotechnical engineering report without first conferring with the geotechnical engineer who prepared it. *And no one - not even you* - should apply the report for any purpose or project except the one originally contemplated.

READ THE FULL REPORT

Serious problems have occurred because those relying on a geotechnical engineering report did not read it all. Do not rely on an executive summary. Do not read selected elements only.

A GEOTECHNICAL ENGINEERING REPORT IS BASED ON A UNIQUE SET OF PROJECT-SPECIFIC FACTORS

Geotechnical engineers consider a number of unique, project-specific factors when establishing the scope of a study. Typical factors include: the client's goals, objectives, and risk management preferences; the general nature of the structure involved, its size, and configuration; the location of the structure on the site; and other planned or existing site improvements, such as access roads, parking lots, and underground utilities. Unless the geotechnical engineer who conducted the study specifically indicates otherwise, *do not rely on a geotechnical engineering report* that was:

- not prepared for you,
- not prepared for your project,
- not prepared for the specific site explored, or
- completed before important project changes were made.

Typical changes that can erode the reliability of an existing geotechnical report include those that affect:

- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light industrial plant to a refrigerated warehouse,
- elevation, configuration, location, orientation, or weight of the proposed structure,
- composition of the design team, or project ownership.

As a general rule, *always* inform your geotechnical engineer of project changes - even minor ones - and request an assessment of their impact. *CGC cannot accept responsibility or liability for problems that occur because our reports do not consider developments of which we were not informed.*

SUBSURFACE CONDITIONS CAN CHANGE

A geotechnical engineering report is based on conditions that existed at the time the geotechnical engineer performed the study. *Do not rely on a geotechnical engineering report* whose adequacy may have been affected by: the passage of time; by man-made events, such as construction on or adjacent to the site; or by natural events, such as floods, earthquakes, or groundwater fluctuations. *Always* contact the geotechnical engineer before applying the report to determine if it is still reliable. A minor amount of additional testing or analysis could prevent major problems.

MOST GEOTECHNICAL FINDINGS ARE PROFESSIONAL OPINION

Site exploration identifies subsurface conditions only at those points where subsurface tests are conducted or samples are taken. Geotechnical engineers review field and laboratory data and then apply their professional judgement to render an opinion about subsurface conditions throughout the site. Actual subsurface conditions may differ - sometimes significantly - from those indicated in your report. Retaining the geotechnical engineer who developed your report to provide construction observation is the most

effective method of managing the risks associated with unanticipated conditions.

A REPORT'S RECOMMENDATIONS ARE NOT FINAL

Do not over-rely on the confirmation-dependent recommendations included in your report. *Those confirmation-dependent recommendations are not final*, because geotechnical engineers develop them principally from judgement and opinion. Geotechnical engineers can finalize their recommendations *only* by observing actual subsurface conditions revealed during construction. *CGC cannot assume responsibility or liability for the report's confirmation-dependent recommendations if we do not perform the geotechnical-construction observation required to confirm the recommendations' applicability.*

A GEOTECHNICAL ENGINEERING REPORT IS SUBJECT TO MISINTERPRETATION

Other design team members' misinterpretation of geotechnical engineering reports has resulted in costly problems. Confront that risk by having your geotechnical engineer confer with appropriate members of the design team after submitting the report. Also retain your geotechnical engineer to review pertinent elements of the design team's plans and specifications. Constructors can also misinterpret a geotechnical engineering report. Confront that risk by having CGC participate in prebid and preconstruction conferences, and by providing geotechnical construction observation.

DO NOT REDRAW THE ENGINEER'S LOGS

Geotechnical engineers prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. To prevent errors or omissions, the logs included in a geotechnical engineering report should *never* be redrawn for inclusion in architectural or other design drawings. Only photographic or electronic reproduction is acceptable, *but recognize that separating logs from the report can elevate risk.*

GIVE CONSTRUCTORS A COMPLETE REPORT AND GUIDANCE

Some owners and design professionals mistakenly believe they can make constructors liable for unanticipated subsurface conditions by limiting what they provide for bid preparation. To help prevent costly problems, give constructors the complete geotechnical engineering report, *but* preface it with a clearly written letter of transmittal. In that letter, advise constructors that the report was not prepared for purposes of bid development and that the report's accuracy is limited; encourage them to confer with the geotechnical engineer who prepared the report (a modest fee may be required) and/or to conduct additional study to obtain the specific types of information they need or prefer. A prebid conference can also be valuable. *Be sure constructors have sufficient time* to perform additional study. Only then might you be in a position to give constructors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

READ RESPONSIBILITY PROVISIONS CLOSELY

Some clients, design professionals, and constructors do not recognize that geotechnical engineering is far less exact than other engineering disciplines. This lack of understanding has created unrealistic expectations that have led to disappointments, claims, and disputes. To help reduce the risk of such outcomes, geotechnical engineers commonly include a variety of explanatory provisions in their reports. Sometimes labeled "limitations," many of these provisions indicate where geotechnical engineer's responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

ENVIRONMENTAL CONCERNS ARE NOT COVERED

The equipment, techniques, and personnel used to perform an *environmental* study differ significantly from those used to perform a *geotechnical* study. For that reason, a geotechnical engineering report does not usually relate any environmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated environmental problems have led to numerous project failures.* If you have not yet obtained your own environmental information, ask your geotechnical consultant for risk management guidance. *Do not rely on an environmental report prepared for someone else.*

OBTAIN PROFESSIONAL ASSISTANCE TO DEAL WITH MOLD

Diverse strategies can be applied during building design, construction, operation, and maintenance to prevent significant amounts of mold from growing on indoor surfaces. To be effective, all such strategies should be devised for the *express purpose* of mold prevention, integrated into a comprehensive plan, and executed with diligent oversight by a professional mold prevention consultant. Because just a small amount of water or moisture can lead to the development of severe mold infestations, many mold prevention strategies focus on keeping building surfaces dry. While groundwater, water infiltration, and similar issues may have been addressed as part of the geotechnical engineering study whose findings are conveyed in this report, the geotechnical engineer in charge of this project is not a mold prevention consultant; ***none of the services performed in connection with the geotechnical engineer's study were designed or conducted for the purpose of mold prevention. Proper implementation of the recommendations conveyed in this report will not of itself be sufficient to prevent mold from growing in or on the structure involved.***

RELY ON YOUR GEOTECHNICAL ENGINEER FOR ADDITIONAL ASSISTANCE

Membership in the Geotechnical Business Council (GBC) of Geoprofessional Business Association exposes geotechnical engineers to a wide array of risk confrontation techniques that can be of genuine benefit for everyone involved with a construction project. Confer with CGC, a member of GBC, for more information.

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Geotechnical Business Council
of the Geoprofessional Business Association
8811 Colesville Road, Suite G 106
Silver Spring, MD 20910

SECTION 00 31 46
PERMITS

PART 1 – GENERAL

1.1. SUMMARY

A. Each project has varying requirements for permits, inspections, and fees based on the scope, size, and location of the project.

B. The City of Madison (Owner) is subject to all permits, inspections and associated fees for construction, demolition, utility connection, storm water management, and other similar requirements that may be required to complete the scope of work associated with these contract documents.

C. The General Contractor (GC) shall be responsible for obtaining all permits, inspections and paying for all associated fees unless specifically identified within this specification.

1.2. REFERENCES

A. The following references are not intended to be all inclusive. It shall be the GC's responsibility to determine all requirements based on the scope of work in the contract documents.

B. City of Madison Ordinances: Review all ordinances that may require a permit or fee that may be connected with a required permit. Contact the following City Agencies to determine the exact requirements during bidding
   1. Building Inspection
   2. Zoning
   3. Engineering
   4. Water Utility
   5. Traffic Engineering
   6. Others as may be specified by the contract documents.

B. State Statutes

C. Other Regulatory Regulations

D. Other Agencies or companies that may have related requirements
   1. Madison Metropolitan Sewerage District
   2. Local gas and electric utility companies
   3. Other utility companies

1.3. GENERAL CONTRACTORS REQUIREMENTS

A. The GC shall be responsible for all of the following:
   1. Execute application for all required permits as may be required by the scope of work described within the contract documents.
   2. Paying all fees associated with the application of any required permits.
   3. Scheduling all required inspections that may be conditions of any required permits.

B. The GC shall provide high quality scanned images of all required permits and inspections and upload them to the Contract Documents-Regulatory Documents Library on the Project Management Web Site.

PART 2 – PRODUCTS – THIS SECTION NOT USED

PART 3 – EXECUTION – THIS SECTION NOT USED

END OF SECTION

SECTION 01 10 00

SUMMARY

PART 1 GENERAL

1.1 PROJECT

A. Project Name: Madison Fire Department - Station 14.

B. The Project consists of the construction of a new fire station..

1.2 OWNER OCCUPANCY

A. Owner intends to occupy the Project upon Substantial Completion.

B. Cooperate with Owner to minimize conflict and to facilitate Owner's operations.

C. Schedule the Work to accommodate Owner occupancy.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION - Not Used

END OF SECTION

SECTION 01 23 00

ALTERNATES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Description of Alternates.

1.2 ACCEPTANCE OF Alternates

A. Alternates quoted on Bid Forms will be reviewed and accepted or rejected at Owner's option. Accepted Alternates will be identified in the Owner-Contractor Agreement.

B. Coordinate related work and modify surrounding work to integrate the Work of each Alternate.

1.3 SCHEDULE OF Alternates

A. Alternate No. 1 - (8) 4-Fold Apparatus Bay Doors in lieu of (8) Overhead Doors: see drawing sheet A801 and Division 08 36 14 for alternate items.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION - Not Used

END OF SECTION

SECTION 01 25 13
PRODUCT SUBSTITUTION PROCEDURES

PART 1 – GENERAL

1.1. SUMMARY

A. The City of Madison uses a specific list of preferred products for various specification items to establish standards of quality, utility, and appearance required.

B. The City of Madison will not allow substitutions for specified Products except as follows:

1. The Product is no longer produced or the product manufacturer is no longer in business.
2. The manufacturer has significantly changed performance data, product dimensions, or other such design criteria for the specified Product(s).
3. Products specified by naming one or more Products or manufacturer's and "or approved equal" or "approved equivalent."

C. The City of Madison will not allow substitutions for specified Products as follows:

1. For Products specified by naming only one Product and manufacturer, no substitute product will be considered.
2. For Products specified by naming several Products or manufacturers select any one of the products or manufacturers named, which complies with the specifications. No substitute product will be considered.

D. Request for substitutions from any party other than the General Contractor (GC) will not be accepted.

1.2. RELATED SPECIFICATIONS

A. Section 01 26 13 Request for Information (RFI)
B. Section 01 31 23 Project Management Web Site
C. Section 01 33 23 Submittals

PART 2 – PRODUCTS

2.1. SUBSTITUTION REQUEST FORM

A. During bidding all contractors (General and Sub-contractors) and suppliers of materials or products shall provide hard copy of the Substitution Request form and all required attachments directly to the Project Architect. Submission shall use the form located at the end of this specification.

1. Contractors and suppliers shall use the screen shot of the form located at the end of this specification to print a hard copy for all pre-bid substitution requests.

B. After bidding only the GC shall submit a request and shall use the form located on the Project Management Web Site.

PART 3 - EXECUTION

3.1. REQUESTING A SUBSTITUTION DURING BIDDING

A. In the event that a substitution is requested during the bidding phase the Contractor or Supplier shall meet the substitution request deadline listed in the bidding documents. No substitution request will be considered during the bidding period after the stated substitution request deadline. In general this procedure shall be as follows:

1. Submit the Substitution Request Form including all required supporting documentation to the City Project Manager and Project Architect by the substitution request deadline specified in Section A of the Contract Documents. Utilize the Substitution Request Form found at the end of this Section.
2. Submit a Substitution Request Form for each product, supported with complete data, drawings and samples as appropriate, including:

i. Comparison of qualities of the proposed substitutions with that specified.
ii. Changes required in other elements of the Work because of the substitution.
iii. Effect on the construction schedule.
iv. Cost data comparing the proposed substitution with the Product specified.
v. Any required license fees or royalties.
vi. Availability of maintenance service and source of replacement materials.

3. The Owner and Architect will review the Substitution Request Form and if approved the City of Madison will publish a bidding addendum authorizing the replacement. The Owner and Architect may reject any substitution request without providing specific reasons.

B. Substitutions submitted and approved during the bidding phase shall be announced by the City of Madison by addenda prior to the bid due date.

3.2. REQUESTING A SUBSTITUTION AFTER AWARD OF CONTRACT

A. A substitution request will only be considered after award of contract if it meets the qualifying provisions as described in 1.1.B.1 and .2 above.

B. The GC shall submit a substitution request using the digital form on the Project Management Web Site located in the Construction Administration-Substitution Request library.

1. Click on *Add document* to open a new digital form, fill out form, provide required attachments, then click the Submit button.
2. Consulting Staff, Owner and Owners Representatives will review the request and provide the appropriate approvals and feed back to the GC.

3.3. UNAUTHORIZED SUBSTITUTIONS

A. Any Contractor who substitutes products without proper authorization by the Owner and Architect will be required to immediately remove and replace the product and all costs required to conform to the Contract Documents shall be borne by the General Prime Contractor.

END OF SECTION

Substitution Request

Today's Date: 1/27/2015

Project Title:

Project Number: Contract Number:

Description	Spec Section	Page	Paragraph

The undersigned requests consideration of the following:

Proposed Substitution:

Attachments

Click here to attach a file

Insert item

- Attached data includes product description, specifications, drawings, photographs, performance and test data adequate for evaluation of the request; applicable portions of the data are clearly identified.
- Attached data also includes a description of changes to the Contract Documents that the proposed substitution will require for its proper installation.

The undersigned General Contractor representative certifies that the following paragraphs are correct.

1. ***The function, appearance, and quality of the proposed substitution are equal or superior to the specified item.***
2. ***The proposed substitution does not affect dimensions shown on drawings.***
3. ***The undersigned will pay for changes to the building design, including engineering design, detailing, and construction costs caused by the request.***
4. ***The proposed substitution will have no adverse affect on other trades, the construction schedule, or specified warranty requirements.***
5. ***Maintenance and service parts will be locally available for the proposed substitution. Provide supporting documentation.***

Submitted By:

****By typing my name and entering the date I hereby give my electronic signature****

Name: Title: Date:

Firm: Address:

Phone:

SECTION 01 26 13
REQUEST FOR INFORMATION (RFI)

PART 1 – GENERAL

1.1. SUMMARY

A. Contractors shall use the RFI form/process to request additional information or clarification regarding the construction documents.

B. All RFI documentation will be processed through the through the Construction Administration-Request for Information Library on the Project Management Web Site (PMWS).

1.2. RELATED SPECIFICATIONS

A.	Section 01 26 46	Construction Bulletin (CB)
B.	Section 01 26 57	Change Order Request (COR)
C.	Section 01 26 63	Change Order (CO)
D.	Section 01 31 23	Project Management Web Site (PMWS)
E.	Section 01 91 00	Commissioning

1.3. PERFORMANCE REQUIREMENTS

A. RFI issues initiated by any contractor shall be done through the General Contractor (GC).
   1. RFIs submitted by any Sub-contractor under the GCs control shall be returned with no response.

B. Submit a new RFI for each issue. Only multiple questions that are of a similar nature may be combined into one RFI shall be allowed and responded to.

1.4. QUALITY ASSURANCE

A. The GC shall be responsible for all of the following:
   1. Ensure that any request for additional information is valid and the information being requested is not addressed in the construction documents.
   2. Ensure that all requests are clearly stated and the RFI form is completely filled out.
   3. Ensure that all Work associated an RFI response is carried out as intended.

B. The PA shall be responsible for the following:
   1. Ensure that all responses to contractor initiated RFIs are properly responded to in a timely fashion.
      a. The CPM, Owner, consulting staff, and other City staff shall be responsible for the initial review of the RFI. The PA shall be responsible for codifying all consultant and Owner/City staff comments into a unified RFI response.

PART 2 – PRODUCTS

2.1. REQUEST FOR INFORMATION FORM

A. The RFI form is located on the Project Management Web Site. The GC, PA, or CPM as appropriate shall click the link in the left margin of the project web site opening a new form. Project information is pre-loaded, provide additional information as indicated below in the execution to complete the form.

PART 3 - EXECUTION

3.1. CONTRACTOR INITIATED RFI

A. Immediately on discovery of the need for additional information or interpretation of the Contract Documents any contractor may initiate an RFI for additional information or clarification through the GC.

B. The GC shall select the "Submit an RFI" link on the Project Management Web Site and completely fill out the form as follows:

1. Contract related information will be automatically populated on the form.
2. Thoroughly explain the issue at hand, provide backup information (photographs, sketches, drawings, data, etc) as necessary, and clearly state the question or problem that requires a resolution. Combine like or related issues but do not include multiple issues on one form.
    a. Example. If a duct interferes with other critical piping and electrical work include all issues into one RFI.
    b. Example. If you have a question regarding the chiller and another regarding toilet partitions create separate RFIs.
3. Check all relevant boxes for trades affected. This will assist the design team in determining who should be reviewing the RFI.

C. Upon completing the RFI click the "Submit" button. The PMWS software will automatically route the RFI to the appropriate reviewers.

3.3. RFI RESPONSES

A. Responses to simple RFI issues shall use the response section of the RFI form and shall be completed within five (5) working days of the RFI form being submitted.

B. Responses to more complex issues may require additional time or may require a Construction Bulletin to be published. The initial RFI shall be responded to within five (5) working days stating that the RFI is being reviewed and provide an estimated date for the response.

C. The following GC generated RFIs will be returned without action:

1. Requests for approval of submittals
2. Requests for approval of substitutions
3. Requests for approval of Contractor's means and methods.
4. Requests for coordination information already indicated in the Contract Documents.
5. Requests for adjustments in the Contract Time or the Contract Sum.
6. Requests for interpretation of A/E's actions on submittals.
7. Incomplete RFI or inaccurately prepared RFI.

3.4. COMMENCEMENT OF WORK RELATED TO AN RFI

A. The GC shall only proceed with the Work of an RFI when additional information is not required.

B. The GC shall not proceed with any Work associated with an RFI while it is under review.

C. The GC shall not proceed with any Work associated with an RFI that clearly states a CB will be issued in response to the RFI.

D. The GC will be required to immediately remove and replace unauthorized Work and all costs required to conform to the Contract Documents shall be borne by the GC.

END OF SECTION

SECTION 01 26 46
CONSTRUCTION BULLETIN (CB)

PART 1 – GENERAL

1.1. SUMMARY

A. Construction Bulletins (CB) are formal published construction documents that modify the original contract bid documents after construction has commenced. CBs may be published for many reasons, including but not limited to the following:
   1. Clarification of existing construction documents including specifications, plans, and details
   2. Change in product or equipment
   3. A response to a Request for Information
   4. Change in scope of the contract as either an add or a deduct of work

B. CBs provide a higher degree of detail in response to a Request for Information (RFI) through directives, revised plans/details, and specifications as necessary.

C. The CB may change the original contract documents through additions or deletions to the Work.

D. Where the directives of a CB are significant enough to warrant a Change Order Request (COR) the GC shall use all information provided in the CB to assemble all required back-up documentation for additions and deletions of materials, labor and other related contract costs for the COR.

E. All CB documentation will be processed through the Construction Administration-Construction Bulletin Library on the Project Management Web Site (PMWS).

1.2. RELATED SPECIFICATIONS

A. Section 01 26 13 Request for Information (RFI)
B. Section 01 26 57 Change Order Request (COR)
C. Section 01 26 63 Change Order (CO)
D. Section 01 31 23 Project Management Web Site
E. Section 01 91 00 Commissioning

1.3. PERFORMANCE REQUIREMENTS

A. Project Architect (PA): The PA shall be the only person authorized to publish a CB as needed for any reason indicated in section 1.1.A above. The PA shall consult as necessary with any of the following while drafting the CB and shall confirm final direction with the CPM prior to issuing a CB:
   1. City Project manager (CPM)
   2. Owner
   3. Members of the consulting staff
   4. Members of city staff
   5. The General Contractor
   6. Sub-contractors
   7. Commissioning Agent (CxA)

B. General Contractor: The GC shall be responsible for the following as needed:
   1. Executing the directives of the CB when he/she believes that no changes in labor, materials, equipment, or contract duration will be required for additions or deletions.
   2. Submit a COR when he/she believes that a change in labor, materials, equipment or contract duration will be required for additions or deletions.

1.4. QUALITY ASSURANCE

A. The PA shall be responsible for ensuring the final CB sufficiently provides direction, details, specifications and other information as necessary for the GC to perform the intended Work.

B. The PA shall be responsible for ensuring the final CB is published as expeditiously as practical based on the complexity of the CB being written. CBs that may affect the GC critical path shall be given priority.

PART 2 – PRODUCTS

2.1. CONSTRUCTION BULLETIN FORM

A. The CB form is located on the Project Management Web Site. The PA shall click the link in the left margin of the project web site opening a new form. Project information is pre-loaded, the PA only needs to enter information and make attachments as needed to complete the form.

PART 3 - EXECUTION

3.1. WRITING THE CONSTRUCTION BULLETIN

A. The PA shall draft a CB as needed using the Construction Bulletin form on the Project Management Web Site.

1. The PA and/or consulting staff as necessary shall provide specifications, model numbers and performance data, details and other such information necessary to clearly state the intentions of the CB.
2. The consulting staff, CPM, Owner, CxA and other City Staff shall review the draft and recommend changes as needed.
3. The PA shall amend the draft as necessary into a final CB for review

B. Once the final CB has been approved the PA shall “Submit” the CB through the Project Management Web Site to the GC.

3.2. EXECUTING THE CONSTRUCTION BULLETIN

A. The GC shall acknowledge receipt of the CB on the Project Management Web Site as instructed in the Tutorial Manual provided to the awarded contractor.

B. The GC shall notify all Sub-contractors of the CB and publish the CB to all field sets of drawings and specifications as appropriate.

C. The GC shall execute the directives of the CB or submit COR documentation as necessary during the execution and implementation of the CB.

1. See Specification 01 26 57 Change Order Request (COR)

END OF SECTION

SECTION 01 26 57
CHANGE ORDER REQUESTS (COR)

PART 1 – GENERAL

1.1. SUMMARY

A. Except in cases of emergency, no changes in the Work required by the Contract Documents may be made by the General Contractor (GC) without having prior approval of the City Engineer or his representative.

B. The City may at any time, without invalidating the Contract and without Notice to Sureties, order changes in the Work by written Change Order (CO). Such changes may include additions and/or deletions.

C. Where the City desires to make changes in the Work through use of written Change Order Request (COR), the following procedures apply:

1. If requested by the City, the GC shall prepare and submit a detailed proposal, including all cost and time adjustments to which the GC believes it will be entitled if the change proposed is incorporated into the Contract. The City shall be under no legal obligation to issue a Change Order for such proposal.
2. The parties shall attempt in good faith to reach agreement on the adjustments needed to the Contract to properly incorporate the proposed change(s) into the Work. In the event that the parties agree on such adjustments, the City may issue a Change Order and incorporate such changes and agreed to adjustments, if any.
3. In some instances, it may be necessary for the City to authorize Work or direct changes in Work for which no final and binding agreement has been reached and for which unit prices are not applicable. In such cases the following shall apply.
    a. Upon written request by the City, the GC shall perform proposed Work
    b. The cost of such change may be determined in accordance with this specification.
    c. In the event agreement cannot be accomplished as contemplated herein, the City may authorize the Work to be performed by City forces or to hire others to complete the Work. Such action on the part of the City shall not be the basis of a claim by the GC for failure to allow it to perform the changed Work.

D. Where changes in the Work are made by the City through use of a force account basis, the GC shall as soon as practicable, and in no case later than ten (10) working days from the receipt of such order, unless another time period has been agreed to by both parties, give the City written Notice, stating:

1. The date, circumstances and source of the extra work; and,
2. The cost of performing extra work described by such Order, if any; and,
3. Effect of the order on the required completion date of the Project, if any.

E. The giving of each Notice by the GC as prescribed by this specification, shall be a requirement to liability of the City for payment of any additional costs incurred by the GC in implementing changes in the Work. Under this specification, no order or statement of the City shall be treated as a Change Order, or shall entitle the GC to an equitable adjustment of the terms of this Contract or damages for costs incurred by the GC on any activity for which the Notice was not given.

F. In the event Work is required due to an emergency as described in this specification the GC must request an equitable adjustment as soon as practicable, and in no case later than ten (10) working days of the commencement of such emergency.

G. All GC requests for equitable adjustment shall be submitted to the CPM per the specifications below. Such requests shall set forth with specificity the amount of and reason(s) for the proposed adjustment and shall be accompanied by supporting information and documents.

H. No adjustment of any kind shall be made to this Contract, if asserted by the GC for the first time, after the date of final payment.

I. This specification shall be used by the GC when preparing documentation for any COR to ensure each has been properly and completely filled out as required by the City of Madison.

J. All COR documentation will be processed through the Construction Administration-Change Order Request Library on the Project Management Web Site (PMWS).

1.2. RELATED SPECIFICATION SECTIONS

A. Section 01 26 13 Request for Information (RFI)
B. Section 01 26 46 Construction Bulletins (CB)
C. Section 01 26 63 Change Order (CO)
D. Section 01 31 23 Project Management Web Site
E. Section 01 91 00 Commissioning

F. Parts of this specification will reference articles within "The City of Madison Standard Specifications for Public Works Construction".

1. Use the following link to access the Standard Specifications web page:
   http://www.cityofmadison.com/business/pw/specs.cfm
   a. Click on the "Part" chapter identified in the specification text. For example if the specification says "Refer to City of Madison Standard Specification **2**10.2" click the link for Part II, the Part II PDF will open.
   b. Scroll through the index of Part II for specification 210.2 and click the text link which will take you to the referenced text.

1.3. DEFINITIONS AND STANDARDS

A. LABOR: The amount of time and cost associated with the performance of human effort for a defined scope of Work. Labor is further defined as follows:
   1. Labor rate is the total hourly rate which includes the basic rate of pay, fringe benefits plus each company's cost of required insurance, also referred to as a reimbursable labor rate.
   2. Unit labor is the labor hours anticipated to install the corresponding unit of material.
   3. Labor cost is the labor hours multiplied by the hourly labor rates.

B. MATERIAL: Actual material cost is the amount paid, or to be paid, by the GC for materials, supplies and equipment entering permanently into the Work, including cost of transportation and applicable taxes. The cost shall not exceed the usual and customary cost for such items available in the geographical area of the project

C. LARGE TOOLS AND MAJOR EQUIPMENT: Large tools and major equipment are those with an initial cost greater than $1,500, whether from the GC or other sources.
   1. Tool and equipment use and time allowed is only for extra work associated with change orders.
      a. Rental Rate is the machine cost associated with operating a piece of equipment for a defined length of time (hour, day, week, or month) and shall not exceed the usual and customary amount for such items available in the geographical area of the project.
      b. Rental cost is the rental rate multiplied by the anticipated duration the equipment shall be required.
   2. The GC shall provide a breakdown of all rental rates to indicate what items and costs are associated with the rate. Examples of items to include in the breakdown would be fuel consumption, lubrication, maintenance and other similar expenses but not including profit and overhead.
   3. When large tools and equipment needed for Change Order work are not already at the job site, the actual cost to get the item there is also reimbursable.

D. BOND COST: The cost shall be calculated at 1% of the total proposed change order.

E. SUB-CONTRACTOR COSTS: Sub-contractor costs are for those labor, material, and equipment costs required by subcontracted specialties to complete the Change Order work including allowable markups as outlined within this specification.

F. OVERHEAD AND PROFIT Markup: The allowable markup percentage to a COR by the GC and Sub-contractors for overhead and profit. All of the following are expenses associated with overhead and profit and shall not be reimbursable as individual items on any COR:
   1. CHANGE ORDER PREPARATION: All costs associated with the preparing and processing of the change order.

2. DESIGN, ESTIMATING, AND SUPERVISION: All such efforts, unless specifically requested by Owner as additional Work to be documented as a COR or portion thereof.
3. INSTALLATION LAYOUT: The layout required for the installation of material and equipment, and the installation design, is the responsibility of the GC.
4. SMALL TOOLS AND SUPPLIES: The cost of small hand tools with an initial cost of $1,500 or less, along with consumable supplies and expendable items such as drill bits, saw blades, gasoline, lubricating or cutting oil, and similar items.
5. GENERAL EXPENSE: The general expense, which is those items that are a specific job cost not associated with direct labor and material such as job trailers, foreman truck, and similar items.
6. RECORD DRAWINGS: The preparation of record or as-built drawings.
7. OTHER COSTS: Any miscellaneous cost not directly assessable to the execution of the Change Order including but not limited to the following:
    a. All association dues, assessments, and similar items.
    b. All education, training, and similar items.
    c. All drafting and/or engineering, unless specifically requested by Owner as additional Work to be documented as a Change Order proposal or portion thereof.
    d. All other items including but not limited to review, coordination, estimating and expediting, field and office supervision, administrative work, etc.

G. Contract Extension: The necessary amount of time to be added to the contract deadlines for the completion of a change order.

1.4. CONTRACT EXTENSION

A. The GC shall not assume that every COR will require a Contract Extension. If the GC feels a contract extension is warranted he/she shall provide sufficient scheduling information that shows how the COR being requested impacts the critical path of the project.

B. The City of Madison strongly encourages the GC to explore alternative methods and practices prior to submitting a COR with a request for contract extension.

1.5. OVERHEAD AND PROFIT MARKUP

A. Pursuant to the City of Madison Standard Specifications for Public Works Construction, Section 104.7, Extra Work, the following maximum allowable markups shall be strictly enforced on all change orders associated with the execution of this contract.
1. The total maximum overhead and profit shall not exceed fifteen percent (15%) of the total costs.
2. The total maximum overhead and profit shall be distributed as follows:
    a. For work performed and materials provided solely by the General Contractor, fifteen percent (15%) of the total costs.
    b. For work performed and materials provided solely by Sub-contractors and supervised by the General Contractor:
        i. Supervision of the GC, five percent (5%) of the total Sub-contractor cost.
        ii. Sub-contractors work and materials ten percent (10%) of the total Sub-contractor cost.

1.6. PERFORMANCE REQUIREMENTS

A. The GC shall become thoroughly familiar with this specification as it will identify procedures and expenses that are or are not allowed under the Change Order and Change Order Request process.

B. The GC shall be responsible for all of the following:
1. Carefully reviewing the CB that is associated with the COR.
2. Collecting required supporting documentation from all contractors that quantify the need for a COR.
    a. Labor hours and wage rates
    b. Material costs
    c. Equipment costs

C. The following shall apply to establishing prices for labor, materials, and equipment costs:
1. Where Work to be completed has previously been established by individual bid items in the contract bid proposal the GC shall use the unit bid prices previously established.
2. Where Work to be completed was bid as a Lump Sum without individual bid items the GC shall provide a breakdown of all labor, materials, equipment including unit rates and quantities required.

D. The completion date is determined by Owner. The schedule, however, is the responsibility of the GC. Time extensions for extra Work will be considered when a schedule analysis of the critical path shows that the Change Order Request places the Work beyond the completion date stated in the Contract.

1.7. QUALITY ASSURANCE

A. The GC shall be responsible for ensuring that all COR supporting documentation meets the following requirements prior to completing the COR form on the Project Management Web Site:
   1. Sufficiently indicates labor, material, and other expenses related to completing the intent of the CB.
   2. No costs exceed the usual and customary amount for such items available in the geographical area of the project, and no costs exceed those established under the contract.

B. The Project Architect (PA), Commissioning Agent (CxA), City Project Manager (CPM), other members of the consulting staff, and city staff shall review all COR requests to ensure that the intent of the CB will be met under the proposal of the COR or request additional information as necessary.

PART 2 – PRODUCTS

2.1. CHANGE ORDER REQUEST FORM

A. The COR form is located on the Project Management Web Site. The GC shall click the link in the left margin of the project web site opening a new form. Follow additional instructions below in the execution section for filling out the form.

PART 3 - EXECUTION

3.1. ESTABLISHING A CHANGE ORDER REQUEST

A. Upon receipt of a Construction Bulletin (CB) where the GC believes a significant change in contract scope warrants the submittal of a COR the GC shall do all of the following within ten (10) working days after receipt of the CB:
   1. Review the CB with all necessary trades and sub-contractors required by the change in scope.
      a. Additions or deletions to the contract scope shall be as directed within the CB.
      b. Additions or deletions of labor and materials shall be determined by the GC based on the directives of the CB.
   2. Assemble all required back-up documentation for additions and deletions of materials, labor and other related contract costs as previously outlined in this specification.
   3. Submit a COR request form on the Project Management Web Site.

B. Submitting a COR does not obligate the GC to complete the work associated with the COR nor does it obligate the Owner to approve the COR as a change to the contract.

3.2. SUBMIT A CHANGE ORDER REQUEST FORM

A. This specification shall provide a subject overview only. In depth instructions shall be provided to the awarded Contractor in a PDF Instructional Manual.

B. The GC shall select the “Submit a COR” link on the Project Management Web Site.

C. The software will open a new COR form and the GC shall provide all of the following information:
   1. DO NOT perform any calculations on this worksheet, only provide the raw data as requested below. All calculations, totals, and markups shall be computed as described within this specification.
   2. Provide a summary description of the COR request, and justification for any requested time extension to the contract, indicate the number of calendar days being requested for the extension and add any attachments to the form as needed.
   3. Provide all GC self performance data including all of the following:
      a. Materials description, quantities, and unit costs.
      b. Labor hours and rates for all Foremen, Journeymen, and Apprentices by trade.
      c. Equipment descriptions, quantities, unit costs and rates.
   4. Provide all Sub-contractor data including all of the following:
      a. Materials description, quantities, and unit costs.
      b. Labor hours and rates for all Foremen, Journeymen, and Apprentices by trade.
      c. Equipment descriptions, quantities, unit costs and rates.
   5. Ensure all calculations performed by the form have been completed correctly. Contact the CPM directly if you suspect an error before hitting the save button.

C. At any time after creating a COR you must at a minimum click “Save as Draft” to save your work.

D. When all data has been entered and verified click on the “Submit COR” button. This will kick off the COR Review and Approval process.

3.3. CHANGE ORDER REQUEST REVIEW, APPROVAL, AND PROCESSING

A. The PA and CPM shall review all CORs submitted by the GC.
   1. Additional consulting staff and city staff having knowledge of the components of the COR shall review and advise the PA and CPM as to the accuracy of the items, quantities, and associated costs of the COR as directed by the CB.
   2. The CPM shall review the COR with the Owner.

B. If required the PA and CPM, shall in good faith, further negotiate the COR with the GC as necessary. All amendments to any COR shall be documented within the Project Management Web Site software.

C. After final review of the COR the CPM and Owner may accept the COR.

D. The CPM shall prepare the COR in the form of an official Board of Public Works Change Order for final review and approval as outlined in Section 01 26 63 Change Order (CO).

E. The GC shall not act upon any accepted COR until it has received final approval through the Public Works process as an official CO to the Work unless instructed to do so by the CPM. Proceeding without the final approval of a fully authorized Change Order is at the GC's own risk.

3.4. EMERGENCY CHANGE ORDER REQUEST

A. In the event Work is required due to an emergency as described in the Contract Documents, the GC must request an equitable adjustment as soon as practicable, and in no case later than ten (10) working days of the commencement of such emergency.

B. The GC shall provide full documentation of all labor, materials and equipment used during the period of emergency as part of the COR submittal.

END OF SECTION

SECTION 01 26 63
CHANGE ORDER (CO)

PART 1 – GENERAL

1.1. SUMMARY

A. Except in cases of emergency, no changes in the Work required by the Contract Documents may be made by the General Contractor (GC) without having prior approval of the City Project Manager (CPM).

B. The City may at any time, without invalidating the Contract and without Notice to Sureties, order changes in the Work by written Change Order. Such changes may include additions and/or deletions.

C. The Change Order (CO) is a Board of Public Works (BPW) form that is reviewed and approved by a specific process.

D. The CO form is typically made up of multiple Change Order Requests (CORs) and/or Bid Items as appropriate depending on the type of project and how the contract was bid.

E. All CO documentation shall be processed through the Construction Administration-Change Order Library and digital workflow on the Project Management Web Site (PMWS).

1.2. RELATED SPECIFICATION SECTIONS

A. Section 01 26 13 Request for Information (RFI)
B. Section 01 26 46 Construction Bulletin (CB)
C. Section 01 26 63 Change Order Request (COR)
D. Section 01 31 23 Project Management Web Site
E. Section 01 91 00 Commissioning

1.3. BOARD OF PUBLIC WORKS PROCEDURE

A. The Board of Public Works has a very explicit procedure for the review and approval of all change orders associated with any Public Works Contract as follows:

1. The Supervisory Chain of the CPM shall review and approve any CO under $10,000 provided it does not include either of the following:
   a. The CO does not request a time extension to the contract.
   b. The CO does not cause the contract contingency sum to be exceeded.
2. The Board of Public Works shall review and approve any CO that requires any of the following:
   a. Any CO over $10,000.
   b. Any CO requesting a time extension to the contract regardless of the monetary value of the CO.
   c. Any CO that that causes the contract contingency sum to be exceeded.

B. The Board of Public Works generally meets every other week and only once in August and December. The GC is cautioned that, under normal scheduling, a CO requiring a BPW review will take a minimum of two (2) weeks to achieve final approval.

1. The City shall not be responsible for additional delays to the Work caused by the scheduling constraints of the Board of Public Works.

C. *SPECIAL NOTE:* The GC is cautioned to never proceed unless told to do so by the CPM. Only in rare instances may the CPM give a written notice to proceed on a COR without an approved CO. Proceeding without the written notice of the CPM or an approved CO is at the GC's own risk.

PART 2 – PRODUCTS

2.1. CHANGE ORDER FORM

A. The CO form is located on the Project Management Web Site. The CPM shall click the link in the left margin of the project web site opening a new form. Project information is pre-loaded, the CPM only needs to enter information and make attachments as needed to complete the form.

PART 3 - EXECUTION

3.1. PREPARATION OF THE CHANGE ORDER

A. The CPM shall prepare the required CO forms in the Construction Administration-Change Order Library on the Project Management Web Site as follows:
   1. Provide information for all contract information.
   2. Provide a general description of the items described within the change order.
   3. Provide detailed information for each Item on the CO form. At the option of the CPM he/she may include multiple Change Order Requests each as their own item.
   4. Provide required pricing and accounting information as needed for the item.
   5. Insert attachments of contractor/architect provided information that clarifies and quantifies the CO. Attachments may include but not be limited to material lists, estimated labor, revised details or specifications, and other documents that may be related to the requested change.
   6. Save the final version of the completed CO.

3.2. EXECUTION OF THE CHANGE ORDER

A. Upon saving the CO as described in section 3.1 above the software associated with the Project Management Web Site shall notify the GC that the CO has been drafted and is ready for review. The GC shall do the following:
   1. Open the appropriate CO form in the Construction Administration-Change Order Library and review all items on the form.
   2. The GC shall notify the CPM immediately of any errors or discrepancies on the form and shall not sign or save it.
      a. The CPM shall make any corrections as needed, re-save the form, and notify the GC.
   3. If/when the GC concurs with the CO form as drafted the GC shall digitally sign the form and click SAVE.

B. After the GC digitally signs/saves the CO it shall be routed through the Project Management Web Site for additional review and/or approvals. The CPM shall do the following:
   1. Monitor the review process to ensure the software is working properly at each review step.
   2. Ensure that proper BPW procedures are executed as needed by the CO approval process.
      a. Schedule the CO on the next available BPW agenda if required.
         i. Attend the BPW meeting to speak on the CO to board members and answer questions.
         ii. The GC and/or PA may be required to attend the BPW meeting to address specific information as it relates to the Work and/or materials associated with the CO.
   3. Monitor final approval and distribution of the CO.
   4. Notify the GC that the CO has been completed.
   5. Ensure that the CO is posted to the next Public Works payment schedule.
   6. Verify that the GC's next Progress Payment-Schedule of Values show the CO as part of the contract sum.

C. Upon final approval of the CO the GC may proceed with executing the Work associated with the CO.

END OF SECTION

SECTION 01 29 73
SCHEDULE OF VALUES

PART 1 – GENERAL

1.1. SUMMARY

A. The Schedule of Values (SOV) is a Contractor provided statement that allocates portions of the total contract sum to various portions of the contracted work and shall be the basis for reviewing the Contractors Progress Payment Requests.

B. AIA Document G702 – Application and Certificate for Payment and AIA Document G703 Continuation Sheet shall be filled out in sufficient detail to be used as a guideline in determining work completed and materials stored on site when verifying Progress Payment Requests.

C. The General Contractor shall be responsible for filling out, updating, and providing these work sheets with each Progress Payment Request.

1.2. RELATED SPECIFICATIONS

A. Section 01 26 63 Change Order (CO)
B. Section 01 29 76 Progress Payment Procedures
C. Section 01 31 23 Project Management Web Site
D. Section 01 32 26 Construction Progress Reporting
E. Section 01 33 23 Submittals

F. Parts of this specification will reference articles within "The City of Madison Standard Specifications for Public Works Construction".

1. Use the following link to access the Standard Specifications web page:
   http://www.cityofmadison.com/business/pw/specs.cfm
   a. Click on the "Part" chapter identified in the specification text. For example if the specification says "Refer to City of Madison Standard Specification **2**10.2" click the link for Part II, the Part II PDF will open.
   b. Scroll through the index of Part II for specification 210.2 and click the text link which will take you to the referenced text.

1.3. RELATED DOCUMENTS

A. The following documents shall be used as the basis for initiating and maintaining the SOV worksheets throughout the execution of this contract.

1. Drawing documents and specifications (including general provisions) as provided with the bid set documents and any published addendums.
2. Documents associated with revisions or clarifications to number 1 above after awarding of the contract, including but not limited to:
   a. Construction Bulletins
   b. Request for Information
   c. Approved Change Orders
3. The latest daily/weekly Construction Progress Report
4. Other specifications as identified in Section 1.2 above

1.4. BASIS OF VALUES

A. The Contractor shall provide a breakdown of the Contract Sum in sufficient detail to assist the Architect and City Project Manager in evaluating Progress Payment Requests. The breakdown detail may require a labor and material breakdown for each division of work or trade or as directed by the CPM.

B. The total sum of all items shall equal the Contract Sum.

PART 2 – PRODUCTS – THIS SECTION NOT USED

PART 3 - EXECUTION

3.1. AIA DOCUMENT G702 – APPLICATION AND CERTIFICATE FOR PAYMENT

A. The Contractor shall use AIA Document G-702 Application and Certificate for Payment with each Progress Payment Request.

B. Completely fill out the Project Information section as follows:
   1. TO OWNER; provide all owner related information as provided in the contract documents.
   2. PROJECT; provide all contract information including contract number, title and address.
   3. FROM CONTRACTOR; provide all contractor related information.
   4. VIA ARCHITECT; provide all the architect's related information including the architect's project reference number if different from the owners.
   5. Indicate the current APPLICATION NO., PERIOD TO date, and CONTRACT DATE.

C. Completely fill out the Contractors Application for Payment section.
   1. Fill out lines 1 through 9 to reflect the current status of the contract through the payment date being requested.
   2. The City of Madison calculates retainage on Public Works Contracts as follows:
      a. In general, across the duration of the contract, 2.5% of the total contract sum, including change orders, is withheld for retainage as referenced from the City of Madison Standard Specification 110.2:
         i. Beginning with Progress Payment 1, 5% retainage will be withheld until such time that 50% of the total contract sum has been paid out.
         ii. No additional retainage will be withheld after 50% of the total contract sum has been paid, unless additional change orders have been approved after the 50% milestone has been reached. Per City of Madison Standard Specification 110.2, additional retainage up to 10%, may be held in the event there are holds placed by Affirmative Action or liquidated damages by BPW.
         iii. Retainage for additional change orders after the 50% milestone will be withheld at the rate of 2.5% of the total cost of the change order.
         iv. Retainage is based on the change orders posted to the City's contract worksheet at the time the progress payment is processed.

D. Completely fill out the Change Order Summary section. Only change orders that have been finalized and posted to the City of Madison's Application for Partial Payment worksheet may be itemized into the SOV documents.

E. The Contractor shall sign and date the application and it shall be properly notarized.

F. The Contractor shall not fill in any information in the Architects Certificate for Payment section.

3.2. AIA DOCUMENT G703 – CONTINUATION SHEET

A. The Contractor shall use AIA Document G-703 Continuation Sheet to itemize his/her SOV for this contract. Provide additional sheets as necessary.

B. Provide information in Column A (Item No.), Column B (Description of Work), and Column C (Scheduled Value) by any method that allocates portions of the total contract sum to various portions of the contracted work. Possible methods include combinations of the following:
   1. By division of work
   2. By contractor, sub-contractor, sub sub-contractor
   3. By specialty item or group
   4. Other methods of breakdown as may be requested by the City Project Manager or City Construction Manager at the pre-construction meeting.

C. Provide total cost of the item/description of work including proportionate shares of profit and overhead related to the item.

3.3. INITIAL SCHEDULE OF VALUES SUBMITTAL

A. The Contractor shall upload his/her initial SOV to the Project Management Web Site, Submittals Library, no later than five (5) working days after the Pre-construction Meeting.
   1. The initial SOV shall provide information in Column A (Item No.), Column B (Description of Work), and Column C (Scheduled Value) only.
   2. The level of detail shall be as described in section 3.2 above.

B. The Project Architect (PA) and the City Project Manager (CPM) shall review the SOV as any other submittal and may require modifications to reflect additional detail as necessary.

C. The Contractor shall resubmit the SOV as necessary until such time as the PPA and CPM have sufficient detail for assessing and approving future Progress Payment Applications.

D. Progress Payment Application 1 will not be processed until such time as the Contractor has met this requirement regardless of the amount of work completed per the application.

3.4. SOV FOR PROGRESS PAYMENT REQUESTS

A. The Contractor shall update the initial SOV with each Progress Payment Application as follows:
   1. Initial items and values as part of Section 3.3 above will not be adjusted once the original Schedule of Values submittal has been approved.
   2. Change orders shall be added as additional items and values at the bottom of the SOV as they become approved and posted to the City's contract worksheet. The value for each change order shall be the value indicated on the SOV and shall stand alone. Values shall not be split out or combined with other existing items with similar work descriptions on the original SOV.
   3. Fill out Columns D, E, F and G to properly reflect the work completed and materials received since the last Progress Payment Application.
   4. Only materials delivered and stored on the project site may be reflected on SOV progress updates.

B. Provide updated G702 and G703 sheets with each Progress Payment application.

C. See Specification 01 29 76 Progress Payment Procedures for additional information on submitting Progress Payment Applications.

END OF SECTION

SECTION 01 29 76
PROGRESS PAYMENT PROCEDURES

PART 1 – GENERAL

1.1. SUMMARY

A. The General Contractor (GC) shall review this and all related specifications prior to submitting progress payment requests.

B. Progress payment requests (Partial Payment-PP) for this contract shall be uploaded digitally by the GC to the Project Management Web Site

C. The Project Architect (PA) and City Project Manager (CPM) shall review and amend or approve the PP on the Project Management Web Site.

D. After approval of the PP by the CPM, he/she shall forward the PP to the appropriate agencies for BPW contractual review and payment processing.

1.2. RELATED SPECIFICATIONS

A.	Section 01 26 63	Change Order (CO)
B.	Section 01 29 73	Schedule of Values
C.	Section 01 31 19	Progress Meetings
D.	Section 01 31 23	Project Management Web Site
E.	Section 01 32 16	Construction Progress Schedules
F.	Section 01 32 26	Construction Progress Reporting
G.	Section 01 33 23	Submittals
H.	Section 01 45 16	Field Quality Control Procedures
I.	Section 01 77 00	Closeout Procedures
J.	Section 01 78 13	Completion and Correction List
K	Section 01 78 23	Operation and Maintenance Data
L.	Section 01 78 36	Warranties
M.	Section 01 78 39	As-Built Drawings
N.	Section 01 78 43	Spare Parts and Extra Materials
O.	Section 01 79 00	Demonstration and Training

1.3. RELATED DOCUMENTS

A. The following documents shall be used when evaluating PP requests.

1. Daily and weekly construction progress reports filed since the last payment request.
2. Contractors Schedule of Values as updated from the last payment request. See Specification 01 29 73.
3. Any document that may be required to be submitted for review and approval, as noted by the specifications listed in Section 1.2 above, or the Progress Payment Milestone Schedule in Section 1.4 below, to achieve a required bench mark of contract progression or contract requirement.

1.4. PROGRESS PAYMENT MILESTONES

A. City Engineering-Facility Management has developed the Project Payment Milestone Schedule (Section 1.4 below) to assist the GC in providing required construction specific documentation and general contractual documentation in a timely manner.

B. The Progress Payment Milestone Schedule is not an all inclusive list. Multiple agencies review progress payment requests and contract closeout requests. Missing, incomplete, or incorrect documentation for any agency may

be a cause for not processing progress payments. It shall be the sole responsibility of the Contractor for providing documentation as required or requested to the appropriate agencies.

C. The milestone schedule is based on the contract total sum and shall be valid for most contracts. Milestone submittals will be required with whatever progress payment hits the percentage of contract total indicated in the schedule.

D. The CPM shall review the milestone schedule with each progress payment request and at his/her option may elect to hold processing the progress payment until such time as the contractor has met the requirements for providing construction specific documentation.

E. It shall be the General Contractors responsibility to comply with all BPW Contract Administration requirements and related deadlines as outlined in the Award Letter, Award Checklist, and Start Work Letter.

Progress Payment (PP) Milestone Schedule		
Milestone Description	***Due Before***	***Remarks***
BPW Contract Administration Documentation • Workforce profiles • Best Value Contracting Documentation • Sub-contractors prequalification approval & Affirmative Action plans • Other as may be required	PP-1, or start work as applicable	• For GC and Sub-contractors before PP-1 regardless of scheduling • Sub-contractors (if applicable), due 10 days before they may start work • Sub-contractors (if applicable), due 10 days before they may start work
Required Construction Submittals/Administrative Documents • Contractors Project Directory • Schedule of Values • Submittals Schedule • Waste Management Plan • Closeout Requirement Checklist • Warranty Checklist	PP-1	References • Specification 01 31 23 • Specification 01 29 73 • Specification 01 32 19 • Specification 01 74 19 • Specification 01 77 00 • Specification 01 78 36
Construction Progress Milestones • Early submittals, per submittal schedule • Detailed Contract Schedules	PP-1	See specifications for specific requirements • Specification 01 32 19, Examples: concrete mix, structural steel, products with long lead times • See Specification 01 32 16
General Construction Progress Requirements are all up to date • Progress Schedules • Submittals/Re-submittals (ongoing) • Schedule of Values • Progress Reporting • LEED Documentation • Waste Management documentation • QMOs are being addressed and closed • Progress Cleaning • As-Built Drawings	Each future PP	Verified with each Progress Payment Request • Specification 01 32 16 • Specification 01 33 23 • Specification 01 29 73 • Specification 01 32 26 • All specifications with LEED documentation requirements • Specification 01 74 19 • Specification 01 45 16 • Specification 01 74 13 • Specification 01 78 39
*** All of the above are being updated on the Project Management Web Site as required**		
BPW Contract Administration Documentation • Weekly payroll reports • Best Value Contracting Reports	25% CT or PP 2	See 1.4.E above. *This progress payment will be with held by BPW for any missing contractual documentation.*

Progress Payment (PP) Milestone Schedule		
Milestone Description	***Due Before***	***Remarks***
• SBE Reports		
Construction Progress Milestones • Construction/Contract Closeout Meeting #1 • Submittals/Re-submittals complete	50% CT	• Specification 01 31 19 • Specification 01 33 23
Operation and Maintenance (O & M) drafts	60% CT	• Specification 01 78 23
Construction/Contract Closeout Meeting #2 • Construction closeout checklist	70% CT	• Specification 01 31 19 • Specification 01 77 00
BPW Contract Administration Documentation • Request Finalization Review from BPW	80% CT	This is a recommendation to the GC and is not a requirement of this PP. • Specification 01 77 00
Construction Progress Milestones • Operation and Maintenance (O & M) finals, accepted • All major QMO issues resolved • As-Built Drawings, Division Trades ready for GC review	80% CT	• Specification 01 78 23 • Specification 01 45 16; Items that could prevent occupancy • Specification 01 78 39
All of the following shall be completed for this PP: • Regulatory Inspections completed • All QMO reports closed • Demonstration and Training completed • Attic Stock completed • Final Cleaning	90% CT	Contractor to determine the proper order of completion: • Governing ordinances and statutes • Specification 01 45 16 • Specification 01 79 00 • Specification 01 78 43 • Specification 01 74 13
Construction Closeout Procedures: • Letter of Substantial Compliance sent to BI and DHS as needed • Certificate of Occupancy issued • As-Built Drawings, finals, accepted • City Letter of Substantial Completion • Warranty letters dated and issued	100% CT	• Specification 01 77 00 • Generated/Signed by the Architect • Building Inspection • Specification 01 78 39 • Signed by the City Engineer • Specification 01 78 36
*** Completion of this begins the one year warranty.**		
BPW Contract Administration Documentation Contract Closeout Procedures • Construction Closeout has been completed • Contractor requests final payment of retainage upon receiving City Letter of Substantial Completion • All BPW contractual requirements are verified	Final	• Specification 01 77 00 • Contractor must provide any missing BPW Contractual Documentation
*** Completion of this closes the contract but not the warranty period/bond.**		

Progress Payment (PP) Milestone Schedule		
Milestone Description	***Due Before***	***Remarks***
***NOTE:* CT = Contract Total less held retainage**		

1.5. PROGRESS PAYMENT SUBMITTAL

A. Each progress payment submittal shall be:
   1. Digital in PDF format
   2. PDF shall be in color
   3. Uploaded to the appropriate Project Management library and properly named per the tutorial instructions provided to the awarded contractor.

B. Submit all required construction progress documentation to the appropriate Project Management Web Site library.

C. In general the following shall apply to all PP requests:
   1. Materials or products:
      a. On order, being shipped, etc. may not be invoiced.
      b. Received and stored on the project site may be invoiced.
      c. Being manufactured off site at any location may not be invoiced (example: cabinetry, ductwork, etc.)
      d. Completed products stored off site locally waiting for delivery to the project site may be invoiced with prior approval by the CPM. All of the following conditions must be met to be allowed:
         i. Items must be visually inspected by CPM to verify product is complete.
         ii. Item must be stored inside a compatible structure and the structure and contents must be insured.
         iii. Contractor is responsible for condition until installation is completed.
   2. All labor and equipment, including rental time for the current progress period may be invoiced.
   3. Only completed installations may be invoiced to 100% based on the Schedule of Values.

D. DO NOT submit BPW Contract Administration Documentation for review with Progress Payment Requests, submit them directly to the correct agency and in the correct format as instructed from information in your BPW Contract Award Packet instructions.

PART 2 - PRODUCTS - THIS SECTION NOT USED

PART 3 - EXECUTION

3.1. GENERAL CONTRACTOR PROCEDURE

A. The GC shall provide an updated version of his/her schedule of values (AIA documents G702 & G 703) with each PP request.
   1. The AIA - Application and Certificate for Payment (G702) shall be properly filled out and prepared for the Architects review. See specification 01 29 73, Schedule of Values for more information.
   2. The AIA - Continuation sheets (G703) shall be properly filled out and indicate the dollar value of the completed work to date for each item on the form. See specification 01 29 73, Schedule of Values for more information.
      a. The GC shall subtotal the work completed to date for all of the original Schedule of Value items.
      b. Divide the sub total of work completed by the Original Contract Total to obtain a percentage complete of the original Lump Sum Bid. This percentage may be taken out to five (5) decimal places (round fifth place up or down as needed).
         i. Example: $5,192.55 of completed work divided by $10,000 original Contract Total = 0.519255, round this to 0.51926
      c. Write the percentage in Column 10 on the City Tabular Sheet for the original lump sum bid item in RED ink.
   3. Ensure that any newly posted change orders from the City of Madison provided tabulation sheet have been entered on the G703 continuation sheets. Repeat steps a thru c above for each change order on the schedule of values and the City Tabular Sheet.

B. The GC shall fill out the City of Madison Application and Certificate of Payment cover sheet as follows:
   1. The GC shall not change any pre-printed information and shall not write in the box that indicates previous progress payments.
   2. The GC shall sign and date the form where indicated.
   3. The GC shall provide the dates from and to for the PP being requested.

4. The GC shall provide the list of all contractors/sub-contractors that were actively working during the dates indicated above.
    a. All contractors/sub-contractors named must be in compliance with all City requirements (Pre-qualified, Affirmative Action Plan on file, etc). The PP will be held and not processed by the City of Madison until all contractors/sub-contractors are in compliance.
    b. Do not list the names of suppliers or manufacturers, doing so will slow down processing and require a re-submittal of the paperwork.

C. The General Contractor (GC) shall scan all of the documents listed below in the order shown, save the scan as a single PDF file for each PP request.
1. City cover sheet – Application and Certificate for Payment
2. City tabulation sheet(s)
3. AIA G702 - Application and Certificate for Payment
4. AIA G703 - Continuation Sheet(s)
5. Any miscellaneous documents that may be requested as backup documentation for the pay request.
    a. Lien waivers are not required and shall not be submitted.
    b. Do not provide contractual administrative documents such as pay reports with pay requests.
    c. Do not supply progress deliverables with pay requests.

F. Upload the pay request PDF to the Contract Documents-GC Partial Pay Apps library on the Project Management Web Site.

3.2. PROJECT ARCHITECT PROCEDURE

A. The PA shall review the AIA-continuation sheets provided by the GC to determine if the Schedule of Values accurately reflects the work completed for the inclusive dates indicated.
B. The PA shall advise the CPM of any discrepancies in the schedule of values.
C. The PA shall work with the GC and the CPM to resolve any issues prior to signing the AIA - Application and Certificate for Payment.
D. When verified, the PA shall digitally sign the original PDF version of the AIA - Application and Certificate for Payment on the Project Management Web Site.

3.3. CITY PROJECT MANAGER PROCEDURE

A. The CPM shall review all documents submitted by the GC and work with the PA to ensure the schedule of values accurately reflects the work completed to date.
B. The CPM may elect to hold processing of any progress payment pending submittal of required progress payment milestones.
C. When verified, the CPM shall digitally sign the City Cover Sheet and forward the required documentation to the appropriate City agencies for further processing of the payment request.
D. The CPM shall add a scanned copy of any documents indicating the PP request processing was completed to the PMWS.

END OF SECTION

SECTION 01 31 13
PROJECT COORDINATION

PART 1 – GENERAL

1.1. SUMMARY

A. Project Coordination covers many areas within the execution of the Contract Documents and the requirements of proper coordination are the applicable to all contractors executing the Work of this contract.

B. This specification provides general information regarding project coordination for the General Contractor and all Sub-contractors. All contractors shall be familiar with project coordination requirements and responsibilities that may be defined in other specification within these Contract Documents.

C. The General Contractor shall at all times be responsible for the project, project site, and execution of the Contract Documents.

1.2. RELATED SPECIFICATIONS

A.	Section 01 29 76	Progress Payment Procedures
B.	Section 01 31 19	Progress Meetings
C.	Section 01 31 23	Project Management Web Site
D.	Section 01 32 16	Construction Progress Schedules
E.	Section 01 32 19	Submittals Schedule
F.	Section 01 33 23	Submittals
G.	Section 01 43 39	Mockups
H.	Section 01 45 16	Field Quality Control Procedures
I.	Section 01 60 00	Product Requirements
J.	Section 01 77 00	Closeout Procedures, including all specifications referenced therein
K.	Section 01 91 00	Commissioning

1.3. GENERAL REQUIREMENTS

A. The following general requirements shall applicable to all contractors:
   1. Cooperate with the Owner, all authorized Owner Representatives, Project Architect and all consultants of the Owner.
   2. Materials, products, and equipment shall be new, as specified and to industry standards except where otherwise noted.
   3. Labor and workmanship shall be of a high quality and to industry standards.

B. Existing conditions:
   1. Verify all existing conditions noted in the contract documents with actual filed locations. Verify dimensions, sizes and locations, of structural, equipment, mechanical and utility components.
   2. Report any inconsistencies, errors, omissions, or code violations in writing to the General Contractor (GC) immediately.
   3. Annotate any inconsistencies, errors, omissions on the GC As-Built record drawings immediately for future reference.

C. Contract Documents:
   1. The Contract Documents are intended to include everything necessary to perform the work. Every item required may not be specifically mentioned, shown, or detailed.
      a. Except where specifically stated all systems and equipment shall be complete, installed, and fully operable.
      b. If a conflict exists within the contract documents the contractor shall furnish the item, system, or workmanship of the highest quality, largest, largest quantity, or most closely fits the intent of the contract documents.

c. Manufacturers recommended installation details shall be verified and used prior to installation of products and equipment so as to not void warranties.

D. Errors and Omissions
1. No Contractor shall take any advantage of any apparent error or omission in the construction documents.
2. The City of Madison shall be permitted to make such corrections and interpretations as may be deemed necessary for the fulfillment of the intent of the construction documents.

E. Owners Representatives
1. All contractors shall be familiar with various Owner Representatives having Quality Management responsibilities for the duration of this project including but not limited to the following:
a. Project Architect, responsible for all decisions affecting the code compliance and design intent of the construction documents.
b. Consulting Architects and Engineers, responsible for providing consulting services to the Project Architect, Owner, and City Project Manager, also responsible for Quality Management of the construction documents.
c. Owner, the designated representative of the City Agency that will occupy the project upon completion.
d. City Project Manager, responsible for all day to day decisions regarding the execution and performance of this Public Works Contract.
e. Consulting City Staff, responsible for providing consulting services to the Project Architect, Owner, and City Project Manager, also responsible for Quality Management of the construction documents.
f. Commissioning Agent (CxA), responsible for ensuring that the project is meeting the Owner's Project Requirements and related quality assurance procedures.
2. Owner Representatives shall be attending progress meetings, pre-installation meetings, performing or being present for final testing and acceptance and quality management reporting during the execution of the contract documents as outlined in other specifications.

1.4. GENERAL CONTRACTOR PERFORMANCE REQUIREMENTS

A. Assume the responsibility for all Work specified in the Contract Documents except where specifically identified to be performed by the Owner or other contractor separately hired by the Owner.
1. Coordinate all work by Owner, equipment provided Owner, or contractor hired by the Owner into the project schedule.

B. Provide all construction management responsibilities as specified in other Division 1 specifications including but not limited to:
1. Scheduling of work
2. Coordination of work between other Trades and Sub-contractors
3. Construction administration and management
4. Site layout, cleanliness, and protection of completed work/stored materials
5. Waste Management
6. Quality Assurance and Quality Control

C. Use Diggers Hotline and private utility locating companies to accurately locate all public and private utilities on the property as needed. The GC is responsible for any repair or replacement to any public or private utility damaged during the execution of the Work

D. Report any inconsistencies, errors, omissions, or code violations in writing to the Project Architect immediately. Failure to report inconsistencies prior to beginning work shall indicate that the GC accepted all existing conditions.

E. The GC shall be responsible for assigning work and related responsibilities where the Contract Documents may not clearly state who is responsible for providing the work, material, or product.

F. Provide construction management oversight of all items described in Section 1.5 below.

G. Coordinate and assist CxA as outlined within 01 91 00 and as directed by Owner.

1.5. SUB-CONTRACTOR PERFORMANCE REQUIREMENTS

A. Be familiar with all of the contract documents as they pertain to your Work, adjacent work and the overall progress of the project.
1. All Sub-contractors shall be familiar with all Division 1 specifications as they may apply to progress, progress payments, quality control construction management, and closeout of the contract.

B. Coordinate your Work with all adjacent work and existing conditions.

1. Perform your work in proper sequence according to the GC's project schedule and in relation to the work of other trades.
2. Notify other sub-contractors and trades whose work may be connected to, combined with, or influenced by your work and allow them reasonable time and access to complete their work.
3. Join your work to the work of others in accordance with the intent of the Contract Documents.
4. Order materials and schedule deliveries to facilitate the general progress of the Work.

C. Cooperate with all other trades to facilitate the general progress of the work. This shall include providing every reasonable opportunity for the installation of work by others and the storage of their materials and equipment.
1. In no case shall any contractor exclude from the premises or work any Sub-contractor or their employees.
2. In no case shall any contractor interfere with the execution or installation of Work by any other Sub-contractor or their employees.

D. Arrange your work, equipment, and materials and dispose of your construction waste so as to not interfere with the work or storage of materials of others.

E. Coordinate all work as indicated during pre-installation meetings with Owner Representatives, the GC and other trades. Any work improperly coordinated shall be relocated as designated by the Owner Representative at no additional cost to the City.

F. Coordinate and assist CxA as outlined within 01 91 00 and as directed by Owner.

PART 2 – PRODUCTS – THIS SECTION NOT USED

PART 3 – EXECUTION – THIS SECTION NOT USED

END OF SECTION

SECTION 01 31 19
PROJECT MEETINGS

PART 1 – GENERAL

1.1. SUMMARY

A. The purpose of this specification is to identify various project related meetings and the responsible parties for scheduling, agendas, minutes, and required attendance.

B. This specification is not intended to be inclusive of all meeting types or a complete list of required meetings.

C. This specification is not intended to cover planning and execution meetings between the General Contractor (GC) and his/her sub-contractors.

1.2. RELATED SPECIFICATIONS

A. 01 31 23 Project Management Web Site

B. 01 32 16 Construction Progress Schedules

C. 01 43 39 Mockups

D. 01 91 00 Commissioning

1.3. PROJECT MEETING TYPES

A. The following project meeting types may be used but not limited to the following

1. Preconstruction Meeting
2. Project Management Web Site – Tutorial Meeting
3. Construction Progress Meetings
4. Pre-installation Meetings (including mock-up review meetings)
5. Weekly Trade Meetings
6. Special Meetings
7. Commissioning Meetings

1.4. GENERAL REQUIREMENTS

A. Representatives of Contractors, Subcontractors, and suppliers attending meetings shall be qualified and authorized to act on behalf of the entity each represents.

PART 2 – PRODUCTS – NOT USED IN THIS SECTION

PART 3 - EXECUTION

3.1. PRECONSTRUCTION MEETING

A. After execution of the Contract the City Project Manager (CPM) shall schedule and conduct the Preconstruction Meeting at the Owner's facilities. The CPM shall coordinate the meeting agenda with the Project Architect and the GC Project Manager.

B. The CPM shall be responsible for the final agenda.

C. The CPM and Project Architect shall take notes on the meeting and post completed meeting minutes.

D. Attendance shall be required by all of the following:

1. Owner Representative(s)

2. Architect and applicable sub consultant(s)
3. General Contractor and applicable subcontractors and suppliers
4. City Quality Management Staff
5. Commissioning Agent
6. Others, as may be invited for particular agenda items.

E. Topics of the Preconstruction Meeting shall include but not be limited to the following:
1. Staff and contractor introductions
2. Completion Date
3. BPW Administrative requirements and due outs
   a. Small Business Enterprise (SBE) (if applicable)
   b. Certified payroll forms
   c. Workforce profiles
   d. Best Value Contracting (BVC)
4. General Facility Management Division 1 Specifications, including:
   a. Section 01 29 76 Progress Payment Procedures
   b. Section 01 31 23 Project Management Web Site (overview)
   c. Section 01 45 16 Field Quality Control Procedures
   d. Section 01 77 00 Closeout Procedures
   e. Section 01 91 00 Commissioning
5. Project Meeting scheduling
   a. Section 01 31 19 Project Meetings
6. Construction Schedule
7. Commissioning Process

3.2. PROJECT MANAGEMENT WEB SITE – TUTORIAL MEETING

A. The CPM shall schedule and conduct a tutorial presentation of the PMWS prior to the beginning of construction.
B. The CPM shall be responsible for the final agenda, there will be no minutes.
C. The required attendance list in 3.1.D. above shall apply except for City Staff in items 1 and 4 who are already familiar with the PMWS system.
D. It is recommended that all contractors bring their lap top, tablet or other internet capable device with them including a fully charged battery and internet connection devices as necessary.

3.3. CONSTRUCTION PROGRESS MEETINGS

A. In general all of the following shall apply:
1. Representatives of Contractors, Subcontractors, and suppliers attending meetings shall be qualified and authorized to act on behalf of the entity each represents.
2. The attendance shall be from the required attendance list in 3.1.D. above.

B. The General Contractor Project Manager (GCPM) shall:
1. Schedule and conduct all construction progress meetings biweekly or more frequently as required.
2. Prepare agenda for meetings including, but not limited to the following:
   a. Safety
   b. Current Schedule, including review of the critical path and 6-week look ahead schedule
   c. Status of project related documentation (Submittals, RFIs, CBs, etc.)
   d. Quality Observation Log and status of correction of deficient items
   e. Project questions and issues from meeting attendees
   f. BPW Administration Check
   g. Other as needed
   h. Status of CORs and COs to be reviewed outside the standard progress meeting time.
3. Make physical arrangements for meetings.
4. GCPM to post meeting agendas to the appropriate libraries on the Project Management Web Site (PMWS) no less than two (2) working days prior to the scheduled meeting. Notify all required attendees, applicable parties to the contract, and others affected of the posted meeting agenda.
5. Preside at meetings.
6. Route a meeting attendance roster for attendees to sign-in on.
7. GCPM to record the minutes of the meeting; include significant proceedings and decisions. Post meeting minutes to the PMWS no more than two (2) working days after the completed meeting. Meeting minutes shall include a scanned copy of the attendance sign-in sheet. Notify all required meeting attendees, applicable parties to the contract, and others affected by decisions made at the meetings.

8. The above requirements do not apply to GC/sub-contractor meetings.

3.4. PRE-INSTALLATION MEETINGS

A. The GCPM shall schedule and conduct all pre-installation meetings, including mockup reviews, before each construction activity that requires coordination with other trades.
B. The GCPM shall be responsible for the final agenda and meeting minutes.
C. The GCPM will work with all concerned parties to resolve issues as needed and submit RFI's if necessary.
D. Required attendance shall be from the list in 3.1.D. above and shall be personnel having a stake in the outcome of the installation or knowledge of the system being installed.
E. In the event the Contractor installs equipment or materials without a pre-installation meeting the Contractor shall be solely responsible for removing, replacing, repositioning materials and equipment as instructed by the Project Architect or City Project Manager at no additional cost to the City.

3.6 PRE-CONTRACT CLOSEOUT MEETINGS

A. Two (2) Pre-contract Closeout Meetings shall be held to review the closeout procedures, requirements, and contract deliverables.
   1. Pre-contract Closeout Meeting #1 shall be scheduled prior to the 50% Progress Payment Request is being requested. This meeting shall discuss items such as closing out QMO reports, providing O&M drafts and finals, payroll and Affirmative Action documentation, and other contract deliverables.
   2. Pre-contract Closeout Meeting #2 shall be scheduled prior to the 80% Progress Payment Request is being requested. This meeting shall discuss, but not be limited to, the status of scheduling final regulatory inspections, cleaning up outstanding QMO's, demonstration and training, attic stock; and finalization review of payroll and other related documents.
B. The GCPM shall schedule, coordinate, and make physical arrangements for both meetings.
C. All of the following shall be required to attend both meetings:
   1. The GCPM and the GC Field superintendent
   2. All Subcontractor Project Managers regardless of the current status of their work.
      a. The GCPM may excuse a Subcontractor PM if he is confident that all contractual requirements for closeout by the subcontractor have been completed and/or delivered to the GCPM. The list of attendees shall be reviewed and agreed upon with CPM ahead of the meeting.
      b. At the option of these project managers the field supervisors may also attend.
   3. The Project Architect and at least one design consultant from each discipline represented by the plans and specifications to address open QMOs, final tests, reports, etc.
   4. The Owner
   5. The CPM
   6. Quality Management staff as needed to address open QMOs, final tests, reports, etc.
   7. The Commissioning Agent
D. The CPM shall publish an agenda and chair the meeting.

3.7 OTHER SPECIAL MEETINGS

A. The Contractor shall schedule special meetings per the requirements of the LEED Specification, the Project Quality Management Plan, the Commissioning Plan and as indicated by other specifications.
B. Special meetings include but are not limited to the following:
   1. Waste Management Conference
   2. Equipment start up meetings
   3. Testing and balancing meetings
   4. Commissioning meetings
   5. Other meetings as necessitated by the contract documents

END OF SECTION

SECTION 01 31 23
PROJECT MANAGEMENT WEB SITE

PART 1 – GENERAL

1.1. GENERAL DESCRIPTION

A. The City of Madison (CoM) has established a web based Project Management Tool (PMT) using a Microsoft product called SharePoint (SP).

B. The software is used throughout the design, construction and warranty process of major remodels and new construction projects executed as a City of Madison, Board of Public Works project.

C. Initially deployed in mid 2013, the PMT software has been successfully deployed on several projects, and we continue to modify/update/enhance the PMT on a regular basis.

1.2. SHAREPOINT PROCEDURE OVERVIEW

A. The CoM PMT is a system of consolidated Document & Form Libraries and Data Lists that assist in performing day to day functions of design/construction management while reducing the use of surface mail, email and email attachments.

1. Document libraries store a wide variety of documents in many different formats including but not limited to Word, Excel, PDF, photographs (all popular formats), etc.
2. Data Lists contain consolidated data information that can be generated and stored for further use. Punch Lists and Warranty issues will be examples of Data Lists.
3. Form libraries contain snapshot information associated with a particular Data Entry form. An example of this is the Quality Management Observation form.

B. The following libraries and sub-libraries on the PMWS are provided for specific workflows and contract documentation. Related specification numbers are in "( )" if applicable.

Contract Documents	Construction Administration	Construction Progress	LEED Documentation	Quality Control	Construction Closeout
Signed Contract	*Change Order Requests (COR Form) (01 26 57)*	*Schedules (01 32 16)*	*LEED Documents*	*Regulatory Inspections*	*Misc Closeout Documents*
GC Partial Pay Apps (01 29 76)	*Change Orders (CO Form) (01 26 63)*	*Progress Meetings (01 31 19)*	*Waste Management (01 74 19)*	*Commissioning Checklists*	*O & M Manuals (01 78 23)*
Construction Documents	*Construction Bulletins (CB Form) (01 26 46)*	*Daily Journal (DJ Form) (01 32 26)*		*System Performance Tests*	*Product Warranties /Guarantees (01 78 36)*
Regulatory Documents	*Request for Information (RFI Form) (01 26 13)*			*Quality Management Observation (QMO Form) (01 45 16)*	*As-Builts (01 78 39)*
Testing Contract	*Submittals (SUB Form) (01 33 23)*			*Safety and Incident Reports*	*Attic Stock (01 78 23)*
				Material Testing & Field Reports	*Demonstration and Training (01 79 00)*
					Warranty Issues (WI Form) (01 78 23)

C. A tutorial document on the web based PMT will be provided to the General Contractor (GC) who is awarded the contract. Additional training will be provided as needed for the GC and Sub-Contractors (SC) by the CoM.

D. The PMT has predefined work flows that channel automated alerts as documents are uploaded, reviewed, and completed. These workflows are designed for inbound information from the contractor as well as outbound information from the Architectural/Engineer consultant and the Owner.

E. The GC will be required to receive email notifications, access the internet to review related documentation and be able to upload/download documentation to the various project libraries.

F. The SC's will be required (at a minimum) to receive email notifications and access the internet to review related documentation. Prior to setting up the final PMT the GC and CPM shall meet to review all SP workflows, the GC will determine to what level over the minimum requirements the SC's will be involved.

1.3. RELATED SPECIFICATIONS

A. The following specification sections are directly related to the CoM PMT system.

1. 01 26 13 Request for Information (RFI)
2. 01 26 46 Construction Bulletins (CB)
3. 01 26 57 Change Order Request (COR)
4. 01 26 63 Change Order (CO)
5. 01 29 76 Progress Payment Procedures
6. 01 31 19 Project Meetings
7. 01 32 16 Construction Progress Schedules
8. 01 32 26 Construction Progress Reporting
9. 01 32 33 Photographic Documentation
10. 01 33 23 Submittals
11. 01 45 16 Field Quality Control Procedures (Owner)

PART 2 - PRODUCTS

2.1. SHAREPOINT SYSTEM RELATED PRODUCTS

A. SharePoint is a Microsoft Windows based software that requires no additional software installation, hardware or other special requirements/applications for the users. There are no costs associated with the use of this system.

B. Currently the CoM is using SharePoint 2010.

1. SharePoint works best if the user's computer is running Windows versions 7 through 8.1.
2. SharePoint works best when used with Internet Explorer versions 7, 8 and 9 (32 bit).
   a. At this time SharePoint is not fully supported by Internet Explorer versions 10 and 11.
   b. At this time SharePoint is not entirely compatible with other internet browsers such as Fire Fox, Google Chrome, and Safari.

PART 3 - EXECUTION

3.1. POST BID-OPENING

A. After bids have been opened, a successful bidder has been determined, and bid acceptance procedures have been initiated the City Project Manager (CPM) will contact the GC to provide the following information.

1. Project Management Software Tutorial. This tutorial is in a PDF printable format with screen shots and associated instructions on how to access and use the PMT.
   a. Tutorial instructions will include but not be limited to the following:
      i. Descriptions of various libraries, documents, and forms that will be used throughout the construction project.
      ii. Uploading procedures for various types of documents including standardized naming conventions.
2. A blank Project Directory in an Excel spread sheet format. The contractor shall provide the following information for GC and SC staffs as indicated on the spreadsheet. This will generally be the Project Manager for the GC as well as the Sub-contractors and the GC Site Supervisor.
   a. Last Name, First Name
   b. Company Name
   c. Email address (valid, work related)
   d. Work Phone Number (required, include area code)
   e. Cell Phone Number (not required, include area code)

3. The GC shall provide the above information for all SC's where the GC is not self-performing the work.
4. The GC may provide project foreperson information for work being self performed if he/she so desires.

3.2. POST PRE-CONSTRUCTION MEETING

A. The GCPM will return the completed Project Directory spread sheet to the CPM no later than the Pre-construction meeting.

B. The CPM is responsible for uploading all project directory data into SharePoint and coordinating with CoM Information Technology (CoM-IT) for creating the logins and passwords of non-city staff (GC/SC staffs).

C. All GC/SC staff will be notified through an automated email from CoM IT that logins and passwords are available. It is the responsibility of each GC/SC to call the CoM-IT number provided in the email to receive his/her login/password over the phone. Logins and passwords will not be released via email.

D. Once the GCPM has received his/her login/password uploading of contract related documents can begin. This would include but not be limited to project schedules, submittals, RFI's, and other documents as needed.

E. All workflows, review of documentation, and general archiving of construction related documentation will be conducted on the PMWS. These documents will generally not be emailed.

F. The following documents related to the execution of the contract will not be part of the PMWS:
   1. All documentation related to executing the contract, such as:
      a. Sub Contractors list
      b. Affirmative Action documentation
      c. Bonding documentation
      d. Documentation associated with payroll verification
      e. Final documentation associated with closing out the contract
   2. Any documentation required/generated by ordinance, code or statute, such as;
      a. Erosion Control inspections
      b. Building Inspection Department inspections

END OF SECTION

SECTION 01 32 16
CONSTRUCTION PROGRESS SCHEDULES

PART 1 – GENERAL

1.1. SCOPE

A. This specification is to identify various project related schedules associated with indicating construction progress and outlook. The following schedules are the responsibility of the General Contractor (GC).
   1. Overall Project Schedule
   2. 6 Week Look-out Schedule

B. This specification is not intended to include internal schedules generated by the contractors during their planning and execution of the contract.

1.2. RELATED SPECIFICATIONS

A. Section 01 29 76 Progress Payment Procedures
B. Section 01 31 23 Project Management Web Site
C. Section 01 31 19 Progress Meetings
D. Section 01 74 13 Progress Cleaning
E. Section 01 77 00 Closeout Procedures
F. Section 01 78 23 Operation and Maintenance Data
G. Section 01 78 36 Warranties
H. Section 01 78 39 As-Built Drawings
I. Section 01 78 43 Spare Parts and Extra Materials
J. Section 01 79 00 Demonstration and Training
K. Section 01 91 00 Commissioning
L. Other specification within the construction documents that may indicate the need for scheduling any event with Owner, Project Architect, Owner Representatives, including any owner provided equipment.

PART 2 – PRODUCTS – THIS SECTION NOT USED

PART 3 - EXECUTION

3.1. OVERALL PROJECT SCHEDULE (OPS)

A. The GC shall prepare an OPS that covers the duration of the contract from the pre-construction meeting through the end of construction to final contract closeout.
   1. The GC shall review Specification 01 77 00 Closeout Procedures to become familiar with definitions, differences, and requirements for closing out the construction and contract including the association with progress payments.
B. The GC shall provide copies and lead a discussion on the OPS during the pre-construction meeting.
C. The OPS shall indicate start and end dates of each task associated with the project.
D. The OPS shall clearly indicate the critical path of the project.
E. The GC shall update the OPS as often as necessary during the duration of the project. Updates will be briefed as needed during bi-weekly progress meetings.

3.2. 6 WEEK LOOK-OUT SCHEDULES (LOS)

A. The GC shall prepare the initial LOS to include detail of daily tasks for the first six (6) weeks of construction in depth for the Pre-construction meeting. The LOS shall be compatible and complimentary to the OPS.
B. The GC shall provide copies and lead a discussion on the LOS during the pre-construction meeting.

C. The LOS shall indicate start and end dates of each major task, associated related sub-tasks, and required parallel or pre-requisite tasks required to complete the major task on time.

D. The LOS shall also include identifying and scheduling such events as:
   1. Pre-installation meetings and mock-up review meetings.
   2. Quality management reviews of installations before they are covered.
   3. Owner provided equipment as designated by the contract documents.
   4. Work by others as designated by the contract documents.
   5. Critical submittal dates.

E. The GC shall update the LOS prior to each bi-weekly progress meeting to indicate the next 6 weeks of scheduled work. Updates will be briefed during each bi-weekly progress meeting.

3.3. PROJECT MANAGEMENT WEB SITE (PMWS)

A. The GC shall upload all project schedules and updates to the PMWS in an original PDF version of the scheduling document. Scans will not be permitted.

END OF SECTION

SECTION 01 32 19
SUBMITTALS SCHEDULE

PART 1 – GENERAL

1.1. SUMMARY

A. The General Contractor shall submit a complete and comprehensive list of all submittals anticipated during the execution of this contract.

B. The GC shall include the Administrative submittals identified in item 1.5 below and shall be required to up load them to the Project Management Web Site.

C. The initial Submittals Schedule shall be based on the original contract documents used at the time of bidding and any posted addenda through awarding of the contract.

D. The Submittal Schedule may be appended during the execution of the contract based on amendments to the contract in the form of Change Orders, Construction Bulletins, and other related documents that add, or change the scope of the work.

1.2. RELATED SPECIFICATIONS

A. Section 01 29 76 Progress Payment Procedures
B. Section 01 31 23 Project Management Web Site
C. Section 01 33 23 Submittals
D. Section 01 91 00 Commissioning

1.3. RELATED DOCUMENTS

A. The following documents shall be used as the basis for initiating the original Submittals Schedule.
   1. Drawing documents and specifications (including general provisions) as provided with the bid set documents and any published addenda.

B. The following documents shall be used to amend the submittals schedule as needed during the execution of this contract.
   1. Documents associated with revisions or clarifications to number A.1 above after awarding of the contract, including but not limited to:
      a. Construction Bulletins
      b. Approved Change Orders

1.4. SUBMITTAL DEFINITIONS

A. Administrative Submittal: Any submittal that may be required by a Division 1 Specification and as noted in Section 1.5 below.

B. Critical Path Submittal: Any early submittal that needs a priority review due to early construction use or long lead times where a delay could affect the critical path of the construction schedule

C. Submittal: Any material, product, equipment, or general requirement as outlined in this and other specifications that require a favorable review or acceptance prior to proceeding with procuring the item or proceeding with the Work.

1.5. SUBMITTAL REQUIREMENTS

A. The GC and all Sub-contractors shall review the construction documents including the specifications of their individual Division or Trade to compile a complete list of all materials, products, or equipment that will require a positively reviewed submittal to be completed prior to procurement and installation.
   1. Submittals shall include but not be limited to any of the following that may apply:
      a. Shop Drawings
      b. Product Data
      c. Assembly Drawings
      d. Engineered Drawings
      e. Product Samples

B. The following items will require an approved submittal, verify with specifications for specific needs and requirements:
   1. Contractor certifications for specialized work such as asbestos removal, well drilling, controls, AV, etc.

1.6. ADMINISTRATIVE SUBMITTALS

A. The GC shall upload the following submittals within 15 working days of receipt of the City of Madison Start Work Letter. All Administrative Submittals shall be approved prior to requesting Progress Payment Number 1.
   1. Contractors Project Directory, see specification 01 31 23, discuss requirements with CPM
   2. Schedule of Values, see Specification 01 29 73
   3. Submittals Schedule, see Specification 01 32 19
   4. Waste Management Plan, see Specification 01 74 19
   5. Closeout Requirement Checklist, see Specification 01 77 00
   6. Warranty Checklist, see Specification 01 78 36

PART 2 – PRODUCTS – THIS SECTION NOT USED

PART 3 - EXECUTION

3.1. OVERALL RESPONSIBILITIES OF ALL CONTRACTORS

A. All contractors shall be responsible for reviewing the drawings and specifications within their Divisions of Work to provide a complete and comprehensive list of submittals to the General Contractor.

B. Each list shall indicate the title of the submittal, the associated specification of the submittal, whether the submittal can be considered an early/middle/late submittal, the anticipated date the submittal will be provided and the anticipated date the submittal needs to be approved.

C. Contractors shall be aware that the goals for submittal review by the Architect staff and City staff will be as follows:
   1. For items on the Critical Path as identified by the GC, five (5) working days
   2. For most other submittals ten (10) working days
   3. Additional time may be needed for complex submittals or if re-submittals are required.

D. The general format of the Submittal Schedule shall be tabular as per this example:

Title	Specification	Critical Path (Y or N)	Date provided	Date required	Remarks
Concrete Mix Design	03 30 00	Y	Oct 1, 2014	Oct 15, 2014	
Paint Draw Downs	09 90 00	N	Jan 2, 2015	Jan 20, 2015	

3.2. GENERAL CONTRACTORS RESPONSIBILITIES

A. The General Contractor shall be responsible for all of the following:
   1. Consolidating all submittal lists from individual contractors into one master list.
   2. Reviewing all submitted lists for completeness, timing with the overall contract, etc. The GC shall meet with individual contractors to make changes as necessary.
   3. Upload the completed Submittals Schedule to the Submittal Library on the Project Management Web Site for review as SD 003.0. See Specification 01 33 23 Submittals for more information on this procedure.
   4. Resubmit the schedule as needed after initial reviews have been completed.

B. The GC shall work with other contractors to amend the Submittals Schedule throughout the execution of the project based on changes and modifications as needed.

C. The GC and Project Architect shall be responsible for reviewing and briefing the submittal schedule and submittals status at each bi-weekly construction meeting.

3.3. STAFF REVIEW RESPONSIBILITIES

A. The Project Architect, consulting staff, Commissioning Agent (CxA), Owner, and city staff will review the Submittal Schedule for completeness per the plans and specifications within their divisions of work. The reviewing staff may provide comments as needed. Some examples might include the following:
   1. Submittal not required
   2. Provide photos of samples with digital submittal
   3. Insure one submittal for complete system
   4. Append the schedule to include…
   5. See Specification <xyz> for additional requirements

B. The Project Architect and City Project Manager will finalize review comments regarding the Submittal Schedule. Re-submittal of the submittal schedule may be required.

END OF SECTION

SECTION 01 32 26
CONSTRUCTION PROGRESS REPORTING

PART 1 – GENERAL

1.1. SUMMARY

A. Daily records of project activities, resources used, weather conditions, and other information related to the ongoing progress of the project are extremely important at all levels of Construction Management.

B. Daily records provide the base for weekly progress reports and updating progress schedules.

1.2. RELATED SPECIFICATION SECTIONS

A. Section 01 31 19 Project Meetings

B. Section 01 31 23 Project Management Web Site

C. Section 01 32 23 Photographic Documentation

1.3. PERFORMANCE AND QUALITY ASSURANCE REQUIREMENTS

A. The General Contractor (GC) shall be responsible for all Construction Progress Reporting as outlined in this and other specifications as noted.

B. The GC shall maintain daily progress journals in a format of his/her choosing provided it is legible and contains the information as outlined in Section3.1 below.

C. The journal shall be located in the job trailer and shall be reviewable by the Project Architect or City Project Manager if so requested.

PART 2 – PRODUCTS - THIS SECTION NOT USED

PART 3 - EXECUTION

3.1. DAILY PROGRESS JOURNAL

A. The GC shall maintain a daily progress journal of daily Work activities for each day on which Work is performed by any employee or entity for which the GC is responsible. Such reports shall include all relevant data concerning the progress of Work activities the GC and Subcontractors are responsible for and the effect of that activity on the time of performance of the Contract.

B. Journal entries shall be made on the Daily Work Report Form located in the Construction Progress-Daily Journal Library on the Project Management Web Site. The form consists of the following areas:

1. Weather; include temperature, humidity, precipitation, wind and other related information such as significant storm events, times, and details.
2. Work completed by trade
3. Delays encountered
4. Deliveries received or delayed
5. Hot issues that need to be addressed
6. Safety issues
7. Photograph progress and upload to the Photo Library on the Project Management Web Site.
8. Other including inspections, testing, etc.
9. Space for attaching documents

C. Daily Work activity reports shall be completed and signed by the GC's Job Superintendent or other on-site representative authorized by the GC confirming each such report is current, accurate and complete.

D. If applicable the GC shall include schedules of quantities and costs, progress schedules, wage rates, reports, estimates, invoices, records and other data as requested by the CPM concerning Work performed or to be

performed under this Contract if the CPM determines such information is needed to substantiate Change Order proposals, claims, or to resolve disputes.

3.2. CONSTRUCTION PROGRESS MEETINGS

A. The GC shall provide a verbal summary of the previous two (2) weeks progress reports at each bi-weekly construction progress meeting.

END OF SECTION

SECTION 01 32 33
PHOTOGRAPHIC DOCUMENTATION

PART 1 – GENERAL

1.1. SCOPE

A. The General Contractor (GC) shall be required to take weekly digital photographs of construction progress and upload the photos directly to the Project Management Web Site (PMWS).

1.2. RELATED SPECIFICATION SECTIONS

A. Section 01 31 23 Project Management Web Site
B. Section 01 32 26 Construction Progress Reporting

PART 2 – PRODUCTS - THIS SECTION NOT USED

PART 3 - EXECUTION

3.1. REQUIREMENTS FOR DIGITAL PHOTOGRAPHS

A. All digital photographs shall be taken with a good quality digital camera, cell phone, tablet, and other such digital device.
B. Digital photographs shall be properly zoomed in/out to capture a specific level of detail as necessary.
C. Digital photographs shall be formatted to achieve a good, clear, and detailed image where the final file size is between 600 KB and 1.2 MB (1200KB).
D. The camera default naming convention is acceptable. The GC does not need to rename or specifically identify pictures in the title.
E. All digital photographs shall be saved in a JPEG (.jpg) format and uploaded directly to the PMWS.

3.2. PICTURE CONTENT

A. The GC shall take exterior photographs from at least two (2) different angles.
   1. This requirement shall only be applicable when there is exterior work connected with the project.
   2. When applicable this requirement shall begin prior to commencing any site work.
   3. This requirement shall end when the exterior work has been substantially completed.
   4. This requirement may be suspended due to weather conditions or substantial delays in exterior progress.
B. The GC shall take interior photographs of interior construction, equipment installation, rough-ins and other such progress that helps document weekly progress reporting. Interior photographs should focus on specific significant installations as well as general progress throughout the progress of the contract.

3.3. PROJECT MANAGEMENT WEB SITE

A. The GC shall upload the digital photographs to the appropriate progress folder in the Project Images Library.
B. Progress folders are labeled with the Construction Week Number and the date for Monday of that week.
C. The GC shall notify the City of Madison Project Manager if additional progress folders need to be created.

END OF SECTION

SECTION 01 33 23
SUBMITTALS

PART 1 – GENERAL

1.1. SUMMARY

A. The General Contractor (GC) shall be responsible for providing submittals for review of all contractors and sub-contractors as designated in the construction documents. Submittals shall include but not be limited to all of the following:
   1. Equipment specified and pre-approved in the specification; to ensure quality, construction, and performance specifications have not changed since final design.
   2. Equipment specified by performance in the specification; to ensure that the intended quality, construction, and performance specified is met by the selected material or product.
   3. Shop, piece, erection, and other such drawings as indicated in the specifications to ensure all structural, dimensional, and assembly requirements are being met.
   4. Submittals indicating installation sequencing
   5. Submittals indicating control sequencing
   6. Contractor licensing, certification, and other such regulatory documentation when required by a specification.
   7. Other submittals as may be required by individual specifications.

B. The submittal process shall not be used to determine alternates to specified products or equipment. All considerations shall be reviewed during the bidding process and acceptable alternates shall be acknowledged by addendum prior to the closing of bidding. See bidding instructions for the information on submitting alternates for consideration.

D. In the event that a manufacturer has significantly changed a product (discontinued a model, changed dimension or performance data changed available colors, etc.) since bid opening the GC shall submit a Request for Information (RFI) to the Project Architect requesting other approved alternates prior to uploading a digital submittal.

E. Contractors and sub-contractors shall be responsible for knowing the submittal requirements of ALL sections within their scope of work under the contract. The Owner reserves the right to request documentation on any materials, equipment, or product being installed where a submittal is not on file. If the material, equipment, or product installed is determined not to meet the intent of the specification the contractor/sub-contractor shall be required to remove and replace the items involved. The GC shall be solely responsible for all costs associated with the removal and replacement.

1.2. RELATED REFERENCES

A. Section 01 29 76 Progress Payment Procedures
B. Section 01 31 23 Project Management Web Site
C. Section 01 32 19 Submittals Schedule
D. Section 01 32 26 Construction Progress Reporting
E. Section 01 91 00 Commissioning
F. All Technical Specifications, contract documents, construction drawings, and any published addendums during the bidding process.
G. All contract documents generated during the execution of the contract including but not limited to Requests for Information (RFI) and Construction Bulletins (CB).

1.3. SUBMITTAL REQUIREMENTS

A. A completed submittal shall meet the following requirements:

1. Digital submittal shall be original PDF of manufacturer's data sheets or high quality color scan of the same.
    a. Submittals shall not include sales fliers or other similar documents that typically do not provide complete manufacturers data.
2. Documents within the PDF submittal shall be printable to a sized sheet no less than 8-1/2 by 11 inches and no larger than 24 by 36 inches.
3. At the beginning of each submittal the contractor shall identify the plan reference (WC-1, EF-3, etc.) in RED block letters that the submittal is for.
4. Where multiple model numbers appear in a table the contractor shall identify the specific model being submitted by using a RED square, box, or other designation to distinguish the correct model from others on the page.

B. A complete submittal will include all information associated with the product or equipment as presented in plans, equipment tables, and specifications. Information shall include but not be limited to the following:
1. Dimensional data
2. Performance data
3. Resource requirements, power, water, waste, etc
4. Clearance and maintenance requirements
5. Finish information, colors, textures, etc.
6. Warranty information

C. Where a submittal includes material samples (carpet, tile, paint draw downs, etc.) the contractor shall do the following:
1. The Contractor shall submit the sample(s) as indicated in the specification.
2. The Contractor shall include a quality photograph(s) of the product with the digital submittal. Photographs shall meet the following requirements:
    a. Formatted to be between 500Kb and 1.0 Mb in file size
    b. Have no glare or flash reflection on the sample
    c. Sample fills the frame of the photo and shows detail as needed. Include multiple photos from other angles as needed.
    d. Scanned copies of products or photos are not acceptable.

D. Uploaded submittals should be relative and related to a specific written specification.
1. Do not upload submittals under a broad category or division (I.E. HVAC 23 00 00). Always upload by the specific specification that identifies a required product or performance to be met.
2. Group related items together if the specification is written that way. (I.E. all of the plumbing fixtures and trim relative to one specific specification should be submitted together).
3. Submittals shall be grouped and adhere to the divisions in the submittal schedule. Submittals that do not conform to the submittal schedule and/or specification divisions will be rejected for re-submittal.

PART 2 – PRODUCTS – THIS SECTION NOT USED

PART 3 - EXECUTION

3.1. GENERAL CONTRACTORS PROCEDURES

A. All required submittals will be uploaded to the Construction Administration-Submittal Drawings Library on the Project Management Web Site (PMWS) by the GC.
1. The GC shall open a new Submittal Form in the Submittals Drawings Library for each required submittal from the Submittals schedule.
2. Fill in required information on the form that will be used for routing the review and comments.
3. Attach all documentation as described in Section 1.3 above.
    a. Submit samples under separate cover to the Project Architect when necessary.

B. Uploading the submittal indicates that the GC has reviewed and approved the submittal against the contract document requirements.

C. The GC shall discuss submittal status at all progress meetings and shall monitor submittal review/approval/re-submittal so as to not incur delays in the project schedule.

D. A completed upload of the submittal to the PMWS initiates the review process workflow.

E. The GC and sub-contractors shall provide re-submittals as required.

3.2. SUBMITTAL REVIEW

A. Upon completion of the submittal upload by the GC the PMWS automatically notifies the appropriate Architect/Engineer and Owner Representative, including CxA, by Division/Specification number that there is a submittal for review.

B. The submittal shall be reviewed internally by the required Architect/Engineer and Owner Representative and CxA in a timely fashion and provide commentary on missing items, incorrect information, or incomplete shop drawings, etc as needed.

C. When the internal review is completed the PMWS will notify the Project Architect the submittal is ready for final review.

3.3. PROJECT ARCHITECTS REVIEW

A. Upon completion of the internal review the Project Architect shall review all internal review comments, confer with the CPM and CxA as needed and determine the appropriate disposition status for the submittal (approved or resubmit).

C. The Project Architect shall summarize final internal review comments onto the submittal cover sheet, provide a final disposition of the submittal and update the review status of the submittal to “Complete…” (with or w/o comments) or “Rejected”.

D. A completed Final Review status initiates the PMWS to notify the GC and appropriate sub-contractor(s) that the review of the submittal has been completed.

END OF SECTION

SECTION 01 43 39
MOCKUPS

PART 1 – GENERAL

1.1. SUMMARY

A. Definition
   1. Mockups are field samples constructed, applied, or assembled at the project site for review by the Owner, Owners Representative, Architect and Consultants.
   2. Mockups are three dimensional, true scale models that illustrate materials and methods, equipment, workmanship, or location; based on plans, details, and assemblies.

B. Approved mockups establish the standard of quality by which the final work will be judged.

C. Approved mockups shall be properly documented and entered Into the Submittal Library on the Project Management Web Site like any other required submittal. See section 3.4 below for more information.

1.2. RELATED SPECIFICATIONS

A.	Section 01 26 13	Request for Information (RFI)
B.	Section 01 26 46	Change Bulletin (CB)
C.	Section 01 26 63	Change Order (CO)
D.	Section 01 31 19	Project Meetings
E.	Section 01 32 16	Construction Progress Schedules
F.	Section 01 33 23	Submittals
G.	Section 01 45 00	Quality Control

1.3. RELATED DOCUMENTS

A. The following documents shall be used for preparing mockups.
   1. All plans, specifications, and details including those derived as revisions (RFI, CB, CO).
   2. Construction Progress Schedules. Mockups shall be done and completed in a timely fashion for review and approval so as to not impact the Contractors project schedule.
   3. Any Manufacturers installation/assembly instructions.

1.4. PERFORMANCE REQUIREMENTS

A. All Contractors shall be responsible for providing and constructing mockups as specified in their Division of Work in the plans and specifications.

B. Materials to be used shall be as specified in the construction documents, full sized and properly assembled.

C. Completed mockups shall be of sufficient size to provide visible detail of all components as needed for the sample.

1.5. QUALITY ASSURANCE

A. The General Contractor (GC) shall be responsible for coordinating all of the following as needed:
   1. Designating the location for the mockup construction
   2. Coordinating the work of all contractors and materials required to complete the mockup
   3. Ensuring that the mockup meets the intent of the construction documents before scheduling the mockup review meeting.

PART 2 - PRODUCTS

2.1. MATERIALS

A. The materials used in mockups shall be only those materials indicated in the plans, specifications, and favorably reviewed submittals.

B. Mockups shall be made of full scale materials as delivered to the project site.

C. All materials associated with a particular detail, construction method, manufacturer's installation instructions shall be properly represented and visible in the mockup. This includes but is not limited to finished mortar joints, sealants, backer rods, tie bars, rebar, etc.

PART 3 - EXECUTION

3.1. REVIEW THE PLANS AND SPECIFICATIONS

A. The GC shall review the plans and specifications with all required contractors prior to constructing the mockup.

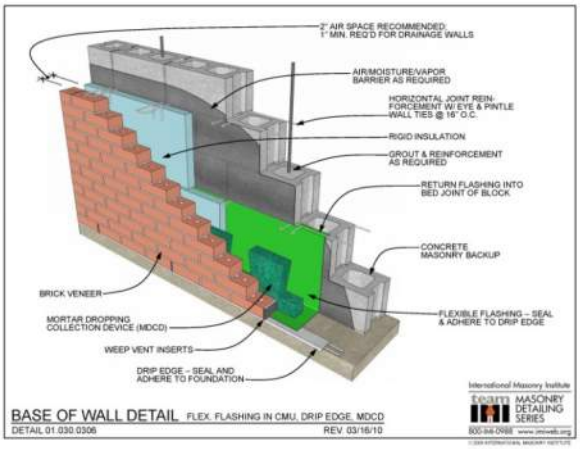
1. Mockups that will be built and remain in place, if favorably reviewed, will be installed in an area easily accessible for review.
2. Mockups that will not be built in place or will not remain will be constructed in a space on the project site protected from weather, construction traffic, and other such disturbances until such time as the associated work has been completed.
3. Insure all products being represented in the mockup meet the plans, specifications, and any published changes.

3.2. MOCKUP CONSTRUCTION

A. Mockups shall be of sufficient size to show various material adjacencies, connectivity, patterns, and other such related features.

B. Mockups shall be constructed in a layered fashion so that all products being used can be seen and evaluated.

C. The construction detail below is an example of a properly layered mockup.



D. **See Sheet 802 and SECTION 03 33 00 for mockup requirements**

3.3. MOCKUP REVIEW

A. The General Contractor and all associated Sub-contractors (Contracting Team) shall meet with the Owner, Owners Representative, Architect and Consultants (Design Team) as necessary to review the mock-up. Contractors shall be prepared to answer questions on materials and methods as necessary.

B. The Contracting and Design Teams shall review the mockup in detail for materials, methods, and workmanship with respect to the intent of the contract documents. Improvements or adjustments shall be discussed as needed.

C. If the mockup is incomplete or does not show sufficient detail of products and workmanship the General Contractor shall resubmit a new mockup.

D. Re-submittal of mockups to meet the intent of the contract documents shall be the responsibility of the General Contractor. No Change Orders will be processed for additional time or materials associated with re-submitting a mockup for approval.
   1. In the event that a submitted mockup meets the criteria of the contract documents but does not meet the expectations of the design team and alternative methods or materials are discussed the following procedure shall be used:
      a. Project Architect shall publish a Construction Bulletin (CB) to detail the required/recommended changes.
      b. The GC shall prepare and submit a new mockup.

3.4. FINAL SUBMITTAL

A. The field approved mockup shall be submitted by the General Contractor as any other submittal for project documentation purposes. The mockup submittal shall consist of the following:
   1. Digitally photograph the field approved mockup. Take as many detailed photos as necessary to capture the complexity of the mockup.
   2. Provide a written summary of the approved mockup. Include all recommended adjustments, level of expected workmanship, and other such detail as discussed during the mockup review.
   3. Submit the mockup to the Project Management Web Site. See Specification 01 33 23 Submittals for additional information.

END OF SECTION

SECTION 01 43 50
AIR BARRIER SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, Division 07 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. This section includes administrative and procedural requirements for accomplishing an airtight building enclosure that controls infiltration or exfiltration of air.

B. Related Sections:
   1. Section 07 25 00: Weather Barriers.
   2. Requirements of this section relate to the coordination between subcontractors required to provide an airtight building enclosure, customized fabrication and installation procedures, not production of standard products.

1.3 DEFINITIONS

A. The airtight components of the building enclosure and the joints, junctures and transitions between materials, products, and assemblies forming the air-tightness of the building enclosure are called “the air barrier system”. Services include coordination between the trades, the proper scheduling and sequencing of the work, pre-construction meetings, inspections, tests, and related actions, including reports performed by Contractor, by independent agencies, and by governing authorities. They do not include contract enforcement activities performed by Architect.

1.4 PERFORMANCE REQUIREMENTS

A. General Performance: The Contractor shall ensure that the intent of constructing the building enclosure with a continuous air barrier system to control air leakage into, or out of the conditioned space is achieved. The air barrier system shall have the following characteristics:
   1. It shall be continuous, with all joints sealed.
   2. It shall be structurally supported to withstand positive and negative air pressures applied to the building enclosure.
   3. Continuity of the air barrier materials and products with joints to provide complete assemblies.
   4. Continuity of all the enclosure assemblies with joints and transition materials to provide a whole building air barrier system.

B. Connection shall be made between:
   1. Foundation and walls.
   2. Walls and windows or doors.
   3. Different wall systems.
   4. Wall and roof.
   5. Wall and roof over unconditioned space.
   6. Walls, floor and roof across construction, control and expansion joints.
   7. Walls, floors and roof to utility, pipe and duct penetrations.

C. Air Barrier Penetrations: All penetrations of the air barrier and paths of air infiltration / exfiltration shall be made air-tight.

D. Compliance Requirements:

1. Assemblies: an air permeance not to exceed 0.03 cfm/ft2p under a pressure differential of 0.3 in. water (1.57psf) (0.15 L/s.m2 @ 75 Pa) when tested in accordance with ASTM E1677.
2. Materials: Materials used for the air barrier system in the opaque envelope shall have an air permeance not to exceed 0.004 cfm/ft2 under a pressure differential of 0.3 in. water (1.57psf) (0.02 L/s.m2 @ 75 Pa) when tested in accordance with ASTM E 2178. Or,
3. Entire Building: The air leakage of the entire building (with the exception of the apparatus bay) shall not exceed 0.15 cfm/sf under a pressure differential of 0.3 in. water (1.57psf) (0.75 L/s.m2 @ 75 Pa) when tested according to ASTM E 779. The air leakage of the apparatus bay shall not exceed 0.4 cfm/sf under a pressure differential of 0.3 in. water (1.57psf) (0.75 L/s.m2 @ 75 Pa) when tested according to ASTM E 779.

1.5 SUBMITTALS

A. Field quality-control reports.

B. Testing agency shall submit a certified written report, in duplicate, of each inspection, test, or similar service to the Architect. If the Contractor is responsible for the service, submit a certified written report, in duplicate, of each inspection, test, or similar service through the Contractor.

1. Submit additional copies of each written report directly to the governing authority, when the authority so directs.

C. Report Data: Written reports of each inspection, test, or similar service include, but are not limited to, the following:

1. Date of issue.
2. Project title and number.
3. Name, address, and telephone number of testing agency.
4. Dates and locations of samples and tests or inspections.
5. Names of individuals making the inspection or test.
6. Designation of the Work and test method.
7. Identification of product and Specification Section.
8. Complete inspection or test data.
9. Test results and an interpretation of test results.
10. Ambient conditions at the time of sample taking and testing.
11. Comments or professional opinion on whether inspected or tested Work complies with Contract Document requirements.
12. Name and signature of laboratory inspector.
13. Recommendations on retesting.

1.6 QUALITY ASSURANCE

A. Requirement for Contractor to provide an airtight building enclosure is not limited by quality-control services required by Architect, Owner, or authorities having jurisdiction and are not limited by provisions of this section.

B. Inspection and testing services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with Contract Document requirements.

1. Qualifications for Air Barrier Testing and Inspection Agencies: Engage Air Barrier inspection and testing service agencies, including independent testing laboratories, that are prequalified and that specialize in the types of air barrier system inspections and tests to be performed.

C. Specific quality-control requirements for individual construction activities are specified in the sections of the specifications. Requirements in those sections may also cover production of standard products. It is the Contractor's responsibility to ensure that each subcontractor is adequately and satisfactorily performing the quality assurance documentation, tests and procedures required by each section.

D. Specified inspections, tests, and related actions do not limit Contractor's quality-control procedures that facilitate compliance with Contract Document requirements.

1.7 PROJECT CONDITIONS

A. Contractor Responsibilities: Unless otherwise indicated as the responsibility of another identified entity, Contractor shall provide coordination of the trades, and the sequence of construction to ensure continuity of the air barrier system joints, junctures and transitions between materials and assemblies of materials and products, from substructure to walls to roof. Provide quality assurance procedures, testing and verification as specified

herein. Facilitate inspections, tests, and other quality-control services specified elsewhere in the Contract Documents and required by authorities having jurisdiction or by the Owner. Costs for these services are included in the Contract Sum.

B. Organize preconstruction meetings between the trades involved in the whole building's air barrier system to discuss where each trade begins and ends and the responsibility and sequence of installation of all the air-tight joints, junctures, and transitions between materials, products and assemblies of products specified in the different sections, to be installed by the different trades.

C. Build a mock-up before proceeding with the work, satisfactory to the Architect, of each air-tight joint type, juncture, and transition between products. materials and assemblies.

D. Associated Services: Cooperate with agencies performing required inspections, tests, and similar services, and provide reasonable auxiliary services as requested. Notify the agency sufficiently in advance of operations to permit assignment of personnel. Auxiliary services required include, but are not limited to, the following:
   1. Provide access to the Work.
   2. Furnish incidental labor and facilities necessary to facilitate inspections and tests.
   3. Take adequate quantities of representative samples of materials that require testing or assist the agency in taking samples.
   4. Deliver samples to testing laboratories.
   5. Provide security and protection of samples and test equipment at the Project Site.

E. Duties of the Testing and Inspection Agency: The independent agency engaged to perform inspections, sampling, and testing of air barrier materials, components and assemblies specified in individual Sections shall cooperate with the Architect and the Contractor in performance of the agency's duties. The testing agency shall provide qualified personnel to perform required inspections and tests.
   1. The agency shall notify the Architect and the Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
   2. The agency is not authorized to release, revoke, alter, or enlarge requirements of the Contract Documents or approve or accept any portion of the Work.
   3. The agency shall not perform any duties of the Contractor.

F. Coordination: Coordinate the sequence of activities to accommodate required services with a minimum of delay. Coordinate activities to avoid the necessity of removing and replacing construction to accommodate inspections and tests.
   1. The Contractor is responsible for scheduling times for inspections, tests, taking samples, and similar activities.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 FIELD QUALITY CONTROL

A. Testing Agency: Contractor will engage a qualified testing agency to perform tests and inspections.

B. Tests and Inspections:
   1. Qualitative Testing and Inspection:
      a. Daily reports of observations, with copies to the Owner, Contractor and Architect.
      b. Continuity of the air barrier system throughout the building enclosure with no gaps, holes.
      c. Structural support of the air barrier system to withstand design air pressures.
      d. Masonry and concrete surfaces are smooth, clean and free of cavities, protrusions and mortar droppings, with mortar joints struck flush, or as required by the manufacturer of the air barrier material.
      e. Site conditions for application temperature and dryness of substrates.
      f. Maximum length of exposure time of materials to ultra-violet deterioration.
      g. Surfaces are properly primed.
      h. Laps in material are 2" minimum, shingled in the correct direction (or mastic applied on exposed edges), with no fishmouths.
      i. Mastic applied on cut edges.
      j. Roller has been used to enhance adhesion.
      k. Measure application thickness of liquid-applied materials to manufacturer's specifications for the specific substrate.
      l. Materials used for compatibility.
      m. Transitions at changes in direction, and structural support at gaps.

n. Connections between assemblies (membrane and sealants) for cleaning, preparation and priming of surfaces, structural support, integrity and continuity of seal.
o. All penetrations sealed.

2. ASTM E 1186/98 “Standard Practices for Air Leakage Site Detection in Building Envelopes and Air Retarder Systems.”
a. Infrared scanning with pressurization/depressurization.
b. Smoke pencil with pressurization/depressurization.
c. Pressurization/depressurization with use of anemometer
d. Generated sound with sound detection
e. Tracer gas measurement of decay rate
f. Chamber pressurization/depressurization in conjunction with smoke tracers
g. Chamber depressurization using detection liquids

3. Quantitative Tests: Provide written test reports of all tests performed, with copies to the Owner, Contractor and Architect.
a. Material compliance for maximum air permeance, ASTM E 2178.
b. ASTM E 283, Determining rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors under Specified Pressure Differences Across the Specimen.
c. Assemblies, ASTM E 1677, test pressure and allowable air leakage rate to be determined by design professional for interior design conditions and location of project.
d. CAN/CGSB 1986 Standard 149.10, Determination of the Airtightness of Building Envelopes by the Fan Depressurization Method.
e. CAN/CGSB 1996 Standard 149.15 Determination of the Overall Envelope Airtightness of Office Buildings by the Fan Depressurization Method Using the Building’s Air Handling System.
f. Canadian National Master Specification Sections 07272 Air Barrier Systems for Exterior Walls of Low-Rise Buildings.
g. Canadian National Master Specification 07272.1 : Durability Assessment of Bead-Applied Urethane-Based Sealant Foam for Air Barriers.
h. Whole building, floors, or suites, ASTM E779, Determining Airtightness of Buildings Air Leakage Rate by Single Zone Air Pressurization.
i. Windows and connections to adjacent opaque assemblies, ASTM E783
j. Tracer gas testing, ASTM E741
k. Pressure test, ASTM E330
l. Bond to substrate, ASTM D4541-95
m. Minimum dry or wet film thickness for liquid-applied materials are per the manufacturer’s requirements.

3.2 REPAIR AND PROTECTION

A. Upon completion of inspection, testing, sample taking and similar services, repair damaged construction and restore substrates and finishes. Comply with Contract Document requirements for Division 1 Section "Cutting and Patching."

B. Protect construction exposed by or for quality-control service activities, and protect repaired construction.

C. Repair and protection is Contractor's responsibility, regardless of the assignment of responsibility for inspection, testing, or similar services.

END OF SECTION

SECTION 01 45 16
FIELD QUALITY CONTROL PROCEDURES

PART 1 – GENERAL

1.1. SUMMARY

A. The City of Madison has developed a multi-faceted Quality Management Program that begins with contract signing and runs through contract closeout to ensure the best quality materials, workmanship, and product are delivered for the contracted Work.
   1. The Progress Management Web Site is a Construction Management tool that provides contractors and staff a single on-line location for the daily operations and progression of the Work.
   2. The Quality Management Observation (QMO) is an ongoing observation of the construction process as it progresses. The City of Madison does not use a "Punch List" or "Corrections List" as it is typically known throughout the construction industry. The QMO process acts as an "in progress punch list".
      a. By using the QMO process the City of Madison's goal is to have a zero item punch list prior to the 90% progress payment and owner occupancy.

B. All contractors shall be required to review the specifications identified in Section 1.2 below, and other related specifications identified therein to become familiar with the terminology and expectations of this City of Madison Public Works contract.

C. It is the intent of this specification to outline the requirements, expectations, and responsibilities of the General Contractor (GC), Project Architect, and other representatives of the Owner for items of Quality Assurance and Quality Control.
   1. This specification is not intended to conflict with Specification 01 40 00 Quality Requirements or other specifications requiring testing and inspecting services.
   2. This specification does not relieve the GC from any requirements associated with regulatory inspections performed by the City of Madison Building Inspection Unit, or inspectors from other agencies as required by code.
   3. Any testing performed by an Owner's Representative does not relieve the GC from performing any testing that may required by the construction documents.

1.2. RELATED SPECIFICATION SECTIONS

A. Section 01 26 13 Request for Information (RFI)
B. Section 01 29 76 Progress Payment Procedures
C. Section 01 31 13 Project Coordination
D. Section 01 31 23 Project Management Web Site
E. Section 01 40 00 Quality Requirements
F. Section 01 77 00 Closeout Procedures
G. Section 01 78 13 Completion and Correction List
H. Section 01 91 00 Commissioning

1.3. PERFORMANCE REQUIREMENTS

A. All contractors shall be responsible for a proper quality assurance/quality control (QA/QC) program throughout the execution of the Work defined within the construction documents, including all recognized construction industry standards and all applicable regulatory codes.

B. The GC shall be responsible for all of the following:
   1. Monitor the quality of all workmanship, supplies, materials, and products being installed by all contractors and installers to ensure they meet or exceed the minimum requirements set forth by the construction documents.
   2. Submit a Request for Information (RFI) whenever manufacturers' instructions or referenced standards conflict with the construction documents before proceeding with the Work.
   3. Ensure that Work requiring special certifications or licensing is being performed by is being performed and supervised by personnel that meet the appropriate requirements.
      a. Ensure that all certificates and licenses are current throughout the execution of the project.

C. The CoM and its representatives shall perform quality assurance and quality control activities throughout the execution of this project. This in no way relieves the GC of maintaining an acceptable QA/QC program. =

1.4. QUALITY ASSURANCE

A. The GC shall be responsible for the following:
   1. All materials, equipment, and products shall be new, clean, undamaged, and meet the performance specifications defined within the construction documents including favorably reviewed submittals.
      a. Any material, equipment, or product that does not meet the requirements of the construction documents shall be removed and replaced, including any adjacent and related work, at the GCs expense.
   2. All Work shall be performed by persons properly trained and/or qualified to produce workmanship of the quality specified in the construction documents.
   3. Providing access to updated as-builts, addenda, submittals, bulletins and other related construction documents at the project site.

B. The CoM and its representatives may be responsible for any of the following:
   1. Attend pre-installation meetings
   2. Attend construction progress meetings
   3. Review all submittals
   4. Conduct field visits for QA/QC purposes, provide feedback to the GC and sub-contractors using Quality Management Observation (QMO) reports.
   5. Review delivered equipment
   6. Witness equipment installations, startups, testing as specified in other specifications

1.5. QUALITY MANAGEMENT OBSERVATION REPORT

A. The Quality Management Observation report or QMO is used as a QA/QC tool by those entities responsible for QA/QC activities, including but not limited to, the GC, CoM, PA, CX agent, etc.

B. QMOs are designed to be an early observation of non-conforming construction work before it becomes buried by follow on work. As such it is most often used as an "in progress punch list".

C. QMO forms are part of the Quality Control Library on the Project Management Web Site.

PART 2 – PRODUCTS - THIS SECTION NOT USED

PART 3 - EXECUTION

3.1. QUALITY MANAGEMENT RESPONSIBILITIES

A. While making routine progress visits to the construction project the GC, CPM, CxA and A/E, and applicable others shall observe the details of the construction and installations to ensure that the intent of the construction documents is being followed.

B. If during the progress visit there is a determination of contract non-conformance a QMO report shall be initiated to begin the documentation process.
   1. The GC field superintendent shall be informed immediately of any issue that may cause harm, damage to finished work, or be buried prior to properly filing a QMO report.

C. The following information when filing a QMO report:
   1. Open a QMO report in the Quality Control Library on the Project Management Web Site
   2. Enter the date and time of the field visit
   2. Provide references to construction documents if any (examples; specification, drawing page, details, approved submittals, RFI, CB, etc)
   3. Provide a short title for the observation being made
   4. Provide a detailed description of the observation being made

5. Select all categories (Sitework, Structure, Enclosure, Interior, etc) from the given list that may apply to the observation being reported.
    a. For each category selected additional boxes shall open with contractor names associated with each category.
6. Select all contractors from the lists provided that may need to be aware of the observation.
7. Provide any attachments that may help provide reference to the observation.
8. Click the SAVE button before closing the form.

D. The software for the Project Management Website will email notifications that a QMO report has been initiated. The software will automatically select and notify the following:
1. The GC, PA, and CPM for all observation reports being filed.
2. Others depending on the observation categories selected.
3. Contractors based on the selections made in the sub-contractors lists.

3.2. RESPONDING TO A QMO

A. All contractors receiving email notification of a QMO Observation shall review the details of the observation.
B. The GC shall be responsible for determining the course of action required to remedy the non-conforming issue and shall coordinate and direct the contractor(s) responsible for any work related to the observation.
C. All contractors assigned to remedy the observation by the GC shall provide follow-up responses on the QMO report as follows:
1. Open the QMO report in the Quality Control Library on the Project Management Web Site.
2. In the “Follow-Up Response” area enter a description of your follow-up response in the box provided.
    a. Click “Insert Item” if additional boxes are required.
3. Add attachments (pictures) if needed to show the work has been completed.
4. Click the SAVE button before closing the form.

3.3. GENERAL CONTRACTORS FOLLOW-UP

A. The GC shall inspect the work to ensure that all assigned contractors have remedied the observation to the intent of the construction documents.
B. The GC shall respond with any additional comments in his/her response box.
1. If no comments are to be made the GC at a minimum must date the response box to trigger the next work flow.
C. Click the SAVE button before closing the form.
D. The software will email a notification to the CPM and the person who initiated the QMO that the issue has been remedied.

3.4. QMO CLOSEOUT PROCEDURE

A. The person who initiated the QMO shall review the remedied work and if properly corrected shall close and date the QMO form.
1. Click SAVE and the software will email a notification to the CPM that final review of the Observation is required.
2. In the event there are still issues the Quality Manager can add additional comments in the response area, click SAVE and re-issue the QMO for additional review as needed.
B. Once the person who initiated the QMO has closed the item the CPM shall review and verify with the PA that the Observation has been properly remedied and provide final closure on the QMO.

3.5. CONSTRUCTION CLOSEOUT

A. The GC shall note that successful close out QMOs are required for construction closeout as follows:
1. Certain progress payments as identified in Specification 01 29 76 are contingent QMO reports being properly closed out.
2. Specification 01 77 00 defines all construction closeout requirements.

END OF SECTION

SECTION 01 45 29
TESTING LABORATORY SERVICES

PART 1 – GENERAL

1.1. REQUIREMENTS INCLUDED

A. The Contractor shall employ and pay for the services of an independent testing laboratory to perform specified services and testing.

B. Testing Laboratory inspection, sampling and testing is required for:

1. Section 03 30 00: Cast-In-Place Concrete
2. Section 05 12 00: Structural Steel Framing
3. Section 05 40 00: Cold-Formed Steel Framing
4. Section 31 20 00: Earthwork

1.2. RELATED REQUIREMENTS

A. Conditions of the Contract: Inspections and testing required by laws, ordinances, rules, regulations, orders or approvals of public authorities.

B. Related Requirements Specified in Other Sections:

1. Division 22 and 23: Testing of Mechanical Systems
2. Division 26: Testing of Electrical Systems

1.3. QUALIFICATION OF LABORATORY

A. Meet "Recommended Requirements of Independent Laboratory Qualification" published by American Council of Independent Laboratories.

B. Meet basic requirements of ASTM E 329, "Standards of Recommended Practice for Inspection and Testing Agencies for Concrete and Steel as Used in Construction."

C. Authorized to operate in State in which the Project is located.

1.4. LABORATORY DUTIES

A. Cooperate with Owner, A/E and Contractor; provide qualified personnel after due notice.

B. Perform specified inspections, sampling and testing of materials and methods of construction:

1. Comply with specified standards.
2. Ascertain compliance of materials with requirements of Contract Documents.

C. Promptly notify the Owner, A/E and Contractor of observed irregularities or deficiencies of work or products.

D. Promptly submit written report of each test and inspection; one copy each to A/E, Consulting Engineer, Owner and Contractor. Each report shall include:

1. Date issued.
2. Project Title and number.
3. Testing laboratory name, address and telephone number.
4. Name and signature of laboratory inspector.
5. Date and time of sampling or inspection.
6. Record of temperature and weather conditions.
7. Date of test.
8. Identification of product and specification section.
9. Location of sample or test in the Project.
10. Type of inspection or test.
11. Results of tests and compliance with Contract Documents.

12. Interpretation of test results, when requested by A/E or the Contractor.

E. Perform additional tests as required by Owner, A/E or the Contractor.

1.5. LIMITATIONS OF AUTHORITY OF TESTING LABORATORY

A. Laboratory is not authorized to:
1. Release, revoke, alter, or enlarge on requirements of Contract Documents.
2. Approve or accept any portions of the Work other than those portions of the Work scheduled for testing.
3. Perform any duties of the Contractor.

1.6. CONTRACTOR'S RESPONSIBILITIES

A. Cooperate with laboratory personnel, provide access to Work and to manufacturer's operations.

B. Secure and deliver to the laboratory, adequate quantities of representative samples of materials proposed to be used and which require testing. Submit concrete mix designs to A/E for approval prior to pouring concrete.

C. Provide to the laboratory the preliminary design mix proposed to be used for concrete, and other material mixes that require control by the testing laboratory.

D. Furnish copies of Product test reports as required.

E. Furnish incidental labor and facilities:
1. To provide access to Work to be tested.
2. To obtain and handle samples at the Project site or at the source of the product to be tested.
3. To facilitate inspections and tests.
4. For storage and curing of test samples.

F. Notify laboratory sufficiently in advance of operations to allow for laboratory assignment of personnel and scheduling of tests.

G. Make arrangements with laboratory and pay for additional samples and tests required for Contractor's convenience.

H. Employ and pay for the services of a separate, equally qualified independent testing laboratory to perform additional inspections, sampling and testing required when initial tests indicate work does not comply with Contract Documents.

I. Temporarily halt the progress of the Work when tested materials do not comply with Contract Documents and promptly notify the Owner or his designated representative and A/E.

J. Remove and replace at no cost to the Owner, all defective materials discovered upon testing not to comply with Contract Documents, including cost for retesting and re-inspecting replaced Work that failed to comply with the Contract Documents.

1.7. SPECIFIC TEST, INSPECTIONS, AND METHODS REQUIRED

A. **Section 03 30 00: Cast-In-Place Concrete**
1. Secure sample of aggregates Contractor proposes to use and test for compliance with Specifications.
2. Certify compliance with Specifications of cement proposed for use by the Contractor.
3. Review and approve the Contractor's proposed concrete mix proportions for the required concrete strengths using materials Contractor proposed to use on the project. Incorporate specified admixtures and not less than amounts of cement specified.
4. Perform appropriate laboratory tests, including compression tests of cylinders and slump test to substantiate mix designs.
5. Inspect and test materials during concrete work to substantiate compliance with Specifications and mix requirements.
a. Testing:
i. Sample and test concrete in accordance with ASTM C 31, ASTM C 143, ASTM C 172, and ASTM C 231.
ii. Perform slump tests in accord with ASTM C 143 from same concrete batch used for test cylinders and record results and comments on compression test reports.
iii. Perform compression tests in accordance with ASTM C39.
iv. When air-entrained concrete is used, a minimum of one (1) air content test shall be performed in accordance with ASTM C 231 for each set of test cylinders taken.
v. Identify all test cylinders with symbols to indicate location on the job where concrete test was made. Record on project record drawings.
vi. Strength tests shall be made for: each day's pour; each class of concrete; each change of supplies or sources; and for each 100 cubic yards of concrete or fraction thereof.

vii. One slump test shall be made for each set of test cylinders taken following the procedure in ASTM C 143.

b. Test Cylinders for all Concrete

i. Each test shall consist of a minimum of four cylinders.

ii. Make test cylinders in conformity with ASTM C 31.

iii. After 24 hours three cylinders to be carefully transported to the testing laboratory for moisture curing and one cylinder to be field cured.

iv. One field cured cylinder to be tested at 7 days and two laboratory cured cylinders to be tested at 28 days. Reserve one cylinder for further testing.

v. The average of all strength tests representing each class of concrete, as well as the average of any three consecutive strength tests for each class of concrete, shall be equal to or greater than the specified strength.

vi. If the A/E has reason to believe that cylinder strength tests are not representative of the strength of concrete in place, A/E shall require drilled cores to be cut and tested at the Contractor's expense. Coring and testing shall be in accordance with ASTM C 42 Standard Method of Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.

B. **Section 05 12 00: Structural Steel Framing**

1. Welding:

a. Provide inspection of shop and field welding in accordance with Section 6 of AWS D1.1.

b. Visually inspect all welds, perform appropriate non-destructive tests on apparent defective welds. Verify conformance with Specifications.

c. Non-destructive testing shall be performed on 20 percent of the total length of all full penetration welds. If a sufficient number of welds are deficient, additional testing may be performed at the discretion of the testing lab, at no cost to Owner.

2. Bolting:

a. Visually inspect all connections for proper number, size and type of bolt.

b. Review all bolted connections for compliance with "snug tight" requirements of AISC.

c. No Slip-critical (SC) connections/bolts are required for this project.

d. Shear Connectors, Headed/Deformed Bar Concrete Anchors:

i. Verify pre-production test records for installation of shear connectors, concrete anchors and threaded studs.

ii. Shear connectors shall be struck with a hammer. Those not producing a "clean" pinging sound indicative of a fully attached shear connector shall be bent 15 degrees off vertical towards the nearest support by striking with a hammer. If shear connector does not become loose and weld is not broken, it shall be considered acceptable, and shall be left in the bent position. Replace failing shear connectors and test as before.

iii. A visual inspection shall be made of shear connectors and headed/deformed bar concrete anchors after installation. If visual inspection reveals that a sound weld and a 360 degree flash has not been obtained, the connector/anchor shall also be tested by bending a minimum of 15 degrees off vertical opposite to the missing weld/flash, irrespective of the results of the "ping" test required for shear connectors. If the connector/anchor does not become loose it shall be considered acceptable and shall be left in this position. Replace failing connector/anchors and inspect as before.

C. **Section 05 40 00: Cold Formed Steel Framing**

1. As directed by A/E, Contractor's testing agency may inspect the maintenance of a quality control program including spot checking weldments and welding procedures in accordance with AWS standards.

D. **Section 31 20 00: Soil Compaction Control and Trenching and Backfilling**

1. Soils Engineer to be onsite during excavation operation.

2. Visually inspect, test, and certify that exposed undisturbed underlying soil is suitable for required footing bearing capacity and placement of fills.

3. Maximum and minimum density of fill soil for compaction percentage of relative density and moisture density shall be determined in accordance with ASTM Designation D 1557. Testing agency will test compaction of soils in place according to ASTM D 1556, ASTM D 2167, ASTM D 2922, and ASTM D 2937, as applicable.

4. Number of tests as follows:

a. Subgrade, Undisturbed and Demolition Surfaces: Visual inspection and probe; test if required.

b. Interior Fills: One test per 2,500 sq. ft for each two foot or less lift.

c. Exterior Fills: One test per 2,500 sq. ft for each two foot or less lift.

d. Utility Trenches: One test per 50 lineal feet for each two foot or less lift.

PART 2 – PRODUCTS – THIS SECTION NOT USED

PART 3 – EXECUTION – THIS SECTION NOT USED

END OF SECTION

SECTION 01 50 00
TEMPORARY FACILITIES AND CONTROLS

PART 1 – GENERAL

1.1. SUMMARY

A. This Section includes general procedural requirements for temporary facilities and controls including, but not limited to the following:
   1. Temporary Utilities
   2. Telecommunications Services
   3. Temporary Sanitary Facilities
   4. Barriers
   5. Fencing
   6. Exterior Enclosures
   7. Security
   8. Vehicular Access and Parking
   6. Waste Removal
   7. Project Identification
   8. Field Offices

1.2. RELATED SPECIFICATION SECTIONS

A. Section 01 31 19 Progress Meetings
B. Section 01 31 23 Project Management Web Site
C. Section 01 74 19 Construction Waste Management and Disposal

1.3. QUALITY ASSURANCE

A. Regulations: Comply with industry standards and applicable laws and regulations if authorities having jurisdiction, including but not limited to:
   1. Building Code requirements
   2. Health and safety regulations
   3. Utility company regulations
   4. Police, Fire Department and Rescue Squad rules
   5. Environmental protection regulations
   6. Joint Commission - Hospital Accreditation Standards

B. Standards: Comply with NFPA 241 "Standard for Safeguarding Construction, Alterations, and Demolition Operations," ANSI A10 Series standards for "Safety Requirements for Construction and Demolition," and NECA Electrical Design Library "Temporary Electrical Facilities".

C. Electrical Service: Comply with NEMA, NECA, and UL standards and regulations for temporary electric service. Install service in compliance with NFPA 70 "National Electric Code".

1.4. TEMPORARY UTILITIES

A. Contractor will provide and pay for (both installation cost and consumption costs) the following:
   1. Electrical power and metering
   2. Water supply

B. General:
   1. No existing facilities on property
   2. New permanent facilities may be used.

C. Water Service: hydrant with backflow preventer and temporary heat (if needed) to be provided by contractor.
   1. Use trigger-operated nozzles for water hoses, to avoid waste of water.

D. Temporary Electric Power Service: Electrical Contractor to provide.

E. Temporary Lighting: Electrical Contractor shall provide temporary lighting with local switching
   1. Install and operate temporary lighting, minimum of 30 fc, to fulfill security and protection requirements, without operating the entire system, and will provide adequate illumination for all areas of work, including construction operations and traffic conditions.

F. Temporary Heat: General Contractor shall provide temporary heat required by construction activities, for curing or drying of completed installations or protection of installed construction from adverse effects of low temperatures or high humidity. Select safe equipment that will not have a harmful effect on completed installations or elements being installed. Coordinate ventilation requirements to produce the ambient condition required and minimize consumption of energy.
   1. Heating Facilities: Except where use of the permanent system is authorized, provide vented self-contained LP gas or fuel oil heaters with individual space thermostatic control.
      a. Use of gasoline-burning space heaters, open flame, or salamander type heating units is prohibited.

1.5. TELECOMMUNICATIONS SERVICES AND WI-FI

A. Provide, maintain, and pay for telecommunications services to field office at time of project mobilization through construction closeout.

B. Telecommunications services shall include:
   1. Windows-based personal computer dedicated to project telecommunications.
   2. Shared access to the internet via WIFI or similar wireless connection.
      a. Access must be capable to support minimum of 10 wireless devices.
   3. Email Account/address dedicated for GC Project Manager of GC Supervisor on site.

1.6. TEMPORARY SANITARY FACILITIES

A. Provide and maintain required facilities and enclosures. Provide at time of project mobilization.

B. Temporary toilets: Comply with regulations and health codes for the type, number, location, operation, and maintenance of fixtures and facilities. Install where facilities will best serve the Project's needs.
   1. Provide toilet tissue, paper towels, paper cups, and similar disposable materials foreach facility. Provide covered waste containers for used material.
   2. Toilets: Install self-contained toilet units. Shield toilets to ensure privacy.

C. Maintain daily in clean and sanitary condition

D. Water: Provide potable water approved by local health authorities

1.7. BARRIERS

A. Provide barriers to prevent unauthorized entry to construction areas, to prevent access to areas that could be hazardous to workers or the public and to protect existing facilities and adjacent properties from damage from construction operations and demolition.

1.8. FENCING

A. Construction: Refer to Plan Documents and Specification Section 01 76 00: Fencing Materials and Barricades

1.9. EXTERIOR ENCLOSURES

A. Provide temporary weather tight closure of exterior openings to accommodate acceptable working conditions and protection for Products, to allow for temporary heating and maintenance of required ambient temperatures identified in individual specification sections, and to prevent entry of unauthorized persons. Provide access doors with self-closing hardware and locks.

1.10. SECURITY

A. Provide security and facilities to protect Work, existing facilities, and Owner's operations from unauthorized entry, vandalism, or theft.

1.11. VEHICULAR ACCESS AND PARKING

A. Comply with regulations relating to use of streets and sidewalks, access to emergency facilities, and access for emergency vehicles.
B. Coordinate access and haul routes with governing authorities and Owner.
C. Provide and maintain access to fire hydrants, free of obstructions.

1.12. WASTE REMOVAL

A. See Section 01 74 19 - Waste Management, for additional requirements.
B. Provide waste removal facilities and services as required to maintain the site in clean and orderly condition.
C. Provide containers with lids. Remove trash from site periodically.
D. If materials to be recycled or re-used on the project must be stored on-site, provide suitable non-combustible containers; locate containers holding flammable material outside the structure unless otherwise approved by the authorities having jurisdiction.
E. Open free-fall chutes are not permitted. Terminate closed chutes into appropriate containers with lids.

1.13. PROJECT IDENTIFICATION

A. Provide project identification sign of design and construction indicated in Section 01 58 13.
B. Erect on site at location determined by Owner.
C. No other signs are allowed without Owner permission except those required by law.

1.14. FIELD OFFICES

A. Office: Weather tight, with lighting, electrical outlets, heating, cooling equipment, and equipped with sturdy furniture, drawing rack and drawing display table.
B. Field Office shall be located on project site .
C. Provide space for Project Meetings with table and chairs to accommodate a minimum of fifteen (15) persons.
D. Provide a minimum of a 40” LCD monitor or other digital projection device to be connected to the computer identified in Section 1.4 Telecommunications Services (above), for use during progress meetings in connection with reviewing construction progress information posted to the Project Management Web Site (Specification 01 31 23) hosted by the Owner.

PART 2 - PRODUCTS

2.1. TEMPORARY PARTITIONS

A. Provide dustproof partitions to limit dust and dirt migration and to separate occupied areas from fumes and noise.
    1. Non-fire rated partitions, standard
        a. Wood stud framing, 6-mil polyethylene

2.2. EQUIPMENT

A. Temporary Lifts and Hoists: Contractors requiring temporary lifts and hoists shall provide facilities for hoisting materials and employees.
B. Electrical Outlets: Electrical Contractor shall provide properly configured NEMA polarized outlets to prevent insertion of 110-120 volt plugs into higher voltage outlets. Provide receptacle outlets equipped with ground-fault circuit interrupters, reset button and pilot light, for connection of power tools and equipment.
C. Electrical Power Cords: Contractors requiring power cords shall provide grounded extension cords; use "hard-service" cords where exposed to abrasion and traffic. Provide waterproof connectors to connect separate lengths of electric cords, if single lengths will not reach areas where construction activities are in progress. Do not exceed safe length-voltage ratio.

D. Lamps and Light Fixtures: Electrical Contractor shall provide general service incandescent lamps of wattage required for adequate illumination. Provide guard cages or tempered glass enclosures, where exposed to breakage. Provide exterior fixtures where exposed to moisture.
E. Heating Units: General Contractor shall provide temporary heating units that have been tested and labeled by UL, FM or another recognized trade association related to the type of fuel being consumed.
F. First Aid Supplies: General Contractor shall provide first aid supplies complying with governing regulations.
G. Fire Extinguishers: General Contractor shall provide hand-carried, portable UL-rated, fire extinguishers of NFPA recommended classes for the exposures, extinguishing agent and size required by location and class of fire exposure.

PART 3 - EXECUTION

3.1. TEMPORARY FIRE PROTECTION

A. Until fire protection needs are supplied by permanent facilities, General Contractor shall install and maintain temporary fire protection facilities of the types needed to protect against reasonably predictable and controllable fire losses.
B. Comply with NFPA 10 "Standard for Portable Fire Extinguishers," and NFPA 241 "Standard for Safeguarding Construction, Alterations and Demolition Operations".
C. Locate fire extinguishers where convenient and effective for their intended purpose.
D. Store combustible materials in containers in fire-safe locations.
E. Maintain unobstructed access to fire extinguishers, fire hydrants, temporary fire protection facilities, stairways and other access routes for fighting fires.
F. Prohibit smoking on the premises.
G. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition according to requirements of authorities having jurisdiction.
H. Develop and supervise an overall fire-prevention and -protection program for personnel at Project site
I. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.

3.2. COLLECTION AND DISPOSAL OF WASTE

A. Collect waste from construction areas and elsewhere daily
B. Comply with requirements of NFPA 241 for removal of combustible waste material and debris. Enforce requirements strictly.
C. Do not hold materials more than 7 days during normal weather or 3 days when the temperature is expected to rise above 80 deg F.
D. Handle hazardous, dangerous, or unsanitary waste materials separately from other waste by containerizing properly. Dispose of material in a lawful manner.

3.3. ENVIRONMENTAL PROTECTION

A. Provide protection, operate temporary facilities and conduct construction in ways and by methods that comply with environmental regulations, and minimize the possibility that air, waterways and subsoil might be contaminated or polluted, or that other undesirable effects might result.
B. Avoid use of tools and equipment which produce harmful noise.
C. Restrict use of noise making tools and equipment to hours that will minimize complaints from persons or firms near the site.

3.4. REMOVAL OF TEMPORARY UTILITIES, FACILITIES, AND CONTROLS

A. Remove temporary utilities, equipment, facilities, and materials prior to Substantial Completion inspection.
B. Remove underground installations to a minimum depth of 2 feet (600 mm). Grade site as indicated.
C. Clean and repair damage caused by installation or use of temporary work.
D. Restore existing facilities used during construction to original condition.
E. Restore new permanent facilities used during construction to specified condition.

END OF SECTION

SECTION 01 58 13
TEMPORARY PROJECT SIGNAGE

PART 1 – GENERAL

1.1. SECTION INCLUDES
A. Project identification sign.

1.2. QUALITY ASSURANCE
A. Design sign and structure to withstand 50 miles/hr wind velocity.
B. Sign Painter: Experienced as a professional sign painter for minimum three years.
C. Finishes, Painting: Adequate to withstand weathering, fading, and chipping for duration of construction.

1.3. SUBMITTALS
A. See Section 01 30 00 – Administrative Requirements for submittal procedures.
B. Shop Drawing: Show content, layout, lettering, color, structure, sizes.

PART 2 - PRODUCTS

2.1. SIGN MATERIALS
A. Structure and Framing: New, wood, structurally adequate.
B. Sign Surfaces: Exterior grade plywood with medium density overlay, minimum ¾" thick, standard large sizes to minimize joints.
C. Rough Hardware: Galvanized

2.2. PROJECT IDENTIFICATION SIGN
A. One painted sign, 32 sq ft area, bottom 6 feet above ground.
B. Content:
1. Project title, City of Madison, Fire Department logo and name of Owner as indicated on Contract Documents.
2. Names and title of Architect.
3. Name of Prime Contractor.
4. Full color project rendering from high resolution image as furnished by Architect.

PART 3 - EXECUTION

3.1. INSTALLATION
A. Install project identification sign within 30 days after date fixed by Notice to Proceed.
B. Erect at designated location.
C. Install sign surface plumb and level, with butt joints. Anchor securely.

3.2. REMOVAL
A. Remove sign, framing supports, and foundations at completion of Project and restore the area.

END OF SECTION

SECTION 01 60 00
PRODUCT REQUIREMENTS

PART 1 – GENERAL

1.1. SUMMARY

A. The purpose of this specification is to provide general guidelines and responsibilities related to the receiving, handling, and storage of all materials and products from arrival on the job site through installation.
   1. Immediate inspection of delivered goods means a timely replacement if damaged.
   2. Proper storage helps prevent damage and loss by weather, vandalism, theft, and job site accidents.
   3. Proper storage helps with job site performance and safety.
   2. Proper handling helps prevent damage and job site accidents.

B. Each Contractor shall be directly responsible for the receiving, handling, and storage of all materials and products associated with the Work of their Division or Trade.

C. Each Contractor responsible for Work associated with Owner provided materials or products shall be responsible for the receiving, handling and storage of the material/product as outlined in Section 3.8 below..

1.2. RELATED SPECIFICATIONS

A. Parts of this specification will reference articles within "The City of Madison Standard Specifications for Public Works Construction".
   1. Use the following link to access the Standard Specifications web page:
      http://www.cityofmadison.com/business/pw/specs.cfm
      a. Click on the "Part" chapter identified in the specification text. For example if the specification says "Refer to City of Madison Standard Specification **2**10.2" click the link for Part II, the Part II PDF will open.
      b. Scroll through the index of Part II for specification 210.2 and click the text link which will take you to the referenced text.
      c. City Standard Detail Drawings (SDD) may be located from the index in Part VIII.

B. Section 01 57 21 Indoor Air Quality

C. Section 01 74 13 Progress Cleaning

D. Section 01 76 00 Protecting Installed Construction

E. Other Divisions and Specifications that may address more specifically the requirements for the storage and handling of materials and products associated Work of other Divisions or Trades.

1.3. QUALITY ASSURANCE

A. The GC shall be responsible for ensuring that these minimum storage and handling requirements are met by all contractors on the project site including but not limited to the following:
   1. Receiving deliveries of materials, products, and equipment.
      a. Inspect all deliveries upon arrival for damage, completeness, and compliance with the construction documents.
         i. Deliveries shall remain in original packaging or crates, shipping manifest shall be kept with the delivery and the packaging shall have visible identification of the items within the packaging.

b. Immediately report any damaged products or equipment to the GC, begin arrangements for immediate replacement.
c. Materials or equipment that have been damaged, are incomplete, or do not comply with the construction documents shall not be permitted to be installed.

2. All materials and products shall be stored within the designated limits of the project site. Only store the amount of material necessary for upcoming operations so as not to interfere with other construction activities and access to Work by the Owner and Architect. Any offsite storage shall be at the expense of the contractor storing the material or product. All offsite storage requirements shall comply with this specification. All offsite storage of materials is subject to Owner Representative Quality Management review at any time.
3. Large storage containers may be used but shall be weather tight, securable, placed on concrete blocks, timbers, or jack stands and shall be level.
4. When lifting equipment is required the equipment rating shall be greater than the loading requirements of the item being lifted. In addition all of the following shall apply as necessary:
   a. Only designated and/or designed lift points shall be used.
   b. Large items shall have tag lines and handlers at all times during lifting operations.
   c. Lift at multiple points as needed to prevent bending.
5. Materials and products stored inside of the structure shall comply with all of the following:
   a. Storage shall not be allowed to impede the flow of work in progress.
   b. Storage shall not be allowed to hide completed work from review and inspections.
   c. Storage shall not exceed the design loads of the structural components it is being stored upon.
6. All materials and products shall be stored according the manufacturers minimum recommended requirements. All of the following shall be considered before storing any product or material:
   a. Dust and dirt
   b. Moisture and humidity, including rain and snow
   c. Excessive temperatures, direct sun, etc
   d. Product or material weight and size
   e. Potential for breakage
   f. Product incompatibility with other products such as corrosiveness, chemical reactions, flammability, etc.
   g. Product or material value and replacement cost
7. The Contractor shall be responsible for providing fully functional tarps or plastic wrap, to protect materials and products from the weather. All coverings shall be free of large holes and tears, and shall be tied, strapped, or weighted down to resist blowing.
8. The Contractor shall be responsible for any temporary heating, cooling, or other utility requirement that may be associated with the storage of a material or product.
9. The Contractor shall be responsible for securing materials and products of value such as copper, A/V equipment, etc. Such items shall be stored in securable shipping containers, job trailers or other such storage devices. Container shall be kept secured when not in use.

B. The GC shall inspect the job site daily to ensure that all products and materials stay weather tight and are secured against vandalism or theft as required by this specification.
C. The Owners Representative may at any time request improvements regarding storage of any material or product being provided under these construction documents.

PART 2 – PRODUCTS – THIS SECTION NOT USED

PART 3 - EXECUTION

3.1. GENERAL CONTRACTOR REQUIREMENTS

A. Designate material storage and handling areas as needed including all of the following:
   1. Designate specific areas of the site for delivery and storage of materials to be used during the execution of the Work.
   2. Designated areas shall not be located so as to interfere with the installation of any Work including Work by others such as the installation of utilities or the maintenance of existing utilities. This shall include not storing items in active utility easements as designated by the site plan.
B. Arrange for openings in the building as needed to allow delivery and installation of large items. Openings shall be appropriately sized to include the use of booms, slings, and other such lifting devices that may be larger than the item being installed.

1. When openings are required in completed Work (new or existing) the GC shall be responsible for providing an appropriate opening and for restoring the opening to the original or better condition upon completion. Restoration shall be weather tight and complete.

C. Repeated moving and handling of items being stored shall not be allowed. The GC shall be responsible for any damage and replacement because of mishandling or excessive handling.

3.2. BULK MATERIAL

A. Bulk material such as sand, gravel, top soil and other types of fill shall be stored away from the construction area and shall be stock piled as follows:
1. All bulk material shall be piled safely and efficiently in as small an area as practical. Only store the amount of material necessary for upcoming operations so as not to interfere with other construction activities and access to Work by the Owner and Architect.
2. All stock piles shall have silt fence/sock properly installed around the perimeter to prevent erosion and loss of material. Refer to City of Madison Standard Specification Section 210.1(f) and other related specification or details.
3. Fine grained material shall be protected with tarps to prevent blowing. Tarps shall be weighted or staked to stay in place.

B. Bulk material such as brick, concrete block, stone, and other palletized materials shall be stored on original shipping pallets until ready for use.

3.3. DRY PACKAGED MATERIAL

A. Dry packaged material such as cement, mortar, etc shall be stored on pallets, on slightly elevated ground or clear stone pad to keep water away from the base of the material being stored. Protect from moisture.

3.4. STRUCTURAL AND FRAMING MATERIAL

A. All structural and framing material shall be stored in an organized manner arranged by type, size and dimension. Materials shall be stored on pallets or timbers as necessary and shall not be allowed to lie directly on the ground.

B. Long and heavy items shall be supported at several points to prevent bending and warping.

3.5. EQUIPMENT

A. Equipment delivered to the site shall be stored away from all construction activities until the item can either be moved inside or properly installed.

B. Equipment shall be stored on slightly elevated ground or clear stone pad to keep water away from the base of the equipment.

3.6. FINISH PRODUCTS

A. Finish products such as flooring, tile, counters, lockers, toilets, partitions, lighting, and other similar items should not be delivered and stored until the structure has been enclosed, is weather tight, temperature controlled and the contractor is ready for such items to be installed.
1. Storage of finished products outside for any length of time shall not be allowed.

B. Products that cannot be stored inside the structure shall be stored in secured containers or job trailers until such time as they are ready to be installed.

C. Products with a high potential for breakage such as glass, mirrors, tiles, toilet fixtures, etc. shall be stored with additional protection as necessary such as but not limited to the following:
1. Store in original shipping containers until ready for installation.
2. Do not store in high traffic areas.
3. Shield with other materials such as cardboard, plywood, or similar products.

3.7. DUCTWORK, PIPING, AND CONDUIT

A. All piping and conduit shall be stored horizontally unless otherwise specified by the manufacturer or Division and Trade Specifications.
1. Do not store directly on grade.
2. Cover metal pipes and tubes to prevent rust and corrosion, allow ventilation to prevent condensation.
3. Whenever possible use pipe stands for storing pipe and conduit to prevent tripping and rolling hazards.

B. All ductwork shall be stored horizontally or vertically as necessary unless otherwise specified by the manufacturer or Division and Trade Specifications.
1. During storage, both ends of each duct shall be protected with plastic sheathing to prevent dust and dirt from getting inside the duct. Sheathing shall be sufficiently taped to the duct.

2. After installation, free/open ends shall remain protected with taped plastic sheathing and or temporary filters as specified by division or Trade specifications.

3.8. OWNER PROVIDED, CONTRACTOR INSTALLED EQUIPMENT

A. Section 3.8.A. shall apply to all equipment being provided to any contractor directly from the Owner for installation under the contract.
   1. The Owner or Owners Representative shall do the following:
      a. Inspect all deliveries upon receipt and notify manufacturer of any issues directly.
      b. Review the received shipment with the contractor.
         i. Only provide products or materials to the contractor that were not damaged through shipping or handling.
         ii. Confirm missing products or materials and anticipated delivery schedule if known.
   2. The Contractor responsible for the installation of Work associated with Owner provided materials or products shall "take ownership" and provide safe and secure storage and handling as previously described within this specification.
      i. The Contractor shall be liable for the repair or replacement of any material or product damaged after taking ownership of the product from receipt through final acceptance.

B. Section 3.8.B. shall apply to all equipment being provided by the Owner but shipped directly to any sub-contractor or the project site for installation under the contract.
   1. The GC and/or Contractor responsible for the Work associated with the Owner provided materials or products shall do the following:
      a. Inspect all deliveries upon receipt and notify the Owner or Owners Representative of any issues directly.
         i. Owner or Owners Representative shall notify manufacturer of any issues directly.
      b. Review the received shipment with the Owner or Owners Representative
         i. Confirm missing products or materials and anticipated delivery schedule if known.
   2. The Contractor shall "take ownership" and provide safe and secure storage and handling as previously described within this specification.
      i. The Contractor shall be liable for the repair or replacement of any material or product damaged after taking ownership of the product from receipt through final acceptance.

END OF SECTION

SECTION 01 71 23
FIELD ENGINEERING

PART 1 – GENERAL

1.1. REQUIREMENTS INCLUDED

A. The Contractor shall provide and pay for field engineering services required for the Project:
   1. Land surveying services required to execute the Work, to include building addition location and layout, and location and layout of pavements and all proposed site improvements.
   2. Verification of existing building dimensions, elevations, and relationship to proposed additions.
   3. Professional Engineering services to execute Contractor's construction methods.
   4. Registered Professional Engineer in the State of Wisconsin to determine the load capacity of the existing structure for use of Contractors temporary facilities, equipment, lifts, machinery, material storage, etc.

1.2. RELATED REQUIREMENTS

A. Conditions of the Contract

1.3. PROCEDURES

A. A property survey has been prepared for the Owner and has been bound with Contract Drawings. Surveys shall describe physical characteristics, legal limitations and utility locations for the site of the Project, and a legal description of the site. If information is incomplete, notify Owner to furnish additional information. Verify easement locations, front, side, and rear yard restrictions, if any; and property line locations. Verify control points, and establish bench marks. Locate and layout roads, walks, parking areas and all civil structures and all proposed site improvements.

B. Verify locations of underground services, utilities, structures, etc. which may be encountered or affected by the Work.

1.4. PROJECT SURVEY REQUIREMENTS

A. Using datum, the lot lines and present levels have been established as indicated on the Drawings. Other grades, lines, levels and benchmarks, shall be established and maintained by the Contractor, who shall be responsible for them. As work progresses, the Contractor shall layout on forms and floor, the locations of all partitions, walls and fix column centerlines as a guide to all trades. The Contractor shall make provision to preserve property line stakes, benchmarks, or datum point. If any are lost, displaced or disturbed through neglect of any Contractor, Contractor's agents or employee, the Contractor responsible shall pay the cost of restoration.

B. Establish lines and levels, locate and layout, by instrumentation and similar appropriate means, additions, column locations, floor levels, stakes for walks, etc.

C. Provide data to all Subcontractors for their use as applicable.

D. From time to time, verify layouts by same methods.

1.5. RECORDS

A. Maintain a complete, accurate log of all control and survey work as it progresses.

PART 2 – PRODUCTS – THIS SECTION NOT USED

PART 3 – EXECUTION – THIS SECTION NOT USED

END OF SECTION

SECTION 01 73 29
CUTTING AND PATCHING

PART 1 – GENERAL

1.1. SUMMARY

A. This Section includes general procedural requirements for cutting and patching including, but not limited to the following:
   1. Examination
   2. Preparation
   3. Performance
   4. Cleanup and Restoration

1.2. RELATED SPECIFICATION SECTIONS

A. Divisions 02 through 32 Sections for specific requirements and limitations applicable to cutting and patching individual parts of the Work.
B. Division 07 Section "Penetration Fire Stopping" for patching fire-rated construction.

1.3. DEFINITIONS

A. Cutting: Removal of in-place construction necessary to permit installation or performance of other Work.
B. Patching: Fitting and repair work required to restore surfaces to original conditions after installation of other Work.
C. Level Alpha

1.4. QUALITY ASSURANCE

A. Structural Elements: Do not cut and patch structural elements in a manner that could change their load-carrying capacity or load-deflection ratio.
B. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that may result in increased maintenance or decreased operational life or safety.
C. Miscellaneous Elements: Do not cut and patch miscellaneous elements or related components in a manner that could change their load-carrying capacity that results in reducing their capacity to perform as intended, or that may result in increased maintenance or decreased operational life or safety. Some miscellaneous elements include the following:
   1. Water, moisture, or vapor barriers
   2. Membranes and flashings
   3. Exterior curtain-wall construction
   4. Equipment supports
   5. Piping, ductwork, vessels, and equipment
   6. Noise and vibration control elements and systems
D. Visual Requirements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch construction exposed on the exterior or in occupied spaces in a manner that would, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.

1.5. WARRANTY

A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during cutting and patching operations, by methods and with materials so as not to void existing warranties.

B. All cutting and patching work performed under this contract shall be warranted like new work as defined by the Specification governing the work.

PART 2 - MATERIALS

2.1. GENERAL

A. Comply with requirements specified within other sections of the Specifications.

B. In-Place Materials: Use materials identical to existing in-place materials. For exposed surfaces use materials that visually match in-place adjacent surfaces to the fullest extent possible.

1. If identical materials are unavailable or cannot be used, use materials that, when installed, will match the visual and functional performance of in-place materials.

PART 3 - EXECUTION

3.1. EXAMINATION

A. Examine surfaces to be cut and patched and conditions under which cutting and patching are to be performed.

1. Compatibility: Before patching, verify compatibility with and suitability of substrates, including compatibility with in-place finishes or primers.
2. Proceed with installation only after unsafe or unsatisfactory conditions have been corrected.

3.2. PREPARATION

A. Temporary Support: Provide temporary support of Work to be cut.

B. Protection: Protect in-place construction and existing conditions during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations. If the failure to protect, or the lack of protection, of in-place construction and/or existing conditions results in damage, the contractor shall be responsible for repair to previous condition.

C. Adjoining Areas: Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.

D. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to eliminate interruption to occupied areas.

3.3. PERFORMANCE

A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.

1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.

B. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.

1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots as small as possible, neatly to size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
3. Concrete or Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
4. Excavating and Backfilling: Comply with requirements in applicable Division 3l Sections where required by cutting and patching operations.
5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
6. Proceed with patching after construction operations requiring cutting are complete.

C. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other Work. Patch with durable seams that are as invisible as possible. Provide materials and comply with installation requirements specified in other Sections.

D. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate integrity of installation.

3.4. CLEANUP AND RESTORATION

A. Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.

1. Clean piping, conduit, and similar features before applying paint or other finishing materials.
2. Restore damaged pipe covering to its original condition.
3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
4. Where patching occurs in a painted surface, apply primer and intermediate paint coats over the patch and apply final paint coat over entire unbroken surface containing the patch. Provide additional coats until patch blends with adjacent surfaces.
5. Ceilings: Patch, repair, or re-hang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.
6. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weather tight condition.
7. Cleaning: Clean areas and spaces where cutting and patching are performed. Completely remove paint, mortar, oils, putty, and similar materials.
8. Any smoke and fire caulking that has been disturbed must be replaced by the Contractor as required by code.

END OF SECTION

SECTION 01 74 13
PROGRESS CLEANING

PART 1 – GENERAL

1.1. SUMMARY

A. Throughout the execution of this contract all contractors shall be responsible for maintaining the project site in a standard of cleanliness as described in this specification.

B. All contractors shall also comply with the requirements for cleaning as described in other specifications.

C. Work included in this specification shall include but not be limited to:

1. Safety Cleaning
2. Project Site Cleaning
3. Progress Cleaning
4. Final Cleaning

1.2. RELATED SPECIFICAITONS

A. Section 01 35 00 Special Procedures
B. Section 01 60 00 Product Requirements
C. Section 01 74 19 Construction Waste Management and Disposal
D. Section 01 76 00 Protecting Installed Construction

1.3. QUALITY ASSURANCE

A. The General Contractor (GC) shall conduct daily inspections, more often if necessary, of the entire project site to ensure the requirements of cleanliness are being met as described within these specifications.

B. All contractors shall comply with other regulatory requirements as they apply to waste recycling, reuse, hauling, and disposal requirements of any governmental authority having jurisdiction.

C. The Owner reserves the right to have work done by others in the event any contractor fails to perform cleaning as described within these specifications. The cost of any Owner provided cleaning shall be charged to the contractor through a deduct change order.

PART 2 - PRODUCTS

2.1. CLEANING MATERIALS AND EQUIPMENT

A. The Contractor shall provide all required personnel, equipment, and materials necessary to maintain the required level of cleanliness as described in this specification.

B. Use only cleaning materials and equipment that are compatible with the surface being cleaned, as recommended by the manufacturer, or as approved by the A/E.

C. Use only cleaning materials, equipment, and methods as recommended in the manufacturers care and use guide of the material, finish or equipment being cleaned.

PART 3 - EXECUTION

3.1. SAFETY CLEANING

A. All Contractors shall be responsible for safety cleaning as required by OSHA and other regulatory requirements as applicable.

B. Safety Cleaning shall include but not be limited to the following:
   1. All work areas, passageways, ramps, and stairs shall be kept free of debris, scrap materials, pallets, and other large items that would obstruct exiting routes. Small items such as tools, electrical cords, etc are picked up when not in use.
   2. Form and scrap lumber shall have nails/screws removed or bent over. Lumber shall be neatly stacked in an area designated by the GC.
   3. Spills of oil, grease, and other such liquids shall be cleaned immediately or sprinkled with sand/oil-dry first, then cleaned.
   4. Oily, flammable, or hazardous items shall be stored in appropriate covered containers and storage devices unless actively being used.
   5. Oily, or flammable rags, and other such waste shall only be disposed of in authorized covered containers.
   6. Disposal by burning shall not be allowed at any time.

3.2. PROJECT SITE CLEANING

A. This section applies to the general cleanliness of the project site as a whole for the duration of the execution of this contract.

B. Exterior Project Site Areas
   1. The GC and other Contractors as appropriate shall ensure the following levels of cleanliness are applied to the exterior project site areas.
      a. The overall appearance of the project site is neat and orderly. Defined areas for material storage, material waste, job trailers, and the project area are clean and well maintained.
      b. The construction fence is maintained, erect with no gaps, and properly posted per all regulatory requirements.
      c. All erosion control measures are properly maintained, cleaned, and repaired as necessary.
      d. All loose materials (construction or waste) are properly tied or weighted down to resist blowing.
      e. All construction materials are properly covered with fully functional tarps or plastic wrap, protected from the weather, coverings are tied, strapped, or weighted down to resist blowing.
      f. Dust control is applied as necessary or as required by any regulatory requirement.

C. Interior Project Site Areas
   1. All Contractors shall ensure the following levels of cleanliness are applied to the interior project site areas.
      a. The overall appearance of the project site is neat and orderly. Defined areas for material storage, material waste, and project area are clean and well maintained.
      b. Stored materials are kept in original shipping containers whenever possible. Stored materials not in shipping containers are properly stored and protected according to other applicable specifications.
      c. All scraps and debris shall be properly disposed of as often as necessary to keep work areas, passageways, stairs, and ramps free of debris and clear for emergency exiting.
      d. Boxes, pallets, and other such shipping containers, are broken down, stored in a consolidated area or, disposed of as often as is necessary.
      e. Hand tools, supplies, materials, electrical cords not being used are picked up and sptored in gang boxes, not left as walking hazards in work areas, passageways, etc.

D. Job Trailer
   1. The interior of the job trailer shall be kept clean and available as a work space at all times. The GC shall ensure that the following is provided for within the job trailer:
      a. Meeting space including tables and chairs.
      b. Sufficient space for all contractors to access the official construction documents, provide updates, etc.

3.3. PROGRESS CLEANING

A. This sub-section shall apply to all Progress Cleaning prior to the installation of finishes, fixtures, and trim (IE rough-in).
   1. For the purposes of this section “clean” shall be defined as a level of cleanliness free of dust and other material capable of being removed by use of reasonable effort using a good quality janitor broom and shop-vac.
   2. Daily cleanings shall be conducted by all contractors at the end of the work day as follows:
      a. Debris in excavated areas shall be removed prior to backfill and compaction.
      b. Debris in wall cavities, chase spaces, etc shall be removed prior to enclosing the spaces.

c. Large items shall be properly stored, returned to designated areas, or disposed of as necessary.
d. Loose materials shall be properly secured.
e. Flammable or hazardous materials are properly stored or disposed of.

3. Weekly cleaning shall be conducted by all contractors as designated by the GC. Weekly cleanings shall include all the above for a daily cleaning and other necessary cleaning as designated by the GC.

B. This sub-section shall apply to Progress Cleaning in preparation for the installation of finishes, fixtures, and trim.
a. Surfaces receiving finishes shall be thoroughly cleaned prior to contractors applying finish materials. The GC shall be responsible for inspecting the area and surfaces being cleaned for finish prior to the sub-contractor applying the finish. This shall include but not be limited to the following:
i. Wall surfaces shall be wiped clean of dirt and oily residues, vacuumed free of dust, and shall be free of surface imperfections prior to painting or installing wall coverings.
ii. Metal surfaces shall be wiped clean of dirt and oily residues, and be free of surface imperfections prior to painting.
iii. Flooring shall be broom swept of large and loose items then vacuumed clean of dust and small particles, and damp mopped clean and dried prior to installing any flooring finish. Additional cleaning may be required depending on the preparation requirements recommended by the flooring material manufacturer.

C. This sub-section shall apply to Progress Cleaning after the installation of finishes, fixtures, and trim.
1. For the purposes of this section "clean" shall be defined as a level of cleanliness free of dust and other material capable of damaging or visually disfiguring finished work, finishes, fixtures, and trim.
2. Progress Cleaning at this point in the contract shall be conducted immediately as follows:
a. Dust, dirt, etc shall be swept and vacuumed off of finish flooring and trim.
b. Liquid spills shall be cleaned up according to the spill type. This shall include drips and spills caused by paint, stain, sealants, and other such items.
3. The Contractor(s) at no additional cost to the Owner shall be responsible for replacing any finished work, finishes, fixtures, and trim damaged or disfigured because of inadequate or improper cleaning.

3.4. FINAL CLEANING

A. As noted in Specification 01 29 76 Progress Payment Procedures, Progress Payment Milestone Schedule, Final Cleaning shall not be conducted prior to requesting the 90% contract total progress payment and all of the following shall be complete:
1. All final regulatory inspections including but not limited to Building Inspection Department and Madison Fire Department inspections have been successfully completed.
2. All Quality Management Observation (QMO) reports have been closed out.
3. All Demonstration and Training has been completed.
4. All Attic Stock has been consolidated and located to its designated area
5. All protection for installed construction shall be removed prior to final cleaning by the contractor responsible for providing the protections. This shall include the removal of any adhesive residues left behind from tapes. Contractors shall only use manufacturer authorized cleaning materials for removing adhesives, etc.

B. For the purposes of this section "clean" shall be defined as a level of cleanliness generally provided by skilled cleaners using commercial quality building maintenance equipment and materials.

C. The GC shall be responsible for ensuring that all requirements under this section are being met.

D. General Requirements
1. Employ experienced personnel or professional cleaners for final cleaning as necessary for the areas or equipment being cleaned.
2. Cleaning equipment used shall be commercial grade equipment commonly used by professional cleaners.
3. Cleaning equipment and materials shall be cleaned, rinsed, or replaced to ensure a uniform level of cleanliness is being maintained during the final cleaning. This shall include but not be limited to the following:
a. Vacuum cleaner bags and/or filters are changed and/or cleaned as often as necessary.
b. Dust & wipe down rags are washed, rinsed, or replaced before starting each room.
c. Mopping equipment
i. Mop water for washing shall have cleaning solution added to the amount and temperature per manufacturer's recommendations. Mop washing water shall be replaced often to maintain the levels of the cleaning solution and temperature required.
ii. Mop water for rinsing shall remain clean, clear, and be replaced as often as necessary.

iii. Mop heads shall be rinsed often and replaced as necessary.
iv. Mop heads and buckets shall be thoroughly rinsed with each change of water.
v. Only new mop heads shall be used for rinsing.

E. Refer to all other specifications in this contract for specific requirements regarding final cleaning of finishes, fixtures, equipment, etc.

F. Exterior Cleaning shall include but not be limited to the following:
1. All exterior glazing surfaces have been professionally cleaned and are free of dust and streaking.
2. Metal roofs, siding, and other surfaces shall be clean of dirt and free of splashed or excess materials such as sealants, mortar, paint, etc.
3. All exterior furnishings shall be clean, waste receptacles shall be empty.
4. Paved areas shall be clean, free of dirt, oily stains and other such blemishes
5. Exterior lights and diffusers are clean and free of dust.

G. Interior Cleaning shall include but not be limited to the following:
1. Remove all labels, stickers, tags, and other such items which are not required by code as permanent labels.
2. All interior glazing surfaces, including mirrors, have been professionally cleaned and are free of dust and streaking.
3. All interior surfaces have been cleaned of excess materials such as paint, sealants, etc and have been wiped free of dust.
4. Interior metals, fixtures, and trim have been cleaned free of dust and oily residues
5. Carpet flooring has been thoroughly cleaned; vacuumed free of dust, excess glues and other stains removed per manufacturers use and care instructions.
6. Resilient flooring has been thoroughly cleaned; vacuumed free of dust, excess glues and other stains removed, mopped and buffed per manufacturers use and care instructions.
7. Interior non-occupied concrete floors shall be broom cleaned, vacuumed free of dust, excess glues and other stains removed per manufacturers use and care instructions.
8. Light fixtures, lamps, diffusers and other such items have been dusted and cleaned as necessary.

3.5. CALL BACK WORK

A. The GC shall be responsible for ensuring that any contractor returning to the project site for completion or correction work has re-cleaned and restored the area to the levels described in section 3.4 above upon completion of the work. This shall include but not be limited to the following:
1. The immediate area(s) where work was completed.
2. Adjacent areas where dust or debris may have traveled.
3. Other areas occupied during the completion of the call back work.
4. Path of entrance/exit, to/from the area(s) of work.

END OF SECTION

SECTION 01 74 19
CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

PART 1 – GENERAL

1.1. SUMMARY

A. This specification includes administrative and procedural requirements for the recycling, re-use, salvaging, and disposal of non-hazardous construction and demolition waste.

B. The General Contractor (GC) shall be fully responsible for complying with all applicable ordinances and other such regulatory requirements during the execution of this contract.

1.2. RELATED SPECIFICAITONS

A. 01 29 76 Progress Payment Procedures
B. 01 31 23 Project Management Web site
C. 01 32 19 Submittals Schedule
D. 01 33 23 Submittals
E. 01 77 00 Closeout Procedures
F. Other Divisions and Specifications that may address the proper disposal of construction or demolition waste as it pertains to work being conducted under that particular specification.

1.3. CITY ORDINANCES

A. There are two (2) Madison General Ordinances (MGO) that the City of Madison has regarding construction and demolition waste.
   1. MGO 10.185, Recycling and Reuse of Construction and Demolition Debris, describes the requirements associated with this ordinance including definitions, documentation requirements, and penalties.
   2. MGO 28.185, Approval of Demolition (Razing, Wrecking) and Removal, describes the requirements associated with applying for and receiving a demolition permit.

B. All City of Madison, Board of Public Works, contracts being conducted by City Engineering, Facility Management, for construction, remodeling, or demolition shall comply with the above ordinances regardless of project type or size.

1.4. DEFINITIONS

A. Clean: Untreated and unpainted material, free of contamination caused by oils, solvents, caulks, and other chemicals.

B. Construction and Demolition Debris: Materials resulting from the construction, remodeling, repair, and demolition of utilities, structures, buildings, and roads.

C. Disposal: Off-site removal of construction and demolition debris and the subsequent sale, recycling, reuse, or deposit in authorized landfill or incinerator.

D. Hazardous: Exhibiting the characteristics of hazardous substance, i.e. ignitability, corrosiveness, toxicity, or reactivity and including but not limited to asbestos containing materials, lead, mercury and PCBs.

E. Non-hazardous: Exhibiting none of the characteristics of a hazardous substance.

F. Nontoxic: Not immediately poisonous to humans or poisonous after a long period of exposure.
G. Recyclable: The ability of a product or material to be recovered at the end of its life cycle and remanufactured into a new product.
H. Recycle: Any process by which construction or demolition debris is diverted from final disposal as solid waste at a permitted landfill and instead is collected, separated, and/or processed into raw materials for new, reused, or reconstituted products; or for the recovery of materials for energy production processes.
I. Recycler: Any recycling facility, transfer station, or other waste handling facility which accepts construction and demolition debris for recycling, or for other transferring to a recycling facility.
J. Recycling: The process of sorting, cleaning, treating, or reconstituting solid waste and other discarded materials for the purpose of preparing the material to be recyclable. Recycling does not include burning, incinerating or thermally destroying waste.
K. Return: To give back reusable items or unused products to vendors for credit.
L. Reuse: Shall mean any of the following:
    1. The on-site use of reprocessed construction and demolitions debris.
    2. The off-site redistribution of a material, for use in the same manner or similar manner at another location.
    3. The use of non-toxic, clean wood as an alternative fuel source.
M. Salvage: To remove a waste material from the project site for resale or reuse by the Owner or others.
N. Toxic: Poisonous to humans either immediately or after a long period of exposure.
O. Trash: Any product or material unable to be re-used, returned, recycled, or salvaged.
P. Waste: Extra materials or products that have reached the end of its useful life or its intended use. Waste includes salvageable, returnable, recyclable and re-useable construction and demolition materials, and trash.

1.5. PERFORMANCE REQUIREMENTS

A. The GC shall develop a Waste Management Plan that results in end-of-project rates for salvage/recycling/reuse of 95 percent (minimum) by weight of the total waste generated by the Work. Percentages may be adjusted on a project by project basis depending on selected LEED goals associated with the project.
B. The GC shall salvage or recycle 100 percent of all uncontaminated packaging materials including but not limited to the following:
    1. Paper
    2. Cardboard
    3. Beverage containers
    4. Boxes
    5. Plastic Sheet and film
    6. Polystyrene packaging
    7. Wood crates and pallets
    8. Plastic pails and buckets
C. Promote a resourceful use of supplies and materials through proper planning and handling. Generate the least amount of waste possible by minimizing errors, poor planning, breakage, mishandling, contamination or other similar factors.
D. Use all reasonable means to divert construction waste from landfills and incinerators through recycling, reuse, or salvage as appropriate.

1.6. SUBMITTALS AND DELIVERABLES

A. The GC shall provide his/her completed Waste Management Plan to the Project Management Web Site as a submittal for review by the Project Architect and City Project Manager.
    1. See item 1.8 below for Waste Management Plan submittal requirements.
    2. The Waste Management Plan shall be completed, submitted, and approved as a pre-requisite for Progress Payment number 1.
    3. Copies of all documentation required by this specification shall be submitted to the appropriate Project Management Web Site Library. Documentation shall be reviewed by the City Project Manager during all Progress Payment reviews for compliance and accuracy.
B. The Waste Management Coordinator shall provide copies of items 1 through 5 below to the appropriate Project Management Web Site Library and shall update the Waste Management Summary Log to reflect the records being submitted.
    1. Records of Donations: Indicate receipt and acceptance of itemized salvageable waste donated to individuals or organizations. Indicate if the organization is tax exempt.

2. Records of Sales: Indicate receipt and acceptance of itemized salvageable waste sold to individuals or organizations. Indicate if the organization is tax exempt.
3. Recycling and Processing Facility Records: Indicate receipt and acceptance of recyclable waste by recycling and processing facilities licensed to accept them. Include manifests, weight tickets, receipts and invoices.
4. Landfill and Incinerator Disposal Records: Indicate receipt and acceptance of waste by landfills and incinerator facilities licensed to accept them. Include manifests, weight tickets, receipts and invoices.
5. Statement of Refrigerant Recovery: The Refrigerant Recovery Technician responsible for recovering refrigerant shall provide the GC with a statement indicating all of the following:
    a. All recovery was performed according to EPA Regulations.
    b. All refrigerant present was recovered; indicate the total quantity recovered by unit.
    c. Date of Recovery.
    d. Name, address, company name, and phone number of technician performing the recovery.
    e. Technician shall sign and date the statement.

C. LEED Submittal: The GC shall provide the following information using the appropriate LEED letter template upon project completion: indicating that the requirements of the credit have been met. *NOTE: This requirement shall only apply to projects having a LEED certification goal.*
1. Total waste material generated.
2. Total waste material diverted by diversion method; recycling, salvage, re-use, etc.
3. Statement that the credit requirements have been met.
4. GC shall sign the letter.

1.7. QUALITY ASSURANCE

A. Waste Management Coordinator: The GC shall be responsible for designating a Waste Management Coordinator. Coordinator may be the GC Supervisor, GC Project Manager or other member of the GC staff having knowledge of proper waste management procedures and all applicable regulations.
B. Regulatory Requirements: comply with all hauling and disposal regulations of authorities having jurisdiction.
C. The Waste Management Coordinator shall comply with Specification 01 31 19 Project Meetings, Section 3.7.B.1 and conduct a Waste Management Conference at the job site. This conference shall be repeated as necessary as additional trades are added to the Work. The conference shall include but not be limited to the following:
1. Identify the Waste Management Coordinator; provide trade contractors with name, phone, and email information.
2. Review and discuss the Waste Management Plan and the roles of the Coordinator.
3. Review the requirements for documenting and reporting procedures of each type of waste and its disposition.
4. Review procedures for material separation; indicate availability and locations of containers and bins.
5. Review procedures for periodic waste collection and transportation to recycling and disposal facilities.
6. Review waste management procedures specific to each trade.

D. Refrigerant Recovery Technician Qualifications: Certified by EPA-approved certification program.

1.8. WASTE MANAGEMENT PLAN

A. Develop a plan consisting of waste identification, a waste reduction work plan, and cost/revenue analysis. Indicate quantities by weight or volume. Use the same units of measure throughout the waste management plan.
1. Waste Identification: Indicate anticipated types and quantities of site clearing, demolition waste, and construction waste that will be generated during the execution of this contract. Include assumptions for the estimates.
2. Waste Reduction Work Plan: The work plan shall consist of but not be limited to all of the following:
    a. Identify methods for reducing construction waste. Re-using, framing and forming materials, re-planning material cuts to minimize waste, etc.
    b. Identify what types of materials will be recycled. Provide lists of local companies that receive and/or process the materials. Include names, addresses, and phone numbers.
    c. Identify what types of materials will be disposed of and whether it will be disposed of in a landfill facility or by incineration facility. Provide lists of local companies that receive and/or process the materials. Include names, addresses, and phone numbers.
    d. Identify methods to be used on site for separating waste including all of the following:
        i. Sizes of containers to be used.
        ii. Labels to be used on the containers to identify the type of waste allowed in the container.

iii. Designated locations on the project site for waste material containers.

B. If project requires demolition incorporate the ordinance required (MGO 28.185) Recycling and Reuse Plan into the Waste Management Plan.

C. Provide all of the following for the Waste Management Coordinator:
   1. Name, employer, employer address, phone number, and email address of the designated coordinator.
      a. The GC shall also provide this information with the required Project Directory Submittal at the beginning of the project.

D. If at the option of the GC, he/she chooses to contract with a Waste Management Disposal Company that allows comingled and unsorted waste materials, the GC shall include with his/her Waste Management Plan the following:
   1. Name, address, phone number, state permitting information, and other pertinent information about the disposal company.
   2. Documentation from the disposal company indicating company policies and procedures regarding comingled and unsorted waste materials to include:
      a. GC responsibilities on the project site.
      b. Disposal company procedures for receiving, sorting, recycling, and disposing of comingled and unsorted waste material.

PART 2 – PRODUCTS – THIS SECTION NOT USED

PART 3 - EXECUTION

3.1. PLAN IMPLEMENTATION

A. Implement the approved waste management plan. Provide adequate containers, storage space, signage, transportation and other items required to implement the plan during the execution of this contract.

B. The GC and Waste Management Coordinator shall be responsible for monitoring and reporting the status of the Waste Management Plan and shall monitor the waste management practices on site as frequently as needed.

C. Train all workers, sub-contractors, and suppliers on proper waste management procedures as appropriate for the work being conducted on the project site.
   1. Distribute the waste management plan to everyone concerned within seven (7) days of submittal approval.
   2. Distribute the waste management plan to new workers, sub-contractors, and suppliers when they first appear on the project site.
   3. Conduct additional training as needed during the execution of the contract to keep a positive focus on the waste management plan.

D. Conduct waste management operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent and used facilities.
   1. Designate and label specific areas on the project site necessary for separating materials to be salvaged, recycled, reused, donated, and sold.
   2. Comply with any specification or regulatory requirements pertaining to dust, dirt, environmental protection, and noise control.

3.2. HAZARDOUS AND TOXIC WASTE

A. The Owner shall be responsible under separate contract for the removal of any asbestos related materials. All other materials shall be removed by the GC.

B. All hazardous and toxic waste shall be separated, stored, and disposed of according to all applicable regulations.

C. All hazardous and toxic materials on site shall have a Material Safety and Data Sheet (MSDS) available that indicates storage requirements, emergency information, and disposal requirements as necessary.

3.3. GENERAL GUIDELINES FOR ALL WASTES

A. Recycle all paper and beverage containers used by workers, sub-contractors, suppliers and visitors to the project site.

B. All revenues, savings, rebates, tax credits, and other such incentives received from recycling, reusing, or salvaging waste materials shall accrue to the GC unless specified otherwise in the contract documents.

C. Separate recyclable, reusable, and salvageable waste from other waste materials, trash, and debris except where Waste Management Disposal Company allows comingled waste materials, see section 1.8.D above.
   1. Separate by type in appropriate containers or designated areas according to the approved waste management plan away from the construction area. Do not store within the drip lines of existing trees.

2. Inspect containers and bins frequently for contamination and inappropriately sorted materials. Remove contaminated materials and resort as necessary.
3. Stockpile bulk materials such as sand, topsoil, stone, etc., on site away from the construction area and without intermixing with other materials. Place, grade, and shape stockpiles to drain surface water, and cover to prevent windblown dust. Do not store within the drip lines of existing trees.
4. Whenever possible store items off the ground and/or protect them from the weather.

3.4. GUIDELINES FOR RECYCLABLE, RE-USABLE, AND SALVAGEABLE WASTE

A. The following guidelines is not a complete or all inclusive list and shall be adjusted as needed by the methods and procedures identified in the Waste Management Plan.
B. Asphalt Paving: Break-up into transportable pieces or grind, transport to an authorized recycling facility.
C. Carpet and Pad: Separate carpet and pad scraps, containerize and transport to an authorized recycling facility.
D. Ceiling System Components: Suspended ceiling system components shall be sorted by material type as follows:
   1. Broken, cut, or damaged tiles shall be containerized, transport to an authorized recycling facility.
   2. Damaged, or cut tracks, trim and other metal grid system components shall be sorted with other metals of similar types, palletize, transport to an authorized recycling facility.
E. Clean Fill: When allowed by Division 31 Specifications; concrete, masonry, stone, asphalt pavement, sand and other such materials may be used as clean fill on this project site. The GC shall verify with the Project Architect, Structural Engineer, or Civil Engineer as necessary prior to using any materials as clean fill. Materials shall be processed, placed, and compacted as specified. If not being re-used on site, transport to an authorized recycling facility.
F. Clean Wood Materials: Including but not limited framing cutoffs, wood sheathing or paneling materials, structural or engineered wood products, and pallets or crates. Clean Wood shall be free of paints, stains, oils, preservatives and other such contaminates.
   1. Useable pieces shall be sorted by type and dimension, bundled and transported off site by the GC or returned to the supplier.
   2. Non-useable pieces shall be palletized or containerized, transport to an authorized recycling facility.
   3. Clean, uncontaminated sawdust and wood shavings shall be bagged, transport to an authorized recycling facility.
G. Concrete: Break-up into transportable pieces, remove all reinforcing and other metals, transport to an authorized recycling facility.
H. Glass Products: Shall be sorted by types, do not include light fixture lamps and bulbs. Products broken in shipment shall be returned to the supplier. Broken or cracked items still in frames shall be taped to prevent further breakage and injury to workers. Transport to an authorized recycling facility.
I. Gypsum Board: Stack large clean pieces on wooden pallets or container, store in a dry location, transport to an authorized recycling facility.
J. Light Fixture Lamps and Bulbs: Fluorescent tubes shall be containerized, transport to an authorized recycling facility.
K. Masonry and CMU: Remove all metal reinforcing, anchors, and ties, clean undamaged pieces and neatly stack on pallets, transport damaged pieces to an authorized recycling facility.
L. Metals: Sort metals by type as follows, this does not include piping:
   1. Architectural metals including but not limited to siding, soffit, and roofing panels shall be sorted by material, palletize or bundle as needed and transport to an authorized recycling facility.
   2. Structural steel, sort by size and type; palletize and transport to an authorized recycling facility.
   3. Miscellaneous metals such as aluminum, brass, bronze, etc shall be sorted by type, containerized or palletized as necessary, transport to an authorized recycling facility.
M. Packaging and shipping materials
   1. Cardboard boxes and containers: Breakdown all cardboard boxes and containers into flat sheets. Bundle and store in a dry location until transported for recycling.
   2. Pallets:
      a. Whenever possible require deliveries using pallets to remove them from the project site.
      b. Neatly stack pallets in preparation for reusing them or providing them to other companies for salvage or re-use.
      c. Break down pallets into component wood pieces that comply with the requirements for recycling clean wood materials. Neatly stack or palletize pieces in preparation for transportation.
   3. Crates: Break down crates into component wood pieces that comply with the requirements for recycling clean wood materials. Neatly stack or palletize pieces in preparation for transportation.
   4. Polystyrene Packaging: Separate and bag materials.

N. Piping and conduit: Reduce all piping and conduit to straight lengths, sort and store by size, material and type. Remove supports, hangers, valves, boxes, sprinkler heads, and other such components, sort and store by size, material and type. Transport to authorized recycling facilities according to material types.

O. Roofing: Roofing materials shall be sorted and containerized by type, transport to authorized recycling facilities according to material types.

P. Site-Clearing Waste: Sort all site waste by type.

1. Only stockpile soils types and quantities required for re-use on the project site. All remaining quantities shall be transported off site to an authorized facility that receives such materials.
2. Brush, branches, and trees with no marketable re-use shall be transported to facilities for chipping into mulch.
3. Trees with a marketable re-use shall be salvaged and transported to facilities that specialize in processing trees for future use as wood products.

3.5. GUIDELINES FOR DISPOSAL OF WASTES

A. The following guidelines shall be adjusted as needed by the methods and procedures identified in the Waste Management Plan.

B. Any waste that is contaminated, organic, or cannot be recycled, re-used, or salvaged shall be legally disposed of in an authorized landfill or incinerator. Disposal methods shall follow all applicable regulatory requirements.

C. No waste material of any kind, except those types designated as clean fill in section 3.4 above, shall be allowed to be buried on the project site at any time.

D. No burning of any kind of waste material shall be permitted on this project site at any time.

E. Paint and Stain: Paints, stains, and their containers shall be disposed of as follows:

1. Whenever possible containers should be thoroughly cleaned immediately after emptying and sorted with as appropriate (metal or plastic) for recycling
2. Empty containers, regardless of type or base material, may be disposed of with lids off with general garbage.
3. Latex paint may be placed with general garbage if properly solidified as follows:
   a. Small amounts (an inch or less in can): Remove lids and allow paint to dry out in the can and harden. Protect cans from rain and freezing.
   b. Large amounts (more than one inch): Mix paint with equal amounts of cat litter, stir and allow to completely dry. Alternate method: mix with commercial paint hardener.
4. Oil-based or combustible paints and stains, regardless of liquid or solid, shall be transported to an approved facility that takes such items such as Dane County Clean Sweep Sites.

F. Treated Wood Materials: Treated wood materials including but not limited to wood that has been painted, stained, or chemically treated shall not be recycled or incinerated.

END OF SECTION

SECTION 01 76 00
PROTECTING INSTALLED CONSTRUCTION

PART 1 – GENERAL

1.1. SUMMARY

A. The purpose of this specification is to provide clear responsibilities, guide lines, and requirements related to providing protection to already installed construction.

B. Already installed construction shall include but not be limited to the following:

1. Any existing site feature such as pavement, curbs, drainage features, utilities, landscaping features (trees, shrubbery, plantings, flagpoles, etc) and other such exterior items not associated with the building whether on or adjacent to the project site.
2. Any existing structure on or adjacent to the project site.
3. Any existing interior work that may be adjacent to the new work including all paths of ingress/egress to areas associated with accessing the Work.
4. Any existing feature of any kind within the public right-of-way that may be on the project site property, adjacent to the project site or across the street from the project site.

C. All contractors shall be familiar with the specifications of their Division of Work for specific requirements on protection of the Work.

D. The requirements noted within this specification do not relieve any contractor of the responsibility for compliance with any code, statute, ordinance, or other such regulatory requirement having jurisdictional authority over these contract documents.

1.2. QUALITY ASSURANCE

A. It shall be the responsibility of every contractor and worker assigned to the project to be diligent in protecting all existing work, and newly installed construction.

B. It shall be the General Contractors' (GC) responsibility under the contract to provide all reasonable protection methods, materials, or precautionary measures required to protect new or existing construction as described in within this specification to the project as a whole.

1. The GC shall be responsible to ensure any damaged new or existing construction is repaired or replaced at no additional cost to the Contract.
2. The GC at his/her discretion may direct other contractors to provide and maintain protection of completed work associated with their Division of Work. I.E.: The carpet installer may be required by the GC to provide carpet protection along traveled paths, ingress/egress, etc after installation.

C. It shall be the responsibility of the GC to ensure that all materials being used to protect installed construction are compatible with, and/or adjacent to, the materials being protected. This shall include but not be limited to the material used as covering, tapes used to fasten protective materials, etc.

1.3. RELATED SPECIFICATIONS

A. Parts of this specification will reference articles within "The City of Madison Standard Specifications for Public Works Construction".
   1. Use the following link to access the Standard Specifications web page:
      http://www.cityofmadison.com/business/pw/specs.cfm
      a. Click on the "Part" chapter identified in the specification text. For example if the specification says "Refer to City of Madison Standard Specification **2**10.2" click the link for Part II, the Part II PDF will open.
      b. Scroll through the index of Part II for specification 210.2 and click the text link which will take you to the referenced text.
      c. City Standard Detail Drawings (SDD) may be located from the index in Part VIII.

B. Section 01 60 00 Product Requirements

C. Section 01 74 13 Progress Cleaning

PART 2 - PRODUCTS

2.1. FENCING MATERIALS AND BARRICADES

A. Except where noted in other areas of the construction documents, the responsible contractor shall provide fencing around the construction site as shown on the Civil Drawings of an appropriate construction as identified below. For temporary barricade situations, the responsible contractor may provide one of the following that sufficiently provide a sturdy physical barrier and/or visual barrier as necessary for the intended application.
   1. Standard orange construction barrels each with a standard rubber base ring and reflective tape
      a. Provide flashing amber lights as needed to increase night time visibility
   2. Steel "T" style fence posts
   3. 4'0" high standard orange construction fence
   4. Traffic barricades
   5. Jersey barriers
   6. Other types of fencing or barricades typically used in the construction industry

B. The contractor responsible for providing the fencing materials and barricades shall also be responsible for maintaining them. This shall include but not limited to fixing damaged fencing, standing up barrels that have been knocked over, realigning barrels, and ensuring flashing lights are fully operational at all times.

C. The following fencing and barricade designations, and their use descriptions shall be used throughout this specification to provide uniformity in describing protection requirements.
   1. Type A, Jersey Barriers, to be used as permanent blocking devices to deny access to alternate project site entrances or exits.
   2. Type B, Traffic Barricades, to be used as temporary blocking devices to deny access to alternate project site entrances or exits.
   3. Type C, Construction Barrels without construction fencing shall be used for lane closures, temporary blocking devices to deny access and the protection of single locations (I.E. identify the location of an access structure) that do not require fencing.
   4. Type D, Construction Barrels with construction fencing where it becomes necessary to surround an object with a complete visual barricade and it is impractical or unacceptable to install fence posts. The surround shall be constructed in such a manner as to provide a buffer zone around and access to the item being protected.
   5. Type E, Steel "T" Fence Posts shall be used at the project lines, as indicated on the Civil Drawings, with six foot galvanized chain link fencing to surround an object with a complete visual barricade and it is practical to install fence posts. The surround shall be constructed in such a manner as to provide a buffer zone around and access to the item being protected. All posts shall be driven installed. Surface mounted posts to only be used for temporary barricades.
   6. Type X, Other fencing or barricade types that may be designated and detailed within the construction documents shall use additional alpha numeric designations.

2.2. EROSION CONTROL PROTECTION

A. Refer to City of Madison Standard Specification 210.2 for authorized materials associated with erosion control materials.

2.3. INTERIOR FINISH PROTECTION MATERIALS

A. Except where noted in other areas of the construction documents or this specification the responsible contractor:
   1. Shall not provide the cheapest or least effective method as an effort to meet any protection requirement.
   2. Shall provide materials of sufficient quality, and durability to provide adequate protection based on the seasonal conditions and the anticipated duration at the time the protection will be needed.
   3. Shall provide sufficient quantity of protection material to protect the construction as needed.

B. Prior to installing protective measures the responsible contractor shall propose to the GC, Project Architect (PA) and City Project Manager (CPM) the proposed plan for protection, materials to be used and samples as necessary.
   1. The PA and CPM reserve the right to disapprove any proposed method and/or material and/or make alternate proposals.

PART 3 - EXECUTION

3.1. GENERAL EXECUTION REQUIREMENTS

A. The GC shall be responsible for ensuring all of the following procedures and requirements are implemented as needed for the duration of the Work performed under this contract.

B. The GC shall also be responsible for the following:
   1. Reporting any incident of damage to existing property, right-of-way, or utility to the CPM immediately upon rendering the incident safe, and notifying emergency response teams, and emergency utility crews as needed.
   2. Conduct a site walk through prior to leaving at the end of each day to assess:
      a. Protection measures are properly in place, provide correction actions as necessary.
      b. Note damage to existing completed work and schedule repair/replacement as needed.
   3. Ensure all contractors and workers are being diligent in protecting existing work, and newly installed construction.

3.2. PROTECT ADJACENT PROPERTIES

A. Whenever possible through the design process the City of Madison shall have previously provided notice to adjacent property owners that work will be occurring on or near their property. The City of Madison shall also have obtained any permanent or temporary easements that may be necessary to complete any Work on adjacent properties.

B. It shall be the responsibility of the GC to do the following for all Work under this contract being performed on or adjacent to the property line:
   1. Contact the adjacent property owner and provide him/her with information on the work to be done, equipment to be used, and estimated duration of the work. Information to be updated and communicated to property owner(s) as construction progresses and site conditions change.
      a. If any adjacent property is a rented or leased space the GC shall also make contact and provide the same information to the tenants.
      b. Determine from the owner and/or tenants if there are any concerns for children, pets, special plantings, or other concerns.
   2. Discuss the following with all contractors performing work on or near the property line.
      a. Work to be completed and timeline.
      b. Concerns of adjacent property owners/tenants from item 1 above.
      c. Which protective measures will be necessary to protect adjacent properties and address the concerns of adjacent property owners/tenants.
   3. Ensure all protective measures are placed and maintained during the execution of Work on or adjacent to the property line. Interact with the adjacent property owners/tenants as needed.

C. Any contractor doing work on or adjacent to the property line shall install and maintain any protective measure identified in the contract documents, this specification, or as directed by the GC.

D. The GC shall be responsible for restoring any damage to structure and property located on or adjacent to the property line.
   1. Restoration shall include but not be limited to repair or replacement using like materials and finishes to its original condition or better.
   2. Restoration of landscaping materials shall include watering of any seed, sod, or other planting of any kind for a reasonable period of time to encourage germination and root development.

E. The GC shall keep the CPM informed directly to any issues pertaining to adjacent property owners and tenants.

3.3. PROTECT LANDSCAPING FEATURES

A. Except where specifically stated in other areas of the construction documents the following minimal protection requirements shall apply under this section.
   1. Whenever possible do not install new landscape features until exterior building construction has been completed, equipment such as scaffolding and lifts are no longer needed and have been removed, and heavy equipment operation is no longer required.
   2. Whenever possible remove and temporarily store all existing landscape features such as benches, waste receptacles, signage, and other such features that will be within the area of Work that can be removed.
   3. Landscape features that cannot be removed such as flag poles, light poles, light bollards, etc. shall be protected with Type D fencing for areas on pavement or Type E fencing for areas on soil.
   4. Planting beds shall be protected using Type E fencing around the exposed perimeter of the planting bed as needed.
   5. The City of Madison Standard Specification 107.13 shall apply to all tree protection in and around the project site at all times.

3.4. PROTECT UTILITIES

A. The contractor shall be responsible for notifying all utilities to determine emergency response procedures and protection requirements prior to installing any construction protection.
   1. This includes requesting utility marking through Diggers Hotline.
      a. Call 811 or 1-800-242-8511 to request a public utility locate
      b. For emergency locate call (262) 432-7910 or (877) 500-9592
   2. Contact the Owner and CPM for any available private utility information on the property that may be available prior to calling a private utility locating company.

B. Except where specifically stated in other areas of the construction documents the following minimal protection requirements shall apply under this section.
   1. Hydrants, lamp posts, electrical transformers, and other utility pedestals shall be protected with Type D fencing for areas on pavement or Type E fencing for areas on soil. Fence posts shall be located so as to not be directly over the utility main.
   2. Storm sewer structures in pavement shall have proper inlet protection according to City of Madison Standard Specification 210.1(g) and Type C Construction Barrels when necessary.
   3. Storm sewer structures in turf and other landscaped areas shall have proper inlet protection according to City of Madison Standard Specification 210.1(g) and Type E fencing for areas on soil.
   4. Stormwater management features such as greenways, retention/detention ponds, bio-filtration ponds and other such features shall be properly protected according to the appropriate erosion control measure specified on the Erosion Control Plan. See multiple sections of City of Madison Standard Specification 210.1
      a. For the protection of hard to see items such as structures, castings, inlets, etc. in grassy areas provide Type E fencing for areas on soil.
      c. For the protection of storm water management features having special soils and plants such as bio-filtration ponds provide Type E fencing for areas on soil.
   5. Other structures and covers including but not limited to cleanouts, wiring hand holes, valve boxes, access structures, grease trap structures, etc shall be protected as follows:
      a. Provide Type E fencing for areas on soil.
      b. When paving operations are complete provide a construction barrel or cone near structures as necessary depending on required heavy construction traffic.

3.5. PROTECT PUBLIC RIGHT OF WAY

A. Except where specifically stated in other areas of the construction documents the following minimal protection requirements shall apply under this section.
   1. All public right-of-way (area from behind the sidewalk to the centerline of the street) shall remain open and accessible except during periods of active work. At such times the public right of way shall be properly closed and signed as referenced in City of Madison Standard Specification 107.9.
   2. Bus stops and bus stop structures shall remain accessible at all times.
   3. Traffic signage and traffic signals, traffic control boxes shall be protected with Type D fencing for areas on pavement or Type E fencing for areas on soil.
      a. Protection at traffic signage/signals shall not obstruct the viewing of the sign/signal for its intended purpose at any time.

B. When additional protection for traffic control is required, the use of barricades, guardrails, lane closures and other such procedures will be detailed within the construction documents.

C. When additional protection for overhead sidewalk cover is required the contract documents shall indicate the specific location and structural requirements of the protective structure.

3.6. PROTECT STORED MATERIALS

A. All contractors shall refer to Specification 01 60 00 Product Requirements for all storage and protection requirements of building materials and products delivered to the site.

3.7. PROTECT WORK - EXTERIOR

A. Provide all temporary services that may be required to protect the installed material from heat, cold, humidity, etc, while materials such as concrete, mortar, sealants, paints, etc, are drying and/or curing.

B. Open trenches, pits, and other such excavations shall be properly covered, lined, or shored as needed during periods of inclement weather to prevent the caving of soils onto existing work in progress. Refer to the appropriate specifications and/or regulatory requirements governing this type of work as necessary.

C. Provide adequate protection at all openings with heavy duty tarps, plastic sheathing, or wood framing and sheathing as needed to protect interior work in progress from inclement weather as needed.

D. Protect exterior finishes of all kinds with heavy duty tarps or plastic sheathing as needed while landscaping is being installed through full germination of seeded areas or installation of filter fabric and mulches to keep dust, dirt, and mud off of finished exterior surfaces.

E. Designate specific curb mounting points and provide wood blocking where small vehicles, skid loaders and other such equipment may need access to areas being landscaped.

F. Provide plywood turning pads for skid loaders to turn on to prevent tire marking on new pavement.

G. Do not permit the parking of vehicles with any kind of fluid leaks to park on new pavement.

H. The contractor shall be responsible for cleaning, repairing, or replacing any completed work or work in progress under this specification as deemed necessary by the CPM without additional cost to the contract.

3.8. PROTECT WORK - INTERIOR

A. The GC shall do all of the following:

1. Provide all temporary services that may be required to protect the installed material from heat, cold, humidity, etc, while materials such as concrete, mortar, sealants, paints, etc, are drying and/or curing.
2. Provide adequate visual and/or physical protection as needed to protect newly completed interior work such as paint, flooring material, sealants, grouts, etc that may be drying and/or curing.
3. Provide adequate space and materials for cleaning boots, tool boxes, supplies, and other items coming into the project site once finish work has begun.
4. Clean dirtied areas and repair/replace damaged areas immediately.

B. The contractors responsible for interior work shall be responsible for protecting their work and finishes from dirt, mud, snow, spills, splatters, and physical damage after installation as follows:

1. Protect vinyl composite, rubber composite, painted/stained concrete, and tiled flooring as follows:
   a. Define foot traffic areas and protect with Ramboard Temporary Floor Protection products as a minimum basis of design or other protection product(s) compatible with installed flooring product if Ramboard is not compatible. Products to be used shall be new.
      i. Tape all edges, seams, etc with a good quality tape that does not leave sticky residue. Do not allow any debris or other material between the installed flooring and the protection material.
      ii. Repair tears immediately, replace worn areas with like material as necessary.
2. Protect carpeted areas as follows:
   a. Define foot traffic areas and protect with a minimum of 6mil, clear, polyethylene sheeting 3 feet wide. Products to be used shall be new.
      i. Tape all edges, seams, etc with a good quality tape that does not leave sticky residue. Do not allow any debris or other material between the installed flooring and the protection material.
      ii. Repair tears immediately, replace worn areas with like materials as necessary.
3. Protect all finished walls in high traffic areas with Ramboard Temporary Wall protection products or approved equal.
      i. Tape all edges, seams, etc with a good quality tape that does not leave sticky residue. Do not allow any debris or other material between the installed flooring and the protection material.

ii. Repair tears immediately, replace worn areas with like materials as necessary.

3. Protect counter tops, cabinets, and other finished surfaces with large sheets of thick cardboard or Ramboard products. Do not allow toolboxes, finish materials, parts and other such items to be placed on finished materials.

C. All protection shall stay in place until the CPM, PA, and GC mutually deem the project is ready for Final Cleaning. The contractors responsible for protecting the work shall be responsible for removing the protection and removing any adhesive residue at that time. Contractors shall only use manufacturer authorized cleaning materials for removing adhesives, etc.

D. Contractors doing work in un-protected areas of finished work shall be required to provide drop cloths and other protection as noted within this specification for the duration of their work.

1. Finished areas shall be sufficiently covered to accommodate all equipment, and materials being used to complete the work being done.
2. Finished areas shall be sufficiently covered to prevent splatters, over spray, etc when doing touch-up work.
3. Contractors who do not provide sufficient protection under this sub-section shall be responsible for any costs associated with cleaning, repairing or replacing already finished construction at no additional cost to the contract.

END OF SECTION

SECTION 01 77 00
CLOSEOUT PROCEDURES

PART 1 – GENERAL

1.1. SUMMARY

A. The purpose of this specification is to clearly define and quantify the requirements associated with closing a City of Madison Public Works Contract for facility related work.

B. All contracts have two distinct but related paths. Each path needs to be properly closed independently in order to close the contract as a whole.

1. Construction closeout is related to closing out all of the Work associated with the construction documents.
   a. It shall be the responsibility of all contractors to be fully aware of the required Work and closeout requirements involved in their individual trades.
2. Contract closeout is related to closing out all of the administrative aspects of the contract in general.
   a. It shall be the responsibility of all contractors to be fully aware of the administrative requirements required by the contract and to provide the supporting documentation required.
3. Construction Closeout must be completed before Contract Closeout can begin.

C. This specification will provide general knowledge associated with the following areas:

1. Construction Closeout Requirements
2. Construction Closeout Procedure
3. Contract Closeout Requirements
4. Contract Closeout Procedure
5. Final Payment and Certificate of Completion

1.2. RELATED SPECIFICATIONS

A. Contractors shall review all references to other specifications including specifications relating to the execution of the Work associated with their Division or Trade.

B.	Section 01 29 76	Progress Payment Procedures
C.	Section 01 31 23	Project Management Web Site
D.	Section 01 32 26	Construction Progress Reporting
E.	Section 01 45 16	Field Quality Control Procedures
F.	Section 01 74 13	Progress Cleaning
G.	Section 01 45 16	Construction Waste Management and Disposal
H.	Section 01 76 00	Protecting Installed Construction
I.	Section 01 78 13	Completion and Correction List
J	Section 01 78 23	Operation and Maintenance Data
K.	Section 01 78 36	Warranties
L.	Section 01 78 39	As-Built Drawings
M.	Section 01 78 43	Spare Parts and Extra Materials
N.	Section 01 79 00	Demonstration and Training
O	Section 01 91 00	Commissioning

P. Other requirements as noted in the contract documents signed by the General Contractor

1.3. DEFINITIONS

A. ***Substantial Compliance***: A letter provided to the City of Madison Building Inspection and signed by the Project Architect indicating that all Work has been completed to a level that would allow Owner Occupancy and that all construction is in compliance with the construction documents. A copy of this letter is also provided to the State of Wisconsin Department of Health and Safety as necessary to clear plan review requirements. This letter does not represent construction closeout.

B. ***Certificate of Occupancy***: The Regulatory letter from the City of Madison Building Inspection Department indicating that all regulatory requirements and inspections have been completed and the building may now be occupied for its intended use. This letter does not represent construction closeout.

C. ***Certificate of Substantial Completion***: A letter provided by the Department of Public Works, signed by the City Engineer indicating that Construction activities are substantially complete. This letter does represent construction closeout and the date of this letter begins the date of the Warranty Period.

D. ***Construction Closeout***: The point in the contract where all contractual requirements associated the execution of the Work as described in the plans, specifications, and other documents have been successfully met and the items described in 1.3.A, .B, and .C above have been completed.

E. ***Final Progress Payment***: The progress payment associated with achieving Construction closeout as described in 1.3.D above. At this point the contractor may request all monies associated with the contract be paid with the exception of held retainage.

F. ***Contract Closeout***: The point in the contract where all contractual requirements associated with the City of Madison, Board of Public Works contract has been successfully met.

G. ***Final Payment***: The final contract payment submittal that may be approved by the City of Madison after all contractual requirements of the Public Works Contract have been met and any remaining monies (retainage) due to the contractor may be released for the Final Payment.

1.4. QUALITY ASSURANCE – CONSTRUCTION CLOSEOUT

A. All contractors shall be responsible for properly executing the construction closeout requirements associated with their Work as described in the specifications governing their Work.

B. The GC shall be responsible for all of the following:

1. Ensuring that all contractors have met the construction closeout requirements associated with their Work.
2. Coordinate the collection of all construction closeout deliverables from all contractors, provide the deliverables to the Project Architect and City Project Manager for review as necessary, and ensure all contractors correct deficiencies of deliverables and resubmit as needed for final acceptance.
3. Ensure all closeout requirements identified in the Construction Closeout Checklist below have been completed as intended by the construction documents.

1.5. QUALITY ASSURANCE – CONTRACT CLOSEOUT

A. The City of Madison, Department of Civil Rights (DCR) monitors contract compliance for construction and procurement contracts to ensure that local, state and federal regulations are followed by contractors working on City of Madison Public Works (PW) projects. DCR will monitor all PW projects from contract award through the final payment at the close of the project. Contractors will be required to submit reporting paperwork throughout the PW project process.

1. Contractors are encouraged to visit the web site identified below for additional information, checklists, forms, and other information provided by DCR as it relates to Contract Compliance.
   http://www.cityofmadison.com/Business/PW/contractCompliance.cfm
2. Questions regarding the process should be directed to parties and offices as identified on the various forms, documents, and instructions or contact:
   City of Madison, Department of Civil Rights
   210 Martin Luther King Jr. Blvd., Room 523
   Madison, WI 53703
   (608) 266-4910

B. All Sub-Contractors have submitted the applicable required documents described in item 1.5.D below to the General Contractor (GC) for Contract Closeout.

C. The GC has submitted the required applicable documents described in item 1.5.D below for all contractors to the appropriate City of Madison Agency per instructions associated with each submittal.

D. The documents required for submittal to the City of Madison for Contract Closeout may include any/all of the items listed below depending on contract type. It is the sole responsibility of all contractors to know and submit the required and complete documentation in a timely fashion.

1. Weekly Payroll Reports
2. Employee Utilization Reports
3. Agent or Subcontractor Affidavit of Compliance with Prevailing Wage Rate Determination
4. Prime Contractor Affidavit of Compliance with Prevailing Wage Rate Determination
5. Documentation required for Small Business Enterprise (SBE) goals
6. Other documents as maybe required or requested through the Finalization Review Process

PART 2 – PRODUCTS – THIS SECTION NOT USED

PART 3 - EXECUTION

3.1. CONSTRUCTION CLOSEOUT CHECKLIST

A. All contractors shall be responsible for reviewing the drawings and specifications within their Divisions of Work to provide a complete and comprehensive list of all Construction Closeout Requirements to the GC.
   1. The checklist shall include all items identified within the construction documents that require any of the following (and examples) prior to moving into Contract Closeout Procedures:
      a. Documents indicating a specified level of performance has been achieved, such as:
         i. Test reports of all types
         ii. Startup reports
      b. Required documentation, such as:
         i. As-builts and record drawings
         ii. Operation and maintenance data
      c. Physical items to be turned over to the owner, such as:
         i. Attic stock
         ii. Keys
      d. Required maintenance completed, such as:
         i. Ducts cleaned
         ii. Filters replaced
      e. Commissioning and LEED related items and submittals
      f. Owner and Maintenance Training

B. Each list shall indicate the title of the closeout requirement, the associated specification of the requirement, the required result or deliverable, the responsible contractor(s), and a column to verify the item has been turned in and completed.

C. The GC shall be responsible for all of the following:
   1. Consolidating all the closeout lists into one master Construction Closeout Checklist.
      a. The checklist shall be in a tabular data format similar to the sample below
   2. Upload the completed checklist to the Contract Closeout-Miscellaneous Documents Library on the Project Management Web Site for review.
   3. Resubmit the checklist as needed after initial reviews have been completed.

D. The GC shall work with all contractors to amend the Construction Closeout Checklist throughout the execution of the project based on changes and modifications as necessary.

Title	Specification	Description	Responsibility	Completed
Quality Management Observation Reports	01 45 16	All QMO reports have been properly responded to, reviewed and closed by the CPM.	All, GC	
As-Built Drawings	01 78 39	As-Built drawings have been reviewed and accepted per the specification	All, GC	
Testing and Balancing of HVAC	23 09 23	Provide final TnB reports indicating design performance has been achieved	HVAC	

3.2. CONSTRUCTION CLOSEOUT REQUIREMENTS

A. The timely submittal or completion of closeout requirements shall go hand in hand with the Progress Payment Milestone Schedule that can be found in Specification 01 29 76 Progress Payments. No payments shall be made until all requirements for that payment have been met.
   1. The GC and all major Subcontractors, PA, and CPM, shall review all requirements for Construction/Contract Closeout during two (2) special meetings.

a. The first meeting shall be held at the 50% Contract Total Payment milestone. This meeting shall discuss the requirements associated with various construction/contract closeout documentation and events when they are due with respect to progress payments.
b. The second meeting shall be held at the 70% Contract Total Payment milestone. This meeting shall review the contractors progress regarding the closeout checklist, begin making plans for upcoming deadlines such as scheduling training, where to put attic stock, and when they are due with respect to progress payments.

2. The GC, PA, and CPM, shall utilize the Construction Closeout checklist to ensure that all construction closeout requirements have been met.

3.3. CONSTRUCTION CLOSEOUT PROCEDURE

A. Upon successful completion and final acceptance of all Construction Closeout Requirements the GC may submit to the CPM and PA the request for Final Progress Payment (100% contract total, less retainage).

B. The PA will confirm with the design consultants, CPM, and other City of Madison staff that all requirements of the Work have been completed and will do the following:
1. Approve the final progress payment application
2. Provide the required signed payment documents to the CPM
3. Provide the required Letter of Substantial Compliance to the following as required:
a. State Safety and Building Division
b. Local Building Inspection office
c. GC
d. CPM

C. The CPM shall draft the City Letter of Substantial Completion for signature by the City Engineer. This letter shall state any of the following that may still be tied to the contract and/or warranty:
1. Indicate that the date of the letter shall also be the beginning of the Warranty period.
2. Indicate any allowed due outs, reasons for them, and anticipated dates of finalization.
a. QMO issues such as off season testing of equipment
b. Off season training of equipment

D. The GC and all subcontractors shall finalize all warranty letters associated with their Work using the date noted on the City Letter of Substantial Completion, and provide the CPM with all warranties as described in Specification 01 78 36 Warranties. Upon receipt and final approval of the Warranties the CPM may initiate final processing of the Final Progress Payment (100% contract total, less retainage).

3.4. CONTRACT CLOSEOUT REQUIREMENTS

A. The GC and all sub-contractors shall follow all requirements associated with documenting contract compliance and provide documentation as required or requested by DCR or PW staff. All contractors are encouraged to stay current with submissions of the following documentation:
1. Weekly Payroll Reports no later than the Progress Payment equal to 50% of the contract total.
2. Employee Utilization Reports
3. Agent or Subcontractor Affidavit of Compliance with Prevailing Wage Rate Determination
4. Prime Contractor Affidavit of Compliance with Prevailing Wage Rate Determination
5. Documentation required for Small Business Enterprise (SBE) goals
6. Other documents as maybe required or requested through the Finalization Review Process

B. Near the Progress Payment equal to 80% of the contract total the GC shall request in writing a Finalization Review. At that time DCR or PW staff shall prepare a report of all contract documentation submitted to date. A list of missing items or outstanding issues will be emailed to the GC. <u>No additional follow-up will be generated by DCR or PW Staff</u>.

3.5. CONTRACT CLOSEOUT PROCEDURE

A. The Contract Closeout Procedure will not begin until the Construction Closeout Procedure has been completed.

B. When the GC feels he/she has successfully met all of the Contract Closeout Requirements associated with Section 3.3 above the GC may submit to the request for Final Payment to the CPM.

C. The CPM shall sign and submit the Final Payment request for processing.

D. DCR and PW staff shall do a complete review of all documentation associated with item 3.3.A above.

E. The GC shall be notified directly by DCR or PW Staff of any documentation that may still be missing, have incomplete information, or other outstanding issues. It shall be the responsibility of the GC to continue follow-up with DCR and PW staff until all documentation has been successfully submitted and accepted.

F. When all required documentation associated with Contract Closeout has been successfully submitted and accepted by DCR and PW Staff the City of Madison shall process the Final Payment of any remaining monies including retainage.

END OF SECTION

SECTION 01 78 13
COMPLETION AND CORRECTION LIST

PART 1 – GENERAL

1.1. SUMMARY

A. The City of Madison has developed a multi-faceted Quality Management Program that begins with contract signing and runs through contract closeout to ensure the best quality materials, workmanship, and product are delivered for the contracted Work.

1. The Progress Management Web Site is a Construction Management tool that provides contractors, consultants, and staff a single on-line location for the daily operations and progression of the Work.
2. The Quality Management Observation (QMO) is an ongoing observation of the construction process as it progresses. The City of Madison does not use a "Punch List" or "Corrections List" as it is typically known throughout the construction industry. The QMO process acts as an "in progress punch list". Work identified as not in compliance with the contract documents by the Owner, Owner Representatives, Owner Consultants, etc. shall be resolved immediately at the Contractor's expense. Unresolved issues will be subject to withholding of progress payment(s) until completed.
3. Very stringent expectations are tied to Construction Closeout and Contract Closeout procedures. Specific milestones throughout the project need to be met and the milestones are tied to the Progress Payment Schedule.

B. All contractors shall be required to review the specifications identified in Section 1.2 below, and other related specifications identified therein to become familiar with the terminology and expectations of this City of Madison Public Works contract.

1.2. RELATED SPECIFICATIONS

A.	Section 01 29 76	Progress Payment Procedures
B.	Section 01 31 23	Project Management Web Site
C.	Section 01 45 16	Field Quality Control Procedures
D.	Section 01 77 00	Closeout Procedures

PART 2 – PRODUCTS – THIS SECTION NOT USED

PART 3 – EXECUTION – THIS SECTION NOT USED

END OF SECTION

SECTION 01 78 23
OPERATION AND MAINTENANCE DATA

PART 1 – GENERAL

1.1. SUMMARY

A. The purpose of this specification is to provide clear responsibilities and guide lines related to providing well documented and complete Operation and Maintenance (O&M) Data related to general facility use, equipment, systems, finishes, and materials to City of Madison Staff (Owner, Owner Representatives, Maintenance, and Custodial Personnel) as needed.

B. Operation and Maintenance Data shall apply to both of the following categories except where specific requirements are noted under their separate titles as follows:

1. Operation and Maintenance Data: Generally shall mean the owner manual that provides information on start-up, shut-down, operation, troubleshooting, maintenance, parts, and other such documentation as it pertains to all equipment and systems installed under the Work.
2. Use and Care instructions: Where applicable use and care instructions shall also be considered O&M for such things as flooring, tile, partitions, and other such finishes and trim related items, installed under the Work.

1.2. RELATED SPECIFICATIONS

A. Section 01 29 76 Progress Payment Procedures
B. Section 01 31 23 Project Management Web Site
C. Section 01 77 00 Closeout Procedures
D. Section 01 78 13 Completion and Correction List
E. Section 01 78 19 Maintenance Contracts
F. Section 01 78 36 Warranties
G. Section 01 79 00 Demonstration and Training
H. Section 01 91 00 Commissioning
I. Other Divisions and Specifications that may address more specifically the requirements for O&M Data.

1.3. QUALITY ASSURANCE

A. All O&M Data shall meet the requirements identified in Section 1.4 below.

B. All contractors shall provide O&M Data for each piece of equipment, system, or finish installed during the installation of the Work. O&M Data shall be provided to the General Contractor (GC) for verification and submittal.

C. The GC shall be responsible for receiving all required O&M Data files from all contractors for verifying that all files submitted meet the requirements in Section 1.4 below.

1.4. O&M DATA REQUIREMENTS

A. O&M Data shall be provided in digital PDF format as follows:

1. PDF files shall be complete first generation consumer useable editions of PDF documents as provided by any of the following:
   a. Product manufacturer
   b. Supplier of product
   c. Product manufacturer internet site

2. Acceptable PDF files shall have the following functionality:
    a. Word searchable
    b. Key areas are bookmarked
    c. Table of Contents and/or Index linked to content is preferred whenever possible.
3. Scanned printed material, with word searchable capabilities, saved as a PDF, is not acceptable and will be rejected without further review.

B. O&M Data shall include but not be limited to the following manufacturers' published information as appropriate for the equipment, system, material, or finish:
1. Installation instructions
2. Parts lists, assembly diagrams, explosion diagrams
3. Wiring diagrams
4. Start-up, shut-down, troubleshooting and other related operation procedures
5. Lubrication, testing, parts replacement, and other such maintenance procedures
6. General use, care, and cleaning instructions
7. Special precautions and safety requirements
8. A list of certified equipment vendors, service companies, parts suppliers including company name, address, and phone number
9. A list of the recommended spare parts to have on hand at all times
10. A list by type of all recommended lubes, oils, packing material, and other maintenance supplies
11. Copies of final test reports, balance reports, and other related documentation
12. Warranty information for equipment and systems

1.5. O&M DATA SUBMITTALS

A. O&M Data shall be prepared as identified in this specification and shall be submitted for review as per the schedule identified in Specification Section 01 29 76, Progress Payment Procedures.

B. O&M Data Draft submittals will be reviewed for content, procedure, and compliance only. A general critique with recommendations for improvement will be made but re-submittals will not be required.

C. O&M Data Final submittals will be reviewed for content, procedure, and compliance. Re-submittals will be required until such time as each submittal is accepted.

NOTE: Acceptance of O&M Data Final submittals is required to be complete prior to scheduling and conducting owner related training and construction closeout.

PART 2 – PRODUCTS – THIS SECTION NOT USED

PART 3 - EXECUTION

3.1. O&M DATA PREPARATION - GENERAL

A. All contractors shall prepare O&M Data for draft and final submission as follows:
1. Obtain digital PDF files for each piece of equipment, system, material or finish as described in Sections 1.4.A.1 and 1.4.A.2 above.
2. Verify that all information as described in Section 1.4.B above is included with the PDF file. Obtain missing information as necessary for a complete submittal.

B. Rename each individual PDF file as follows.
1. Do not use special characters such as #, %, &, /, etc. These characters are reserved by the Project Management Web Site software the City of Madison uses; however the under-score (or under-bar) '_' is an allowed character.
2. Use the following format and examples for renaming your file:
    a. Format: ***Equipment name_What_Project name_Contract number_Year***
        i. *Equipment Name* represents the name of any equipment, system, material or finish as designated in the Contract Documents.
        ii. *What* represents what the file is about
        iii. *Project Name* represents the title of the project or contract. A shortened version of the title may be identified by the City Project Manager to be used by all contractors.
        iv. *Contract number* is the specific identification number the Work was bid under and appears on the plan set title sheet and in each sheet title block
        v. *Year* represents the year the contract will be closed out
    b. Examples of file names

i. AHU 2_Operation Manual_Fire Admin_1234_2015
ii. CPT 2_Use and Care_MPD West_9876_2011

C. All contractors shall submit the completed digital PDF files to the GC in sufficient time for the GC to meet the O&M Data submission deadlines as described in Specification Section 01 29 76, Progress Payment Procedures.

D. O&M Data shall be submitted and reviewed as described in sections 3.2 and 3.3 below.

3.2. O&M DATA DRAFT SUBMITTAL

A. All contractors shall prepare and submit the following for an O&M Data Draft review submittal:
1. Prepare three (3) complete O&M Data file samples as described in section 3.1 above.
2. Review all specifications within his/her Division of Work and prepare a complete O&M Data checklist listing all equipment, systems, materials, or finishes. Checklist shall be in tabular form similar to the example below and shall indicate the title (and plan identifier when applicable) of the O&M Data, the associated specification, and a column to verify the item has been turned in and completed.

B. The GC shall be required to review all contractors' samples and checklists for compliance with this specification and shall return any to the originating contractor that are insufficient for re-submittal.
1. When acceptable to the GC, he/she shall upload each O&M Data draft submittal file to the O&M Draft library on the Project Management Web Site.

C. The Project Architect, City Project Manager, CxA, Consulting Staffs and Owner Representatives shall review the O&M Data draft submittals and checklist within fifteen 15 working days as follows:
1. Provide general critique comments by Division on O&M Data samples submitted. Critique is intended to provide all contractors with information on strengths and weaknesses of their submittals.
a. Re-submittal of the O&M Data samples will not be required.
2. Review in detail the O&M Data Checklist for completeness. Provide comments as needed.
a. Re-submittal of the O&M Checklist will be required until accepted.

Title	Specification	Completed
Overhead Door Operator	08 36 00	
Air Handling Unit (AHU-3)	23 00 00	
Water Heater (WH-1)	22 30 00	

3.3. O&M DATA FINAL SUBMITTAL

A. All contractors shall prepare and submit the following for an O&M Data Final review submittal:
1. Prepare complete O&M Data files as described in Section 3.1 above according to their approved checklist as described in Section 3.2 above.
2. Submit completed checklist and all final O&M Data files to the GC for final submittal review.

B. The GC shall be required to spot check all contractors' submittals for completeness against their checklists and for compliance with this specification and shall return any to the originating contractor that are insufficient for re-submittal.
1. When acceptable to the GC, he/she shall upload each O&M Data final submittal file to the O&M Final library on the Project Management Web Site.

C. The Project Architect, City Project Manager, CxA, Consulting Staffs and Owner Representatives shall review the O&M Data final submittals and checklist within fifteen (15) working days as follows:
1. Review the files submitted against the checklist and request any missing files through the GC.
2. Review in detail all of the O&M Data files for completeness.
a. Submittals shall be accepted or rejected as individual PDF files.
b. Contractors shall re-submit entire O&M submittal if any portion is rejected or incomplete.

3.4. CONSTRUCTION CLOSEOUT

A. All contractors shall review Specification 01 77 00, Closeout Procedures and Specification 01 79 00 Demonstration and Training.
1. Acceptance of all final O&M Data submittals is required prior to scheduling Demonstration and Training Sessions.
2. Completion of all Demonstration and Training Sessions is required to receive the Substantial Compliance for Occupancy Certificate, and to begin Construction Closeout procedures.

END OF SECTION

SECTION 01 78 36
WARRANTIES

PART 1 – GENERAL

1.1. SUMMARY

A. The purpose of this specification is to provide clear responsibilities and guide lines related to providing all Warranties and Guarantees related to the Work, workmanship, materials, equipment, and other such items required by the Construction Documents.

B. Manufacturers' disclaimers and limitations on product warranties do not relieve any contractor of the warranty on the Work that includes the product.

C. Manufacturers' disclaimers and limitations on product warranties do not relieve suppliers, manufacturers and any contractor required to provide special warranties under the contract documents.

1.2. RELATED SPECIFICATIONS

A. Section 01 29 76 Progress Payment Procedures
B. Section 01 31 23 Project Management Web Site
C. Section 01 77 00 Closeout Procedures
D. Section 01 78 23 Operation and Maintenance Data
E. Section 01 91 00 Commissioning
F. Other Divisions and Specifications that may address more specifically the requirements for Warranties related to the installation of all items and equipment installed under the execution of the Work.

1.3. DEFINITIONS

A. See specification 01 77 00 for the definitions of the following terms that may also be used in this specification:
1. Substantial Compliance
2. Certificate of Occupancy
3. Certificate of Substantial Completion
4. Construction Closeout
5. Contract Closeout

B. Emergency Repair: The Owner or Owner Representative reserves the right to make emergency repairs as required to keep equipment or materials in operation or to prevent damage to property and injury to persons without voiding the contractors warranty or bond or relieving the contractor of his/her responsibilities during the warranty period.

C. Installer: The company or contractor hired to install a finished product that was manufactured and supplied specifically for the Work within this contract. The Installer may or may not be the same company that supplied the product. See the definition for supplier.

D. Supplier: Any company that makes a specific finished product for the Work from information within the Contract Documents. Examples of suppliers would include custom cabinets, steel stairs and railings, etc. A supplier would not be a company that distributes items manufactured by others such as an electrical or plumbing supplier.

E. Warranty: A written guarantee from the manufacturer to the owner on the integrity of a product and its installation, and the manufacturers' responsibility to repair or replace the defective product or components within a specified time from the date of ownership. Warranty may also be used interchangeably with Guarantee. The following warranty types may be part of any specification within the Work associated with the Construction Documents:

1. Expressed Warranty: A warranty that provides specific repair or replacement for covered components of a product over a specified length of time.
2. Implied Warranty: A warranty that is not stated explicitly by a seller or manufacturer that the product is merchantable and fit for the intended purpose.
3. Standard Product Warranty: Preprinted written warranties published by individual manufacturers for particular products and are specifically endorsed by the manufacturer to the Owner. Standard warranties may be for any amount of time but shall not be for anything less than one (1) year from the warranty date.
4. Special Warranty: A written warranty required by the Contract Documents either to extend the time limit provided under a standard warranty or to provide greater rights to the Owner.

F. Warranty Date: The effective date that begins all warranty periods required for products, installations, and work-manship associated with the execution of the Work for this contract. The Warranty Date shall be set by the CPM.

G. Related Damages and Losses: When correcting failed or damaged Warranted Work, remove and reinstall (or replace if necessary) the construction that has been damaged as a result of the failure or the construction that must be removed and replaced to obtain access for the correction of Warranted Work.

H. Reinstatement of Warranty: When Work covered by a warranty has failed and been corrected reinstate the warranty by a new written endorsement. The reinstated warranty shall be equal to the original warranty with an equitable adjustment for depreciation unless specifically noted otherwise in a specification.

I. Replacement Cost: All costs that may be associated with Work being replaced under warranty including but not limited to the following:
1. Related damages and losses
2. Labor, material and equipment
3. Permits and inspection fees
4. This shall be regardless of any benefit the Owner may have had from the Work through any portion of its anticipated useful service life.

J. Replacement Work: All materials, products, required labor, and equipment necessary to replace failed or damaged warranted to an acceptable condition that complies with the requirements of the original Construction Documents.

K. Owners Recourse: Expressed warranties made to the Owner are in addition to implied warranties and shall not limit the duties, obligations, rights, and remedies otherwise available under the law. Expressed warranty periods shall not be interpreted as limitations on the time in which the Owner can enforce such other duties, obligations, rights, and remedies.
1. Rejection of Warranties: The Owner reserves the right to reject any warranty and to limit the selection of products with warranties not in conflict with the requirements of the contract documents.
2. Where the Contract Documents require a Special Warranty or similar commitment on the Work or product, the Owner reserves the right to refuse acceptance of the Work until the Contractor presents evidence the entities required to countersign such required commitments have done so.

1.4. GENERAL CONTRACTORS RESPONSIBILITIES

A. The General Contractor (GC) shall be responsible to remedy, at his/her expense, any defect in the Work and any damage to City owned or controlled real or personal property when the damage is a result of:
1. The GC's failure to conform to Contract Document requirements.
   a. Any substitutions not properly approved and authorized may be considered defective.
2. Any defect in workmanship, materials, equipment, or design furnished by the GC or Sub-contractors.

B. All warranties as described in this specification and these Contract Documents shall take effect on the date established by the CPM, as noted in Section 1.3F above.
1. All warranties shall remain in effect for one (1) year thereafter unless specifically stated otherwise in the Contract Documents or where standard manufacturer warranties are greater.

C. The GC's warranty with respect to Work repaired or replaced, including restored or replaced Work due to damage, will run for one (1) year from the date of Owner Acceptance of said repair or replacement.
1. This shall be regardless of any benefit the Owner may have had from the Work through any portion of its anticipated useful service life.

D. Warranty Response
1. See Section 3.5 of this specification.

PART 2 – PRODUCTS - THIS SECTION NOT USED

PART 3 - EXECUTION

3.1. WARRANTY CHECKLIST

A. All contractors shall be responsible for reviewing the drawings and specifications within their Divisions of Work to provide a complete and comprehensive list of all Warranty Requirements to the GC.

B. Each list shall indicate the title (and plan identifier when applicable) of the warranted item, the associated specification of the warranted item, the terms of the warranty (years), and a column to verify the item has been turned in and completed.

C. The GC shall be responsible for all of the following:

1. Consolidating all the warranty lists into one master Warranty Checklist.
   a. The checklist shall be in a tabular data format similar to the sample below.
2. Upload the completed checklist to the Submittal Library on the Project Management Web Site for review. See Specification 01 33 23 Submittals for more information on this procedure.
3. Resubmit the schedule as needed after initial reviews have been completed.

D. The GC shall work with all contractors to amend the Warranty Checklist throughout the execution of the project based on changes and modifications as necessary.

Title	Specification	Terms	Completed
Overhead Door Operator	08 36 00	MFR 2yr	
Exterior Bench and Trash Receptacles	12 93 00	MFR 3 year warranty on finish	
Kitchen Sink (SK-1)	22 42 00	MFR 5 year	
Disposal (D-1)	22 42 00	MFR 7 year parts and in-home service	
Toilet (WC-1)	22 42 00	MFR 1 year limited	

3.2. LETTERS OF WARRANTY

A. All letters of warranty shall be in a typed letter format and provide the following information:

1. The letter shall be on official company stationary including company name, address, and phone number.
2. Indicate project name, contract number, and contract address the warranty is for on the reference line.
3. Provide a description of the warranty(ies) being provided.
   a. Include Division, Trade, or Specification information as necessary.
   b. Only combine warranties of related Divisional Work together. Create new letters for additional Divisions as necessary.
4. Indicate the effective Warranty Date. As noted in Section1.3.F above, the Warranty Date shall be the date the Certificate of Substantial Completion was signed by the City Engineer.
5. Contractor Letters of Warranty shall only be signed by a principal officer of the company.
6. After signing the letter provide the GC with a high quality color scanned image in PDF format and the original signed letter.

B. The GC shall be responsible for the Final Warranty submittal as identified in Section 3.4 below.

C. The GC shall obtain letters of warranty from all of the following:

1. The General Contractor shall provide warranty letters for all Work that was self performed under the contract documents, identify all trades or Divisions of Work.
2. All Sub-contractors shall provide warranty letters for Work performed under the contract documents; identify all trades or Divisions of Work.
3. Suppliers, as required by other specifications within the Construction Documents where the manufacture of a specific product unique to the Work of this contract was required.
   a. The terms and conditions of the Supplier Letter of Warranty shall be as defined by the specifications associated with the Work but shall not be less than the industry standard of repair, or replace defective materials and workmanship within one (1) year of the warranty date.
   b. When the supplier is also the installer a single written letter may be submitted identifying both the warranty for the manufacture of the product and the warranty for the installation of the product.
4. Installers as required by other specifications within the Construction Documents where the installation of a specific product unique to the Work of this contract was required.
   1. The terms and conditions of the Installer Letter of Warranty shall be as defined by the specifications associated with the Work but shall not be less than the industry standard of repair,

or replace defective materials and workmanship associated with the installation of the product within one (1) year of the warranty date.

5. Special Letters of Warranty shall be required from any contractor, supplier, installer or manufacturer who agrees to provide warranty services required by any Division Specification in excess of their Standard Product Warranty.

3.3. STANDARD PRODUCT WARRANTY

A. All contractors shall be responsible for collecting and providing copies of all standard product warranties for commercially available products purchased and installed under this contract.

B. Only one copy of the manufacturers' standard warranty needs to be submitted as representative for all quantities of the same model number used throughout the Work.

C. Provide the manufacturers certificate, letter, or other standard documentation for each Standard Product Warranty submitted as follows:

1. Whenever possible a PDF version of the document shall be used.
    a. If a PDF version is used all additional information shall be completed using simple PDF editing tools such as text boxes, highlight, etc.
    b. If a PDF version is not available and an original document is furnished the additional information shall be neatly hand written and highlighted on the document in such a fashion so that it does not obscure any part of the written warranty.
2. Provide the following additional information on each warranty document:
    a. Contract warranty date.
    b. Provide the manufacturer name and model number of the product if not specified within the warranty.
        i. Where the manufacturer name and model number is specified within the warranty it shall be highlighted for visibility.
    c. Provide the plan identifier (LAV-1, WC-2, etc) when applicable.

D. Each completed warranty shall be saved as a digital PDF. The file shall be named using the specification number and item description. I.E. 22 42 00 Toilet (WC-1).pdf
    a. Where an original certificate was furnished provide a high quality colored scan of the completed document with the additional information. Save the scanned image in PDF format and use the same naming convention as indicated above.

E. Provide all PDF files and any original documents to the GC for final consolidation to be provided to the Owner.

3.4. FINAL WARRANTY SUBMITTAL

A. The GC shall receive all required warranties (digital PDF and any original documents) from all contractors, suppliers, installers and manufacturers.

B. The GC shall inventory all received warranties with the Warranty Submittal List to ensure all required warranties have been received and all warranty periods are correct according to the specifications.

C. Provide with each Operation and Maintenance Manual a complete copy of any associated warranty.

D. Scan all warranties into a single organized electronic PDF file as follows:
1. Organize the PDF file into an orderly sequence based on the table of contents of the Specifications.
2. Provide a typed Table of Contents for the entire file at the front of the document.
3. Provide bookmarks and links to each individual PDF to enable quick navigation through the PDF document.

E. Upload the warranty submittal to the appropriate document library on the Project Management Web Site for review by the PA and CPM.

F. Correct any deficiencies or omissions and resubmit as necessary.

3.5. WARRANTY NOTIFICATION, RESPONSE, EXECUTION AND FOLLOW-UP

A. Warranty Notification:
1. The City of Madison, Project Management Web Site, uses an email notification system for all warranty related issues. The GC will be required to provide, and keep current during the warranty period, a minimum of two (2) email addresses and phone numbers of current employees to receive email notifications and provide response regarding Work associated with these construction documents.
    a. In the event a Warranty Issue is deemed by the City of Madison to be an emergency, the GC shall first receive a phone call with a follow-up email from the Project Management Web Site.
    b. The Contract Closeout-Warranty Issue Library on the Project Management Web Site uses a form for each warranty issue that is logged into the system.

i. The GC shall open each warranty issue form, review the issue description and any attached documentation or photos.
ii. The GC shall also notify any other sub-contractor, supplier, or installer that may be required to review the warranty issue.

B. Warranty Response:
1. The GC shall upon notification by the City of Madison provide warranty response as follows:
a. Critical Systems or equipment: Where damage to equipment and other building components, or injury to personnel is probable provide immediate emergency shut-down information and an on-site response team as soon as possible but in no case shall on-site response exceed 24 hours.
b. For non-critical responses where damage or injury is unlikely provide on-site response no later than the next business day.
c. Where Technical Assistance support is part of the written warranty provide all assistance necessary via phone, text, or internet systems as indicated by the warranty. If issues cannot be resolved provide on-site response no later than the next business day.
d. If the request cannot be supported in sufficient time as outlined above the Owner (or Owner Representative) reserves the right to contact other contractors or service companies having similar capability to expedite the repair or replacement and shall invoice all associated costs to the Owner back to the GC.

C. Warranty Execution:
1. The GC shall provide all repairs or replacements as necessary to restore broken or damaged Work to the original level of acceptance as intended by the Contract Documents.
a. Provide all materials, equipment, products, and labor necessary to complete the repair or replacement associated with the Warranty Issue.
b. Provide all cleaning services as may be required before, during, and after the repair or replacement as per Specification 01 74 13 Progress Cleaning.
c. Provide any protection necessary for existing construction as per Specification 01 76 00 Protecting Installed Construction
d. Provide new letters of warranty when required.

D. Warranty Follow-up:
1. Logged Warranty Issues:
a. The GC shall provide complete documented responses of all logged Warranty Issues. Responses shall provide a description of work completed, by who, inclusive dates, and photos of completed or repaired work.
i. Provide call back response if work is not acceptable.
b. The City Project Manager shall review the submitted response documentation and do a field inspection if necessary.
i. If work is not acceptable, contact GC to review details and expectations of the repair as needed.
ii. If work is acceptable close the Warranty Issue.
2. Quarterly Warranty Reviews:
a. The GC shall be responsible for scheduling quarterly on-site review with all of the following:
i. City Project Manager, and other City staff as needed
ii. Owner and Owner Tenant Representative
iii. Commissioning Agent (CxA)
iv. Plumbing, Heating, Electrical Sub-contractors
v. Other Sub-contractors that may be responsible for open Warranty issues
b. Quarterly reviews shall be scheduled at 3 months, 6 months, and 11 months after the effective date of the warranty. The review meetings shall:
i. Review the status of all open Warranty Issues, determine course of action and estimated date of completion.
ii. In the appropriate quarter, provide shut-down, start-up, testing, and training of off-season equipment as required by the contract documents.
iii. The 11th month review shall review all open Warranty Issues, final plan for resolution, and all Warranty Issues where a new letter of warranty may have been issued.

END OF SECTION

SECTION 01 78 39
AS-BUILT DRAWINGS

PART 1 – GENERAL

1.1. SUMMARY

A. This specification is intended to provide clear guidelines and identify the responsibilities of all contractors as they pertain to City of Madison contract procedures regarding the accurate recording of the Work associated with the execution of this contract. This shall include but not be limited to work that will be hidden, concealed, or buried.

B. Each contractor shall be responsible for maintaining an accurate record of all installations, locations, and changes to the contract documents during the execution of this contract as it may relate to their specific division or trade.

C. The General Contractor (GC) shall be responsible for ensuring all contractors provide as-built record information to the Master As-Built Document Set as described in this specification.

1.2. RELATED SPECIFICAITONS

A. 00 31 21 Survey Information
B. 01 26 13 Request for Information
C. 01 31 23 Construction Bulletin
D. 01 32 33 Photographic Documentation
E. 01 26 63 Change Orders
F. 01 29 76 Progress Payment Procedures
G. 01 31 23 Project Management Web Site
H. 01 33 23 Submittals
I. 01 77 00 Closeout Procedures
J 01 91 00 Commissioning
K. Other Divisions and Specifications that may address more specifically the requirements for field recording the installation of all items associated with the execution of this contract by Division or Trade.

1.3. RELATED DOCUMENTS

A. Other related documents shall include but not be limited to the following:
1. Bidding documents including drawings, specifications, and addenda.
2. Required regulatory documents of conditional approval.
3. Field orders, verbal or written by inspectors having regulatory jurisdiction.
4. Shop drawings and installation drawings.

1.4. PERFORMANCE REQUIREMENTS

A. The GC shall be responsible for maintaining the “Master As-Built Document Set” in the job trailer at all times during the execution of this contract. This document set shall include all of the following:
1. Master As-Built Plan Set
2. Master As-Built Specification Set
3. Other Document Sets

B. The GC shall designate one person of the GC staff to be responsible for maintaining the Master As-Built Document Set at the job trailer. This shall include, posting updates, revisions, deletions and the monitoring of all contractors posting as-built information as described in this specification.

C. All contractors shall use this specification as a general guideline regarding the requirements for documenting their completed Work. Contractors shall explicitly follow additional specification requirements within their own Division of Trade as it may apply to this specification.

1.5. QUALITY ASSURANCE

A. The GC shall be responsible for all of the following:
   a. Spot checking all sub-contractors field documents to insure daily information is being recorded as work progresses.
   b. Discuss as-built recording to the plan set at weekly job meetings with all sub-contractors on site.
   c. Schedule time with sub-contractors in the job trailer for recording as-built information to the plan set.
   d. Insure that all sub-contractors are providing clear and accurate information to the plan set in a neat and organized manner.
   e. Insure sub-contractors who have completed work have finalized recording all as-built information to the plan set before releasing them from the project site.

B. The Project Architect, the City Project Manager, Commissioning Agent and other design team staff will perform random checks of the Master As-Built Document Set during the execution of this contract to ensure as-built information is being recorded in a timely fashion as the Work progresses. An updated and current Master As-Built Document Set is a stipulation for approval of the progress payment.

PART 2 – PRODUCTS

2.1. OFFICE SUPPLIES

A. The GC shall provide a sufficient supply of office products in the job trailer at all times for all contractors to use in recording as-built information into the plan set. This shall include but not be limited to the following:
   a. Red ink pens, medium point. Pens that bleed through paper, markers, and felt tips will not be accepted.
   b. The use of highlighters is acceptable. Assign colors to various trades for consistency in recording information.
   c. Straight edges of various lengths for drawing dimension, extension and other lines.
   d. Civil and Architectural scales
   e. Clear transparent, non-yellowing, single sided tape.
   f. Correction tape or correction fluid for correcting small errors.

PART 3 - EXECUTION

3.1. FIELD DOCUMENT AS-BUILTS

A. The GC and all Sub-contractors shall be responsible for keeping their own field set of as-built documents including plans, specifications and published changes.

B. Field sets shall be kept dry and in good condition at all times.

C. No Work shall be buried, covered, or hidden, by any additional Work, regardless of Contractor or Trade, until locations of all materials and equipment has been properly documented as described below.

D. All contractors shall be required to record the following as-built information:
   a. Notes on the daily installation of materials and equipment.
   b. Sketches, corrections, and markups indicating final location, positioning, and arrangement of materials and equipment such as pipes, conduits, valves, cleanouts, pull boxes and other such items. Note all final locations on plan sheets, indicate dimension off identifiable building features. Riser diagrams need only be corrected for significant changes in locations, routing or configuration.
      i. The use of photographs in lieu of hand drawn sketches is acceptable.
      ii. Photos shall be taken according to Specification 01 32 33 Photographic Documentation
      iii. Print photo and markup with dimensions or notes as necessary.
   c. Identify by the use of existing plan symbology and notes the size, type, quantity, and use as applicable of materials such as pipes, valves, conduits, etc.

d. Note whether horizontal runs are below slab or above ceiling, include dimensions above or below finished floor elevation.

E. All contractors shall be responsible for transferring the information from their field set of documents to the Master As-Built Plan Set kept in the GC job trailer. See Section 3.3.D. below for the proper procedure.

F. All contractors shall update the GC Master Plan Set as often as necessary, but not less than once per work week.

3.2. SITE SURVEY AS-BUILT

A. The Land Surveyor Sub-Contractor shall provide digital as-built information including but not be limited to the following:

a. For underground buried utility laterals and services of all types locate all of the following that may apply:

i. Connection points at all mains
ii. Storm discharge points to open air
iii. All corners and bends regardless of angle, large radius sweeps shall have multiple point locations sufficient to define the sweep.
iv. All vertical drops
v. All wells
vi. Private buried utilities such as buried electrical cables, irrigation systems, etc.
v. Other information that may need to be located in the future by the owner prior to digging

b. Record all surface features including but not limited to the following:

i. Building corners, pavement edges, and other permanent structural features.
ii. All surface covers for inlets, catch basins, cleanouts, access structures, curb stops and other such devices.
iii. Other permanent surface features such as hydrants, lamp posts, and other permanent site amenities.

c. The following data shall be recorded while locating items in sub-sections 3.2.a and 3.2.b above:

i. Flow lines at both ends of pipes
ii. Pipe sizes and material types
iii. Rim elevations for all covers
iv. Sump elevations and invert elevations of all structures
v. Spot elevations for all pads, driveways, walks, stoops, and floors

B. The Surveyor shall provide the final digital as-built on a media and in a format specified in Specification 00 31 21 Survey Information to the GC for turn in to the Project Architect and the Civil Engineer.

C. The Surveyor shall provide two printed as-built site plans to the GC for inclusion in the Master As-Built Plan Set as follows:

1. One sheet to show all features (but not contour information) with text neatly organized for each item identified.
2. One sheet showing contours, contour labels, and features from item 1 above, but with no additional text.

3.3. MASTER AS-BUILT DOCUMENT SET

A. The GC shall be responsible for maintaining the Master As-Built Document Set in the job trailer at all times.

1. The Master As-Built Plan Set (Plan Set) shall begin with one complete bid set of drawings and any additional sheets that were supplied by published addenda during the bidding process. The cover sheet shall be titled as the “Master As-Built Plan Set” in large bold red letters approximately 2” in height and shall not be used for any other purpose.

a. The Plan Set shall be kept dry, legible, and in good condition at all times.

b. The Plan Set shall be kept up to date with new revisions within two (2) working days of supplemental drawings being issued. Revisions shall be posted as follows:

i. Insert new, revised sheets into the plan set. Void old sheets but do not remove them from the plan set. Indicate date received and what document (RFI, CB, CO, etc) caused the change.
ii. Insert new, revised individual details into the plan set. Void old details, tape new details over the old details with a “tape hinge” to allow them to be viewed. Indicate date received and what document (RFI, CB, CO, etc) caused the change.
iii. Add new details in appropriate white space on relevant sheets. If no space is available use the back side of the previous sheet or insert a new sheet. Indicate date received and what document (RFI, CB, CO, etc) caused the change.

c. The Plan Set shall be available at anytime for easy reference during progress meetings and for emergency location information of new work already completed.

2. The Master As-Built Specification Set (Spec Set) shall begin with one complete bid set of specifications and any additional specifications that were supplied by published addenda during the bidding process. The Spec Set shall be provided in three "D" ring type binders of sufficient thickness to accommodate the specification set. Multiple binders are allowed as necessary. Label the front cover and binding edge with "Master As-Built Specifications" in bold red letters. Provide other information as necessary to distinguish the contents of multi-volume sets.
   a. The Spec Set shall be kept dry, legible, and in good condition at all times.
   b. The Spec Set shall be kept up to date with new revisions within two (2) working days of supplemental drawings being issued.
   c. The Spec Set shall be available at anytime for easy reference during progress meetings.
3. Other Document Sets may be kept at the GCs option in three "D" ring type binders of sufficient thickness to accommodate the documentation. Other documentation sets may include but not be limited to RFIs, CBs, COs, etc.

C. The Land Surveyor Sub-Contractor shall be required to use digital surveying for all exterior site surveying, and provide deliverable digital as-builts as specified in Specification 00 31 21 Survey Information. As soon as practical the surveyor shall provide the GC with a preliminary copy of installed buried utilities for inclusion with the plan set in the job trailer. The surveyor shall provide final digital as builts as per section 3.2 above.

D. All contractors shall be responsible for updating the Plan Set from their field sets at least once per work week. Updates shall include but not be limited to the following procedures:
   a. All updates shall be done only in red ink. Place a "cloud" around small areas of correction to call attention to the change.
   b. Whenever possible place general work notes, field sketches, supplemental details, photos, and other such information on the reverse side of the preceding sheet. Installation notes including dates shall be kept neatly organized in chronological order as necessary.
   c. Accurately locate items on the plan set as follows:
      i. For items that are located as dimensioned provide a check mark or circle indicating the dimension was verified.
      ii. For items that are within 5 feet of the location indicated on the plans leave as shown and:
         - Provide correct dimensions to existing dimension strings or,
         - Accurately locate with new dimension strings
      iii. For items that are more than 5 feet from the location indicated on the plans
         - Accurately draw the items in the new location as installed and,
         - Accurately locate with new dimension strings and,
         - Note that the existing location is void.
   d. Include dimensioned locations for items that will be buried, concealed, or hidden in the ground, under floors, in walls or above ceilings.
      i. Dimensions shall be pulled from identifiable building features, not from centers of columns or other buried features.
      ii. When necessary pull more dimensions as needed from opposing directions to properly locate single items.

3.4. AS-BUILT REVIEW AND ACCEPTANCE

A. The GC shall provide the Master As-Built Plan Set to the Project Architect (PA), the City Project Manager (CPM), the Commissioning Agent (CxA) and other design team staff for content review prior to the Progress Payment Milestone indicated in Specification 01 29 76 Progress Payment Procedures. The submitted plan set shall include the digital survey information produced under Section 3.2 above.
   1. If the plan set is not approved:
      a. The PA and CPM shall only be required to generalize deficiencies by trade there shall be no requirement or expectation to generate a "punch list" of required corrections.
      b. The GC and Sub-contractors as necessary shall be responsible for inspecting the installation and correcting the drawings as needed.
      c. The GC shall re-submit the plan set for review.
   2. If the plan set is approved the PA shall take possession of the plan set to be used in providing the owner with digital CAD record drawings. Upon completion of transferring the information to CAD the PA shall provide the Owner with CAD record drawings, record PDFs, and the Master As-Built Plan Set.

3.5. CHANGES AFTER ACCEPTANCE

A. No Contractor shall be responsible for making changes to the As-Built record documents after acceptance by the PA and CPM except when necessitated by changes resulting from any Work made by the Contractor as part of his/her guarantee.

END OF SECTION

SECTION 01 78 43
SPARE PARTS AND EXTRA MATERIALS

PART 1 – GENERAL

1.1. SUMMARY

A. This specification is intended to provide clear guidelines and identify the responsibilities of all contractors as they pertain to City of Madison contract procedures regarding spare parts, special tools, special materials, and extra materials.

B. Each contractor shall be responsible for knowing the specific requirements of their Division Specifications as they may relate to the general information provided in this specification.

C. The General Contractor (GC) shall be responsible for ensuring all contractors provide spare parts and extra materials as described in this specification.

1.2. RELATED SPECIFICAITONS

A. 01 29 76 Progress Payment Procedures

B. 01 31 23 Project Management Web Site

C. 01 77 00 Closeout Procedures

D. Other Divisions and Specifications that may address more specifically how to proceed with spare parts, special tools, special materials, and extra materials.

1.3. DEFINITIONS

A. Spare Parts: Any component of a product or assembly that comes pre-packaged or was specially ordered for the explicit use of the product or assembly. This shall include but not be limited to fastening devices, mounting brackets, replacement parts, wheels, pulleys, wiring, alternate assembly pieces, etc.

B. Special Tools: Any tool of any kind that was pre-packaged or specially ordered, and is required to be used for the installation or maintenance of an installed product or assembly as part of this contract.

C. Special Materials: Any oil, lubricant, glue, touch-up paint, or other such material that comes pre-packaged or was specially ordered and is required to be used for the installation or maintenance of an installed product or assembly as part of this contract.

D. Extra Materials (Attic Stock): Any surplus materials in new and useable condition that was installed a part of this contract. Attic Stock shall include but not be limited to the following: ceiling tiles, paint, stain, floor coverings, ceramic tiles, light bulbs/lamps, filters, strainers, etc. Attic Stock shall include partially opened bulk items and additional unopened quantities as directed by other specifications.

1.4. PERFORMANCE REQUIREMENTS

A. All contractors shall be responsible for consolidating spare parts, special tools, special materials, and attic stock as it pertains to the specific Work within their Division or Trade.

B. All contractors shall use this specification as a general guideline regarding the requirements for turning spare parts, special tools, special materials, and attic stock over to the owner. Contractors shall explicitly follow specification requirements within their own Division of Trade.

1.5. QUALITY ASSURANCE

A. The General Contractor (GC) shall be responsible for all of the following:

1. Coordinate the location for and the delivery of all spare parts, special tools, special materials, and attic stock being provided by all contractors under this contract to one centralized location as designated by the Owner.
2. Verify that all items being delivered are:
   a. Clean, new, and in a usable condition.
   b. Properly sealed, protected, and labeled
   c. Properly documented

PART 2 – PRODUCTS – THIS SECTION NOT USED

PART 3 - EXECUTION

3.1. PACKAGING

A. Whenever possible all surplus items should remain in their original packaging such as parts envelopes.
B. Package small parts in re-sealable plastic bags (Ziploc) or envelopes with clasp fasteners. Do not use envelopes that seal with glue or tape envelopes closed. Do not leave packaging unsealed.
C. Package like parts together for products or assemblies. I.E. keep all spare parts for flushometers together.
D. Many small packages may be grouped together into a larger container by trade.
E. Do not use unrelated boxes or containers for packaging spare items. I.E. do not use a light fixture box for spare breakers, or flushometers parts.

3.2. LABELING

A. Whenever possible the original labeling indicating part numbers and other pertinent information shall remain on the original packaging.
B. If original labeling is not available the contractor shall label all parts and packages using tape or labels and permanent black markers. Tape or labels being used shall absorb the permanent marker without bleeding or allowing ink to be smeared or rubbed off.
C. Labels shall include the name of the product or equipment the item belongs to, part number and/or name, and any other information that would assist maintenance personnel in identifying the piece and related product.
D. Labels shall include plan or specification designations (WC-1, LAV-3, DF-2, CPT-1, etc) that identify the particular product or finish material it represents.
E. Labels for parts stored in clear re-sealable plastic bags may be placed inside the bag. Label shall face out and be able to be read from one side. Multiple bags shall be numbered individually for identification.
F. Label the outside of large containers with the trade name (Plumbing, Electrical, etc).

3.3. INVENTORY

A. All contractors shall provide the GC with complete inventories of all spare parts, special tools, special materials, and attic stock that they are providing at the end of the contract. The inventories shall be organized as follows:
   1. The cover sheet shall indicate the Contractors name, address, phone number, identify that the document is the “Spare Parts and Extra Materials Inventory”, and identify the Division or Trade the inventory is for.
   2. Provide an inventory in a tabular format of all items being provided under this and other specifications. The minimum information to be provided for each item on the inventory shall be as follows:
      a. Bag or container number, all items of one bag or container shall be grouped together on the inventory
      b. Item description
      c. Item size (if applicable)
      d. Total quantity provided
      e. Identify if item is a spare part, tool, special material, or attic stock
B. The GC shall consolidate inventories from all sub-contractors into one tabular data sheet organized by Division or Trade of Work.
   1. Upon completing the consolidated list the GC shall upload the completed inventory to the Contract Closeout-Attic Stock Library on the Project Management Web Site.
   2. The GC shall notify the Project Architect and City Project Manager that the scans have been uploaded.
   3. Consulting Staff and Owner Staff shall review the inventories prior to Final Review to verify that minimum required quantities have been met. Deficiencies shall be noted and returned back to the GC for corrective action.

3.4. STORAGE

A. Prior to the 80% Progress Payment milestone the GC shall coordinate with the City Project Manager and Maintenance Personnel where spare parts, special tools, special materials, and attic stock shall be stored.

B. The GC shall instruct all contractors as to the location and proper storage procedures.

C. The GC shall be responsible for ensuring the storage area is kept neat and orderly as follows:

1. Like items are stored together by material, product, or trade as necessary.
2. Liquids are stored in sealable containers and the lids have been properly installed to prevent drying out, spillage, etc.
3. All labels are clearly visible and provide the required information.

D. Large items shall be stored so as not to damage other items. Do not stack heavy items or items with distinct shapes/outlines on softer items that may get crushed or imprinted.

3.5. CLOSEOUT PROCEDURE

A. Prior to the 90% Progress Payment milestone the GC shall review all attic stock already stored by the contractors to ensure the following:

1. Materials are stored in the proper location(s).
2. All boxes, containers and items are properly labeled according to the submitted/approved inventory.
3. Quantities are correct according to the submitted/approved inventory.

B. The GC shall ensure that all deficiencies are corrected prior to conducting Demonstration and Training Sessions.

C. The GC shall review with Maintenance Staff all inventories and labeling during the scheduled Demonstration and Training Sessions.

D. Any discrepancies associated with Attic Stock shall be resolved and verified prior to the CPM releasing the 90% CT progress payment.

END OF SECTION

SECTION 01 79 00
DEMONSTRATION AND TRAINING

PART 1 – GENERAL

1.1. SUMMARY

A. The purpose of this specification is to provide clear responsibilities and guidelines related to providing Demonstration and Training (D&T) Sessions related to general facility use, equipment, systems, finishes, and materials to City of Madison Staff (Owner, Owner Representatives, Maintenance, and Custodial Personnel) as needed.

B. All D&T shall be coordinated through the General Contractor (GC), Project Architect (PA) and City Project Manager (CPM), and will be based on or customized to the needs of City of Madison Staff being trained. New equipment and systems may have complete D&T sessions as described in this specification while equipment or systems staff is familiar with may have sessions more focused on maintenance only.

1.2. RELATED SPECIFICATIONS

A. Section 01 29 76 Progress Payment Procedures
B. Section 01 78 13 Completion and Correction List
C. Section 01 78 19 Maintenance Contracts
D. Section 01 78 23 Operation and Maintenance Data
E. Section 01 78 36 Warranties
F. Section 01 78 39 As-Built Drawings
G. Section 01 78 43 Spare Parts and Extra Materials
H Section 01 91 00 Commissioning
I. Other Divisions and Specifications that may address more specifically the requirements for D&T sessions related to the installation of all items and equipment installed under the execution of the Work.

1.3. QUALITY ASSURANCE

A. All contractors shall have the responsibility of preparing for and conducting D&T sessions as determined by this and other Division or Trade related specifications, Owner Operation and Maintenance Manuals, and other such documentation related to the Work.

B. The GC shall have responsibility for:

1. Ensuring that all contractors required to conduct a D&T session have successfully completed all of the following:
    a. Turned in all required documentation for review and documentation has been approved/accepted prior to scheduling D&T sessions.
    b. Other required documentation as needed is available and ready for use during the D&T session.
    c. All systems have been started, tested, and running as per appropriate specification and/or manufacturers recommendations prior to scheduling D&T sessions.
    d. All contractors are sufficiently prepared for their D&T session
    e. Documents the D&T session including date, time, contractor and company name, attendees and other information regarding the session
2. Organizing the coordination and scheduling of all D&T sessions between all contractors and the appropriate representatives of the Owner. These representatives may include any of the following depending on the Work of the Contract:

a. Owner – end users
b. Facility Maintenance personnel
   i. Facility general operation procedures including custodial services
   ii. Electrical
   iii. Mechanical
   iv. Plumbing
   v. Site
c. Information Technology (IT) Department
d. Traffic Engineering – Radio Shop
e. Architects, Engineers and Facility Management staff as project completion overview

PART 2 – PRODUCTS – THIS SECTION NOT USED

PART 3 - EXECUTION

3.1. GENERAL REQUIREMENTS

A. The GC shall develop a specific D&T plan to be scheduled and conducted as described below but no sooner than the meeting discussed in 3.2.A.2 below.

C. The GC shall not schedule D&T sessions to preclude required personnel from attending multiple sessions.

3.2. COORDINATING AND SCHEDULING THE TRAINING

A. The GC, PA, CxA and CPM, shall review all Training and Demonstration requirements during two (2) special meetings.
   1. The first meeting shall be held at the 50% Contract Total Payment. During this meeting the following shall be discussed:
      a. Preliminary schedule of training dates to be completed prior to beginning construction closeout.
      b. List of documentation and items that need to be completed and available before and during the training session.
      c. Who (Owner, Maintenance, etc) will be attending what training session(s).
   2. The second meeting shall be held at the 80% Contract Total Payment. This meeting shall review due outs that have not yet been completed for the 90% Contract Total Payment and the requirements necessary for Construction Closeout. All Demonstration and Training sessions shall be completed prior to receiving the 90% progress payment and beginning Construction Closeout Procedures (see Specification 01 77 00).
      a. This does not include any requirement associated with off season equipment preparation and/or demonstration and Training Sessions.

B. All of the Construction Work shall be operationally ready prior to conducting training as follows:
   1. All contractors shall have their As-Built Drawing Records available for reviewing locations of system components during training.
   2. All <u>final and approved</u> Operations and Maintenance Data shall be completed no less than two (2) full weeks prior to the scheduled training.
   3. All systems shall have been started, functionally tested, balanced, and fully operational, and all piping and equipment labeling complete at least two (2) days prior to the scheduled training.
      a. Seasonal equipment shall not be trained out of season. Contractors having seasonal equipment shall work with the GC and CPM for coordinating additional training sessions as appropriate for seasonal equipment.

C. Correction list items that prevent a piece of equipment or system from being fully operational for training shall be corrected prior to conducting the training.

3.3. TRAINING OBJECTIVES

A. For each piece of equipment or system installed train on the following objectives/topics as applicable:
   1. System design, concept, and capabilities
   2. Review of related contractor as-built drawings
   3. Facility walkthrough to identify key components of the system
   4. System operation and programming including weekly, monthly, annual test procedures
   5. System maintenance requirements
   6. System troubleshooting procedures
   7. Testing, inspection, and reporting requirements associated with any regulatory requirements
   8. Identification of any correction list items still outstanding

9. Review of system documentation including the following:
    a. Operation and maintenance data
    b. Warranties
    c. Valve charts, tags, and pipe identification markers

B. For each piece of specialty equipment train on the following objectives/topics as applicable:
1. Manufacturers operations instructions
2. Manufacturers use and care instructions
3. Manufacturers maintenance and troubleshooting instructions
4. System operation and programming including weekly, monthly, annual test procedures
5. Identification of any correction list items still outstanding
6. Review of system documentation including the following:
    a. Operation and maintenance data
    b. Warranties

C. End User Orientation
1. Facility walkthrough
2. Security and emergency features
3. General facility operation procedures

D. Facility General Use and Custodial Services – if requested
1. Facility walkthrough
2. Security and emergency features
3. General facility operation procedures
4. Care and maintenance of specialty items, finishes, etc as requested
5. Attic stock inventory and material designations

3.4. DEMONSTRATION AND TRAINING PROGRAM PREPARATION

A. Each contractor having a responsibility for providing D&T sessions shall meet with the GC, CPM, and other City Staff as needed to review the extent of the Training Objectives in section 3.3 above needed for each piece of equipment, system, finish, etc. This meeting shall occur no less than four (4) weeks prior to the anticipated training session.

B. The contractor shall use the information from item 3.4.A above to prepare a formal training program for each piece of equipment or system based on the Training Objectives in 3.3 above.
1. The formal training program shall include the following information:
    a. Session title
    b. List of systems, equipment, use, care, etc to be covered during the session
    c. Provide the following for each systems, equipment, use, care, etc to be covered during the session
        i. Name and affiliation of each instructor to be used. As needed and discretion of the Owner the GC to require attendance by the installing technician, installing Contractor and the appropriate trade or manufacturer's representative.
        ii. Qualifications of each instructor to be used. Practical building operation expertise as well as in-depth knowledge of all modes of operation of the specific piece of equipment as installed in this project is required by the training personnel. If Owner determines training was not adequate, the training shall be repeated until acceptable to Owner.
        iii. A checklist of all documentation and system/equipment requirements necessary to complete a successful training session and the current status of each
        iv. Any additional documents, training aids, video or other items to be used to complete the training
        v. Any special requirements or needs associated with item iv above to complete the training
    d. The intended audience for the training
    e. The approximate duration of each objective or topic to be covered
2. Submit the completed training program to the GC for review and approval by the PA and CPM.

C. The PA and CPM shall work with staff as necessary to ensure all points of anticipated training needs have been met. The PA and CPM will approve the program as submitted or recommend changes for re-submittal as necessary.

3.5. CONDUCTING A DEMONSTRATION AND TRAINING SESSION

A. All contractors shall conduct their required D&T Sessions as follows:
1. Begin with a classroom session
    a. Provide a sign in sheet indicating all training to be conducted, instructors, etc.

b. Provide an overview of the training to be conducted including the approximate schedule.

2. Conduct a general walk-through of the site.
   a. Point out locations of various equipment, valves, charts, and other related items.
   b. Use the Division or Trade As-Built record drawings to indicate locations of hidden or buried items.
3. Provide a demonstration of general equipment/system operation including using the O&M manual.
   a. Startup and shutdown procedures.
   b. Normal operational levels as depicted by any gauges, software, etc.
   c. Indicate warning devices, signs etc. and demonstrate emergency shut-down procedures.
4. Provide a demonstration of all owner level maintenance using the O&M manual.
   a. Indicate frequency of maintenance.
   b. Provide and review all spare parts, special tools, and special materials.
5. Provide and review all spare parts, special tools, special materials, or attic stock as applicable.
6. While conducting D&T sessions:
   a. Allow hands on training whenever practical.
   b. Answer questions promptly
   c. Repeat demonstrations and procedures as necessary.

B. Within two (2) working days of completing the D&T session the contractor responsible for the session shall turn-in any documentation generated including the sign in roster to the GC.

C. The GC shall turn over all training documentation to the PA and CPM upon completion of D&T sessions.

D. Re-schedule any training that has been determined to be inadequate or inappropriate for any reason including but not limited to any of the following;
   1. Unqualified instructor
   2. System installation incomplete or untested to the specifications
   3. Equipment failure during demonstration
   4. Un-expected cancellation

3.6. CLOSEOUT PROCEDURE

A. Prior to receiving the 90% Progress payment the GC shall:
   1. Verify with the PA and CPM that each Demonstration and Training Session was conducted properly and according to the submitted plan.
   2. Any required “Off Season” equipment testing, balancing, and Demonstration and Training Sessions have been tentatively scheduled with the GC, necessary sub-contractors, instructors and Owner/Owner Representatives as necessary.

END OF SECTION

SECTION 01 81 13
SUSTAINABLE DESIGN REQUIREMENTS – LEED FOR NEW CONSTRUCTION V3

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Comply with Wisconsin Commercial Building Codes/International Building Code (IBC).

C. Comply with Americans with Disabilities Architectural Guidelines, and ICC/ANSI A117.1-Latest Edition.

D. Comply with USGBC LEED prerequisites and credits needed for Project to obtain "LEED Silver certification based on USGBC's LEED 2009 for New Construction and Major Renovations".

1.2 SUMMARY

A. Section includes general requirements and procedures for compliance with certain USGBC LEED prerequisites and credits needed for Project to obtain "LEED Silver certification based on USGBC's LEED-NC (New Construction and Major Renovations)" Version 3.0.

1. Other LEED prerequisites and credits needed to obtain LEED certification depend on product selections and may not be specifically identified as LEED requirements. Compliance with requirements needed to obtain LEED prerequisites and credits may be used as one criterion to evaluate substitution requests and comparable product requests.
2. Additional LEED prerequisites and credits needed to obtain the indicated LEED certification depend on Architect's design and other aspects of Project that are not part of the Work of the Contract.
3. A copy of the LEED Project checklist is attached at the end of this Section for information only.
4. Specific requirements for LEED are included in greater detail in other Sections.

B. Related Sections: Divisions 01 through 32 Sections for LEED requirements specific to the work of each of these Sections. Requirements may or may not include reference to LEED.

1.3 DEFINITIONS

A. Albedo (a.k.a. solar reflectance): The ratio of the reflected electromagnetic energy to the incoming electromagnetic energy.

B. Chain-of-Custody Certificates: Certificates signed by manufacturers certifying that wood used to make products was obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship." Certificates shall include evidence that manufacturer is certified for chain of custody by an FSC-accredited certification body.

C. Emissivity (a.k.a. infrared emittance): A parameter between 0 and 1 that indicates the ability of a material to shed infrared radiation.

D. LEED: Leadership in Energy and Environmental Design. Green Building Rating System representing the US Green Building Council's effort to provide a national standard for what constitutes a "green building". The standard requires quantitative and technical documentation to demonstrate compliance with goals described in the US Green Building Council's Green Building Rating System, Version 3.0.

E. Hydrofluorocarbons (HFCs): Refrigerants used in building equipment that do not deplete the stratospheric ozone layer.

F. Locally-Manufactured (for LEED™ Materials Credit 5): Refers to the final assembly of components into the building product that is furnished and installed by the trades people. For example, if the hardware comes from Seoul, South Korea, the lumber from Vancouver, British Columbia, and the joist is assembled in Kent Washington, then the location of the final assembly is Kent, Washington.

G. Post-Consumer Recycled Content: The percentage of waste material by weight available from consumer use incorporated into a building material.

H. Pre-consumer (aka Post-Industrial Recycled) Content: The percentage of waste material by weight available from industrial use incorporated into a building material. Post-industrial recyclable materials are different from industrial scrap, a by-product of industrial processes that can easily be reused as a feedstock.

I. Potable Water: Water that is suitable for drinking and is supplied from wells or municipal water systems.

J. Recycling: The collection, reprocessing, marketing and use of materials that were recovered or diverted from the solid waste stream. Note that LEED uses the term "pre-consumer" rather than "post-industrial." Also note that when manufacturers and trade associations use the term "post- industrial" it often includes spills, scraps, and damaged and surplus materials that are fed back into the same manufacturing process and that these materials are not considered recycled content by the LEED rating systems.

K. Recycled Content: The recycled content value of a material assembly shall be determined by weight. The recycled fraction of the assembly is then multiplied by the cost of assembly to determine the recycled content value.

L. "Post-consumer" material is defined as waste material generated by households or by commercial, industrial, and institutional facilities in their role as end users of the product, which can no longer be used for its intended purpose.

M. "Pre-consumer" material is defined as material diverted from the waste stream during the manufacturing process. Excluded is reutilization of materials such as rework, regrind, or scrap generated in a process and capable of being reclaimed within the same process that generated it.

N. Regional Materials: Materials that have been extracted, harvested, or recovered, as well as manufactured, within 500 miles of Project site. If only a fraction of a product or material is extracted/harvested/recovered and manufactured locally, then only that percentage (by weight) shall contribute to the regional value.

O. Regionally Manufactured Materials: Materials that are manufactured within a radius of 500 miles from Project site. Manufacturing refers to the final assembly of components into the building product that is installed at Project site.

P. Regionally Extracted and Manufactured Materials: Regionally manufactured materials made from raw materials that are extracted, harvested, or recovered within a radius of 500 miles from Project site.

Q. Solar Reflectance: See "Albedo."

R. Sustainable Forestry: The practice of managing forest resources to meet the long-term product needs of humans while maintaining the biodiversity of forested landscapes. The primary goal is to restore, enhance, and sustain a full range of forest values, both economic and ecological.

S. Type A Finishes: Material and finishes with potential for short-term levels of off gassing from chemicals inherent in their manufacturing process, or which are applied in form requiring vehicles or carriers for spreading which release high level of particulate matter in process of installation and/or curing. Including, but not limited to:

1. Composite wood products, specifically including particleboard from which millwork, wood paneling, doors, or furniture may be fabricated.
2. Adhesives, sealants, and glazing compounds, specifically those with petrochemical vehicles or carriers.
3. Wood preservatives, finishes, and paint.

4. Control and/or expansion joint fillers.
5. Hard finishes requiring adhesive installation.
6. Gypsum board and associated finish processes.

T. Type B Finishes: Fuzzy material and finishes which are woven, fibrous, or porous in nature and tend to adsorb chemicals off-gassed by Type A finishes or may be adversely affected by particulates. These materials become "sink" for deleterious substances which may be released much later, or collectors of contaminants that may promote subsequent bacterial growth. Including, but not limited to:
1. Carpeting and padding.
2. Fabric wallcovering.
3. Insulation exposed to air stream.
4. Acoustic ceiling materials.
5. Fabric covered acoustic wall panels.
6. Upholstered furnishings.
7. Materials that can be categorized as both Type A and Type B.

U. Ventilation: The process of supplying and removing air to and from interior spaces by natural or mechanical means.

V. Volatile organic compounds (VOCs): Chemical compounds based on carbon and hydrogen structures that are vaporized at room temperatures. VOCs are one type of indoor air contaminant.

W. Waste Materials: Large and small pieces of materials indicated which are excess to contract requirements and generally include materials salvaged from existing construction and items of trimmings, cuttings, and damaged goods resulting from new installations which cannot be effectively used in Work.

X. LEED Project Administrator: LEED Certified Professional hired by the project owner to review LEED submittals.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Respond to questions and requests from Architect and the USGBC regarding LEED credits that are the responsibility of the Contractor, that depend on product selection or product qualities, or that depend on Contractor's procedures until the USGBC has made its determination on the project's LEED certification application. Document responses as informational submittals.

1.5 ACTION SUBMITTALS

A. General: Submit additional LEED submittals required by other Specification Sections.

B. LEED submittals are in addition to other submittals. If submitted item is identical to that submitted to comply with other requirements, submit duplicate copies as a separate submittal to verify compliance with indicated LEED requirements.

C. LEED Submittals: Submit LEED related information under a separate Tab within each product submittal. The LEED submittal shall include:
1. Summary Sheet: A summary, on General Contractors letterhead, of all LEED information requested in specifications shall include:
   a. Project name.
   b. LEED Submittal List: A list of all materials being submitted. For products com- posed of multiple materials the submittal shall include a list of all materials composing the product.
   c. For Products in Divisions 2 - 10, include the following information:
      i. Material costs, for each material on the LEED submittal list, excluding labor costs, delivery cost, cost of installation, as well as profit and overhead.
      ii. The preconsumer and post-consumer recycled content of each material on the LEED submittal list.
      iii. List of all material manufacturing locations.
      iv. Provide distance between manufacturing and construction site.
   d. All other LEED information required in specification.
2. Manufacturer's literature with information highlighted that confirm the figures used in the summary report.
   a. If a range is used in the manufacturer's literature, the summary report shall use the lowest number in the range.
   b. For VOC Submissions: Submit MSDS sheets or manufacturer's literature with VOC figure highlighted.

D. Project Material Costs Data: Provide a statement, on Contractor's letterhead, documenting the total material for the project. Include a spreadsheet tallying the material cost for all materials specified in Divisions 2 - 32. The

total in the material cost data will be used in the LEED Online template to be completed by the Contractor as the actual material cost of the project.

E. LEED Action Plan: Provide preliminary submittal within 30 days of Notice to Proceed that contains:
   1. Example spreadsheets for each construction credit identified in this section.
   2. Contact information for Contractor's LEED coordinators.
   3. Brief description of how the following requirements will be met.
      a. Credit SS Prerequisite 1: Construction Activities Pollution Prevention complying with Section 31 25 00, Erosion Control.
      b. Credit MR c2: Construction Waste Management complying with Section 01 74 19 Construction Waste Management and Disposal. Include a sample spreadsheet showing how the tipping information is going to be recorded to comply with LEED requirements.
      c. Credit MR c4: Recycled content information including methods of collection and recording.
      d. Credit MR c5: Manufacturing location information including methods of collection and recording.
      e. Credit MR c6: Rapidly renewable materials information including methods of collection recording.
      f. Credit MR c7: Certified wood product incorporated into the construction of the facility and a description of how certified wood information, including the chain-of-custody letters are going to be collected and recorded.
      g. EQ c4.1 – 4.4: VOC information including methods of collection and recording required LEED information.
   4. After CPM approval of the Preliminary Action Plan the Contractor shall update the plan monthly with LEED information collected to date and be submitted as part of a monthly progress report.

F. LEED Progress Reports: Concurrent with each Application for Payment, submit reports comparing the actual construction and purchasing activities with LEED requirements for the following:
   1. Credit SS Prerequisite 1: Construction Activities Pollution Prevention.
   2. Credit MR c2: Construction Waste Management.
   3. Credit MR c4: Recycled content for materials specified in Divisions 2 - 32.
   4. Credit MR c5 Regional Materials: Distance to manufacturing for materials specified in Divisions 2 - 32.
   5. Credit MR c6: Rapidly Renewable Materials: Content and cost for materials specified in Divisions 2- 32.
   6. Credit MR c7: Certified wood products including the chain-of-custody letters identifying the forest of origin.
   7. IEQ c4.1 – 4.4: VOC information.

G. LEED Documentation Online Submittals: The Contractor shall be responsible for completing the following LEED submissions using the LEED online tool for credit submission to USGBC. The LEED Project Administrator will determine if the information prepared by the Contractor is satisfactory for USGBC submission.
   1. Credit EA 5: Product data and wiring diagrams for sensors and data collection system used to provide continuous metering of building energy-consumption performance over a period of time of not less than one year of post-construction occupancy.
   2. Credit MR 2: Comply with Division 1 Section "Construction Waste Management and Disposal."
   3. Credit MR 4: Product data and certification letter from product manufacturers indicating percentages by weight of post-consumer and pre-consumer recycled content for products having recycled content. Include statement indicating material costs for each product having recycled content.
   4. Credit MR 5: Product data for regional materials indicating location and distance from Project of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating cost for each regional material and the fraction by weight that is considered regional.
   5. Credit MR 7: Product data and chain-of-custody certificates for products containing certified wood. Include statement indicating cost for each certified wood product.
   6. Credit IEQ 3.1:
      1. Construction indoor-air-quality management plan.
      2. Product data for temporary filtration media.
      3. Product data for filtration media used during occupancy.
      4. Construction Documentation: Six photographs at three different times during the construction period, along with a brief description of the SMACNA approach employed, documenting implementation of the indoor-air-quality management measures, such as protection of ducts and on-site stored or installed absorptive materials.
   7. Credit IEQ 3.2: Construction IAQ Plan: Before Occupancy.
      1. Signed statement describing the building air flush-out procedures including the dates when flush-out was begun and completed and statement that filtration media was replaced after flush-out.

2. Report from testing and inspecting agency indicating results of indoor-air- quality testing and documentation showing compliance with indoor-air-quality testing procedures and requirements.
8. Credit IEQ 4.1: Product data for adhesives and sealants used inside the weatherproofing system indicating VOC content of each product used. Indicate VOC content in g/L calculated according to 40 CFR 59, Subject D (EPA Method 24).
9. Credit IEQ 4.2: Product data for paints and coatings used inside the weatherproofing system indicating VOC content of each product used. Indicate VOC content in g/L calculated according to 40 CFR 59, Subject D (EPA Method 24).
10. Credit IEQ 4.4: Product data for products containing composite wood or agrifiber products or wood glues indicating that they do not contain urea-formaldehyde resin.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For LEED coordinator.
B. Project Materials Cost Data: Provide statement indicating total cost for materials used for Project. Costs exclude labor, overhead, and profit. Include breakout of costs for the following categories of items:
1. Furniture.
2. Plumbing.
3. Mechanical.
4. Electrical.
5. Specialty items such as elevators and equipment.
6. Wood-based construction materials.
C. LEED Action Plans: Provide preliminary submittals within 30 days of date established for the Notice of Award indicating how the following requirements will be met:
1. Credit MR 2: Waste management plan complying with Section 01 74 19 "Construction Waste Management and Disposal."
2. Credit MR 4: List of proposed materials with recycled content. Indicate cost, post- consumer recycled content, and pre-consumer recycled content for each product having recycled content.
3. Credit MR 5: List of proposed regional materials. Identify each regional material, including its source, cost, and the fraction by weight that is considered regional.
4. Credit MR 7: List of proposed certified wood products. Indicate each product containing certified wood, including its source and cost of certified wood products.
5. Credit IEQ 3.1: Construction indoor-air-quality management plan.
D. LEED Progress Reports: Concurrent with each Application for Payment, submit reports comparing actual construction and purchasing activities with LEED action plans for the following:
1. Credit MR 2: Waste reduction progress reports complying with Section 01 74 19 "Construction Waste Management and Disposal."
2. Credit MR 4: Recycled content.
3. Credit MR 5: Regional materials.
4. Credit MR 7: Certified wood products.

1.7 QUALITY ASSURANCE

A. LEED Coordinator: Engage an experienced LEED-Accredited Professional to coordinate LEED requirements. LEED coordinator may also serve as waste management coordinator.

1.8 CONTRACTOR RESPONSIBILITIES

A. This project has been registered with USGBC. The Contractor shall provide all necessary documentation for LEED v3.0 certification in accordance with the specifications. Format and content of all construction documentation must be in accordance with the LEED Reference Guide requirements for supporting data required in event of USGBC audit of the particular credit. Con- tractor is required to coordinate all requirements to assure assembled data is acceptable to USGBC and respond to USGBC requests for additional construction data in the course of preparing the project for certification.

PART 2 – PRODUCTS

2.1 MATERIALS, GENERAL

A. Provide products and procedures necessary to obtain LEED credits required in this Section. Although other Sections may specify some requirements that contribute to LEED credits, the Contractor shall determine additional materials and procedures necessary to obtain LEED credits indicated.

2.2 RECYCLED CONTENT OF MATERIALS

A. Credit MR 4.1: Building materials shall have recycled content such that post-consumer recycled content plus one-half of pre-consumer recycled content constitutes a minimum of [10] percent of cost of materials used for Project.

1. Cost of post-consumer recycled content plus one-half of pre-consumer recycled content of an item shall be determined by dividing weight of post-comsumer recycled comtent plus one-half of pre-consumer recycled content in the item by total weight of the item and multiplying by cost of the item.
2. Cost of post-consumer recycled content plus one-half of pre-consumer recycled content of an item shall be determined by dividing weight of post-consumer recycled content plus one-half of pre-consumer recycled content in the item by total weight of the item and multiplying by cost of the item.
3. Do not include plumbing, mechanical and electrical components, and specialty items such as elevators and equipment in the calculation.

2.3 REGIONAL MATERIALS

A. Credit MR 5: Provide a minimum of 10 percent of building materials (by cost) that are regional materials.

2.4 RAPIDLY RENEWABLE MATERIALS

A. Credit MR 6: Provide a minimum of 2.5 percent of the building materials (by cost) that are rapidly renewable materials.

2.5 CERTIFIED WOOD

A. Credit MR 7: Not less than 50 percent (by cost) of wood-based materials that are produced from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship."

1. Wood-based materials include, but are not limited to, the following materials when made from wood, engineered wood products, or wood-based panel products:
   a. Rough carpentry.
   b. Miscellaneous carpentry.
   c. Finish carpentry.
   d. Architectural woodwork.

2.6 LOW-EMITTING MATERIALS

A. Credit IEQ 4.1: For field applications that are inside the weatherproofing system, use adhesives and sealants shall comply with the following limits for VOC content limits when calculated according to 40 CFR 59, Subpart D (EPA Method 24):

1. Wood Glues: 30 g/L.
2. Metal to Metal Adhesives: 30 g/L.
3. Adhesives for Porous Materials (Except Wood): 50 g/L.
4. Plastic Foam Adhesives: 50 g/L.
5. Carpet Adhesives: 50 g/L.
6. Carpet Pad Adhesives: 50 g/L.
7. VCT and Asphalt Tile Adhesives: 50 g/L.
8. Cove Base Adhesives: 50 g/L.
9. Gypsum Board and Panel Adhesives: 50 g/L.
10. Rubber Floor Adhesives: 60 g/L.
11. Ceramic Tile Adhesives: 65 g/L.
12. Multipurpose Construction Adhesives: 70 g/L.
13. Contact Adhesive: 80 g/L.
14. Structural Wood Member Adhesive: 140 g/L.
15. Special Purpose Contact Adhesive (contact adhesive that is used to bond melamine covered board, metal, unsupported vinyl, rubber or wood veneer 1/16 inch or less in thickness to any surface): 250 g/L.
16. Top and Trim Adhesive: 250 g/L.
17. ABS Welding Compounds: 325 g/L.
18. CPVC Welding Compounds: 490 g/L.
19. PVC Welding Compounds: 510 g/L.

20. Adhesive Primer for Plastic: 550 g/L.
21. Plastic Cement Welding Compounds: 350 g/L.
22. ABS Welding Compounds: 400 g/L.
23. CPVC Welding Compounds: 490 g/L.
24. PVC Welding Compounds: 510 g/L.
25. Adhesive Primer for Plastic: 650 g/L.
26. Sheet Applied Rubber Lining Adhesive: 850 g/L.
27. Aerosol Adhesive, General Purpose Mist Spray: 65 percent by weight.
28. Aerosol Adhesive, General Purpose Web Spray: 55 percent by weight.
29. Special Purpose Aerosol Adhesive (All Types): 70 percent by weight.
30. Other Adhesives: 250 g/L.
31. Architectural Sealants: 250 g/L.
32. Non-membrane Roof Sealants: 300 g/L.
33. Single-Ply Roof Membrane Sealants: 450 g/L.
34. Other Sealants: 420 g/L.
35. Sealant Primers for Nonporous Substrates: 250 g/L.
36. Sealant Primers for Porous Substrates: 775 g/L.
37. Modified Bituminous Sealant Primers: 500 g/L.
38. Other Sealant Primers: 750 g/L.

B. Credit IEQ 4.2: For field applications that are inside the weatherproofing system, paints and coatings shall comply with the following VOC content limits when calculated according to 40 CFR 59 (EPA method 24):

1. Flat Paints and Coatings: VOC not more than 50 g/L.
2. Nonflat Paints and Coatings: VOC not more than 150 g/L.
3. Dry-Fog Coatings: VOC not more than 400 g/L.
4. Primers, Sealers, and Undercoaters: VOC not more than 200 g/L.
5. Anticorrosive and Antirust Paints Applied to Ferrous Metals: VOC not more than 250 g/L.
6. Zinc-Rich Industrial Maintenance Primers: VOC not more than 340 g/L.
7. Pretreatment Wash Primers: VOC not more than 420 g/L.
8. Clear Wood Finishes, Varnishes: VOC not more than 350 g/L.
9. Clear Wood Finishes, Lacquers: VOC not more than 550 g/L.
10. Floor Coatings: VOC not more than 100 g/L.
11. Shellacs, Clear: VOC not more than 730 g/L.
12. Shellacs, Pigmented: VOC not more than 550 g/L.
13. Stains: VOC not more than 250 g/L.

C. Credit IEQc4.3: All flooring must comply with the following as applicable to the project scope:

1. All carpet and carpet cushion must meet the requirements of the Carpet and Rug Institute Green Label Program.
2. All carpet adhesive must have VOC limit of 50 g/L.
3. All hard surface flooring must meet the requirements of the FloorScore Standard.
4. Concrete, wood, bamboo and cork floor finishes and tile setting adhesives must meet the requirements of South Coast Air Quality Management District (SCAQMD) Rules 1113 and 1168.

D. Credit IEQc4.4: Do not use composite wood, agrifiber products or adhesives that contain urea- formaldehyde resin. FF & E are not included. Products include:

1. Panel substrates
2. Door cores
3. Strawboard
4. Wheatboard
5. Plywood
6. Medium density fiberboard (MDF)
7. Particleboard

PART 3 – EXECUTION

3.1 CONSTRUCTION ACTIVITIES POLLUTION PREVENTION

A. SS Prerequisite 1 Construction Activities Pollution Prevention:
   1. Follow LEED instructions in LEED NCv3.0 Reference Guide and complying with Section 31 25 00, Erosion Control.
   2. Contractor is responsible for completing the LEED online credit template and attaching the following information to the template:
      a. Provide record of compliance with Erosion and Sediment Control Plan:
         i. Monthly photographs of barriers and containment.
         ii. Monthly photographs of dust control measures
         iii. Records of inspections by agency in charge of overseeing compliance.
   3. The LEED Project Administrator will determine if the information prepared by the Contractor is satisfactory for USGBC submission.

3.2 CONSTRUCTION WASTE MANAGEMENT

A. Credit MRc2: Comply with Division 1 Section "Construction Waste Management and Disposal".
   1. Contractor is responsible for completing the LEED online credit template. Attached documentation in support of the credit shall include:
      a. Monthly photographs of waste recycling sorting area including:
         i. Debris control fencing.
         ii. Signage clearly identifying the containers content.
      b. Spreadsheet containing the following information:
         i. Diverted materials description.
         ii. Diverted materials/waste hauler name.
         iii. Date of each haul.
         iv. Quantity of material in each haul.
      c. Copies of recycling vender and waste hauler tipping receipts.
   2. The LEED Project Administrator will determine if the information prepared by the Contractor is satisfactory for USGBC submission.

3.3 RECYCLED CONTENT OF BUILDING MATERIALS

A. Credit MRc4: Recycled Content:
   1. Follow LEED instructions in LEED NCv3.0 Reference Guide.
   2. Provide record showing the preconsumer and post-consumer recycled content of all materials specified in Divisions 2 - 32.
   3. Contractor is responsible for completing the LEED online credit template and attaching the following information to the template:
      a. Spreadsheet containing the following information:
         i. The description of each materials in each product specified in Divisions 2 - 32.
         ii. Material manufacturer's name.
         iii. Material cost.
         iv. Percent preconsumer recycled content of each material.
         v. Percent post-consumer recycled content of each material.
         vi. Recycled content information source.
      b. Copies of vendors literatures or a statement from vendors on vendor's letterhead confirming the figures used in the spreadsheet.
   4. The LEED Project Administrator will determine if the information prepared by the Contractor is satisfactory for USGBC submission.

3.4 REGIONAL MATERIALS

A. Credit MRc5: Regional Materials:
   1. Follow LEED instructions in LEED NCv3.0 Reference Guide.
   2. Provide record showing the manufacturing location for all materials specified in Divisions 2 - 32.
   3. Contractor is responsible for completing the LEED online credit application and attaching the following information to the application:
      a. Copies of vendors literatures or a statement from vendors on vendor's letterhead confirming the figures used in the spreadsheet.
   4. The LEED Project Administrator will determine if the information prepared by the Contractor is satisfactory for USGBC submission.

3.5 RAPIDLY RENEWABLE MATERIALS

A. Credit MRc6: Rapidly Renewable Materials:
   1. Follow LEED instructions in LEED NCv3.0 Reference Guide.
   2. Provide record showing the cost for all rapidly renewable materials specified in Divisions 2 - 32.
   3. Contractor is responsible for completing the LEED online credit application and attaching the following information to the application:
      a. Spreadsheet containing the following information:
         i. The description of each materials in each product specified in Divisions 2 - 32.
         ii. Material manufacturer's name.
         iii. Material cost.
         iv. Percent rapidly renewable.
      b. Copies of vendors literatures or a statement from vendors on vendor's letterhead confirming the figures used in the spreadsheet.
   4. The LEED Project Administrator will determine if the information prepared by the Contractor is satisfactory for USGBC submission.

3.6 CERTIFIED WOOD

A. Credit MRc7 Certified Wood:
   1. Follow LEED instructions in LEED NCv3.0 Reference Guide to comply with Credit MRc7 requirements for certified wood installed in construction.
   2. Contractor is responsible for completing the LEED online credit template and attaching the following information to the template:
      a. Copies of vendors literatures or a statement from vendors on vendor's letterhead confirming the figures used in the LEED Online Certified Wood Materials Calculator spreadsheet.
      b. Copies of the chain-of-custody documentation received from vendors on vendors.
   3. The LEED Project Administrator will determine if the information prepared by the Contractor is satisfactory for USGBC submission.

3.7 CONSTRUCTION INDOOR-AIR-QUALITY MANAGEMENT

A. Credit IEQc3.1: Comply with SMACNA's "SMACNA IAQ Guideline for Occupied Buildings under Construction."
   1. If Owner authorizes use of permanent heating, cooling, and ventilating systems during construction period as specified in Division 1 Section "Temporary Facilities and Controls", install filter media having a MERV 8 according to ASHRAE 52.2 at each return-air inlet for the air-handling system used during construction.
   2. Replace all air filters immediately prior to occupancy.
   3. Provide record of compliance with Indoor Air Quality Management Plan:
      a. Monthly photographs of equipment and ductwork protection.
      b. Monthly photographs of filters used to protect air distribution and equipment.
      c. Contractor's report documenting that MERV 8 filters were used to protect equipment during construction and MERV 13 filters were installed prior to occupancy.

B. Credit IEQc3.2: Indoor Air Quality management Plan – Before Occupancy:
   1. After construction ends, prior to occupancy and with all interior finishes installed, perform a building flush-out by supplying a total volume of 14000 cu. ft. of outdoor air per sq. ft. of floor area while maintaining an internal temperature of at least 60 deg F and a relative humidity no higher than 60 percent.
   2. If occupancy is desired prior to flush-out completion, the space may be occupied following delivery of a minimum of 3500 cu. ft. of outdoor air per sq. ft. of floor area to the space. Once a space is occupied, it shall be ventilated at a minimum rate of 0.30 cfm per sq. ft. of outside air or the design minimum outside air rate determined in IEQ Prerequisite 1, whichever is greater. During each day of the flush-out period, ventilation shall begin a minimum of three (3) hours prior to occupancy and continue during occupancy. These conditions shall be maintained until a total of 14000 cu. ft./sq. ft. of outside air has been delivered to the space.
   3. Air-Quality Testing: If the Contractor chooses to test for compliance with LEED Credit IEQc3.2 the following is required:
      a. Conduct baseline indoor-air-quality testing, after construction ends and prior to occupancy, using testing protocols consistent with the EPA's "Compendium of Methods for the Determination of Air

Pollutants in Indoor Air," and as additionally detailed in the USGBC's "Green Building Design and Construction Reference Guide".

b. Demonstrate that the contaminant maximum concentrations listed below are not exceeded:
   i. Formaldehyde: 27 ppb.
   ii. Particulates (PM10): 50 micrograms/cu. m.
   iii. Total Volatile Organic Compounds (TVOC): 500 micrograms/cu. m.
   iv. 4-Phenylcyclohexene (4-PH): 6.5 micrograms/cu. m.
   v. Carbon Monoxide: 9 ppm and no greater than 2 ppm above outdoor levels.

c. For each sampling point where the maximum concentration limits are exceeded, conduct additional flush-out with outside air and retest the specific parameter(s) exceeded to indicate the requirements are achieved. Repeat procedure until all requirements have been met. When retesting non-complying building areas, samples are to be taken from the same locations as the first test.

d. Air-sample testing shall be conducted as follows:
   i. All measurements shall be conducted prior to occupancy but during normal occupied hours and with building ventilation system starting at the normal daily start time and operated at the minimum outside air flow rate for the occupied mode throughout the duration of the air testing.
   ii. Building shall have all interior finishes installed including, but not limited to, millwork, doors, paint, carpet, and acoustic tiles. Non-fixed furnishings such as workstations and partitions are encouraged, but not required to be in place for the testing.
   iii. Number of sampling locations will vary depending on the size of building and number of ventilation systems. For each portion of building served by a separate ventilation system, the number of sampling points shall not be less than one per 25,000 sq. ft. or for each contiguous floor area, whichever is larger, and shall include areas with the least ventilation and greatest presumed source strength.
   iv. Air samples shall be collected between 3 and 6 feet from the floor to represent the breathing zone of occupants, and over a minimum four- hour period.

4. The LEED Project Administrator will determine if the information prepared by the Contractor is satisfactory for USGBC submission.

3.8 LOW EMITTING MATERIALS

A. Credit IEQc4.1 through Credit MRc4.4: Low Emitting Materials:
   1. Follow LEED instructions in LEED NCv3.0 Reference Guide.
   2. Contractor is responsible for completing the LEED online credit template and attaching the following information to the template:
      a. Copies of vendor's literature or MSDS sheets confirming the figures used in the spreadsheet.
   3. The LEED Project Administrator will determine if the information prepared by the Contractor is satisfactory for USGBC submission.

3.9 INDOOR CHAMICAL AND POLLUTANT SOURCE CONTROL

A. Credit IEQc5: Indoor Chemical and Pollutant Source Control:
   1. Install new air filtration media, with a MERV 13 Rating, in regularly occupied areas prior to occupancy.

3.10 SUPPLEMENT

A. The supplements listed below, following "End of Section," is a part of this Specification:
   1. LEED for New Construction v3.0 Registered Project Checklist.
   2. LEED Materials Documentation Submittal Cover Sheet

END OF SECTION

1

LEED v3 for New Construction and Major Renovations
Project Checklist 03-10-17

23	**0**	**0**	**3**		**Sustainable Sites**		Possible	**26**
Y	?Y	?N	N	d/C				
Y				C	Prereq 1	Construction Activity Pollution Prevention		
1				d	Credit 1	Site Selection		1
5				d	Credit 2	Development Density and Community Connectivity		5
			1	d	Credit 3	Brownfield Redevelopment		1
6				d	Credit 4.1	Alternative Transportation—Public Transportation Access		6
1				d	Credit 4.2	Alt Transportation—Bike Storage and Changing Rooms		1
2			**1**	d	Credit 4.3	Alternative Transportation—L.E. and Efficient Vehicles		3
1			**1**	d	Credit 4.4	Alternative Transportation—Parking Capacity		2
1				C	Credit 5.1	Site Development—Protect or Restore Habitat		1
1				d	Credit 5.2	Site Development—Maximize Open Space		1
1				d	Credit 6.1	Stormwater Design—Quantity Control		1
1				d	Credit 6.2	Stormwater Design—Quality Control		1
1				C	Credit 7.1	Heat Island Effect—Non-roof		1
1				d	Credit 7.2	Heat Island Effect—Roof		1
1				d	Credit 8	Light Pollution Reduction		1
6	**0**	**0**	**4**		**Water Efficiency**		Possible Points:	**10**
Y	?Y	?N	N	d/C				
Y				d	Prereq 1	Water Use Reduction—20% Reduction		
4				d	Credit 1	Water Efficient Landscaping		2 to 4
						Reduce by 50%		2
						4 No Potable Water Use for Irrigation		4
			2	d	Credit 2	Innovative Wastewater Technologies		2
2			**2**	d	Credit 3	Water Use Reduction		2 to 4
						2 Reduce by 30%		2
						Reduce by 35%		3
						Reduce by 40%		4
29	**0**	**0**	**6**		**Energy and Atmosphere**		Possible Points:	**35**
Y	?Y	?N	N	d/C				
Y				C	Prereq 1	Fundamental Commissioning of Building Energy Systems		
Y				d	Prereq 2	Minimum Energy Performance		
Y				d	Prereq 3	Fundamental Refrigerant Management		
15			**4**	d	Credit 1	Optimize Energy Performance		1 to 19
						Improve by 12% for New Buildings		1

							Improve by 14% for New Buildings	2
							Improve by 16% for New Buildings	3
							Improve by 18% for New Buildings	4
							Improve by 20% for New Buildings	5
							Improve by 22% for New Buildings	6
							Improve by 24% for New Buildings	7
							Improve by 26% for New Buildings	8
							Improve by 28% for New Buildings	9
							Improve by 30% for New Buildings	10
							Improve by 32% for New Buildings	11
							Improve by 34% for New Buildings	12
							Improve by 36% for New Buildings	13
							Improve by 38% for New Buildings	14
						15	Improve by 40% for New Buildings	15
							Improve by 42% for New Buildings	16
							Improve by 44% for New Buildings	17
							Improve by 46% for New Buildings	18
							Improve by 48%+ for New Buildings	19
7				d	Credit 2	On-Site Renewable Energy		1 to 7
							1% Renewable Energy	1
							3% Renewable Energy	2
							5% Renewable Energy	3
							7% Renewable Energy	4
							9% Renewable Energy	5
							11% Renewable Energy	6
						7	13% Renewable Energy	7
2				C	Credit 3	Enhanced Commissioning		2
2				d	Credit 4	Enhanced Refrigerant Management		2
3				C	Credit 5	Measurement and Verification		3
			2	C	Credit 6	Green Power		2
6	**0**	**0**	**8**	d/C	**Materials and Resources**		Possible Points:	**14**
Y	?Y	?N	N					
Y				d	Prereq 1	Storage and Collection of Recyclables		
			3	C	Credit 1.1	Building Reuse—Maintain Existing Walls, Floors, and Roof		1 to 3
							Reuse 55%	1
							Reuse 75%	2
							Reuse 95%	3
			1	C	Credit 1.2	Building Reuse—Maintain 50% of Interior Non-Structural		1
2				C	Credit 2	Construction Waste Management		1 to 2
							50% Recycled or Salvaged	1

						2	75% Recycled or Salvaged	2
			2	C	Credit 3	Materials Reuse		1 to 2
						1	Reuse 5%	1
						1	Reuse 10%	2
2				C	Credit 4	Recycled Content		1 to 2
						1	10% of Content	1
						1	20% of Content	2
2				C	Credit 5	Regional Materials		1 to 2
						1	10% of Materials	1
						1	20% of Materials	2
			1	C	Credit 6	Rapidly Renewable Materials		1
			1	C	Credit 7	Certified Wood		1
13	**0**	**0**	**2**		**Indoor Environmental Quality**		Possible Points:	**15**
Y	?Y	?N	N	d/C				
Y				d	Prereq 1	Minimum Indoor Air Quality Performance		
Y				d	Prereq 2	Environmental Tobacco Smoke (ETS) Control		
1				d	Credit 1	Outdoor Air Delivery Monitoring		1
			1	d	Credit 2	Increased Ventilation		1
1				C	Credit 3.1	Construction IAQ Management Plan—During Construction		1
1				C	Credit 3.2	Construction IAQ Management Plan—Before Occupancy		1
1				C	Credit 4.1	Low-Emitting Materials—Adhesives and Sealants		1
1				C	Credit 4.2	Low-Emitting Materials—Paints and Coatings		1
1				C	Credit 4.3	Low-Emitting Materials—Flooring Systems		1
1				C	Credit 4.4	Low-Emitting Materials—Composite Wood and Agrifiber		1
1				d	Credit 5	Indoor Chemical and Pollutant Source Control		1
			1	d	Credit 6.1	Controllability of Systems—Lighting		1
1				d	Credit 6.2	Controllability of Systems—Thermal Comfort		1
1				d	Credit 7.1	Thermal Comfort—Design		1
1				d	Credit 7.2	Thermal Comfort—Verification		1
1				d	Credit 8.1	Daylight and Views—Daylight		1
1				d	Credit 8.2	Daylight and Views—Views		1
5	**0**	**0**	**1**		**Innovation and Design Process**		Possible Points:	**6**
Y	?Y	?N	N					
1				d	Credit 1.1	'Innovation in Design: Low Mercury Lighting Plan		1
1				C	Credit 1.2	'Innovation in Design: Green Cleaning		1
1				C	Credit 1.3	Innovation in Design: MRc5: 30% Regional Materials		1
1				d	Credit 1.4	Innovation in Design: Building Education Program		1
			1	d	Credit 1.5	Innovation in Design: EAc1 (50% or better)		1
1				d	Credit 2	LEED Accredited Professional		1

4	**0**	**0**	**0**		**Regional Priority Credits**		Possible Points:	**4**
Y	?Y	?N	N	d/C				
1				d	Credit 1.1	Regional Priority: SSc2		1
1				d	Credit 1.2	Regional Priority: SSc4.2		1
1				d	Credit 1.3	Regional Priority: WEc3 (30%)		1
1				d	Credit 1.4	Regional Priority: EAc2 (1%)		1
86	0	0	24		**Total**		Possible Points:	**110**
Y	?Y	?N	N					

1

LEED MATERIALS DOCUMENTATION SUBMITTAL COVER SHEET
USGBC LEED BD+C v3 RATING SYSTEM

OPN ARCHITECTS

***Instructions to Contractor/Sub-Contractors*:** For each product / material included in your contract, please complete the following information. Use additional submittal sheets as needed. The General Contractor should use the information provided on this sheet in conjunction with the LEED Materials Tracking Excel Spreadsheet (provided by OPN Architects, Inc.) to document all of the materials and products selected and installed in the project.

Project Name: _____ Company: _____

Signed by (print): _____ Signature: _____ Date: _____

Estimated total cost of all products and materials included in your contract: _____

PART ONE

LEED Materials Breakdown (Divisions 3 – 12 and 31 – 33)

Please list the estimated material cost to be charged to the client (excluding any equipment rental, or installation labor costs but including all delivery/shipping costs to the jobsite) for all products / materials included in your contract. The total of all items listed in the chart below must equal the estimated total cost of all products and materials listed above. Attach additional copies of the Cover Sheet if you need more space than provided in the chart below. All information requested in Part One of this Cover Sheet must be received by the architect before your initial pay application will be processed.

Spec. Section	Product / Material	Manufacturer / Vendor	Product Model #	Prod. / Mat. Cost
Total				

1

LEED MATERIALS DOCUMENTATION SUBMITTAL COVER SHEET
USGBC LEED BD+C v3 RATING SYSTEM

OPN ARCHITECTS

Instructions to Contractors/Vendors/Material Suppliers/Installers: For each product or material, please complete the following information in all applicable categories. Use a separate Submittal Cover Sheet for each product or material supplied. Attach cut sheets, letters from manufacturers, and/or other supporting information and **submit with Shop Drawing submittal for review and approval**. The General Contractor should use the information provided on this sheet in conjunction with the Materials Tracking Excel Spreadsheet (provided by OPN Architects, Inc.) to document all of the materials and products selected and installed in the project.

Project Name: _____ Company: _____

Signed by (print): _____ Signature: _____ Date: _____

Product Name: _____ Manufacturer: _____ Division: _____

PART TWO

LEED MR credit 4: Recycled Content (Divisions 3 – 12 and 31 – 33)

Does the material / product contain pre-consumer or post-consumer content? Yes / No / NA

(The information below must correspond with data provided in Part One of this Cover Sheet)

Product / Material Description	Percent pre-consumer	Percent post-consumer

If only select components of a product contain recycled content, see LEED BD+C v.3 Reference Guide for instructions to calculate total product recycled content (based on relative material weights).

❑ *I confirm that appropriate backup documentation has been provided and attached to this Cover Sheet*

LEED MR credit 5: Locally Harvested/Extracted Materials (Divisions 3 – 12 and 31 – 33)

Were the raw materials extracted/harvested and the final product manufactured within 500 miles of the site?

(The information below must correspond with data provided in Part One of this Cover Sheet)

Product / Material	Location of extraction	Distance	Location of manufacture	Distance

If you wish, you may use http://indo.com/distance/ to confirm linear distance (as-a-crow flies) from the project site.

❑ *I confirm that appropriate backup documentation has been provided and attached to this Cover Sheet*

LEED MR credit 7: FSC Certified Wood (Divisions 3 – 12 and 31 – 33)

Does the material/product contain Forest Stewardship Council (FSC) certified wood? Yes / No / NA

(The information below must correspond with data provided in Part One of this Cover Sheet)

Component	% of Material	Chain-of-Custody Certificate #	Cost

❑ *I confirm that appropriate backup documentation has been provided and attached to this Cover Sheet*

LEED EQ credit 4.1: Low-Emitting Materials - Adhesives and Sealants (Anywhere w/in moisture barrier)

Do the adhesives and sealants comply with the LEED BD+C v3 VOC limits? Yes / No / NA

(The information below must correspond with data provided in Part One of this Cover Sheet)

Product Name	Manufacturer	VOC Content (grams / liter)

VOC limits can be found at http://www.usgbc.org/ShowFile.aspx?DocumentID=5546 pages 66 & 67.

❑ *I confirm that appropriate backup documentation has been provided and attached to this Cover Sheet*

LEED EQ credit 4.2: Low-Emitting Materials - Paints and Coatings (Anywhere w/in moisture barrier)

Do the paints and coatings comply with the LEED BD+C v3 VOC limits? Yes / No / NA

(The information below must correspond with data provided in Part One of this Cover Sheet)

Product Name	Manufacturer	VOC Content (grams / liter)

VOC limits can be found at http://www.usgbc.org/ShowFile.aspx?DocumentID=5546 pages 68.

❑ *I confirm that appropriate backup documentation has been provided and attached to this Cover Sheet*

LEED EQ credit 4.3: Low-Emitting Materials – Flooring Systems

Does the carpet meet the Carpet and Rug Institute's Green Label Plus IAQ testing requirements? Yes / No / NA

Does the cushion meet the Green Label IAQ testing requirements? Yes / No / NA

Are carpet adhesives free of VOCs? Yes / No / NA

Do all time setting adhesives and grout meet 2005 SCAQMD VOC limits? Yes / No / NA

Do all concrete, wood, bamboo and cork floor finishes such as sealer, stain and finish met the 2004 SCAQMD requirements? Yes / No / NA

Are all hard-surface flooring products certified as compliant with the FloorScore Standard? Yes / No / NA

(The information below must correspond with data provided in Part One of this Cover Sheet)

Product Name	Manufacturer	CRI Green Label Plus Certification Number	Adhesive VOC Content

❑ *I confirm that appropriate backup documentation has been provided and attached to this Cover Sheet*

VOC limits can be found at http://www.usgbc.org/ShowFile.aspx?DocumentID=5546 pages 69 & 70.

LEED EQ credit 4.4: Low-Emitting Materials - Composite Wood and Agrifiber

Does the material/product contain any added urea-formaldehyde resins? Yes / No / NA

(The information below must correspond with data provided in Part One of this Cover Sheet)

Product/Manufacturer	Yes or No?

❑ *I confirm that appropriate backup documentation has been provided and attached to this Cover Sheet*

VOC limits can be found at http://www.usgbc.org/ShowFile.aspx?DocumentID=5546 pages 71.

SECTION 01 91 00
GENERAL COMMISSIONING REQUIREMENTS

PART 1 – GENERAL

1.01. RELATED DOCUMENTS

A. Owner Program Requirements and Basis of Design

1.02. GENERAL DESCRIPTION

A. Commissioning is the process of verifying and validating that all building systems are installed and perform interactively according to the design intent; that systems are efficient and cost effective to operate and meet the Owner's operational needs; that the installation is adequately documented; and that Operators are adequately trained. It serves as a tool to minimize post-occupancy operational problems. It establishes testing and communication protocols in an effort to advance the building systems from installation to full dynamic operation and optimization.

B. Commissioning Provider shall work with the Contractor and the Engineer to direct and oversee the Commissioning process.

1. Utilize Autodesk BIM-360 collaboration software to maintain an observation log, equipment installation and start-up status.
2. Contractors and subcontractors shall interface with the Cx process using BIM-360 web interface and/or an Apple iPad.
3. Generate a commissioning plan including schedule.
4. Integrate commissioning activities into the general construction schedule.
5. Provide commissioning specifications
6. Lead commissioning kick-off and coordination meetings.
7. Verify that applicable equipment and systems are installed according to the contract documents, manufacturer's recommendation, and industry accepted minimum standards and that they receive adequate operational checkout by the installing contractors.
8. Verify and document test, adjust and balance is complete and accurate.
9. Verify and document proper performance of equipment and systems.

10. Verify that operation and maintenance documentation left onsite is complete.
11. Verify that the owner's operating personnel are adequately trained.
12. Provide a Final Commissioning report.

C. The Commissioning Plan details the commissioning process.

D. The Commissioning process does not take away from or reduce the responsibility of the system designers or installing contractors to provide a finished and fully functional product as defined in the plans and specifications.

E. This Section and other Sections of the specifications detail the Contractor's responsibilities relative to the Commissioning process. It expands on the Commissioning Plan, which covers the roles and responsibilities of all Parties. It also indicates the details of the Functional Performance Testing in which the Contractor must participate.

1.03. SUMMARY

A. Section includes:
1. General requirements that apply to implementation of commissioning without regard to specific systems, assemblies, or components.

B. Specific Equipment/systems to be utilized is “to be determined” (TBD) at this time. At minimum, the following general equipment/systems shall be commissioned:
1. HVAC system and controls.
2. Lighting control system.
3. Domestic hot water system.
4. Metering.

C. References:
1. ASHRAE Standard 202-2013, “The Commissioning Process for Building and Systems”
2. ASHRAE Guideline 0-2013, “The Commissioning Process”
3. ASHRAE Guideline 1.1-2007, " HVAC & R Technical Requirements for the Commissioning Process"
4. ASHRAE Guideline 4-2008, “Preparation of Operating and Maintenance Documentation for HVAC&R Systems”
5. American Society for Testing and Materials (ASTM)
6. BCA - Building Commissioning Association
7. Electronics Industry Association/Telecommunications Industry Association (EIA/TIA)
8. International Building Code (IBC)
9. Illuminating Engineering Society (IES)
10. Institute of Electrical and Electronics Engineers (IEEE)
11. International Electrical Testing Association (NETA)
12. National Electrical Manufacturers Associates (NEMA)
13. National Fire Protection Association (NFPA)
14. NEBB - Procedural Standards for Building Systems Commissioning
15. National Electric Code (NEC)
16. NETA-ATS, Testing Standards
17. Underwriters Laboratory, Inc. (UL)
18. U.S. Green Building Council (USGBC)
19. Washington State Energy Code (WSEC)
20. Washington Sustainable Schools Protocol (WSSP) Fundamental Commissioning
21. WSSP Enhanced Commissioning

D. Related Sections:
1. Section 23 05 93 "Testing, Adjusting and Balancing".
2. Section 23 09 00 " Controls "

1.04. DEFINITIONS

1. Acceptance Phase: This is the phase of the project when the facility and its systems and equipment are inspected, tested, verified, and documented; and when most of the Functional Performance Testing and formal training occurs. This will generally occur after the Construction Phase is complete (start-up and checks have been accomplished). The Acceptance Phase typically begins with Substantial Completion and ends with Functional Completion.
2. A/E: General reference to the Architect/Engineer lead-design entity.
3. Building Automation System (BAS): The computer-based heating, ventilation and air-conditioning (HVAC) control or automation system.

4. BoD: Basis of Design. A document that records concepts, calculations, decisions, and product selections used to meet the OPR and to satisfy applicable regulatory requirements, standards, and guidelines. The document includes both narrative descriptions and lists of individual items that support the design process.
5. Commissioning Plan: A document that outlines the organization, schedule, allocation of resources, and documentation requirements of the commissioning process.
6. Commissioning Authority (CA): The Party retained by the Owner who will oversee the Commissioning process as well as develop and stipulate many of the Commissioning requirements. They will also manage the Commissioning process, and ensure and validate that systems and equipment are designed, installed and tested to meet the Owner's requirements.
7. Commissioning Coordinator (CxC): This refers to the Individual within each of the various Parties that is designated the point of contact for that Party relative to Commissioning activities.
8. Commissioning Portal: This is an internet hub for the collaboration on Commissioning information. This portal will act as a hub for posting electronic information.
9. Commissioning Plan: The Commissioning Plan is a part of the Contract Documents and outlines many of responsibilities, procedures and tasks throughout the Commissioning process. It also describes the Functional Performance Tests that will be performed during the Acceptance Phase. The Contractor must have an understanding of commissioning process and the Contractor requirements within the plan.
10. Commissioning Team (CxT): The group of Parties involved in the commissioning process for any given system. The Commissioning Team will include a core group involved with all systems. This core group will typically include the CA, the Construction Manager's Commissioning Coordinator (CM-CxC), the Owner's Commissioning Coordinator (O/O-CxC) and the General Contractor's Commissioning Coordinator (GC-CxC). On any given system, the Commissioning Team will also include the Commissioning Coordinator for the Contractor(s) responsible for the system or equipment.
11. Contractor: As used herein, 'Contractor' is a general reference to the installing Party and can therefore refer to the General Contractor, subcontractors, or vendors as inferred by its usage. The contractor generally refers to the person or entity who has agreed with the owner to perform work. Whereas the subcontractor is any person other than the contractor who agrees to furnish or furnishes any supplies, material, equipment, or services of any kind in connection with the work.
12. Construction Manager (CM): The Party retained by the Owner to represent the Owner and make decisions on the Owner's behalf throughout the design and construction process.
13. Construction Phase: Phase of the project during which the facility is constructed and/or systems and equipment are installed and started. Contractor and subcontractors complete the installation, complete start-up documentation, submit operation and maintenance information, establish trends, and perform any other applicable requirements to get systems started. Contractor and Vendors may also conduct equipment specific training. The Construction Phase will generally end upon completed start-up and test, adjust and balance of systems and equipment.
14. Deficiency: A condition in the installation or function of a component, piece of equipment or system that is not in compliance with the Contract Documents (that is, does not perform properly or is not complying with the design intent).
15. Engineer: Licensed Professional Engineer that designed and stamped the project reflecting his or her specific area of certification and expertise.
16. Factory Authorized Representative: An individual fully trained on the equipment and certified by the manufacturer to start-up equipment, perform the respective task, and make reports.
17. Factory Testing: Testing of equipment off-site at the manufacturer's facility. The testing may be witnessed by the members of the project team.
18. Factory Start-Up: Start-up of equipment by a Factory Authorized Representative.
19. Functional Performance Testing (FPT): The detailed and thorough testing of building systems and their interactions with building components and other building systems.
20. IAQ: Indoor Air Quality.
21. Installation, Operation and Maintenance (I,O&M) Documentation: This refers to Contractor-developed documentation designed to address the needs of facilities personnel and customized for the context of the specific facility and installation. The foundation of I,O&M Documentation is manufacturer's literature (including 'installation and operational and maintenance manual', parts lists, troubleshooting guides, etc.) as well as Contractor-developed instructions for start-up and shut-down, sequences, and other installation-specific information. I,O&M Documentation content is a subset of the Facility Manual, so it is common for only one or the other to be specified. All documentation shall be submitted to Owner in electronic format. See Division 1, Section 01785 for additional information.

22. Measurement and Verification (M&V): Period after commissioning where systems are trended and analyzed for proper operations and for hitting energy savings requirements. This is a separate service apart from commissioning.
23. Observation Log: This is a list that is maintained and updated by the commissioning provider that includes all Observation Items that relate to Commissioning activities and site observations requiring contractor action or response.
24. OPR: Owner's Project Requirements. A document that details the functional requirements of a project and the expectations of how it will be used and operated. These include Project goals, measurable performance criteria, cost considerations, benchmarks, success criteria, and supporting information.
25. Opposite Season: The season opposite that when the majority of the testing occurs.
26. Installation verification: Preliminary testing accomplished during a scheduled system outage to verify system functionality prior to placing the system/equipment into preliminary service.
27. Start-Up: Refers to the quality control process whereby the Contractor verifies the proper installation of a device or piece of equipment, executes the manufacturer's starting procedures, completes the Start-Up Checklist, energizes the device, verifies that it is in proper working order and ready for dynamic testing, including Start-Up Tests.
28. Systems, Subsystems, Equipment, and Components: Where these terms are used together or separately, they shall mean "as-built" systems, subsystems, equipment, and components.
29. TAB: Can refer to the test, adjust, and balance process or the Testing, Adjusting, and Balancing Contractor.
30. Transition Period: Time period after FPT completed to operate systems to purge the building and stabilize equipment operations. Time is also used by the CA to test system performance.
31. Trending: Monitoring and recording a history of parameters typically using the BAS.
32. Warranty Phase: Includes the early occupancy of the building and can continue through the Warranty Period and at least into the opposite season from when it was initially tested.

1.05. COMMISSIONING TEAM

A. Members Appointed by Contractor(s): Individuals, each having the authority to act on behalf of the entity he or she represents, explicitly organized to implement the commissioning process through coordinated action. The commissioning team shall consist of, but not be limited to, representatives of each Contractor, including Project superintendent and subcontractors, installers, suppliers, and specialists deemed appropriate by the CA.

B. Members Appointed by Owner:
   1. CA: The designated person, company, or entity that plans, schedules, and coordinates the commissioning team to implement the commissioning process. Owner will engage the CA under a separate contract.
   2. Representatives of the facility user and operation and maintenance personnel.
   3. Architect and engineering design professionals.

1.06. OWNER RESPONSIBILITIES

A. Provide the OPR documentation to the CA and Contractor for information and use.

B. Assign operation and maintenance personnel and schedule them to participate in commissioning team activities.

C. Provide the BoD documentation, prepared by Architect and Engineer and approved by Owner, to the CA and Contractor for use in developing the commissioning plan, systems manual, and operation and maintenance training plan.

1.07. COORDINATION MANAGEMENT PROTOCOL

A. Coordination responsibilities and management protocols relative to Commissioning are initially defined below but will be refined and documented in the Commissioning Plan. Contractor shall have input in the protocols and all parties will commit to scheduled obligations. The CA will record and distribute.
   1. Submittals and Shop Drawings: CM shall distribute the submittal log to the CA. CA shall review the submittal log and communicate which submittals need to be forwarded.
   2. CA Review Comments for Shop Drawings: An email reply is sent directly to the CM, A/E, and Owner by the CA. The Owner and A/E will consider and incorporate at their discretion.
   3. Deficiencies Identified by the Commissioning Provider: When the CA identifies a deficiency the CA shall make a good faith assessment of responsible parties. Those parties, as well as the Owner and CM shall be notified of the perceived deficiency. This communication is FOR INFORMATION ONLY and is not a direction to resolve the deficiency or to take any action. Contractor may elect to accept responsibility and resolve the deficiency. If the contractor contests either the deficiency or responsibility for that deficiency, Contractor shall respond to that deficiency indicating disagreement. If responsibility is not

agreed to via the Commissioning dialogue, CM shall issue a work directive or RFI via the normal contractual channels to resolve the issue.

4. Requests for Meetings: In general request by the contractor for a meeting with the CA shall be routed through Owner and CM who will then determine the validity. Note that every attempt should be made to deal with Commissioning issues at regularly scheduled Commissioning Meetings.
5. Control Sequence Modifications: CA shall review the sequences during the design and submittal phases and address any known issues prior to the submittal approval. However, CA and the contractor may incorporate minor changes to the sequence during testing when it is apparent that it improves the control of the equipment but does not fundamentally change the sequence, subject to the approval of the Owner and Engineer. Any and all changes must be thoroughly documented in the record documents.
6. Notification of Completion Milestones: Contractor shall notify the CA, Owner and CM at least one week prior to any anticipated commissioning activity or commissioning milestone (such as FPT). The Owner or CM (as applicable) shall then coordinate the scheduling of the activity between all required parties. Notification shall be via email.
7. Observation Log: CA maintains a categorized Observation Log which tracks the Commissioning related action items. Any party that is copied on an email resulting from an Observation Item posting may respond to it and contribute to the dialogue. CA normally distributes a copy of the current open items on the action list with each site visit report.
8. Start-Up Checklist and Test Documents: Minimum start-up and documentation requirements are listed in the respective sections of the specifications for controls and mechanical commissioning. The Contractor then performs the reviewed and approved Start-Up procedures, completes the documentation and signs, and submits it. CA subsequently spot checks the procedures and documentation during the FPT. They are then included in the Commissioning Record.
9. Functional Performance Test Documents: FPTs are witnessed and documented by the CA but performed by the contractor. They are developed during the construction phase generally after completed submittals. CA drafts and forwards the FPT procedures to the CM to be subsequently distributed to the subcontractors for review by the CM. Contractors review and comment on the procedures. Throughout the Commissioning process, CA maintains a current record of the testing procedures and keeps the documentation up to date and accessible for all to access the current progress. Upon request, the CA will provide an electronic copy of completed functional test procedures at any significant stage of Cx.

B. Coordination Between Testing Parties

1. Factory Start-Ups: For many systems and equipment, Factory Start-Ups are specified. The Contractor is responsible for providing onsite support for the Factory representatives. These Factory Start-Ups will be reviewed and checked during FPT. All costs associated with the Factory Start-Ups are included with the bid unless otherwise noted. Contractor shall make notification of when Factory Start-Ups are occurring and coordinate these with witnessing Parties. The CA and CxT members may witness Factory Start-Ups at their discretion. Aspects of FPT accomplished during the Factory Start-Ups may be accomplished and approved by the CA if they meet the intent of the FPT. It is assumed that the Factory representatives budget the appropriate numbers of trips to support initial start-up, resolving equipment issues, TAB and training.
2. Independent Testing Agencies and Special Inspectors: For systems where contractor's independent testing agencies or special inspectors are specified, the cost of this testing is included with the bid unless otherwise noted. Much of the testing performed by these independent agencies or special inspectors will cover aspects required in the Start-Up Procedures and FPTs.
3. Contractor, testing agencies, and special inspectors shall coordinate with the CA so that the CA can support the testing (when necessary), witness the testing, and approve the applicable aspects of the FPTs. The Contractor should not start up equipment or systems without CA approval.
4. The CA may independently spot-check work of the testing agencies or special inspector if the tests were not witnessed. However, it is not the intent for the CA to re-accomplish testing by others that is specified in the construction specifications.
5. Contractor is responsible for coordinating the efforts of testing agency or special inspector with that of the Cx process. Documentation shall be contiguous and seamless and duplication will be avoided. Testing agencies or special inspectors shall complete the documentation of the Cx process as required.

1.08. CONTRACTOR RESPONSIBILITIES

A. Construction Phase: The following delineates the commissioning-related responsibilities of the Contractor (and their subcontractors) during the Construction Phase.

1. Include Commissioning requirements in price and plan for work.

2. Designate a CxC from each major subcontractor with activities related to commissioning. These CxCs are to be the primary contacts for Commissioning activities.
3. Attend Construction Phase Commissioning Kick Off Meeting. The CxC and Project Manager from each major subcontractor shall attend at a minimum.
4. The CxC shall attend all Commissioning progress meetings unless otherwise agreed to by the CA.
5. Remedy any deficiencies identified throughout construction.
6. Submit Start-Up Procedures along with the manufacturer's application, installation and start-up information to the CA for review prior to implementation.
7. TAB shall submit Project specific TAB Plan and sample balancing forms for approval prior to starting work.
8. Contractor shall incorporate the Commissioning process into the construction schedule outlining generic Commissioning tasks with precedents or prerequisites to each task. These tasks will apply to many systems and the Contractor shall incorporate as such. Examples of enumerated tasks include:
    a. Contractor preparation of the Training Plan.
    b. Independent Testing Agency activities.
    c. Contractor documentation of pipe pressure testing, flushing, and cleaning of applicable systems.
    d. Documentation of the Start-Up Procedures for equipment and systems
    e. TAB of applicable system
    f. Training Events
    g. Preparation of the O&M Manual content
    h. FPT and Acceptance
    i. Observation Period and System Optimization
    j. Occupant or other Regulatory Agency testing or approval process
9. Coordinate the work of subcontractors, vendors, manufacturers, Testing Agencies and Special Inspectors provided with the bid, and ensure that they are informed of and are adhering to the requirements of the Commissioning process specified throughout the contract documents. Particular reference is made to providing the required O&M Documentation; submittal of training materials and documentation of that training; collaboration with the overall start-up and testing process; developing comprehensive integrated procedures for scheduling and task notification and documenting them in a common format; and electronic delivery requirements if applicable.
10. Provide assistance to the CA in preparation for the specific FPT procedures. Contractors, subcontractors and vendors shall review the FPTs to ensure feasibility, safety and equipment protection and provide necessary written alarm limits to be used during the tests. Damage caused to equipment performed in accordance with the approved procedures that is the result of malfunctioning equipment or contract deficiencies, shall be the responsibility of the Contractor.
11. Thoroughly complete and inspect installation of systems and equipment as detailed throughout Contract Documents, as required by reference or industry standards, and as specifically indicated elsewhere this section. The Contractor (and subcontractors) shall record, in the form of photographs, compliance to and/or deviation from IAQ standards.
12. Contractor shall notify the CA at least 7 days in advance of any tests, start-ups, or training. CA shall witness selected tests and start-ups. Notification shall be accompanied by a schedule showing the coordinated start date and task duration and all open prerequisites
13. Start-up, TAB of systems and equipment prior to verification and FPT by the CA. Start-up procedures shall be in accordance with Contract Documents, reference or industry standards, and Commissioning specs. Provide skilled technicians who are qualified to do the work required. Provide factory trained/authorized technicians where required by the contract documents and stated in the applicable technical section. Generally start-up and testing shall proceed from device checkout, to component checkout, to system checkout, to inter-system checkout.
14. Record start-up and testing procedures on start-up forms or checklists and certify that the systems and equipment have been started and/or tested in accordance with the requirements specified above. Each task or item shall be indicated with the party actually performing the task or procedure.
15. Demonstrate the operation of all systems as specified.
16. Certify that systems have been installed and are operating per Contract Documents and OEM prior to FPT and acceptance.
17. Support/Assist in the building flush-out per Construction Indoor Air Quality, Section 01561. If the flush-out is not performed or is incomplete then the Contractor shall coordinate an air quality test from an approved Industrial Hygienist after construction is complete to verify the chemical air contaminants are below the specified limits.
18. Maintain an updated set of Record Documentation as required by the Contract Documents.

19. Conduct and document Equipment and Systems Training events as required by this Section and by applicable sections of the Specifications pertaining to each piece of equipment or system and general training requirements.
20. Operate systems under direction of the CA during FPT's and other acceptance testing.

B. Acceptance Phase: The following delineates the commissioning-related responsibilities of the Contractor (and their subcontractors) during the Acceptance Phase.
1. Will work in conjunction with CA in FPT and will generally include the following:
   a. Operate and Manipulate systems and equipment to facilitate testing (as dictated in this section, relevant technical sections and the Commissioning Plan).
   b. Operate and Manipulate BAS and other control systems to facilitate FPT (as dictated in this section, relevant technical sections and the Commissioning Plan).
   c. Provide Point to Point and Devise Calibration reports prior to coordination to facilitate FPT.
2. Correct any work not in accordance with Contract Documents.
3. Maintain record documentation and update and resubmit it after Functional Completion.
4. Compensate the Owner for additional CA fees and expenses incurred to retest equipment and systems following testing failures.
5. Monitor systems, equipment and areas throughout the Acceptance Phase. Log and diagnose all alarms during this period. Maintain trends and logs of all parameters. Forward the logs and trends on a weekly basis throughout the Acceptance Phase.

C. Warranty Phase: The following delineates the commissioning-related responsibilities of the Contractor (and their subcontractors) during the Warranty Phase.
1. Provide warranty service.
2. Conduct BAS Sequence Training.
3. Respond to and document Warranty issues.
4. Participate as required in the opposite season testing.
5. Correct any deficiencies identified throughout the Warranty Phase.
6. Update record documentation to reflect any changes made throughout the Warranty Phase and resubmit final Record Drawings and data records at the close of the Warranty period.

1.09. DESIGN REVIEW

A. The A/E provides the CA a design development (DD) set for review; the drawing set should be near 100% complete. The CA reviews the design set for inconsistencies, misses, OPR & BOD compliance, and opportunities for improvement. The CA documents their comments and provides them to the A/E for incorporation into the design set.

B. The A/E provides a Construction Document (CD) set that is near 50% and/or 90% complete to the CA for review. The CA reviews the set to verify previous comments have been addressed and to identify any further misses or opportunities. The CA documents their comments and provides them to the A/E for incorporation into the construction set.

1.10. COMMISSIONING PLAN

A. The CA will develop the Commissioning Plan and its elements shall be included in the project schedule when approved by the owner or construction manager. The following provides an overview of the Commissioning tasks discussed in the Commissioning Plan.
1. Commissioning program overview - Goals & Objectives, general project information, system to be commissioned
2. Commissioning team - Team members, roles & responsibilities, communications & protocols, meetings and management
3. Commissioning process activities - Document owner's project requirements, review the basis of designs, review submittals, development of system functional performance testing, verify system performance, report deficiencies & the resolution process, accepting the building system and training
4. Commissioning schedule - A commissioning schedule will typically include start and end dates for the following.
   a. Design set review
   b. CD set review
   c. Bid packages released
   d. Distributed power available
   e. Distributed water available
   f. Start-up tests

g. Point to Point
h. TAB
i. Functional performance testing
j. Training

1.11. OBSERVATION LOG

A. CA shall maintain an Observation Log (required information, identified deficiencies, work required, etc.) that relates to Commissioning. Each item shall be tracked with the initiator, the parties responsible, due date, the date of closure, and a description of the resolution. Each item shall be categorized for sorting and tracking and for documentation on applicable forms.

B. CA will disseminate this list as appropriate to keep all parties informed.

C. All parties indicated as responsible for an action item shall respond. The preferred response method is via e-mail. Response with a plan of action (either repair or plan to resolve) is expected within 48 hours.

1.12. SUBMITTAL

A. The CA will provide appropriate contractors with a specific request for the type of submittal documentation the CA requires to facilitate the commissioning work. These requests will be integrated into the normal submittal process and protocol of the construction team. At minimum, the request will include the manufacturer and model number, the manufacturer's printed installation and detailed start-up procedures, full sequences of operation, O&M data, performance data, any performance test procedures, control drawings and details of owner contracted tests. In addition, the installation and checkout materials that are actually shipped inside the equipment and the actual field checkout sheet forms to be used by the factory or field technicians shall be submitted to the Commissioning Provider. All documentation requested by the CA will be included by the Subs in their O&M manual contributions.

B. The Commissioning Provider will review and provide comment on submittals related to the commissioned equipment for conformance to the Contract Documents as it relates to the commissioning process, to the functional performance of the equipment and adequacy for developing test procedures. This review is intended primarily to aid in the development of functional testing procedures and only secondarily to verify compliance with equipment specifications. The Commissioning Provider will notify the CM, Owner Representative, or A/E as requested, of items missing or areas that are not in conformance with Contract Documents and which require resubmission.

C. The CA may request additional design narrative from the A/E and Controls Contractor, depending on the completeness of the design intent documentation and sequences provided with the Specifications.

D. These submittals to the CA do not constitute compliance for O&M manual documentation. The O&M manuals are the responsibility of the Contractor, though the CA will review and approve them.

E. Contractor's responsibility for deviations in submittals from requirements of the Contract Documents is not relieved by the Commissioning Provider's review.

PART 2 - PRODUCTS

2.01. INSTRUMENTATION

A. All test instruments described in this section shall be acceptable for any portion of the commissioning process herein described. All instruments shall conform to the standards specified in the most recent edition of “NEBB Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems” in regard to accuracy and calibration status. Current calibration certificates must be available to the CA as requested.

B. Test instrument accuracy and resolution must match or exceed that of the system component being verified or calibrated.

C. Test instruments must be used within guidelines as recommended by instrument manufacturer. All measuring methods must be appropriate to the instrument application and measurements must be repeatable under equivalent conditions.

D. Standard Testing Instrumentation: Standard instrumentation normally used for performance assessment and diagnosis will be provided by Cx/Contractor. These include:

1. Electronic Manometer (for Air and Flow Hood)
2. Electronic Manometer (for Water)
3. Temperature Instruments
4. Humidity Instruments
5. CO2 Instrument
6. Sound Meter

7. Electronic Multimeter
8. Tachometer
9. Ultrasonic Flow Meter
10. Thermal Infrared Camera
11. Others as required

PART 3 - EXECUTION

3.01. INSTALLATION VERIFICATION

A. All equipment, components, and devices applicable to installation verification must be installed, and the installation verification must be documented and approved. This includes installation, identification labeling, insulation, and all other requirements for placing systems into dynamic operation.

B. Required submittal documentation shall be present and located convenient to testing area. Validate that all required documentation has been submitted and is per the contract requirements.

C. Contractor shall provide the completed installation verification procedures at the time of testing. CA shall review the installation verification procedure documentation and spot-check at the beginning of Start-Up.

D. Contractor shall demonstrate that access is sufficient to perform required maintenance.

E. System and equipment configurations shall be compared against the contract documents.

3.02. START-UP CHECKS

A. All equipment, components, and devices applicable to the FPT must be started, and the Start-Up must be documented and approved. This includes completion of Start-Up Procedures, pressure testing (of equipment, duct and piping), flushing/cleaning, identification labeling, insulation, and all other requirements for placing systems into dynamic operation.

B. Unless specifically agreed to by the Owner and CA, all support systems shall be complete prior to FPT. For instance, an air handler will require that:
   1. The electrical system serving it is completed and tested.
   2. The hydronic systems serving it have been pressure tested, flushed, and functional performance tested.
   3. Balancing has been completed.
   4. The control systems have been started and calibrated.
   5. The CA shall determine the optimal sequence of testing.

C. Required submittal documentation shall be present and located convenient to testing area. Validate that all required documentation has been submitted and is per the contract requirements.

D. Contractor shall provide the completed Start-Up Procedures at the time of testing. CA shall review the Start-Up Procedure documentation and spot-check at the beginning of FPT.

E. Contractor shall demonstrate that access is sufficient to perform required maintenance.

F. BAS trends shall have been established as required in the documents. These shall generally be reviewed prior to or during FPT.

G. Capacities and adjusted/balanced conditions as applicable shall be subject to review.

H. Sequencing Verification: For applicable systems and equipment, all modes of operation shall be verified for proper sequencing.

I. System and equipment configurations shall be compared against the contract documents.

J. Verify Modes (such as heating and cooling) are coordinated and do not overlap or 'fight'.

K. All adjusted, balanced, controlled systems shall be assessed to determine the optimal setting for the system as applicable. The optimal settings should be determined to establish reliable, efficient, safe and stable operation.

L. BAS or Local Panel Dynamic Graphics: The graphic displays for all components, systems, and areas required to be represented by a graphic shall be checked for adequacy and accuracy. Furthermore, when setpoints or other parameters are required to be adjustable, CA shall verify that they can be adjusted directly from the graphic screen.

3.03. START-UP PROCEDURE

A. Purpose: The Commissioning process requires that the normal quality control processes involved with preparing systems and equipment for operation are performed to a high standard of care and are thoroughly documented. The required commissioning-related Start-Up Procedures involve nothing additional over that which would be done for a proper installation. These procedures shall be performed on all installed systems and equipment and no sampling strategy is used for the start-up process. The Commissioning process requires all Parties to collaborate to establish the optimal standard of care for starting systems and equipment. After the procedures

are established, the Contractor performs them and documents them with the Start-up Procedures that are developed by the Contractor.

B. Start-Up Procedures: The content of these Start-Up Procedures shall provide the minimally acceptable content in accordance with the OEM field quality control requirements. These procedures and protocols will normally be common across different manufacturers.

C. Content of Start-Up Procedures: Start-Up Procedures shall generally include the following for each item of equipment or system (as applicable):
   1. Project-specific designation, location and service.
   2. Indication of the Party performing and documenting the Start-Up Procedure.
   3. Clear explanation of the inspection, test, measurement, and outcome with a Pass/Fail indication and a record of measure parameters.
   4. A Start-up Checklist item indicating that proper maintenance clearances have been maintained.

D. Recording and Documentation of Factory Start-Up: Manufacturer's start-up protocols shall be executed and forms shall be completed by a qualified/authorized technician.

E. Recording and Documentation of non-Factory Start-Up: The start-up tests and checklists shall be completed by a qualified technician.

F. Commissioning Provider Review: CA will review and spot-check procedures during FPT.

G. Documentation Completion: The individual executing the start-up must complete the start-up and pre-functional documentation for any given equipment and acknowledge acceptability with the indication of who did the associated task.

H. Sampling and Final Submission: All (100% of) systems are started and documented per the approved procedures and NO sampling strategy is used. Completed Start-up and pre-functional checklists for all pieces of equipment associated with independent systems shall be submitted to CA prior to any associated FPT. Any outstanding item shall be clearly indicated and an associated Action Item must be entered to track resolution.

I. Owner Access: Contractor shall allow access by Owner representatives to inspect the equipment and ensure its proper operation.

3.04 POINT TO POINT VERIFICATION

A. A documented, comprehensive point to point and basic function testing in the field is required on all installations. Factory calibration and bench tests are not acceptable alternates to onsite field-testing.

B. Point-to-point (or calibration verification) scope of work consists of testing from all end field devices (any device that provides an input signal to, or receives an output signal from the control hardware) through proper input/output to the graphic and operator interface. Testing must be complete, detailed and documented on approved point to point verification forms. Point-to-point should be performed with a separate device from the installation sensor - “ringing out a sensor” alone is not an acceptable level point-to-point testing. Point-to-point testing forms will include all point database requirements (i.e. alarm priority, paging, email, device range, etc.).

C. Submittal of the control provider's forms for approval must take place 3 weeks prior to commencement of field testing. The point-to-point report summary documentation must include the signature of the test technicians and date completed. The technician's signature certifies that the system has been tested and is fully ready for the commissioning lead's performance verification testing.

D. The CA will select up to 10% of the readings from the BAS Reports and spot check them, as part of the time allocations for the various systems. If subsequent failures are found, the Controls contractor will be required to justify noted failures or re-verify and re-document the system.

E. The maximum failure rate for this sample is 10%. The readings selected by the CA may include air temperature, fluid temperature, air flow rate, liquid flow rate, differential pressure, gage pressure, relative humidity, CO concentration, CO2 concentration, and refrigerant monitoring.

F. For all readings a deviation of more than the below between the verification reading and reported data shall be considered as failing the FPT

Sensor Application	**Accepted BAS Tolerance**
Airflow (Pressurized Spaces)	± 3 %
Airflow (Measuring Stations)	± 5 %
Airflow (Terminal)	± 10 %
Air Pressure Differential (Space)	± .001 in wg
Air Pressure (Ducts)	± .01 in wg

Air Relative Humidity	± 2 % RH
Air Temperature (Ducted)	± 1 deg F
Air Temperature (Room, AC unit, TU, etc.)	± 1 deg F
Air Temperature (Outside)	± 2 deg F
Air Wet Bulb Temperature Outdoor (Dew point)	± 2 deg F
Air Wet Bulb Temperature Indoor (Dew point)	± 1 deg F
Air Temperature Differential	± .25 deg F
Carbon Dioxide Monitor	± 50 PPM (of mid-range)
Carbon Monoxide Monitor	± 5 % (of mid-range)
Oxygen Monitor	± 5 %
Refrigerant Monitor	± 5 % (at 50 PPM)
Fluid Flow	± 5 %
Fluid Pressure	± 2 % (of full-scale)
Fluid Temperature	± 1 deg F
Electrical	± 5 %
Thermal Energy	± 5 %
Steam Flow	± 5 %
Steam Temperature	± 2 deg F
Vibration	± 5 %

■Notes:
Accepted calibration tolerances will vary according to measured medium and application of sensors. The tolerances listed are standard accepted criteria.
Not all sensors listed above may be in the project.

3.05 TEST, ADJUST, AND BALANCE

A. CA shall review TAB Plan, Draft / Final TAB reports.

B. The CA will select up to 10% of the readings from the Balancing Reports and spot check them, as part of the time allocations for the various systems. If subsequent failures are found, the TAB contractor will be required to justify noted failures or rebalance and re-document the system.

C. The maximum failure rate for this sample is 10%. The readings selected by the CA may include supply air diffuser readings (both minimum and maximum readings for variable air volume boxes), main and branch supply duct traverse readings, outside/return air flow readings, exhaust air flow readings, water flow readings, amp readings, and water pressure drop readings through coils, heat exchangers, and other hydronic elements.

D. For all readings a deviation of more than 10% between the verification reading and reported data shall be considered as failing the FPT.

3.06 FUNCTIONAL PERFORMANCE TESTING

A. Objectives and Scope:

1. The objective of FPT is to demonstrate that each system is operating according to the documented design intent and Contract Documents. Functional testing facilitates bringing the systems from a state of substantial completion to full dynamic operation. Additionally, during the testing process, areas of deficient performance are identified and corrected, thus improving the function and operation of the systems.
2. Each system shall be operated through all modes of operation (seasonal, occupied, unoccupied, warm-up, cool-down, normal [and emergency power], fire alarm, part- and full-load) where there is a specified system response. Verifying each sequence in the sequences of operation is required. Proper responses to such modes and conditions as power failure, freeze condition, no flow, equipment failure, etc. shall also be tested.

B. Development of Test Procedures:

1. CA shall develop specific test procedures and forms to verify and document proper operation of each piece of equipment and system. Prior to execution, the CA shall provide a copy of the test procedures to

the Contractor who shall review the tests for feasibility, safety, equipment and warranty protection, and scope. The CA will also submit the tests to Owner for Review.

2. Contractor shall review the FPTs in detail and submit edits and comments to the CA for possible incorporation.
3. The purpose of any given specific FPT is to verify and document compliance with the stated criteria of acceptance, modes of operation and performance.

C. Scheduling: After Contractors' notification that systems are ready for testing and submittal and review of all the required submittals has occurred, CM shall schedule the testing. To the extent practical, tests shall be scheduled to allow efficient and contiguous testing of inter-related systems and equipment.

D. Phasing: Non-interdependent segments of the project testing can be phased. Phasing of this project will be determined as the project progresses.

E. Participation: CA will direct, witness and document FPTs performed by the contractor after Start-Up Procedure documentation of systems and equipment has been reviewed and accepted. CA will orchestrate the execution of the FPTs unless otherwise specified. Contractor shall perform the FPTs as described in section 3.6 with manipulation of the systems or equipment, provision of supporting equipment or materials (lifts, ladders, specialty test equipment, safety equipment), and on-the-spot remediation of minor identified deficiencies whenever possible.

1. Required participating Parties shall be indicated in the individual FPT. Typically, multiple Parties are required for any given test, yet participation for any given Party is only required for the respective portion of the test for which the Party is responsible.
2. Frequently, on multiple samples where a given party does not directly perform the test, the participation of that party will only be required for an initial quantity of systems/equipment. Whenever practical and at the discretion of the CA with the contractor's full approval, the CA will continue with the remaining portion of the sample without assistance from the Contractor(s) not directly performing the test. However, the Contractor is allowed to be present for any or all FPTs conducted.
3. The required parties shall be available on-site throughout the testing of any given system for which they are required participants. Therefore, time for which they are not directly involved can be spent performing other work (typically addressing identified punch list items or failed tests).
4. No party involved with the project is prohibited from participation in or witnessing of any tests. Any Contractor may elect to witness all tests on their systems even if their involvement is not directly required (for instance, BAS Vendor involvement is sometimes required on the first few of a sample and not on the entire sample).
5. CA will endeavor to coordinate effectively with the individual Contractors throughout FPT and minimize their required involvement.

F. Completeness: All systems must be completed and ready for FPT. All start up, factory authorized field testing, independent testing agency tests, and TAB procedures must be complete and the control systems must be tested and started for the respective system or component.

G. Test Documentation: CA will witness and document the tests. CA will record all test results on the forms developed for the testing. CA will 'Pass' or 'Fail' the testing and record the date and time of the test. Deficiencies shall clearly be indicated when the test is failed. When all related testing is completed successfully, CA shall recommend acceptance of the system or component. In the case of specialized testing, witness (at CA's discretion) and review the testing reports prepared by the Contractor.

H. After functional testing is completed all settings adjusted to test the equipment/system will be returned to normal.

I. FPT Acceptance:

1. The Acceptance Criteria shall be as follows unless specifically indicated within applicable individual specification sections or test procedures. CA may exercise professional judgment to relax requirements and pass tests and recommend approval by the Owner and Engineer when appropriate.
2. Accuracy/repeatability on sensing devices will be as specified for the device. CA and TAB will use calibrated gages for independent validation and use judgment in passing or failing the devices. In many cases, the coordination of multiple related sensors is more important than absolute accuracy.
3. HVAC sequence-related criteria will be as explicitly specified in the documents and as interpreted by the CA.
4. Testing may be deferred due to seasonal or operational constraints. In either situation the testing will be coordinated and be governed by the specifications for the project.

J. FPT Deficiencies:

1. Non-Conformance: Non-conformance deficiencies identified during FPT shall be resolved as follows:

a. The CA will record the results of the functional test. All deficiencies or non-conformance issues shall be noted as Observation Log Items and reported to the Owner and CM.
b. Corrections of identified minor deficiencies may be made during the tests at the discretion of the CA. In such cases the deficiency will be noted on the FPT documents.
c. Every effort will be made by the CA to expedite the testing process and minimize unnecessary delays, while not compromising the integrity of the procedures.
d. As tests progress and deficiencies are identified, the CA will discuss the issue with the executing Contractor.
e. When there is no dispute on the deficiency and the Contractor accepts responsibility to correct it:
    i. The CA shall document the deficiency along with the Contractor's response and intentions, and they go on to another test or sequence. A copy/email of the deficiency shall be generated and provided to the Contractor and CA. The Contractor corrects the deficiency, completes the Action Item response certifying that the issue is resolved and/or the equipment is ready to be retested, and sends it back to the CA.
    ii. The CA reschedules the test and the test is repeated.
f. If there is a dispute about a deficiency, regarding whether it is a deficiency and/or who is responsible:
    i. The deficiency shall be documented as an Observation Log Item with the Contractor's response and the Owner and CM will be notified. The CM will track this issue under the construction contract dispute resolution provisions.
    ii. Final interpretive authority is with the A/E. Final acceptance authority is with the Owner and CM.
    iii. The CA documents the resolution to the Observation Log Item.
    iv. Once the interpretation and resolution have been decided, the appropriate party corrects the deficiency, and responds to the Action Item indicating completion. The CA reschedules the test and the test is repeated until satisfactory performance is achieved. CA then closes the Action Item.

K. Max Failure Limit and Sample Percentages: A Maximum Failure Limit is indicated along with the Sampling Percentages. The Max Failure Limit indicates the maximum percentage of the tested devices that may have any test that fails before an entirely new sample must be tested. This is based on the concept that if many failures occur, it is a result of inadequate start-up by the Contractor. When the maximum number of failures is reached, testing on that sample will be terminated and re-testing will be scheduled.
    1. If no Max Failure Limit is indicated, all tested samples must pass (Max Failure Limit 0%).
    2. Where sample tests involve multiple systems (i.e., checking strainers on different hydronic systems) the Maximum Failure Limit will apply per system.
    3. The responsible Contractors shall reimburse the Owner for the CA's cost of that sample test, and redo the start-up and TAB for the applicable devices/systems.
    4. All work necessitated by sample failures shall be at no cost to the Owner.
L. Failure Due to Manufacturer's Defects: If 10% of identical pieces of equipment fail to perform to the Contract Documents (mechanically or substantively) due to manufacturing defect, all identical units may be considered unacceptable by the CM. (For the purposes of defining 'identical equipment' for this Section, size or capacity alone does not constitute a difference.) In case of failure due to manufacturer's defects, the Contractor shall provide the Owner with the following:
    1. Manufacturer's response in writing as to the cause of the failure and proposed resolution.
    2. Manufacturer shall implement their proposed resolution on a representative sample of the product.
    3. The CM will determine whether a replacement of all identical units or a repair is acceptable.
    4. Upon acceptance, the manufacturer shall replace or repair all identical items at their expense and shall extend the warranty accordingly (if the original equipment warranty had begun).
    5. Manufacturer shall pay the costs of all retesting necessitated by the failure.

3.07 ACCEPTANCE

A. The CA notes each satisfactorily demonstrated function on the test form. Formal approval of the functional test is made later after review by the CA and by the CM, if necessary. The CA recommends acceptance of each test to the CM using a standard form. The CM gives final approval on each test using the same form, providing a signed copy to the CA and the Contractor.

3.08 CLOSEOUT

A. Commissioning Report:

1. A final summary report (about four to six pages, not including backup documentation) by the CA will be provided to the CM, focusing on evaluating commissioning process issues and identifying areas where the process could be improved.
2. All acquired documentation, logs, minutes, reports, deficiency lists, communications, findings, unresolved issues, etc., will be compiled in appendices and provided with the summary report.
3. Installation verification, Start Up checklists, TAB, functional tests and monitoring reports will not be part of the final report, but will be stored in the Commissioning Record in the I,O&M manuals.
4. Off season testing and additional factory start-ups shall clearly be identified and the designated test period noted for contractor and owner coordination. See Warranty Period.

B. Code Required Reports:
1. Provide Contractor with all commissioning reports required by state and local authorities for compliance with governing energy code and mechanical code.

3.09 TRAINING

A. The CM shall be responsible for training coordination and scheduling and ultimately for ensuring that training is completed.
1. A training plan shall be generated and include the following elements:
a. Equipment
b. Intended audience
c. Location of training
d. Objectives
e. Subject covered (description, duration of discussion and special methods)
f. Instructor for each subject
g. Method of instruction (classroom lecture, manufacturer video, site walk through, actual operational demonstration, written handouts)
2. The controls contractor shall attend any training in which their system interfaces (minimally mechanical)
3. Recommended training
a. Use printed installed ad O&M manuals
b. Review of O&M - include start-up, all modes of operation, shutdown, seasonal changes, and emergency operations (emphasis should be given on safety and proper operations).
c. Health and safety issues
d. Warranties and guarantees
e. Common troubleshooting
f. Peculiarities
g. Overrides

B. The CA shall be responsible for overseeing and approving the content and adequacy of the training of Owner personnel for commissioned equipment.

3.10 INSTALLATION, OPERATION AND MAINTENANCE

A. Prior to substantial completion, the CA shall review the I,O&M manuals, documentation and redline as-builds for systems that were commissioned to verify compliance with the Specifications. The CA will communicate deficiencies in the manuals to the CM or A/E, as requested.

B. Upon a successful review of the corrections, the CA recommends approval and acceptance of these sections of the O&M manuals to the CM or A/E.

C. The CA also reviews each equipment warranty and verifies that all requirements to keep the warranty valid are clearly stated. This work does not supersede the A/E's review of the I,O&M manuals according to the A/E's contract.

3.11 WARRANTY REVIEW

A. During the warranty period, seasonal testing (tests delayed until weather conditions are closer to the system's design) shall be completed as part of this contract. The CA shall coordinate this activity. Tests will be executed, documented and deficiencies corrected by the appropriate Subs, with facilities staff and the CA witnessing. Any final adjustments to the I,O&M manuals and as-builds due to the testing will be made.

END OF SECTION

SECTION 01 95 00
MEASUREMENT AND VERIFICATION

PART 1 – GENERAL

1.01. OVERVIEW

A. This Measurement and Verification (M&V) plan is based on Option D: Calibrated Simulation of the *International Performance Measurement & Verification Protocol (IPMVP) Volume III: Concepts and Options for Determining Energy Savings in New Construction, April, 2003.* The plan is intended to verify the cost savings associated with energy efficiency measures incorporated into the design, and to provide a recalibrated energy model that will serve as a tool for building operators in identifying and remedying causes of underperformance.

1.02. SCOPE OF WORK

A. McKinstry is primarily responsible for the M&V Plan's development, coordination and implementation. The project owner and building operations staff will support implementation of the plan

B. A comprehensive measurement and verification plan will be developed which will detail the project milestones listed below:

Baseline energy model
Recalibrate baseline energy model to reflect as-built and post-occupancy conditions
Identification of ECMs for inclusion in the M&V plan
Development of M&V plan
Compilation of all occupancy, controls, BAS data, and scheduling information during the M&V period
Spot metering during M&V period
Installation of required sub-metering equipment
M&V Report
Corrective Action Plan (if necessary)

1.03. MEASUREMENT & VERIFICATION TEAM

A. The measurement & verification team as referred to in all sections will consist of the job-specific group responsible for performing M&V duties throughout the project lifecycle. The primary point of contract is the project's performance assurance specialist at McKinstry.

B. Additional parties crucial to the process but not directly responsible for Measurement & Verification in the capacity of those listed above are:

1. Mechanical Contractor Project Manager
2. Mechanical Field Foremen
3. Mechanical Design Engineer
4. Control Contractor Representative
5. Control Field Engineers / Technicians
6. General Contractor Representative
7. Electrical Contractor Representative

C. The nature of the process requires a significant amount of communication between and participation of all members listed above.

1.04 MEASUREMENT & VERIFICATION PLAN

A. Prior to project commencement the McKinstry team shall develop a comprehensive measurement & verification plan which will address the following:

1.05 INSTRUMENTATION

A. All test instruments described in this section shall be acceptable for any portion of the measurement & verification process herein described. All instruments shall conform to the standards specified in the most recent edition of "International Performance Measurement and Verification Protocol (IPMVP)" regarding accuracy and calibration status. Current calibration certificates must be available.

B. Test instrument accuracy and resolution must match or exceed that of the system component being verified or calibrated.

C. Test instruments must be used within guidelines as recommended by instrument manufacturer. All measuring methods must be appropriate to the instrument application and measurements must be repeatable under equivalent conditions.

D. The M&V team shall assume full responsibility for safekeeping of all instrumentation during the course of work.

PART 2 – PRODUCTS – THIS SECTION NOT USED

PART 3 - EXECUTION

3.01. PRE-CONSTRUCTION

A. During the pre-construction phase, the measurement & verification team shall be available to all concerned parties in a consulting capacity. The role of the team in the construction phase affords them with practical knowledge that can be applied during the design and construction scheduling processes. Pre-construction input is intended to reduce or eliminate issues that have historically hindered timely project completion or have caused unanticipated project cost impact. Examples include:

1. Engineering design issues.
2. Manufacturer-specific equipment performance.
3. System control strategies.
4. Subcontractor performance.
5. Project scheduling conflicts.
6. Owner / contractor expectations.

3.02. POST-INSTALLATION EQUIPMENT MONITORING

A. Following installation and before occupancy, commissioning activities were used to verify the proper fundamental operations of the building systems. Should a component of an ECM fail to work in the designed manner, maintenance will be performed to restore the equipment to its designed operation. Permanent and spot metering will be used to measure electrical consumption. Operation staff will use metered trend data and spot checks to identify underperforming systems so that corrective action can be taken.

B. The method of metering will be through sealed electronic sub meters, these meters will record the electrical loads indicated within this plan. These meters are intended to validate the anticipated energy savings previously indicated in LEED EAc1 and as indicated below. Recalibration of the meters can be done by sending these meters back to the factory, contacts with these vendors have indicated that this is typically done every five years. The table below shows the metering strategy that will be used to monitor electrical loads.

3.03. M&V PERIOD VERIFICATION ACTIVITIES

A. On a monthly basis, operations staff shall record the energy consumption of loads associated with ECMs. Also record any significant O&M activities performed on the systems during that time period, including any associated costs. At the end of the one-year M&V period, summarize the electrical consumption data for comparison with the recalibrated baseline and expected consumption. The metered equipment shall be inspected at the conclusion of the M&V period and as needed to verify proper operation. All collected information and comparison results will be included in the M&V report.

B. All efforts will be made to prevent the omission or loss of metered data. In the event that data is missing or lost, existing data from before and after the missing portion will be used to extrapolate if appropriate. Extension of the M&V period is also an option for mitigating the effect of lost data.

3.04 BUILDING AUTOMATION SYSTEM LOGGING/TRENDING

A. The schedule of point trends will be developed by McKinstry and shared with the project team upon project execution and DDC system selection.

B. The BAS includes data logging functions that will also be used to provide ongoing measurement and verification data pertaining to certain mechanical systems. BAS data will be used in conjunction with metered electricity to track equipment performance, identify underperforming systems. This data will also be used to assist the baseline energy model recalibration. The table below shows the metering strategy that will be used to monitor mechanical systems that use electricity.

END OF SECTION

SECTION 03 10 00
CONCRETE FORMWORK

PART 1 - GENERAL

1.1 DESCRIPTION

A. The General and Supplementary Conditions of the Construction Contract and Division 1 - General Requirements apply to the work specified in this section.

B. This section includes the design, construction and treatment of formwork and related accessories to confine and shape concrete to the required dimensions.

C. This section also includes the installation of embedded items such as flashing reglets, shelf angles, and PVC weeps.

D. Structural notes indicated on the drawings regarding concrete formwork shall be considered a part of this specification.

1.2 QUALITY ASSURANCE

A. Codes and Standards: Comply with the provisions of the following codes, specifications, and standards except where more stringent requirements are shown or specified.

1. ACI 117 – Standard Specification for Tolerances for Concrete Construction and Materials.
2. ACI 301 – Standard Specification for Structural Concrete.
3. ACI 318 – Building Code Requirements for Structural Concrete.
4. ASTM C31 – Standard Specification for Making and Curing Concrete Test Specimens in the Field.
5. ASTM C39 – Standard Test Method for Compressive Strength of Cylindrical Concrete Test Specimens.

B. Where provisions of the pertinent Codes and Standards conflict with this specification, the more stringent provision shall govern.

C. Forest Certification: For the following wood products, provide materials produced from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, “FSC Principles and Criteria for Forest Stewardship.”

1. Non-rented temporary concrete formwork.

1.3 SUBMITTALS

A. Formwork Release Agent: Submit data on the formwork release agent proposed for use with each form surface to be used for acceptance unless otherwise specified in the Contract Documents. Include certification that agent is compatible with finish.

B. Testing for Formwork Removal: When methods other than cylinder tests are proposed for determining time for formwork removal, submit data on methods for approval.

C. LEED Certification: Submit manufacturer’s certification for formwork including the following:

1. LEED Credit MRc 4.1/4.2 – Recycled content including percentage of pre-consumer (post-industrial) and post-consumer recycled content. Also provide manufacturer’s name and product cost.

2. LEED Credit MRc 5.1/5.2 – Location of manufacturing plant, manufacturer's name, product cost and location of extraction or harvest of raw materials.

3. LEED Credit MRc 7 – Chain-of-custody certificates certifying that wood used for formwork complies with forest certification requirements. Include evidence that manufacturer is certified for chain-of-custody by an FSC-accredited certification body.

a. Include statement indicating costs for each certified wood product.

1.4 DESIGN REQUIREMENTS

A. Design and Engineering of formwork is the responsibility of the Contractor. Design and construct formwork, shoring and bracing to conform to Contract Documents and building code requirements. Design for construction loads, lateral pressure, and requirements of the applicable building code.

B. Drawings show the design requirements and dimensions for structural strength, but structural drawings do not show all detail dimensions to fit intricate Architectural and mechanical detail. Contractor shall so construct the concrete work that it will conform to the clearance required by the Architectural, Mechanical and Electrical design.

C. Maximum deflection of facing materials forming concrete surfaces exposed to view shall be 1/240 of the center-to-center span between structural members of the formwork.

PART 2 - PRODUCTS

2.1 MATERIALS AND ACCESSORIES

A. Formwork Accessories: Use commercially manufactured accessories for formwork accessories that are partially or completely embedded in concrete, including ties and hangers.

B. Formwork Release Agent: Use commercially manufactured form release agents that will prevent formwork absorption of moisture, prevent bond with concrete, and will not stain the concrete surface. Formwork release agent shall be compatible with paint or any other finish applied to the concrete; submit data indicating compatibility.

C. Form Material:

1. No aluminum shall be allowed in the concrete work unless coated to prevent aluminum-concrete reaction.

2. Concrete form materials must be used in a manner so as to provide the surface finish specified.

3. Design formwork in accordance with the provisions of the building code or the following standards if not covered in the building code:

a. Wood - AF & PA "National Design Specification".
b. Plywood - American Plywood Association "Plywood Design Specification".
c. Steel - AISC "Manual of Steel Construction - Allowable Stress Design".
d. Cold-formed Steel - AISI "Cold-Formed Steel Design Manual".
e. Aluminum - Aluminum Association "Aluminum Construction Manual".
f. Concrete - ACI 318.
g. Other materials - as directed by manufacturer.

D. Chamfer Strips:

1. Chamfer strips shall be 3/4 inch by 3/4 inch strips. Verify material finish with Architect.

2.2 FORM FINISHES

A. Rough Form Finish:

1. Concrete surfaces not exposed to view in the finished work shall have a rough-form finish. No form-facing material is specified for rough-form finish.

2. Set and maintain forms so finished concrete dimensions shall conform to the tolerances. Rough form finish is Designated Surface Finish-1.0 from ACI 301, except that surface tolerance Class C is required as specified in ACI 117.

B. Smooth Form Finish:

1. Concrete surfaces exposed to view in the finished work or surfaces to receive finishes of any type (paint, textured paint, etc.) shall have a smooth form finish. Form-facing material shall be plywood, tempered concrete-form-grade hardboard, metal, plastic, paper, or other acceptable material capable of producing the desired finish. Form-facing material shall produce a smooth, uniform texture on the concrete. Do not use form facing material with raised grain, torn surfaces, worn edges, patches, dents, or other defects that might impair the texture of the concrete surfaces.

2. Set and maintain forms so finished concrete dimensions shall conform to the tolerances. Smooth form finish is Designated Surface Finish-3.0 from ACI 301, including surface tolerance Class A as specified in ACI 117.

C. Patching and repairing concrete finishes are specified under Section 03 30 00.

2.3 FABRICATION AND MANUFACTURE

A. Form Ties: Factory-fabricated, removable or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.

1. Furnish units that will leave no corrodible metal closer than 1 inch to the plane of the exposed concrete surface.

2. Furnish ties that, when removed, will leave holes not larger than 1 inch in diameter in concrete surface.

3. Furnish ties with integral water-barrier plates to walls indicated to receive dampproofing or waterproofing.

PART 3 - EXECUTION

3.1 CONSTRUCTION OF TEMPORARY FORMWORK

A. Design, erect, shore, brace, and maintain formwork to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until concrete structure can support such loads.

B. At construction joints, lap contact surface of the form sheathing for flush surfaces exposed to view over the hardened concrete in the previous placement by not more than 1 inch. Ensure formwork is held firmly against hardened concrete to prevent offsets or loss of mortar at construction joints and to maintain a true surface.

C. Unless specified in the Contract Documents, construct formwork so concrete surfaces conform to tolerance limits. The class of surface for offset between adjacent pieces of formwork facing material shall be Class C, unless specified otherwise.

D. Provide positive means of adjustment (wedges or jacks) of shores and struts. Do not make adjustments in the formwork after concrete has taken its initial set. Brace formwork securely against lateral deflection and lateral instability.

E. To maintain specified tolerances, camber formwork to compensate for anticipated deflections in formwork prior to hardening of concrete. Formwork camber calculations are the responsibility of the formwork designer. Set formwork and intermediate screed strips for slabs accurately to produce designated elevations and contours of the finished surface prior to removal of formwork. Ensure that edge forms and screed strips are sufficiently strong to support vibrating screeds or roller pipe screeds when the finish specified requires the use of such equipment.

F. When formwork is cambered, set screeds to a like camber to maintain required concrete thickness.

G. Fasten form wedges in place after final adjustment of forms and prior to concrete placement.

H. Anchor formwork to shores, supporting surfaces, or members to prevent upward or lateral movement of the formwork system during concrete placement.

I. Securely brace and shore forms to prevent displacement and to safely support construction loads.

J. Construct formwork for wall openings to facilitate removal and to counteract swelling of wood formwork. Keep wood forms wet as necessary to prevent shrinkage.

K. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical. Chamfer wood inserts for forming keyways, reglets, recesses, and the like, for easy removal.

L. Do not use rust-stained steel form-facing material.

M. Provide temporary openings at the base of column and wall formwork and at other points where necessary to facilitate cleaning and inspection.

N. Unless noted otherwise, all footings shall be centered under walls, piers or columns.

O. Provide runways for moving equipment and support runways directly on formwork or structural member without resting on the reinforcing steel.

P. Place sleeves, inserts, anchors, and embedded items required for adjoining work or for support of adjoining work prior to concrete placement.

Q. Position and support expansion joint material and other embedded items to prevent displacement. Fill voids in sleeves, inserts, and anchor slots temporarily with readily removable material to prevent entry of concrete into voids.

R. Projecting corners of walls and columns shall be formed with a 3/4 inch chamfer. Unless noted otherwise on Architectural drawings.

S. Clean surfaces of formwork and embedded materials of mortar, grout, and foreign material before concrete is placed.

T. Cover surfaces of formwork with acceptable formwork release agent. Apply form release agent before placing reinforcing steel and concrete according to manufacturer's written instructions. Do not allow formwork release agent to puddle in forms. Do not allow formwork release agent to contact reinforcing steel or hardened concrete against which fresh concrete is to be placed

U. Clean and inspect formwork immediately before concrete is placed.

V. Provide forms for concrete work adjacent to earth banks including sides of footings, except where footing excavation is vertical rock cut.

W. Construct forms plumb and straight to conform to slopes, lines and dimensions shown.

X. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.

3.2 COORDINATION

A. Install all required pipe sleeves, cavities or slots. Notify appropriate trades in due time so that they may furnish information and make necessary installations. Check sizes, location and alignment of all openings, frames and other work, which are to be built-in including electrical boxes and conduit.

B. Layout the run of partitions and establish location of openings so that other trades may properly locate their work.

C. Core drilling concrete is not permitted unless noted otherwise or approved in writing by the Architect. Notify the Architect in advance of conditions not shown on the drawings.

3.3 INSTALLATION OF EMBEDDED ITEMS

A. Built-In Items:

1. Confirm with Architect that all materials to be embedded are suitable for embedment in concrete.

2. Build in anchors, inserts, and other devices indicated or required for various portions of work.

3. Build in sleeves, thimbles, and other items furnished or set in place by other trades.

4. Accurately position and support all embedded items prior to concrete placement. Secure embedded items against displacement during concrete placement operations.

5. Fill voids with readily removable material to prevent entry of concrete into voids.

6. Mechanical and electrical shall provide and set required sleeves.

7. Coordinate setting of all embedded items.

3.4 REMOVAL OF FORMS

A. When removal of formwork is based on concrete reaching a specified compressive strength, concrete will be presumed to have reached this strength when either of the following requirements has been met:

1. Test cylinders, molded and cured under the same conditions for moisture and temperature as used for the concrete they represent, have reached the specified compressive strength.

2. Concrete has been cured in accordance with the specifications for the same length of time as laboratory-cured cylinders, which have reached the specified strength. Determine the length of time concrete has been cured in the structure by the cumulative number of days or fractions thereof, not necessarily consecutive, during which the temperature of the air in contact with the concrete is above 50 degrees and the concrete has been damp or thoroughly sealed from evaporation and loss of moisture.

B. Forms shall remain in place for the following periods of time. These periods represent cumulative number days or hours, not necessarily consecutive, during which the temperature of the air surrounding the concrete is above 50 F:

1. Walls, piers, and footings: 50% specified compressive strength or minimum 24 hours.

C. When finishing is required, remove forms as soon as removal operations will not damage concrete.

D. Loosen wood formwork for wall openings when this can be accomplished without causing damage to concrete.

E. Do not allow removal of formwork to damage the fresh concrete for columns, walls, sides of beams, and other parts supporting the weight of the concrete. Perform needed repair and treatment required on vertical surfaces at once and follow immediately with specified curing.

3.5 FASTENER REMOVAL

A. Remove all protruding fasteners left as a result of securing inserts to forms by Contractor responsible for insert.

B. Cutting flush with surface is not acceptable.

C. Patch exposed concrete surfaces if damaged during fastener removal process.

3.6 REMOVING AND REUSING FORMS

A. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-release agent.

B. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Architect

END OF SECTION

SECTION 03 20 00
CONCRETE REINFORCEMENT

PART 1 - GENERAL

1.1 DESCRIPTION

A. The General and Supplementary Conditions of the Construction Contract and Division 1 - General Requirements apply to the work specified in this section.

B. This section includes the fabrication and placement of reinforcing steel for concrete, and all related accessories.

C. Reinforcing steel for use in bond beams, masonry columns, and lintels is specified in Division 4 and is not a part of the work in this section.

D. Structural notes indicated on the drawings regarding concrete reinforcement shall be considered a part of this specification.

1.2 QUALITY ASSURANCE

A. Codes and Standards: Comply with the provisions of the following codes, specifications and standards, except where more stringent requirements are shown or specified.

1. ACI 117 - Standard Specifications for Tolerances for Concrete Construction and Materials.
2. ACI 301 - Standard Specification for Structural Concrete.
3. ACI 318 - Building Code Requirements for Structural Concrete.
4. ACI 315 - Details and Detailing of Concrete Reinforcement.
5. ASTM A82 - Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.
6. ASTM A184 - Standard Specification for Welded Deformed Steel Bar Mats for Concrete Reinforcement.
7. ASTM A185 - Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete.
8. ASTM A615 - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
9. ASTM C1116 – Standard Specification for Fiber-Reinforced Concrete.
10. AWS D1.4 - Structural Welding Code - Reinforcing Steel.
11. CRSI - Manual of Standard Practice.

B. Where provisions of other pertinent codes and standards conflict with this specification, the more stringent provision shall govern.

1.3 SUBMITTALS

A. Placing Drawings: Submit placing drawings showing fabrication dimensions and locations for placement of reinforcement and reinforcement accessories. Indicate bar sizes, spacing, locations, and quantities of reinforcing steel, bending and cutting diagrams, and supporting and spacing devices. Dowels shall be shown in placing drawings for the element that is to be placed first. Reinforcing steel descriptions or shop drawings shall be inch-pound sizes.

B. Product Data: Submit product data sheets for all specified products.

1. Fibrous concrete reinforcing material.

a. Application rate per cubic yard of concrete.
b. Manufacturer's printed batching and mixing instructions.
c. Letter of Certification that materials supplied meets or exceeds ASTM C1116.

C. Manufacturer's Certificate: Submit mill certifications at time of delivery.

D. Splices: Submit request for splices not indicated in the Contract Documents. Request shall indicate locations, types, and lengths of splices for approval.

E. Field Bending: Submit requests and procedure for field bending or straightening of reinforcement partially embedded in concrete not described in the Contract Documents.

F. Reinforcement Relocation: Submit requests to adjust reinforcement spacing necessitated by conflicts with other reinforcement, conduits, etc. for approval.

G. LEED Certification: Submit manufacturer's certification for reinforcement including the following:

1. LEED Credit MRc 4.1/4.2 – Recycled content, including percentage of pre-consumer (post-industrial) and post-consumer recycled content. Also provide manufacturer's name, product cost, and steel processing furnace type.

2. LEED Credit MRc 5.1/5.2 – Location of manufacturing plant, manufacturer's name, product cost and location of extraction or harvest of raw materials.

1.4 COORDINATION

A. Coordinate reinforcement installation with the placement of formwork and other embedded items such as inserts, conduit, pipe sleeves, drains, metal supports, anchor rods, etc.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver reinforcement to the jobsite in bundles sorted and labeled with durable tags indicating bar size, length, and shop drawing mark.

B. Store elevated clear of ground and protect at all times from contamination and deterioration.

C. Prevent bending, coating with earth, oil, or other material, or otherwise damaging the reinforcement.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Bar Deformations: Bars used for reinforcement shall be deformed except welded wire reinforcement, which may be plain.

B. Reinforcing Steel: Reinforcing steel shall conform to the ASTM standard and grade indicated in the General Notes on the Drawings.

C. Synthetic Macro Fiber Reinforcing: Shall meet the requirements of ASTM C116, Type III, be approved by UL for use in a two-hour rated floor assembly, and be specifically manufactured for use as concrete secondary reinforcement.

1. Fiber Length: 1-1/2" to 2".

2. Aspect Ratio: Between 70 and 100.

3. Specific Gravity: Between 0.90 and 0.93.

4. Mix proprietary materials in accordance with manufacturer's instructions, product data and technical bulletins.

5. Application Rate: Per drawings.

a. Available Products: Subject to compliance with requirements, products that may be incorporated in the Work include:

1) STRUX 90/40; Grace Construction Products.
2) Fibermesh 650; Propex Concrete Systems.
3) TUF-STRAND SF; Euclid Chemical Company.

D. Welded Wire Reinforcement: Welded wire reinforcement shall conform to the ASTM standard indicated in the General Notes on the Drawings.

E. Joint Dowel Bars: Plain-steel bars. Cut bars true to length with square ends and free of burrs.

F. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete or fiber-reinforced concrete of greater compressive strength than concrete, and as follows:

1. For concrete surfaces exposed to view where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected or CRSI Class 2 stainless-steel bar supports.

2. Concrete cast against earth: Bars may be supported by precast concrete bricks or approved prefabricated wire bar supports with footpads large enough to support the weight of the bars and construction traffic without being pushed into underlying grade. Precast concrete blocks shall have a minimum compressive strength of 6,000 psi.

G. Epoxy Anchoring System: Epoxy anchoring shall consist of a reinforcing dowel and the epoxy adhesive cartridge.

1. Reinforcing shall be as specified earlier in this Section.

2. Epoxy injection gel shall consist of a two-component structural epoxy adhesive applied in a dual cartridge dispensing system, which properly mixes the components at the point of application. Refer to General Notes for acceptable epoxy anchoring systems.

2.2 FABRICATION

A. Fabrication Tolerances: Reinforcing steel shall be shop fabricated within tolerances to conform in size, shape, quantity, dimensions, etc. to the Construction Drawings and approved Shop Drawings.

B. Bar Condition: Bars shall be free from mill scale, excessive rust and other coatings, which would reduce or destroy the bond with the concrete.

C. Bars Bending: Bars shall be bent cold, and no method of fabrication shall be used which would be injurious to the material. Heating of bars for bending is not permitted.

D. Identification: After fabrication, bars shall be sorted, bundled and tagged with metal tags bearing the bar mark before delivery to the jobsite.

E. Corner Bars: Provide corner bars to make reinforcing continuous at all times, including intersections at footings, walls, beams or caps. Such bars shall be the same size and spacing as the horizontal reinforcing and each leg shall have a length of at least 30 inches.

F. Reinforcing for continuous footings shall extend into spread footings a minimum of 2'-0".

G. Dowels between footings and walls or columns shall be the same grade, size and spacing or number as the vertical reinforcing respectively, unless noted otherwise.

2.3 LEED CREDIT

A. LEED Credit MRc 4.1/4.2:

1. Provide steel products made using an Electric Arc Furnace having a minimum recycled content of 80%, including at least 40% post-consumer recycled content and 30% post-industrial recycled content.

2. Provide steel products made using a Basic Oxygen Furnace having a minimum recycled content of 25%, including at least 20% post-consumer recycled content and 5% post-industrial recycled content.

B. LEED Credit MRc 5.1/5.2:

1. Steel products shall be manufactured within 500 miles of project site. Recycled steel products shall be procured from within 500 miles of the project site.

PART 3 - EXECUTION

3.1 PLACING

A. Reinforcement Relocation: When necessary to move reinforcement beyond the specified spacing to avoid interference with other reinforcement, or embedded items, submit resulting arrangement of reinforcement to Engineer for approval.

B. Reinforcement Cutting: Cutting of reinforcement which conflicts with embedded objects is not acceptable.

C. Welded Wire Reinforcement: Extend welded wire reinforcement to within 1 inch of the concrete edge. Lap edges and ends of fabric sheets a minimum of one full mesh square plus 2". Support welded wire reinforcement during placing of concrete to assure required positioning in the slab. Do not place wire reinforcement on grade or metal deck and raise into position in freshly-placed concrete.

D. Wire Tie Orientation: Set wire ties so that ends are directed away from concrete surface.

E. Slab on Grade Reinforcement Placement: Place shrinkage and temperature reinforcement 2 inches from the top surface of the slabs on grade unless noted otherwise on the Drawings.

F. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.

G. Support for Reinforcement: Unless noted otherwise, supports for reinforcement shall have Class 2 protection as defined in the CRSI Manual of Standard Practice. Submit data on supports indicating class of protection at all different locations for approval.

H. Fibrous Reinforcement: Add fibrous reinforcement to concrete materials at the time concrete is batched in amounts indicated on the approved submittals for each type of concrete required.

1. Mix concrete for uniform and complete distribution of fibrous reinforcement.

I. Support for Bars in Concrete Cast on Ground: Bar supports for slabs on grade, grade beams, footings, and all other concrete cast directly onto grade shall be supported at an average spacing of 4 feet or less in each direction.

J. Securing Reinforcing Bars: All bars must be placed, spaced, secured and supported prior to casting concrete. Bars embedded in hardened or partially hardened concrete shall not be bent unless approved in writing prior to placement by the Engineer of Record.

K. Foot Traffic: Restrict foot traffic over the slab on grade reinforcing after it has been properly positioned.

L. Reinforcement at Expansion Joints: Do not continue reinforcement or other embedded metal items bonded to concrete through expansion joints. Dowels bonded on only one side of a joint and waterstops may extend through joint.

M. Pumping Concrete: When using a pump to place concrete, pump hose shall be supported directly on forms. Do not allow hose to rest on reinforcing bars if doing so could cause displacement of bars.

END OF SECTION

SECTION 03 30 00
CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 DESCRIPTION

A. The General and Supplementary Conditions of the Construction Contract and Division 1 - General Requirements apply to the work specified in this section.

B. The work includes all items required for executing and completing the cast-in-place concrete work and related work shown on the drawings or specified herein. Work shall include installation of items furnished in other sections of these specifications.

C. Concrete paving, walks, and curbs are specified in Division 3 or 32.

D. Structural notes indicated on the drawings regarding Cast-In-Place concrete shall be considered a part of this specification.

1.2 QUALITY ASSURANCE

A. Codes and Standards: Comply with the provisions of the following codes, specifications, and standards, except where more stringent requirements are shown or specified herein:

1. ACI 117 - Standard Specifications for Tolerances for Concrete Construction and Materials.
2. ACI 301 - Standard Specifications for Structural Concrete
3. ACI 305.1 - Specification for Hot Weather Concreting
4. ACI 306.1 - Standard Specification for Cold-Weather Concrete
5. ACI 318 - Building Code Requirements for Reinforced Concrete.
6. ASTM C31 - Standard Practice for Making and Curing Concrete Test Specimens in the Field.
7. ASTM C33 - Standard Specification for Concrete Aggregates.
8. ASTM C39 - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
9. ASTM C42 - Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
10. ASTM C94 - Standard Specification for Ready-Mixed Concrete.
11. ASTM C143 - Standard Test Method for Slump of Hydraulic Cement Concrete.
12. ASTM C150 - Standard Specification for Portland Cement.
13. ASTM C157 - Standard Test Method for Length Change of Hardened Hydraulic-Cement Mortar and Concrete
14. ASTM C171 - Standard Specification for Sheet Materials for Curing Concrete.
15. ASTM C172 - Standard Practice for Sampling Freshly Mixed Concrete.

16. ASTM C173 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method.

17. ASTM C231 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.

18. ASTM C260 - Standard Specification for Air-Entraining Admixtures for Concrete.

19. ASTM C309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.

20. ASTM C494 - Standard Specification for Chemical Admixtures for Concrete.

21. ASTM C618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete.

22. ASTM C1017 - Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete.

23. ASTM C1064 - Standard Test Method for Temperature of Freshly Mixed Portland Cement Concrete.

24. ASTM C1077 - Standard Practice for Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation.

25. ASTM D1751 - Standard Specification for Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types).

26. ASTM E154 - Standard Test Method for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover.

27. ASTM E329 –Standard Specification for Agencies Engaged in Testing and/or Inspection of Material Used in Construction

28. Concrete Reinforcing Steel Institute (CRSI) - Manual of Standard Practice.

B. Comply with all local building code requirements which are more stringent than those listed above. All referenced codes or standards shall be the most currently adopted as of the date for Receipt of Proposal.

C. Where any provision of other pertinent codes and standards conflict with this specification, the more stringent provision shall govern.

D. Maintain records verifying materials used are of the specified and accepted types and sizes and are in conformance with the requirements of the Contract Documents.

E. Use of testing services will not relieve the Contractor of the responsibility to furnish materials and construction in full compliance with the Contract Documents.

1.3 TESTING AND INSPECTION

A. Inspection and Testing:

1. The Contractor shall employ an Inspection Agency to perform the duties and responsibilities specified below.

2. Refer to architectural, civil, mechanical, and electrical specifications for testing and inspection requirements of non-structural components.

3. Work performed on the premises of a fabricator approved by the building official need not be tested and inspected per the table below. The fabricator shall submit a certificate of compliance that the work has been performed in accordance with the approved plans and specification to the building official and the Architect and Engineer of Record.

4. Duties of the Inspection Agency:

   a. Perform all testing and inspection required per the Testing and Inspection Schedule indicated below.

   b. Furnish inspection reports to the building official, the Owner, the Architect, the Engineer of Record, and the General Contractor. The reports shall be completed and furnished within 48 hours of inspected work.

   c. Submit a final signed report stating whether the work requiring Inspection was, to the best of the Inspection Agency's knowledge in conformance with the approved plans and specifications.

5. Structural Component Testing and Inspection Schedule for Section 03 30 00 is as follows:

Concrete and Concrete Placement	Continuous	Periodic	Referenced Standard
Review of proposed mix design and supporting test results		X	
Inspect bolts to be installed in concrete prior to and during placement of concrete where allowable loads have been increased or where strength design is used.	X		ACI 318: 8.1.3, 21.2.8
Inspection of anchors installed in hardened concrete.		X	ACI 318: 3.8.6, 8.1.3, 21.1.8
Verifying use of required design mix		X	ACI 318: Ch. 4, 5.2-5.4
At the time fresh concrete is sampled to fabricate specimens for strength tests, perform slump and air content tests, and determine the temperature of the concrete.	X		ASTM C172, ASTM C31, ACI 318: 5.6, 5.8
Inspection of concrete placement for proper application techniques	X		ACI 318: 5.9, 5.10
Inspection for maintenance of specified curing temperature and techniques.		X	ACI 318: 5.11 - 5.13
Verification of in-situ concrete strength, prior to removal of shores and forms from beams and structural slabs		X	ACI 318: 6.2

B. Sampling and testing requirements:

1. Take samples of fresh concrete at the job site for each mix design placed each day. Sampling and testing shall be done after the final addition and proper mixing of any water or admixtures that are added on site.

   a. Personnel and testing equipment shall meet the requirements of ASTM E329.

b. Testing Frequency: Obtain at least one composite sample for each 150 cu. yd. or 5,000 sq. ft. of surface area, whichever is less or fraction thereof of each concrete mixture placed each day.

1) On a given project, if the total volume of concrete is such that the frequency of testing required above would provide less than five strength tests for a given class of concrete, tests shall be made from at least five randomly selected batches or from each batch if fewer than five batches are used.

c. A strength test shall be the average of the strengths of two cylinders made from the same sample of concrete and tested at 28 days.

2. For each sample of fresh concrete, perform the following duties:

a. Measure and record slump in accordance with ASTM C143.

b. Measure and record temperature in accordance with ASTM C1064.

1) Provide one test hourly when air temperature is 40°F (4.4°C) and below and when 80°F (27°C) and above, and one test for each composite sample.

c. Measure and record air content by volume in accordance with either ASTM C231 or ASTM C173.

d. Mold three cylinders (laboratory cylinders) in accordance with ASTM C31 to be laboratory-cured. Protect from moisture loss and maintain at 60°F to 80°F for 24 to 48 hours before moving. Deliver cylinders to testing laboratory for curing and testing.

e. Mold one cylinder (field cylinder) in accordance with ASTM C31 to be field-cured. Field cylinder shall be placed as near as possible to the in-place concrete from which it was taken, protected, and cured in the same manner. Deliver field-cured cylinder to testing laboratory, and measure and record compressive strength in accordance with ASTM C39. Field cylinder shall be used to determine if concrete footings, walls, or piers have reached the required compressive strength for steel erection to begin.

3. Measure and record compressive strength in accordance with ASTM C39 for laboratory cylinders. Test one laboratory cylinder at 7 days and all other cylinders at 28 days. Acceptance is based on the average of the two laboratory cured 28-day tests. Notify Architect in the event strength levels do not meet the acceptance requirements of ACI 318.

a. Any additional cylinders molded for Contractor to have a compressive strength test done before seven days shall be at the Contractor's expense.

4. Prepare and submit test reports to the Architect, Engineer, Contractor, and Supplier. Reports shall be completed and furnished within 48 hours of testing. Refer to description in Submittals.

5. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.

1.4 SUBMITTALS

A. Concrete Materials: Submit information on concrete materials as listed below.

1. Cementitious materials: Submit type, class, producer name, and certification not more than 90 days old of compliance with applicable ASTM standard.

2. Aggregates: Submit type, pit or quarry location, producer name, gradations, specific gravity, water content, and certification not more than 90 days old.

3. Admixtures: Submit product data sheet. Product data shall include: dosages and performance data, brand names, producers, chloride ion concentrations, and certifications of compliance with applicable ASTM standard. Certifications shall not be more than 90 days old.

4. Water: Submit name of source.

B. Product Data: Prepare and submit product and performance data for materials and accessories, including patching compounds, joint systems, curing compounds, finish materials and other concrete related items.

C. Testing Agency Qualifications: When requested, the proposed testing agencies shall submit data on qualifications for acceptance.

D. Concrete Mix Design:

1. Concrete mix design submittals shall be submitted at least 14 days prior to placing concrete.

2. Submit concrete mixture proportions and characteristics for each concrete mix. Include standard deviation analysis or trial batch data with mix design. Submit historical field test data to demonstrate the average compressive strength for approval. Concrete mix proportions, materials, and handling methods for field test data or trial batches shall be the same as used for the work. Include the following information for each mix design:

   a. Water/cementitious materials ratio.
   b. Slump per ASTM C143
   c. Air content per ASTM C231 or ASTM C173
   d. Unit weight of concrete per ASTM C138
   e. Compressive strength at 28 days per ASTM C39

3. If trial batches are used, submit representative samples of each proposed ingredient to independent testing laboratory for use in preparation of mix design.

4. Include alternate mix designs when characteristics of materials, project conditions, weather, test results, or other circumstances warrant adjustments. Indicate amounts of mix water to be withheld for later addition at Project site.

5. Provide a record copy of the final mix designs and test results to the testing agency prior to commencement of the concrete work.

E. LEED Certification: Submit manufacturer's certification for each concrete product including the following:

1. LEED Credit MRc 4.1/4.2 – Recycled content, including percentage by weight of pre-consumer (post-industrial) and post-consumer recycled content. Also provide manufacturer's name and product cost.

2. LEED Credit MRc 5.1/5.2 – Location of manufacturing plant, manufacturer's name, product cost and location of extraction or harvest of raw materials.

F. Concrete Finish Shop Drawings: Submit drawings indicating type of finish to be used at each location.

G. Slab-on-Grade Joint Layout: Submit drawings for proposed slab-on-grade control joint and construction joint layout for approval.

H. Test Reports: Submit laboratory test reports for concrete materials, mix design, compressive strength, slump, air content, and temperature. Each report shall indicate date of sampling, date of test, mix design, and location of concrete in structure.

I. Repair Methods: When stains, rust, efflorescence, and surface deposits must be removed, submit the proposed method of removal.

J. Certificates: Submit written certification regarding the design mix from the ready-mix supplier and the admixture manufacturer stating all concrete and admixtures do not contain chloride ions in excess of concentrations specified herein.

K. Placement Notification: Notify the Architect at least 24 hours in advance of concrete placement.

L. Adjustments: Submit any adjustments to mixture proportions or changes in materials, suppliers, or sources along with supporting documentation during the course of the work.

M. Cold Weather Procedure Submittal: Refer to Cold Weather Concreting article in Part 3 for more information.

1.5 MATERIAL DELIVERY, STORAGE, AND HANDLING

A. Cementitious materials: Store cementitious materials in dry weather tight buildings, bins, or silos that exclude contaminants.

B. Aggregates: Store and handle aggregate in a manner that will avoid segregation and prevent contamination with other materials or other sizes of aggregates. Store aggregates so as to drain freely.

C. Admixtures: Protect stored admixtures against contamination, evaporation, or damage. Protect liquid admixtures from freezing and temperature changes, which would adversely affect their performance. Handle chemical admixtures in accordance with manufacturer's instructions.

PART 2 - PRODUCTS

2.1 CONCRETE MATERIALS

A. Portland Cement: Portland cement shall conform to ASTM C150, Type I Normal, and be a standard brand of Portland cement. Use one brand of cement throughout project, unless approved in writing by the Engineer. Cement, which conforms to ASTM C150 Type II, may be used if it also meets the requirements of ASTM C150 Type I. Cement used in concrete shall be of the same brand and type as the cement used in the concrete represented by the submitted field test data or used in the trial mixtures. Maintain consistent cement color throughout project unless directed otherwise by architectural requirements.

1. Total replacement of Portland cement by supplementary cementitious materials in design mixture shall not exceed 50% (by weight).

B. Supplementary Cementitious Materials

1. Fly Ash: Fly ash shall conform to ASTM C618, Class C or Class F. Replacement of Portland cement by fly ash shall not exceed the following (percentages are by weight):

   a. Concrete Flatwork: 20 percent.
   b. Mass Concrete (more than two feet thick): 50 percent.
   c. All other concrete: 25 percent.
   d. Concrete to be placed in cold weather as defined herein: No fly ash allowed unless the cold weather procedure submitted has compensated for the increased setting time and decreased rate of strength gain due to cold weather and fly ash.

2. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.

   a. Ground Granulated Blast-Furnace Slab Limit: 50% by weight of total cementitious materials.

b. In mass concrete more than 2 feet thick, the usage rate may be 80% by weight of total cementitious materials.

3. Combined Fly Ash and Ground Granulated Blast-Furnace Slag:

a. Supplementary Cementitious Materials Limit: 50% with fly ash not exceeding 25% by weight of total cementitious materials.

b. In mass concrete more than 2 feet thick: 80% with fly ash not exceeding 50% by weight of total cementitious materials.

C. Blended Hydraulic Cements

1. Portland Blast-Furnace Slag Cement: ASTM C 595, Type IS.

a. Blast-Furnace Slag Content: 25% to 50% by weight of total cementitious materials.

2. Portland-Pozzolan Cement: ASTM C 595, Type IP.

a. Pozzolan Content: 15% to 40% by weight of Pozzolan total cementitious materials.

3. Pozzolan-Modified Portland Cement: ASTM C 595, Type I (PM).

a. Pozzolan Content: 0% to 15% by weight of total cementitious materials.

4. Slag-Modified Portland Cement: ASTM C 595, Type I (SM.

a. Blast-Furnace Slag Content: 0% to 25% by weight of total cementitious materials.

D. Coarse Aggregate for Normal Weight Concrete: Comply with ASTM C33. Provide coarse aggregate from a single source for exposed concrete. Gradations shall be similar to that described in the following table:

COARSE AGGREGATE GRADATIONS							
SIEVE SIZE - PERCENT PASSING							
Grade No.	1-1/2"	1"	3/4"	1/2"	3/8"	No. 4	No. 16
4	90-100 Note 1	20-55	0-15	---	0-5		---
57	100	95-100	---	25-60	0-10	0-10	---
67		100	90-100	---	20-55	0-10	---
89	---	---	---	100	90-100	20-55	0-10

1. Shall be 100 percent passing the 2" sieve.

2. A maximum of 30% of coarse aggregate may be recycled aggregate for footing concrete.

E. Fine Aggregate for Normal Weight Concrete: Comply with ASTM C33. Provide fine aggregate from a single source for exposed concrete. Fine aggregate shall consist of washed sand. Gradations shall be similar to that described in the following table:

FINE AGGREGATE GRADATIONS							
SIEVE SIZE - PERCENT PASSING							
Grade No.	3/8	No. 4	No. 8	No. 16	No. 50	No. 80	No. 100
FA	100	95-100	80-100	50-85	5-30	---	0-10

1. A maximum of 10% of fine aggregate may be recycled aggregate for footing concrete.

F. Do not use aggregates containing deleterious substances that could cause spalling on any exterior exposed surface. These include, but are not limited to the following:

1. Organic impurities.
2. Ferrous metals.
3. Soluble salts.
4. Coal, lignite, or other lightweight materials.
5. Soft particles.
6. Clay lumps and friable particles.
7. Cherts of less than 2.40 specific gravity.

G. Water: Mixing water for concrete shall meet the requirements of ASTM C94. Water shall be clean and free from injurious amounts of acids, alkalies, organic materials, chloride ions and oils deleterious to concrete or reinforcing steel.

H. Testing agency shall be given access to plants and stockpiles to obtain samples for testing for compliance with the Contract Documents.

2.2 ADMIXTURES

A. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures. Calcium chloride thiocyanates or admixtures containing more than 0.05 percent chloride ions by weight are not permitted.

B. Water Reducing Admixture: Material shall comply with ASTM C494, Type A. Acceptable manufacturers and products include:

1. Euclid Chemical Company - Eucon WR Series.
2. Sika Chemical Corp. - Plastocrete 161.
3. GRT – Polychem 400 NC.
4. Grace Construction Products - WRDA 82.

C. High Range Water Reducing Admixture (superplasticizer): Material shall comply with ASTM C494, Type F or Type G. Acceptable manufacturers and products include:

1. Euclid Chemical Company - Eucon 37 or Plastol Series.
2. Sika – ViscoCrete 2100.
3. GRT – Melchem.
4. Grace Construction Products - Mira 110.

D. High Range Water Reducing, Slump Retaining Admixture: Material shall comply with ASTM C494, Type F or Type G. Acceptable manufacturers and products include:

1. Euclid Chemical Company - Eucon 537, Eucon 1037, or Plastol Series.
2. Sika – Sikament 686.
3. GRT – Melchem – M.
4. Grace Construction Products – ADVA FLEX.

E. Non-Chloride Accelerator: Material shall comply with ASTM C494, Type C or Type E, and not contain a higher chloride ion concentration than municipal drinking water. Acceptable manufacturers and products include:

1. Euclid Chemical Company - Accelguard Series.
2. Sika Chemical Corp. - Sika Rapid-1.
3. GRT – Polychem HE.
4. Grace Construction Products – Lubricon NCA.

F. Air Entraining Admixture: Air entraining admixture shall comply with ASTM C260, and be certified by the manufacturer to be compatible with other admixtures to be used. Acceptable manufacturers and products include:

1. Euclid Chemical Company - Air-Mix or AEA Series.
2. Sika Chemical Corporation - Sika-Aer.
3. GRT – Polychem VR.
4. Grace Construction Products - Darex II or Daravair 1000.

G. Admixtures used in concrete shall be the same brand, type, and dosage used in concrete represented by field test data or used in trial mixes.

2.3 CURING PRODUCTS

A. Moisture Retaining Cover

1. Plastic Film: Use 6 mil polyethylene film sheet materials that meet the requirements of ASTM C171.

2. White burlap-polyethylene sheet meeting ASTM C171.

3. Reinforced Curing Paper complying with ASTM C171.

4. Moisture Retaining Fabric: A naturally colored, non-woven, polypropylene fabric with a 4-mil, non-perforated reflective (white) polyethylene coating containing stabilizers to resist degradation from ultraviolet light. Fabric shall exhibit low permeability and high moisture retention. Acceptable manufacturers and products include:

   a. PNA Construction Technologies, Inc.: Hydracure M15.
   b. Reef Industries Incorporated: Transguard 4000.

B. Dissipating Resin Curing Compound: Clear, waterborne, membrane-forming curing compound complying with ASTM C309, Type 1, Class B shall be composed of hydrocarbon resins and dissipating agents that begin to break down upon exposure to ultraviolet light and traffic approximately 4 to 6 weeks after application, providing a film that is removable with standard degreasing agents, and mechanized scrubbing actions so as to not impair the later addition of applied finishes.

1. Curing compounds used on interior enclosed environments shall be a water-borne product and VOC compliant as required by the U.S. EPA Architectural Coating Rule.

C. Non-dissipating Curing Compound: Clear, membrane-forming curing compound complying with ASTM C309, Type 1, Class B.

1. Curing compounds used on interior enclosed environments shall be a water-borne product and VOC compliant as required by the U.S. EPA Architectural Coating Rule.

D. Curing and Sealing Compound: Clear, membrane-forming curing and sealing compound complying with ASTM C309, Type 1, and ASTM C1315, Type 1, Class A. Compound shall dry to a clear finish, resist yellowing due to ultraviolet degradation and provide a long lasting finish that has high resistance to chemicals, oil, grease, deicing salts, and abrasion.

1. Curing and sealing compounds used on interior enclosed environments shall be a water-borne product and VOC compliant as required by the U.S. EPA Architectural Coating Rule.

2.4 MISCELLANEOUS MATERIALS

A. Patching Mortar: Non-shrink, non-slump, non-metallic, quick setting. Acceptable manufacturers and products:

1. Euclid Chemical Company - Eucospeed.
2. BASF - Thorite.
3. Adhesive Technologies. - Hard Rok Vertipatch.
4. W.R. Meadows - Speed Crete (Red Line).
5. Dayton Superior – Re-Crete 20 minute.
6. SpecChem - Precast Patch.

B. Expansion Joint Material: Preformed, resilient, non-extruding asphalt impregnated resilient fiber conforming to ASTM D1751. Thickness of expansion joint material shall be 1/2" unless noted otherwise on the drawings.

C. Magnesium phosphate patching cement specially designed for cold weather grouting and anchoring. Acceptable Manufacturer:

1. BASF - MasterEmaco T545.
2. Euclid Chemical Company - Eucospeed MP.

D. Vapor Retarder: ASTM E 1745, Class A, not less than 10 mils (0.25 mm) thick. Acceptable manufacturers and products:

1. Stego Industries, LLC - Stego Wrap.
2. W.R. Meadows, Inc. - Perminator.
3. Raven Industries - Vapor Block
4. Insulation Solutions - Viper VaporCheck II.

E. Penetrating Liquid Floor Treatment: Chemically reactive, waterborne solution of inorganic silicate or siliconate materials and proprietary components; odorless; colorless; that penetrates, hardens, and densifies concrete surfaces. Acceptable manufacturers and products:

1. Conspec Marketing & Manufacturing Co., Inc. - Intraseal
2. Curecrete Chemical Co., Inc. - Ashford Formula
3. Dayton Superior Corporation - Day-Chem Sure Hard (J-17)
4. Euclid Chemical Company - Eucosil
5. L&M Construction Chemicals, Inc. - Seal Hard
6. Vexcon Chemicals, Inc - Vexcon Starseal PS
7. SpecChem - SpecHard

F. Control Joint Filler: Flexible, single-component polyurethane sealant with backer rod compliant with ASTM C 920, Type S, Grade P, Class 25. Apply sealant per manufacturers written recommendations. Acceptable manufacturers and products:

1. Dayton Superior – Perma 230 SL.
2. Euclid Chemical Company – Eucolastic I.
3. Sonneborn – Sonolastic SL 1.

2.5 STRENGTH AND PROPERTIES

A. Concrete Mix Designs: Refer to Drawings for specified compressive strength. Proportion concrete mixes according to the properties in the following tables. The concrete supplier may produce a mix at a lower water-cement ratio to allow for adjustment of slump at the site by adding water. The addition of site water shall be in accordance with ASTM C94, and the total water-cement ratio shall not exceed the value specified below.

Class	Coarse Aggregate Gradation	Fine Aggregate Gradation	Range of Slump	Max. w/c	Air Content	Other Requirements
A	57 or 67	FA	1" to 4"	0.40	5% to 8%	
B	57 or 67	FA	1" to 4"	0.45	5% to 8%	
C	57 or 67	FA	1" to 4"	0.50	—	
D	57 or 67	FA	4" to 6"	0.50	—	Use water reducing admixture to achieve slump specified
E	4 or 57	FA	1" to 4"	0.50	—	
F	4 or 57	FA	5" to 8"	0.50	—	Use retarder
H	89	FA	5" to 8"	0.50	—	
J	Lightweight	FA	5” max	0.5	4% to 7%	Maximum 107-116 pcf dry density

Note: w/c = water-cementitious materials ratio.

B. Schedule of Concrete Classes: Provide concrete of the specified class according to the following schedule.

1. Footings: Class E
2. Exterior foundation walls and piers: Class B
3. Interior slabs on grade: Class D
4. Floor topping: Class H
5. Unless noted otherwise: Class B

C. Slump of Superplasticized Concrete: Concrete containing high-range water reducing admixtures (superplasticizer) shall have 8" maximum slump, unless otherwise approved by Structural Engineer. Concrete shall arrive at job site with 2" to 3" slump, be verified, then high range water reducing admixture added to increase slump to approved level.

D. Accelerators: Add non-chloride accelerator to all concrete slabs placed at air temperatures below 50°F.

E. Water Reducer: Add water reducing admixture or high range water reducing admixtures (superplasticizers) as follows:

1. All pumped concrete.
2. Fiber reinforced concrete.
3. As required for placement or workability.
4. As required by high temperatures, low humidity, or other adverse placement conditions.
5. Concrete with water-cementitious materials ratio below 0.50.

F. No other admixtures shall be used unless approved by Structural Engineer of record.

G. Chlorides: Admixtures or other ingredients including aggregates containing calcium chloride or more than 0.05% chloride ions by weight shall not be used.

H. Workability: Concrete shall have a workability such that it will fill the forms without voids, honeycombs, or rock pockets with proper vibration without permitting materials to separate or excess water to collect on the surface.

I. Concrete Temperatures: Minimum concrete temperature of fresh concrete varies in relation to average air temperature over a 24-hour period as follows:

1.	Air temperature below 0°F	Concrete temperature 70°F min.
2.	Air temperature 0°F to 30°F	Concrete temperature 65°F min.
3.	Air temperature 30°F to 50°F	Concrete temperature 50°F min.
4.	Air temperature above 50°F	No minimum temperature

The maximum temperature of concrete at the time of delivery shall be 90°F. When concrete temperature exceeds 90°F, concrete supplier shall attempt to reduce temperature by shading aggregates and cement and cooling mix water. When these methods fail to reduce concrete temperature below 90°F, supplier shall use ice in the water to reduce the concrete temperature.

2.6 LEED CREDITS

A. LEED Credit MRc 4.1/4.2 –Concrete flatwork shall contain at least 15% recycled cement (slag cement and fly ash). Concrete footings and drilled piers shall contain at least 50% recycled content. All other concrete shall contain at least 25% recycled cement.

B. LEED Credit MRc 5.1/5.2 – Concrete shall be manufactured within 500 miles of the project site. Aggregate, sand and water shall be procured form within 500 miles of the project site.

PART 3 - EXECUTION

3.1 PREPARATION

A. Do not place concrete until data on materials and mix designs have been approved, Architect has been notified, and all other affected trades have coordinated their work.

B. Remove snow, ice, frost, water, mud, and other foreign material from surfaces, reinforcing bars and embedded items against which concrete will be placed.

C. Do not allow form release agent to contact reinforcing bars.

3.2 SLABS

A. Slab on Grade:

1. All interior slabs on grades shall have a polyethylene vapor retarder conforming to ASTM E1745. Lap all joints minimum 6” and seal edges with adhesive tape. Fit vapor retarder around utilities and seal with adhesive tape as required. Place, protect, and repair vapor-retarder sheets according to ASTM E 1643 and manufacturer's written instructions.

2. Refer to Drawings and Section 31 23 00 for required sub-grade preparation beneath slabs on grade.

3. Where vapor retarder is not used below slab on grade, wet sub-grade below slab prior to placing concrete. Subgrade shall be moist with no free water and no muddy or soft spots.

4. Saw cut control joints: Cut with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks. Control joints shall be located along column lines, with intermediate joints spaced at a maximum distance of 36 times the slab thickness, unless noted otherwise. Control Joints shall be continuous, not staggered or offset. Slab panels shall have a maximum length to width ratio of 1.5 to 1. Provide additional control joints at all reentrant or isolated corners formed in the slab on grade. Refer to Drawings for typical control joint detail.

5. Provide isolation joints around each column and along foundation walls. Form isolation joints with 1/2" expansion joint material. Extend isolation joint material full width and depth of joint, terminating flush with finished concrete surface, unless otherwise indicated.

6. Depress slabs as required for mats architectural finishes. Obtain layout and locations from Architect.

7. Verify completion of all under slab work with mechanical and electrical trades before placing slabs.

8. Slope slabs as indicated on Drawings and to provide positive drainage. Slope slab keeping bottom level and varying top. Maintain minimum thickness of concrete as indicated on Drawings. Refer to floor finishes for tolerances.

B. All slabs not on grade (all supported slabs), including slabs-on-steel decking and cast-in-place concrete slabs:

1. Supported slabs have deflections that may cause areas of concrete to have thicknesses greater than indicated on the Drawings. Contractor is expected to provide that volume as needed to finish the floor at the specified elevation. If specified floor finish tolerances are not achieved during the concrete floor construction, the Contractor shall install, at no cost to the project, a self-leveling cementitious underlayment (Master Builders Mastertop 110 Underlayment or approved equal) to correct the floor flatness and levelness.

C. Embedded Items:

1. The outside diameter of embedded conduit or pipe shall not exceed one-third of the slab thickness in structural slabs, including at crossovers, and shall be placed between the top and bottom reinforcing with a minimum 3” clear cover. Conduit or pipe running parallel to each other shall be spaced at least 8” apart and no more than 2 runs stacked vertically in the slab. Conduit or pipe shall not be embedded in any supported slab less than 6” thick. No embedded conduit or pipe is allowed in any concrete slab-on-steel deck.

3.3 CONSTRUCTION JOINTS

A. Construction Sequence Submittal: Contractor shall submit a construction sequence indicating construction joints and the pour sequence.

B. Vertical: Locate vertical construction joints in walls not farther than a maximum of 100 feet on center. Coordinate joint locations with architectural design.

C. Horizontal: Locate horizontal joints in walls, piers and columns at underside of slabs and at the top of slabs and footings unless otherwise indicated. At least 24 hours shall elapse between placing concrete in a wall or column and placing concrete in an area supported by the walls or columns, unless approved in writing by Structural Engineer.

D. Reinforcing: Stop all welded wire reinforcement and/or reinforcing at construction joint in slabs on grade and provide dowel bars as detailed. Provide reinforcement at other construction joints as detailed. Roughen and thoroughly clean the surface of the concrete, remove all laitance, and wet the surface before placing new concrete against the joint. Slush vertical joints with a neat cement grout before placing new concrete.

3.4 CONCRETE PLACEMENT

A. Place concrete as continuously as possible until placement is complete. Do not place against concrete that has attained initial set, except at authorized joints. If, for any reason, concrete pour is delayed for more than 45 minutes, bulkhead off pour at last acceptable construction joint. Immediately remove excess concrete and clean forms.

B. Do not begin to place concrete during periods of rain, sleet or snow unless adequate protection is provided.

C. No concrete shall be cast onto or against sub-grades containing free water, frost, ice or snow.

D. Notify the architect in advance if concrete is to be pumped.

E. Do not place concrete until all reinforcement is in place, forms have been thoroughly cleaned and approval has been given.

F. Do not accept concrete delivered to the job site more than 90 minutes after initial mixing.

G. Concrete from its point of release to mixers, hoppers, or conveyances, shall not be permitted to drop more than 5 feet (10 feet for concrete containing high range water reducers). Deposit concrete directly into conveyances and directly from conveyances to final points of deposit. Sufficient transportation equipment in good working order shall be on hand before work begins. All conveying equipment must be clean and kept clean during concreting operations. Take every possible precaution to prevent segregation or loss of ingredients.

H. Deposit concrete in wall forms in layers not greater than 12 inches in depth, each layer being compacted by internal vibration before succeeding layer is placed.

I. Place concrete as near as possible to its final position to prevent segregation. Do not use vibrators to transport concrete within forms. Consolidate concrete in walls, columns, beams and slabs or joist construction thicker than 8" with internal vibrators (8,000 to 12,000 V.P.M.). Slabs less than 8" thick may be consolidated with internal vibrators (9,000 to 13,500 V.P.M.) or vibrating screeds supported on forms, boards or rails, approved by Structural Engineer, supplement vibration by forking or spading by hand along surfaces adjacent to forms and construction joints.

J. Re-tempering of concrete will not be permitted. Concrete that has obtained its initial set shall be discarded.

K. Exercise care in placing concrete over waterproof membranes, rigid insulation and/or protection boards to avoid damaging those materials. Report damage immediately, and do not proceed until damage is repaired.

L. Remove loose debris from surfaces, thoroughly wet and slush with a neat cement grout immediately before placing new concrete, or apply bonding compound to surface and let dry before placing new concrete.

M. Protect existing concrete work to be exposed to view and other finished materials from damage and staining resulting from concreting operations. Handle concrete carefully to avoid dripping and spillage. Remove spilled concrete from existing surfaces immediately. Covering sills, ledges, and other surfaces with protective coverings may be necessary to protect the work.

N. Filling In: Fill in holes and openings left in concrete structures, unless otherwise indicated, after work of other trades is in place. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete Work.

O. Steel Pan Stairs: Provide concrete fill for steel pan stair treads, landings, and associated items. Cast-in inserts and accessories as shown on Drawings. Screed, tamp, and trowel-finish concrete surfaces.

3.5 CONCRETE FINISHES AND TOLERANCES

A. Exposed Smooth Formed Surfaces: Remove forms and perform necessary repairs and patch to produce surface finish-3.0 as specified in ACI 301. Apply the following to smooth-formed finished concrete exposed to view in the finished work. Confirm finishes with architect prior to concrete placement by submitting shop drawings indicating locations of all types of finishes.

1. Smooth-Rubbed Finish: Not later than one day after form removal, moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture. Do not apply cement grout other than that created by the rubbing process.

B. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise indicated.

3.6 CONCRETE SLAB FINISHES AND TOLERANCES

A. Trowel Finish:

1. Screed concrete to an even plane, float, then power trowel the surface.

2. Hand trowel the surface smooth and free of trowel marks. Continue hand troweling until a ringing sound is produced as the floor is troweled.

3. Provide trowel finish as indicated on the Drawings and at the following locations:

   a. Concrete floors exposed in finished work unless otherwise indicated.
   b. Slabs to receive curing compounds and sealers.
   c. Slabs to receive resilient flooring or carpet.

B. Fine Broom Finish:

1. Screed concrete to an even plane, float, then power trowel the surface. Provide fine hair broom finish perpendicular to slope, free of loose particles, ridges, projections, voids and concrete droppings.

2. Provide fine broom finish as indicated on the Drawings and at the following locations:

   a. Stoop slabs.
   b. Raised curbs and walkway areas.
   c. Slabs to receive thin set ceramic tile.

C. Broom Finish:

1. Screed concrete to an even plane and then float. Immediately after concrete has received a floated finish, give the concrete surface a coarse transverse scored texture by drawing a coarse broom across the surface.

2. Provide as indicated on the Drawings and at the following locations:

   a. ADA ramp slabs.
   b. Exterior walkway slabs.

D. Float Finish:

1. Screed concrete to an even plane then float.

2. Provide as indicated on the Drawings and at the following locations:

   a. Slabs to directly receive concrete topping.
   b. Roof slabs to receive loose laid roof insulation.

E. Floor Finish Tolerances: Floor finish tolerances shall be measured by placing a freestanding (unleveled) 10 foot straightedge anywhere on the slab and allowing it to rest upon two high spots within 72 hours after placement of slab and removal of shoring (if present). The gap at any point between the straightedge and the floor (and between the high spots) shall not exceed:

1. Slab on Grade: 1/4”

F. Slab Drainage: Finish all concrete slabs to proper elevations to insure that all surface moisture will drain freely to floor drains, and that no puddle areas exist. Contractor shall bear the cost of corrections to provide positive drainage.

G. Special Tolerances for Concrete Slabs: No abrupt change in vertical elevation of 1/4" or more is acceptable at the interface between slabs and within areas where pedestrian traffic is expected:

3.7 CONCRETE CURING

A. Freshly placed concrete shall be protected from premature drying and excessively hot temperatures.

B. Concrete other than high-early strength shall be maintained above 50°F and in a moist condition for at least the first 7 days after placement, except when special curing is used. Special curing procedures shall not be used without written permission from the Structural Engineer of Record.

C. Formed surfaces shall be cured by leaving the formwork in place during the curing period.

D. Protect concrete from excessive changes in temperature during the curing period and at the termination of the curing process. Changes in the temperature of the concrete shall be as uniform as possible and shall not exceed 5°F in any one hour or 50°F in any 24 hour period.

E. Protect concrete from injury from the elements until full strength is developed. Protect from mechanical injury.

F. During cold weather construction, all footings shall be protected from frost penetration until the building is enclosed and temporary heat is provided.

3.8 SLAB CURING

A. Begin curing after finishing concrete, but not before free water has disappeared from concrete surface. Use one of the methods described below.

B. Moisture-Retaining-Cover Curing for Concrete Floors not Exposed in Final Condition: Cover concrete surface with waterproof sheet material as soon as finishing operations are complete and the concrete is sufficiently hard to be undamaged by covering. The cover shall be placed flat on the concrete surface, avoiding wrinkles. Sprinkle concrete with water as necessary during application of covering. Place in widest practicable width, with sides and ends lapped at least 12 inches, and seal with waterproof tape or adhesive. Verify that the concrete is continuously wet under the sheets; otherwise, add water through soaker hoses under the sheets. Weight down covering to prevent displacement. Immediately repair any holes or tears during the curing period using polyethylene sheet and waterproof tape. Curing process shall be maintained for a minimum of 7 days.

C. Moisture-Retaining-Fabric Curing for Concrete Floors to Remain Exposed: Cover concrete surface with moisture retaining fabric as soon as finishing operations are complete and the concrete is sufficiently hard to be undamaged by covering. The cover shall be installed in accordance with manufacturer's written recommendations, in largest practical widths. Wet the slab to rejection, then thoroughly wet fabric side of cover and install with poly side up. Lap over adjacent covers a minimum of 18". Wet all laps and outside edges to prevent displacement and to ensure intimate contact with concrete and adjacent covers. Rewet as necessary and protect covers from damage during curing process.

1. After minimum 7-day cure, remove moisture retaining fabric in sections.

2. A maximum of 3,500 square feet of concrete curing cover may be removed at any one time. At no time shall the exposed area be permitted to dry prior to completion of the floor scrubbing process.

3. Using a high powered floor scrubber capable of a minimum 80 pounds head pressure, and a mild citrus-based detergent that does not damage or mar the surface in any way, scrub the floor to remove any minerals or soluble salts that may have accumulated at the floor surface. Rinse area thoroughly with clean fresh water. Remove water and allow floor to dry. If whitening occurs during drying, repeat scrubbing process before floor dries until no whitening occurs during drying.

4. All areas of the floor shall remain wet during floor scrubbing process. Expose only the amount of floor surface that can be cleaned before any drying occurs without exceeding the maximum allowable exposed area.

D. Curing Compound: Apply uniformly in continuous operation by low pressure spray equipment or roller as soon as finishing operations are complete, free water on the surface has disappeared and no water sheen can be seen. Follow the manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period. Verify compatibility of the curing compound with paint, finishes, or toppings that require positive bond to the concrete. If curing compound is not compatible with paint finishes or toppings, utilize a dissipating curing compound and remove in accordance with the manufacturer's recommendations.

3.9 PENETRATING LIQUID FLOOR TREATMENTS

A. Penetrating Liquid Floor Treatment: Prepare, apply, and finish penetrating liquid floor treatment according to manufacturer's written instructions.

B. Remove curing compounds, sealers, oil, dirt, laitance, and other contaminants and complete surface repairs in accordance with manufacturer's written instructions.

C. Do not apply to concrete that is less than seven days old.

D. Apply liquid until surface is saturated, scrubbing into surface until a gel forms; rewet; and repeat brooming or scrubbing. Rinse with water; remove excess material until surface is dry. Apply a second coat in a similar manner if surface is rough or porous.

3.10 JOINT FILLING

A. Prepare, clean, and install joint filler according to manufacturer's written instructions.

B. Do not fill joints until construction traffic has permanently ceased.

C. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joint clean and dry.

D. Install semi-rigid joint filler in saw-cut joints and in formed joints. Overfill joint and trim joint filler flush with top of joint after hardening.

3.11 APPLICATION OF FLOOR SEALER - FINISH COAT

A. Give concrete floors as indicated in Room Finish Schedule and where exposed in finished Work, second coat of curing and sealing compound immediately prior to Substantial Completion.

B. Clean floors and apply sealer strictly according to manufacturer's instructions. Dilution and coverage shall be as recommended by the manufacturer. Apply sealer evenly.

3.12 COLD WEATHER CONCRETING

A. Definition: Cold weather shall be defined as a period when for more than three successive days the average daily outdoor temperature drops below 40°F. The average daily temperature is the average of the highest and lowest temperature during the period from midnight to midnight. When temperatures above 50°F occur during more than half of any 24 hour duration, the period shall not be regarded as cold weather.

B. All cast-in-place concrete work occurring during cold weather shall conform to all requirements of ACI 306.1, "Standard Specification for Cold Weather Concreting", published by the American Concrete Institute, Detroit, Michigan, except as modified by the contract documents or this specification.

C. Planning: The General Contractor, concrete contractor, concrete supplier and the architect shall have a pre-construction conference to outline the cold weather concreting operations concerning the placing, finishing, curing and protection of the concrete during cold weather. Pre-construction conference shall occur before cold weather is expected to occur.

D. Detailed procedure submittal: Concrete contractor shall prepare and submit for review detailed procedures for the production, transportation placement, protection, curing and temperature monitoring of concrete during cold weather. Include procedures to be implemented upon abrupt changes in weather conditions. Do not begin cold weather concreting until these procedures have been reviewed and approved.

E. Mixing: Concrete flatwork poured in cold weather shall be proportioned to obtain a lower slump to minimize the amount of bleed water during finishing. All bleed water should be skimmed off flatwork prior to troweling. Concrete that will be exposed to cycles of freezing and thawing while saturated should be properly air entrained as outlined in this specification.

F. Protection of Concrete: Cure and protect concrete against damage from freezing for a minimum period of 72 hours, unless approved by the structural engineer. The protection period may be reduced according to ACI 306.1 requirements. Concrete contractor shall submit a letter of request to reduce the protection period, by outlining the method used to achieve the reduction per ACI 306.1.

1. When practical for the construction schedule, formwork shall be insulated and remain in place for at least the required protection period.

G. Concrete Temperatures: The minimum temperature of concrete immediately after placement shall be as specified in the following table.

Section Size	Minimum temperature of concrete as placed and maintained during the protection period	Maximum gradual decrease in surface temperature during any 24 hours after the end of the protection.	Mixing Temperatures		
			Above 30°F	0 to 30°F	Below 0°F
< 12 in	55°F	50°F	60°F	65°F	70°F
12-36 in	50°F	40°F	55°F	60°F	65°F
36-72 in	50°F	30°F	50°F	55°F	60°F
> 72 in	50°F	20°F	45°F	50°F	55°F

H. Mixing Temperatures: As the ambient air temperature decreases the concrete mixing temperature shall be increased to compensate for the heat lost in the period between mixing and placement. The concrete supplier shall use one or both of the following methods for increasing the concrete temperature.

1. Heating the mixing water to a temperature necessary to offset the temperature losses during transport. Supplier shall not heat water to temperatures in excess of 140°F, without taking special precautions as outlined in ACI 306.

2. Heating the aggregate with a circulated steam piping system.

I. Temperature measurements: The Contractor shall be responsible for monitoring and recording the concrete temperatures during placement and throughout the protection period.

1. Inspection personnel shall keep a record of the date, time, outside air temperature, temperature of concrete as placed, and weather conditions.

2. Temperature of the concrete and the outside air shall be recorded at regular intervals but not less than twice in a 24 hour period. The record shall include temperatures at several points within the enclosure and on the concrete surface of sufficient frequency to determine a range of temperatures.

3. Inspection agency shall submit the temperature logs to the Architect for permanent job records.

3.13 HOT WEATHER PROTECTION

A. Definition: Hot weather shall be defined as any combination of high ambient temperature, low relative humidity, high winds and intense solar radiation that leads to higher than usual evaporation. The table below defines low relative humidity based on air temperature. For a given air temperature, if the relative humidity is equal to or less than the specified minimum, provisions for hot weather concreting shall be as follows:

Air Temperature	Minimum Relative Humidity
105°F	90%
100°F	80%
95°F	70%
90°F	60%
85°F	50%
80°F	40%
75°F	30%

B. Scheduling: When hot weather is expected, adjust concrete placement schedules to avoid placing or finishing during the period from noon until 3:00 pm. When possible, slab pours should be delayed until the building is enclosed to protect the concrete from wind and direct sunlight, Construction schedule shall account for 7 day moist curing period.

C. Mixing: Concrete supplier shall adjust mix designs and admixtures to minimize slump loss. Concrete shall be mixed at a water-cement, which is lower than the specified maximum to allow for the adjustment of slump by addition of water in the field. Water reduction shall be accomplished without reducing initial slump by increasing dosage of water reducing admixture.

D. Preparation: Do not order concrete earlier than is required to avoid delays. Cool forms, subgrades and reinforcing bars with water spray from fog nozzle prior to concrete placement.

E. Delivery: Site traffic shall be coordinated and delivery times scheduled to minimize waiting times for concrete trucks.

F. Placement: Preparations shall be made to place and consolidate the concrete at the fastest possible rate. Maintain a continuous flow of concrete to the job site to avoid development of cold joints, during placement of slabs, apply fog spray to prevent moisture loss without causing surplus water to stand on concrete surface.

G. Finishing: Finish concrete as fast as practical. Continue fogging concrete during finishing. Where fogging is not possible, apply sprayable moisture-retaining film between finishing passes.

H. Curing: Formed concrete shall be covered with a waterproof material to retain moisture. Flat work shall be moisture cured as described in this specification. Moist curing shall continue for at least 7 days.

3.14 FIELD QUALITY ASSURANCE

A. Independent Testing Agency and Inspector shall each perform their prescribed inspection, sampling, and testing services as described in Part 1 of this specification section.

B. In cases where samples have not been taken or tests conducted as specified or strength of laboratory test cylinders for a particular portion of the structure fails to meet requirements of ACI 301, for evaluation of concrete strength, Structural Engineer shall have the right to order compressive or flexural test specimens or both be taken from the hardened concrete according to ASTM C42, load tests according to ACI 318, or such other tests as may be necessary to clearly establish the strength of the in situ concrete, and such tests shall be paid for by the Contractor.

3.15 REPAIR OF DEFECTIVE AREAS

A. All repair of defective areas shall be made, with prior approval of Architect, as to method and procedure, in accordance with Section 5 of ACI 301, except specified bonding compound must be used.

B. Patch form tie holes at the following locations:

1. Unfinished exposed concrete (not scheduled for painting, plus at board formed concrete finish).

2. All other areas: Prime voids with bonding compound and fill with patching mortar. Strike flush without overlap, float to uniform texture to match adjacent surfaces.

3. Exposed areas scheduled for spray texture:

   a. Remove projections and protrusions: 1/16" or larger.
   b. Remove continuous ridges 1/32" or larger.
   c. Fill voids and pin holes.

4. Exposed areas scheduled for paint or epoxy:

   a. Remove projections, ridges, and other protrusions 1/32" or larger.
   b. Fill voids and pin holes 1/16" or larger.

5. Exposed areas not scheduled for paint or other finishes:

   a. Remove projections, ridges and other protrusions not conforming to requirements specified under Section 03 10 00.
   b. Fill voids and pin holes not conforming to requirements specified under Section 03 10 00.

C. All structural repairs shall be made, with prior approval of the Architect/Engineer, as to method and procedure, using the specified epoxy adhesive and/or epoxy mortar.

D. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.

1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension in solid concrete but not less than 1 inch in depth. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.

2. Repair defects on surfaces exposed to view by blending white Portland cement and standard Portland cement so that, when dry, patching mortar will match surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.

3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Architect.

E. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.

1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.

2. After concrete has cured at least 14 days, correct high areas by grinding.

3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.

4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.

5. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.

6. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least 3/4 inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mix as original concrete except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.

7. Repair random cracks and single holes 1 inch or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.

3.16 CLEANING

A. Clean exposed concrete to remove laitance, efflorescence and stains.

END OF SECTION

SECTION 03 33 00

CAST-IN-PLACE BOARD FORM CONCRETE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Mock-up(s)

B. Concrete formwork

C. Concrete for cast-in-place architectural board form concrete site walls

D. Concrete curing and protection

1.2 RELATED REQUIREMENTS

A. Section 01 43 39 - Mockups

B. Section 03 20 00 - Concrete Reinforcement

1.3 REFERENCE STANDARDS

A. ACI 117 - Standard Specifications for Tolerances for Concrete Construction and Materials; 2010.

B. ACI 211.1 - Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete; 1991 (Reapproved 2009).

C. ACI 301 - Specifications for Structural Concrete; 2016.

D. ACI 304R - Guide for Measuring, Mixing, Transporting, and Placing Concrete; 2000.

E. ACI 305R - Guide to Hot Weather Concreting; 2010.

F. ACI 306R - Cold Weather Concreting; 2010.

G. ACI 308R - Guide to Curing Concrete; 2001 (Reapproved 2008).

H. ACI 318 - Building Code Requirements for Structural Concrete and Commentary; 2014 (Errata 2016).

I. ACI 347R - Guide to Formwork for Concrete; 2014.

J. ASTM C33/C33M - Standard Specification for Concrete Aggregates; 2016.

K. ASTM C39/C39M - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens; 2016b.

L. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete; 2016a.

M. ASTM C109/C109M - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or (50-mm) Cube Specimens); 2016a.

N. ASTM C143/C143M - Standard Test Method for Slump of Hydraulic-Cement Concrete; 2015a.

O. ASTM C150/C150M - Standard Specification for Portland Cement; 2016.

P. ASTM C171 - Standard Specification for Sheet Materials for Curing Concrete; 2016.

Q. ASTM C173/C173M - Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method; 2016.

R. ASTM C260/C260M - Standard Specification for Air-Entraining Admixtures for Concrete; 2010a (Reapproved 2016).

S. ASTM C309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete; 2011.

T. ASTM C494/C494M - Standard Specification for Chemical Admixtures for Concrete; 2016.

U. ASTM C618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete; 2015.

V. ASTM C1017 - Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete.

W. ASTM C1240 - Standard Specification for Silica Fume Used in Cementitious Mixtures; 2015.

1.4 SUBMITTALS

A. Product Data: Submit manufacturers' data on manufactured products showing compliance with specified requirements and installation instructions.

B. Mix Design: Submit proposed concrete mix design.
   1. Indicate proposed mix design complies with requirements of ACI 301, Section 4 - Concrete Mixtures.
   2. Indicate proposed mix design complies with requirements of ACI 318, Chapter 5 - Concrete Quality, Mixing and Placing.

C. Manufacturer's Installation Instructions: For concrete accessories, indicate installation procedures and interface required with adjacent construction.

D. Sustainable Design Submittal: If any fly ash, ground granulated blast furnace slag, silica fume, or other waste material is used in mix designs to replace Portland cement, submit the total volume of concrete cast in place, mix design(s) used showing the quantity of portland cement replaced, reports showing successful cylinder testing, and temperature on day of pour if cold weather mix is used; use LEED New Product Content Form.

E. Project Record Documents: Accurately record actual locations of embedded utilities and components that will be concealed from view upon completion of concrete work.

1.5 QUALITY ASSURANCE

A. Perform work of this section in accordance with ACI 301 and ACI 318.

B. Follow recommendations of ACI 305R when concreting during hot weather.

C. Follow recommendations of ACI 306R when concreting during cold weather.

1.6 MOCK-UP

A. Pre-construction mock-up(s) shall be required to test specific concrete mix, slump, placement rates, form pressures, vibration methods, form stripping, and overall aesthetic.

B. The mock-up(s) must duplicate the materials, methods, workmanship, placement rates, and form pressures that will actually be used on the job.

C. Mock-up Requirments
   1. Size: Full exposed height x 6' minimum length
   2. Include all finish details including, but not limited to:
      a. Vertical board-form aesthetic
      b. Toe Kick
      c. Drainage channel
      d. Form tie pattern (if applicable)
      e. Chamfer
      f. Top of wall slope and finish
   3. Quantity: Minimum of 1, maximum of 3

D. Accepted mock-up is considered basis of quality for the finished work. Keep mock-up exposed to view for duration of concrete work.

E. Mock-up may not remain as part of the Work.

1.7 WARRANTY

A. See Section 01 78 36 - Warranties, for additional warranty requirements

PART 2 PRODUCTS

2.1 FORMWORK

A. Formwork Design and Construction: Comply with guidelines of ACI 347R to provide formwork that will produce concrete complying with tolerances of ACI 117.

B. Form Framing and Support Materials: Contractor's choice of standard products with sufficient strength to withstand hydrostatic head without distortion in excess of permitted tolerances.

C. Form Facing Materials: The below options should each be represented in the contractor's initial mock-up for review and selection by Owner and Architect. Additional mock-ups; if necessary, will proceed with the preferred option.
   1. Form Facing for Exposed Board-Form Architectural Concrete
      a. Option I: Douglas Fir Species
         1) Boards shall have minimal naturally occuring blemishes such as knots and zero knot holes

2) Boards clear of damage such as dents, splinters, splits and checks
3) Varying board widths ranging between 2 1/2" - 5 1/2", arranged randomly
4) Boards placed in a vertical orientation

b. Option II: Spruce, Pine, or Fir Species
1) Meeting all requirements of Option I in addition to the below
2) Board surface lightly sandblasted to enhance natural grain pattern of wood

c. Option III: Formliner
1) Manufacturer: Fitzgerald Formliners, 1500 E. Chestnut Ave., Santa Ana, CA 92701; www.formliners.com; 800-547-7760
2) Pattern #16020, Rough Sawn Plank
3) Vertical board pattern orientation

2. Boards at outside corners shall be mitered rather than overlapped

D. Special attention shall be taken in the construction of Formwork to assure all formwork is plumb and straight

E. Screws rather than nails shall be used in the construction of formwork to prevent movement and to aid in form striping after curing

F. Form Coating: Release agent that will not adversely affect concrete.

G. Form Ties: If necessary, Fiberglass at exposed wall surfaces

2.2 REINFORCEMENT

A. Comply with requirements of Section 03 20 00.

2.3 CONCRETE MATERIALS

A. Cement: ASTM C150/C150M, Type I - Normal Portland type.
1. Acquire cement for all board-form architectural concrete from the same source.

B. Fine and Coarse Aggregates: ASTM C 33.
1. Acquire aggregates for all board-form architectural concrete from same source.

C. Fly Ash: ASTM C618, Class C or F.

D. Calcined Pozzolan: ASTM C618, Class N.

E. Silica Fume: ASTM C1240, proportioned in accordance with ACI 211.1.

F. Water: Clean and not detrimental to concrete.

2.4 ADMIXTURES

A. Do not use chemicals that will result in soluble chloride ions in excess of 0.1 percent by weight of cement.

B. Air Entrainment Admixture: ASTM C260/C260M.

C. Plasticizers for Flowing Concrete: ASTM C1017

D. High Range Water Reducing and Retarding Admixture: ASTM C494/C494M Type G.

E. High Range Water Reducing Admixture: ASTM C494/C494M Type F.

2.5 CONCRETE MIX DESIGN

A. Proportioning Normal Weight Concrete: Comply with ACI 211.1 recommendations.

B. Concrete Strength: Establish required average strength for concrete on the basis of field experience or trial mixtures, as specified in ACI 301.
1. For trial mixtures method, employ independent testing agency acceptable to Architect for preparing and reporting proposed mix designs.

C. Admixtures: Add acceptable admixtures as recommended in ACI 211.1 and at rates recommended or required by manufacturer.

D. Normal Weight Concrete:
1. Compressive Strength, when tested in accordance with ASTM C39/C39M at 28 days: 4,000 pounds per square inch.
2. Total Air Content: 6 percent plus or minus 1.5 percent, determined in accordance with ASTM C173/C173M.

3. Maximum Slump: 6 inches.

2.6 MIXING

A. Transit Mixers: Comply with ASTM C94/C94M.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify lines, levels, and dimensions before proceeding with work of this section.

3.2 PREPARATION

A. Formwork: Comply with requirements of ACI 301. Design and fabricate forms to support all applied loads until concrete is cured, and for easy removal without damage to concrete.

B. Verify that forms are clean and free of rust before applying release agent.

C. Coordinate placement of embedded items with erection of concrete formwork and placement of form accessories.

3.3 PLACING CONCRETE

A. Place concrete in accordance with ACI 304R.

B. Notify Architect not less than 24 hours prior to commencement of placement operations.

C. Maintain records of concrete placement. Record date, location, quantity, air temperature, and test samples taken.

D. Ensure reinforcement and embedded parts will not be disturbed during concrete placement.

E. Place concrete continuously without construction (cold) joints wherever possible; where construction joints are necessary, before next placement prepare joint surface by removing laitance and exposing the sand and sound surface mortar, by sandblasting or high-pressure water jetting.

3.4 CONCRETE FINISHING

A. Unexposed Form Finish: Rub down or chip off fins or other raised areas 1/4 inch or more in height.

B. Exposed Board-From Finish: Prior to any surface repair, review with Architect to determine which raised fins, bug holes, and/or areas of honeycombing should be repaired - if any - and to discuss methods and expected results from repairs.

C. Top of Wall Finish: Rub down or chip off and smooth fins or other raised areas 1/4 inch or more in height. Provide finish as follows:

1. Smooth Rubbed Finish: Wet concrete and rub with carborundum brick or other abrasive, not more than 24 hours after form removal.

3.5 CURING AND PROTECTION

A. Comply with requirements of ACI 308R. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.

B. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.

1. Normal concrete: Not less than 7 days.

C. Formed Surfaces: Cure by moist curing with forms in place for full curing period.

3.6 FIELD QUALITY CONTROL

A. The Contractor shall employ an Inspection Agency to perform the duties and responsibilities specified in Section 03 30 00 Cast-in-Place-Concrete, Part 1.

B. Provide free access to concrete operations at project site and cooperate with appointed firm.

C. Submit proposed mix design of each class of concrete to inspection and testing firm for review prior to commencement of concrete operations.

D. Tests of concrete and concrete materials may be performed at any time to ensure conformance with specified requirements.

E. Take one additional test cylinder during cold weather concreting, cured on job site under same conditions as concrete it represents.

3.7 DEFECTIVE CONCRETE

A. Test Results: The testing agency shall report test results in writing to Architect and Contractor within 24 hours of test.

B. Defective Concrete: Concrete not conforming to required lines, details, dimensions, tolerances or specified requirements.

C. Repair or replacement of defective concrete will be determined by the Architect. The cost of additional testing shall be borne by Contractor when defective concrete is identified.

D. Do not patch, fill, touch-up, repair, or replace exposed concrete except upon express direction of Architect for each individual area.

END OF SECTION

SECTION 03 35 11

CONCRETE FLOOR FINISHES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Surface treatments for concrete floors and slabs.

1.2 RELATED REQUIREMENTS

A. Section 03 30 00 - Cast-in-Place Concrete: Finishing of concrete surface to tolerance; floating, troweling, and similar operations; curing.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordinate the work with concrete floor placement and concrete floor curing.

1.4 SUBMITTALS

A. Product Data: Manufacturer's published data on each finishing product, including information on compatibility of different products and limitations.

B. Maintenance Data: Provide data on maintenance and renewal of applied finishes.

1.5 PREINSTALLATION CONFERENCE

A. Preinstallation Conference: Conduct conference at Project site.
   1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Architect, , and Owner's Representative of scheduled meeting dates.

1.6 QUALITY ASSURANCE

A. Polisher Qualifications:
   1. Experience: Company experienced in performing specified work similar in design, products, and extent to scope of this Project; with a record of successful in-service performance; and with sufficient production capability, facilities, and personnel to produce specified work.
   2. Manufacturer Qualification: Approved by manufacturer to apply liquid applied products.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in manufacturer's sealed packaging, including application instructions.

1.8 FIELD CONDITIONS

A. Maintain light level equivalent to a minimum 200 W light source at 8 feet above the floor surface over each 20 foot square area of floor being finished.

B. Do not finish floors until interior heating system is operational.

C. Maintain ambient temperature of 50 degrees F minimum.

PART 2 PRODUCTS

2.1 DENSIFIERS AND HARDENERS

A. Liquid Densifier/Hardener: Penetrating chemical compound that reacts with concrete, filling the pores and dustproofing; for application to concrete after set or as otherwise recommended by manufacturer.
   1. Composition: Lithium silicate.
   2. Products:
      a. ProSoCo; Consolideck LS.
      b. W.R. Meadows, Inc; Liqui-Hard Ultra: www.wrmeadows.com/sle.

2.2 COATINGS

A. Enhancing Sealer: High-gloss, enhancing sealer for hardened concrete.
   1. Products:
      a. ProSoCo; Consolideck LS Guard.
      b. W.R. Meadows, Inc.; Bellatrix.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that floor surfaces are acceptable to receive the work of this section.

B. Verify that flaws in concrete have been patched and joints filled with methods and materials suitable for further finishes.

C. Starting work within a particular area will be construed as acceptance of surface conditions.

3.2 PREPARATION

A. Alkalinity:
   1. Test Method: Measure pH according to method indicated in ASTM F 710.
   2. Acceptable Results: pH between 8 and 10.

B. Moisture Vapor Transmission Rate:
   1. Test Method: Perform anhydrous calcium chloride test according to ASTM F 1869.
   2. Acceptable Results: Not more than 5 pounds per 1000 square feet in 24 hours.

C. Relative Humidity:
   1. Test Method: Perform relative humidity test using in situ probes according to ASTM F 2170.
   2. Acceptable Results: Not more than 75 percent.

3.3 GENERAL

A. Apply materials in accordance with manufacturer's instructions.

3.4 COATING APPLICATION

A. Verify that surface is free of previous coatings, sealers, curing compounds, water repellents, laitance, efflorescence, fats, oils, grease, wax, soluble salts, residues from cleaning agents, and other impediments to adhesion. Remove if present. Clean in accordance with concrete floor finish manufacturer's written instructions.

B. Protect adjacent non-coated areas from drips, overflow, and overspray; immediately remove excess material.

C. At concrete surfaces indicated to be sealed, but not polished, provide the following:
   1. Confirm that concrete slab is acceptable to concrete floor finish manufacturer for application of hardener. Apply hardener/densifier in accordance with manufacturer's instructions. Allow to dry per manufacturer's instructions prior to applying enhancing sealer.
   2. Apply two coats of enhancing sealer after hardener/densifier has dried per manufacturer's instructions.
   3. Once enhancing sealer is dry, brunish after each coat using a high speed burnisher in accordance with manufacturer's instructions.
   4. At Substantial Completion, apply and burnish two additional coats of enhancing sealer to all sealed floor areas.

3.5 PROTECTION

A. Cover floors with masonite during construction. Remove at Substantial Completion.

3.6 FINAL APPLICATION

A. At Substantial Completion, apply two coats of enhancing sealer to concrete surfaces receiving hardener/densifier.

END OF SECTION

SECTION 03 41 00
STRUCTURAL PRECAST CONCRETE

PART 1 - GENERAL

1.1 DESCRIPTION

A. The General and Supplementary Conditions of the Construction Contract and Division 1 - General Requirements apply to the work specified in this section.

B. This section includes engineering, fabrication and erection of structural precast concrete units. Work shall include, but not be limited to, the following items:

1. Precast Hollow Core Slab Sections

C. Work shall also include headers for openings, connections, anchor bolts, templates, installation instructions and grouting of precast units. Anchor bolts shall be installed by other contractor.

1.2 QUALITY ASSURANCE

A. Codes and Standards: Comply with the provisions of the following codes, specifications, and standards except where more stringent requirements are shown or specified.

1. ACI 301 - Standard Specifications for Structural Concrete.
2. ACI 318 - Building Code Requirements for Reinforced Concrete.
3. ASTM A36 – Standard Specification for Carbon Structural Steel.
4. ASTM A82 - Standard Specification for Steel Wire, Plain for Concrete Reinforcement.
5. ASTM A185 - Standard Specification for Steel Welded Wire Reinforcing, Plain for Concrete Reinforcement.
6. ASTM A416 - Standard Specification for Steel Strand, Uncoated Seven-Wire for Prestressed Concrete.
7. ASTM A615 - Standard Specification for Deformed and Plain Billet Steel Bars for Concrete Reinforcement.
8. ASTM C33 - Standard Specification for Concrete Aggregates.
9. ASTM C150 - Standard Specification for Portland Cement.
10. ASTM C260 - Standard Specification for Air-Entraining Admixtures for Concrete.
11. ASTM C494 - Standard Specification for Chemical Admixtures for Concrete.
12. ASTM C618 - Standard Specification for Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete.
13. ASTM C1240 - Standard Specification for Silica Fume for use as a Mineral Admixture in Hydraulic-Cement Concrete, Mortar, and Grout.
14. ASTM F3125 - Standard Specification for High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 120 ksi and 150 ksi Minimum Tensile Strength, Inch Dimensions.

15. AWS D1.1 - Structural Welding Code - Steel.

16. AWS D1.4 - Structural Welding Code - Reinforcing Steel.

17. CRSI - Manual of Standard Practice.

18. PCI MNL-120 - PCI Design Handbook – Precast and Prestressed Concrete.

19. PCI MNL-116 - Manual for Quality Control for Plants and Production of Precast and Prestressed Concrete Products.

20. PCI MNL-117 - Manual for Quality Control for Plants and Production of Architectural Precast Concrete Products.

21. PCI MNL-123 - Manual on Design of Connections for Precast Prestressed Concrete.

22. PCI MNL-124 - Manual on Design for Fire Resistance of Precast Prestressed Concrete.

23. PCI MNL-126 - Manual for the Design of Hollow Core Slabs.

24. PCI MNL-127 - Recommended Practice for Erection of Precast Concrete.

25. PCI MNL-135 - Tolerance Manual for Pre-cast and Prestressed Concrete Construction.

26. UL - Underwriter's Laboratories.

B. Where any provisions of other pertinent codes and standards conflict with this specification, the more stringent provision shall govern.

C. Qualifications:

1. Fabricate and perform testing of precast units in accordance with PCI MNL-116 Manual for Quality Control for Plants and Production of Precast and Prestressed Concrete Products.

2. The engineer preparing design calculations, shop drawings, and other structural data for the precast concrete units shall be a registered engineer in the state where the project is located, with not less than three (3) years of continuous experience in design work of similar scope to that shown on the drawings.

3. The precast concrete manufacturer shall not have less than five (5) years of continuous experience in the manufacture of precast concrete units.

4. The precast concrete manufacturer shall have production capacity to produce required units without causing delay in work.

5. The precast concrete erector shall not have less than five (5) years of continuous experience in the erection of structural precast concrete units.

6. All welding of structural steel shall be performed by operators who have been qualified within the past one year as prescribed in "Qualification Procedures" of the American Welding Society (AWS).

1.3 DESIGN REQUIREMENTS

A. Precast units and their connections shall be designed by a licensed, qualified engineer licensed in the State were the project is located, to withstand the loadings and criteria indicated on the drawings and contained within this section.

B. Precast units shall be designed to meet the project fire ratings as specified by the Architect.

C. Precast hollow core slabs shall not be designed as composite sections with the concrete topping slab indicated on the drawings.

D. Fire-Test-Response Characteristics: Provide precast concrete units that comply with the following requirements:

1. UL, ITS or another testing and inspecting agency acceptable to authorities having jurisdiction has performed fire-response testing on each assembly.

2. Material and construction of fire-resistance-rated assemblies, as listed by UL's "Fire Resistance Directory," ITS's "Directory of Listed Products," or the listings of another testing and inspection agency, are identical to those tested per ASTM E119.

3. Products are identified with appropriate markings of applicable testing and inspecting agency.

1.4 SUBMITTALS

A. Shop Drawings:

1. Prepare and submit complete erection and detailed shop drawings for Engineer's approval, including but not limited to the following:

a. Member piece marks and completely dimensioned size, shape and type of each member.

b. Plans and/or elevations locating and defining all products furnished by the manufacturer. Indicate separate face and backup mix locations plus thicknesses and indicate the limits of each finish.

c. Indicate locations and extent and treatment of dry joints if two-stage casting is proposed.

d. Sections and details showing connections, cast-in items and their relation to the structure.

e. Methods of connecting, anchoring, fastening, bracing and attaching work of other trades.

f. Indicate welded connections by AWS standard symbols.

g. Indicate size and location of openings, either saw-cut or formed, to be coordinated with other trades.

h. Joints and openings in units and between units and the structure.

i. Description of all loose, cast-in and field hardware.

j. Headers required for openings.

2. Manufacturer shall submit the shop drawings showing floor member and roof member layout to the Mechanical Contractor for review of openings and inserts required by mechanical components.

B. Product Data:

1. Products: Prepare and submit product data for Engineer's approval for shop applied primers, fasteners, grout and other miscellaneous materials.

C. LEED Submittals:

1. LEED Certification: Submit manufacturer's certification for each concrete product including the following:

a. LEED Credit MRc 4.1/4.2 – Recycled content, including percentage by weight of pre-consumer (post-industrial) and post-consumer recycled content. Also provide manufacturer's name and product cost.

b. LEED Credit MRc 5.1/5.2 – Location of manufacturing plant, manufacturer's name, product cost and location of extraction or harvest of raw materials.

D. Qualification Data:

1. When requested by the Architect, provide lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

E. Design Calculations:

1. Prepare and submit one complete set of signed and sealed structural calculations to the Owner for approval of each unique and distinct precast member and precast connection prepared and certified by a Engineer licensed in the state where the project is located. Owner's approval or acceptance of the manufacturer's design calculations shall in no way relieve the manufacturer of the full responsibility for the correctness of the calculations or the structural performance of the completed members or sections.

F. Production Drawings:

1. Be prepared to submit, upon the Owner's request, production drawings indicating the following:

a. Sections and details to indicate quantities, type and position of reinforcing steel, anchors, inserts, etc.

b. Dimensions and finishes.

c. Prestress for strand and concrete strengths.

d. Methods for storage and transportation.

G. Test Reports:

1. Be prepared to submit, upon the Owner's request, test reports showing compliance with the testing provisions contained in PCI MNL-116, Manual for Quality Control for Plants.

H. Certifications:

1. Submit manufacturer's certifications that the precast units have been fabricated to meet the fire ratings specified by the Architect.

2. Submit copies of welding procedures and personnel.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Precast units shall be transported, stored and erected in a manner that will avoid any damage or deformation. Precast units shall be lifted and supported during manufacturing, stock-piling, transporting and erection operations only at the lifting and/or supporting points shown on the approved shop drawings.

B. Store units at the project site in such a manner so as to prevent cracking, distortion, staining, or other physical damage, and so that markings are visible. Protect edges of precast units from chipping or spalling.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Concrete Materials:

1. Refer to Section 03 30 00, Concrete, for additional information and requirements for concrete, formwork, materials application, admixtures, accessories, etc.

2. Portland Cement: ASTM C150, Type I or III, gray and white.

3. Normal-Weight Aggregates: ASTM C33

4. Admixtures – As determined by precast manufacturer, but conforming to:

   a. Air-entraining Admixtures: ASTM C260.
   b. Chemical Admixtures: ASTM C494.
   c. Fly Ash: ASTM C618, Class C or F.
   d. Silica Fume: ASTM C1240.

5. Water – Potable and free from foreign materials in amounts harmful to concrete and embedded steel.

B. Reinforcement and Prestressing Strands:

1. Refer to Section 03 20 00, Reinforcement, for additional information and requirements for fabrication, installation, etc.

2. Reinforcing Bars - ASTM A615, Grade 60, deformed.

3. Prestressing Strand - ASTM A416, Grade 250 or 270, uncoated, seven-wire, low-relaxation strand.

4. Plain-Steel Wire - ASTM A82.

5. Plain-Steel Welded Wire Reinforcement- ASTM A185, fabricated from steel wire into flat sheets.

C. Anchors, Inserts and Connection Material:

1. Steel Plates and Shapes - ASTM A36.
2. Anchor Rods - ASTM F1554.
3. Deformed Bar Anchors - ASTM A496.
4. Steel Headed Studs - AWS D1.1, Type B.
5. High-Strength Bolts - ASTM F3125, Grade A325.
6. Welding Electrodes - Comply with AWS standards.

D. Grout:

1. Cement Grout - Portland cement, ASTM C150, Type I, and clean, natural sand, ASTM C144. Mix at a ratio of 1.0 part cement to 2.5 parts sand, by volume, with minimum water required for placement and hydration. Minimum compressive strength to be 3000 psi.

2. Non-metallic, non-shrink grout - Grout shall be a pre-mixed, non-metallic, non-corrosive, non-staining product, containing selected silica sand, Portland cement, shrinkage compensating agents, plasticizing and water reducing agents, and complying with ASTM C1107. Minimum compressive strength to be 7,000 psi at 28 days.

E. Bearing Pads: Manufacturer to choose one of the following.

1. Elastomeric Pads: AASHTO M251, plain, vulcanized, 100 percent polychloroprene (neoprene) elastomer, molded to size or cut from a molded sheet, 50 to 70 Shore A durometer, minimum tensile strength 2250 psi per ASTM D412.

2. Random-Oriented, Fiber-Reinforced Elastomeric Pads: Preformed, randomly oriented synthetic fibers set in elastomer. Surface hardness of 70 to 90 Shore A durometer.

3. Cotton-Duck-Fabric-Reinforced Elastomeric Pads: Preformed, horizontally layered cotton-duck fabric bonded to an elastomer. Surface hardness of 80 to 100 Shore A durometer.

4. Hardboard: AHA A135.4, Class 1, tempered hardboard strips, smooth on both sides.

5. High-Density Plastic: Multimonomer, nonleaching, plastic strip.

2.2 CONCRETE MIXES

A. Concrete shall achieve a minimum 28-day compressive strength of 5000 psi.

B. Prestressed concrete shall achieve a minimum release strength of 3500 psi.

2.3 FABRICATION AND MANUFACTURE

A. Fabricate precast member in plastic lined or metal forms which are true to line and plane. Form openings of 100 square inches in area.

1. Edge and Corner Treatment: Uniformly chamfered.

B. General Contractor shall identify opening locations to precast manufacturer for coordination and shall provide precaster with cast-in items required by other trades.

C. Manufacture units in compliance with PCI MNL-116. Comply with the tolerances specified in PCI MNL-116.

D. Precast hollow core slabs shall have end bearings lengths as indicated on the structural drawings, but at least 3 inches minimum.

E. Clean reinforcement of loose rust, mill scale, and other materials, which may reduce or destroy bond with concrete.

F. Place reinforcement to obtain at least the minimum coverage for concrete protection as specified by ACI-318. Arrange, space and securely tie bars and bar supports to hold reinforcement in position during concrete placement. Set wire ties so ends are directed into concrete, not toward exposed concrete surfaces.

G. Install welded wire reinforcement in longest lengths practical. Lap adjoining pieces one full mesh and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.

H. Cast in structural inserts, plates and accessories as indicated on the Drawings and as determined by the fabricator for erection and anchorage. Cast in architectural accessories to receive windows, dowels, waterstops, flashings and other similar work.

I. Provide cast-in-place or structural steel headers for openings larger than one slab width according to fabricator's written recommendations.

J. Finishes, unless otherwise indicated on the drawings, provide:

1. Precast hollow core slabs:

a. Standard underside - As resulting from casting against approved forms. Small surface holes, normal color variations, normal joint marks, minor chips and spalls will be tolerated. Major imperfections, honeycombs, structural defects, or other defects will not be tolerated.

b. Standard topside - As resulting from vibrating screed and additional hand finishing at projections. Normal color variations, normal joint marks, minor chips and spalls will be tolerated. Major imperfections, honeycombs, structural defects, or defects which would affect finished floor materials will not be tolerated.

K. Provide permanent markings to identify pick-up points and orientation in structure, complying with the markings indicated on approved shop drawings. Imprint date of casting on each precast unit on a surface, which will not show in the structure.

L. Weight of hollow core precast units shall not exceed the following:

1. 8" hollow-core: 63 psf.

2.4 LEED CREDIT

A. LEED Credit MRc 4.1/4.2 – Precast wall panels, hollowcore, double tees, columns, and beams shall have a maximum recycled content for standard products.

B. LEED Credit MRc 5.1/5.2 – Precast shall be manufactured within 500 miles of project site. Aggregate, sand, water, and reinforcing shall be procured within 500 miles of project site.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions under which Work is to be performed and notify the General Contractor in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with work until unsatisfactory conditions have been corrected in a manner acceptable to the installer.

B. Do not install precast concrete units until supporting concrete has attained 75% of its design compressive strength.

3.2 ERECTION

A. The General Contractor shall be responsible for:

1. Providing suitable access to the site, proper drainage, and firm, level bearing for the hauling and erection equipment to operate under their own power.

2. At time of delivery, provide area inside and outside the building to allow adequate maneuverability for erection procedures.

3. Placement and accurate alignment of anchor bolts, plates or dowels in footings or foundation walls, ledge angles and other field placed support units.

4. Provide all shoring and bracing required by manufacturer's recommendations and as indicated on the Precast Shop Drawings.

B. Install bearing pads on true, level and uniform bearing surfaces. Maintain the correct position of the pads until precast units are in place.

C. Locate lifting hooks as specified on the shop drawings.

D. Erect units in compliance with PCI MNL-127, Recommended Practices for Erection of Precast Concrete.

E. After precast units are in place, remove lifting hooks and handling inserts, level bottom of slab to correct for unequal camber prior to grouting and perform necessary welding in accordance with AWS D1.1.

F. Shore and brace precast units to maintain location, stability and alignment until permanent connections are established.

G. Precast units shall be properly aligned and leveled as required by the shop drawings.

H. Remove hoisting or shoring devices and fill voids with sand-cement grout to be flush to adjacent surfaces.

I. Repair damaged metal surfaces by cleaning and applying a coat of galvanizing repair paint to galvanized surfaces or repainting damaged surfaces. Damage to those surfaces having special finishes as specified, shall be brought to the attention of the Architect.

J. Required openings less than 100 square inches in area in precast units shall be field cut. No openings shall be cut so as to pass through the leg sections of the prestressed units. Holes cut in slabs not concealed by finished ceiling systems shall be cut through, starting on underside with hand or mechanical chisels or from top only with core type drills. Restrict openings to as small as possible.

K. Use flowable cement grout (minimum compressive strength 5,000 psi) to grout keyways between hollow core slabs as follows:

1. Clean and prepare keyways to be filled. Joints should be free of debris and dust.
2. Seal underside of slab joints to prevent grout leakage.
3. Fill grout keys full and strike flush with top surface.
4. Remove grout that seeps through to ceiling below before grout hardens.

L. Welding: Comply with AWS D1.1 and AWS D1.4

1. Protect precast concrete units and bearing pads from damage by field welding or cutting, and provide noncombustible shields as required.

M. Field touch up:

1. Immediately after erection, field welding and/or final bolting, clean exposed surfaces of precast concrete units after erection to remove weld marks, other markings, dirt and stains.

3.3 FIELD QUALITY CONTROL

A. The contractor may choose to employ a separate testing laboratory to evaluate the precast manufacturer's quality control and testing methods. If requested, the precast manufacturer shall allow the Owner's testing company access to the manufacturing facility, and provide samples of material for additional evaluation.

B. Precast units which do not conform to specified requirements, including strength, tolerances, and finishes, or which are damaged during handling and erection, shall be replaced with precast concrete units that meet the requirements of this specification.

C. The contractor shall be responsible for the cost of corrections to other work affected by or resulting from corrections to precast concrete work.

D. Precast units having dimensions greater than required will be rejected if appearance or function of the structure is adversely affected, or if larger dimensions interfere with other construction. The contractor shall be responsible for the cost of necessary repair, removal and replacement of rejected units.

E. The precast supplier shall inspect all field cutting, which cuts reinforcing. The precast manufacturer shall issue a letter to the Owner either accepting the system as modified or directing corrective procedures to offset cut reinforcing. The contractor shall be responsible for the cost of any corrective procedures.

F. Clean all exposed surfaces after erection to remove weld marks, other markings, stains and dirt. Wash and rinse according to manufacturer's recommendations. Protect other work from damage or staining during cleaning operations.

END OF SECTION

SECTION 04 20 01

MASONRY VENEER

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Calcium silicate masonry units.

B. Mortar and Grout.

C. Reinforcement and Anchorage.

D. Flashings.

E. Accessories.

1.2 RELATED REQUIREMENTS

A. Section 04 20 00 - Unit Masonry.

1.3 REFERENCE STANDARDS

A. TMS 402/602 - Building Code Requirements and Specification for Masonry Structures; 2016.

B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2016a.

C. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2015.

D. ASTM C144 - Standard Specification for Aggregate for Masonry Mortar; 2011.

E. ASTM C150/C150M - Standard Specification for Portland Cement; 2016.

F. ASTM C207 - Standard Specification for Hydrated Lime for Masonry Purposes; 2006 (Reapproved 2011).

G. ASTM C270 - Standard Specification for Mortar for Unit Masonry; 2014a.

H. ASTM C476 - Standard Specification for Grout for Masonry; 2016.

I. ASTM C979/C979M - Standard Specification for Pigments for Integrally Colored Concrete; 2016.

J. BIA Technical Notes No. 7 - Water Penetration Resistance – Design and Detailing; 2005.

K. BIA Technical Notes No. 28B - Brick Veneer/Steel Stud Walls; 2005.

L. BIA Technical Notes No. 46 - Maintenance of Brick Masonry; 2005.

1.4 SUBMITTALS

A. Product Data: Provide data for masonry units, fabricated wire reinforcement, and mortar.

B. Samples: Submit four samples of calcium silicate masonry units to illustrate color, texture, and extremes of color range.

1.5 QUALITY ASSURANCE

A. Comply with provisions of TMS 402/602, except where exceeded by requirements of the contract documents.

1.6 MOCK-UP

A. Construct a masonry wall as a mock-up panel sized __ feet long by ___ feet high; include mortar and accessories and structural backup in mock-up.

B. Locate where directed.

C. Approved mock-up may not remain as part of the Work.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver, handle, and store masonry units by means that will prevent mechanical damage and contamination by other materials.

1.8 FIELD CONDITIONS

A. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602. General Contractor to provide winter protection and heat sources for installation of masonry units, as required to maintain project constructions schedule, at no additional cost to Owner.

B. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602. When ambient temperature exceeds 100 deg F, or 90 deg F with a wind velocity greater than 8 mph, do not spread mortar beds more than 48 inches ahead of masonry. Set masonry units within one minute of spreading mortar.

PART 2 PRODUCTS

2.1 CALCIUM SLICATE MASONRY UNITS

A. Calcium Silicate Masonry Units: to ASTM C73, Grade SW; solid units that have been pressure formed and autoclaved; 3-5/8" bed depth; special shapes as indicated; and as follows:
   1. Modular Size: As indicated on Drawings.
   2. Texture: smooth on exposed faces and ends.
   3. Basis-of-Design: Arriscraft, Montecito Renaissance.

2.2 MORTAR AND GROUT MATERIALS

A. Portland Cement: ASTM C150/C150M, Type I; color as required to produce approved color sample.

B. Hydrated Lime: ASTM C207, Type S.

C. Mortar Aggregate: ASTM C144.

D. Pigments for Colored Mortar: Pure, concentrated mineral pigments specifically intended for mixing into mortar and complying with ASTM C979/C979M.

E. Water: Clean and potable.

2.3 REINFORCEMENT AND ANCHORAGE

A. Reinforcement and Anchorage: As specified in section 04 20 00 - Unit Masonry.

B. Masonry Veneer Anchors: 2-piece anchors that permit differential movement between masonry veneer and structural backup, hot dip galvanized to ASTM A 153/A 153M, Class B.
   1. Anchor plates: Not less than 0.075 inch thick, designed for fastening to structural backup through sheathing by two fasteners; provide design with legs that penetrate sheathing and insulation to provide positive anchorage.
   2. Wire ties: Manufacturer's standard shape, 0.1875 inch thick.
   3. Vertical adjustment: Not less than 3-1/2 inches.

2.4 FLASHINGS

A. Rubberized Asphalt Flashings with stainless steel drip edges, as specified in Section 07 25 00 - Weather Barriers.

B. Stainless Steel: ASTM A666, Type 304, soft temper; 26 gage, 0.0187 inch thick; finish 2B to 2D.

2.5 ACCESSORIES

A. Cavity Vents: Molded PVC grilles, insect resistant.
   1. Manufacturers:
      a. Dur-O-Wall; Cekk Vents: www.dur-o-wal.com.
      b. Heckmann Building Products Inc.; No. 85 Cell Vent.
      c. Hohmann & Barnard, Inc, Quadro-Vent: www.h-b.com/sle.
      d. WIRE-BOND, Cell Vents: www.wirebond.com.

B. Cavity Mortar Control: Semi-rigid polyethylene or polyester mesh panels, sized to thickness of wall cavity, and designed to prevent mortar droppings from clogging weeps and cavity vents and allow proper cavity drainage.

1. Provide one of the following:
    a. Full-Height Airspace Maintenance and Drainage Material: Mesh panels, fitted between masonry ties.
        1) Manufacturers:
            (a) CavClear/Archovations, Inc; CavClear Masonry Mat: www.cavclear.com.
    b. Mortar Diverter: Semi-rigid mesh designed for installation at flashing locations.
        1) Manufacturers:
            (a) Advanced Building Products Inc; Mortar Break: www.advancedflashing.com/sle.
            (b) Mortar Net Solutions; MortarNet: www.mortarnet.com.

C. Cleaning Solution: Non-acidic, not harmful to masonry work or adjacent materials.

D. Compressible Filler: Premolded, closed cell, filler strips complying with ASTM D 1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene, urethane or PVC.

2.6 MORTAR AND GROUT

A. Mortar for Unit Masonry: ASTM C270, Proportion Specification.
    1. Masonry below grade and in contact with earth; Type S.
    2. Exterior, non-loadbearing masonry; Type N.

B. Colored Mortar: Proportion selected pigments and other ingredients to match Architect's sample, without exceeding manufacturer's recommended pigment-to-cement ratio.

C. Grout: ASTM C476; consistency as required to fill volumes completely for grouting; fine grout for spaces with smallest horizontal dimension of 2 inches or less; coarse grout for spaces with smallest horizontal dimension greater than 2 inches.

D. Mixing: Use mechanical batch mixer and comply with referenced standards.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that field conditions are acceptable and are ready to receive masonry.

B. Verify that related items provided under other sections are properly sized and located.

C. Verify that built-in items are in proper location, and ready for roughing into masonry work.

D. Verify foundations are constructed with tolerances conforming to the requirements of ACI 117.

E. Verify reinforcing dowels are positioned in accordance with the project drawings.

3.2 PREPARATION

A. Direct and coordinate placement of metal anchors supplied for installation under other sections.

B. Provide temporary bracing during installation of masonry work. Maintain in place until building structure provides permanent bracing.

3.3 COLD AND HOT WEATHER REQUIREMENTS

A. Cold Weather Procedures:
    1. Heat mortar sand or mixing water to produce mortar temperatures between 40°F and 120°F at the time of mixing. Maintain mortar above freezing until used in masonry.
    2. When the mean daily temperature is between 40°F and 32°F, protect completed masonry from rain or snow by covering.
    3. When the mean daily temperature is between 32°F and 25°F, completely cover completed masonry with a weather resistive membrane for 24 hours after construction.
    4. When ambient temperature is between 25°F and 20°F, use heat sources on both sides of the masonry under construction and install wind breaks when wind velocity is in excess of 15 mph. Completely cover completed masonry with insulating blankets or equal protection for 24 hour period after construction.
    5. When ambient temperature is below 20°F, provide an enclosure for the masonry under construction and use heat sources to maintain temperatures above 32°F within the enclosure 24 hours after construction.

B. Frozen Materials:

1. Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen work. Do not lay masonry units having a temperature below 20°F.

C. Remove and replace masonry work damaged by frost or freezing

D. Hot Weather Proceedures:
1. Hot weather construction is defined when the ambient air temperature exceeds 100°F or exceeds 90°F with a wind velocity greater than 8 mph. Hot weather procedures include the following:
   a. Maintain sand piles in a damp, loose condition.
   b. Maintain temperature of mortar and grout below 120°F.
   c. Flush mixer, mortar transport container, and mortarboards with cool water before they come in contact with mortar ingredients or mortar.
   d. Maintain mortar consistency by retempering with cool water.
   e. Use mortar within 2 hours of initial mixing.
   f. Fog spray all newly constructed masonry until damp, at least three times a day until the masonry is three days old.
2. Do not spread mortar beds more than 4 feet ahead of masonry. Set masonry within one minute of spreading mortar

3.4 INSTALLATION, GENERAL

A. Use full-size units without cutting if possible. If cutting is requied, cut units with motor-driven saws, provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.

B. Select and arrange units for exposed unit masonry produce a uniform blend of colors and textures.

C. Wetting of Brick: Wet brick before laying if initial rate of absorption exceeds 30g/30 sq. in. per minute where tested per ASTM C 67. Allow units to absorb water so they are damp but not wet at time of laying.

D. Comply with tolerances in ACI 530.1/ASCE 6/TMS 620 and with the following:
1. For conspicuous vertical lines, suce as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2 inch maximum.
2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2 inch maximum.

3.5 COURSING

A. Establish lines, levels, and coursing indicated. Protect from displacement.

B. Maintain masonry courses to uniform dimension. Form vertical and horizontal joints of uniform thickness.

C. Calcium Silicate Masonry Units:
1. Bond: Running.
2. Coursing: One unit and one mortar joint to equal 8 inches.
3. Mortar Joints: Concave.

3.6 PLACING AND BONDING

A. Lay solid masonry units in full bed of mortar, with full head joints, uniformly jointed with other work.

B. Lay hollow masonry units with face shell bedding on head and bed joints.

C. Buttering corners of joints or excessive furrowing of mortar joints is not permitted.

D. Remove excess mortar as work progresses.

E. Interlock intersections and external corners.

F. Do not shift or tap masonry units after mortar has achieved initial set. Where adjustment must be made, remove mortar and replace.

G. Perform job site cutting of masonry units with proper tools to provide straight, clean, unchipped edges. Prevent broken masonry unit corners or edges.

3.7 WEEPS/CAVITY VENTS

A. Install cavity vents in veneer walls at 24 inches on center horizontally below shelf angles and lintels, at top of walls, and above through-wall flashing.

3.8 CAVITY MORTAR CONTROL

A. Do not permit mortar to drop or accumulate into cavity air space or to plug weep/cavity vents.

B. For cavity walls, build inner wythe ahead of outer wythe to accommodate accessories.

C. Cavity Mortar Control Panels: Install cavity mortar control panels continuously throughout full height of exterior masonry cavities during construction of exterior wythe, complying with manufacturer's installation instructions. Verify that airspace width is no more than 3/8 inch greater than panel thickness. Install horizontally between joint reinforcement. Stagger end joints in adjacent rows. Fit to perimeter construction and penetrations without voids.

D. Cavity Mortar Diverter: Install cavity mortar diverter at base of cavity and at other flashing locations as recommended by manufacturer to prevent mortar droppings from blocking weep/cavity vents.

3.9 ANCHORAGE - MASONRY VENEER

A. Masonry Back-Up: Embed anchors in masonry back-up to bond veneer at maximum 1.77 sq ft of wall surface per anchor. Place additional anchors at perimeter of openings and ends of panels, so maximum spacing of anchors is 8 inches on center.

3.10 MASONRY FLASHINGS

A. Whether or not specifically indicated, install masonry flashing to divert water to exterior at all locations where downward flow of water will be interrupted.
   1. Extend flashings full width at such interruptions and at least 6 inches, minimum, into adjacent masonry or turn up at least 8 inches, minimum, to form watertight pan at non-masonry construction.
   2. Remove or cover protrusions or sharp edges that could puncture flashings.
   3. Seal lapped ends and penetrations of flashing before covering with mortar.

B. Lap end joints of flashings at least 6 inches, minimum, and seal watertight with flashing sealant/adhesive.

3.11 TOLERANCES

A. Maximum Variation From Unit to Adjacent Unit: 1/16 inch.

B. Maximum Variation from Plane of Wall: 1/4 inch in 10 ft and 1/2 inch in 20 ft or more.

C. Maximum Variation from Plumb: 1/4 inch per story non-cumulative; 1/2 inch in two stories or more.

D. Maximum Variation from Level Coursing: 1/8 inch in 3 ft and 1/4 inch in 10 ft; 1/2 inch in 30 ft.

E. Maximum Variation of Mortar Joint Thickness: Head joint, minus 1/8 inch, plus 3/8 inch.

3.12 CUTTING AND FITTING

A. Cut and fit for pipes and conduit. Coordinate with other sections of work to provide correct size, shape, and location.

B. Obtain approval prior to cutting or fitting masonry work not indicated or where appearance or strength of masonry work may be impaired.

3.13 CLEANING

A. Remove excess mortar and mortar smears as work progresses.

B. Clean soiled surfaces with cleaning solution.

3.14 PROTECTION

A. Without damaging completed work, provide protective boards at exposed external corners that are subject to damage by construction activities.

END OF SECTION

SECTION 04 22 00
REINFORCED UNIT MASONRY

PART 1 - GENERAL

1.1 DESCRIPTION

A. The General and Supplementary Conditions of the Construction Contract and Division 1 - General Requirements apply to the Work specified in this Section.

B. This section includes the supply and installation of all reinforced concrete unit masonry and accessories as shown on the Drawings and herein specified.

C. This section defines work including: Concrete unit masonry, mortar, grout, reinforcement, anchors, ties, and accessories.

D. Masonry, cavity wall board insulation, loose fill insulation, and foam core insert insulation is specified elsewhere; however, installation shall be a part of the Work of this Section.

E. Notes indicated on the drawings regarding reinforced unit masonry shall be considered part of this specification.

1.2 QUALITY ASSURANCE

A. Codes and Standards: Comply with the provisions of the following codes, specifications, and standards except where more stringent requirements are shown or specified.

1. ACI 530.1/ASCE 6/TMC 602 - Masonry Standards Joint Committee (MSJC) Code and Specification.
2. ASTM A153 - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
3. ASTM A615 - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
4. ASTM A641 - Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire.
5. ASTM A951 - Standard Specification for Steel Wire for Masonry Joint Reinforcement.
6. ASTM C90 - Standard Specification for Load-bearing Concrete Masonry Units.
7. ASTM C270 - Standard Specification for Mortar for Unit Masonry.
8. ASTM C387 - Specification for Packaged, Dry, Combined Materials for Mortar and Concrete.
9. ASTM C476 - Standard Specification for Grout for Unit Masonry.
10. ASTM C780 - Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry.
11. ASTM C1019 - Standard Test Method for Sampling and Testing Grout.
12. IMIAC - International Masonry Industry All-Weather Council: Recommended Practice and Guide Specification for Cold Weather Masonry Construction.

B. Where any provision of other pertinent codes and standards conflict with this specification, the more stringent provision shall govern.

C. Mockup:

1. Prior to installation of masonry work, erect sample wall panel to further verify color and texture characteristics of selected masonry units and mortar and to demonstrate the level of workmanship required for the unit masonry.

2. Construct mockup at the site, where directed. Mockup shall be full thickness, including face and back-up wythes, as well as all accessories. Mockup shall indicate the proposed range or color, texture, and quality of workmanship to be expected in the completed work.

3. Obtain Architect's acceptance of visual qualities of the mockup before start of masonry work.

4. Retain mockup during construction as a standard for judging completed masonry work.

5. Construct mockup panels for the following walls:

a. Exterior masonry wall construction.

6. Demolish and remove mockups from site when directed by Architect/Engineer.

1.3 FIRE RESISTANT CONSTRUCTION

A. Whenever a fire resistant classification is indicated for unit masonry construction, provide concrete block units as tested and listed for the particular fire resistant construction.

1.4 QUALIFICATIONS

A. Installation Company: Company shall have not less than five years of documented experience in the construction of masonry projects of similar scope and complexity.

B. For the actual cutting and placing of concrete masonry units, use only skilled masons who are thoroughly experienced with the material and methods specified and thoroughly familiar with the design requirements. Workers shall have not less than three years of documented experience in the construction of masonry walls.

1.5 SUBMITTALS

A. Prepare and submit product data for Engineer's approval. Data should include all horizontal reinforcement, anchoring devices, and all other embedded items herein specified.

B. Prepare and submit shop drawings detailing the fabrication, bending, and placement of reinforcing bars.

C. When requested by the Architect and before any materials are delivered to Worksite, submit for approval one sample of the proposed masonry materials, showing the full range of colors and textures available.

D. Submit a letter of certification from manufacturer of concrete masonry units certifying that all concrete masonry units delivered to the worksite are in strict conformance with the provisions of this specification.

E. Submit concrete unit masonry compressive strength test results demonstrating that the units meet the specified strength. Test must be conducted by a qualified independent testing agency.

F. Submit mortar mix design and test results as follows:

1. Mix designs shall indicate type and proportions of ingredients in compliance with the proportion requirements of ASTM C270.

2. For mix designs not in accordance with the proportion requirements of ASTM C270, the mortar test history must be performed in accordance with ASTM C780 to verify performance with property

requirements of ASTM C270. Tests must meet the type of mortar specified on the drawings. Tests must be done by a qualified independent testing agency.

G. Submit grout mix designs and test results as follows:

1. Mix designs shall indicate type and proportions of the ingredients in compliance with the proportion requirements of ASTM C476.

2. For mix designs not in accordance with the proportion requirements of ASTM C476, the grout test history must be performed in accordance with ASTM C1019 to verify performance with property requirements of ASTM C476. Tests must meet the type of grout specified on the drawings. Test must be done by a qualified independent testing agency.

a. Perform one test prior to construction and perform at least one test during construction for each 5000 square feet of wall.

H. LEED Submittals: Submit product certificates for each masonry product and material including the following:

1. LEED MRc4.1/4.2 – Recycled content, including percentage by weight of pre-consumer (post-industrial) and post-consumer recycled content. Also provide manufacturer's name and product cost.

2. LEED Credit MR 5.1/5.2 - Indicate location and distance of manufacturer from project and point of extraction or recovery for each raw material.

a. Include cost for each regional material and the fraction by weight that is considered regional.

1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. All masonry units shall be delivered to worksite and stacked on pallets to allow the circulation of air through all units. Cover with a waterproof covering anchored to prevent displacement during high winds.

B. Masonry accessories, including reinforcing steel, shall be stored clear of the ground to prevent deterioration or damage due to moisture, temperature changes, contaminants, and corrosion.

C. Deliver all materials in sufficient quantity and time to maintain approved construction schedule.

D. Deliver all packaged materials in manufacturer's original containers, with labels and markings intact and legible.

E. Immediately remove all damaged materials or containers from site and replace with new items.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Concrete Masonry Units: ASTM C90, as follows:

1. Weight: Normal weight.
2. Compressive Strength: As indicated on the Drawings.
3. Nominal Size: As indicated on the Drawings.
4. Actual Size: 3/8" less than nominal size.
5. Aggregates:
   a. Normal Weight: ASTM C33.

6. Provide special units for 90° corners, lintels jambs, sash, control joints, headers, bond beams, and other special conditions conforming to ASTM C90.
7. All exposed unit masonry shall be free of chips, cracks, and other imperfections.

B. Mortar and Grout:

1. Compressive Strength: As indicated on the drawings.
2. Mortar type for masonry construction shall be as designated in the General Notes of the drawings, conforming to ASTM C270, and grout shall conform to ASTM C476.
3. Portland Cement: ASTM C150, Type I, non-staining, no air entraining, natural color cement.
4. Blended Cement: ASTM C595.
5. Masonry Cement: ASTM C91.
6. Mortar Aggregate: ASTM C144, standard masonry type.
7. Hydrated Lime: ASTM C207.
8. Quicklime: ASTM C5, non-hydraulic type.
9. Premix Mortar: ASTM C387, using gray cement, normal strength.
10. Grout Aggregate: ASTM C404.
11. Grout Fine Aggregate: Sand.
12. Water: Clean and potable.
13. Do not use calcium chloride in mortar or grout.

C. Joint Reinforcement:

1. Provide joint reinforcement formed from galvanized carbon-steel wire in accordance with ASTM A641, Class 1 for interior walls; and ASTM A153, Class B-2, for exterior walls.

2. Provide welded wire units prefabricated with 9 gauge deformed continuous side rods and 9 gauge plain cross rods into straight lengths of not less than 10 feet with matching corner and tee units. Unit widths to be 1-1/2" to 2 inch less than the wall thickness.

D. Ties and Anchors:

1. Structural steel column anchor ties shall be adjustable weld-on 1/4 inch diameter steel rods and minimum 3/16 inch galvanized triangular shaped tie.

2. Adjustable Anchor System: For use with stone/brick veneer and CMU backup.
   a. Single screw veneer tie for CMU backup construction. Fabricated from carbon steel with a premium quality organic polymer coating. A dual diameter barrel wth factory-installed EPDM washer to seal both the face of the insulation and the air/vapor barrier. #14 screw integrated into the dual-diameter barrel. Provide with a projecting eyelet to accept wire ties.
   b. Wire Tie. Wire ties to be 3/16” diameter, Stainless Steel. Length as required.

E. Reinforcement:

1. Use deformed billet bars with unprotected finish conforming to ASTM A615, 60 ksi yield strength.

F. Control and Expansion Joints:

1. Control joint material for unit masonry shall consist of cross-shaped extruded polyvinyl gaskets sized to match wall thickness.

2. Expansion or joint filler material, unless otherwise indicated, shall be 1/2 inch thick asphalt impregnated cellular board.

3. Compressible filler shall be pre-molded filler strips complying ASTM D1056, Type 2, Class A, Grade 1; compressible up to 35 percent of width and thickness indicated.

4. Bond breaker strips shall be asphalt-saturated, organic roofing felt complying with ASTM D226, Type I (No. 15 asphalt felt).

G. Flashing:

1. Provide metal flashing at window sills, exterior lintels, base courses of masonry walls, and elsewhere as shown on drawings or specified herein. Flashing shall be prefabricated minimum 18 gauge galvanized pre-finished sheet metal flashing.

H. Breath wicks shall be 3/16 inch diameter cotton sash cord or glass fiber rope. Provide 2 inches of exposure to the outside and space wicks at 18 inches on center along the wall.

I. Insulation Board: Refer to Board Insulation in Division 7.

J. Masonry Cleaners shall be non-acidic and not harmful to masonry worker adjacent materials.

2.2 LEED CREDIT

A. LEED MRc4.1/4.2 - Provide masonry units that contain a percentage of recycled materials.

B. LEED Credit MR 5.1/5.2:

1. Provide masonry units that have been manufactured within 500 miles of project location and from aggregates and cement that have been extracted, recovered, or manufactured, within 500 miles of project site.

2. Provide aggregate for mortar and grout cement, and lime that have been extracted, recovered, or manufactured within 500 miles of the project site.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that field conditions are acceptable and are ready to receive work.

1. Verify foundations are constructed with tolerances conforming to the requirements of ACI 117.

2. Verify reinforcing dowels are positions in accordance with the Project Drawings.

B. Verify items provided by other Sections of work are properly sized and located.

C. Verify that built-in items are in proper location and ready for roughing into masonry work.

D. Beginning of installation means Installer accepts existing conditions.

3.2 PREPARATION

A. Layout walls in advance for accurate spacing of bond patterns, with uniform joint widths and to properly locate openings, expansion joints, and offsets.

B. Direct and coordinate placement of metal anchors supplied to other Sections.

C. The Contractor is responsible to design, provide, and install bracing that will ensure stability of masonry during construction. Maintain in place until building structure provides permanent bracing.

D. Remove laitance, loose aggregate, and anything else that would prevent mortar from bonding to the foundation.

E. Clean all reinforcement by removing mud, oil, or other materials that will adversely affect or reduce bond at the time mortar or grout is placed.

3.3 COLD WEATHER CONSTRUCTION

A. When ambient temperature is below 40ºF (4.5ºC), implement cold weather procedures.

B. Special cold weather requirements for various temperature ranges are as follows:

1. Air temperature 40ºF to 32ºF (4.5ºC to 0ºC): Sand or mixing water shall be heated to produce mortar temperatures between 40ºF to 120ºF (4.5ºC to 49ºC).

2. Air temperature 32ºF to 25ºF (0ºC to -4ºC):

a. Sand and mixing water shall be heated to produce mortar temperatures between 40ºF to 120ºF (4.5ºC to 49ºC). Maintain temperature of mortar on boards above freezing.

b. Grout aggregates and mixing water shall be heated to produce grout temperature between 70ºF to 120ºF (21ºC to 49ºC).

3. Air temperature 25ºF to 20ºF (-4ºC to -7ºC): Comply with requirements for air temperature between 32ºF to 25ºF (0ºC to -4ºC) and the following:

a. Provide heat sources on both sides of the wall under construction to heat masonry surfaces to 40ºF (4.5ºC). Windbreaks shall be used when wind is excess of 15 miles per hour.

b. Heat masonry to a minimum temperature of 40ºF (4.5ºC) prior to grouting.

4. Air temperature 20ºF(-7ºC) and below. Comply with requirements for air temperature between 32ºF to 20ºF (0ºC to -7ºC) and the following:

a. Enclosure and auxiliary heat shall be provided to maintain air temperature above freezing. Do not lay masonry units having a temperature below 20ºF (-7ºC).

C. Cold-Weather Protection:

1. When the mean daily air temperature is 40ºF to 25ºF (4.5ºC to -4ºC), masonry shall be completely covered for 24 hours with weather-resistive membrane.

2. When the mean daily air temperature is 25ºF to 20ºF (-4ºC to -7ºC), masonry shall be completely covered for 24 hours with insulating blankets with a weather-resistive covering. Extend time period to 48 hours for grouted masonry.

3. When the mean daily air temperature is 20ºF (-7ºC) or below, masonry temperature shall be maintained above freezing for 24 hours by enclosure and auxiliary heating. Extend time period to 48 hours for grouted masonry.

D. Do not lay masonry units having either a temperature below 20ºF (-6.7ºC) or containing frozen moisture, visible ice, or snow on their surfaces.

E. Remove visible ice and snow from the top surface of existing foundations and masonry to receive new construction. Heat these surfaces above freezing.

F. Top of all walls not enclosed or sheltered shall be covered with strong weather-resistive material at the end of each day or shutdown.

G. Partially completed walls shall be covered at all times when work is not in progress.

H. Any section of masonry deemed frozen and damaged shall be removed before continuing construction of that section.

I. Masonry units shall be dry at the time of placement. Wet or frozen unit shall not be laid.

J. All cold weather masonry construction shall conform to IMIAC - Recommended Practices and Specification for Cold Weather Masonry Construction.

3.4 HOT WEATHER CONSTRUCTION

A. Hot weather construction is defined when:

1. The ambient air temperature exceeds 100°F or exceeds 90°F with a wind velocity greater than 8 mph.

B. Hot Weather Procedures:

1. Maintain sand piles in a damp, loose condition.

2. Provide necessary conditions and equipment to produce mortar having a temperature below 120°F.

3. Flush mixer, mortar transport container, and mortar boards with cool water before they come in contact with mortar ingredients or mortar.

4. Use mortar within two hours of initial mixing.

5. Fog spray all newly constructed masonry until damp, at least three times a day until the masonry is three days old.

6. Do not spread mortar beds more than 4’ ahead of masonry. Set masonry within one minute of spreading mortar.

3.5 COURSING

A. Establish lines, levels, and coursing indicated. Protect from displacement. Grouted cells shall be in vertical alignment.

B. Maintain masonry courses to uniform dimension. Form vertical and horizontal joints of uniform thickness.

C. Lay concrete masonry units in bond to match existing at all patch and infill locations.

D. Unless noted otherwise, provide masonry control joints at 30'-0" on center maximum.

E. Unless noted otherwise, build non-bearing interior partitions walls full height to underside of structure.

3.6 PLACING AND BONDING

A. Unless noted otherwise, construct masonry in running bond pattern.

B. Lay hollow masonry units with face shell bedding on head and bed joints.

C. Bed and Head Joints:

1. Unless otherwise required, construct 3/8 inch thick bed and head joints.

2. At foundation, construct bed joint of the starting course a thickness not less than 1/4 inch, and not more than 3/4 inch.

3. Unless otherwise noted, tool joint with a round jointer when the mortar is thumbprint hard.

4. Remove masonry protrusions extending 1/2 inch or more into cells or cavities to be grouted.

D. Collar Joints:

1. Unless otherwise required, solidly fill collar joints less than 3/4 inch wide with mortar as the job progresses.

E. Place hollow units as follows:

1. With face shells of bed joints fully mortared.

2. With webs fully mortared in:

a. All courses of piers columns and pilasters.
b. In the starting course on foundations.
c. When necessary to confine grout or loose fill.
d. When otherwise required.

3. With head joints mortared, a minimum distance from each face equal to the face shell thickness of the unit.

4. Vertical cells to be grouted are aligned and openings are unobstructed.

F. Place solid units as follows:

1. Unless otherwise required, solidly fill bed and head joints with mortar.
2. Do not fill head joints by grouting with mortar.
3. Construct head by shoving mortar tight against the adjoining unit.
4. Do not deeply furrow bed joints.

G. Buttering corners of joints or excessive furrowing of mortar joints is not permitted.

H. Remove excess mortar as work progresses.

I. Interlock intersections and external corners.

J. Do not shift or tap masonry units after mortar has achieved initial set. Where adjustment must be made, remove mortar and replace.

K. Perform job site cutting of masonry units with proper tools to provide straight, clean, undamaged edges. Prevent broken masonry unit corners or edges.

L. Isolate masonry partitions from vertical structural framing members with a control joint.

M. Isolate top joint of masonry partitions from horizontal structural framing members and slabs or decks with compressible joint filler and pin top of wall with prefabricated partition anchors that allow vertical movement.

3.7 HORIZONTAL REINFORCEMENT AND ANCHORS

A. Install horizontal joint reinforcement as follows:

1. Interior non-load bearing walls - 24 inches on center vertically.
2. Exterior walls and interior load bearing walls - 16 inches on center vertically.
3. Parapet walls - 8 inches on center vertically unless noted otherwise.
4. Foundation walls - 8 inches on center vertically unless noted otherwise.

B. Place masonry joint reinforcement in first and second horizontal joints above and below openings. Extend minimum 16 inches each side of opening.

C. Place joint reinforcement continuous in first and second joint below top of walls.

D. Lap joint reinforcement ends minimum 6 inches. Extend minimum 16 inches each side of openings.

E. Place joint reinforcement so longitudinal wires are embedded in mortar with a minimum cover of 1/2 inch when not exposed to weather or earth, and 5/8 inch when exposed to weather or earth.

F. Anchor masonry to structural members where masonry abuts or faces such members.

G. Wall Ties:

1. Embed the ends of wall ties in mortar joints. Embed wall tie ends at least 1/2" into the outer face shell of hollow units. Embed wire wall ties at least 1-1/2" into the mortar bed of solid masonry units or solid grouted hollow units.

2. Do not bend wall ties after embedded in grout or mortar.

3. Unless otherwise required, install adjustable ties in accordance with the following requirements.

   a. One tie for each 1.77 square feet of wall area.

   b. Do not exceed 16 inches horizontal or vertical spacing.

   c. The maximum misalignment of bed joints from one wythe to the other is 1-1/4".

   d. The maximum clearance between connecting parts of the ties is 1/16".

   e. When pintle legs are used, provide ties with at least two legs made of wire size W2.8.

   f. Install wire ties perpendicular to a vertical line on the face of the wythe from which they protrude. Where one-piece ties or joint reinforcement is used, the bed joints of adjacent wythes shall align.

   g. Unless otherwise required, provide additional unit ties around all openings larger than 16 inches in either dimension. Space ties around perimeter of opening at a maximum of 3 feet on center. Place ties within 12 inches of opening.

H. Veneer Anchors:

1. Embed veneer anchors in mortar joint and extend into the veneer a minimum of 1-1/2 inch at least 5/8 inch cover to the outside face.

2. Install adjustable veneer anchors as follows:

   a. The maximum misalignment of bed joints from one wythe to the other is 1-1/4 inch.

   b. The maximum clearance between connecting parts of the ties is 1/16 inch.

   c. When pintle legs are used, provide anchors with at least two legs made of wire size W2.8.

   d. Provide at least one adjustable two-piece anchor of wire size W1.7 or 22 gauge corrugated sheet metal anchor for each 2.67 square feet of wall area.

3. Install non-adjustable veneer anchors for each 3.5 square feet of wall area.

4. Space anchors at a maximum of 32 inches horizontally and 16 inches vertically.

5. Provide additional anchors around all openings larger than 16 inches in either dimension. Space anchors around the perimeter of opening at a maximum of 3 feet on center. Place anchors within 12 inches of the opening.

3.8 VERTICAL REINFORCEMENT

A. Support and secure reinforcing bars from displacement beyond the tolerances allowed by construction loads or by placement of grout or mortar. Maintain position within 1/2 inch of masonry unit or formed surface, but not less than 1/4 inch (only when fine grout is used).

B. Lap splices minimum 48 bar diameters.

C. Dowels in footings shall be set to align with cores containing reinforcing steel.

D. Place and consolidate grout fill without displacing reinforcing. Completely embed reinforcing bars in grout.

E. All cells containing reinforcing in concrete blocks shall be filled solid with grout.

F. Do not bend reinforcement after it is embedded in grout or mortar.

G. Reinforce masonry unit cores and cavities with vertical reinforcement bars and grout as indicated on drawings. Place reinforcements and ties in grout spaces prior to grouting.

H. Retain vertical reinforcement in position at top and bottom of cells and at intervals not exceeding 192 bar diameters.

I. Place steel in walls and flexural elements within 1/2 inch of required location.

J. Place vertical bars within 2 inches of the required location along the length of the wall.

3.9 CONCRETE UNIT MASONRY

A. Lay masonry units with core cells vertically aligned clear of mortar dropping, debris, loose aggregates, and any material deleterious to masonry grout.

B. Do not place grout until height of masonry to be grouted has attained sufficient strength to resist grout pressure.

C. Do not wet concrete masonry units before laying.

D. Grout spaces less than two inches in width with fine grout using low lift grouting techniques. Grout spaces two inches or greater in width with course grout using high lift or low lift grouting techniques.

E. When grouting is stopped for more than one hour, terminate grout 1-1/2 inch below top of upper masonry unit to form a positive key for subsequent grout placement.

F. Grouting:

1. Place grout in lifts not to exceed five feet. Consolidate grout at time of placement.

a. Consolidate grout pours 12 inches or less in height by mechanical vibration or by puddling.

b. Consolidate grout pours exceeding 12 inches in height by mechanical vibration and reconsolidate by mechanical vibration after initial water loss and settlement has occurred.

2. When the grout pour height exceeds 5 feet 4 inches, provide cleanout opening no less than 3 inches high at the bottom of each cell to be grouted by cutting one face shell of masonry unit. Opening should be sufficient size to permit removal of debris.

3. Pump grout into spaces. Maintain water content in grout to intended slump without aggregate segregation.

4. Limit grout lift to 60 inches and rod for grout consolidation. Wait 30 to 60 minutes before placing next lift.

3.10 GROUTING REINFORCED CONCRETE BLOCK WALLS

A. Provide reinforcing bars at indicated spacing and grout bars and voids solid with grout having a 28-day compressive strength as listed in the General Notes of the Drawings.

3.11 GROUTING BLOCK CELLS BELOW LINTELS AND BEAMS

A. For lintel spans greater than 5'-0": Grout block cells 24 inches beneath the lintel and 24 inches each side of lintel.

B. For all beams: Grout block cells 24 inches beneath the lintel and 24 inches each side of lintel

3.12 LINTELS AND BOND BEAMS

A. Steel Lintels: Install steel lintel supplied from Division 5 of this specification. Provide a minimum of 8 inches of end bearing on each side of opening unless noted otherwise. All exterior exposed steel lintels shall be hot-dip galvanized in accordance with ASTM A123.

B. Bond Beams:

1. Use specially shaped lintel units at hollow masonry unit walls, with reinforcing bars as shown and filled with concrete grout.

2. Provide minimum 8 inches of end bearing at each side of opening.

3. Provide reinforced concrete block lintels over openings less than 3'-0" wide which are not scheduled.

4. Place and consolidate concrete without disturbing the reinforcing.

5. Allow lintels to reach 100 percent of their design strength before removing temporary supports.

6. Do not place vertical control joints above bond beams or within 8 inches each side of bond beam.

3.13 CONTROL AND EXPANSION JOINTS

A. Do not continue horizontal joint reinforcement through control and expansion joints except above wall openings.

B. Provide vertical expansion, control, and isolation joints as indicated on the drawings. If joints are not indicated, then provide control joints at a maximum spacing of 30'-0".

C. Install all built-in masonry accessory items as work progresses.

D. Rake out mortar where sealants are shown or required.

3.14 BUILT-IN WORK AND EMBEDDED ITEMS

A. As work progresses, build in metal door and glazed frames, fabricated metal lintels, anchor bolts, plates, and other items furnished by other Sections.

B. Place pipes and conduits passing horizontally through masonry beams or masonry walls in steel sleeves or cored holes.

C. Install pipes and conduits passing horizontally through non-bearing masonry partitions.

D. Install and secure connectors, flashing, weep holes, weep vents, nailing blocks, and other accessories.

E. Do not embed aluminum conduits, pipes, and accessories in masonry, grout, or mortar, unless effectively coated or covered to prevent aluminum-cement chemical reaction or electrolytic action between aluminum and steel.

F. Build in items plumb and level.

G. Bed anchors of metal door and glazed frames in adjacent mortar joints. Fill frame voids solid with grout.

H. Do not build in organic materials subject to deterioration.

3.15 PREFABRICATED CONCRETE AND MASONRY ITEMS

A. Erect prefabricated concrete and masonry items in accordance with the requirements.

3.16 TOLERANCES

A. Comply with tolerances in the MSJC Specification and the following:

1. Maximum variation from alignment of columns and pilasters: 1/4 inch.

2. Maximum variation from unit to adjacent unit: 1/32 inch.

3. Maximum variation from plane of wall: 1/4 inch in 10 feet and 3/8 inch in 20 feet or more.

4. Maximum variation from plumb: 1/4 inch per story non-cumulative.

5. Maximum variation from level coursing: 1/8 inch in 3 feet and 1/4 inch in 10 feet; 1/2 inch in 30 feet.

6. Maximum variation of bed joint thickness: 1/8 inch.

3.17 CUTTING AND FITTING

A. Cut and fit for chases, pipes, conduit, sleeves, and structural members. Coordinate with other Sections of work to provide correct size, shape, and location.

B. Obtain the Engineer's approval prior to cutting or fitting masonry work not indicated or where appearance or strength of masonry work may be impaired.

3.18 CLEANING

A. Remove excess mortar and mortar smears.

B. Replace defective mortar.

C. Clean soiled surfaces with cleaning solution.

D. Use non-metallic tools in cleaning operations.

E. Clean exposed masonry surfaces of all stains, efflorescence, mortar or grout droppings, and debris.

3.19 PROTECTION OF FINISHED WORK

A. Without damaging completed work, provide protective boards at exposed external corners that may be damaged by construction activities.

END OF SECTION

SECTION 05 12 23
STRUCTURAL STEEL

PART 1 - GENERAL

1.1 DESCRIPTION

A. The General and Supplementary Conditions of the Construction Contract and Division 1 - General Requirements apply to the work specified in this section.

B. This section includes fabrication and erection of structural steel work, as shown on the Drawings and specified herein. Work shall include, but not be limited to the following items:

1. Structural steel
2. Base and bearing plates.
3. Deck support angles and framing for roof openings.
4. Steel lintel members for masonry openings.
5. Edge angles and bent plates.
6. Connection plates.
7. Architecturally Exposed Structural Steel (AESS).
8. All other steel items as listed in AISC – "Code of Standard Practice for Steel Buildings and Bridges" as shown on structural and architectural drawings.

C. Work shall also include grouting of all structural steel members where indicated.

D. Structural notes indicated on the drawings regarding structural steel framing should be considered a part of this specification.

E. No substitutions will be allowed without the Engineer's approval.

1.2 QUALITY ASSURANCE

A. Codes and Standards: Comply with the provisions of the following codes, specifications, and standards except where more stringent requirements are shown or specified.

1. AISC - Specification for Structural Joints Using High-Strength Bolts.
2. AISC - Code of Standard Practice for Buildings and Bridges.
3. AISC - Specification for the Design of Steel Hollow Structural Sections.
4. AISC - Specification for Allowable Stress Design of Single-Angle Members or Specification for Load and Resistance Factor Design of Single-Angle Members.
5. AISC 360-05 – Specification for Structural Steel Buildings – Allowable Strength Design, 13th Edition.
6. ASTM A36 - Standard Specification for Carbon Structural Steel.
7. ASTM A108 - Standard Specification for Steel Bar, Carbon, Cold-Finished, Standard Quality.
8. ASTM A123 - Standard Specification for Zinc (Hot Dip Galvanized) Coatings on Iron and Steel Products.
9. ASTM A153 - Standard Specification for Zinc Coating (Hot Dip), on Iron and Steel Hardware.
10. ASTM A193 - Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service.

11. ASTM A307 - Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.

12. ASTM A500 - Standard Specification for Cold Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.

13. ASTM A563 - Standard Specification for Carbon and Alloy Steel Nuts.

14. ASTM A572 - Standard Specification for High Strength, Low-Alloy Columbium-Vanadium Structural Steel.

15. ASTM A992 - Standard Specification for Steel for Structural Shapes for use in Building Framing.

16. ASTM A1085 - Standard Specification for Cold-Formed Welded Carbon Steel Hollow Structural Sections.

17. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel.

18. ASTM F436 - Standard Specification for Hardened Steel Washers.

19. ASTM F1554 - Standard Specification for Anchor Bolts, Steel 36, 55 and 105 ksi Yield Strength

20. ASTM F3125 - Standard Specification for High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 120 ksi and 150 ksi Minimum Tensile Strength, Inch Dimensions.

21. AWS D1.1 - Structural Welding Code.

22. SSPC - Steel Structures Painting Council.

B. Where any provisions of other pertinent codes and standards conflict with this specification, the more stringent provision shall govern.

C. Fabrication, Erection, and Welding Qualifications:

1. Fabricate structural steel members in accordance with AISC Specification for the design, fabrication and erection of structural steel for buildings.

2. Steel fabricator shall not have less than five (5) years of continuous experience in fabrication of structural steel framing.

3. Steel detailer shall have five (5) years of continuous experience in the production of steel fabrication drawings.

4. Steel erector shall not have less than five (5) years of continuous experience in the erection of structural steel framing.

5. All welding of structural steel shall be performed by operators who have been recently qualified as prescribed in “Qualification Procedures” of the American Welding Society (AWS).

D. Tolerances: Tolerances shall be as indicated by the AISC Code of Standard Practice for Buildings and Bridges except that tolerances for fabricating, rolling, cambering and erection shall not be cumulative.

1.3 TESTING AND INSPECTION

A. Inspection and Testing:

1. The Contractor shall employ an Inspection Agency to perform the duties and responsibilities specified below.

2. Refer to architectural, civil, mechanical, and electrical specifications for testing and inspection requirements of non-structural components.

3. Work performed on the premises of a fabricator approved by the building official need not be tested and inspected per the table below. The fabricator shall submit a certificate of compliance that the work has been performed in accordance with the approved plans and specification to the building official and the Architect and Engineer of Record.

4. Duties of the Inspection Agency:

   a. Perform all testing and inspection required per approved testing and inspection program.

   b. Furnish inspection reports to the building official, the Owner, the Architect, the Engineer of Record, and the General Contractor. The reports shall be completed and furnished within 48 hours of inspected work.

   c. Submit a final signed report stating whether the work requiring Inspection was, to the best of the Inspection Agency's knowledge in conformance with the approved plans and specifications.

5. Structural Component Testing and Inspection Schedule for Section 05 12 23 is as follows:

Structural Steel	Continuous	Periodic	Referenced Standard
1. Material verification of high-strength bolts, nuts, and washers:			
A. Identification markings to conform to ASTM standards specified in the approved construction documents.		X	Applicable ASTM material standards: AISC 360, Section A3.3
B. Manufacturer's certificate of compliance required.		X	
2. Inspection of high-strength bolting:			
A. Snug-tight joints.		X	AISC 360, Section M2.5
B. Pretensioned and slip-critical joints using turn-of-nut with matchmarking or direct tension indicator methods of installation.		X	
C. Pretensioned and slip-critical joints using turn-of-nut without matchmarking or calibrated wrench methods of installation.	X		
3. Material verification of structural steel:			
A. Identification markings to conform to AISC 360.		X	AISC 360, Section M5.5
B. Manufacturer's certified test reports.		X	
4. Material verification of weld filler materials:			
A. Identification markings to conform to AWS specification in the approved construction documents.		X	AISC 360, Section A3.5 and applicable AWS A5 documents
B. Manufacturer's certificate of compliance required		X	
5. Inspection of welding:			
A. Complete and partial joint penetration groove welds	X		AWS D1.1
B. Multi-pass fillet welds	X		AWS D1.1
C. Single-pass fillet welds > 5/16" (7.9 mm)	X		AWS D1.1
D. Plug and slot welds.	X		AWS D1.1
E. Single-pass fillet welds ≤ 5/16" (7.9 mm)		X	AWS D1.1

Structural Steel	Continuous	Periodic	Referenced Standard
6. Inspection of steel frame joint details for compliance:			
A. Details such as bracing and stiffening.		X	
B. Member locations.		X	
C. Application of joint details at each connection.		X	

1.4 SUBMITTALS

A. Shop Drawings:

1. Prepare and submit complete erection and detailed shop drawings for Engineer's approval, including framing plans indicating size, weight and location of all structural members. Shop drawings shall indicate methods of connecting, anchoring, fastening, bracing and attaching work of other trades.

   a. Where contract documents indicate verify in field (VIF) dimensions, shop drawings shall indicate these dimensions and Contractor shall note that the dimensions have been verified.

   b. This specification modifies AISC Code of Standard Practice by deleting the following sentence from 4.4.1(c): "Release by the Owner's Designated Representatives for Design and Construction for the Fabricator to begin fabrication using the approved submittals." Review of the shop drawings by the Engineer shall not relieve the fabricator of this responsibility.

2. Furnish both the Engineer and Architect with one copy of the following:

   a. Final shop drawings containing all review notations.
   b. Field Use/For Construction Drawings.

3. The steel fabricator shall submit a setting plan for all embedded items for Engineer's approval.

4. Shop drawings shall identify and mark AESS members and items. Specific project requirements for AESS (required blast cleaning, SSPC designation, special handling etc.) relating to shop fabrication and field erection practices shall be indicated on the shop drawings.

5. Welder's Certification: Submit certification for all welders employed on the project demonstrating they have been AWS qualified to perform the welding procedures required for this project.

6. General Contractor/Construction Manager to provide copies of field concrete cylinder breaks indicating the concrete meets 75% of the design compressive strength to the steel erector.

B. The General Contractor shall conduct a field survey of as-built anchors and bearing plate locations and elevations prior to steel erection. Survey shall be furnished to the steel fabricator. Contractor shall identify deviations from approved shop drawings and submit proposed repairs and modifications to the Engineer and steel fabricator for approval.

C. Product Data:

1. Prepare and submit product data for Engineer's approval for shop applied primers, finished paint system, expansion and/or adhesive anchors, non-shrink grout and other miscellaneous materials.

D. LEED Certification: Submit manufacturer's certification for each steel product including the following:

1. LEED Credit MRc 4.1/4.2 – Recycled content, including percentage of pre-consumer (post-industrial) and post-consumer recycled content. Also provide manufacturer's name, product cost and steel processing furnace type.

2. LEED Credit MRc 5.1/5.2 – Location of manufacturing plant, manufacturer's name, product cost and location of extraction or harvest of raw materials.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Steel members shall be transported, stored and erected in a manner that will avoid any damage or deformation. Materials should be stored to allow easy access for inspection and identification. Bent or deformed members will be rejected and shall be replaced or repaired at the expense of the responsible party. Store clear of the ground and in such a manner as to eliminate excessive handling.

B. Store fasteners in a protected location. Clean and re-lubricate bolts and nuts before use.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Structural Steel:

1. All structural steel shall be free from defects impairing strength, durability or appearance. All structural steel shall meet the latest minimum requirements as follows:

a. Structural steel shapes, bars and plates shall conform to the ASTM designations listed in the General Notes of the Drawings.

b. Square and rectangular structural tubing shall be cold formed conforming to the ASTM designations listed in the General Notes of the Drawings.

B. High Strength Structural Bolts:

1. High strength structural bolts shall conform to the ASTM designations listed in the General Notes of the Drawings.

2. High strength bolts shall be detailed and installed in accordance with AISC - "Specification for Structural Joints Using High-Strength Bolts."

3. Manufacturer's symbol and grade markings shall appear on all bolts and nuts.

C. Anchoring Devices:

1. Anchor Rods: Anchor rods used with structural steel members shall be plain threaded rods conforming to the ASTM designations listed in the General Notes of the Drawings.

2. Expansion Anchors: Expansion anchors shall consist of one-piece wedge type carbon steel anchors with heavy-duty nuts and washers. All components shall be zinc plated in accordance with ASTM B633. Refer to the drawing details and General Notes for the expansion anchors used as the basis of design and the acceptable alternates.

3. Adhesive Anchoring System: Adhesive anchoring system shall consist of a threaded anchor rod complete with nut and washer and the adhesive cartridge. Refer to the drawing details and General Notes for the adhesive anchoring systems used as the basis of design and the acceptable alternates.

   a. Nuts shall meet ASTM A563, Grade DH, and washers shall meet ASTM F436.

   b. All components shall be zinc plated in accordance with ASTM B633 SC1.

   c. Adhesive shall consist of a two-part acrylic based adhesive applied in a dual cartridge dispensing system that properly mixes the components at the point of application.

D. Welding Materials:

1. Type required for material being welded in conformance with AWS D1.1.

E. Stud Connectors:

1. For threaded studs that are being used to connect steel beams to embed plates, use ASTM A108, Type A, Grades 1010 through 1020 forged steel, headed uncoated with a minimum tensile strength of 61,000 psi. Fabricated within the tolerances set forth in AWS D1.1.

2. Studs applied by means of the electric arc welding process and shall use an arc shield ferrules of heat resistant ceramic.

F. Paints and Primers:

1. Fabricator's standard lead- and chromate-free, non-asphalitic, rust-inhibiting primer.

2. Galvanizing repair paint: SSPC Paint 20.

3. Refer to Specification Section 09 90 00 for additional paint requirements.

G. Non-Shrink Grout for Base and Bearing Plates: Non-shrink grout, conforming to ASTM C1107, shall be pre-mixed, non-metallic, non-corrosive, non-staining product containing selected silica sand, Portland cement, shrinkage compensating agents, plasticizing and water reducing agents. All constituents shall meet the requirements of these specifications. Minimum compressive strength at 28-days shall be 7,000 psi as determined by ASTM C109. Follow manufacturer's instructions for handling, mixing, placing and curing. Acceptable products are:

1. Euclid Chemical Company - Euco N.S. Grout
2. L&M Construction Chemical - Crystex.
3. Master Builders - Masterflow 713.
4. Sonneborn - Sonnogrout.
5. Five Star Products Inc. – Five Star Grout.
6. Dayton Superior - Sure-Grip High Performance Grout.
7. Dayton Superior – 1107 Advantage Grout.

2.2 FABRICATION AND MANUFACTURE

A. Fabrication Procedures:

1. Fabricate all structural steel items in accordance with AISC Specifications and as indicated on the drawings.

2. Properly mark materials for field assembly. Fabricate for delivery sequence that will expedite erection and minimize handling of materials.

3. Complete structural steel assemblies before shop priming or galvanizing.

B. Architecturally Exposed Structural Steel (AESS):

1. Fabricate and erect all structural steel items identified on the drawings as AESS in accordance with the AISC Code of Standard Practice for Buildings and Bridges.

a. Fabricate with exposed surfaces smooth, square, and free of surface blemishes including pitting, rust, scale, seam marks, roller marks, rolled trade names, and roughness.

b. Remove blemishes by filling or grinding or by welding and grinding, before cleaning, treating, and shop priming.

2. Prepare AESS surfaces according to the following specifications and standards:

a. SSPC-SP6 "Commercial Blast Cleaning"

C. Shop Connections:

1. All shop connections shall be welded, unless noted otherwise on drawings. Connections shall develop the full strength of the adjoining members unless detailed otherwise.

2. All holes shall be either drilled or punched, as no burning of holes will be permitted, including the enlargement of holes. Provide all holes required for connections and for attaching the work of other trades where such holes are shown if furnished prior to fabrication.

3. Connections shall be detailed as standard framed beam connections (bearing type) in accordance with the AISC Manual of Steel Construction - Allowable Stress Design. Connections which require oversized holes or slotted holes in which the force is other than normal to the axis of the slot shall be detailed as "Slip-Critical Connections" and noted as such on the erection drawings. Provide bearing plates and end anchorage for beams resting on masonry.

4. All full and partial penetration welds shall be fully detailed on the shop drawings. Use backing for all full penetration welds.

5. Weld access holes shall be fabricated in accordance with the recommendations of AWS D1.1 and AISC Specification.

D. Shear Connectors:

1. Steel stud shear connectors shall be securely welded in the field to structural steel beams as detailed on the drawings. Welds shall be such that the shear connector stud will deform before weld failure occurs. Welding shall be done in accordance with AWS D1.1.

2. Shear stud connector for embedded plates and angles shall be welded in the fabrication shop in accordance with AWS D1.1.

E. Deck support framing and seats: Furnish all miscellaneous framing necessary to fully support the roof and floor steel decking.

F. Shop Priming:

1. Unless noted otherwise below, structural steel shall be shop primed.

2. The following surfaces are exceptions to shop priming:

a. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches.

b. Surfaces to be field welded.

c. Surfaces to be high-strength bolted with slip-critical connections.

d. Surfaces to receive sprayed fire-resistive materials.

e. Galvanized surfaces.

3. Surface Preparation: Clean Surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces according to the following specifications and standards:

a. SSPC-SP3, "Power Tool Cleaning."

4. Priming: Apply primer in accordance with paint manufacturer's recommendations, and at a rate recommended by SSPC to provide a dry film thickness of not less than 1.5 mils. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.

G. Finished Paint System:

1. Finished paint coats shall be in accordance with paint manufacturer's recommendations, and specification Division 9.

2. Paint shall be free of sags, runs, drips or other defects. Allow ample drying time before handling to prevent damage to coatings.

3. Strip paint corners, crevices, bolts, welds, and sharp edges.

4. Apply one coat of shop paint to surfaces that will be inaccessible after assembly or erection.

H. Galvanizing:

1. Hot-Dip Galvanized Finish: Apply Zinc coating by the hot-dip process to structural steel according to ASTM A 123.

a. Fill vent holes and grind smooth after galvanizing.

b. Unless otherwise noted on drawings or in Division 9, all exterior steel components exposed to the elements shall be galvanized, including, but not limited to, lintels.

2.3 LEED CREDIT

A. LEED Credit MRc 4.1/4.2:

1. Steel products shall be made using an Electric Arc Furnace and shall have a minimum recycled content of 80%, including at least 65% post-consumer recycled content and 15% post-industrial recycled content.

2. Steel products made using a Basic Oxygen Furnace shall have a minimum recycled content of 25%, including at least 20% post-consumer recycled content and 5% post-industrial recycled content.

B. LEED Credit MRc 5.1/5.2:

1. Steel products shall be manufactured within 500 miles of project site. Recycled scrap products shall be procured from within 500 miles of the project site.

PART 3 - EXECUTION

3.1 ERECTION

A. Erection Procedures:

1. The erector and not the structural engineer of record shall be responsible for the means, methods and safety of erection of the structural steel framing.

2. Erection of all structural steel items shall meet the requirements of AISC "Specification and Code of Standard Practice."

3. All work shall be erected square, plumb, straight and true, accurately fitted and with tight joints and intersections, by mechanics experienced in the erection of structural steel. Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.

4. All base plates shall be supported on steel wedges, steel shims or heavy duty leveling nuts until the supported members have been leveled and plumbed.

   a. Snug tighten anchor rods after supported members have been positioned and plumb. Do not remove wedges or shims but, if protruding, cut off flush with edge of base plate before packing with grout.

   b. Promptly place non-shrink grout between bearing surfaces and base plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturers written installation instructions for shrinkage-resistant grouts.

5. Field connections of structural work shall be made with either high strength bolts (bearing type) or by welding. Proper precaution shall be taken to ensure that anchored items will not be distorted or overstressed due to improperly fabricated items.

6. Splice members only where indicated.

7. Remove erection bolts on welded, Architecturally Exposed Structural Steel; fill holes with plug welds; and grind smooth at exposed surfaces.

8. Do not use thermal cutting during erection unless approved by the Engineer/Architect in writing.

9. Steel erection shall not proceed without concrete in footings, piers, and walls attaining 75% of the intended minimum compressive design strength. Documentation must be provided indicating compliance with this requirement.

B. Bracing and Protection:

1. Steel shall be well plumbed, leveled and braced to prevent any movement.

   a. Contractor shall provide and maintain all necessary temporary guying of steel frame to resist safely all wind and construction loads during erection and to assure proper alignment of all parts of the steel frame.

2. Provide all temporary flooring, bracing, shoring and guards necessary to prevent damage or injury. All partially erected steel shall be secured in an approved manner during interruptions of work.

C. Anchor and Foundation Rods:

1. All anchor or foundation rods and similar steel items to be built into concrete or masonry are to be set by the concrete or masonry contractors and shall be furnished promptly so that they may be built in as the work progresses because cutting of structural steel members to accommodate errors pertaining to embedded items will not be permitted.

3.2 FIELD WELDING

A. Welding Procedures:

1. All field welding shall be in accordance with AISC Specifications and conform to AWS D1.1 "Structural Welding Code - Steel".

a. Comply with AISC's "Code of Standard Practice for Steel Buildings and Bridges" for bearing, adequacy of temporary connections, alignment, and removal of paint on surfaces adjacent to field welds.

b. Assemble and weld built-up sections by methods that will maintain true alignment of axes without exceeding tolerances of AISC's "Code of Standard Practice" for Steel Buildings and Bridges" for mill material.

c. Verify that weld sizes, fabrication sequence, and equipment used for Architecturally Exposed Structural Steel will limit distortions to allowable tolerances. Prevent damage due to field welding on exposed surfaces.

1) Grind butt welds flush.

2) Grind or fill exposed fillet welds to smooth profile. Dress exposed welds.

2. Contractor shall remove ceramic ferrules from shear connectors in sufficient time so as to allow for inspection of welds prior to placement of the concrete.

3.3 REPAIRS, PROTECTION, AND TOUCH UP

A. Repair damaged galvanized coatings and on galvanized items with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

B. Touch up Painting: After installation, promptly clean, prepare, and prime or reprime field welds, final connections, rust spots, and abraded surfaces of prime-painted joists, bearing plates and abutting structural steel.

1. Clean and prepare surfaces by SSPC-SP2 hand-tool cleaning or SSPC-SP3 power-tool cleaning.

2. Apply a compatible primer of the same type as shop primer used on adjacent surfaces.

3.4 GROUTING

A. Grouting under structural framing members shall be completed after all members have been plumbed and braced and before imposed loads are placed thereon.

B. Remove all defective concrete, dirt, oil, grease and other foreign matter from surfaces to which grout will be placed.

3.5 MISCELLANEOUS STEEL AND STEEL LINTELS

A. Furnish and install all miscellaneous steel as detailed in Architectural and Structural Drawings.

B. The steel fabricator shall furnish all steel lintels required for masonry wall construction indicated in the Architectural and Structural Drawings and Schedules.

C. Provide additional steel framing for continuous support of steel deck edges at openings and column interruptions.

D. All exterior exposed steel shall be hot-dip galvanized in accordance with ASTM A123.

END OF SECTION

SECTION 05 21 00
STEEL JOISTS

PART 1 - GENERAL

1.1 DESCRIPTION

A. The General and Supplementary Conditions of the Construction Contract and Division 1 - General Requirements apply to the work specified in this section.

B. This section includes the fabrication and erection of open web steel joists. Work shall include but not be limited to, the following items:

1. K-series and DLH-series joists.
2. Bridging.
3. Joist anchors and connections.

C. Perform work in accordance with SJI Standard Specifications, Load Tables, and Weight Tables for Steel Joist and Joist Girders.

D. Structural notes indicated on drawings regarding steel joists shall be considered a part of this specification.

1.2 QUALITY ASSURANCE

A. Codes and Standards: Comply with the provisions of the following codes, specifications and standards, except where more stringent requirements are shown or specified.

1. AISC 360-05 – Specification for Structural Steel Buildings – Allowable Strength Design, 13th Edition.
2. ASTM A108 - Standard Specification for Steel Bars, Carbon, Cold-Finished, Standard Quality.
3. ASTM A153 - Standard Specification for Zinc Coating (Hot Dip) on Iron and Steel Hardware.
4. ASTM A307 - Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength
5. ASTM A36 – Standard Specification for Carbon Structural Steel
6. ASTM A572 - Standard Specification for High Strength, Low-Alloy Columbium-Vanadium Structural Steel
7. ASTM F3125 - Standard Specification for High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 120 ksi and 150 ksi Minimum Tensile Strength, Inch Dimensions.
8. AWS D1.1 - Structural Welding Code.
9. SJI – Standard Specification for Open Web Steel Joists, K-Series
10. SJI - Standard Specifications for Longspan Steel Joists LH-Series and Deep Longspan Steel Joists DLH-Series.
11. SSPC - Steel Structures Painting Council.

B. Where any provisions of other pertinent codes and standards conflict with this specification, the more stringent provision shall govern.

1.3 SUBMITTALS

A. Prepare and submit shop and erection drawings for Engineer's approval.

B. Shop Drawings:

1. Indicate standard designations, configuration, sizes, spacing, location of joists, joist chord extensions.

2. Joining and anchorage details of attachment to other construction.

3. Size, location and configuration of all code required bridging, bracing and connections.

4. Joist cambers.

5. Type of paint and shop primer.

C. Welder's Certificates: Submit certification for all welders employed on the project demonstrating they have been AWS qualified to perform the welding procedures required for this project.

D. LEED Certification: Submit manufacturer's certification for each steel product including the following:

1. LEED Credit MRc 4.1/4.2 – Recycled content, including percentage of pre-consumer (post-industrial) and post-consumer recycled content. Also provide manufacturer's name, product cost and steel processing furnace type.

2. LEED Credit MRc 5.1/5.2 – Location of manufacturing plant, manufacturer's name, product cost and location of extraction or harvest of raw materials.

1.4 QUALIFICATIONS

A. Manufacturer: Company specializing in performing the work of this section with minimum ten (10) years documented experience. Fabrication Company shall be certified by the Steel Joist Institute (SJI) to manufacture joists complying with the SJI Standard Specifications and Load Tables.

B. Manufacturer shall assume responsibility for engineering special joists indicated on the Drawings to comply with the SJI standard specification performance requirements. This responsibility includes the preparation of Shop Drawings and comprehensive engineering analysis by a qualified structural engineer licensed in the state where the project is located.

C. Erector: Company specializing in performing the work of this section with minimum five (5) years documented experience.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

A. All joists and accessories shall be transported, stored and erected in a manner, which will prevent any damage or deformation. Damaged joists shall not be erected or repaired without Structural Engineer's approval. Joists shall be stored clear of the ground in such a manner so as to eliminate excessive handling, and protect from weather with a weatherproof covering.

B. Deliver and store all joists and accessories to the site according to all SJI requirements.

1.6 FIELD MEASUREMENTS

A. Verify that field measurements are as shown on the drawings.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Bar Joists: Steel used in the manufacture of bar joists shall be as allowed by the Steel Joist Institute (SJI) standard specification for chord and web members.

B. High Strength Bolts and Nuts: ASTM F3125, Grade A325, Type 1 heavy hex steel structural bolts, heavy hex carbon steel nuts, and hardened carbon steel washers. Finish shall be plain, uncoated.

C. Carbon Steel Bolts and Threaded Fasteners: ASTM A307, Grade A, carbon steel, hex head bolts and threaded fasteners; carbon steel nuts; and flat unhardened steel washers. Finish shall be plain, uncoated.

D. Miscellaneous items, such as bridging, headers, bolts, nuts, washers, anchors and all other appurtenances for a complete metal joist installation shall be furnished as a part of the work of this section.

E. Primer: Provide the manufacturer's standard shop primer with good resistance to normal atmospheric corrosion and complying with the performance requirements specified in the SJI "Standard Specification" previously cited.

1. Do not prime paint joists and accessories scheduled to receive spray applied fireproofing.

2. Contractor shall certify compatibility of shop primer coat with field applied paint finishes.

F. Welding Materials: AWS D1.1; type required for materials being welded.

2.2 FABRICATION AND MANUFACTURE

A. Manufacture K-Series steel joists according to "Standard Specification for Open Web Steel Joists, K-Series," in SJI "Specifications," with steel angle top and bottom chord members, underslung ends, and parallel top chords; of joist type indicated.

B. Manufacture long span steel joists according to "Standard Specifications for Longspan Steel Joists, LH-Series and Deep Longspan Steel Joists, DLH-Series," in SJI's "Specifications," with steel-angle top- and bottom-chord members; of joist type and end and top-chord arrangements as indicated on the Drawings.

C. All steel joists shall consist of an electrically welded open-web type, designed and fabricated to conform to the "Standard Specifications" included in the SJI or AISC publications cited above and shall be manufactured by a current member of the Steel Joist Institute.

D. Provide holes in chord members for connecting and securing other construction to joists. General Contractor shall coordinate this information and provide the manufacturer with drawings outlining the location of any required holes.

E. Bridging members for open web joists, unless otherwise indicated on the drawings, shall be continuous wall to wall, complete with suitable anchorage at each end, all in accordance with SJI "Standard Specifications".

F. Design and fabricate joists and bridging to support a minimum net uplift as indicated on the drawings. A 1/3 stress increase shall not be used in uplift design.

G. Camber joists in accordance with SJI Standard Specification or as indicated.

H. All steel joists including all accessories, before leaving the shop shall be thoroughly cleaned of all mill scale, rust and foreign matter and shall be given one (1) coat of primer complying with the performance requirements specified in the SJI "Standard Specification" previously cited.

I. Provide bottom and top chord extensions as indicated on the Drawings.

2.3 CLEANING, PRIMING AND PAINTING

A. Clean joist by using solvent cleaning, SSPC-SP 1 to remove oil and grease.

B. Apply one shop coat of primer to joists and joist accessories to be primed to provide a continuous dry film thickness of not less than 1 mil.

C. Painting of joists and joist accessories is specified in Division 9 Section "Painting."

2.4 LEED CREDIT

A. LEED Credit MRc 4.1/4.2:

1. Steel products shall be made using an Electric Arc Furnace and shall have a minimum recycled content of 80%, including at least 65% post-consumer recycled content and 15% post-industrial recycled content.

2. Steel products made using a Basic Oxygen Furnace shall have a minimum recycled content of 25%, including at least 20% post-consumer recycled content and 5% post-industrial recycled content.

B. LEED Credit MRc 5.1/5.2:

1. Steel products shall be manufactured within 500 miles of project site. Recycled scrap products shall be procured from within 500 miles of the project site.

PART 3 - EXECUTION

3.1 ERECTION

A. Erection of all metal joist items shall meet the applicable requirements of the SJI “Standard Specifications” previously cited.

B. All anchor bolts, wall anchors, bridging anchors, bearing plates and similar items to be built into concrete or masonry are to be set by the concrete or masonry contractors and shall be furnished promptly so that they may be built-in as the work progresses as no cutting for the same afterward will be permitted. Beginning of installation means erector accepts existing conditions.

C. All metal joists shall be accurately set to the lines, elevations and dimensions indicated on the approved shop drawings.

D. Bridging shall be installed concurrently with joist erection and before loads are applied. Bridging shall be securely welded to joist chords in a manner that will not damage joist members and so as to insure positive resistance to both tensile and compressive stresses. Anchor ends of bridging lines at top and bottom chords if terminating at walls or beams.

E. All K-series joists must bear a minimum of 4 inches on masonry or concrete surfaces and a minimum of 2-1/2 inches on steel surfaces. All DLH-series joists shall bear a minimum of 6 inches on masonry or concrete surfaces and a minimum of 4 inches on steel surfaces. All joists bearing on concrete or masonry shall bear on a steel bearing plate and joists bearing on steel shall be welded to the supporting steel.

F. K-series joists shall be anchored at a minimum with (2) 1/8" fillet welds (1" long) at each support, or (2) 1/2" diameter bolts. DLH-series joists shall be anchored at a minimum with (2) 1/4" fillet welds (2" long) at each support, or (2) 3/4" diameter bolts.

G. All field welding shall be in accordance with AWS previously cited.

H. All construction loads shall be kept off joists until they are permanently anchored and bridged. During construction, care shall be taken to avoid excessive concentrated or moving loads. Provide for adequate distribution of any such loads so that the carrying capacity of the joists is not exceeded.

I. Joist shall not be positioned any greater than 1/4 inch from true alignment, and shall not vary more than 1/4 inch from plumb.

3.2 FIELD TOUCH UP

A. Immediately after erection, Contractor shall touch up all erection bolts, all field welds and all scratched or abraded areas and paint out erection markings with matching rust-inhibitive primer in color and formulation to match shop primer.

END OF SECTION

SECTION 05 31 00
STEEL DECK

PART 1 - GENERAL

1.1 DESCRIPTION

A. The General and Supplementary Conditions of the Construction Contract and Division 1 - General Requirements apply to the work specified in this section.

B. This section includes the fabrication and erection of steel deck. The Work shall include, but not be limited to the following:

1. Roof deck, roof deck accessories, and roof deck fasteners.
2. Acoustical roof deck, acoustical insulation component and accessories.

C. Structural notes indicated on the drawings regarding steel decking shall be considered a part of this specification.

1.2 QUALITY ASSURANCE

A. Codes and Standards: Comply with the provisions of the following codes, specifications and standards, except where more stringent requirements are shown or specified.

1. AISI - Specification for the Design of Cold-Formed Steel Structural Members.
2. ANSI/AWS D1.1 - Structural Welding Code.
3. ANSI/AWS D1.3 - Structural Welding Code - Sheet Steel.
4. ASTM A1008- Standard Specification for Structural Steel (SS), Sheet, Carbon, Cold-Rolled
5. ASTM A36 – Standard Specification for Carbon Structural Steel.
6. ASTM A653 - Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot Dip Process.
7. ASTM A924 - Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
8. SDI - Design Manual for Composite Decks, Form Decks, Roof Decks by the Steel Deck Institute.

B. Manufacture steel decking in accordance with the Steel Deck Institute's (SDI) "Design Manual for Composite Decks, Form Decks and Roof Decks".

C. All steel deck shall be designed and fabricated in accordance with the above AISI and SDI specifications. The gauges and section moduli indicated on the drawings or specified herein are minimum and the gauge and section modules of the deck furnished shall meet or exceed these minimum requirements. All gauges are United States standard, measured prior to coating.

D. Where any provisions of other pertinent codes and standards conflict with this specification, the more stringent provision shall govern.

1.3 QUALIFICATIONS

A. Fabricator: Company specializing in performing the work of this section with minimum five (5) years documented experience at manufacturing steel deck. Fabrication Company shall be a current member of the Steel Deck Institute (SDI).

B. Erector: Company specializing in performing the work of this section with minimum five (5) years documented experience at erecting steel deck.

1.4 SUBMITTALS

A. Prepare and submit shop drawings for Engineer's approval. Shop drawings shall indicate deck layout, depth, uncoated metal thickness, framing and supports with unit dimensions and sections and complete end jointing.

B. Provide details of all accessories.

C. Shop drawings shall also indicate typical welding or mechanical anchoring pattern for steel deck and accessories.

D. Prepare and submit allowable construction span tables and allowable total load tables for Engineer's approval. Tables shall be accompanied with a letter of certification from the manufacturer stating the tabulated design values were determined in accordance with the steel deck institute's "Design Manual for Composite Decks, Form Decks, and Roof Decks."

E. Provide manufacturer's latest recommendations and installation instructions.

F. Prepare and submit product data of proposed materials.

G. LEED Certification: Submit manufacturer's certification for each steel product including the following:

1. LEED Credit MRc 4.1/4.2 – Recycled content, including percentage of pre-consumer (post-industrial) and post-consumer recycled content. Also provide manufacturer's name, product cost and steel processing furnace type.

2. LEED Credit MRc 5.1/5.2 – Location of manufacturing plant, manufacturer's name, product cost and location of extraction or harvest of raw materials.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

A. All decking materials shall be transported, stored and erected in a manner that will prevent damage or deformation of sheets. Damaged material shall not be erected or repaired without Structural Engineer's approval.

B. Deck panels shall be stored clear of the ground, elevated on one end, and protected from weather with waterproof covering.

1.6 COORDINATION

A. Coordinate the installation of the sound-absorbing insulation strips in the topside ribs of the acoustical deck with roof installation specified in Division 7 to ensure protection of insulation strips against damage from the effects of weather and other elements.

PART 2 - PRODUCTS

2.1 STEEL ROOF DECK

A. Standard Steel Roof Deck: Fabricate panels to comply with "SDI Specification and Commentary for Steel Roof Deck," and the following:

1. Steel decking sheet material, minimum yield strength, depth, gage, profile, and finish are indicated on the Drawings, as classified by Steel Deck Institute (SDI). Panels shall be formed with integral ribs and overlapping side flanges.

2.2 ACOUSTICAL STEEL ROOF DECK

A. Acoustical Steel Roof Deck: Fabricate panels to comply with "SDI Specification and Commentary for Steel Roof Deck," and the following:

1. Steel decking sheet material, minimum yield strength, depth, gage, profile, and finish are indicated on the Drawings, as classified by Steel Deck Institute (SDI). Panels shall be formed with integral ribs and overlapping side flanges.

2. Acoustical Perforations: Deck units with manufacturer's standard perforated vertical webs.

3. Sound Absorbing Insulation: Provide the deck manufacturer's standard premolded roll or strip glass fiber or mineral fiber insulation. Provide continuous wire mesh deck/insulation spacers for field painted decking.

4. Acoustical Performance: NRC = 0.95

2.3 FASTENERS

A. Support Fasteners:

1. Welded: 5/8" diameter electric arc spot (puddle) welds. Refer to Drawings for weld spacing requirements.

a. Weld washers required for material less than 0.028" thick. Welding washers shall a minimum thickness of 0.0598 inches and be applicable to AWS D1.3 type welding and of type as recommended by the deck manufacturer.

b. Weld metal shall penetrate all layers of deck material and shall have good fusion to the supporting steel. Fasten ribbed deck to steel support members at ends and intermediate supports.

1) All welding shall be in conformance with previously cited AWS recommendations in appearance and quality of welds, and the methods used in correcting welding work.

B. Side Lap Fasteners:

1. Mechanical: Zinc coated self-drilling, self-tapping type (minimum No. 10) steel screws. Refer to Drawings for fastener spacing requirements.

2.4 ACCESSORIES

A. Provide all closers, fillers, starters, sump pans, metal cant strips, ridge and valley plates, and similar accessories required for a complete installation. Provide cover plates at all locations where direction of deck span changes. Unless otherwise noted, accessories shall be of the same steel sheet material, finish, and thickness as the deck sections.

2.5 LEED CREDIT

A. LEED Credit MRc 4.1/4.2:

1. Steel products shall be made using an Electric Arc Furnace and shall have a minimum recycled content of 80%, including at least 65% post-consumer recycled content and 15% post-industrial recycled content.

2. Steel products made using a Basic Oxygen Furnace shall have a minimum recycled content of 25%, including at least 20% post-consumer recycled content and 5% post-industrial recycled content.

B. LEED Credit MRc 5.1/5.2:

1. Steel products shall be manufactured within 500 miles of project site. Recycled scrap products shall be procured from within 500 miles of the project site.

PART 3 - EXECUTION

3.1 ERECTION

A. Verify that field conditions are acceptable and are ready to receive work.

B. Deck units and deck accessories herein specified shall be thoroughly and securely erected by experienced workmen fastening to supporting steel members as herein specified. All work shall be in conformance with manufacturer's latest printed recommendations and approved shop drawings.

C. Beginning of installation means installer accepts existing conditions.

D. The finished work shall be true, flat planes and to slopes indicated with end joints flush and without sharp protruding edges. Exposed underside of deck shall be true without defect.

E. Erector shall cut all openings in deck for piping and equipment furnished by other trades. Wherever ribs are cut and are not supported by supplemental framing, the erector shall provide steel angles of adequate size on all sides of the opening welded to the underside of each rib.

F. Burning of holes in decking will not be permitted.

G. Steel decking shall be installed to span supporting steel members at right angles. Panels shall be securely anchored to each structural support it rests on or passes.

3.2 ROOF DECK

A. Fasten roof deck panels to steel supporting members using welds as specified herein and on the Drawings.

B. Unless noted otherwise, secure side laps and perimeter edges of units with fasteners at mid-span between supports or 36 inches on center, whichever distance is smaller.

C. Deck shall be fastened through the bottom of the deck rib to all structural supports for the specific deck sections.

D. End bearing of roof decking shall have a minimum of 1-1/2 inches of bearing occurring over structural supports

E. End joints shall be lapped 2 inches minimum.

F. Install sound absorbing insulation into the topside ribs of the acoustical deck as specified in the deck manufacturer's installation instructions. Coordinate with the roofing installation to protect the insulation from damage.

G. Place deck panels on structural supports and adjust to final position with ends aligned. Attach to supports immediately after placement.

H. Roof sump pans shall be installed over openings provided in roof deck with flanges welded to the top of the deck. Space welds at 12 inches apart with at least 1 weld in each corner.

I. Install all roof deck accessories in accordance with the roof deck manufacturer's written instructions.

3.3 FIELD TOUCH UP

A. After erection, all weld burn marks and abraded spots shall be cleaned and field painted with a rust-inhibiting metal primer matching formulations and color of shop coat or a zinc-rich rust inhibiting paint for galvanized deck surfaces.

END OF SECTION

SECTION 05 50 00

METAL FABRICATIONS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Shop fabricated steel and aluminum items.
   1. Fabricated items include, but are not limited to, the following:
      a. Steel lintels.
      b. Bollards.
      c. Trash enclosure gates.
      d. Steel framing and supports for applications where framing and supports are not specified in other Sections.
      e. Photovoltaic panel roof attachment system.

B. Prefabricated ladders and ship ladders.

1.2 RELATED REQUIREMENTS

1.3 REFERENCE STANDARDS

A. ANSI A14.3 - American National Standard for Ladders -- Fixed -- Safety Requirements; 2008.

B. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2014.

C. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2012.

D. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2016a.

E. ASTM A283/A283M - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates; 2013.

F. ASTM A501/A501M - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing; 2014.

G. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.

H. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2015.

I. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2015.

J. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2014.

K. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric); 2014.

L. ASTM B210 - Standard Specification for Aluminum and Aluminum-Alloy Drawn Seamless Tubes; 2012.

M. ASTM B210M - Standard Specification for Aluminum and Aluminum-Alloy Drawn Seamless Tubes (Metric); 2012.

N. ASTM B211 - Standard Specification for Aluminum and Aluminum-Alloy Rolled or Cold Finished Bar, Rod, and Wire; 2012.

O. ASTM B211M - Standard Specification for Aluminum and Aluminum-Alloy Rolled or Cold-Finished Bar, Rod, and Wire (Metric); 2012.

P. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2014.

Q. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2013.

R. ASTM F3125/F3125M - Standard Specification for High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 120 ksi (830 MPa) and 150 ksi (1040 MPa) Minimum Tensile Strength, Inch and Metric Dimensions; 2015a.

S. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination; 2012.

T. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2015 (with March 2016 Errata).

U. AWS D1.2/D1.2M - Structural Welding Code - Aluminum; 2008.

V. SSPC-Paint 20 - Zinc-Rich Primers (Type I, "Inorganic," and Type II, "Organic"); 2002 (Ed. 2004).

1.4 SUBMITTALS

A. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Include erection drawings, elevations, and details where applicable.
   1. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.
   2. Signed and sealed by the qualified professional engineer responsible for thier preparation and structural calculations, include loads from photovoltaic

B. Welders' Certificates: Submit certification for welders employed on the project, verifying AWS qualification within the previous 12 months.

PART 2 PRODUCTS

2.1 MATERIALS - STEEL

A. Steel Sections: ASTM A36/A36M.

B. Steel Tubing: ASTM A501/A501M hot-formed structural tubing.

C. Plates: ASTM A283/A283M.

D. Pipe: ASTM A53/A53M, Grade B Schedule 40, black finish.

E. Slotted Channel Framing: ASTM A653/A653M, Grade 33.

F. Slotted Channel Fittings: ASTM A1011/A1011M.

G. Bolts, Nuts, and Washers: ASTM F3125/F3125M, Type 1, galvanized to ASTM A153/A153M where connecting galvanized components.

H. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.

I. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, Type I - Inorganic, complying with VOC limitations of authorities having jurisdiction.

2.2 MATERIALS - ALUMINUM

A. Extruded Aluminum: ASTM B221 (ASTM B221M), 6063 alloy, T6 temper.

B. Sheet Aluminum: ASTM B209 (ASTM B209M), 5052 alloy, H32 or H22 temper.

C. Aluminum-Alloy Drawn Seamless Tubes: ASTM B210 (ASTM B210M), 6063 alloy, T6 temper.

D. Aluminum-Alloy Bars: ASTM B211 (ASTM B211M), 6061 alloy, T6 temper.

E. Bolts, Nuts, and Washers: Stainless steel.

F. Welding Materials: AWS D1.2/D1.2M; type required for materials being welded.

2.3 FABRICATION

A. Fit and shop assemble items in largest practical sections, for delivery to site.

B. Fabricate items with joints tightly fitted and secured.

C. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.

D. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

2.4 FABRICATED ITEMS

A. Miscellaneous Framing and Supports: Provide steel framing and supports not specified in other Sections as needed to complete the Work.
   1. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.

2. Fabricate supports for operable partitions from continuous steel beams of sizes recommended by partition manufacturer with attached bearing plates, anchors, and braces as recommended by partition manufacturer. Drill or punch bottom flanges of beams to receive partition track hanger rods; locate holes where indicated on operable partition Shop Drawings.

B. Ladders: Steel; in compliance with ANSI A14.3; with mounting brackets and attachments; galvanized finish.
1. Side Rails: 3/8 x 2 inches members spaced at 20 inches.
2. Rungs: Minimum 3/4 inch diameter solid square bar spaced 12 inches on center.
3. Space rungs with no less than 7 inches of clearance from wall and/or nearest object.
4. Provide nonslip surfaces on top of each rung by coating with abrasive material metallically bonded to rung.
5. Provide minimum of 15 inch clearance from center line of ladder to walls/obstructions to left and right sides of ladder.
6. Provide step across gap distance from top rung to a weight bearing surface of no more than 12 inches.
7. Provide mounting for wall mounting and floor mounting.

C. Bollards: Steel pipe, concrete filled, crowned cap, or as otherwise detailed; galvanized finish.
1. Bollards for mounting of ADA actuators shall have welded steel plate cap.

D. Lintels: As detailed; galvanized finish.

E. Miscellaneous Steel Trim
1. Unless otherwise indicated, fabricate units from steel shapes, plates, and bars of profiles shown with continuously welded joints and smooth exposed edges. Miter corners and use concealed field splices where possible.
2. Galvanize miscellaneous steel trim.

2.5 PREFABRICATED LADDERS

A. Prefabricated Ship Ladder: Welded metal unit complying with ANSI A14.3; factory fabricated to greatest degree practical and in the largest components possible.
1. Components: Manufacturer's standard rails, rungs, treads, handrails. returns, platforms and safety devices complying with the requirements of the MATERIALS article of this section.
2. Materials: Aluminum; ASTM B221 (ASTM B221M), 6063 alloy, T52 temper.
3. Incline: As indicated on drawings.
4. Finish: Mill finish aluminum.
5. Manufacturers:
a. O'Keeffe's Inc; Model 520: www.okeeffes.com/sle.

2.6 PHOTOVOLTAIC PANEL ROOF ATTACHMENT SYSTEM

A. Pre-engineered Photovoltaic Panel Roof Attachment System: Aluminum rails and roof attachement system specifically manufactured for attaching photovoltaic panels to standing seam metal roof panel system. Provide manufacturer's standing seam clamps that securely clamp to roof seams and do not interfere or damage the integrity of the seam.
1. Fasteners: ASTM A666, Type 316 stainless steel.
2. Angle: Provide system that mounts photovoltaic panels at 15 degrees from horizontal.
3. Provide fully engineered system with shop drawings signed and sealed by the qualified professional engineer responsible for thier preparation and structural calculations. Coordinate structural design of system with design of metal roof panel system.
4. Basis-of-Design: Schletter, FixZ-7.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that field conditions are acceptable and are ready to receive work.

3.2 PREPARATION

A. Clean and strip primed steel items to bare metal where site welding is required.

B. Supply setting templates to the appropriate entities for steel items required to be cast into concrete or embedded in masonry.

3.3 INSTALLATION

A. Install items plumb and level, accurately fitted, free from distortion or defects.

B. Provide for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.

C. Anchor bollards in place with concrete footings, unless otherwise indicated. Center and align bollards in holes 3 inches above bottom of excavation. Place concrete and vibrate or tamp for consolidation. Support and brace bollards in position until concrete has cured.

D. Field weld components as indicated on drawings.

E. Perform field welding in accordance with AWS D1.1/D1.1M.

F. Obtain approval prior to site cutting or making adjustments not scheduled.

3.4 TOLERANCES

A. Maximum Variation From Plumb: 1/4 inch per story, non-cumulative.

B. Maximum Offset From True Alignment: 1/4 inch.

C. Maximum Out-of-Position: 1/4 inch.

END OF SECTION

SECTION 05 51 00

METAL STAIRS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Stairs with concrete treads.

B. Structural steel stair framing and supports.

C. Handrails and guards.

1.2 RELATED REQUIREMENTS

A. Section 03 30 00 - Cast-in-Place Concrete: Concrete fill in stair pans.

1.3 REFERENCE STANDARDS

A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2014.

B. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2012.

C. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2016a.

D. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; 2013.

E. ASTM A501/A501M - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing; 2014.

F. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable; 2016.

G. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2015.

H. ASTM F3125/F3125M - Standard Specification for High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 120 ksi (830 MPa) and 150 ksi (1040 MPa) Minimum Tensile Strength, Inch and Metric Dimensions; 2015a.

I. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2015 (with March 2016 Errata).

J. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer; 1999 (Ed. 2004).

K. SSPC-SP 2 - Hand Tool Cleaning; 1982 (Ed. 2004).

1.4 SUBMITTALS

A. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories.
   1. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.
   2. Include the design engineer's stamp or seal on each sheet of shop drawings.

B. Delegated Design Data: Include loads and other information as required by authorities having jurisdiction.

1.5 QUALITY ASSURANCE

A. Structural Designer Qualifications: Professional Structural Engineer experienced in design of this work and licensed in the State in which the Project is located, or personnel under direct supervision of such an engineer.

PART 2 PRODUCTS

2.1 METAL STAIRS - GENERAL

A. Metal Stairs: Provide stairs of the design specified, complete with landing platforms, vertical and horizontal supports, railings, and guards, fabricated accurately for anchorage to each other and to building structure.
   1. Regulatory Requirements: Provide stairs and railings complying with the most stringent requirements of local, state, and federal regulations; where requirements of the contract documents exceed those of regulations, comply with the contract documents.

2. Structural Design: Provide complete stair and railing assemblies complying with the applicable local code.
3. Dimensions: As indicated on drawings.
4. Shop assemble components; disassemble into largest practical sections suitable for transport and access to site.
5. No sharp or rough areas on exposed travel surfaces and surfaces accessible to touch.
6. Separate dissimilar metals using paint or permanent tape.

B. Metal Jointing and Finish Quality Levels:
1. Commercial: Exposed joints as inconspicuous as possible, whether welded or mechanical; underside of stair not covered by soffit IS considered exposed to view.
a. Welded Joints: Intermittently welded on back side, filled with body putty, and sanded smooth and flush.
b. Welds Exposed to View: Ground smooth and flush.
c. Mechanical Joints: Butted tight, flush, and hairline.
d. Bolts Exposed to View: Countersunk flat or oval head bolts; no exposed nuts.
e. Exposed Edges and Corners: Eased to small uniform radius.
f. Metal Surfaces to be Painted: Sanded or ground smooth, suitable for satin or matte finish.

C. Fasteners: Same material or compatible with materials being fastened; type consistent with design and specified quality level.

D. Anchors and Related Components: Same material and finish as item to be anchored, except where specifically indicated otherwise; provide all anchors and fasteners required.

2.2 METAL STAIRS WITH CONCRETE TREADS

A. Jointing and Finish Quality Level: Architectural, as defined above.

B. Risers: Closed.

C. Treads: Metal pan with field-installed concrete fill.
1. Concrete Depth: 1-1/2 inches, minimum.
2. Tread Pan Material: Steel sheet.
3. Tread Pan Thickness: As required by design; 14 gage, 0.075 inch minimum.
4. Concrete Reinforcement: Welded wire mesh.
5. Concrete Finish: For resilient floor covering.

D. Risers: Same material and thickness as tread pans.
1. Nosing Depth: Not more than 1-1/2 inch overhang.
2. Nosing Return: Flush with top of concrete fill, not more than 1/2 inch wide.

E. Stringers: Steel tubes.
1. Stringer Depth: 10 inches.

F. Railings: Steel pipe railings.

G. Finish: Shop- or factory-prime painted.

2.3 PIPE AND TUBE HANDRAILS AND GUARDS

A. Wall-Mounted Rails: Round pipe or tube rails unless otherwise indicated.
1. Outside Diameter: 1-1/4 inch, minimum, to 1-1/2 inches, maximum.

B. Guards:
1. Hand Rails: Round pipe or tube rails unless otherwise indicated.
a. Outside Diameter: 1-1/4 inch, minimum, to 1-1/2 inches, maximum.
2. End and Intermediate Posts: Same material and size as top rails.
a. Horizontal Spacing: As indicated on drawings.
b. Mounting: Welded to top surface of stringer.

2.4 MATERIALS

A. Steel Sections: ASTM A 36/A 36M.

B. Steel Tubing: ASTM A500/A500M or ASTM A501/A501M structural tubing, round and shapes as indicated.

C. Pipe: ASTM A 53/A 53M, Grade B Schedule 40, black finish.

D. Ungalvanized Steel Sheet: Hot- or cold-rolled, except use cold-rolled where finished work will be exposed to view.
   1. Hot-Rolled Steel Sheet: ASTM A1011/A1011M, Designation CS (commercial steel).
   2. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, Designation CS (commercial steel).

E. Concrete Fill: Type specified in Section 03 30 00.

F. Concrete Reinforcement: Mesh type, galvanized.

2.5 ACCESSORIES

A. Steel Bolts, Nuts, and Washers: ASTM F3125/F3125M, Type 1, and galvanized to ASTM A153/A153M where connecting galvanized components.

B. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.

C. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.

2.6 SHOP FINISHING

A. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.

B. Do not prime surfaces in direct contact with concrete or where field welding is required.

C. Prime Painting: Use specified shop- and touch-up primer.
   1. Preparation of Steel: In accordance with SSPC-SP 2, Hand Tool Cleaning.
   2. Number of Coats: One.

2.7 FABRICATION, GENERAL

A. Provide complete stair assemblies, including metal framing, hangers, struts, railings, clips, brackets, bearing plates, and other components necessary to support and anchor stairs and platforms on supporting structure.
   1. Join components by welding unless otherwise indicated.

B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges. Remove sharp or rough areas on exposed surfaces.

C. Form bent-metal corners to smallest radius possible without impairing work.

D. Weld connections to comply with the following:
   1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
   2. Obtain fusion without undercut or overlap.
   3. Remove welding flux immediately.

2.8 FINISHES

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Finish metal stairs after assembly.

C. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning.

D. Apply shop primer to uncoated surfaces of metal stair components. Comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install components plumb and level, accurately fitted, free from distortion or defects.

B. Allow for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.

C. Provide welded field joints where specifically indicated on drawings. Perform field welding in accordance with AWS D1.1/D1.1M.

D. Other field joints may be either welded or bolted provided the result complies with the limitations specified for jointing quality levels.

E. Obtain approval prior to site cutting or creating adjustments not scheduled.

F. After erection, prime welds, abrasions, and surfaces not shop primed, except surfaces to be in contact with concrete.

3.2 TOLERANCES

A. Maximum Variation From Plumb: 1/4 inch per story, non-cumulative.

B. Maximum Offset From True Alignment: 1/4 inch.

END OF SECTION

SECTION 06 10 00

ROUGH CARPENTRY

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Sheathing.

B. Preservative treated wood materials.

C. Fire retardant treated wood materials.

D. Concealed wood blocking, nailers, and supports.

E. Miscellaneous wood nailers, furring, and grounds.

1.2 RELATED REQUIREMENTS

A. Section 05 50 00 - Metal Fabrications: Miscellaneous steel connectors and support angles for wood framing and photovoltaic panel roof attachment system.

B. Section 07 41 13 - Metal Roof Panels: Metal roof panel system.

1.3 REFERENCE STANDARDS

A. ASTM C1177/C1177M - Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing; 2013.

B. ASTM D2898 - Standard Test Methods for Accelerated Weathering of Fire-Retardant-Treated Wood for Fire Testing; 2010.

C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2016.

D. AWPA U1 - Use Category System: User Specification for Treated Wood; 2016.

E. PS 1 - Structural Plywood; 2009.

F. PS 20 - American Softwood Lumber Standard; 2015.

1.4 SUBMITTALS

A. Product Data: Provide technical data on insulated sheathing, wood preservative materials, and application instructions.

B. Include structural analysis signed and sealed by qualified structural engineer, indicating conformance of roof sheathing system to loading conditions including loads from metal roofing panels and photovoltaic panel attachment system.

C. Manufacturer's Certificate: Certify that wood products supplied for rough carpentry meet or exceed specified requirements.

1.5 DELIVERY, STORAGE, AND HANDLING

A. General: Cover wood products to protect against moisture. Support stacked products to prevent deformation and to allow air circulation.

B. Fire Retardant Treated Wood: Prevent exposure to precipitation during shipping, storage, or installation.

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Dimension Lumber: Comply with PS 20 and requirements of specified grading agencies.
   1. If no species is specified, provide any species graded by the agency specified; if no grading agency is specified, provide lumber graded by any grading agency meeting the specified requirements.
   2. Grading Agency: Any grading agency whose rules are approved by the Board of Review, American Lumber Standard Committee (www.alsc.org) and who provides grading service for the species and grade specified; provide lumber stamped with grade mark unless otherwise indicated.

B. Lumber fabricated from old growth timber is not permitted.

2.2 DIMENSION LUMBER

A. Sizes: Nominal sizes as indicated on drawings, S4S.

B. Moisture Content: S-dry or MC19.

C. Miscellaneous Framing, Blocking, Nailers, Grounds, and Furring:
   1. Lumber: S4S, No. 2 or Standard Grade.
   2. Boards: Standard or No. 3.

2.3 CONSTRUCTION PANELS

A. Glass Mat Gypsum Roof Sheathing: Glass mat faced gypsum, ASTM C1177/C1177M, 5/8 inch Type X fire resistant.

B. Communications and Electrical Room Mounting Boards: PS 1 A-D plywood, or medium density fiberboard; 3/4 inch thick; flame spread index of 25 or less, smoke developed index of 450 or less, when tested in accordance with ASTM E84.

2.4 ACCESSORIES

A. Fasteners and Anchors:
   1. Metal and Finish: Stainless steel for high humidity and preservative-treated wood locations, unfinished steel elsewhere.
   2. Drywall Screws: Bugle head, hardened steel, power driven type, length three times thickness of sheathing.

B. Glass Mat Faced Sheathing Tape: Self-adhering glass-fiber tape, minimum 2 inches wide, 10 by 10 by 20 threads/inch, of type recommended by sheathing and tape manufacturers for use with silicone emulsion sealant in sealing joints in glass-mat gypsum sheathing with a history of successful service.

2.5 FACTORY WOOD TREATMENT

A. Treated Lumber and Plywood: Comply with requirements of AWPA U1 - Use Category System for wood treatments determined by use categories, expected service conditions, and specific applications.
   1. Fire-Retardant Treated Wood: Mark each piece of wood with producer's stamp indicating compliance with specified requirements.

B. Fire Retardant Treatment:
   1. Manufacturers:
      a. Arch Wood Protection, Inc: www.wolmanizedwood.com.
      b. Hoover Treated Wood Products, Inc: www.frtw.com.
      c. Koppers, Inc: www.koppers.com.
   2. Exterior Type: AWPA U1, Category UCFB, Commodity Specification H, chemically treated and pressure impregnated; capable of providing a maximum flame spread index of 25 when tested in accordance with ASTM E84, with no evidence of significant combustion when test is extended for an additional 20 minutes both before and after accelerated weathering test performed in accordance with ASTM D2898.
      a. Kiln dry wood after treatment to a maximum moisture content of 19 percent for lumber and 15 percent for plywood.
      b. Treat all exterior rough carpentry items, including sheathing.
      c. Do not use treated wood in direct contact with the ground.
   3. Interior Type A: AWPA U1, Use Category UCFA, Commodity Specification H, low temperature (low hygroscopic) type, chemically treated and pressure impregnated; capable of providing a maximum flame spread index of 25 when tested in accordance with ASTM E84, with no evidence of significant combustion when test is extended for an additional 20 minutes.
      a. Kiln dry wood after treatment to a maximum moisture content of 19 percent for lumber and 15 percent for plywood.
      b. Treat rough carpentry items as indicated .
      c. Do not use treated wood in applications exposed to weather or where the wood may become wet.

PART 3 EXECUTION

3.1 PREPARATION

A. Coordinate installation of rough carpentry members specified in other sections.

3.2 INSTALLATION - GENERAL

A. Select material sizes to minimize waste.

B. Reuse scrap to the greatest extent possible; clearly separate scrap for use on site as accessory components, including: shims, bracing, and blocking.

C. Where treated wood is used on interior, provide temporary ventilation during and immediately after installation sufficient to remove indoor air contaminants.

3.3 BLOCKING, NAILERS, AND SUPPORTS

A. Provide framing and blocking members as indicated or as required to support finishes, fixtures, specialty items, and trim.

B. In framed assemblies that have concealed spaces, provide solid wood fireblocking as required by applicable local code, to close concealed draft openings between floors and between top story and roof/attic space; other material acceptable to code authorities may be used in lieu of solid wood blocking.

C. In metal stud walls, provide continuous blocking around door and window openings for anchorage of frames, securely attached to stud framing.

D. In walls, provide blocking attached to studs as backing and support for wall-mounted items, unless item can be securely fastened to two or more studs or other method of support is explicitly indicated.

E. Where ceiling-mounting is indicated, provide blocking and supplementary supports above ceiling, unless other method of support is explicitly indicated.

F. Provide the following specific non-structural framing and blocking:
1. Cabinets and shelf supports.
2. Wall brackets.
3. Handrails.
4. Grab bars.
5. Towel and bath accessories.
6. Wall-mounted door stops.
7. Chalkboards and marker boards.
8. Wall paneling and trim.
9. Joints of rigid wall coverings that occur between studs.

3.4 INSTALLATION OF CONSTRUCTION PANELS

A. Roof Sheathing: Secure panels with long dimension perpendicular to framing members, with ends staggered and over firm bearing.
1. At long edges provide solid edge blocking where joints occur between roof framing members.
2. Screw panels to framing; staples are not permitted.

B. Wall Sheathing: Secure with long dimension perpendicular to wall studs, with ends over firm bearing and staggered, using nails, screws, or staples.
1. Wood Structural Panel Sheathing Installation:
   a. Comply with applicable recommendations in APA Form No. E30, "Engineered Wood Construction Guide," for types of structural-use panels and applications indicated.
   b. Fasten panels as indicated below:
      1) Screw to cold-formed metal framing.
      2) Space panels 1/8 inch apart at edges and ends.
2. Gypsum Sheathing Installation:
   a. Comply with GA-253 and with manufacturer's written instructions.
      1) Fasten gypsum sheathing to cold-formed metal framing with screws.
      2) Install boards with a 3/8 inch gap where non-load bearing construction abuts structural elements.
      3) Install boards with a 1/4 inch gap where they abut masonry or similar materials that might retain moisture, to prevent wicking.

C. Communications and Electrical Room Mounting Boards: Secure with screws to studs with edges over firm bearing; space fasteners at maximum 24 inches on center on all edges and into studs in field of board.
1. At fire-rated walls, install board over wall board indicated as part of the fire-rated assembly.

2. Where boards are indicated as full floor-to-ceiling height, install with long edge of board parallel to studs.
3. Install adjacent boards without gaps.
4. Size and Location: As indicated on drawings.

3.5 TOLERANCES

A. Framing Members: 1/4 inch from true position, maximum.

B. Variation from Plane (Other than Floors): 1/4 inch in 10 feet maximum, and 1/4 inch in 30 feet maximum.

3.6 CLEANING

A. Waste Disposal: Comply with the requirements of Section 01 74 19 - Construction Waste Management and Disposal.
   1. Comply with applicable regulations.
   2. Do not burn scrap on project site.

B. Do not leave any wood, shavings, sawdust, etc. on the ground or buried in fill.

C. Prevent sawdust and wood shavings from entering the storm drainage system.

END OF SECTION

SECTION 06 20 00

FINISH CARPENTRY

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Finish carpentry items.

1.2 REFERENCE STANDARDS

A. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards; 2014.

1.3 SUBMITTALS

A. Shop Drawings: Indicate materials, component profiles, fastening methods, jointing details, and accessories.
   1. Provide the information required by AWI/AWMAC/WI (AWS).

B. Samples:
   1. Provide four samples of fasteners to be used for fastening wood treads to stair structure.
   2. Provide one full size stair tread sample with specified finish and nosing inserts. Allow for up to two additional stair samples with alternative finishes applied.

1.4 QUALITY ASSURANCE

A. Fabricator Qualifications: Company specializing in fabricating the products specified in this section with minimum five years of documented experience.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Protect work from moisture damage.

PART 2 PRODUCTS

2.1 FINISH CARPENTRY ITEMS

A. Quality Grade: Unless otherwise indicated provide products of quality specified by AWI/AWMAC/WI (AWS) for Custom Grade.

B. Interior Woodwork Items:
   1. Wood Base and Chair Rail:
      a. Transparent finish: Species as indicated on drawing sheet A601, interior finish specifications.

2.2 WOOD-BASED COMPONENTS

A. Wood fabricated from old growth timber is not permitted.

2.3 LUMBER MATERIALS

A. Hardwood Lumber: Maximum moisture content of 6 percent.

2.4 FASTENINGS

A. Fasteners: Of size and type to suite application.

2.5 ACCESSORIES

A. Wood Filler: Oil base, tinted to match surface finish color.

2.6 FABRICATION

A. Shop assemble work for delivery to site, permitting passage through building openings.

B. Wood column surrounds shall be constructed of shop fabricated laminated lumber. Use wood glues for laminating lumber layers that are not visible in completed assemblies and that do not interfere with appearance of transparent finish.

C. When necessary to cut and fit on site, provide materials with ample allowance for cutting. Provide trim for scribing and site cutting.

2.7 SHOP FINISHING OF INTERIOR FINISH CARPENTRY

A. Apply wood filler in exposed nail and screw indentations.

B. On items to receive transparent finishes, use wood filler that matches surrounding surfaces and is of type recommended for the applicable finish.

C. Finish work in accordance with AWI/AWMAC/WI (AWS), Section 5 - Finishing for grade specified and as follows:
   1. Transparent Finish:
      a. System - 5, Varnish, Conversion.
      b. Stain and Sheen: Match Architect's sample.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify adequacy of backing and support framing.

3.2 INSTALLATION

A. Install work in accordance with AWI/AWMAC/WI (AWS) requirements for grade indicated.

B. Set and secure materials and components in place, plumb and level.

C. Carefully scribe work abutting other components, with maximum gaps of 1/32 inch. Do not use additional overlay trim to conceal larger gaps.

3.3 TOLERANCES

A. Maximum Variation from True Position: 1/16 inch.

B. Maximum Offset from True Alignment with Abutting Materials: 1/32 inch.

END OF SECTION

SECTION 06 41 00

ARCHITECTURAL WOOD CASEWORK

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Specially fabricated cabinets and casework.

B. Cabinet hardware.

C. Shop finishing.

D. Preparation for installing utilities.

1.2 RELATED REQUIREMENTS

A. Section 12 36 00 - Countertops.

1.3 REFERENCE STANDARDS

A. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards; 2014.

B. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards, U.S. Version 3.0; 2016.

C. BHMA A156.9 - American National Standard for Cabinet Hardware; 2015.

D. AWI/AWMAC (AWS) - Architectural Woodwork Standards, Eighth Edition.

1.4 SUBMITTALS

A. Shop Drawings: Indicate materials, component profiles, fastening methods, jointing details, and accessories.

B. Product Data: Provide data for hardware accessories.

C. Samples: Submit actual samples of architectural cabinet construction, minimum 12 inches square, illustrating proposed cabinet, countertop, and shelf unit substrate and finish.

D. Samples: Submit actual sample items of proposed pulls, hinges, shelf standards, and locksets, demonstrating hardware design, quality, and finish.

1.5 QUALITY ASSURANCE

A. Fabricator Qualifications: Company that follows AWI's "Architectural Woodwork Quality Standards", specializing in fabricating the products specified in this section with minimum seven years of documented experience. Shop that employs skilled workers who custom-fabricate products similar to those required for this Project and whose products have a record of successful in-service performance.
   1. Fabricator of this section must also provide work specified in Division 6 Section "Wood-Veneer Paneling".
   2. Fabricator of this section must also provide work specified in Division 12 Section "Countertops".

B. Quality Standards: Unless otherwise indicated, comply with AWI's "Architectural Woodwork Quality Standards."

1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect units from moisture damage.

1.7 FIELD CONDITIONS

A. During and after installation of custom cabinets, maintain temperature and humidity conditions in building spaces at same levels planned for occupancy.

B. Field Measurements: Where cabinets are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
   1. Locate concealed framing, blocking, and reinforcements that support cabinets by field measurements before being enclosed, and indicate measurements on Shop Drawings.

1.8 COORDINATION

A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that wood-veneer-faced architectural cabinets can be supported and installed as indicated.

PART 2 PRODUCTS

2.1 CASEWORK

A. Quality Grade: Unless otherwise indicated provide products of quality specified by AWI Architectural Woodwork Standards for Custom Grade.

B. Wood Veneer Faced Cabinets and Casework: Custom grade.
   1. Exposed Surfaces: Grade A, slip matched.
      a. Species and Cut: Refer to Finish Specification on Drawing Sheet A602.

C. Plastic Laminate Faced Cabinets: Custom grade.

D. Wood Veneer Cabinets and Casework:
   1. Finish - Exposed Exterior Surfaces: Wood.
   2. Finish - Exposed Interior and Concealed Surfaces: Thermoset decorative laminate panels.
   3. Finish - Drawer Subfronts, Backs, Sides and Bottoms: Thermoset decorative laminate panels.
   4. Provide same finish on both sides of all panels. If different finishes are indicated for each side of finished panels, provide back to back layers.
   5. Door and Drawer Front Edge Profiles: Square edge with thick applied band.
   6. Interface Style for Cabinet and Door: Style 1 - Overlay; flush overlay.
   7. Grain Direction: Vertical on all surfaces, except drawers shall be horizontal, unless otherwise indicated on drawings.
   8. Grained Face Layout for Cabinet and Door Fronts: Flush panel.
      a. Custom Grade: Doors, drawer fronts and false fronts wood grain to run and match vertically within each cabinet unit.
   9. Adjustable Shelf Loading: 50 lbs. per sq. ft.
      a. Shelving shall be 1" thick minimum.
      b. Provide bored hole shelf rest system with metal shelf rests unless otherwise indicated.
   10. Cabinet Style: Flush overlay.
   11. Veneer Matching within Panel Face: Center-balance match.
   12. Cabinet Doors and Drawer Fronts: Flush style.
   13. Drawer Construction: Fabricate with exposed fronts fastened to subfront with mounting screws from interior of body.
      a. Join subfronts, backs, and sides with glued dovetail joints.
   14. Provide dust panels of ¼ inch plywood or tempered hardboard above compartments and drawers, unless located directly under tops.

E. Plastic Laminate Cabinets and Casework:
   1. Cabinet Construction: Flush overlay.
   2. Laminate Cladding for Exposed Surfaces: High-pressure decorative laminate as follows:
      a. Laminate Grade: HGS.
   3. Edge Treatment for doors and drawers: PVC edge banding, 3 mm thickness, matching laminate in color, pattern, and finish.
   4. Materials for Semiexposed Surfaces Other Than Drawer Bodies: Thermoset decorative panels.
   5. Drawer Sides and Backs: Thermoset decorative panels.
   6. Drawer Bottoms: Thermoset decorative panels.
   7. Colors, Patterns, and Finishes: Refer to sheet A602 for material finish specification.
   8. Adjustable Shelf Loading: 50 lbs. per sq. ft.
      a. Shelving shall be 1" thick minimum.
      b. Provide bored hole shelf rest system with metal shelf rests unless otherwise indicated.
   9. Core Material: Particleboard or Medium Density Fiberboard. Use exterior grade plywood for core material at sinks.

10. Drawer Construction: Fabricate with exposed fronts fastened to subfront with mounting screws from interior of body.
    a. Join subfronts, backs, and sides with glued dovetail joints.
11. Provide dust panels of 1/4-inch plywood or tempered hardboard above compartments and drawers, unless located directly under tops.

2.2 WOOD-BASED COMPONENTS

A. Wood fabricated from old growth timber is not permitted.

B. Composite Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of woodwork and quality grade specified unless otherwise indicated.
   1. Medium-Density Fiberboard: ANSI A208.2, Grade 130, made with binder containing no added urea formaldehyde.
   2. Particleboard: ANSI A208.1, Grade M-2, made with binder containing no added urea formaldehyde.
   3. Wood Veneer-Faced Panel Products: HPVA HP-1, with plywood, particleboard or medium density fiberboard cores, made with adhesive containing no urea formaldehyde.
   4. Thermoset Decorative Panels (Melamine): Medium-density fiberboard or particleboard finished with thermally fused, melamine-impregnated decorative paper and complying with requirements of NEMA LD 3, Grade VGL, for test methods 3.3, 3.4, 3.6, 3.8, and 3.10.

C. Hardwood Edgebanding: Use solid hardwood edgebanding matching species, color, grain, and grade for exposed portions of cabinetry.

2.3 ACCESSORIES

A. Adhesive: Type recommended by fabricator to suit application.

B. Grommets in Wood Veneer Surfaces: Standard plastic grommets for cut-outs, with notched cap, in color to match adjacent surface.

2.4 HARDWARE

A. Hardware: BHMA A156.9, types as recommended by fabricator for quality grade specified.

B. Drawer and Door Pulls: Stainless steel, back mounted, solid metal, 5 inches long, 1-1/2 inches deep, and 5/16 inch in diameter.

C. Cabinet Locks: Keyed cylinder, two keys per lock, master keyed, steel with satin finish.

D. Drawer Slides:
   1. Type: Full extension.
   2. Static Load Capacity: Heavy Duty grade.
   3. Mounting: Side mounted.
   4. Steel ball bearings.
   5. Provide all screws and mounting brackets.
   6. Approved Products:
      a. Accuride International, Inc; Product Heavy Duty Slide Full Extension Model 3607/3657: www.accuride.com.
      b. Knape & Vogt Manufacturing Company; Heavy Duty Full Extension Drawer Slide 8800: www.knapeandvogt.com.

E. Hinges: European style concealed self-closing type, 120 degree, steel with satin finish.
   1. Basis-of-Design:
      a. Grass America Inc #3903 with Clip Plates: www.grassusa.com.
      b. Julius Blum, Inc CLIP top hinges: www.blum.com.

F. Utility Shelving:
   1. Grade: Custom.
   2. Shelf Material: 3/4 inch melamine faced panel product with matching melamine edge.
   3. Shelf Supports: Knap & Vogt; 87 Standards with 187 brackets.
      a. Provide one of the following:
         1) Knap & Vogt; 87 Standards with 187 Brackets.
         2) Granger; 1WDP Standards with 1WDP Brackets.

b. Finish: White (powdercoat paint) or Anochrome (electrozinc-plated and clear lacquered cold rolled steel) as selected by the Architect.
c. Bracket and Standard Metal Thickness: 12 gauge.
d. Size: Provide brackets for shelf depths and spacing as indicated on drawings, if spacing is not indicated, provide the following:
   1) Standards: 2 standards for shelves 3 feet or less, 1 additional standard for each additional 3 foot shelf length.
   2) Brackets: Provide 1 bracket at every shelf.

G. Bumper Pads: ¼" diameter neoprene, adhesively applied to cabinet body at contact points for doors and drawers.

H. Counter Supports: Doug Mockett, 18 1/8" Inter-Arc Work Support SWS2. Color to be selected by Architect.

2.5 FABRICATION

A. Assembly: Shop assemble cabinets for delivery to site in units easily handled and to permit passage through building openings.

B. Fitting: When necessary to cut and fit on site, provide materials with ample allowance for cutting. Provide matching trim for scribing and site cutting.

C. Plastic Laminate: Apply plastic laminate finish in full uninterrupted sheets consistent with manufactured sizes. Fit corners and joints hairline; secure with concealed fasteners. Slightly bevel arises. Locate counter butt joints minimum 2 feet from sink cut-outs.
   1. Apply laminate backing sheet to reverse side of plastic laminate finished surfaces not exposed to view.

D. Matching Wood Grain: Comply with requirements of quality standard for specified Grade and as follows:
   1. Provide balance matched panels at each elevation.

E. Provide cutouts for plumbing fixtures. Verify locations of cutouts from on-site dimensions. Prime paint cut edges.

2.6 SHOP FINISHING

A. Sand work smooth and set exposed nails and screws.

B. On items to receive transparent finishes, use wood filler matching or blending with surrounding surfaces and of types recommended for applied finishes.

C. Finish work in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), Section 5 - Finishing for grade specified and as follows:
   1. Transparent:
      a. System - 5, Varnish, Conversion.
      b. Stain and Sheen: Match Architect's sample.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify adequacy of backing and support framing.

B. Verify location and sizes of utility rough-in associated with work of this section.

3.2 INSTALLATION

A. Before installation, condition woodwork to average prevailing humidity conditions in installation areas. Examine shop-fabricated work for completion and complete work as required, including removal of packing and backpriming.

B. Set and secure custom cabinets in place, assuring that they are rigid, plumb, and level.

C. Grade: Install woodwork to comply with requirements for the same grade specified in Part 2 for fabrication of type of woodwork involved.

D. Install woodwork level, plumb, true, and straight to a tolerance of 1/8 inch in 96 inches. Shim as required with concealed shims.

E. Scribe and cut woodwork to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.

F. Anchor woodwork to anchors or blocking built in or directly attached to substrates. Secure with countersunk, concealed fasteners and blind nailing as required for complete installation. Use fine finishing nails for exposed fastening, countersunk and filled flush with woodwork and matching final finish if transparent finish is indicated.

G. Cabinets: Install without distortion so doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation.

1. Fasten wall cabinets through back, near top and bottom, at ends and not more than 16 inches o.c. with No. 10 wafer-head screws sized for 1-inch penetration into wood framing, blocking, or hanging strips.

3.3 ADJUSTING

A. Adjust moving or operating parts to function smoothly and correctly.

3.4 CLEANING

A. Clean casework, counters, shelves, hardware, fittings, and fixtures.

END OF SECTION

SECTION 07 14 00

FLUID-APPLIED WATERPROOFING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Fluid-Applied Waterproofing:
   1. Synthetic rubber waterproofing.

1.2 ABBREVIATIONS

1.3 REFERENCE STANDARDS

A. ASTM D412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers--Tension; 2006a (Reapproved 2015a).

B. ASTM D746 - Standard Test Method for Brittleness Temperature of Plastics and Elastomers by Impact; 2014.

C. ASTM D3468 - Standard Specification for Liquid-Applied Neoprene and Chlorosulfonated Polyethylene Used in Roofing and Waterproofing; 1999 (Reapproved 2013).

D. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; 2016.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordinate with the installation of other components that comprise the exterior building envelope.

1.5 SUBMITTALS

A. Shop Drawings: Indicate special joint or termination conditions and conditions of interface with other materials.

B. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

C. Compatibility: Submit letter from manufacturer stating that materials proposed for use are permanently chemically compatible and adhesively compatible with adjacent materials proposed for use. Submit letter from manufacturer stating that cleaning materials used during installation are chemically compatible with each of the adjacent materials proposed for use.

1.6 QUALITY ASSURANCE

A. Manufacturer: System shall be manufactured and marketed by a firm with a minimum of 20 years experience in the production and sales of waterproofing and air barrier products. Manufacturers proposed for use but not named in these specifications shall submit evidence of ability to meet all requirements specified, and include a list of projects of similar design and complexity completed within the past 5 years.

B. Installer Qualifications:
   1. Company specializing is performing the work of this section as a primary occupation, which has at least 3 years of documented experience and is certified in writing by the manufacturer.
   2. Installer must show evidence of adequate equipment and trained field personnel to successfully complete the project in a timely manner.
   3. Company performing the work of this section will also perform the work of all other related air and weather barrier sections, including, but not limited to:
      a. Section 07 25 00 - Weather Barriers.

C. Materials: Fluid applied waterproofing material shall be cold vulcanized two part synthetic rubber based system free of isocyanates and bitumen. For each type of material required for the work of this section and related sections of performance, provide primary materials, associated materials, and material assemblies which are the products of one manufacturer.

D. Pre-Installation Conference: A pre-installation conference shall be held two weeks prior to commencement of field operations to establish procedures to maintain optimum working conditions and to coordinate this work with related and adjacent work. Attendance shall include the contractors of adjacent systems and substrates, and the waterproofing manufacturer representative. Agenda for meeting shall include but not be limited to the following:
   1. Requirements for Building Envelope Commissioning.

2. Review of submittals.
3. Review of surface preparation, minimum curing period and installation procedures.
4. Review of special details and flashings.
5. Sequence of construction, responsibilities and schedule for subsequent operations.
6. Review of mock-up requirements.
7. Review of inspection, testing, protection and repair procedures.

1.7 MOCK-UP

A. Construct mock-up to represent finished work including inside and outside corners. Incorporating back-up wall, cladding, window and doorframe and sill, insulation, flashing and any other critical junction (roof, foundation, etc).

1.8 DELIVERY, STORAGE AND HANDLING

A. Deliver materials and products in labeled packages. Store and handle in strict compliance with manufacturer's instructions, recommendations and material safety data sheets. Protect from damage from sunlight, weather, excessive temperatures and construction operations. Remove damaged material from the site and dispose of in accordance with applicable regulations.

B. Do not double-stack pallets of fluid applied membrane components on the job site. Provide cover on top and all sides, allowing for adequate ventilation.

C. Protect fluid-applied membrane components from freezing and extreme heat.

D. Sequence deliveries to avoid delays, but minimize on-site storage.

1.9 PROJECT CONDITIONS

A. Perform work only when existing and forecasted weather conditions are within the limits established by the manufacturer of the materials and products used.

B. Proceed with installation only when substrate construction and preparation work is complete and in condition to receive membrane waterproofing.

1.10 WARRANTY

A. Fluid Applied Waterproofing Membrane: Provide written 5 year material warranty issued by the membrane manufacturer upon completion of the work.

B. Contractor shall correct defective work within a two year period after date of substantial completion, remove and replace materials concealing waterproofing at no extra cost to the Owner. Bentonite grouting shall not be acceptable.

PART 2 PRODUCTS

2.1 MATERIALS

A. Fluid applied membrane, two-part, self-curing, synthetic rubber based material:
   1. Basis-of-Design: Provide W.R. Grace; Procor System or a comparable product by one of the following:
      a. Henry Company. Aqua-Bloc System.
      b. W.R. Meadows, Mel-Rol System.
      c. Note that the same manufacturer of material used for Section 07 25 00 Weather Barriers of this project, shall be the same manufacturer of material used for this section. Written manufacturer compatibility and adhesion certification shall be required.

2.2 MEMBRANE AND FLASHING MATERIALS

A. Synthetic Rubber Waterproofing: Cold-applied neoprene or CSPE complying with ASTM D3468; one or two component, quick setting.
   1. Cured Thickness: 0.06 inch, minimum.
   2. Suitable for installation over concrete substrates.
   3. Cured Film Thickness: 1.5 mm (0.060 inch) nominal, measured in accordance with ASTM D 3767 Method A.
   4. Volatile Organic Compound content: < 75 g/L.
   5. Elongation: 500 percent, measured in accordance with ASTM D 412.

6. Water Vapor Permeability: 0.08 perm inch, measured in accordance with ASTM E96/E96M.
7. Peel Adhesion to Concrete: 5 lb./inch, according to ASTM D 903 Modified.
8. Minimum Application Temperature: 20 deg. F.
9. Brittleness Temperature: minus 40 degrees F, measured in accordance with ASTM D746.

2.3 INSULATION

A. Rigid Insulation: Specified in Section 07 21 00 Thermal Insulation.

2.4 ACCESSORIES

A. Prefabricated Drainage Composite: Hydroduct 660 Drainage Composite by Grace Construction Products for horizontal surfaces. Hydroduct 220 Drainage Composite by Grace Construction Products for all vertical surfaces. Drainage composite shall be designed to promote positive drainage while serving as a protection course.

B. Miscellaneous Materials: Tape and other accessories specified or acceptable to manufacturer of fluid applied waterproofing membrane.

PART 3 EXECUTION

3.1 EXAMINATION

A. The installer shall examine conditions of substrates and other conditions under which this work is to be performed and notify the contractor, in writing, of circumstances detrimental to the proper completion of the work. Do not proceed with work until unsatisfactory conditions are corrected.

3.2 PREPARATION OF SUBSTRATE

A. Protect adjacent surfaces from damage not designated to receive waterproofing.

B. Tie-holes and “bugholes” larger than 1/2 inch in diameter or deeper than 1/8 inch, or both, should be either pretreated per manufacturer’s instructions or repaired with with a lean concrete mix or grout. See ASTM D 5295, Preparation of Concrete Surfaces for Adhered Membrane Waterproofing Systems, for further details on substrate preparation.

C. Cracked, pitted, honeycombed or heavily bugholed surfaces can be filled by spraying from close in (10” to 12”) but high material usage with result. Under these circumstances it may be more efficient to fill the surface with a parge coat of lean mortar mix before application of the waterproofing. It is also acceptable to fill in gaps with a compatible sealant or caulk.

D. Cast-In-Place Concrete Substrates:
   1. Surface shall be free of any visible water, frost, or ice.
   2. Fill form tie rod holes with concrete and finish flush with surrounding surface.
   3. Repair bugholes greater than ½ inch in depth and ¼ inch in diameter deep and finish flush with surrounding surface.
   4. Remove scaling to sound, unaffected concrete and repair exposed area.
   5. Grind irregular construction joints to suitable flush surface.

E. Masonry Substrates: Apply waterproofing over concrete block and brick with smooth trowel-cut mortar joints or parge coat.

F. Plywood Substrates: Pretreat all plywood joints with 3 inches wide, reinforced self-adhesive tape. Secure all fasteners.

3.3 INSTALLATION

A. Apply waterproofing in accordance with manufacturer's instructions, including, but not limited to, the following:
   1. Apply minimum 0.060 in. in all areas to be waterproofed. Apply minimum 0.120 inches in all detail areas.
   2. If area to be waterproofed is in direct sunlight and temperature is rising, apply “scratch coat” (a thin application of fluid applied waterproofing) prior to the full application of the waterproofing membrane.
   3. In applications where a minimum slope of 0.13 in./ft cannot be achieved, a two coat application of membrane is recommended to achieve the total thickness.
   4. Apply protection board and related materials in accordance with manufacturer’s recommendations.
   5. For vertical applications, install board insulation before installing drainage panels.

B. Install flexible flashings and seal into waterproofing material. Seal items penetrating through membrane (i.e. water piping, electrical conduit, etc.) with flashings.

C. Seal membrane and flashings to adjoining surfaces.

3.4 CLEANING AND PROTECTION

A. Remove any masking materials after installation. Clean any stains on materials which would be exposed in the completed work.

B. Protect completed membrane waterproofing from subsequent construction activities as recommended by manufacturer.

C. Do not leave installed materials exposed to weather for longer than 30 days.

END OF SECTION

SECTION 07 21 00

THERMAL INSULATION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Board insulation at perimeter foundation wall, underside of floor slabs, and exterior wall behind masonry wall finish.

B. Mineral wool insulation in exterior wall construction.

1.2 REFERENCE STANDARDS

A. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus; 2015.

B. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications; 2013.

C. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation; 2016.

D. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation; 2014.

E. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2016.

1.3 SUBMITTALS

A. Product Data: Provide data on product characteristics, performance criteria, and product limitations.

B. Manufacturer's Installation Instructions: Include information on special environmental conditions required for installation and installation techniques.

C. Submit surface temperature and dew point analysis. Analytical models shall include building areas clad with Composite Wood Veneer Panels, Aluminum Composite Panels and Fiber Reinforced Cement Panels, regardless of whether those materials are included in this Section or not. Identify temperatures for all surfaces, not just surfaces exposed to view. Analyze typical details and sufficient number of non-typical details to assure that the worst case has been identified. Required data includes:
   1. Identification of dewpoint temperature.
   2. Isothermal plots with color legend and numerical temperature values for: coldest indoor surface; indoor surfaces at or below dew point; indoor surfaces 0 to 5 degrees warmer than dewpoint.
   3. Tabulation identifying solid materials, conductiveness and emissivities.
   4. Tabulation identifying cavity dimensions, temperatures and emissivities.
   5. Tabulation identifying boundary condition temperatures and film coefficients.

PART 2 PRODUCTS

2.1 LEED REQUIREMENTS

A. Recycled Content: Preference for products with a recycled content greater than 35 percent.

B. VOC Content: for adhesives applied on the interior, comply with requirements of Section 01 35 47 VOC CONTENT RESTRICTIONS.

2.2 APPLICATIONS

A. Insulation Under Concrete Slabs: Extruded polystyrene board.

B. Insulation at Perimeter of Foundation: Extruded polystyrene board.

C. Insulation in Exterior Wall Cavity: Mineral wool insulation.

D. Insulation Inside Masonry Cavity Walls: Extruded polystyrene board.

2.3 FOAM BOARD INSULATION MATERIALS

A. Extruded Polystyrene Board Insulation: Extruded polystyrene board; ASTM C578; with either natural skin or cut cell surfaces, and the following characteristics:

1. Flame Spread Index (FSI): Class A - 0 to 25, when tested in accordance with ASTM E84.
2. Smoke Developed Index (SDI): 450 or less, when tested in accordance with ASTM E84.
3. R-value; 1 inch of material at 72 degrees F: 5, minimum.
4. Board Edges: Square.
5. Water Absorption, Maximum: 0.3 percent, by volume.
6. Compressive Strength: 25 psi.
7. Manufacturers:
   a. Dow Chemical Company; STYROFOAM: www.dow.com/sle.
   b. Owens Corning Corporation; FOAMULAR Extruded Polystyrene (XPS) Insulation: www.ocbuildingspec.com/sle.

2.4 MINERAL WOOL INSULATION MATERIALS

A. Mineral Wool Insulation: Semi-rigid mineral fiber, ASTM C612; unfaced flame spread index of 0 (zero) when tested in accordance with ASTM E84.
   1. Smoke Developed Index: 0 (zero), when tested in accordance with ASTM E84.
   2. Combustion: Rated non-combustible per NFPA Standard 220 in accordance with ASTM E 136
   3. Board Size: As required for application.
   4. Board Thickness: As indicated on drawings.
   5. Board Edges: Square.
   6. Moisture Absorption: 1% max. per ASTM C1104.
   7. Thermal Resistance: R-value of 4.2 degrees F hr sq ft/Btu at 75 degrees F, minimum, when tested according to ASTM C518.
   8. Products:
      a. Thermafiber, Inc; RainBarrier: www.thermafiber.com.
      b. ROXUL, Inc; CAVITYROCK: www.roxul.com/sle.

2.5 ACCESSORIES

A. Adhesive: Type recommended by insulation manufacturer for application.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that substrate, adjacent materials, and insulation materials are dry and that substrates are ready to receive insulation.

3.2 BOARD INSTALLATION AT FOUNDATION PERIMETER

A. Install boards vertically over waterproofing systems on foundation perimeter where indicated on Drawings.
   1. Butt edges and ends tightly to adjacent boards and to protrusions.
   2. Start board installation flush with foundation wall corner. Extend board end on opposite side of same corner to overlap end of first panel.
   3. Fit panel bottom ends tight to tops of spread footings.

B. Extend boards over expansion joints, unbonded to foundation on one side of joint.

C. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.

3.3 BOARD INSTALLATION AT EXTERIOR WALLS

A. Install boards horizontally on walls.

B. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.

3.4 BOARD INSTALLATION UNDER CONCRETE SLABS

A. Place insulation under slabs on grade after base for slab has been compacted.

B. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.

C. Prevent insulation from being displaced or damaged while placing vapor retarder and placing slab.

3.5 BATT INSTALLATION

A. Install insulation in accordance with manufacturer's instructions.

B. Install in exterior roof spaces without gaps or voids. Do not compress insulation.

C. Trim insulation neatly to fit spaces. Insulate miscellaneous gaps and voids.

D. Fit insulation tightly in cavities and tightly to exterior side of mechanical and electrical services within the plane of the insulation.

3.6 PROTECTION

A. Do not permit installed insulation to be damaged prior to its concealment.

END OF SECTION

SECTION 07 25 00

WEATHER BARRIERS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Fluid-applied air and vapor barrier membrane system.

B. Materials and installation methods to bridge and seal air leakage pathways in wall junctions with roofs and foundations, and at window and door openings, control and expansion joints, masonry ties, piping and other penetrations through the wall assembly.

C. Accessories and miscellaneous materials as required for complete membrane application.

1.2 RELATED REQUIREMENTS

A. Section 03 30 00 - Cast-in-Place Concrete: Vapor retarder under concrete slabs on grade.

B. Section 04 42 00 - Unit Masonry.

C. Section 07 14 00 - Fluid-Applied Waterproofing

1.3 REFERENCE STANDARDS

A. ASTM D1970/D1970M - Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection; 2015a.

1.4 SUBMITTALS

A. Product Data: Submit manufacturer's product data, shop drawings as indicated, installation instructions, supplemental installation details, use limitations and recommendations, test data, and compatibility test results.

B. Shop Drawings: Provide drawings of special joint conditions.

C. Compatibility: Submit letter from manufacturer stating that materials proposed for use are permanently chemically compatible and adhesively compatible with adjacent materials proposed for use. Submit letter from manufacturer stating that cleaning materials used during installation are chemically compatible with each of the adjacent materials proposed for use.

D. Warranty: Submit manufacturer warranty and ensure forms have been completed in the Owner's name and registered with the manufacturer.

1.5 QUALITY ASSURANCE

A. Installer Qualifications:
   1. Installer must show evidence of adequate equipment and trained field personnel to successfully complete the project in a timely manner.
   2. Company performing the work of this section will also perform the work of all other related air and weather barrier sections, including, but not limited to:
      a. Section 07 14 00 - Fluid-Applied Below Grade Waterproofing.

B. Materials: Fluid-applied air and vapor barrier system. For each type of material required for the work of this section and related sections of performance, provide primary materials, associated materials, and material assemblies which are the products of one manufacturer. All accessory materials (self-adhered transition membranes, termination bars, compatible sealants/mastics, etc.) will be provided by, or approved by, the membrane system manufacturer to ensure compatibility and single-source responsibility.

1.6 MOCK-UP

A. Provide fluid-applied air and vapor barrier system in Exterior Wall Mock-up indicated on the Drawings.

B. Construct mock-up with specified product types with other components noted.

C. Locate where directed by Design Professional.

D. Mock-up may not remain as part of the Work.

PART 2 PRODUCTS

2.1 AIR AND WATER BARRIER

A. Air and Water Barrier: Liquid applied, resilient, UV-resistant coating and associated joint treatment.
   1. Suitable for use on concrete, masonry, plywood and gypsum sheathing.
   2. Joint Preparation Treatment: Coating manufacturer's recommended method, either tape or reinforcing mesh saturated with coating material.
   3. Basis-of-Design: GPC Applied Technologies (Grace), Perm-A-Barrier Liquid.
   4. Other Acceptable Products:
      a. Carlisle Coatings and Waterproofing, Inc; Barriseal-R: www.carlisleccw.com/sle.
      b. Henry Company; Air-Bloc 32MR: www.henry.com/sle.
   5. Performance Requirements:

Property	Test Method	BOD Value
Cured Film Thickness	ASTM D 3767, Method A	60 mils (1.5 mm) nominal
Volatile Organic Compound (VOC) content, maximum		< 0.63 lb/gal (< 75g/L)
Air Permeance at 75 Pa (0.3 in. water) Differential Pressure	ASTM C 2178	<0.0002 cfm/ft2 (<0.001 L/s.m2)
Assembly Air Permeance at 75 Pa (0.3 in. water) Differential Pressure.	ASTM C 2357	<0.0008 cfm/ft2 (<0.004 L/s.m2)
Water Vapor Permeance	ASTM E 96, Method BW	0.08 perms (<4.6 ng/Pa.s.m2)
Pull Adhesion to Concrete Block (CMU)	ASTM D 4541-02	35 psi (0.24 N/mm²)
Pull Adhesion to Glass-Faced Gypsum Board	ASTM D 4541-02	18 psi (0.12 N/mm²)
Peel Adhesion to Concrete	ASTM D 903 Modified*1*	5 lbs/in (880 N/m)
Elongation	ASTM D 412	500% minimum
Pliability; 180° bend over 1 inch mandrel at -23°F	ASTM D 1970	Unaffected
Low Temperature Flexibility and Crack Bridging; 1/8 inch crack cycling at -15°F	ASTM C 836	Pass
Extensibility over 1/4 crack after heat aging	ASTM C 836	Pass
Application Temperature, minimum		20°F (-7°C)
Peak Heat Release	ASTM E 1354	< 150 KW/M²
Total Heat Release	ASTM E 1354	< 20 MJ/M²
Effective Heat of Combustion	ASTM E 1354	< 18 MJ/kg
Flame Spread Index	ASTM E 84 or UL 723	< 25
Smoke-Developed Index	ASTM E 84 or UL 723	< 450

Footnote *1*: Waterproofing membrane is applied to concrete and allowed to cure. Peel adhesion of the membrane is measured at a rate of 2 inches per minute with a peel angle of 90 degrees at room temperature.

   6. Joint Filler: As recommended by coating manufacturer and suitable to the substrate.

2.2 ACCESSORIES

A. Transition Membrane: A 40 mil self-adhering waterproofing used for flashing around beams, columns, and wall openings (including window, door and curtain wall frames, louvers, etc.); consisting of 36 mils of rubberized

asphalt, integrally bonded to a 4 mil high-density cross- laminated polyethylene film. Membrane shall be interleaved with disposable silicone-coated release paper until installed. Fully-supported self-adhered membranes must be provided at all corners, (inside and outside), transitions, and changes in substrate. Liquid applied membranes that utilize mesh reinforcements will not be allowed.

1. Basis-of-Design Product: GCP Applied Technologies (Grace) Perm-A-Barrier Detail Membrane.
2. Other Acceptable Manufacturers:
   a. Henry Corporation
   b. Carlisle Coatings & Waterproofing
3. Performance Requirements:

Property	Test Method	BOD Value
Water Vapor Transmission, max.	ASTM E 96, Method B	0.05 perms (2.9 ng/Pa.s.m2)
Air Permeance at 0.3 in. water (75 Pa) differential pressure, max.	ASTM C 2178	<0.0012 cfm/ft2
Puncture Resistance, minimum	ASTM E 154	40 lbs (178 N)
Lap Adhesion, min; at -25°F (-4°C)	ASTM E 1876	5 lbs/in (880 N/m)
Low Temperature Flexibility; at	ASTM D 1970	Unaffected
Tensile Strength, Film, minimum	ASTM D 412, Die C Modified	400 lbs/in2 (2.7 MPa)
Elongation, min; ultimate failure of rubberized asphalt, minimum	ASTM D 412, Die C	200%

B. Flexible Membrane Through-Wall Flashing: ASTM D1970/D1970M, 40 mil heavy-duty self-adhering membrane used for through-wall flashing; consisting of 32 mils of rubberized asphalt, integrally bonded to a 8 mil high-density cross-laminated polyethylene film. Membrane shall be interleaved with disposable silicone-coated release paper until installed.

1. Basis-of-Design Product: GCP Applied Technologies (Grace) Perm-A-Barrier Wall Flashing.
2. Other Acceptable Manufacturers:
   a. Henry Corporation
   b. Carlisle Coatings & Waterproofing
3. Performance Requirements:

Property	Test Method	BOD Value
Water Vapor Transmission, max.	ASTM E 96, Method B	0.05 perms (2.9 ng/Pa.s.m2)
Water Absorption, maximum	ASTM D 570	0.1% by weight
Puncture Resistance, minimum	ASTM E 154	80 lbs (356 N)
Tear Resistance, Initiation, min.	ASTM D 1004	13 lbs (58 N) M.D.
Tear Resistance, Propagation, min	ASTM D 1938	9 lbs (40 N) M.D.
Lap Adhesion, min; at -25°F	ASTM E 1876	5 lbs/in (880 N/m)
Low Temperature Flexibility	ASTM D 1970	Unaffected at -45°F
Tensile Strength, Film, minimum	ASTM D 412, Die C Modified	800 lbs/in2 (5.5 MPa)
Elongation, min; ultimate failure of rubberized asphalt	ASTM D 412, Die C	200%

C. Metal Drip Edge: Provide metal drip edge where flashing is exposed or partially exposed and where indicated, complying with Division 7 Section "Sheet Metal Flashing and Trim" and as follows:
   1. Stainless Steel: ASTM A 240/A 240M, Type 304, 0.016 inch thick.
      a. Metal Drip Edges: Fabricate from stainless steel. Extend into wall and 1/2 inch out from wall, with outer edge bent down 30 degrees and hemmed.
   2. Basis-of-Design Product: Hohmann & Barnard 26 gage minimum, 1-1/2" minimum, stainless steel hemmed drip plate.

D. Detailing Compound: Two-part, elastomeric, trowel grade material for use with self-adhered membranes and tapes.
   1. Basis-of-Design Product: GCP Applied Technologies (Grace) Bituthene Liquid Membrane.
   2. Other Acceptable Manufacturers:
      a. Henry Corporation.
      b. Carlisle Coatings & Waterproofings.

E. Miscellaneous Materials: Tape and other accessories specified or acceptable to manufacturer of fluid- applied air and vapor barrier membrane.

F. Miscellaneous Materials: Tape and other accessories specified or acceptable to manufacturer of fluid- applied air and vapor barrier membrane.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that surfaces and conditions are ready to accept the work of this section.

B. The installer shall examine conditions of substrates and other conditions under which this work is to be performed and notify the Contractor, in writing, of circumstances detrimental to the proper completion of the work. Do not proceed with work until unsatisfactory conditions are corrected

C. Verify that items built-in under other sections are properly located, sized, and securely installed.

3.2 PREPARATION

A. Protect adjacent work areas and finish surfaces from damage during installation.

B. Refer to manufacturer's literature for requirements for preparation of substrates. Surfaces shall be structurally sound and free of voids, spalled areas, loose aggregate and sharp protrusions. Remove contaminants such as grease, oil and wax from exposed surfaces. Remove dust, dirt, loose stone and debris. Use repair materials and methods which are acceptable to manufacturer of fluid-applied air and vapor barrier.

C. Cast-In-Place Concrete Substrates:
   1. Surface shall be free of any visible water, frost, or ice.
   2. Fill form tie rod holes with concrete and finish flush with surrounding surface.
   3. Repair bug holes greater than 1/2 inch in diameter and 1/4 inch deep, and finish flush with surrounding surface.
   4. Remove scaling to sound, unaffected concrete, and repair exposed area.
   5. Grind irregular construction joints and protrusions taller than 1/8" .to suitable flush surface.

D. Exterior Sheathing Panels: Ensure that the boards are sufficiently stabilized with corners and edges fastened with appropriate screws. Pre-treat all board joints with 2 to 3 inch wide, reinforced self-adhesive tape, or fiberglass mesh-style gypsum board tape. Fill gaps greater than 1/4 inch with mastic or caulk, allowing sufficient time for full curing before application of tape and fluid-applied membrane

E. Masonry Substrates: Apply air and vapor barrier over concrete block with smooth flush mortar joints. Fill all voids and holes, particularly in the mortar joints, with a lean mortar mix, non-shrinking grout or parge coat.

F. Related Materials: Treat joints and install flashing as recommended by membrane manufacturer.

3.3 INSTALLATION

A. Install materials in accordance with manufacturer's instructions.

B. Application of Fluid-Applied Membrane:

1. Spray- or trowel-apply a continuous uniform film at minimum 60 mils dry film thickness using multiple, overlapping passes.
2. When spraying, use a cross-hatching technique (alternating horizontal and vertical passes) to ensure even thickness and coverage.
3. When spraying, use high pressure, multi-component, airless spray equipment approved by material manufacturer.
4. Carry membrane into any openings a minimum of 2 inches.
5. Seal all brick-ties and other penetrations as work progresses.

C. Application of Transition Membrane:
1. After allowing the fluid-applied membrane to cure to tack-free finish, apply transition membrane with a minimum overlap of 3 inches onto each surface at all beams, columns and joints as indicated on Drawings.
2. Tie-in to window and door frames, spandrel panels, roof and floor intersections and changes in substrate.
   a. Install products in accordance to manufacturer's installation instructions, necessary to provide a continuous weather barrier for all transitions in plane.
3. Use pre-cut, easily-handled lengths for each location.
4. Remove silicone-coated release paper and position membrane flashing carefully before placing it against the surface.
5. When properly positioned, place against surface by pressing firmly into place using hand roller.
6. Overlap adjacent pieces 2 inches, and roll all seams with a hand roller.
7. Seal top edge of flashing with sealant compatible with all surrounding materials.
8. Transition flashing is not to be pre-installed prior to application of fluid-applied membrane, apply transition flashing as above. Spray or trowel a continuous uniform film of Fluid-Applied Membrane at minimum 60 mils dry film thickness using multiple, overlapping passes, with a minimum overlap of 3 inches between the fluid applied and the transition flashing

D. Application of Flexible Membrane Wall Flashing:
1. Precut pieces of flashing to easily handled lengths for each location.
2. Remove silicone-coated release paper and position flashing carefully before placing it against the surface.
3. When properly positioned, place against surface by pressing firmly into place using hand roller. Fully-adhere flashing to substrate to prevent water from migrating under flashing.
4. Overlap adjacent pieces 2 inches and roll all seams with a hand roller.
5. Trim bottom edge 1/2 inch back from exposed face of the wall. Flashing shall not be permanently exposed to sunlight.
6. At heads, sills and all flashing terminations, turn up flashing ends a minimum of 2 inches, and make careful folds to form an end dam, with the seams sealed.
7. Seal top edge of flashing with sealant compatible with all surrounding materials.
8. Do not allow the rubberized-asphalt surface of the flashing membrane to come in contact with poly- sulfide sealants, creosote, uncured coal tar products, or ethylene-propylene-diene-terpolymer products (EPDM).

E. Installation of the primary membrane is to occur prior to all inside and outside corners, fenestration rough openings and penetrations, then install the initial application of detail membrane.

3.4 TOLERANCES

A. System to be installed to accommodate the following maximum live load deflection in the plane of the exterior wall:
1. Verify maximum live load deflection with structural requirements or 3/8 inch, whichever is greater.

3.5 CLEANING AND PROTECTION

A. Remove any masking materials after installation. Clean any stains on materials which would be exposed in the completed work using procedures as recommended by manufacturer.

B. Fluid-applied air and vapor barrier membrane is not suitable for permanent exposure and should be protected from the effects of sunlight.

C. Schedule work to ensure that the membrane system is covered as soon as possible after installation. Protect membrane system from damage during subsequent operations. If the air and vapor barrier membrane system cannot be covered within sixty (60) days after installation, apply temporary UV protection such as dark plastic sheet or tarpaulins.

3.6 FIELD QUALITY CONTROL

A. Do not cover installed fluid-applied air and vapor barrier until required inspections have been completed by testing agency.

B. The testing agency shall verify proper application thickness via a wet mil gauge during the application process.

C. Hose tests will be performed for areas clad with composite wood panels, aluminum composite panels, fiber reinforced cementitions panels, and thin limestone adhered panel. Refer to those sections for testing requirements. Replace and/or repair components that have failed field testing and retest until performance is satisfactory.

3.7 PROTECTION

A. Do not leave materials exposed to weather longer than recommended by manufacturer.

END OF SECTION

SECTION 07 26 00

UNDER-SLAB VAPOR BARRIER

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Vapor Barrier

B. Seam Tape/Mastic

C. Pipe Boots

1.2 RELATED REQUIREMENTS

A. Section 01 40 00 - Quality Requirements

B. Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions

C. Section 03 30 00 – Cast-In-Place Concrete

D. Section 07 21 00 – Thermal Insulation

E. Section 07 90 05 – Joint Sealers

1.3 REFERENCE STANDARDS

A. The following standards and publications are applicable to the extent referenced in the text.

B. American Society for Testing and Materials (ASTM)

1. ASTM E 1745-97 (2004) Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill Under Concrete Slabs
2. ASTM E 154-99 (2005) Standard Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs
3. ASTM E 96-05 Standard Test Methods for Water Vapor Transmission of Materials
4. ASTM F 1249-06 Standard Test Method for Water Vapor Transmission Rate Through Plastic Film and Sheeting Using a Modulated Infrared Sensor
5. ASTM E 1643-11 Standard Practice for Installation of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs

C. American Concrete Institute (ACI)

1. ACI 302.1R-04 Vapor barrier component (plastic membrane) is not less than 10 mils thick.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordinate with the installation of other components that comprise the exterior building envelope.

1.5 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Installation instructions: Submit manufacturer's installation instructions for placement, seaming, and pipe boot installation.

C. Compatibility: Submit letter from manufacturer stating that materials proposed for use are permanently chemically compatible and adhesively compatible with adjacent materials proposed for use. Submit letter from manufacturer stating that cleaning materials used during installation are chemically compatible with each of the adjacent materials proposed for use.

1.6 QUALITY ASSURANCE

A. Manufacturer: System shall be manufactured and marketed by a firm with a minimum of 15 years experience in the production and sales of waterproofing and air barrier products. Manufacturers proposed for use but not named in these specifications shall submit evidence of ability to meet all requirements specified, and include a list of projects of similar design and complexity completed within the past 5 years.

B. Installer Qualifications:

1. Company specializing is performing the work of this section as a primary occupation, which has at least 3 years experience.

C. Materials: For each type of material required for the work of this section, provide primary materials, associated materials, and material assemblies which are the products of one manufacturer.

D. Pre-Installation Conference: A pre-installation conference shall be held two weeks prior to commencement of field operations to establish procedures to maintain optimum working conditions and to coordinate this work with related and adjacent work. Attendance shall include the contractors of adjacent systems and substrates, and the manufacturer representative. Agenda for meeting shall include but not be limited to the following:
1. Requirements for Building Envelope Commissioning.
2. Review of submittals.
3. Review of surface preparation and installation procedures.
4. Review of special details and flashings.
5. Sequence of construction, responsibilities and schedule for subsequent operations.
6. Review of inspection, testing, protection, and repair procedures.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials and products in labeled packages. Store and handle in strict compliance with manufacturer's instructions, recommendations and material safety data sheets. Protect from damage from sunlight, weather, excessive temperatures and construction operations. Remove damaged material from the site and dispose of in accordance with applicable regulations.

B. Do not double-stack pallets of components on the job site. Provide cover on top and all sides, allowing for adequate ventilation.

C. Sequence deliveries to avoid delays, but minimize on-site storage.

1.8 PROJECT CONDITIONS

A. Perform work only when existing and forecasted weather conditions are within the limits established by the manufacturer of the materials and products used.

B. Proceed with installation only when substrate construction and preparation work is complete and in condition to receive vapor barrier.

PART 2 PRODUCTS

2.1 MATERIALS

A. Multi-layer, reinforced polyethylene or equivalent, complying with ASTM E 1745, Class A; stated by manufacturer as suitable for installation in contact with soil or granular fill under concrete slabs. Single ply polyethylene is PROHIBITED.
1. Thickness: Minimum 15 mil, 0.015 inch (0.38 mm).
2. Water Vapor Permeance: ASTM E 96 or ASTM F 1249; less than 0.01 perm after mandatory conditioning tests per ASTM E 1745 (7.1.1 - 7.1.5)
3. Water Vapor Transmission Rate: ASTM E 96 or ASTM F 1249; less than 0.006 grains/hr.ft2
4. after mandatory conditioning tests per ASTM E 1745 (7.1.1 - 7.1.5).
5. Tensile Strength: ASTM D882 or ASTM E 154; minimum 60lbf/in.
6. Puncture Resistance: ASTM D 1709; minimum 2750 grams.

B. Acceptable Manufacturers:
1. Insulation Solutions, Inc; Viper VaporCheck II: www.insulationsolutions.com.
2. Raven Industries, Inc; Vapor Block 15: www.ravenind.com.
3. W.R. Meadows, Inc; Perminator 15 Mil: www.wrmeadows.com.
4. IntePlast Group; Barrier-Bac VB350 16 mil: www.barrierbac.com.

2.2 ACCESSORIES

A. Seam Tape:
1. Permeance less than 0.3 perms per ASTM F 1249 or ASTM E 96

B. Vapor Proofing Mastic:

1. Permeance less than 0.3 perms per ASTM F 1249 or ASTM E 96

C. Pipe Boots
   1. Construct pipe boots from vapor barrier material, pressure sensitive tape and/or mastic per manufacturer's instructions.

PART 3 EXECUTION

3.1 EXAMINATION

A. The installer shall examine conditions of substrates and other conditions under which this work is to be performed and notify the contractor, in writing, of circumstances detrimental to the proper completion of the work. Do not proceed with work until unsatisfactory conditions are corrected.

B. Ensure that subsoil is approved by Geotechnical Engineer.
   1. Level and tamp or roll aggregate, sand or granular base.

3.2 INSTALLATION

A. Install vapor barrier in accordance with manufacturer's instructions and ASTM E 1643-11.
   1. Unroll vapor barrier with the longest dimension parallel with the direction of the concrete pour. Level and compact base material
   2. Extend vapor barrier to the perimeter of the slab. If practicable, terminate it at the top of the slab, otherwise (a) at a point acceptable to the structural engineer or (b) where obstructed by impediments (such as dowels, waterstops, or any other site condition requiring early termination of the vapor barrier). At the point of termination, seal vapor barrier to the foundation wall, grade beam or slab itself.
   3. Overlap joints 6 inches and seal with manufacturer's tape.
   4. Apply seam tape to a clean and dry vapor barrier.
   5. Seal all penetrations (including pipes) per manufacturer's instructions.
   6. No penetration of the vapor barrier is allowed except for reinforcing steel and permanent utilities.
   7. If non-permanent stakes are driven through vapor retarder, repair as recommended by vapor retarder manufacturer.
   8. Repair damaged areas by cutting patches of vapor barrier material of similar (or better) permeance, puncture and tensile, overlapping damaged area 6 inches and taping all four sides with tape.

3.3 CLEANING AND PROTECTION

A. Protect membrane in accordance with manufacturer's recommendations until placement of concrete. Inspect for damage just prior to placement of concrete and make repairs in accordance with manufacturer's recommendations.

3.4 FIELD QUALITY CONTROL

A. Do not place concrete until required inspections have been completed by manufacturer's technical representative.

3.5 SCHEDULE

A. Follow the installation sequence as directed by the manufacturer specification.

END OF SECTION

SECTION 07 41 13

METAL ROOF PANELS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Roofing system of preformed steel panels.

B. Fastening system.

C. Accessories and miscellaneous components.

1.2 RELATED REQUIREMENTS

A. Section 05 50 00- Metal Fabrications: Photovoltaic panel roof attachment system.

B. Section 06 10 00 - Rough Carpentry: Roof sheathing.

1.3 REFERENCE STANDARDS

A. ASTM A792/A792M - Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process; 2010 (Reapproved 2015).

B. ASTM D1970/D1970M - Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection; 2015a.

C. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; 2016.

D. ICC-ES AC188 - Acceptance Criteria for Roof Underlayments; 2012, with Editorial Revision (2015).

1.4 SUBMITTALS

A. Shop Drawings: Include layouts of roof panels, details of edge and penetration conditions, spacing and type of connections, flashings, underlayments, and special conditions.
   1. Show work to be field-fabricated or field-assembled.
   2. Include loads for photovoltaic panel roof attachnent system.
   3. Include structural analysis signed and sealed by qualified structural engineer, indicating conformance of roofing system to loading conditions.

B. Selection Samples: For each roofing system specified, submit color chips representing manufacturer's full range of available colors and patterns.

C. Test Reports: Indicate compliance of metal roofing system to specified requirements.

D. Warranty: Submit specified manufacturer's warranty and ensure that forms have been completed in Owner's name and are registered with manufacturer.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store roofing panels on project site as recommended by manufacturer to minimize damage to panels prior to installation.

1.6 WARRANTY

A. Waterproofing Warranty: Provide manufacturer’s warranty for weathertightness of roofing system, including agreement to repair or replace roofing that fails to keep out water within specified warranty period of 10 years from date of Substantial Completion.

PART 2 PRODUCTS

2.1 ARCHITECTURAL METAL ROOF PANELS

A. Metal Roofing: Provide complete engineered system complying with specified requirements and capable of remaining weathertight while withstanding anticipated movement of substrate and thermally induced movement of roofing system.

B. Metal Panels: Factory-formed panels with factory-applied finish.

1. Steel Panels:
   a. Aluminum-zinc alloy-coated steel conforming to ASTM A792/A792M; minimum AZ55 coating.
   b. Steel Thickness: Minimum 22 gage (.029 inch).
2. Profile: Standing seam, with minimum 2.0 inch seam height; concealed fastener system for field seaming with special tool.
3. Texture: Smooth.
4. Length: Full length of roof slope, without lapped horizontal joints.
5. Width: Maximum panel coverage of 12 inches.
6. Basis-of-Design: MBCI, BattenLok HS.

2.2 ATTACHMENT SYSTEM

A. Concealed System: Provide manufacturer's standard stainless steel concealed anchor clips designed for specific roofing system and engineered to meet performance requirements, including anticipated thermal movement and support of photovoltaic panel roof support system.

2.3 ACCESSORIES AND MISCELLANEOUS ITEMS

A. Miscellaneous Sheet Metal Items: Provide flashings, gutters, downspouts, trim, moldings, closure strips, preformed crickets, caps, and equipment curbs of the same material, thickness, and finish as used for the roofing panels. Items completely concealed after installation may optionally be made of stainless steel.
   1. Downspouts: Open face, rectangular profile.

B. Rib and Ridge Closures: Provide prefabricated, close-fitting components of steel with corrosion resistant finish or combination steel and closed-cell foam.

C. Sealants:
   1. Exposed Sealant: Elastomeric; silicone, polyurethane, or silyl-terminated polyether/polyurethane.
   2. Concealed Sealant: Non-curing butyl sealant or tape sealant.

D. Underlayment: Self-adhering rubber-modified asphalt sheet complying with ASTM D1970/D1970M; 22 mil total thickness; with strippable release film and woven polypropylene sheet top surface.
   1. Minimum Requirements: Comply with requirements of ICC-ES AC188 for non-self-adhesive sheet.
   2. Sheet Thickness: 22 mil (0.022 inch) minimum total thickness.
   3. Self Sealability: Passing nail sealability test specified in ASTM D1970/D1970M.
   4. Low Temperature Flexibility: Passing test specified in ASTM D1970/D1970M.
   5. Water Vapor Permeance: 0.067 perm, maximum, when tested in accordance with ASTM E96/E96M Procedure A (desiccant method).

2.4 FABRICATION

A. Panels: Fabricate panels and accessory items at factory, using manufacturer92s standard processes as required to achieve specified appearance and performance requirements.

PART 3 EXECUTION

3.1 EXAMINATION

A. Do not begin installation of preformed metal roof panels until substrates have been properly prepared.

B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

A. Coordinate roofing work with provisions for roof drainage, flashing, trim, penetrations, and other adjoining work to assure that the completed roof will be free of leaks.

B. Separate dissimilar metals by applying a bituminous coating, self-adhering rubberized asphalt sheet, or other permanent method approved by roof panel manufacturer.

C. Where metal will be in contact with wood or other absorbent material subject to wetting, seal joints with sealing compound and apply one coat of heavy-bodied bituminous paint.

3.3 INSTALLATION

A. Overall: Install roofing system in accordance with approved shop drawings and panel manufacturer's instructions and recommendations, as applicable to specific project conditions. Anchor all components of roofing system securely in place while allowing for thermal and structural movement.
   1. Install roofing system with concealed clips and fasteners, except as otherwise recommended by manufacturer for specific circumstances.
   2. Minimize field cutting of panels. Where field cutting is absolutely required, use methods that will not distort panel profiles. Use of torches for field cutting is absolutely prohibited.

B. Accessories: Install all components required for a complete roofing assembly, including flashings, gutters, downspouts, trim, moldings, closure strips, preformed crickets, caps, equipment curbs, rib closures, ridge closures, and similar roof accessory items.

C. Roof Panels: Install panels in strict accordance with manufacturer92s instructions, minimizing transverse joints except at junction with penetrations.

3.4 CLEANING

A. Clean exposed sheet metal work at completion of installation. Remove grease and oil films, excess joint sealer, handling marks, and debris from installation, leaving the work clean and unmarked, free from dents, creases, waves, scratch marks, or other damage to the finish.

3.5 PROTECTION

A. Do not permit storage of materials or roof traffic on installed roof panels. Provide temporary walkways or planks as necessary to avoid damage to completed work. Protect roofing until completion of project.

B. Touch-up, repair, or replace damaged roof panels or accessories before Date of Substantial Completion.

END OF SECTION

SECTION 07 42 13

COMPOSITE WOOD VENEER PANELS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Wood veneer composite panel system including the following:
      a. Wood veneer composite panels with mounting system. Panel mounting system including anchorages, clips, shims, offsets furring, fasteners and related flashing adapters as required for a complete system.

1.2 DEFINITION

A. Composite wood veneer panel Assembly: Composite wood veneer panels, attachment system components, miscellaneous metal framing and accessories necessary for a complete rainscreen wall system.

1.3 RELATED SECTIONS

A. Section 07 21 00 – Thermal Insulation: Insulation.

B. Section 07 25 00 – Weather Barriers.

C. Section 07 62 00 - Sheet Metal Flashing and Trim.

D. Section 07 92 00 – Joint Sealants.

1.4 SUBMITTALS

A. Product Data: Manufacturer's data sheet on each product to be used including:

B. Preparation instructions and recommendations.

C. Storage and handling requirements and recommendations.

D. Installation methods.

E. Quality Assurance: Certified test results from independent testing laboratory substantiating specified performance characteristics and physical properties.

F. Design Drawings: Include installation details and elevations showing all panel sizes, fastener locations.
   1. Provide details and calculations indicating loads of cladding system on thermal clip support assembly.
   2. Include design engineer's stamp or seal on shop drawings for panels, backup framing, attachments and anchors. Engineer shall be licensed in Iowa.

G. Samples: Submit two 6"x6" samples of specified color.

1.5 QUALITY ASSURANCE

A. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
   1. Provide installation and materials for mockups indicated on Drawings.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Delivery: Deliver Materials to site in Manufacturer's original, unopened packaging, with labels clearly identifying product name and manufacturer.

B. Storage: Store Materials in accordance with the Manufacturer's instruction in unopened packaging until ready for installation. Store materials in a covered area, away from water, on a flat, level surface with adequate support to prevent sagging.

C. Handling: Protect materials during handling to prevent damage.

1.7 ACCLIMATIZATION

A. All boxes shall be opened and all components removed from the packaging and stacked flat with spacers between the pieces in their final environment for a minimum 3-4 days prior to installation.

1.8 PROJECT CONDITIONS

A. Do not install composite wood veneer panel material under environmental conditions where it is likely to be immersed in water, or where the temperature is likely to exceed 120 degrees Fahrenheit for extended periods of time.

1.9 WARRANTY

A. Manufacturer's Warranty: Provide manufacturer's 10 year warranty.

PART 2 - PRODUCTS

2.1 PRODUCTS

A. Products: Subject to compliance with requirements, provide the following:
   1. ProdEX, Prodema North America. Website: www.prodema.com

B. System Description
   1. A complete, engineered metal aluminum or stainless steel clip girt system with metal member framing, closure pieces, trim and flashing. The system is to be composed of composite wood veneer panels fastened to metal sub-frame. System to be designed and engineered to attach to wall assembly substructure as indicated below. System shall be designed to incorporate flashing and drainage components in such a way that system will properly perform as a rear ventilated rainscreen system.
   2. System installation shall allow for all movements within structure and to support loads transferred from the adjacent construction and to fit within the space allotted without projections into the finished space as shown on the Drawings.
   3. Provide in conjunction with wall substrate and air/water barrier a weather tight wall assembly utilizing the “rain screen principle”.
      a. System design shall be single-source responsibility by the cladding supplier. All design criteria shall be project specific in accordance with the requirements of cladding supplier. Products provided must conform to the design intent shown.
      b. Panel System: Drained and Back Ventilated Rainscreen Design. System shall drain water and condensation to exterior. A complete pre-engineered system including but not limited to cladding panels, support structure, closure pieces, trim and flashing. Wall panels shall be removable. Fasteners are exposed. The panels shall be secured to a thermally broken above grade cladding support wall assembly substructure provided in this section with fastening to bracket horizontally to allow for concealed attachment of panels.
      c. Joints: Shall be dry and un-caulked.
      d. Metal Flashing: Provide metal flashing for a proper water managed assembly, to direct condensation and water infiltration within the wall to weeping points.
         1) Drainage flashing is the primary component of a water managed system which diverts water that has penetrated the exterior cladding away from the cladding compartment or condensation that occurs at the interior face of cladding surface.
         2) Provide metal drainage flashing at locations listed below prior to installation of membrane to assure proper water drainage. Membrane shall assure proper lap over flashing:
            (a) At bottom of system.
            (b) At penetrations: windows, doors, louvers, etc.
            (c) At floor line or other locations which accommodate vertical movement.
   4. System shall provide minimum 1 inch “clear” airspace behind cladding for proper ventilation.
   5. Design Modifications: Shall be provided only as necessary to satisfy as-built conditions and to meet performance requirements. Significant system and aesthetic design shall be requested in writing to architect 10 days prior to bid date.
   6. Material supplier shall be responsible for engineering system per architectural design criteria and performance requirements.
   7. Condensation: System shall accommodate positive drainage for moisture entering or condensation occurring within panel system.
   8. Flatness: System shall be flat with no noticeable warpage, buckling, deflections or other surface irregularities

C. System Description: The system shall consist of composite wood veneer panels and a system of custom aluminum extrusions in profiles indicated on drawings. The back-up framing shall utilize Cascadia fiberglass clips with aluminum extrusions in profiles indicated on the drawings. The details show the preferred profiles and performance requirements. Provide a rainscreen and structurally sound, self-draining wall panel system with minimal water penetration.

2.2 THERMAL CLIP CLADDING SUPPORT ASSEMBLY

A. Thermal Clip Cladding Support Assembly:
1. All thermal clip systems are to be designed for a fully engineered, sub-framing thermal spacer insulation clip.
2. Provide a system designed to thermally isolate the exterior cladding systems. The system shall provide the insulation retainage in addition to withstanding the loads, wind loads and dead loads imposed by the cladding systems.
   a. Approved Manufacturers:
      1) Advanced Architectural Products: SMARTci
3. Insulation clip system design: Minimum 4” wide thermal spacer designed for cladding system girt attachment.
4. Clip System and final girt attachment must be coordinated with cladding system manufacturers.
5. Final girt attachment must be designed to be perpendicular to the cladding system primary attachment system.
6. All fastener penetrations through air and vapor shall be fully sealed with compatible sealant where clip system is attached to substrate.
7. No push pin installations allowed for insulation. Insulation to be retained without fasteners.
8. Insulation to be installed in staggered layers with no gaps or voids.
9. Transition between the insulation clip system and the cladding final girt attachment will occur within the staggered layers of the insulation. Attachment of the cladding to the insulation clip may not occur at the outside face of the final layer of insulation.
10. System to be designed to accommodate the following maximum live load deflection in the plane of the exterior wall:
    a. Verify maximum live load deflection with structural requirements or 3/8 inch, whichever is greater.

2.3 MATERIALS

A. Wood Veneer Exterior Wall Panel with Resin Core
1. Panels: Grade A rotary cut, hardwood veneer from farmed forests and bonded to a bakelite core.
2. Fire Rating: Class A in accordance with ASTM E-84 criteria for flame spread 10 and smoke development 10 and Class 2 (M1) fire rating in accordance with UNE-EN 2372
3. Color: Pale
4. Panel Thickness: 8 mm.
5. Panel Dimensions: As indicated on drawings. Provide panels factory cut to required sizes. Factory finish all factory cut edges.
6. Adjacent flashings to match reveals.
7. Mounting: Exposed Fasteners to an subframe as required to suit loading.
8. Subframe Assembly: Extruded aluminum system. Provide manufacturer's standard sections as required for support and alignment of metal panel system which allows for attachment clips as necessary to accommodate continuous insulation.
9. Fasteners: Self-threading screws (SFS-SX3-L-12) with smooth heads lacquered to match panels.
10. Copings, Break Metal, Flashings and Trim: Provide as specified in Section 07 62 00 Sheet Metal Flashing and Trim.

B. MOUNTING SYSTEM
1. Manufacturer's ventilated facade mounting system.
   a. Sub-Structure: Exposed Fasteners to an Aluminum Subframe.
   b. Fasteners: Manufacturer's exposed head fasteners, color matched to color of wood veneer panel

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine supporting structure and conditions under which the work is to be erected, and notify the Contractor in writing of conditions detrimental to proper and timely completion of the work. Do not proceed with erection until unsatisfactory conditions have been corrected.

B. Prior to installation, verify water barrier has been properly installed over sheathing substrate. Notify Architect in writing of unsatisfactory conditions prior to beginning installation.

3.2 PREPARATION

A. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

B. Protect metal surfaces in contact with concrete, masonry mortar, plaster or other cementitious surface with isolation coating.

3.3 EXTERIOR WALL THERMAL CLIP SYSTEM AND INSULATION

A. Install thermal clip assembly in accordance with approved shop drawings and manufacturer's instructions. Install to depth of cladding attachment system as detailed.

B. Install exterior wall insulation in conjunction with installation of attachment system provided as part of each cladding system.

C. All fastener penetrations through air and vapor shall be fully sealed with compatible sealant where clip system is attached to substrate.

D. No push pin installations allowed for insulation. Insulation to be retained without fasteners.

E. Insulation to be installed in staggered layers with no gaps or voids.

F. Transition between the insulation clip system and the cladding final girt attachment will occur within the staggered layers of the insulation. Attachment of the cladding to the insulation clip may not occur at the outside face of the final layer of insulation.

3.4 INSTALLATION

A. Comply with panel manufacturer’s instructions for assembly, installation and erection of panels, trims, flashings and sealants.

B. Do not install component parts, which are observed to be defective, including warped, bowed, dented, abraded and/or broken members

C. Install composite wood veneer panel subframe per manufacturer’s written instructions.

D. Do not force panels into place.

E. Install structural supports required to provide a complete system. Support system shall be installed to the same tolerance as required of the panel system.

F. Attach panels with exposed fastening. Space fastener symmetrically in straight rows as approved in shop drawings.

3.5 FIELD QUALITY CONTROL

A. Field hose testing for resistance to water leakage shall be conducted and results interpreted as defined herein. Perform a minimum of three (3) field hose tests. Test areas shall include both panel and adjacent curtain wall construction. Coordinate testing of panel areas with adjacent curtain wall construction contractors as required. Area and time of tests shall be per the direction of the Architect. Initial testing shall be conducted early in the construction schedule. Schedule any out of sequence work necessary, such as out of sequence sealant work, so that selected areas can be tested as specified.

B. Size of panel test areas will be as selected by Architect and will primarily be at areas surrounding curtain wall test area openings. There shall be no unacceptable water leakage as defined in this Section.

C. Conduct test with Monarch Type B-25 #6.030 brass nozzle and 3/4 inch diameter hose. Water pressure to nozzle shall be in the range 30 to 35 psi. Working upward from bottom of test area, direct water at 5 foot long segments

of panel joints and perimeter joints, moving slowly back and forth on each segment for minimum of 5 minutes. Sustained spraying at one point while the nozzle remains stationary is acceptable. Tip of nozzle shall be 12 inches from specimen exterior surface. Nozzle shall generally be perpendicular to specimen surface, but shall be tilted to any angle that maximizes exposure of a given joint to water flow rate and kinetic energy. Continuously check for leakage on indoor side. If necessary to pinpoint leak sources, perform additional testing. Repeated testing of joints is acceptable. The use of masking to pinpoint leaks is acceptable.

D. Check completed areas below test area, and report any leaks that occur. A test that results in leakage at a completed area below a designated test area is a failure.

E. Contractor performing work of this Section shall provide powered scaffold, hose, water supply, and manpower to perform each test, plus any unsuccessful tests.

F. If failure occurs, revise and retest specimens. Modifications must be realistic in terms of project conditions, must maintain standards of quality and durability and are subject to approval.

G. If failure necessitates retesting, Contractor for Work of this Section shall pay all additional fees associated with retesting, including fees and costs incurred by the testing agency, the Architect, Owner and their representatives.

H. Submit, for information only, reports that contain dates of tests, elevation drawings of test areas with locations relative to grid lines (including any lower areas where leaks occur), and location of each leak.

I. Coordinate testing under this section with testing specified in Section 08 44 13 - Glazed Aluminum Curtain Walls.

J. Replace and/or repair components that have failed field testing and retest until performance is satisfactory.

3.6 MAINTENANCE

A. Remove stains and graffiti with mild ph-neutral, non-abrasive soap and damp cloth.

B. Avoid use of caustic cleaning solutions, automatic cleaners or excessive liquids.

END OF SECTION

SECTION 07 42 13.23

ALUMINUM COMPOSITE PANELS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Exterior cladding consisting of formed aluminum composite material (ACM) sheet, secondary supports, and anchors to structure, attached to solid backup.

B. Matching flashing and trim.

C. Interior aluminum composite column covers.

1.2 RELATED REQUIREMENTS

A. Section 07 21 00 – Thermal Insulation: Insulation and thermal clip assembly.

B. Section 07 25 00 - Weather Barriers

C. Section 07 92 00 - Joint Sealants: Sealing joints between siding and adjacent construction and fixtures.

1.3 REFERENCE STANDARDS

A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2014.

B. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2015.

C. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2016a.

D. ASTM A276/A276M - Standard Specification for Stainless Steel Bars and Shapes; 2016a.

E. ASTM A480/A480M - Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip; 2016a.

F. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.

G. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2015.

H. ASTM A792/A792M - Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process; 2010 (Reapproved 2015).

I. ASTM D523 - Standard Test Method for Specular Gloss; 2014.

J. ASTM D1781 - Standard Test Method for Climbing Drum Peel for Adhesives; 1998 (Reapproved 2012).

K. ASTM D1929 - Standard Test Method for Determining Ignition Temperature of Plastics; 2016.

L. ASTM D2244 - Standard Practice for Calculation of Color Tolerances and Color Differences from Instrumentally Measured Color Coordinates; 2016.

M. ASTM D4214 - Standard Test Methods for Evaluating the Degree of Chalking of Exterior Paint Films; 2007 (Reapproved 2015).

N. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2016.

O. ASTM E283 - Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen; 2004 (Reapproved 2012).

P. ASTM E330/E330M - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference; 2014.

Q. ASTM E331 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference; 2000 (Reapproved 2016).

1.4 ADMINISTRATIVE REQUIREMENTS

A. Pre-Installation Meeting: Convene one week before starting work of this section to verify project requirements, co-ordinate with installers of other work, establish condition and completeness of building substrate, and review manufacturers' installation instructions and warranty requirements.

1. Require attendance by the installer and relevant sub-contractors.
2. Include ACM sheet manufacturer's representative and wall system manufacturer's representative to review storage and handling procedures.
3. Review in detail truck transportation, parking, vertical transportation, schedule, personnel, installation of adjacent materials and substrate.
4. Review procedures for protection of work and other construction.

1.5 SUBMITTALS

A. Product Data - MCM Sheets: Manufacturer's data sheets on each product to be used, including thickness, physical characteristics, and finish, and:
   1. Finish manufacturer's data sheet showing physical and performance characteristics.
   2. Storage and handling requirements and recommendations.
   3. Fabrication instructions and recommendations.
   4. Specimen warranty for finish, as specified herein.

B. Product Data - Wall System: Manufacturer's data sheets on each product to be used, including:
   1. Physical characteristics of components shown on shop drawings.
   2. Storage and handling requirements and recommendations.
   3. Installation instructions and recommendations.

C. Shop Drawings: Show layout and elevations, dimensions and thickness of panels, connections, details and location of joints, sealants and gaskets, method of anchorage, number of anchors, supports, reinforcement, trim, flashings, and accessories.
   1. Indicate panel numbering system.
   2. Differentiate between shop and field fabrication.
   3. Indicate substrates and adjacent work with which the wall system must be coordinated.
   4. Include large-scale details of anchorages and connecting elements.
   5. Include large-scale details or schematic, exploded or isometric diagrams to fully explain flashing at a scale of not less than 1-1/2 inches per 12 inches.
   6. Provide calculations indicating loads of cladding system on thermal clip support assembly.
   7. Include design engineer's stamp or seal on shop drawings for panels, backup framing, attachments and anchors. Engineer shall be licensed in Iowa.

D. Test Report: Submit report of full-size mock-up tests for air infiltration, water penetration, and wind performance.

E. Maintenance Data: Care of finishes and warranty requirements.

F. Executed Warranty: Submit warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

G. Compatibility:
   1. Submit letter from manufacturer stating that materials proposed for use are permanently chemically compatible and adhesively compatible with adjacent materials proposed for use.
   2. Submit letter from manufacturer stating that cleaning materials used during installation are chemically compatible with each of the adjacent materials proposed for use.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver products in manufacturer's original, unopened, undamaged containers with identification labels intact.
   1. Protect finishes by applying heavy duty removable plastic film during production.
   2. Package for protection against transportation damage.
   3. Provide markings to identify components consistently with drawings.
   4. Exercise care in unloading, storing and installing panels to prevent bending, warping, twisting and surface damage.

B. Store products protected from exposure to harmful weather conditions and at temperature conditions recommended by manufacturer.
   1. Store in well ventilated space out of direct sunlight.
   2. Protect from moisture and condensation with tarpaulins or other suitable weather tight covering installed to provide ventilation.
   3. Store at a slope to ensure positive drainage of any accumulated water.
   4. Do not store in any enclosed space where ambient temperature can exceed 120 degrees F.

5. Avoid contact with any other materials that might cause staining, denting, or other surface damage.

1.7 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal wall panel assemblies that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Structural failures, including rupturing, cracking or puncturing.
      b. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
   2. Warranty Period: Three years from date of Substantial Completion.

B. ACM Sheet Manufacturer's Finish Warranty: Provide manufacturer's written warranty stating that the finish will perform as follows for minimum of 20 years:
   1. Chalking: No more than that represented by a No. 8 rating based on ASTM D4214.
   2. Color Retention: No fading or color change in excess of 5 Hunter color difference units, calculated in accordance with ASTM D2244.
   3. Gloss Retention: Minimum of 30 percent gloss retention, when tested in accordance with ASTM D523.

PART 2 PRODUCTS

2.1 LEED REQUIREMENTS

A. Recycled Content: Minimum 30 percent recycled content value: post-consumer recycled content plus one-half of pre-consumer recycled content.

2.2 WALL PANEL SYSTEM

A. Wall Panel System: Metal panels, fasteners, and anchors designed to be supported by framing or other substrate provided by others; provide installed panel system capable of maintaining specified performance without defects, damage or failure.
   1. Provide structural design by or under direct supervision of a Structural Engineer licensed in the State in which the Project is located.
   2. Provide drained and back ventilated, reveal joint, rout and return panel system:
      a. The system shall consist of ACM panels, and a system of custom aluminum extrusions of size and shape indicated on drawing as specified herein. The system must utilize a Rout and Return configuration and a system of custom aluminum extrusions of size and shape indicated on drawings and as specified herein. The panel system shall be non-directional/non-sequential type installation and shall allow for the indiscriminate removal of any panel without disturbing adjacent panels. The system must allow for the removed panel to be replaced in the original and tested method.
   3. Basis-of-Design: Metal Design System, Series 44.

B. System Description
   1. A complete, engineered metal aluminum or stainless steel clip girt system with metal member framing, closure pieces, trim and flashing. The system is to be composed of aluminum composite panels attached to perimeter channels. System to be designed and engineered to attach to wall assembly substructure as provided under Section 07 21 00. System shall be designed to incorporate flashing and drainage components in such a way that system will properly perform as a rear ventilated rainscreen system.
   2. System installation shall allow for all movements within structure and to support loads transferred from the adjacent construction and to fit within the space allotted without projections into the finished space as shown on the Drawings.
   3. Provide in conjunction with wall substrate and air/water barrier a weather tight wall assembly utilizing the "rain screen principle".
      a. System design shall be single-source responsibility by the cladding supplier. All design criteria shall be project specific in accordance with the requirements of cladding supplier. Products provided must conform to the design intent shown.
      b. Panel System: Drained and Back Ventilated Rainscreen Design. System shall drain water and condensation to exterior. A complete pre-engineered system including but not limited to cladding panels, support structure, closure pieces, trim and flashing. Wall panels shall be removable. Fasteners are exposed.
      c. Joints: Shall be dry and un-caulked.

d. Metal Flashing: Provide metal flashing for a proper water managed assembly, to direct condensation and water infiltration within the wall to weeping points.
   1) Drainage flashing is the primary component of a water managed system which diverts water that has penetrated the exterior cladding away from the cladding compartment or condensation that occurs at the interior face of cladding surface.
   2) Provide metal drainage flashing at locations listed below prior to installation of membrane to assure proper water drainage. Membrane shall assure proper lap over flashing:
      (a) At bottom of system.
      (b) At penetrations: windows, doors, louvers, etc.
      (c) At floor line or other locations which accommodate vertical movement.

4. System shall provide minimum 1 inch “clear” airspace behind cladding for proper ventilation.
5. Design Modifications: Shall be provided only as necessary to satisfy as-built conditions and to meet performance requirements. Significant system and aesthetic design shall be requested in writing to architect 10 days prior to bid date.
6. Material supplier shall be responsible for engineering system per architectural design criteria and performance requirements.
7. Condensation: System shall accommodate positive drainage for moisture entering or condensation occurring within panel system.
8. Flatness: System shall be flat with no noticeable warpage, buckling, deflections or other surface irregularities

C. Performance Requirements:
1. Thermal Movement: Provide for free and noiseless vertical and horizontal thermal movement due to expansion and contraction under material temperature range of minus 20 degrees F to 180 degrees F without buckling, opening of joints, undue stress on fasteners, or other detrimental effects; allow for ambient temperature at time of fabrication, assembly, and erection procedures.
2. Wind Performance: Provide system tested in accordance with ASTM E330/E330M without permanent deformation or failures of structural members under the following conditions:
   a. Panels shall be designed to withstand the Design Wind Load based upon the local building code, but in no case less than 20 pounds per square foot (psf) and 30 psf on parapet and corner panels.
   b. Maximum deflection of perimeter framing member of L/175 or 3/4", whichever is less, normal to plane of the wall; maximum deflection of individual panels of L/60.
   c. Maximum anchor deflection in any direction of 1/16 inch at connection points of framing members to anchors.
   d. At 1-1/2 times design pressure, permanent deflections of framing members shall not exceed L/100 of span length and components shall not experience failure or gross permanent distortion. At connection points of framing members to anchors, permanent set shall not exceed 1/16".
3. Air Infiltration: 0.06 cfm/sq ft of wall area, maximum, when tested at 1.57 psf in accordance with ASTM E283.
4. Water Penetration: No water penetration under static pressure when tested in accordance with ASTM E331 at a differential of 10 percent of inward acting design load, 6.24 psf minimum, after 15 minutes.
   a. Water penetration is defined as the appearance of uncontrolled water on the interior face of the wall.
   b. Dynamic Water Infiltration – System will show compliance with the requirements stated in the AAMA 501 Dynamic Water Infiltration test.n to drain leakage and condensation to the exterior face of the wall.

D. Panels: One inch deep pans formed of metal composite material sheet by routing back edges of sheet, removing corners, and folding edges.
1. Reinforce corners with riveted aluminum angles.
2. Provide concealed attachment to supporting structure by adhering attachment members to back of panel; attachment members may also function as stiffeners.
3. Flatness Criteria: Maximum 1/8” in 15’-0” on panel in any direction for assembled units (non-accumulative).
4. Secure members to back face of panels using structural silicone sealant approved by ACM sheet manufacturer.
5. Fabricate panels under controlled shop conditions.
6. Where final dimensions cannot be established by field measurement before commencement of manufacturing, make allowance for field adjustments without requiring field fabrication of panels.
7. Fabricate as indicated on drawings and as recommended by MCM sheet manufacturer.
   a. Make panel lines, breaks, curves and angles sharp and true.

b. Keep plane surfaces free from warp or buckle.
c. Keep panel surfaces free of scratches or marks caused during fabrication.

8. Provide joint details providing a watertight and structurally sound wall panel system that allows no uncontrolled water penetration on inside face of panel system.

E. Perimeter Channels: Extruded aluminum channels which integrate to the continuous sub-system as detailed on drawings, so as to provide the following essential features:
1. Edges of ACM shall be supported by aluminum channels on all four sides.
2. Minimum overall system is 1-7/8".
3. The ACM panel shall be held in place with stainless steel pins through the panel returns and engaged over the channel extrusion allowing the panel to free float for thermal expansion in all directions. Panel systems utilizing attachment methods which secure two edges of the panel to the structure will not be allowed.
4. Channels shall be mill finished.

F. Reveals at Panel Joints:
1. Panel joints are to be joined with manufacturer's standard clip and snap cover. Snap covers shall be painted to match aluminum composite panel color.
2. Panel joints shall be ½" wide x 3/8" deep open reveal (Nominal).

G. Flashings:
1. Fabricate flashing from aluminum sheet in matching color; where exposed to view finish to match adjacent panels. Provide lap strip under flashing at abutted conditions; with lapped surfaces sealed with a full-bed of non-hardening sealant.

2.3 MATERIALS

A. Aluminum Composite Material (ACM) Sheet: Two sheets of aluminum sandwiching a core of extruded thermoplastic material; no foamed insulation material content.
1. Overall Sheet Thickness: 3 mm, minimum.
2. Face Sheet Thickness: 0.020 inches, minimum.
3. Bond and Peel Strength: No adhesive failure of the bond between the core and the skin nor cohesive failure of the core itself below 22.4 inch-pound/inch with no degradation in bond performance, when tested in accordance with ASTM D1781, simulating resistance to panel delamination, after 8 hours of submersion in boiling water and after 21 days of immersion in water at 70 degrees F.
4. Surface Burning Characteristics: Flame spread index of 25, maximum; smoke developed index of 450, maximum; when tested in accordance with ASTM E84.
5. Flammability: Self-ignition temperature of 650 degrees F or greater, when tested in accordance with ASTM D1929.
6. Finish: Exterior surfaces shall be coil coated with FEVE or PVDF based resin which meets or exceeds AAMA 2605-02 testing for durability In particular, the coating must have successfully passed the following or equal tests:
a. Humidity Resistance:
1) Test Method: ASTM D-2247. No formation of blisters when subjected to condensing water fog at 100% relative humidity and 100 degree Fahrenheit for 3000 hours.
b. Salt Spray Resistance
1) Test Method: ASTM B-117; expose coating system to 3000 hours, using 5% NaCl solution.
(a) Corrosion creepage from scribe line: 1/8" max.
(b) Minimum blister rating of 8 within the test specimen field.
c. Weather Exposure
1) Outdoor
(a) Ten year exposure at 45 degree angle facing south Florida exposure.
(b) Maximum color change of 5 Delta E units as calculated in accordance with ASTM D-2244.
(c) Maximum chalk rating of 8 in accordance with ASTM D-659.
(d) No checking, crazing, adhesion loss.
7. Color: As selected by Architect.
8. Products:
a. ALPOLIC material manufactured by Mitsubishi Plastics Composites America, Inc. ALPOLIC Materials Division.
b. REYNOBOND material manufactured by Reynolds Metals Company, Alcoa Architectural Products (USA).

c. ALUCOBOND material manufactured by 3A Composites USA Inc.

B. Metal Framing Members: Include sub-girts, zee-clips, base and sill angles and channels, hat-shaped and rigid channels, and furring channels required for complete installation.
1. Provide material strength, dimensions, configuration as required to meet the applied loads applied and in compliance with applicable building code.
2. Sheet Steel Components: ASTM A653/A653M galvanized to G90/Z275 or zinc-iron alloy-coated to A60/ZF180; or ASTM A792/A792M aluminum-zinc coated to AZ60/AZM180.
3. Stainless Steel Sheet Components: ASTM A480/A480M.

C. Flashing: Sheet aluminum; 0.040 inch thick, minimum; finish and color to match MCM sheet.

D. Anchors, Clips and Accessories: Use one of the following:
1. Stainless steel complying with ASTM A276/A276M, ASTM A480/A480M, or ASTM A666.
2. Steel complying with ASTM A36/A36M and hot-dipped galvanized to ASTM A153/A153M.
3. Steel complying with ASTM A36/A36M and hot-dipped galvanized to ASTM A123/A123M Coating Grade 10.

E. Fasteners:
1. Exposed Fasteners: Stainless steel; permitted only where absolutely unavoidable and subject to prior approval of the Architect.
2. Screws: Self-drilling or self-tapping Type 410 stainless steel or zinc-alloy steel hex washer head, with EPDM or PVC washer under heads of fasteners bearing on weather side of metal wall panels.
3. Bolts: Stainless steel.
4. Fasteners for Flashing and Trim: Blind fasteners of high-strength aluminum or stainless steel.

F. Provide panel system manufacturer's and installer's standard corrosion resistant accessories, including fasteners, clips, anchorage devices and attachments.

2.4 FABRICATION

A. Fabricate panel units to dimensions indicated on the drawings based on an assumed design temperature of 70 degrees F.

B. Fabricate panels in sizes shown using composite aluminum panel material and perimeter clips so that the panel thickness at the joinery is as required by design. Completed panel shall be properly fabricated and designed so that no restraints can be placed on the panel, which might result in compressive skin stresses. The installation detailing shall be such that the installed panels shall remain flat due to temperature changes and at all times remain water and wind tight. Oil canning of panel surface is not acceptable.

C. Shop fabricate units ready for erection. If not shop assembled, pre-fabricate components at the shop as required for proper and expeditious field assembly.

D. Design, fabricate, assemble, and erect wall panel units.

E. Where drawings indicate, factory curve panels to required radius.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify dimensions, tolerances, and interfaces with other work.

B. Verify substrate on-site to determine that conditions are acceptable for product installation in accordance with manufacturers written instructions.

C. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

D. Notify Architect in writing of conditions detrimental to proper and timely completion of work. Do not proceed with erection until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Do not install products that are defective, including warped, bowed, dented, and broken members, and members with damaged finishes.

B. Comply with instructions and recommendations of ACM sheet manufacturer and wall system manufacturer, as well as with approved shop drawings.

C. Do not cut, trim, weld, or braze component parts during erection, in a manner which would damage finish, decrease strength, or result in a visual imperfection or a failure in performance of wall panels. Return component parts which require alteration to shop for re-fabrication, if possible, or for replacement by new parts.

D. Install wall system securely allowing for necessary thermal and structural movement; comply with wall system manufacturer's instructions for installation of concealed fasteners.

E. Do not handle or tool products during erection in manner that damages finish, decreases strength, or results in visual imperfection or failure in performance. Return component parts that require alteration to shop for refabrication, if possible, or for replacement with new parts.

F. Do not form panels in field unless required by wall system manufacturer and approved by the Architect; comply with ACM sheet manufacturer's instructions and recommendations for field forming.

G. Separate dissimilar metals; use gasket fasteners, isolation shims, or isolation tape where needed to eliminate possibility of electrolytic action between metals.

H. Install flashings as indicated on shop drawings At flashing butt joints, provide a lap strap under flashing and seal lapped surfaces with a full bed of non-hardening sealant.

I. Install square, plumb, straight, and true, accurately fitted, with tight joints and intersections maintaining the following installation tolerances:
   1. Variation From Plane or Location: 1/2 inch in 30 feet of length and up to 3/4 inch in 300 feet, maximum.
   2. Deviation of Vertical Member From True Line: 0.1 inch in 25 feet run, maximum.
   3. Deviation of Horizontal Member From True Line: 0.1 inch in 25 feet run, maximum.
   4. Offset From True Alignment Between Two Adjacent Members Abutting End To End, In Line: 0.03 inch, maximum.

J. Replace damaged products.

3.3 FIELD QUALITY CONTROL

A. Field hose testing for resistance to water leakage shall be conducted and results interpreted as defined herein. Perform a minimum of one (1) field hose test. Test areas shall include both panel and adjacent curtain wall construction. Coordinate testing of panel areas with adjacent curtain wall construction contractors as required. Area and time of tests shall be per the direction of the Architect. Initial testing shall be conducted early in the construction schedule. Schedule any out of sequence work necessary, such as out of sequence sealant work, so that selected areas can be tested as specified.

B. Size of panel test areas will be as selected by Architect and will primarily be at areas surrounding curtain wall test area openings. There shall be no unacceptable water leakage as defined in this Section.

C. Conduct test with Monarch Type B-25 #6.030 brass nozzle and 3/4 inch diameter hose. Water pressure to nozzle shall be in the range 30 to 35 psi. Working upward from bottom of test area, direct water at 5 foot long segments of panel joints and perimeter joints, moving slowly back and forth on each segment for minimum of 5 minutes. Sustained spraying at one point while the nozzle remains stationary is acceptable. Tip of nozzle shall be 12 inches from specimen exterior surface. Nozzle shall generally be perpendicular to specimen surface, but shall be tilted to any angle that maximizes exposure of a given joint to water flow rate and kinetic energy. Continuously check for leakage on indoor side. If necessary to pinpoint leak sources, perform additional testing. Repeated testing of joints is acceptable. The use of masking to pinpoint leaks is acceptable.

D. Check completed areas below test area, and report any leaks that occur. A test that results in leakage at a completed area below a designated test area is a failure.

E. Contractor performing work of this Section shall provide powered scaffold, hose, water supply, and manpower to perform each test, plus any unsuccessful tests.

F. If failure occurs, revise and retest specimens. Modifications must be realistic in terms of project conditions, must maintain standards of quality and durability and are subject to approval.

G. If failure necessitates retesting, Contractor for Work of this Section shall pay all additional fees associated with retesting, including fees and costs incurred by the testing agency, the Architect, Owner and their representatives.

H. Submit, for information only, reports that contain dates of tests, elevation drawings of test areas with locations relative to grid lines (including any lower areas where leaks occur), and location of each leak.

I. Coordinate testing under this section with testing specified in Section 08 44 13 - Glazed Aluminum Curtain Walls.

J. Replace and/or repair components that have failed field testing and retest until performance is satisfactory.

3.4 CLEANING

A. Ensure weep holes and drainage channels are unobstructed and free of dirt and sealants.

B. Remove protective film after installation of joint sealers, after cleaning of adjacent materials, and immediately prior to completion of work.

C. Remove temporary coverings and protection of adjacent work areas.

D. Clean installed products in accordance with manufacturer's instructions.

3.5 PROTECTION

A. Protect installed panel system from damage until Date of Substantial Completion.

END OF SECTION

SECTION 07 62 00

SHEET METAL FLASHING AND TRIM

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Fabricated sheet metal items, including flashings, counterflashings, and trim.

B. Sealants for joints within sheet metal fabrications.

1.2 REFERENCE STANDARDS

A. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2014a.

B. ASTM D4586/D4586M - Standard Specification for Asphalt Roof Cement, Asbestos-Free; 2007 (Reapproved 2012).

C. CDA A4050 - Copper in Architecture - Handbook; current edition.

D. SMACNA (ASMM) - Architectural Sheet Metal Manual; 2012.

1.3 SUBMITTALS

A. Shop Drawings: Indicate material profile, jointing pattern, jointing details, fastening methods, flashings, terminations, and installation details.

B. Samples for Verification: For each type of exposed finish required, prepared on samples of size below:
   1. Sheet Metal Flashing: 12 inches long. Include fasteners, closures, and other attachments.
   2. Trim: 12 inches long. Including fasteners and other exposed accessories.

1.4 QUALITY ASSURANCE

A. Perform work in accordance with SMACNA (ASMM) and CDA A4050 requirements and standard details, except as otherwise indicated.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Stack material to prevent twisting, bending, and abrasion, and to provide ventilation. Slope metal sheets to ensure drainage.

B. Prevent contact with materials that could cause discoloration or staining.

PART 2 PRODUCTS

2.1 SHEET MATERIALS

A. Steel:
   1. Aluminum-zinc alloy-coated (Galvalume) steel conforming to ASTM A792/A792M; minimum AZ55 coating.

2.2 FABRICATION, GENERAL

A. Form sections true to shape, accurate in size, square, and free from distortion or defects.

B. Form pieces in longest possible lengths.

C. Hem exposed edges on underside 1/2 inch; miter and seam corners.

D. Form material with flat lock seams, except where otherwise indicated; at moving joints, use sealed lapped, bayonet-type or interlocking hooked seams.

E. Fabricate corners from one piece with minimum 18 inch long legs; seam for rigidity, seal with sealant.

2.3 SHEET METAL FABRICATIONS

A. Copings: Fabricate in minimum 96 inch long, but not exceeding 10 foot long sections. Fabricate joint plates of same thickness as copings. Furnish with continuous cleats to support edge of exernal leg. Miter corners, seal watertight. Fabricate from the following material:
   1. Galvalume Coated Steel: 0.050 inch thick.

B. Skylight Flashings: Fabricate from the following material:

1. Galvalume Coated Steel: 0.050 inch thick.

2.4 ACCESSORIES

A. General: Provide materials and types of fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation.

B. Fasteners: Stainless steel.

C. Primer: Zinc chromate type.

D. Concealed Sealants: Non-curing butyl sealant.

E. Exposed Sealants: ASTM C920; elastomeric sealant, with minimum movement capability as recommended by manufacturer for substrates to be sealed; color to match adjacent material.

F. Plastic Cement: ASTM D4586/D4586M, Type I.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify roof openings, curbs, pipes, sleeves, ducts, and vents through roof are solidly set, reglets in place, and nailing strips located.

B. Verify roofing termination and base flashings are in place, sealed, and secure.

3.2 PREPARATION

A. Install starter and edge strips, and cleats before starting installation.

B. Back paint concealed metal surfaces with protective backing paint to a minimum dry film thickness of 15 mil.

3.3 INSTALLATION

A. General: Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement and to comply with SMACNA's "Architectural Sheet Metal Manual". Use fasteners, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.

B. Secure flashings in place using concealed fasteners, and use exposed fasteners only where permitted..

C. Apply plastic cement compound between metal flashings and felt flashings.

D. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contract surfaces with bituminous coating or by other permanent separation as recommended by fabricator or manufactuers of dissimilar materials.

E. Install exposed sheet metal flashing and trim without excessive oil canning, buckling and tool marks.

F. Install sheet metal flashing and trim true to line and levels indicated. Provide uniform, neat seams with minimum exposeure of solder, welds and elastomeric sealant.

G. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped or bayonet-type expansion provisions cannot be used or would not be sufficiently watertight, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with elastomeric sealant concealed within joints.

H. Copings: Anchor to resist uplift and outward forces according to recommendations in FMG Loss Prevention Data Sheet 1-49.
   1. Interlock exterior bottom edge of coping with continuous cleats anchored to substrate at 16 inch centers.
   2. Anchor interior leg of coping with screw fasteners at washers at 18 inch centers.

I. Roof-Penetration Flashing: Coordinate installation of roof-penetration flashing with installation of roofing and other items penetrating roof.

J. Miscellaneous Trims: Install with concealed fastener. Install work with laps, joints and seams that will be permanently watertight.

K. Fit flashings tight in place; make corners square, surfaces true and straight in planes, and lines accurate to profiles.

END OF SECTION

SECTION 07 72 00

ROOF ACCESSORIES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Roof hatches.

B. Smoke Hatch

C. Snow guards.

1.2 REFERENCE STANDARDS

A. 29 CFR 1910.23 - Ladders; current edition.

1.3 SUBMITTALS

A. Product Data: Manufacturer's data sheets on each product to be used.
   1. Preparation instructions and recommendations.
   2. Storage and handling requirements and recommendations.
   3. Installation methods.
   4. Maintenance requirements.

B. Shop Drawings: Submit detailed layout developed for this project. Show dimensioned location and number for each type of roof accessory.

C. Warranty Documentation:
   1. Submit manufacturer warranty.
   2. Ensure that forms have been completed in Owner's name and registered with manufacturer.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.

B. Store products under cover and elevated above grade.

1.5 WARRANTY

A. Correct defective Work within a five year period after Date of Substantial Completion.

PART 2 PRODUCTS

2.1 ROOF HATCHES

A. Manufacturers - Roof Hatches:
   1. Babcock-Davis; ThermalMAX: www.babcockdavis.com/sle.
   2. Bilco Company, Type TB: www.bilco.com/sle.

B. Manufacturers - Smoke and Heat Vents:
   1. Colt AXS 140 combined AOV smoke ventilator and roof access hatch. provide guardrails similar to roof hatch..

C. Roof Hatches, General: Factory-assembled steel frame and cover, complete with operating and release hardware.
   1. Style: Provide flat metal covers unless otherwise indicated.
   2. Mounting: Provide frames and curbs suitable for mounting on standing seam metal roofing.
   3. Thermally Broken Hatches: Added insulation to frame and cover; available in all manufacturer's standard, single leaf sizes; special sizes available upon request
   4. Size(s): As indicated on drawings; single-leaf style unless indicated as double-leaf.

D. Frames/Curbs: One-piece curb and frame with integral cap flashing to receive roof flashings; extended bottom flange to suit mounting.
   1. Material: Galvanized steel, 14 gage, 0.0747 inch thick.
   2. Finish: Factory prime paint.
   3. Insulation: Manufacturer's standard; 1 inch rigid glass fiber, located on outside face of curb.
   4. Curb Height: 12 inches from finished surface of roof, minimum.

E. Metal Covers: Flush, insulated, hollow metal construction.
   1. Capable of supporting 40 psf live load.
   2. Material: Galvanized steel; outer cover 14 gage, 0.0747 inch thick, liner 22 gage, 0.03 inch thick.
   3. Finish: Factory prime paint.
   4. Insulation: Manufacturer's standard 1 inch rigid insulation.

F. Safety Railing System: Manufacturer's standard accessory safety rail system mounted directly to curb.
   1. Comply with 29 CFR 1910.23, with a safety factor of two.
   2. Manufacturers:
      a. Keehatch https://simplifiedsafety.com/safety-railing/roofhatch-guardrail/ galvanized with gate.

G. Hardware: Type 316 stainless steel, unless otherwise indicated or required by manufacturer.
   1. Lifting Mechanisms: Compression or torsion spring operator with shock absorbers that automatically opens upon release of latch; capable of lifting covers despite 10 psf load.
   2. Hinges: Heavy duty pintle type.
   3. Hold open arm with vinyl-coated handle for manual release.
   4. Latch: Upon closing, engage latch automatically and reset manual release.
   5. Manual Release: Pull handle on interior.
   6. Locking: Padlock hasp on interior.

2.2 SNOW GUARDS

A. Fence Type Snow Guard: Continuous snow guard; manufacturer's standard pipe, bar, channel, or solid rod, set in brackets or posts, with optional plates and optional metal trim to match roof.
   1. Brackets: Zinc plated steel.
   2. Pipe or Square Tube: Aluminum, mill finish.
      a. Sleeve Couplings: As recommended by manufacturer.
      b. End Collars and Caps: Metal to match.
   3. Manufacturers:
      a. https://www.rockymountainsnowguards.com/products/s5-blizzard-ii-fence-style-snow-guard-bracket.

PART 3 EXECUTION

3.1 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.

B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 INSTALLATION

A. Install in accordance with manufacturer's instructions, in manner that maintains roofing weather integrity. Anchor roof accessories securely in place and capable of resisting forces specified. Use fasteners, separators, sealants, and other miscellaneous items as required for completing roof accessory installation. Install roof accessories to resist exposure to weather without failing, rattling, leaking, and fastener disengagement.

B. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.
   1. Underlayment: Where installing exposed-to-view components of roof accessories directly on cementitious or wood substrates, install a course of felt underlayment and cover with a slip sheet, or install a course of polyethylene underlayment.
   2. Bed flanges in thick coat of asphalt roofing cement where required by roof accessory manufacturers for waterproof performance.

C. Install roof accessories level, plumb, true to line and elevation, and without warping, jogs in alignment, excessive oil canning, buckling, or tool marks.

D. Seal joints with elastomeric sealant as required by manufacturer of roof accessories.

3.4 CLEANING

A. Clean installed work to like-new condition.

3.5 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Date of Substantial Completion.

END OF SECTION

SECTION 07 84 00

FIRESTOPPING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Firestopping systems.

B. Firestopping of all joints and penetrations in fire-resistance rated and smoke-resistant assemblies, whether indicated on drawings or not, and other openings indicated.

1.2 REFERENCE STANDARDS

A. ASTM E1966 - Standard Test Method for Fire Resistive Joint Systems; 2007 (Reapproved 2011).

B. ASTM E2307 - Standard Test Method for Determining Fire Resistance of Perimeter Fire Barriers Using Intermediate-Scale, Multi-story Test Apparatus; 2015b.

C. ASTM E2837 - Standard Test Method for Determining the Fire Resistance of Continuity Head-of-Wall Joint Systems Installed Between Rated Wall Assemblies and Nonrated Horizontal Assemblies; 2013.

D. ITS (DIR) - Directory of Listed Products; current edition.

E. FM 4991 - Approval Standard for Firestop Contractors; 2013.

F. FM (AG) - FM Approval Guide; current edition.

G. UL 2079 - Standard for Tests for Fire Resistance of Building Joint Systems; Current Edition, Including All Revisions.

H. UL (DIR) - Online Certifications Directory; current listings at database.ul.com.

I. UL (FRD) - Fire Resistance Directory; current edition.

1.3 SUBMITTALS

A. Schedule of Firestopping: List each type of penetration, fire rating of the penetrated assembly, and firestopping test or design number.

B. Product Data: Provide data on product characteristics, performance ratings, and limitations.

C. Manufacturer's Installation Instructions: Indicate preparation and installation instructions.

D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

E. Certificate from authority having jurisdiction indicating approval of materials used.

F. Installer Qualification: Submit qualification statements for installing mechanics.

1.4 QUALITY ASSURANCE

A. Fire Testing: Provide firestopping assemblies of designs that provide the scheduled fire ratings when tested in accordance with methods indicated.
   1. Listing in UL (FRD), FM (AG), or ITS (DIR) will be considered as constituting an acceptable test report.
   2. Valid evaluation report published by ICC Evaluation Service, Inc. (ICC-ES) at www.icc-es.org will be considered as constituting an acceptable test report.
   3. Submission of actual test reports is required for assemblies for which none of the above substantiation exists.

B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

C. Installer Qualifications: Company specializing in performing the work of this section and:
   1. Approved by Factory Mutual Research Corporation under FM 4991, or meeting any two of the following requirements:.
   2. With minimum 3 years documented experience installing work of this type.
   3. Able to show at least 5 satisfactorily completed projects of comparable size and type.
   4. Licensed by authority having jurisdiction.

1.5 PERFORMANCE REQUIREMENTS

A. General: For penetrations through fire-resistance-rated constructions, including both empty openings and openings containing penetration items, provide through-penetration firestop systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated.

B. Rated Systems: Provide through-penetration firestop systems with the following ratings determined per ASTM E 814 or UL 1479, with a minimum positive pressure differential of 0.01 inch of water:
   1. F-Rated Systems: Provide through-penetration firestop systems with F-ratings indicated, but not less than that equaling or exceeding fire-resistance rating of constructions penetrated.
   2. T-Rated Systems: For the following conditions, provide through-penetration firestop systems with T-ratings indicated, as well as F-ratings, where systems protect penetrating items exposed to potential contact with adjacent materials in occupiable floor areas:
      a. Penetrations located outside wall cavities.
      b. Penetrations located outside fire-resistance-rated shaft enclosures.

C. For through-penetration firestop systems exposed to view, traffic, moisture, and physical damage, provide products that, after curing, do not deteriorate when exposed to these conditions both during and after construction.
   1. For piping penetrations for plumbing and wet-pipe sprinkler systems, provide moisture-resistant through-penetration firestop systems.
   2. For floor penetrations with annular spaces exceeding 4 inches in width and exposed to possible loading and traffic, provide firestop systems capable of supporting floor loads involved, either by installing floor plates or by other means.
   3. For penetrations involving insulated piping, provide through-penetration firestop systems not requiring removal of insulation.

D. For through-penetration firestop systems exposed to view, provide products with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined bu ASTM E84.

1.6 FIELD CONDITIONS

A. Comply with firestopping manufacturer's recommendations for temperature and conditions during and after installation. Maintain minimum temperature before, during, and for 3 days after installation of materials.

PART 2 PRODUCTS

2.1 FIRESTOPPING - GENERAL REQUIREMENTS

A. Primers, Sleeves, Forms, Insulation, Packing, Stuffing, and Accessories: Type required for tested assembly design.

2.2 FIRESTOPPING ASSEMBLY REQUIREMENTS

A. Perimeter Fire Containment Firestopping: Use any system that has been tested according to ASTM E2307 to have fire resistance F Rating equal to required fire rating of the floor assembly.
   1. Movement: In addition, provide systems that have been tested to show movement capability as required.
   2. Temperature Rise: In addition, provide systems that have been tested to show T Rating as required.

B. Head-of-Wall Firestopping at Joints Between Non-Rated Floor and Fire-Rated Wall: Use any system that has been tested according to ASTM E2837 to have fire resistance F Rating equal to required fire rating of floor or wall, whichever is greater.
   1. Movement: In addition, provide systems that have been tested to show movement capability as required.

C. Floor-to-Floor, Wall-to-Wall, and Wall-to-Floor Joints, Except Perimeter, Where Both Are Fire-Rated: Use any system that has been tested according to ASTM E1966 or UL 2079 to have fire resistance F Rating equal to required fire rating of the assembly in which the joint occurs.
   1. Movement: In addition, provide systems that have been tested to show movement capability as required.
   2. Listing by FM (AG), ITS (DIR), UL (DIR), or UL (FRD) in their certification directories will be considered evidence of successful testing.

2.3 FIRESTOPPING SYSTEMS

A. Firestopping: Any material meeting requirements.

1. Fire Ratings: Penetrations through fire-rated assemblies shall be protected by an approved penetration firestop system installed as tested in accordance with ASTM E 814 or UL 1479, with a minimum positive pressure differential of 0.01 inch of water, and as follows:
    a. Wall Penetrations: Shall have an F rating of not less than the required fire-resistance rating of the wall penetrated.
    b. Horizontal Assembly Penetrations: Shall have an F Rating/T Rating not less than 1 hour but not less than the required rating of the floor penetrated.
        1) Exceptions:
            (a) Floor penetrations contained and located within the cavity of a wall above the floor or below the floor do not require a T rating.
            (b) Floor penetrations by floor drains, tub drains, or shower drains contained and located within the concealed space of a horizontal assembly do not require a T rating.
    c. Membrane Penetrations: Membrane penetrations by boxes other than electrical boxes, provided such penetrating items and the annular space between the wall membrane and the box, are protected by an approved membrane penetration firestopping shall have an F and T rating of not less than the required fire-resistance rating of the wall penetrated and shall be installed in accordance with their listing.

2.4 MATERIALS

A. Provide all materials required to comply with approved firestopping systems.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify openings are ready to receive the work of this section.

3.2 PREPARATION

A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other matter that could adversely affect bond of firestopping material.

B. Remove incompatible materials that could adversely affect bond.

3.3 INSTALLATION

A. Install materials in manner described in fire test report and in accordance with manufacturer's instructions, completely closing openings.

B. Install forming/damming/backing materials and other accessories of types requried to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.
    1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of firestop systems.

C. Install fill materials for firestop systems by proven techniques to produce the following results:
    1. Fill voids and cavities formed by openings, forming materials, accessories, and penetrating items as required to achieve fire-resistance ratings indicated.
    2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
    3. For fill materials that will remain exposed after completing Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

D. Identification: Identify through-penetration firestop systems with preprinted metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches of edge of the firestop systems so that labels will be visible to anyone seeking to remove penetrating items or firestop systems. Use mechanical fasteners for metal labels. Include the following information on labels:
    1. The words "Warning - Through-Penetration Firestop System- Do Not Disturb. Notify Building Management of Any Damage."
    2. Through-penetration firestop system designation of applicable testing and inspecting agency.
    3. Date of installation.
    4. Through-penetration firestop system manufacturer's name.
    5. Installer's name.

3.4 CLEANING

A. Clean adjacent surfaces of firestopping materials.

3.5 PROTECTION

A. Protect adjacent surfaces from damage by material installation.

END OF SECTION

SECTION 07 92 00

JOINT SEALANTS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Nonsag gunnable joint sealants.

B. Self-leveling pourable joint sealants.

C. Joint backings and accessories.

1.2 RELATED REQUIREMENTS

1.3 REFERENCE STANDARDS

A. ASTM C834 - Standard Specification for Latex Sealants; 2014.

B. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2014a.

C. ASTM C1193 - Standard Guide for Use of Joint Sealants; 2016.

D. ASTM C1248 - Standard Test Method for Staining of Porous Substrate by Joint Sealants; 2008 (Reapproved 2012).

E. ASTM C1311 - Standard Specification for Solvent Release Sealants; 2014.

F. ASTM C1521 - Standard Practice for Evaluating Adhesion of Installed Weatherproofing Sealant Joints; 2013.

1.4 SUBMITTALS

A. Product Data for Sealants: Submit manufacturer's technical data sheets for each product to be used, that includes the following.
   1. Physical characteristics, including movement capability, VOC content, hardness, cure time, and color availability.
   2. List of backing materials approved for use with the specific product.
   3. Substrates that product is known to satisfactorily adhere to and with which it is compatible.
   4. Substrates the product should not be used on.

B. Color Cards for Selection: Where sealant color is not specified, submit manufacturer's color cards showing standard colors available for selection.

C. Preinstallation Field Adhesion Test Plan: Submit at least two weeks prior to start of installation.

D. Preinstallation Field Adhesion Test Reports: Submit filled out Preinstallation Field Adhesion Test Reports log within 10 days after completion of tests; include bagged test samples and photographic records.

1.5 QUALITY ASSURANCE

A. Preinstallation Field Adhesion Test Plan: Include destructive field adhesion testing of one sample of each combination of sealant type and substrate, except interior acrylic latex sealants, and include the following for each tested sample.
   1. Identification of testing agency.
   2. Preinstallation Field Adhesion Test Log Form: Include the following data fields, with known information filled out.
      a. Test date.
      b. Copy of test method documents.
      c. Age of sealant upon date of testing.
      d. Test results, modeled after the sample form in the test method document.
      e. Indicate use of photographic record of test.

B. Field Adhesion Test Procedures:
   1. Allow sealants to fully cure as recommended by manufacturer before testing.
   2. Have a copy of the test method document available during tests.
   3. Record the type of failure that occurred, other information required by test method, and the information required on the Field Quality Control Log.

4. When performing destructive tests, also inspect the opened joint for proper installation characteristics recommended by manufacturer, and report any deficiencies.
5. Deliver the samples removed during destructive tests in separate sealed plastic bags, identified with project, location, test date, and test results, to Owner.
6. If any combination of sealant type and substrate does not show evidence of minimum adhesion or shows cohesion failure before minimum adhesion, report results to Architect.

C. Destructive Field Adhesion Test: Test for adhesion in accordance with ASTM C1521, using Destructive Tail Procedure.
1. Sample: At least 18 inch long.
2. Minimum Elongation Without Adhesive Failure: Consider the tail at rest, not under any elongation stress; multiply the stated movement capability of the sealant in percent by two; then multiply 1 inch by that percentage; if adhesion failure occurs before the "1 inch mark" is that distance from the substrate, the test has failed.
3. If either adhesive or cohesive failure occurs prior to minimum elongation, take necessary measures to correct conditions and re-test; record each modification to products or installation procedures.

1.6 WARRANTY

A. Correct defective work within a five year period after Date of Substantial Completion.

B. Warranty: Include coverage for installed sealants and accessories that fail to achieve watertight seal , exhibit loss of adhesion or cohesion, or do not cure.

PART 2 PRODUCTS

2.1 JOINT SEALANT APPLICATIONS

A. Scope:
1. Exterior Joints: Seal open joints, whether or not the joint is indicated on the drawings, unless specifically indicated not to be sealed. Exterior joints to be sealed include, but are not limited to, the following items.
   a. Wall expansion and control joints.
   b. Joints between door, window, and other frames and adjacent construction.
   c. Joints between different exposed materials.
   d. Openings below ledge angles in masonry.
   e. Other joints indicated below.
2. Interior Joints: Do not seal interior joints unless specifically indicated to be sealed. Interior joints to be sealed include, but are not limited to, the following items.
   a. Joints between door, window, and other frames and adjacent construction.
   b. Joints in concrete floors.
   c. Expansion joints in finish flooring.
   d. Other joints indicated below.
3. Do not seal the following types of joints.
   a. Intentional weepholes in masonry.
   b. Joints within rainscreen system.
   c. Joints indicated to be treated with manufactured expansion joint cover or some other type of sealing device.
   d. Joints where sealant is specified to be provided by manufacturer of product to be sealed.
   e. Joints where installation of sealant is specified in another section.
   f. Joints between suspended panel ceilings/grid and walls.

B. Exterior Joints: Use non-sag non-staining silicone sealant, unless otherwise indicated.
1. Lap Joints in Sheet Metal Fabrications: Butyl rubber, non-curing; includes the following:
   a. Thresholds.
   b. Sheet metal flashings and trim joints, including scuppers and gutters.
2. Control and Expansion Joints in Concrete Paving: Self-leveling polyurethane "traffic-grade" sealant.

C. Interior Joints: Use non-sag polyurethane sealant, unless otherwise indicated.
1. Wall and Ceiling Joints in Non-Wet Areas: Acrylic emulsion latex sealant.
2. Joints between Fixtures in Wet Areas and Floors, Walls, and Ceilings: Mildew-resistant silicone sealant; white.
3. In Sound-Rated Assemblies: Acrylic emulsion latex sealant.

4. Other Floor Joints: Self-leveling polyurethane "traffic-grade" sealant.

D. Interior Wet Areas: Bathrooms, restrooms, kitchens, food service areas, and food processing areas; fixtures in wet areas include plumbing fixtures, food service equipment, countertops, cabinets, and other similar items.

E. Sound-Rated Assemblies: Walls and ceilings identified as "STC-rated", "sound-rated", or "acoustical".

2.2 NONSAG JOINT SEALANTS

A. Non-Staining Silicone Sealant: ASTM C920, Grade NS, Uses M and A; not expected to withstand continuous water immersion or traffic.
1. Movement Capability: Plus and minus 50 percent, minimum.
2. Non-Staining To Porous Stone: Non-staining to light-colored natural stone when tested in accordance with ASTM C1248.
3. Color: To be selected by Architect from manufacturer's standard range.
4. Products:
a. Dow Corning Corporation; 795 Silicone Building Sealant: www.dowcorning.com/construction/sle.
b. Sika Corporation; Sikasil WS-290/WS-295: www.usa-sika.com.
c. Tremco, Spectrem 1/Spectrem 2/Spectrem 4-TS: www.tremcosealants.com.
5. Applications:
a. Exterior joints unless otherwise indicated, including, but not limited to, the following:
1) Exterior vertical and horizontal nontraffic joints in cast-in-place concrete.
2) Exterior vertical and horizontal nontraffic joints between plant-precast architectural concrete units.
3) Exterior vertical control and expansion joints in unit masonry.
4) Exterior horizontal pressure-relieving joints in unit masonry.
5) Exterior joints between flashing materials and unit masonry.
6) Exterior butt joints between metal panels.
7) Exterior perimeter joints between different materials listed above.

B. Mildew-Resistant Silicone Sealant: ASTM C920, Grade NS, Uses M and A; single component, mildew resistant; not expected to withstand continuous water immersion or traffic.
1. Color: White.
2. Products:
a. Dow Corning Corporation, 786 Mildew Resistant.
b. Pecora Corporation; 898NST Sanitary Silicone Sealant - Class 50: www.pecora.com.
c. Sika Corporation; Sikasil GP: www.usa-sika.com.
d. Tremco; Tremsil 200: www.tremcosealants.com.
3. Applications:
a. Interior joints between plumbing fixtures and adjoining walls, floors, and counters.
b. Joints between counters and adjoining walls and floors at bathrooms, kitchens and other wet areas.

C. Polyurethane Sealant: ASTM C920, Grade NS, Uses M and A; single or multi-component; not expected to withstand continuous water immersion or traffic.
1. Color: Match adjacent finished surfaces.
2. Manufacturers:
a. BASF; MasterSeal NP1/NP2.
b. Pecora Corporation; DynaTrol I-XL/DynaTrol II.
c. Sika Corporation; Sikaflex-1a/Sikaflex-2c: www.usa-sika.com.
d. Tremco; Vulkem 116/Dymeric 240: www.tremcosealants.com
3. Applications:
a. Vertical joints on exposed surfaces of interior unit masonry and concrete walls and partitions.
b. Interior perimeter joints of exterior openings.
c. Joints between top of non-load bearing unit masonry walls and underside of cast-in-place concrete slabs and beams.

D. Acrylic Emulsion Latex: Water-based; ASTM C834, single component, non-staining, non-bleeding, non-sagging; not intended for exterior use.
1. Color: To be selected by Architect from manufacturer's standard range.
2. Products:

a. Pecora, AC-20 + Silicone: www. pecora.com.
b. Sherwin-Williams Company; 950A Siliconized Acrylic Latex Caulk: www.sherwin-williams.com.
c. Tremco, Tremflex 834: www.tremcosealants.com.

3. Applications:
   a. Perimeter joints between interior wall surfaces and frames of interior doors, windows and elevator entrances.

E. Non-Curing Butyl Sealant: Solvent-based; ASTM C1311; single component, non-sag, non-skinning, non-hardening, non-bleeding; vapor-impermeable; intended for fully concealed applications.
1. Applications:
   a. Thresholds.

2.3 SELF-LEVELING SEALANTS

A. Self-Leveling Polyurethane Sealant: ASTM C920, Grade P, Uses M and A; single or multi-component; explicitly approved by manufacturer for traffic exposure; not expected to withstand continuous water immersion .
1. Movement Capability: Plus and minus 25 percent, minimum.
2. Color: To be selected by Architect from manufacturer's standard range.
3. Products:
   a. Pecora Coprporation, Urexpan NR-200: www.pecora.com
   b. Sika Corporation; Sikaflex-1c SL: www.usa-sika.com.
   c. Tremco Sealants; THC-900/THC-901: www.tremcosealants.com.
4. Applications:
   a. Exterior horizontal nontraffic and traffic isolation and contraction joints in cast-in-place concrete slabs.
   b. Exterior control and expansion joints in horizontal traffic surfaces of brick pavers, ceramic tile, stone paving units and similar materials unless otherwise specified in individual specification sections.
   c. Interior expansion, control, contraction, and isolation joints in horizontal traffic surfaces in concrete, ceramic tile, dimension stone, dimension stone tile and brick, unless otherwise specified in individual specification sections.

2.4 ACCESSORIES

A. Backer Rod: Cylindrical cellular foam rod with surface that sealant will not adhere to, compatible with specific sealant used, and recommended by backing and sealant manufacturers for specific application.

B. Backing Tape: Self-adhesive polyethylene tape with surface that sealant will not adhere to and recommended by tape and sealant manufacturers for specific application.

C. Primers: Type recommended by sealant manufacturer to suit application; non-staining.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that joints are ready to receive work.

B. Verify that backing materials are compatible with sealants.

C. Verify that backer rods are of the correct size.

D. Preinstallation Adhesion Testing: Install a sample for each test location shown in the test plan.
1. Test each sample as specified in PART 1 under QUALITY ASSURANCE article.
2. Notify Architect of date and time that tests will be performed, at least 7 days in advance.
3. Record each test on Preinstallation Adhesion Test Log as indicated.
4. If any sample fails, review products and installation procedures, consult manufacturer, or take whatever other measures are necessary to ensure adhesion; re-test in a different location; if unable to obtain satisfactory adhesion, report to Architect.
5. After completion of tests, remove remaining sample material and prepare joint for new sealant installation.

3.2 PREPARATION

A. Remove loose materials and foreign matter that could impair adhesion of sealant.

1. Clean porous joint substate surfaces by brushing, grinding, blast cleaning, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include, but are not limited to, the following:
   a. Concrete.
   b. Masonry.
   c. Unglazed surfaces of ceramic tile.
2. Clean nonporous surfaces surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include, but are not limited to, the following:
   a. Metal.
   b. Porcelain enamel.
   c. Glazed surfaces of ceramic tile.

B. Clean joints, and prime as necessary, in accordance with manufacturer's instructions.

C. Perform preparation in accordance with manufacturer's instructions and ASTM C1193.

D. Mask elements and surfaces adjacent to joints from damage and disfigurement due to sealant work; be aware that sealant drips and smears may not be completely removable.

3.3 INSTALLATION

A. Perform work in accordance with sealant manufacturer's requirements for preparation of surfaces and material installation instructions.

B. Perform installation in accordance with ASTM C1193.

C. Precast Architectural Concrete Panel Joints: Install two-stage sealant joints and expansion joints in accordance with PCI Architectural Precast Concrete Design Manual, Section 4.7 and as detailed on drawings.

D. Measure joint dimensions and size joint backers to achieve width-to-depth ratio, neck dimension, and surface bond area as recommended by manufacturer, except where specific dimensions are indicated.

E. Install bond breaker backing tape where backer rod cannot be used.

F. Install sealant free of air pockets, foreign embedded matter, ridges, and sags, and without getting sealant on adjacent surfaces.

G. Do not install sealant when ambient temperature is outside manufacturer's recommended temperature range, or will be outside that range during the entire curing period, unless manufacturer's approval is obtained and instructions are followed.

H. Nonsag Sealants: Tool surface concave, unless otherwise indicated; remove masking tape immediately after tooling sealant surface.

I. Concrete Floor Joint Filler: After full cure, shave joint filler flush with top of concrete slab.

END OF SECTION

SECTION 08 11 13

HOLLOW METAL DOORS AND FRAMES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Non-fire-rated hollow metal doors and frames.

B. Fire-rated hollow metal doors and frames.

C. Thermally insulated hollow metal doors with frames.

D. Hollow metal borrowed lites glazing frames.

1.2 RELATED REQUIREMENTS

A. Section 08 71 00 - Door Hardware.

B. Section 08 80 00 - Glazing: Glass for doors and borrowed lites.

1.3 REFERENCE STANDARDS

A. ANSI/SDI A250.8 - Specifications for Standard Steel Doors and Frames (SDI-100); 2014.

B. ANSI/SDI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames; 2011.

C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.

D. ITS (DIR) - Directory of Listed Products; current edition.

E. NAAMM HMMA 840 - Guide Specifications for Installation and Storage of Hollow Metal Doors and Frames; 2007.

F. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2016.

G. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; 2012.

H. UL (DIR) - Online Certifications Directory; current listings at database.ul.com.

I. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies; Current Edition, Including All Revisions.

1.4 SUBMITTALS

A. Product Data: Materials and details of design and construction, hardware locations, reinforcement type and locations, anchorage and fastening methods, and finishes; and one copy of referenced standards/guidelines.

B. Shop Drawings: Details of each opening, showing elevations, glazing, frame profiles, and any indicated finish requirements.

1.5 QUALITY ASSURANCE

A. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to UL 10C.

B. Fire-Rated, Borrowed-Light Frame Assemblies: Assemblies complying with NFPA 80that are listed and labeled, by a testing and inspecting agency acceptance to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 257 or UL 9. Label each individual glazed lite.

C. Smoke-Control Door Assemblies: Comply with NFPA 105 or UL 1784.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Comply with NAAMM HMMA 840 or ANSI/SDI A250.8 (SDI-100) in accordance with specified requirements.

B. Protect with resilient packaging; avoid humidity build-up under coverings; prevent corrosion and adverse effects on factory applied painted finish.

PART 2 PRODUCTS

2.1 DESIGN CRITERIA

A. Combined Requirements: If a particular door and frame unit is indicated to comply with more than one type of requirement, comply with the specified requirements for each type; for instance, an exterior door that is also indicated as being sound-rated must comply with the requirements specified for exterior doors and for sound-rated doors; where two requirements conflict, comply with the most stringent.

2.2 HOLLOW METAL DOORS

A. Exterior Doors: Thermally insulated.
   1. Grade: ANSI A250.8 Level 4, physical performance Level A, Model 2, seamless (continuously welded with seams dressed smooth).
   2. Core Material: Mineral fiberboard insulation with 22-guage vertical steel stiffener ribs, welded at both ends.
   3. Door Thickness: 1-3/4 inch, nominal.
   4. Top Closures: Inverted steel channel closure, installed flush, filled and finished smooth
   5. Door edges shall be fabricated using beveled edges on hinge and lock sides.
   6. All door seams shall have 1-inch welds every 6-inches on center, ground and finished smooth.
   7. Insulating Value: R-value of not less than 6.0 deg F x h x sq. ft./Btu when tested according to ASTM C 1363.
   8. Weatherstripping: Refer to Section 08 71 00.
   9. Door Finish: Factory primed for field finishing.

B. Interior Doors, Non-Fire Rated:
   1. Grade: ANSI A250.8 Level 3, physical performance Level A, Model 2, seamless.
   2. Core Material: Sound insulation core with 22-guage vertical steel stiffener ribs, welded at both ends.
   3. Door Thickness: 1-3/4 inch, nominal.
   4. Door Finish: Factory primed for field finishing.

C. Fire-Rated Doors:
   1. Grade: ANSI A250.8 Level 3, physical performance Level A, Model 2, seamless.
   2. Fire Rating: As indicated on Door Schedule, tested in accordance with UL 10C and NFPA 252 ("positive pressure fire tests").
      a. Provide units listed and labeled by UL (DIR) or ITS (DIR).
      b. Attach fire rating label to each fire rated unit.
   3. Core Material: As required to provide fire-protection ratings indicated with 22-guage vertical steel stiffener ribs, welded at both ends.
   4. Door Thickness: 1-3/4 inch, nominal.
   5. Door Finish: Factory primed for field finishing.

2.3 HOLLOW METAL FRAMES

A. Comply with standards and/or custom guidelines as indicated for corresponding door in accordance with applicable door frame requirements.

B. Exterior Door Frames: Full profile/continuously welded type. “Timely” and “Redi-frames” are prohibited.
   1. Galvanizing: Components hot-dipped zinc-iron alloy-coated (galvannealed) in accordance with ASTM A653/A653M, with A60/ZF180 coating.
   2. Frame Metal Thickness: 14 gage, 0.067 inch, minimum.
   3. Weatherstripping: Integral, recessed into door edge or frame.

C. Interior Door Frames, Non-Fire Rated: Fully welded type. “Timely” and “Redi-frames” are prohibited.
   1. Frame Metal Thickness: 16 gage, 0.053 inch, minimum.

D. Door Frames, Fire-Rated: Fully welded type. “Timely” and “Redi-frames” are prohibited.
   1. Fire Rating: Same as door, labeled.
   2. Frame Metal Thickness: 16 gage, 0.053 inch, minimum.

E. Borrowed Lites Glazing Frames: Construction and face dimensions to match door frames, and as indicated on drawings.

F. Provide mortar guard boxes for hardware cut-outs in frames to be installed in masonry or to be grouted.

G. Provide 6" styrofoam block with same profile as frame so as not to allow grout in the bottom 6" of frame.

H. Frames in Masonry Walls: Size to suit masonry coursing with head member 4 inches high to fill opening without cutting masonry units.

I. Frame corner joints shall be mitered, interlocked, welded and ground smooth.

J. Doors shall be template reinforced for hardware 7 ga. on hinges, 12 ga. everywhere else.

2.4 ACCESSORIES

A. Glazing: As specified in Section 08 80 00, factory installed.

B. Grout for Frames: Portland cement grout with maximum 4 inch slump for hand troweling; thinner pumpable grout is prohibited.
   1. Provide 6 inch polystyrene rigid insulation fillers cut to frame profile installed in bottoms of frames to keep grout out of bottom 6 inches of frame.

C. Sound Batt Insulation for Frames: At all interior frames in metal framed walls, provide acoustic batt insulation as specified in Section 09 21 16.

D. SPF Insulation for Frames: Provide SPF insulation as specified in Section 07 21 19 Spray Polyurethane Insulation Air Barrier.

E. Silencers: Resilient rubber, fitted into drilled hole; 3 on strike side of single door, 3 on center mullion of pairs, and 2 on head of pairs without center mullions.

F. Ceiling Struts: Minimum 1/4 inch thick by 1 inch wide steel.

G. Temporary Frame Spreaders: Provide for factory- or shop-assembled frames.

H. Jamb Anchors:
   1. Masonry Type: Adjustable strap-and stirrup or T-shaped anchors to suit frame size, not less than 0.042 inch thick, with corrugated or perforated straps not less than 2 inches wide by 10 inches long; or wire anchors not less than 0.177 inch thick.
   2. Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than 0.042 inch thick.
   3. Postinstalled Expansion Type for In-Place Concrete or Masonry: Minimum 3/8 inch diameter bolts with expansion shields or inserts. Provide pipe spacer from frame to wall, with throat reinforcement plate, welded to frame at each anchor location.

I. Floor Anchors: Formed from same material as frames, not less than 0.042 inch thick, and as follows:
   1. Monolithic Concrete Slabs: Clip-type anchors, with extension clips, allowing not less than 2-inch hieght adjustment. Terminate bottom of frames at finish floor surface.

2.5 STOPS AND MOLDINGS

A. Moldings for Glazed Lites in Doors: Minimum 0.032 inch thick, same material as door face sheet.

B. Fixed Frame Moldings: Formed integral with hollow metal frames, a minimum of 5/8 inch high unless otherwise indicated.

C. Loose Stops for Glazed Lites in Frames: Minimum 0.032 inch thick, same material as frames.

2.6 FINISHES

A. Primer: Rust-inhibiting, complying with ANSI/SDI A250.10, door manufacturer's standard.

B. Automotive Undercoating: Provide a field applied, non-flammable, low-VOC automotive undercoat layer to the inside of all frames that will be in contact with anti-freezing agents in plaster or mortar.

2.7 FABRICATION

A. Tolerances: Fabricate hollow metal work to tolerances indicated in SDI 117.

B. Hollow Metal Doors:
   1. Exterior Doors: Provide weep-hole openings in bottom of exterior doors. Seal joints in top edges of doors against water penetration.
   2. Glazed Lites: Factory cut openings in door.

3. Astragals: Provide overlapping astragal on one leaf of pairs of doors where required by NFPA 80 for fire-performance rating or where indicated.
4. Steel-Stiffened Door Cores: Provide minimum thickness 0.026 inch, steel vertical stiffeners of same material as face sheets extending full-door height, with vertical webs spaced not more than 6 inches apart. Spot weld to face sheets no more than 5 inches o.c. Fill spaces between stiffeners with glass- or mineral-fiber insulation.

C. Hollow Metal Frames: Where frames are fabricated in sections, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.
1. Welded Frames: Weld flush face joints continuously; grind, fill, dress and make smooth, flush, and invisible.
2. Sidelight and Transom Bar Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by butt welding.
3. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indiated.
4. Grout Guards: Weld guards to frame at back of hardware mortises in frames to be grouted.
5. Floor Anchors: Weld anchors to bottom of jambs and mullions with at least four spot welds per anchor.
6. Jamb Anchors: Provide number and spacigin of anchor as follows:
    a. Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:
        1) Two anchors per jamb up to 60 inches high.
        2) Three anchors per jamb from 60 to 90 inches high.
        3) Four anchors per jamb from 90 to 96 inches high.
        4) Five anchors per jamb plus 1 additional anchor per jamb for each 24 inches or fraction thereof above 96 inches high.
7. Door Silencers: Except on weather-stripped doors, drill stips to receive door silencers.
    a. Single-Door Frames: Three door silencers.
    b. Double-Door Frames: Two door silencers.

D. Hardware Preparation: Factory prepare hollow metal work to receive templated mortised hardware according to the Door Hardware Schedule and templates furnished as specified in Division 08 Section "Door Hardware".
1. Locate hardware as indicated, or if not indicated, according to ANSI/SDI A250.8.
2. Reinforce doors and frames to receive nontemplated, mortised and surface-mounted door hardware.
3. Comply with applicable requirements in ANSI/SDI A250.6 and ANSI/DHI A115 Series specifications for preparation of hollow metal work for hardware.
4. Coordinate locations of conduit and wiring boxes for electical connections with Division 26 electrical sections.

E. Stops and Moldings: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with butted or mitered hairline joints.
1. Single Glazed Lites: Provide fixed stops and moldings welded on secure side of hollow metal work.
2. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames.
3. Provide loose stops and moldings on inside of hollow metal work.
4. Coordinate rabbet width between fixed and removeable stops with type of glazing and type of installation indicated.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that opening sizes and tolerances are acceptable.

C. Verify that finished walls are in plane to ensure proper door alignment.

3.2 INSTALLATION

A. Install doors and frames in accordance with manufacturer's instructions and related requirements of specified door and frame standards or custom guidelines indicated.

B. Install fire rated units in accordance with NFPA 80.

C. Coordinate frame anchor placement with wall construction.

D. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.

E. Grout frames in masonry construction, using hand trowel methods; brace frames so that pressure of grout before setting will not deform frames.

F. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with postinstalled expansion anchors.

G. Metal-Stud Partitions: Solidly pack batt insulation behind frames.

H. Masonry Walls: Coordinate installation of frames to allow for solidly filling space betwwen frames and masonry with grout.

I. Ceiling Struts: Extend struts vertically from top of frame at each jamb to overhead structural support at each jamb. Bend top of struts to provide flush contact for securing to supporting construction. Provide adjustable wedged or bolted anchorage to frame jamb members.

J. Hollow Metal Doors: Fit hollow metal doors accurately in frames, within clearances specified below. Shim as necessary.

K. Glazing: Comply with installation requirements in Division 08 Section "Glazing" and with hollow metal manufacturer's written instructions.
   1. Secure stops with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches o.c. and not more than 2 inches o.c. from each corner.

L. Coordinate installation of hardware.

M. Comply with glazing installation requirements of Section 08 80 00.

3.3 TOLERANCES

A. Clearances Between Door and Frame: Comply with related requirements of specified door and frame standards or custom guidelines indicated.

B. Maximum Diagonal Distortion: 1/16 in measured with straight edge, corner to corner.

3.4 ADJUSTING

A. Adjust for smooth and balanced door movement.

B. Prime Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.

C. Metallic-Coated Surfaces: Clean abraded areas and repair with glavanizing repair paint according to manufacturer's written instructions.

END OF SECTION

SECTION 08 14 16

FLUSH WOOD DOORS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Flush wood doors; flush and flush glazed configuration; fire-rated and non-rated.

1.2 RELATED REQUIREMENTS

A. Section 08 11 13 - Hollow Metal Doors and Frames.

B. Section 08 71 00 - Door Hardware.

C. Section 08 80 00 - Glazing.

1.3 REFERENCE STANDARDS

A. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards; 2014.

B. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2016.

C. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies; Current Edition, Including All Revisions.

1.4 SUBMITTALS

A. Product Data: Indicate door core materials and construction; veneer species, type and characteristics.

B. Shop Drawings: Show doors and frames, elevations, sizes, types, swings, undercuts, beveling, blocking for hardware, factory machining, factory finishing, cutouts for glazing and other details.

C. Specimen warranty.

D. Samples: Submit two samples of door veneer, 12 by 12 inch in size illustrating wood grain, stain color, and sheen.

E. Manufacturer's Installation Instructions: Indicate special installation instructions.

F. Warranty, executed in Owner's name.

1.5 QUALITY ASSURANCE

A. Quality Standard: In addition to requirements specified, comply with AWI's "Architectural Woodwork Quality Standards Illustrated."

1.6 DELIVERY, STORAGE, AND HANDLING

A. Package, deliver and store doors in accordance with specified quality standard.

B. Accept doors on site in manufacturer's packaging. Inspect for damage.

C. Protect doors with resilient packaging sealed with heat shrunk plastic. Do not store in damp or wet areas; or in areas where sunlight might bleach veneer. Seal top and bottom edges with tinted sealer if stored more than one week. Break seal on site to permit ventilation.

1.7 WARRANTY

A. Interior Doors: Provide manufacturer's warranty for the life of the installation.

B. Include coverage for delamination of veneer, warping beyond specified installation tolerances, defective materials, and telegraphing core construction.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Wood Veneer Faced Doors:
   1. Algoma Hardwoods, Inc.
   2. Eggers Industries: www.eggersindustries.com.
   3. Graham Wood Doors: www.grahamdoors.com.

4. Marshfield Door Systems, Inc: www.marshfielddoors.com.

2.2 DOORS

A. Doors:
   1. Quality Standard: Custom Grade, Heavy Duty performance, in accordance with AWI/AWMAC/WI (AWS), unless noted otherwise.
   2. Wood Veneer Faced Doors: 5-ply or 7-ply unless otherwise indicated.

B. Interior Doors: 1-3/4 inches thick unless otherwise indicated; flush construction.
   1. Provide solid core doors at each location.
   2. Fire Rated Doors: Tested to ratings indicated on drawings in accordance with UL 10C - Positive Pressure; Underwriters Laboratories Inc (UL) or Intertek/Warnock Hersey (WHI) labeled without any visible seals when door is open.

2.3 DOOR AND PANEL CORES

A. Non-Rated Solid Core and 20 Minute Rated Doors: Type structural composite lumber core (SCLC), plies and faces as indicated.

B. Fire-Rated Doors: Mineral core type, with fire resistant composite core (FD), plies and faces as indicated above; with core blocking as indicated below:
   1. Blocking: Provide composite blocking with improved screw-holding capability approved for use in door of fire-protection ratings indicated:
      a. 5 inch top rail blocking.
      b. 5 inch bottom rail blocking, in doors indicated to have protection plates.
      c. 5 inch midrail blocking, in doors indicated to have armor plates or exit devices.
   2. Edge Construction: At hinge stiles, provide laminated-edge construction with improved screw-holding capability and split resistance. Comply with specified requirements for exposed edges.

2.4 DOOR FACINGS

A. Veneer Facing for Transparent Finish: Species and cut as indicated on material finish specifications on drawing sheet A602, veneer grade in accordance with quality standard indicated, with with slip match between leaves of veneer, balance match of spliced veneer leaves assembled on door or panel face.
   1. Vertical Edges: Same species as face veneer.
   2. "Pair Match" each pair of doors; "Set Match" pairs of doors within 10 feet of each other when doors are closed.

2.5 DOOR CONSTRUCTION

A. Fabricate doors in accordance with door quality standard specified.

B. Factory machine doors for hardware other than surface-mounted hardware, in accordance with hardware requirements and dimensions.

C. Factory fit doors for frame opening dimensions identified on shop drawings, with edge clearances in accordance with specified quality standard.

D. Provide edge clearances in accordance with the quality standard specified.

2.6 FACTORY FINISHING - WOOD VENEER DOORS

A. Finish work in accordance with AWI/AWMAC/WI (AWS), Section 5 - Finishing for grade specified and as follows:
   1. Transparent:
      a. System - 5, Varnish, Conversion.
      b. Sheen: Satin.

B. Factory finish doors in accordance with approved sample.

2.7 ACCESSORIES

A. Hollow Metal Door Frames: As specified in Section 08 11 13.

B. Glazing: As specified in Section 08 80 00.

C. Glazing Stops: Wood, of same species as door facing, mitered corners; prepared for countersink style tamper proof screws.

D. Door Hardware: As specified in Section 08 71 00.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that opening sizes and tolerances are acceptable.

C. Do not install doors in frame openings that are not plumb or are out-of-tolerance for size or alignment.

3.2 INSTALLATION

A. Install doors in accordance with manufacturer's instructions and specified quality standard.
   1. Install fire-rated doors in accordance with NFPA 80 requirements.

B. Factory-Finished Doors: Do not field cut or trim; if fit or clearance is not correct, replace door.

C. Use machine tools to cut or drill for hardware.

D. Coordinate installation of doors with installation of frames and hardware.

E. Align in frames for uniform clearances at each edge.

F. Coordinate installation of glazing.

3.3 TOLERANCES

A. Conform to specified quality standard for fit and clearance tolerances.

B. Conform to specified quality standard for telegraphing, warp, and squareness.

3.4 ADJUSTING

A. Adjust doors for smooth and balanced door movement.

B. Adjust closers for full closure.

END OF SECTION

SECTION 08 36 13

SECTIONAL DOORS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Overhead sectional doors, electrically operated.

B. Operating hardware and supports.

C. Electrical controls.

1.2 RELATED REQUIREMENTS

A. Section 05 50 00 - Metal Fabrications: Steel channel opening frame.

B. Section 06 10 00 - Rough Carpentry: Rough wood framing for door opening.

C. Section 07 90 05 - Joint Sealers: Perimeter sealant and backup materials.

1.3 REFERENCE STANDARDS

A. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2014.

B. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2013.

C. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass; 2012.

D. ASTM E330/E330M - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference; 2014.

E. DASMA 102 - American National Standard Specifications for Sectional Overhead Type Doors; 2011.

F. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.4 SUBMITTALS

A. Shop Drawings: Indicate opening dimensions and required tolerances, connection details, anchorage spacing, hardware locations, and installation details.

B. Product Data: Show component construction, anchorage method, and hardware.

C. Manufacturer's Installation Instructions: Include any special procedures required by project conditions.

D. Operation Data: Include normal operation, troubleshooting, and adjusting.

E. Maintenance Data: Include data for motor and transmission, shaft and gearing, lubrication frequency, spare part sources.

F. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of experience.

B. Conform to applicable code for motor and motor control requirements.

C. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified.

1.6 WARRANTY

A. Correct defective Work within a 10 year period after Date of Substantial Completion.

B. Warranty: Include coverage for electric motor and transmission.

C. Provide five year manufacturer warranty for electric operating equipment.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Aluminum and Glass Sectional Doors - Basis of Design: Overhead Door Corproration, Model 521.

B. Basis-of-Design: The design for sectional overhead doors is based on the products indicated. Subject to compliance with requirements, provide the named product or a comparable product by one of the following:
   1. Clopay Corporation: www.clopaydoor.com.
   2. Raynor.
   3. Wayne-Dalton, a Division of Overhead Door Corporation: www.wayne-dalton.com.

2.2 ALUMINUM DOOR COMPONENTS

A. Aluminum Doors: Stile and rail aluminum with glazed panels; lift as indicated on drawings with track and hardware.
   1. Performance: Withstand positive and negative wind loads equal to 1.5 times design wind loads specified by local code without damage or permanent set, when tested in accordance with ASTM E330/E330M, using 10 second duration of maximum load.
   2. Door Assembly: Stile and rail assembly secured with 1/4 inch diameter through rods.
   3. Door Nominal Thickness: 1-3/4 inches thick.
   4. Center Stile Width: 2-11/16 inches.
   5. End Stile Width: 3-5/16 inches.
   6. Intermediate Rail Pair Width: 3-11/16 inches.
   7. Stiles and Rails: 6063 - T6 aluminum.
   8. Finish: Factory anodized; **powder coated black**
   9. Weatherstripping:
      a. Flexible bulb-type strip at bottom section.
      b. Flexible Jamb seals.
      c. Flexible Header seal.
   10. Operation: Electric.

B. Door Panels: Paneled aluminum construction; extruded aluminum stiles and rails; 1/2 inch thick infill panels of glass; stile and rail joints welded; rabbeted weather joints at meeting rails.

C. Glazing: Fully tempered glass; insulated; clear, low-E; 1/2 inch thick.

2.3 DOOR COMPONENTS

A. Tracks: Manufacturer's standard, galvanized-steel track system of configuration indicated, sized for door size and weight, designed for lift type and clearances indicated on Drawings. Provide complete track assembly including brackets, bracing, and reinforcement for rigid support of ball-bearing roller guides for required door type and size. Slot vertical sections of track spaced 2 inches apart for door-drop safety device. Slope tracks at proper angle from vertical or design tracks to ensure tight closure at jambs when door unit is closed. Powder coat all tracks and brackets for aluminum doors, white color.

B. Hinge and Roller Assemblies: Heavy duty (14 gage) double hinges and adjustable roller holders of galvanized steel; floating hardened steel bearing rollers, located at top and bottom of each panel, each side.

C. Lift Mechanism: Torsion spring on cross head shaft, with braided galvanized steel lifting cables. Connect to door with galvanized aircraft-type lift cables with cable safety factor of at least 7 to 1. Provide springs calibrated for a minimum of 50,000 cycles. Provide spring bumpers.
   1. Cable Safety Device: Include a spring-loaded, steel or bronze cam mounted to bottom door roller assembly on each side and designed to automatically stop door if either cable breaks.
   2. Bracket: Provide anchor support bracket as required to connect stationary end of spring to the wall and to level shaft and prevent sag.

D. Sill Weatherstripping: Resilient hollow rubber strip, one piece; fitted to bottom of door panel, full length contact.

E. Jamb Weatherstripping: Roll formed steel section full height of jamb, fitted with resilient weatherstripping, placed in moderate contact with door panels.

F. Head Weatherstripping: EPDM rubber seal, one piece full length.

G. Panel Joint Weatherstripping: Neoprene foam seal, one piece full length.

H. Chain Lock Keeper: Suitable for padlock.

I. Provide safety interlock switch to disengage power supply when door is locked.

2.4 MATERIALS

A. Aluminum Extrusions: ASTM B221 (ASTM B221M), 6063 alloy, T6 temper.

B. Float Glass: Provide float glass glazing, unless noted otherwise.
   1. Heat-Strengthened and Fully Tempered Types: ASTM C1048.

2.5 ELECTRICAL OPERATION

A. Operator, Controls, Actuators, and Safeties: Comply with UL 325; provide products listed by a testing agency acceptable to authorities having jurisdiction.

B. General: Provide heavy-duty, electric door operator assembly of size and capacity recommended and provided by door manufacturer for door and operation-cycle requirements specified to move door in either direction at not less than 2/3 foot nor more than 1 foot per second; with electric motor and factory-prewired motor controls, starter, gear-reduction unit, solenoid-operated brake, clutch, remote-control stations, control devices, integral gearing for locking door, and accessories required for proper operation.

C. Comply with NFPA 70.

D. Disconnect Device: Hand-operated disconnect device for automatically engaging operator and releasing brake for emergency manual operation while disconnecting motor without affecting timing of limit switch. Mount disconnect device and operator so they are accessible from floor level. Include interlock device to automatically prevent motor from operating when emergency operator is engaged.

E. Electrical Characteristics:
   1. Provide hp as recommended by manufacaturer for door size, but not less than 1/2 hp.; manually operable in case of power failure, transit speed of not less than 12 inches per second.
   2. 115 volts, single phase, 60 Hz.

F. Wiring Terminations: Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to NFPA 70.

G. Disconnect Switch: Factory mount disconnect switch in control panel.

H. Safety Edge: At bottom of door panel, full width; electro-mechanical sensitized type, wired to stop door upon striking object; hollow neoprene covered to provide weatherstrip seal.

I. Safety Beams: Manufacturer's photoelectric safty sensors to reverse door. Provide two on each side of every sectional door. Locate at two different heights as directed by Owner.

J. Control Station: Standard three button (open-close-stop) momentary type control for each electric operator.
   1. Surface mounted.
   2. Locate at inside door jamb.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that wall openings are ready to receive work and opening dimensions and tolerances are within specified limits.

B. Verify that electric power is available and of the correct characteristics.

3.2 PREPARATION

A. Prepare opening to permit correct installation of door unit to perimeter air and vapor barrier seal.

3.3 INSTALLATION

A. Install door unit assembly in accordance with manufacturer's instructions.

B. Anchor assembly to wall construction and building framing without distortion or stress.

C. Securely brace door tracks suspended from structure. Secure tracks to structural members only.

D. Fit and align door assembly including hardware.

E. Coordinate installation of electrical service. Complete power and control wiring from disconnect to unit components.

F. Accessibility: Install sectional doors, switches, and controls along accessible routes in compliance with regulatory requirements for accessibility.

G. Coordinate installation of sealants and backing materials at frame perimeter as specified in Section 07 90 05.

3.4 TOLERANCES

A. Maximum Variation from Plumb: 1/16 inch.

B. Maximum Variation from Level: 1/16 inch.

C. Longitudinal or Diagonal Warp: Plus or minus 1/8 inch from 10 ft straight edge.

D. Maintain dimensional tolerances and alignment with adjacent work.

3.5 ADJUSTING

A. Adjust door assembly for smooth operation and full contact with weatherstripping.

B. Have manufacturer's field representative present to confirm proper operation and identify adjustments to door assembly for specified operation.

3.6 CLEANING

A. Clean doors and frames and glazing.

B. Remove temporary labels and visible markings.

3.7 PROTECTION

A. Protect installed products from damage until Date of Substantial Completion.

B. Do not permit construction traffic through overhead door openings after adjustment and cleaning.

END OF SECTION

SECTION 08 36 14

FOUR-FOLD DOOR SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes Four-Fold metal doors with surface mounted tube frames.

B. Operation of Four-Fold metal doors includes overhead mounted electro-mechanical operators.

1.2 SUBMITTALS

A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.

B. Product Data for each type of product specified consisting of manufacturer's technical Product Data and installation instructions for each type of door required, including data substantiating that products comply with requirements.

C. Submittal Drawings showing fabrication and installation of Four-Fold metal doors including plans, elevations, sections, details of components, hardware, operating mechanism, and attachments to the other units of Work. Include wiring diagrams for coordination with electrical trade.

D. Reference list including (5) successful installations of this type of door within the past two (2) years.

1.3 QUALITY ASSURANCE

A. Doors shall be designed to withstand external or internal horizontal wind loads of 20 pounds minimum per square foot. The maximum allowable deflection shall not exceed 1/120 of the span. Fiber stresses in main members shall be limited to 27,000 pounds per square inch. Steel frames shall be designed in accordance with the AISC "Steel Construction Manual".

B. Door manufacturer shall have at least 10 years experience in manufacturing door type specified for emergency vehicle applications.

1.4 DELIVERY, STORAGE AND HANDLING

A. Store delivered materials and equipment in dry locations with adequate ventilation, free from dust and water, and so as to permit access for inspection and handling.

B. Handle materials carefully to prevent damage.

1.5 WARRANTY

A. The door manufacturer shall provide a written standard limited warranty for material and workmanship.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design: Door Engineering and Manufacturing, FF300 Series - Glazed.

2.2 MATERIALS

A. Steel Tube: ASTM A513 and ASTM A500/A500M

B. Steel Sheets: Steel sheets of commercial quality, complying with ASTM A1011/A1011M hot-rolled steel sheet.

C. Hardware: Manufacturer's standard components.

D. Fasteners: Zinc-coated steel.

2.3 FOUR-FOLD DOORS

A. Construction: Door framing shall be minimum 14-gauge structural steel tube with 14-gauge steel sheet on the exterior and interior faces. Sheeting shall be formed on the vertical edges with no visible welds on the interior or exterior panel faces. All frames and framing members shall be true to dimension and square in all directions, and no door shall be bowed, warped, or out of line, in the vertical or horizontal plane of the door opening by more than

1/8 inch in 20 feet. Exposed welds and welds which interfere with the installation of various parts shall be ground smooth and flush.

B. Surface Mounted Tube Frame: Supply pre-hung tube frame system constructed of minimum TS6x4x0.25, designed to anchor to masonry wall construction or weld to steel structure. All hinges, track supports and operator supports shall be factory attached.

C. Factory finish: Door Panels and Tube Frames shall be finished with manufacturer's standard PPG Spectracron epoxy primer and polyurethane top coat. Customer to select from Manufacturer's standard color chart or furnish sample to match.
   1. Operator and operating hardware shall be powder-coated manufacturer's standard gray.

D. Hardware: Hardware shall include guide tracks and brackets, trolleys, center guides, not less than three pairs of jamb and fold hinges per opening, and all bolts, nuts, fasteners, etc. necessary for complete installation and operation.

E. Hinges: Jamb hinges shall be dual shear and have two thrust bearings and two needle bearings. Fold hinges shall be stainless steel and be dual shear with two thrust bearings. All bearings shall be completely concealed within the hinge barrel and include grease zerks. All hinge pins shall be minimum ¾" diameter hardened steel.

F. Weatherstripping: Material shall be adjustable and readily replaceable and provide a substantially weather-tight installation. Weatherstripping at center shall be 1/16" cloth inserted neoprene and include no exposed fasteners on the exterior face of the panel. Weatherstripping at sill shall include two 1/16" cloth inserted neoprene sweeps with an aluminum retainer. The retainer shall be attached to the door with adhesive.

G. Perimeter Weatherstripping: Provide jamb and head weatherstipping of 1/16" cloth-inserted neoprene bulb (or closed cell neoprene).

H. Vision Panels or Grilles: Provide 1" insulated vision panels or grilles of the size, shape and location as noted on the drawings.

2.4 OPERATOR

A. Each Four-Fold door shall be operated by an overhead mounted electro-mechanical drive unit designed for high cycle operation. Operator consists of an electric motor, gear reducer, and rotating drive arm. The door shall be operated with connecting rods attached to the rotating drive arm on the operator and to control arms attached to the jamb door section and to the door lintel. The connecting rods shall be positive drive, keeping the door under firm control at all times. The connecting rods shall be fitted with spherical bearings and control arms shall be equipped with oil impregnated bronze bearings on polished shafts.

B. Operator shall be instantly reversible, open and close rapidly and start and stop gradually. Operator shall be adjustable to allow door to fully clear the opening. Operator shall automatically lock the door in the closed position. Operator shall be equipped with disengaging mechanism to convert to free wheeling mode for manual operation.

C. Electric motor shall be of sufficient size to operate doors under normal operating conditions at no more than 75 percent of rated capacity. The motor shall be wound for three phase 208/230/480 VAC, 60 Hertz operation.

D. Electric Controls: Controls shall be furnished by the door manufacturer and shall be complete for each door, and built in accordance with the latest NEMA standards. Incoming electrical shall be 208VAC single phase, 208/230VAC 3-phase, 480VAC 3-phase.
   1. Controls shall include a programmable logic controller with digital message display or LED indicators. Controller shall include programmable close timers and programmable inputs/outputs.
   2. Motor starters shall be magnetic reversing, factory wired with overload and under voltage protection, and equipped with mechanical interlocks. All control components shall be enclosed in one enclosure with a wiring diagram placed on the inside of the cover.
   3. If incoming voltage is single phase, control panel shall include a variable frequency drive to convert voltage to 3-phase for the motor
   4. Enclosures shall be NEMA 4 with disconnect switch.
   5. Pushbuttons (interior) for each door shall have one (1) momentary pressure three-button push-button station marked "OPEN", "CLOSE" and "STOP". Push button enclosure shall be NEMA 4.
   6. Limit switches shall be provided to stop the travel of the door in its fully open or fully closed position.
   7. Safety edges: Provide electric safety edges on leading edge of all doors to reverse door upon contact with obstruction.
   8. Photo eyes: Provide (1) exterior, jamb mounted, thru-beam type photo eyes, NEMA 4 rated.

9. Presence Sensor: Provide (1) interior, overhead mounted, presence sensor.
10. Radio controls: Provide one (1) Liftmaster 850 radio receiver and (2) Liftmaster 811 single button remotes per door. Remotes to open and close doors with single button.
11. Timer Activation Loop Detectors (fire station applications): Provide "pulse on exit type" loop detector to activate auto close timer once loop has been activated and cleared, include hand/auto switch to deactivate timer. G.C. to coordinate installation of preformed loop with installer prior to exterior apron being poured.

E. Wiring: Door manufacturer shall supply controls and components only. Electrical contractor shall install controls and furnish and install conduits and wiring for jobsite power and control wiring.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install Four-Fold metal doors in strict accordance with the approved drawings by qualified door erection crews. All door openings shall be completely prepared by the general contractor prior to the installation of the doors. Permanent or temporary electric wiring shall be brought to the door opening before installation is started and shall be completed so as not to delay the inspection test.

B. Doors shall be set plumb, level, and square, and with all parts properly fastened and mounted. All moving parts shall be tested and adjusted and left in good operating condition.

3.2 ADJUSTING AND CLEANING

A. Inspection of the doors and a complete operating test will be made by the installer in the presence of the general contractor or architect as soon as the erection is complete. Any defects noted shall be corrected. After door approval in the above test, the general contractor must assume the responsibility for any damage or rough handling of the doors during construction until the building is turned over to the owner and final inspection is made.

B. Clean surfaces and repaint abraded or damaged finished surfaces to match factory-applied finish.

END OF SECTION

SECTION 08 43 13

ALUMINUM-FRAMED STOREFRONTS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Aluminum-framed storefront, with vision glass.

B. Aluminum doors and frames.

C. Weatherstripping.

1.2 RELATED REQUIREMENTS

A. Section 08 80 00 - Glazing: Glass and glazing accessories.

1.3 REFERENCE STANDARDS

A. AAMA CW-10 - Care and Handling of Architectural Aluminum From Shop to Site; 2015.

B. AAMA 501.2 - Quality Assurance and Diagnostic Water Leakage Field Check of Installed Storefronts, Curtain Walls, and Sloped Glazing Systems; 2015.

C. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum; 2014 (2015 Errata).

D. AAMA 1503 - Voluntary Test Method for Thermal Transmittance and Condensation Resistance of Windows, Doors and Glazed Wall Sections; 2009.

E. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2014.

F. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2013.

G. ASTM E283 - Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen; 2004 (Reapproved 2012).

H. ASTM E330/E330M - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference; 2014.

I. ASTM E331 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference; 2000 (Reapproved 2016).

J. ASTM E331 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference; 2000 (Reapproved 2009).

1.4 SUBMITTALS

A. Product Data: Provide component dimensions, describe components within assembly, anchorage and fasteners, glass and infill, internal drainage details.

B. Shop Drawings: Indicate system dimensions, framed opening requirements and tolerances, affected related Work, expansion and contraction joint location and details, and field welding required. Include plans, elevations, sections, details, attachements to other work, embedment type, size and layout.

1. Provide water control diagrams for condensation and infiltration evacuation.
2. Include structural analysis data signed and sealed by the professional engineer, licensed in the State of Iowa, responsible for their preparation.

C. Samples: Submit two samples 2 x 3 inches in size illustrating finished aluminum surface, color matched to existing storefront framing..

1.5 QUALITY ASSURANCE

A. Designer Qualifications: Design structural support framing components under direct supervision of a Professional Structural Engineer experienced in design of this Work and licensed in the State in which the Project is located.

B. Manufacturer Qualifications: Company specializing in performing work of type specified and with at least three years of documented experience.

C. Mockups: Provide materials and installation for mockups specified in Division 01 Section "Mock-Up Requirements and as indicated on Drawings Sheet A---- to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Handle products of this section in accordance with AAMA CW-10.

B. Protect finished aluminum surfaces with wrapping. Do not use adhesive papers or sprayed coatings that bond to aluminum when exposed to sunlight or weather.

1.7 FIELD CONDITIONS

A. Do not install sealants when ambient temperature is less than 40 degrees F. Maintain this minimum temperature during and 48 hours after installation.

1.8 WARRANTY

A. Standard Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of aluminum-framed systems that do not comply with requirements or that deteriorate as defined in this Section within spedified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Structural failures including, but not limited to, excessive deflection.
      b. Noise or vibration caused by thermal movements.
      c. Deterioration of metals and other materials beyond normal weathering.
      d. Water leakage through fixed glazing and framing areas.
      e. Failure of operating components to function property.
   2. Warranty Period: Two years from date of Substantial Completion.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Basis of Design: See below under description of products.
   1. Exterior Storefront System: Kawneer, Trifab VG 451T.

B. Other Acceptable Manufacturers:
   1. EFCO Corporation: www.efcocorp.com.
   2. Architectural Wall Systems.
   3. YKK AP America Inc
   4. Manko Window Systems, Inc.: www.mankowindows.com.
   5. United States Aluminum Corp
   6. Vistawall Architectural Products
   7. Pittco Architectural Metals Inc: www.pittcometals.com/sle.
   8. Tubelite, Inc.: www.tubeliteinc.com.

2.2 STOREFRONT

A. Aluminum-Framed Storefront: Factory fabricated, factory finished aluminum framing members with infill, and related flashings, anchorage and attachment devices.
   1. Finish: Class I natural anodized.
      a. Factory finish all surfaces that will be exposed in completed assemblies.

B. Performance Requirements:
   1. General: Provide aluminum-framed systems, including anchorage, capable of withstanding, without failure, the effects of the following:
      a. Structural loads.
      b. Thermal movements.
      c. Movements of supporting structure indicated on Drawings including, but not limited to, story drift and deflection from uniformly distributed and concentrated live loads.
      d. Dimensional tolerances of building frame and other adjacent construction.
      e. Failure includes the following:

1) Deflection exceeding specified limits.
2) Thermal stresses transferred to building structure.
3) Framing members transferring stresses, including those caused by thermal and structural movements, to glazing.
4) Noise or vibration created by wind and thermal and structural movements.
5) Loosening or weakening of fasteners, attachments, and other components.
6) Sealant failure.
7) Failure of operating units to function properly.

2. Structural Loads:
   a. Wind Loads: As indicated on Structural Drawings.
   b. Seismic Loads: As indicated on Structural Drawings.
3. Deflection of Framing Members Normal to Wall Plane: Limited to 1/175 of clear span for spans up to 13 feet 6 inches and to 1/240 of coear span plus 1/4 inch for spans greater than 13 feet 6 inches or an amount that restricts edge deflection of individual glazing lites to 3/4 inch, whichever is less.
4. Structural-Test Performance: Systems tested according to ASTM E 330 as follows:
   a. When tested at positive and negative wind-load design pressures, systems do not evidence deflection exceeding specified limits.
   b. When tested at 150 percent of positieve and negative wind-load design pressures, systems, including anchorage, do not evidence material failures, structural distress, and permanent deformation of main framing members exceeding 0.2 percent of span.
   c. Test Durations: As required by design wind velocity but not less than 10 seconds.
5. Wind Loads: Design and size components to withstand the specified load requirements without damage or permanent set, when tested in accordance with ASTM E330/E330M, using loads 1.5 times the design wind loads and 10 second duration of maximum load.
   a. Member Deflection: Limit member deflection to flexure limit of glass in any direction, with full recovery of glazing materials.
6. Water Penetration Resistance: No uncontrolled water on interior face, when tested in accordance with ASTM E331 at pressure differential of 8 psf.
7. Air Leakage: Maximum of 0.06 cu ft/min sq ft of wall area, when tested in accordance with ASTM E283 at 6.27 psf pressure differential across assembly.
8. Movement: Accommodate movement between storefront and perimeter framing and deflection of lintel, without damage to components or deterioration of seals.
9. Air Infiltration: Limit air infiltration through assembly to 0.06 cu ft/min/sq ft of wall area, measured at minimum static-air-pressure difference of 6.24 lbf/sq. ft. across assembly in accordance with ASTM E 283.
10. Condensation Resistance Factor: Measure in accordance with AAMA 1503 with 1 inch insulating glass installed. Fixed glazing and framing areas of systems have condensation-resistance factor (CRF) of not less than 53 when tested according to AAMA 1503.
11. Water Leakage: None, when measured in accordance with ASTM E 331 at a minimum static-air-pressure difference of 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft.
12. System Internal Drainage: Drain to the exterior by means of a weep drainage network any water entering joints, condensation occurring in glazing channel, and migrating moisture occurring within system.
13. Air and Vapor Seal: Maintain continuous water barrier membrane throughout assembly, primarily in line with pane of glass and heel bead of glazing compound.
14. Expansion/Contraction: Provide for expansion and contraction within system components caused by cycling temperature range of 170 degrees F over a 12 hour period without causing detrimental effect to system components, anchorages, and other building elements.

2.3 COMPONENTS

A. Aluminum Framing Members: Tubular aluminum sections, thermally broken with interior section insulated from exterior, drainage holes and internal weep drainage system.
   1. Framing members for interior applications need not be thermally broken.
   2. Cross-Section: As indicated on drawings.

B. Swing Doors: Glazed aluminum.
   1. Thickness: 1-3/4 inches.
   2. Top Rail: 3-1/2 inches wide.
   3. Vertical Stiles: 3-1/2 inches wide.

4. Bottom Rail: 10 inches wide.
5. Glazing Stops: Square.
6. Finish: Same as storefront.

2.4 MATERIALS

A. Extruded Aluminum: ASTM B221 (ASTM B221M).

B. Fasteners: Stainless steel.

C. Glass: As specified in Section 08 80 00.

D. Glazing Accessories: As specified in Section 08 80 00.

2.5 FINISHES

A. Class I Natural Anodized Finish: AAMA 611 AA-M12C22A41 Clear anodic coating not less than 0.7 mils thick.

2.6 HARDWARE

A. Door Hardware: As specified in Section 08 71 00 - Door Hardware.

B. Weatherstripping: Wool pile, continuous and replaceable; provide on all doors.

C. Sill Sweep Strips: Resilient seal type, retracting, of neoprene; provide on all doors.

2.7 FABRICATION

A. Fabricate components with minimum clearances and shim spacing around perimeter of assembly, yet enabling installation and dynamic movement of perimeter seal and that have the following characteristics:
   1. Profiles that are sharp, straight and free of defects or deformations.
   2. Accurately fitted and secure joints and corners. Make joints flush, hairline, and weatherproof.
   3. Means to drain water passing joints, condensation occurring within framing members, and moisture migrating within the system to exterior.
   4. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
   5. Provisions for field replacement of glazing from exterior of building.
   6. Fasteners, anchors, and connection devices that are concealed from view to greatest extend possible.

B. Door Frames: Reinforce as required to support loads imposed by door operation and for installing hardware.
   1. At exterior doors, provide compression weather stripping at fixed stops. Provide continous aluminum drip above all doors, extend to outside of door frame.
   2. At interior doors, provide silencers at stops to prevent metal-to-metal contact. Install three silencers on strike jamb of single-door frames and two silencers on head of frames for pairs of doors.

C. Doors: Reinforce doors as required for installing hardware.
   1. At pairs of exterior doors, provide sliding weather stripping retained in adjustable strip mortised into door edge.
   2. At exterior doors, provide weather sweeps applied to door bottoms.

D. Prepare components to receive anchor devices. Fabricate anchors.

E. Coat concealed metal surfaces that will be in contact with cementitious materials or dissimilar metals with bituminous paint.

F. Arrange fasteners and attachments to conceal from view.

G. Reinforce components internally for door hardware .

H. Reinforce framing members for imposed loads.

I. Finishing: Apply factory finish to all surfaces that will be exposed in completed assemblies.
   1. Touch-up surfaces cut during fabrication so that no natural aluminum is visible in completed assemblies, including joint edges.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify dimensions, tolerances, and method of attachment with other work.

B. Verify that wall openings and adjoining air and vapor seal materials are ready to receive work of this section.

3.2 INSTALLATION

A. Install wall system in accordance with manufacturer's instructions.

B. Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities.

C. Provide alignment attachments and shims to permanently fasten system to building structure.

D. Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances, aligning with adjacent work.

E. Provide thermal isolation where components penetrate or disrupt building insulation.

F. Install sill flashings. Turn up ends and edges; seal to adjacent work to form water tight dam.

G. Where fasteners penetrate sill flashings, make watertight by seating and sealing fastener heads to sill flashing.

H. Install anti-walking clips in openings that are more than three frames wide per manufacturers instructions.

I. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration.

J. Coordinate attachment and seal of perimeter air and vapor barrier materials.

K. Pack fibrous insulation in shim spaces at perimeter of assembly to maintain continuity of thermal barrier.

L. Metal Protection:
   1. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape or installing nonconductive spacers as recommended by manufactuer for this purpose.
   2. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.
   3. If necessary protect the exterior framing during masonry wash down.

M. Install glass and infill panels in accordance with Section 08 80 00, using glazing method required to achieve performance criteria.

N. Entrances: Install to produce smooth operation and tight fit at contact points.
   1. Exterior Entrances: Install to produce tight fit at weather stripping and weathertight closure.
   2. Field-Installed Hardware: Install surface-mounted hardware according to hardware manufacturers' written instructions using concealed fasteners to greatest extent possible.

O. Door Hardware: Install door hardware specified in Division 8 Section "Door Hardware."

P. Touch-up minor damage to factory applied finish; replace components that cannot be satisfactorily repaired.

3.3 TOLERANCES

A. Maximum Variation from Plumb: 0.06 inches every 3 ft non-cumulative or 1/16 inches per 10 ft, whichever is less.

B. Maximum Misalignment of Two Adjoining Members Abutting in Plane: 1/32 inch.

3.4 FIELD QUALITY CONTROL

A. Water Spray Test: Before installation of interior finishes has begun, a minimum area of 25 feet by 1 story of aluminum-framed systems designated by Architect shall be tested for water leakage in accordance with AAMA 501.2 and shall not evidence water penetration.

B. Repair or remove work where test results and inspections indicate that it does not comply with specified requirements.

C. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.5 ADJUSTING

A. Adjust operating hardware and sash for smooth operation.

3.6 CLEANING

A. Remove protective material from pre-finished aluminum surfaces.

B. Remove excess sealant by method acceptable to sealant manufacturer.

3.7 PROTECTION

A. Protect installed products from damage until Date of Substantial Completion.

END OF SECTION

SECTION 08 44 13

GLAZED ALUMINUM CURTAIN WALLS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Aluminum-framed curtain wall, with vision glazing and glass infill panels.

B. Miscellaneous components.

1.2 RELATED REQUIREMENTS

A. Section 07 42 13 - Composite Wood Veneer Panels.

B. Section 07 42 13.23 - Aluminum Composite Panels.

1.3 REFERENCE STANDARDS

A. AAMA CW-10 - Care and Handling of Architectural Aluminum From Shop to Site; 2015.

B. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum; 2014 (2015 Errata).

C. AAMA 1503 - Voluntary Test Method for Thermal Transmittance and Condensation Resistance of Windows, Doors and Glazed Wall Sections; 2009.

D. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2014.

E. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2014.

F. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric); 2014.

G. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2014.

H. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2013.

I. ASTM E283 - Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen; 2004 (Reapproved 2012).

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordinate with installation of other components that comprise the exterior enclosure.

B. Preinstallation Meeting: Conduct a preinstallation meeting two weeks before starting work of this section; require attendance by all affected installers. Preinstallation meeting shall to establish procedures to maintain optimum working conditions, and to coordinate this work with related and adjacent work. Agenda for the meeting shall include, but not limited to, the following:
   1. Requirements for Building Envelope Commissioning.
   2. Review of submittals.
   3. Review of surface preparation, minimum curing period and installation procedures.
   4. Review of special details and flashings.
   5. Sequence of construction, responsibilities and schedule for subsequent operations.
   6. Review of mock-up requirements.
   7. Review of inspection, testing, protection and repair procedures.

C. Provide necessary compatibility information for Building Envelope Commissioning.

1.5 SUBMITTALS

A. Product Data: Provide component dimensions, describe components within assembly, anchorage and fasteners, internal drainage details, glazing, and infill.

B. Provide stamped structural calculations for curtain wall assemblies and anchorages prepared by a professional engineer licensed in the State of Iowa.

C. Shop Drawings: : Indicate configurations (including plans, elevations and section views), and construction of all parts of the work, including metal and glass thickness, methods of joining, details of all field connections and

anchorage, fastening and sealing methods, metal finishes, and all pertinent information; completed by the curtain wall manufacturer.

1. Submit full size sections when needed for clarity.
2. Clearly indicate relationship to other work.
3. Begin fabrication only after shop drawings for that work have been accepted by the Design Professional.
4. Submit manufacturer's installation instructions.

D. Verification Samples: Include representative samples of the following for approval:
1. Submit three (3) samples of finished aluminum, 6 x 6 inch in size, illustrating specified color and finish for review and approval by the Design Professional.
2. Glass, each type.
3. Frame, mullion and corner sections.
4. Fasteners and anchors.

E. Test Reports: Submit report of full-size mock-up tests for air infiltration, water penetration, and wind performance.

F. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.6 QUALITY ASSURANCE

A. Provide test reports stating the performance as specified in Article 1.05, not more than four (4) years old.

B. Manufacturer test reports shall be accompanied by the curtain wall manufacturer's letter of certification stating that the tested curtain wall meets or exceeds the referenced criteria for the appropriate curtain wall type.

C. Manufacturer: System shall be manufactured and marketed by a firm with a minimum of twenty (20) years experience in the production and sales of curtain wall systems. Manufacturers proposed for use, but not named in these specifications, shall submit evidence of ability to meet all requirements specified, and include a list of projects of similar design and complexity completed within the past five (5) years.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Handle products of this section in accordance with AAMA CW-10.

B. Protect finished aluminum surfaces with wrapping. Do not use adhesive papers or sprayed coatings that bond to aluminum when exposed to sunlight or weather.

1.8 FIELD CONDITIONS

A. Do not install sealants when ambient temperature is less than 40 degrees F. Maintain this minimum temperature during and 48 hours after installation.

1.9 WARRANTY

A. Provide ten year manufacturer warranty against excessive degradation of exterior finish. Include provision for replacement of units with excessive fading, chalking, or flaking.

B. Total Curtain Wall System:
1. Provide a total system warranty for performance of the total curtain wall installation for five years after the date of Substantial Completion. This includes the glazing (including insulated units), anchorage and setting system, sealing, flashing, etc. as it relates to air, water, and structural adequacy, and these specifications and approved shop drawings.
2. Any deficiencies due to such elements not meeting the specifications shall be corrected by the responsible contractor at his expense during the warranty period.

PART 2 PRODUCTS

2.1 LEED REQUIREMENTS

A. Recycled Content: Provide highest recycled content available, but not less than minimum postconsumer plus one half of pre-consumer content 35 percent.

B. Comply with Section 07 92 00 "Joint Sealants" for silicone sealants. Coordinate with adjacent curtain wall construction.

C. Provide sealants for use inside of the weatherproofing system that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.2 MANUFACTURERS

A. Glazed Aluminum Curtain Walls: Kawneer Company, Inc.: Product 1600 Wall System 1 / System 2.

B. Acceptable manufacturers:
   1. EFCO Corporation
   2. Oldcastle BuildingEnvelope
   3. Wausau Window and Wall Systems
   4. YKK AP
   5. Tubelite.
   6. Pittco Architectural Metals

2.3 COMPONENTS

A. Aluminum-Framed Curtain Wall: Factory fabricated, factory finished aluminum framing members with infill, and related flashings, anchorage and attachment devices.
   1. Outside dry glazed; includes exterior aluminum pressure plate and snap-on mullion cover with interior and exterior dense EPDM preset gasket.
   2. Aluminum Framing Members: Tubular aluminum sections, thermally broken with interior section insulated from exterior, drainage holes and internal weep drainage system.
      a. Cross-Sections: Sizes and shapes as indicated on the Drawings.
      b. Extrusion Wall Thickness: Minimum 1/8 inch (3 mm); all vertical and horizontal members.
   3. Finish: Superior performing organic coatings.
      a. Factory finish surfaces that will be exposed in completed assemblies.
      b. Touch-up surfaces cut during fabrication so that no natural aluminum is visible in completed assemblies, including joint edges.
      c. Coat concealed metal surfaces that will be in contact with cementitious materials or dissimilar metals with bituminous paint.
   4. Provide flush joints and corners, weathersealed, accurately fitted and secured; prepared to receive anchors; fasteners and attachments concealed from view; reinforced as required for imposed loads.
   5. Construction: Eliminate noises caused by wind and thermal movement, prevent vibration harmonics, and prevent "stack effect" in internal spaces.
   6. System Internal Drainage: Drain to the exterior by means of a weep drainage network any water entering joints, condensation occurring in glazing channel, and migrating moisture occurring within system.
   7. Air and Vapor Seal: Maintain continuous air barrier and vapor retarder throughout assembly, primarily in line with inside pane of glazing and inner sheet of infill panel and heel bead of glazing compound.

B. Entrance Doors: Glazed aluminum.
   1. Basis-of-Design Product: Kawneer Company, Inc.; 190 Standard Entrance.
   2. Acceptable manufacturers:
      a. EFCO Corporation
      b. Oldcastle BuildingEnvelope
      c. Wausau Window and Wall Systems
      d. YKK AP
      e. Tubelite Inc.
      f. Pittco Architectural Metals
   3. Major Extruded Sections: 1-3/4 inch thick; minimum 1/8 inch wall thickness.
      a. Top Rail: Minimum 2-1/4 inches wide.
      b. Vertical Stiles: Minimum 2-1/8 inches wide.
      c. Bottom Rail: Minimum 10 inches wide.
   4. Glazing Method: Dry glazed with extruded pressure-fitting aluminum glazing stops, and a gasket that complies with ASTM E 2203.
   5. Glazing Stops: Square; minimum 0.050 inch thickness. Exterior stops shall be an integral part of the door; interior stops shall be snap-in type.
   6. Finish: Same as curtain wall frames.
   7. Construction: Welded corner. Tie rod only construction is not acceptable.

8. Storefront and Vestibule Framing: Where storefront framing is indicated on drawings, provide storefront framing by same manufacturer as curtain wall in sizes as indicated on drawings.

C. Structural Performance Requirements: Design and size components to withstand the following load requirements without damage or permanent set.
   1. Design Wind Loads: Comply with the applicable code.
   2. Movement: Accommodate the following movement without damage to components or deterioration of seals:
      a. Expansion and contraction caused by 180 degrees F surface temperature.
      b. Expansion and contraction caused by cycling temperature range of 170 degrees F over a 12 hour period.
      c. Movement of curtain wall relative to perimeter framing.
      d. Deflection of structural support framing, under permanent and dynamic loads.

D. Water Penetration Resistance: No uncontrolled water on indoor face when tested as follows:
   1. Test Pressure Differential: 10 psf.

E. Air Leakage: Maximum of 0.06 cu ft/min sq ft of wall area, when tested in accordance with ASTM E283 at 6.27 psf pressure differential across assembly.

F. Thermal Performance Requirements:
   1. Condensation Resistance Factor of Framing: 50, minimum, measured in accordance with AAMA 1503.
   2. Overall U-value Including Glazing: 0.36 Btu/(hr sq ft deg F), maximum.

G. COMPONENTS

H. Glazing: As specified in Section 08 80 00.

2.4 MATERIALS

A. Extruded Aluminum: ASTM B221 (ASTM B221M).

B. Sheet Aluminum: ASTM B209 (ASTM B209M).

C. Structural Steel Sections: ASTM A36/A36M; shop primed.

D. Fasteners: Stainless steel; type as required or recommended by curtain wall manufacturer.

E. Concealed Flashings: Stainless steel, 20 gage, 0.032 inch minimum thickness.

F. Curtain Wall Break Metal: Aluminum, minimum 0.064 inch thick, finished to match curtain wall framing.

G. Glazing Gaskets: Type to suit application to achieve weather, moisture, and air infiltration requirements.

H. Glazing Accessories: As specified in Section 08 80 00.

I. Silicone Transision: Provide silicone transition strip at perimeter conditions between composite wood panels, aluminum composite panels, fiber reinforced cementitions panels, thin limestone adhered panels and the work of this section to provide an air and watertight seal. Silicone transition strip must be compatible with the air and vapor barrier being applied to the exterior sheathing withing the exterior cladding systems.
   1. Acceptable Products:
      a. Dow Corning 123 Preformed Silicone Seal
      b. Momentive UltraSpan US1100
      c. Tremco Spectrem Simple Seal

2.5 FINISHES

A. Class I Natural Anodized Finish: AAMA 611 AA-M12C22A41 Clear anodic coating not less than 0.7 mils thick.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify dimensions, tolerances, and method of attachment with other related work.

B. Verify that curtain wall openings and adjoining air and vapor seal materials are ready to receive work of this section.

C. Verify that anchorage devices have been properly installed and located.

3.2 INSTALLATION

A. Install curtain wall system in accordance with manufacturer's instructions.

B. Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities.

C. Provide alignment attachments and shims to permanently fasten system to building structure.

D. Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances, aligning with adjacent work.

E. Provide thermal isolation where components penetrate or disrupt building insulation.

F. Install sill flashings. Turn up ends and edges; seal to adjacent work to form water tight dam.

G. Structural Sealant Glazing (SSG) Adhesive: Install structural sealant glazing adhesive and weatherseal sealant in accordance with manufacturer's instructions.

H. Touch-up minor damage to factory applied finish; replace components that cannot be satisfactorily repaired.

I. Silicone Transition Installation:
   1. Coordinate installation methods and sequencing of installation with weather barrier, composite wood panels, aluminum composite panels, fiber reinforced cementitions panels, and thin limestone adhered panel contractors. Silicone transition must be installed and sealed to air/water/vapor barrier within panel walls after air/water/vapor barrier components have been installed and prior to installation of cladding panels.
   2. Clean surfaces where silicone transition is to be applied in accordance with transition boot manufacturer’s written recommendations. Set transition material in a continuous bed of sealant.
   3. Secure silicone transition on both sides of the perimeter joints and provide continuous sealant compatible with air/water/vapor barrier.

3.3 TOLERANCES

A. Maximum Variation from Plumb: 0.06 inches every 3 ft non-cumulative or 0.5 inches per 100 ft, whichever is less.

B. Maximum Misalignment of Two Adjoining Members Abutting in Plane: 1/32 inch.

C. Sealant Space Between Curtain Wall Mullions and Adjacent Construction: Maximum of 3/4 inch and minimum of 1/4 inch.

3.4 FIELD QUALITY CONTROL

A. Hose Tests
   1. Field hose testing for resistance to water leakage shall be conducted and results interpreted as defined herein. Perform a minimum of five (5) field hose tests. Test areas shall include both curtain wall system(s) and adjacent construction. Coordinate testing of curtain wall areas with adjacent construction contractors as required. Area and time of tests shall be per the direction of the Architect. Initial testing shall be conducted early in the construction schedule. Schedule any out of sequence work necessary, such as out of sequence sealant work, so that selected areas can be tested as specified.
   2. For curtain wall areas, each test area shall be three glass openings wide by two floors high, or 400 ft2, whichever is greater. There shall be no unacceptable water leakage as defined in this Section.
   3. Conduct test with Monarch Type B-25 #6.030 brass nozzle and 3/4 inch diameter hose. Water pressure to nozzle shall be in the range 30 to 35 psi. Working upward from bottom of test area, direct water at 5 foot long segments of glazing seals, frame joints and perimeter joints, moving slowly back and forth on each segment for minimum of 5 minutes. Where a framing member is between two glass units and its width does not exceed 4 inches, both lines of glazing seal may be tested as one segment by centering the spray on one glazing seal while moving in one direction, and centering the spray on the other glazing seal while moving in the opposite direction. Sustained spraying at one point while the nozzle remains stationary is acceptable. Tip of nozzle shall be 12 inches from specimen exterior surface. Nozzle shall generally be perpendicular to specimen surface, but shall be tilted to any angle that maximizes exposure of a given joint to water flow rate and kinetic energy. Continuously check for leakage on indoor side. If necessary to pinpoint leak sources, perform additional testing. Repeated testing of joints is acceptable. The use of masking to pinpoint leaks is acceptable.
   4. Check completed areas below test area, and report any leaks that occur. A test that results in leakage at a completed area below a designated test area is a failure.

5. Contractor performing work of this Section shall provide powered scaffold, hose, water supply, and manpower to perform each test, plus any unsuccessful tests.
6. If failure occurs, revise and retest specimens. Modifications must be realistic in terms of project conditions, must maintain standards of quality and durability and are subject to approval. If failure necessitates retesting, Contractor for Work of this Section shall pay all additional fees associated with retesting, including fees and costs incurred by the testing agent, the Architect, Owner and their representatives.
7. Submit, for information only, reports that contain dates of tests, elevation drawings of test areas with locations relative to grid lines (including any lower areas where leaks occur), and location of each leak.

B. Replace curtain wall components that have failed field testing and retest until performance is satisfactory.

3.5 ADJUSTING

A. Adjust operating sash for smooth operation.

3.6 CLEANING

A. Remove protective material from pre-finished aluminum surfaces.

3.7 PROTECTION

A. Protect installed products from damage until Date of Substantial Completion.

END OF SECTION

SECTION 08 45 10

INSULATED TRANSLUCENT WALL PANEL SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes requirements for daylighting - insulated translucent wall panel system as shown and specified herein

1.2 WORK INCLUDES

A. Design, engineer, manufacture and installation of unitized quad glazed insulated translucent wall light panel system. An assembly of two independent insulated 10mm single glazing multi-cell polycarbonate panels in one integrated daylighting panel assembly, incorporated into a complete aluminum framed system that has been tested and warranted by the manufacturer as a single source system. Design shall provide for the replacement of the exterior panel, independently of the interior single panel and without exposing the interior or compromising the weather tightness or interfering with the normal working functions of the building. The interior single insulated panel remains intact for the life of the building envelope. Single panel extruded polycarbonate cellular or fiberglass sandwich panel systems in lieu of 2 panel's assembly with removable skin technology will not meet these requirements and are not acceptable.

B. All anchors, brackets, and hardware attachments necessary to complete the specified structural assembly, weatherability and water-tightness performance requirements. All flashing up to but not penetrating adjoining work are also required as part of the system and shall be included.

C. Trained and factory authorized labor with supervision to complete the entire panel installation.

1.3 QUALITY ASSURANCE

A. The glazing panels must be evaluated and listed by recognized building code evaluation organization: International Council Evaluation Service Inc (ICC-ES)

B. Materials and Products shall be manufactured by a company continuously and regularly employed in the manufacturing, engineering, and designing, stocking and building of wall lights using the specified material and system for a period of at least ten (10) years.

C. Erection shall be by a factory-approved installer who has been in the business of erecting similar material for at least five (5) consecutive years and can show evidence of satisfactory completion of projects of similar size, scope and type.

D. The manufacturer shall be responsible for the configuration and fabrication of the complete panel system, in accordance with the requirements of this specification.

1.4 SUBMITTALS

A. Manufacturer shall submit written guarantee accompanied by substantiating data, stating that the products to be furnished are in accordance with or exceed these specifications.

B. The manufacturer shall submit certified test reports made by an independent organization. Reports shall verify that the material will meet all performance requirements of this specification. Previously completed test reports will be acceptable if they are indicative of products used on this project. Test reports required are:
   1. Self-Ignition Temperature (ASTM 1929-3)
   2. Smoke Density (ASTM D-2843)
   3. Burning Extent (ASTM D-635)
   4. Interior Flame Spread (ASTM E-84)
   5. Color Difference (ASTM D-2244-85)
   6. Tests on a weathered system after approximately10 years of actual exposure in Florida field conditions. Tests shall include:
      a. Uniform static air pressure per ASTM 330
      b. Impact loading per ASTM E695
      c. Cyclic static air pressure and missile impact level D per ASTM 1886 & ASTM E1996.
   7. Weathering Evaluation before and after exposure to 300°F, 25 minutes include Light Transmission and Color Change, per ASTM E-1175, and ASTM D-2244 respectively.

8. Large Missile Test - Impact Resistance per SFBC PA 201-94
9. Impact loading per ASTM E695
10. Insulation's 'U' value for Center of Glazing per NFRC100.
11. Insulation's 'U' value for wall-light system, glazing and aluminum framing, per NFRC 100 & NFRC 700 certification.
12. Visible light Transmission (VT) per ASTM E972 & ASTM E1084
13. Solar Heat Gain Coefficient (SHGC) based on tests or calculations which are based on tests per methodology and procedure given in the NFRC/Calorimeter Standard.
14. Maximum air infiltration rate for fenestration assemblies of Curtain walls, per NFRC 400 or ASTM E283.
15. Water Penetration (ASTM E-331)
16. Load Bearing Capability (ASTM E-330-97).
17. Performance of exterior windows, curtain walls per ASTM E 1886 & ASTM E 1996-02, Level D
18. Haze per ASTM D 1003 for glare measurement.
19. ICC evaluation service report for compliance with IBC building code for polycarbonate glazing as an approved light transmission plastic with CC1 rating per chapter 26, and class A interior finish glazing per chapter 8.

C. MAINTENANCE DATA: The manufacturer shall provide recommended maintenance procedures, schedule of maintenance and materials required or recommended for maintenance.

D. Submit Installer Certificate signed by installer, certifying compliance with project qualification requirements.

1.5 WARRANTY

A. Provide a single source Wall Light system manufacturer warranty against defective materials and fabrication. Submit manufacturer's written warranty agreeing to repair Wall Light system work, which fails in materials within two years from date of delivery.

B. Provide single source Wall Light's manufacturer 10 year glazing panel warranty. Third party warranty for glazing panels shall not be acceptable. Glazing warranty to include:
1. Change in light transmission of no more than 6% per ASTM D-1003
2. No delamination of panel affecting appearance, performance or structural integrity of the panel or the system
3. Thermal aging - the light transmission and the color shall not change after exposure to heat of 300°F for 25 minutes (when measured per ASTM D-1003 and ASTM D-2244 respectively).

C. In addition submit installer's written warranty agreeing to repair installation workmanship, defects and leaks two years from date of delivery.

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. Basis-of-Design: UniQuad – Unitized quad-glazed (2 panel's assembly) Wall-Light system as manufactured by CPI Daylighting, Inc.

2.2 TRANSLUCENT PANEL PERFORMANCE AND APPEARANCE

A. Panel construction for Longevity and Resistant to Buckling and Pressure:
1. Translucent panels must be constructed of tight cell sizes not exceeding 0.18". Wide cell l size exceeding 0.18"shall not be acceptable.
2. The translucent panel shall include an integral extruded tight-cell structural core. The panel's exterior skins shall be connected with supporting continuous ribs, perpendicular to the skins, at a spacing not to exceed 0.18" (truss-like construction). In addition, the space between the two exterior skins shall be divided by multiple parallel horizontal surfaces, at a spacing not to exceed 0.18".

B. Translucent Wall Panel – Unitized Quad Glazed
1. Design, engineer, manufacture and installation of unitized quad glazed insulated translucent wall-light system. An assembly of two independent insulated single glazing polycarbonate multi-cell panels in one integrated daylighting panel assembly, incorporated into a complete aluminum framed system that has been tested and warranted by the manufacturer as a single source system. Design shall provide for the replacement of the exterior panel independently of the interior single panel and without exposing the interior

or compromising the weather tightness or interfering with the normal working functions of the building. The interior single insulated panel remains intact for the life of the building envelope. Single panel extruded polycarbonate cellular or fiberglass sandwich panel systems in lieu of 2 panel's assembly with removable skin technology will not meet these requirements and are not acceptable.

2. Panel glazing assembly thickness shall be a minimum 4" two panel system with concealed interlocking connector or H battens. Minimum thickness of the exterior and the interior single panels shall be 10mm thick each.

C. Thermal and Solar Performance:
   1. Insulation "U" Value performance per NFRC100 & 700, is required by the IBC/IECC/ASHRE energy code. Such performance values must be certified and labeled by NFRC.
   2. U value for standard panel assembly with no bat or aerogel insulation, Center of Glazing per NFRC100: 0.22
   3. U value for panel system assembly with no bat or aerogel insulation and including wall-light aluminum framing per NFRC100 & NFRC700: 0.26.
   4. Visible Light Transmission - Center of Glass 50% per ASTM E972 ASTM & E1084.
   5. Solar Heat Gain Coefficient (SHGC) 0.39 independently tested or calculated based on testing per methods and procedures given in the NFRC Calorimeter
   6. Standard Color: Clear Matt.

D. Translucent Panel Joint System:
   1. Panel shall be extruded in one single formable length. Transverse connections are not acceptable.
   2. The panels should be manufactured with grip-lock double tooth upstands that are integral to the unit. The upstands shall be 90 degrees to the panel face (standing seam dry glazed concept). Welding or gluing of upstands or standing seam is not acceptable.
   3. The metal H battens shall consist of 2 pieces, male/female concept with build in silicon gasket, allowing for a unitized panel assembly.
   4. Water Penetration: No water penetration of the panel H joint connection length at test pressure of 6.24 PSF per ASTM E-331
   5. Air Infiltration: In accordance with NFRC 400.
   6. Free movement of the panels shall be allowed to occur without damage to the weather tightness of the completed system.
   7. The panel joint connection shall comply with the deflection limitation of IBC Table 1604.3 for exterior walls with flexible finishes - span/120 per ASTM E-330.

E. Flammability:
   1. The exterior and interior panels shall be an approved light transmitting panel with a CC1 fire rating classification per ASTM D-635. Flame spread no greater than 25 per ASTM E-84. Smoke density no greater than 75 per ASTM D2843 and a minimum self-ignition temperature of 1000°F per ASTM 1929.
   2. Interior flame spread classification of Class A per ASTM E84.

F. Impact Resistance - the panels shall pass the following tests:
   1. SFBC – PA 201-94, impact resistance of 350 ft. lbs.
   2. ASTM E 695 - Impact loading per - 500 ft. lbs.
   3. ASTM E-1996-02 - Must comply with standard specification for performance of exterior windows or curtain walls when impacted by windborne debris at level D and after cyclic wind loading at the specified design load.

G. Cyclic Wind Load:
   1. Translucent Panels shall be tested for cyclic wind loads and impact resistance per ASTM E 1886-97 and ASTM E 1996-02 at test load to verify the positive and negative design loads and level D impact.

H. Weatherability:
   1. The light transmission shall not decrease more than 6% as measured by ASTM D-1003 over 10 years, or after exposure to temperature of 300°F for 25 minutes (thermal aging performance standard).
   2. The weathering performance should be justified by successful testing of the glazing panel's performance after exposure to actual Florida weather conditions for approximately 10 years in comparison to a new panel assembly. This performance must be demonstrated by providing independent lab test reports for the exposed and a new panel assembly of Quadwall with 10mm exterior, 6' wide x 12' long for:
      a. Uniform static air pressure per ASTM 330 at negative load of -105psf and positive load of 130psf
      b. Impact loading per ASTM E695 of 500 ft-lb.
      c. Cyclic static air pressure at 65 PSF and impact level D per ASTM 1886 & ASTM E1996

3. Test results must show that there is no deterioration in performance for the 10 year's exposed panels versus a new panel.
4. Panels must be manufactured from polycarbonate resin with a permanent, co- extruded ultra-violet protective layer. Post-applied coatings or films of dissimilar materials are unacceptable.
5. The faces shall not become readily detached when exposed to temperatures of 300°F and 0°F for 25 minutes.
6. Thermal aging - the interior and exterior panel shall not change color in excess of 0.75 Delta E per ASTM D2244 and shall not darken more than 0.3 units Delta L per ASTM D2244 and shall show no cracking or crazing when exposed to 300°F for 25 minutes.
7. Panel shall be factory sealed at the sill to restrict dirt ingress.

I. Glare and Diffused Light Transmission:
1. To avoid glare per IECC requirements, the panels shall have a matte finish with a minimum Haze measurement of 90% per ASTM D1003.

2.3 METAL FRAME STRUCTURE

A. Design loads: As indicated on Structural Drawings.

B. The wall light framing is designed to be self-supporting between the support constructions. The deflection of the structural framing members in a direction normal to the plane of the glazing, when subjected to a uniform load deflection, shall not exceed L/120 for the unsupported span per IBC 2012 table 1604.3. The wall lights will impose reactions to the support construction. All adjacent and support construction must support the transfer of all loads including horizontal and vertical, exerted by the wall lights. Design or structural engineering services for the supporting structure or building components is not included in the wall light scope of this section.

C. Water Penetration: The metal framed wall light panels shall allow no water penetration at a minimum differential static pressure of 6.24 lbs. per sqf per AAMA 501 pressure difference recommendations and as demonstrated by prior testing of typical framing sample per ASTM E-331

D. Water test of metal frame structure shall be conducted according to procedures in AAMA 501.2.

E. Maximum air infiltration rate for fenestration of the two panel assemblies of wall light shall be per NFRC 400.

2.4 METAL MATERIALS

A. Extruded Aluminum shall be ANSI/ASTM B221; 6063-T6: 6063-T5 or 6005-T5.

B. Flashing:
1. 5005 H34 aluminum
2. Sheet metal flashings/closures/claddings are to be furnished shop formed to profile - when lengths exceed 10 ft. in nominal 10-ft lengths. Field trimming of the flashing and field forming the ends is necessary to suit as-built conditions. Sheet metal ends are to overlap at least 6-in. to 8-in., set in a full bed of sealant and riveted if required.

C. All Fasteners for aluminum framing to be stainless steel or cadmium plated steel, excluding the final fasteners to the building.

D. Finish: Clear anodized with 5 year warranty.

PART 3 - EXECUTION

3.1 EXAMINATION

A. General Contractor to verify when structural support is ready to receive all work in this section and to convene a Pre-Installation Conference at least one week prior to commencing work of this Section. Attendance required of General Contractor, wall light installer and all parties directly affecting and effected by the work of this section.

B. All submitted opening sizes, dimensions and tolerances are to be field verified by general contractor unless otherwise stipulated.

C. Installer shall examine area of installation to verify readiness of site conditions. Notify general contractor about any defects requiring correction. Do not work until conditions are satisfactory.

3.2 INSTALLATION

A. Install components in strict accordance with manufacturer's instructions and approved shop drawings. Use proper fasteners, caulking and hardware for material attachments as specified.

B. Use methods of attachment to structure allowing sufficient adjustment to accommodate tolerances.

C. Remove all protective coverings on panels immediately after installation.

3.3 CLEANING

A. Follow manufacturer's instructions when washing down exposed panel surfaces using a solution of mild detergent in warm water that is applied with soft, clean wiping cloths. Always test a small area before applying to the entire area.

B. Follow strict panel manufacturer guidelines when removing foreign substances from panel surfaces requiring mineral spirits or any solvents that are acceptable for use. Always test a small sample to validate compliance before applying to the entire glazing panels.

C. Installers shall leave panel system clean at completion of installation. Final cleaning is by others upon completion of project, following manufacturer's cleaning instructions.

END OF SECTION

SECTION 08 62 23

TUBULAR SKYLIGHTS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Tubular skylights, consisting of skylight dome, reflective tube, and diffuser assembly.

1.2 REFERENCE STANDARDS

A. AAMA/WDMA/CSA 101/I.S.2/A440 - North American Fenestration Standard/Specification for windows, doors, and skylights; 2011.

B. AAMA Standard 1600, Voluntary Specification for Skylights

C. ASTM D635 - Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position; 2014.

D. ASTM D1929 - Standard Test Method for Determining Ignition Temperature of Plastics; 2016.

E. ASTM D2843 - Standard Test Method for Density of Smoke from the Burning or Decomposition of Plastics; 2010.

F. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2016.

G. ASTM E283 - Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen; 2004 (Reapproved 2012).

1.3 SUBMITTALS

A. Product Data: Manufacturer's data sheets on each product to be used, including:
   1. Preparation instructions and recommendations.
   2. Storage and handling requirements and recommendations.
   3. Installation methods.

B. Shop Drawings: Submit shop drawings showing layout, profiles and product components, including anchorage, flashings and accessories.

C. Grade Substantiation: Prior to submitting shop drawings or starting fabrication, submit one of the following showing compliance with specified grade:
   1. Evidence of AAMA Certification.
   2. Evidence of WDMA Certification.
   3. Evidence of CSA Certification.
   4. Test report(s) by independent testing agency itemizing compliance and acceptable to authorities having jurisdiction.

D. Test Reports: Prior to submitting shop drawings or starting fabrication, submit test report(s) by independent testing agency showing compliance with performance requirements in excess of those prescribed by specified grade.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with not less than ten years documented experience.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.

B. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.6 FIELD CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

1.7 WARRANTY

A. Skylights: Manufacturer's standard warranty for 10 years.

B. Electrical Parts: Manufacturer's standard warranty for three years, unless otherwise indicated.

PART 2 PRODUCTS

2.1 TUBULAR SKYLIGHTS

A. Tubular Skylights: Transparent roof-mounted skylight dome and curb, reflective tube, and ceiling level diffuser assembly, transferring sunlight to interior spaces.
   1. Fabrication and assembly of components is by single manufacturer.
   2. Non-Metal Parts: Flammability less than the following.
      a. Roof-Top Components: Class B when tested in accordance with ASTM E108 or UL 790.
      b. Self-Ignition Temperature: Greater than 650 degrees F, when tested in accordance with ASTM D1929.
      c. Smoke Developed Index: Maximum of 450, when tested in accordance with ASTM E84; or maximum rating of 75, when tested in accordance with ASTM D2843.
      d. Combustibility - Light Transmitting Parts: Minimum 2.5 inches/min (ICC Class CC-2), when tested in accordance with ASTM D635.
      e. Combustibility - Non-Light Transmitting Parts: Minimum 2.5 inches/min (ICC Class CC-2), when tested in accordance with ASTM D635.
   3. Thermal Movement: Fabricate to allow for thermal movement resulting from temperature differential from minus 30 to 180 degrees F without damage to components, fasteners, or substrates.

B. Basis-of-Design: Solatube Model 750 DS-O Closed Ceiling, 21 inch Daylighting System:
   1. Roof Dome Assembly: Transparent, UV and impact resistant dome with flashing base supporting dome and top of tube.
      a. Outer Dome Glazing: Type DA, 0.125 inch minimum thickness injection molded acrylic classified as CC2 material; UV inhibiting (100 percent UV C, 100 percent UV B and 98.5 percent UV C), impact modified acrylic blend.
      b. Raybender 3000: Variable prism optic molded into outer dome to capture low angle sunlight and limit high angle sunlight.
      c. Inner Dome Glazing: Type DAI, 0.115 inch minimum thickness acrylic classified as CC2 material.
   2. Roof Flashing Base:
      a. One Piece: One piece, seamless, leak-proof flashing functioning as base support for dome and top of tube. Sheet steel, corrosion resistant conforming to ASTM A 653/A 653M or ASTM A 463/A 463M, 0.028 inch thick.
         1) Base Style: Type FC, Curb cap, with inside dimensions of 27 inches by 27 inches to cover roof curb.
   3. Dome Edge Protection Band: Type PB, For fire rated roofs with turret height less than 8 inches Galvanized steel. Nominal thickness of 0.039 inch.
   4. Tube Ring: Attached to top of base section; 0.090 inch nominal thickness injection molded high impact PVC; to prevent thermal bridging between base flashing and tubing and channel condensed moisture out of tubing.
   5. Tube Ring Seal: Attached to the base of the dome ring; butyl glazing rope 0.24 inch diameter; to minimize air infiltration
   6. Dome Seal: Adhesive backed weatherstrip, 0.63 inch tall by 0.28 inch wide.
   7. Reflective Tubes: Aluminum sheet, thickness 0.018 inch.
      a. General:
         1) Interior Finish: Spectralight Infinity high reflectance specular finish on exposed reflective surface. Specular reflectance for visible spectrum (400 nm to 760 nm) greater than 99 percent. Total solar spectrum reflectance (400 nm to 2500 nm) less than 80.2 percent.
         2) Color: a* and b* (defined by CIE L*a*b* color model) shall not exceed plus 2 or be less than minus 2 as determined in accordance to ASTM E 308.
   8. Diffuser Assemblies for Tubes Not Penetrating Ceilings (Open Ceiling): Solatube Model 750 DS-O. 21 inch diameter diffuser attached directly to bottom of tube.
      a. Lens: Type L2, Prismatic lens designed to maximize light output and diffusion. Visible Light Transmission shall be greater than 90 percent at 0.100 inch thick. Classified as CC2.

b. Diffuser Seal: Open cell foam, acrylic adhesive backed, 0.75 in wide by 0.125 in thick to minimize condensation and bug, dirt and air infiltration per ASTM E 283.
c. Diffuser Trim Ring: Injection molded acrylic. Nominal wall thickness 0.172 inches.

9. Accessories:
   a. Closed Ceiling Trim Ring: Type R, ABS Plastic, White; nominal thickness of 0.04 inch.
   b. Local Dimmer Control utilizing a butterfly baffle design of Spectralight Infinity reflective material to minimize shadowing when in use: Provided with dimmer switch and cable.
      1) Daylight Dimmer: (Provide in locations indicated) Type D Electro-mechanically actuated daylight valve; for universal input voltages ranging between 90 and 277 V at 50 or 60 Hz; maximum current draw of 50 ma per unit; controlled by low voltage, series Type T02: circuited, 4 conductor, size 22 cable; providing daylight output between 2 and 100 percent. Provided with dimmer switch and cable.
      2) Switch: Type SW, Manufacturer-specific low voltage DC DP/DT switch (white) required to operate Daylight Dimmer.
      3) Cable: Type CA, Two conductor low voltage cable (500 foot) for multiple unit DC connection.
   c. Security Kit: Type SK Dome Security Kit, rivets with nylon spacers to replace dome screws.

2.2 PERFORMANCE REQUIREMENTS

A. Grade: AAMA/WDMA/CSA 101/I.S.2/A440 requirements for specific tubular skylight:
   1. Product Type: Tubular Daylighting Device, Closed Ceiling (TDDCC).

B. Positive and negative wind loads as indicated on structural drawings.

C. No permanent deflection in excess of 0.2 percent of span.

D. Air Infiltration: Maximum 0.10 cu ft/min sq ft per unit area of outside frame dimension at 6.27 psf pressure differential when tested in accordance with ASTM E283.

E. Water Resistance: No uncontrolled water leakage at 6.27 psf pressure differential with water rate of 5 gallons/h/sf, when tested in accordance with ASTM E331; design to ensure that water will not accumulate inside assembly.

2.3 ACCESSORIES

A. Fasteners: Same material as metals being fastened, non-magnetic steel, non-corrosive metal of type recommended by manufacturer, or injection molded nylon.

B. Suspension Wire: Steel, annealed, galvanized finish, size and type for application and ceiling system requirement.

C. Sealant: Elastomeric, silicone or polyurethane; compatible with materials being sealed.

PART 3 EXECUTION

3.1 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.

B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 INSTALLATION

A. Install in accordance with manufacturer's written instructions.

B. Set roof assembly flashing in continuous bead of sealant.

C. Seal joints exposed to weather in accordance with sealant manufacturer's written instructions.

D. Conduct field test for water tightness; conduct water test in presence of Architect. Correct defective work and re-test until satisfactory.

3.4 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Date of Substantial Completion.

END OF SECTION

SECTION 08 71 00

DOOR HARDWARE

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. Mechanical door hardware for the following:

   a. Swinging doors.
   b. Sliding doors.

2. Cylinders for door hardware specified in other Sections.
3. Electrified door hardware.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Details of electrified door hardware.

C. Samples: For each exposed product and for each color and texture specified.

D. Other Action Submittals:

1. Door Hardware Schedule: Prepared by or under the supervision of Installer, detailing fabrication and assembly of door hardware, as well as installation procedures and diagrams. Coordinate final door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.

   a. Format: Use same scheduling sequence and vertical format and use same door numbers as in the Contract Documents.
   b. Content: Include the following information:

      1) Identification number, location, hand, fire rating, size, and material of each door and frame.
      2) Locations of each door hardware set, cross-referenced to Drawings on floor plans and to door and frame schedule.
      3) Complete designations, including name and manufacturer, type, style, function, size, quantity, function, and finish of each door hardware product.
      4) Description of electrified door hardware sequences of operation and interfaces with other building control systems.

2. Keying Schedule: Prepared by or under the supervision of Supplier, detailing Owner's final keying instructions for locks.

1.3 QUALITY ASSURANCE

A. Supplier Qualifications: The hardware supplier shall be a corporate member in good standing of The Door and Hardware Institute (DHI), employing at least one Architectural Hardware Consultant (AHC) who is currently participating in DHI's continuing education program (CEP).

B. Source Limitations: Provide electrified door hardware from same manufacturer as mechanical door hardware, unless otherwise indicated.

C. Items of hardware not definitely specified herein but necessary for completion of the work shall be provided. Such items shall be of type and quality suitable to the service required and comparable to the adjacent hardware. Where size and shape of members is such as to prevent the use of types specified, hardware shall be furnished of suitable types having as nearly as practicable the same operation and quality as the type specified. Sizes shall be adequate for the service required.

D. Include such nuances as strike type, strike lip length, raised barrel hinges, mounting brackets, blade stop spacers, special templates, fasteners, shims, and coordination between conflicting products. All doors shall be provided with a stop.

E. Fire-Rated Door Assemblies: Where fire-rated door assemblies are indicated, provide door hardware rated for use in assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10C, unless otherwise indicated. Provide positive latching and self-closing, regardless if specified in sets.

F. Smoke- and Draft-Control Door Assemblies: Where smoke- and draft-control door assemblies are required, provide door hardware that meet requirements of assemblies tested according to UL 1784 and installed in compliance with NFPA 105.

1. Air Leakage Rate: Maximum air leakage of0.3 cfm/sq. ft. (3 cu. m per minute/sq. m) at the tested pressure differential of 0.3-inch wg (75 Pa) of water.

G. Electrified Door Hardware: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction.

H. Means of Egress Doors: Latches do not require more than 15 lbf (67 N) to release the latch. Locks do not require use of a key, tool, or special knowledge for operation.

I. Accessibility Requirements: For door hardware on doors in an accessible route, comply with ICC/ANSI A117.1.

1. Provide operating devices that do not require tight grasping, pinching, or twisting of the wrist and that operate with a force of not more than 5 lbf (22.2 N).
2. Comply with the following maximum opening-force requirements:

    a. Interior, Non-Fire-Rated Hinged Doors: 5 lbf (22.2 N) applied perpendicular to door.
    b. Sliding or Folding Doors: 5 lbf (22.2 N) applied parallel to door at latch.
    c. Fire Doors: Minimum opening force allowable by authorities having jurisdiction.

3. Bevel raised thresholds with a slope of not more than 1:2. Provide thresholds not more than 1/2 inch (13 mm) high.
4. Adjust door closer sweep periods so that, from an open position of 90 degrees, the door will take at least 5 seconds to move to a point 12 degress from the latch, measured to the leading edge of the door.

J. Keying Conference: Conduct conference at Project site to comply with requirements in Section 013100 "Project Management and Coordination."

1.4 DELIVERY, STORAGE, AND HANDLING

A. Deliver keys and permanent cores to Owner by registered mail or overnight package service.

1.5 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Manufacturers' standard warranty period.

PART 2 - PRODUCTS

2.1 SCHEDULED DOOR HARDWARE

A. Provide door hardware for each door as scheduled in Part 3 "Door Hardware Schedule" Article to comply with requirements in this Section.

1. Door Hardware Sets: Provide quantity, item, size, finish or color indicated, and named manufacturers' products.
2. Sequence of Operation: Provide electrified door hardware function, sequence of operation, and interface with other building control systems indicated.

B. Designations: Requirements for design, grade, function, finish, size, and other distinctive qualities of each type of door hardware are indicated in Part 3 "Door Hardware Schedule" Article. Products are identified by using door hardware designations, as follows:

1. Named Manufacturers' Products: Manufacturer and product designation are listed for each door hardware type required. Manufacturers' names are abbreviated in Part 3 "Door Hardware Schedule" Article.

2.2 CONTINUOUS HINGES

A. Continuous Hinges: BHMA A156.26; minimum 0.120-inch- (3.0-mm-) thick, hinge leaves with minimum overall width of 4 inches (102 mm); fabricated to full height of door and frame and to template screw locations; with components finished after milling and drilling are complete.

B. Continuous, Gear-Type Hinges: Extruded-aluminum, pinless, geared hinge leaves joined by a continuous extruded-aluminum channel cap; with concealed, self-lubricating thrust bearings.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Hager Companies.
b. Select Products Limited.
c. Stanley Commercial Hardware; Div. of The Stanley Works.

2.3 MECHANICAL LOCKS AND LATCHES

A. Strikes: Provide manufacturer's standard strike for each lock bolt or latchbolt complying with requirements indicated for applicable lock or latch and with strike box and curved lip extended to protect frame; finished to match lock or latch.

1. Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.
2. Extra-Long-Lip Strikes: For locks used on frames with applied wood casing trim.
3. Aluminum-Frame Strike Box: Manufacturer's special strike box fabricated for aluminum framing.

B. Bored Locks: BHMA A156.2; Grade 1; Series 4000.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Best Access Systems; Div. of Stanley Security Solutions, Inc.
b. Corbin Russwin Architectural Hardware; n ASSA ABLOY Group Company.
c. SARGENT Manufacturing Company; an ASSA ABLOY Group company.

C. Push-Pull Latches: Mortise, BHMA A156.13; Grade 1; with paddle handles that retract latchbolt; capable of being mounted vertically or horizontally.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Architectural Builders Hardware Mfg., Inc.
b. Corbin Russwin Architectural Hardware; an ASSA ABLOY Group company.
c. SARGENT Manufacturing Company; an ASSA ABLOY Group company.

2.4 AUXILIARY LOCKS

A. Narrow Stile Auxiliary Locks: BHMA A156.5; Grade 1; with strike that suits frame.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Adams Rite Manufacturing Co.; an ASSA ABLOY Group company.

2.5 MANUAL FLUSH BOLTS

A. Manual Flush Bolts: BHMA A156.16; minimum 3/4-inch (19-mm) throw; designed for mortising into door edge.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Hager Companies.
b. Rockwood Manufacturing Company.
c. Trimco.

2.6 AUTOMATIC AND SELF-LATCHING FLUSH BOLTS

A. Automatic and Self-Latching Flush Bolts: BHMA A156.16; minimum 3/4-inch (19-mm) throw; designed for mortising into door edge.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Hager Companies.
b. Rockwood Manufacturing Company.
c. Trimco.

2.7 EXIT DEVICES AND AUXILIARY ITEMS

A. Exit Devices and Auxiliary Items: BHMA A156.3.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Corbin Russwin Architectural Hardware; an ASSA ABLOY Group company.
b. Precision Hardware, Inc.; Division of Stanley Security Solutions, Inc.
c. SARGENT Manufacturing Company; an ASSA ABLOY Group company.

2.8 LOCK CYLINDERS

A. Lock Cylinders: Tumbler type, constructed from brass or bronze, stainless steel, or nickel silver.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. Best Access Systems; Div. of Stanley Security Solutions, Inc.

B. Construction Cores: Provide construction cores that are replaceable by permanent cores. Provide 10 construction master keys.

2.9 KEYING

A. Keying System: Factory registered, complying with guidelines in BHMA A156.28, Appendix A. Incorporate decisions made in keying conference.
1. Existing System:

a. Master key or grand master key locks to Owner's existing Best system.

B. Keys: Brass.

1. Stamping: Permanently inscribe each key with a visual key control number and include the following notation:

a. Notation: Information to be furnished by Owner.

2. Quantity: In addition to one extra key blank for each lock, provide the following:

a. Cylinder Change Keys: Three.
b. Master Keys: Five.

2.10 KEY CONTROL SYSTEM

A. Key Control Cabinet: BHMA A156.5; metal cabinet with baked-enamel finish; containing key-holding hooks, labels, 2 sets of key tags with self-locking key holders, key-gathering envelopes, and temporary and permanent markers; with key capacity of 150 percent of the number of locks.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. American Key Boxes and Cabinets.
b. GE Security, Inc.

c. HPC, Inc.
d. Lund Equipment Co., Inc.
e. MMF Industries.
f. Tri Palm International.

2. Wall-Mounted Cabinet: Cabinet with hinged-panel door equipped with key-holding panels and pin-tumbler cylinder door lock.

2.11 OPERATING TRIM

A. Operating Trim: BHMA A156.6; stainless steel, unless otherwise indicated.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Hager Companies.
b. Rockwood Manufacturing Company.
c. Trimco.

2.12 ACCESSORIES FOR PAIRS OF DOORS

A. Coordinators: BHMA A156.3; consisting of active-leaf, hold-open lever and inactive-leaf release trigger; fabricated from steel with nylon-coated strike plates; with built-in, adjustable safety release; and with internal override.

B. Carry-Open Bars: BHMA A156.3; prevent the inactive leaf from opening before the active leaf; provide polished brass or bronze carry-open bars with strike plate for inactive leaves of pairs of doors unless automatic or self-latching bolts are used.

C. Astragals: BHMA A156.22.

2.13 SURFACE CLOSERS

A. Surface Closers: BHMA A156.4; rack-and-pinion hydraulic type with adjustable sweep and latch speeds controlled by key-operated valves and forged-steel main arm. Comply with manufacturer's written recommendations for size of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Provide factory-sized closers, adjustable to meet field conditions and requirements for opening force. Provide extra duty arms at parallel arm closers.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Corbin Russwin Architectural Hardware; an ASSA ABLOY Group company. DC8000 Series.
b. SARGENT Manufacturing Company; an ASSA ABLOY Group company. 281 Series.
c. Stanley Door Closers; a Division of Stanley Security Solutions, Inc. D-4550 Series.

2.14 MECHANICAL STOPS AND HOLDERS

A. Wall- and Floor-Mounted Stops: BHMA A156.16; polished cast brass base metal.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Hager Companies.
b. Rockwood Manufacturing Company.

c. Trimco.

2.15 OVERHEAD STOPS AND HOLDERS

A. Overhead Stops and Holders: BHMA A156.8.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Architectural Builders Hardware Mfg., Inc.
b. Rockwood Manufacturing Company.
c. SARGENT Manufacturing Company; an ASSA ABLOY Group company.

2.16 DOOR GASKETING

A. Door Gasketing: BHMA A156.22; air leakage not to exceed 0.50 cfm per foot (0.000774 cu. m/s per m) of crack length for gasketing other than for smoke control, as tested according to ASTM E 283; with resilient or flexible seal strips that are easily replaceable and readily available from stocks maintained by manufacturer.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Hager Companies.
b. National Guard Products.
c. Pemko Manufacturing Co.; an ASSA ABLOY Group company.
d. Reese Enterprises, Inc.

2.17 THRESHOLDS

A. Thresholds: BHMA A156.21; fabricated to full width of opening indicated.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Hager Companies.
b. National Guard Products.
c. Pemko Manufacturing Co.; an ASSA ABLOY Group company.
d. Reese Enterprises, Inc.

2.18 METAL PROTECTIVE TRIM UNITS

A. Metal Protective Trim Units: BHMA A156.6; fabricated from 0.050-inch- (1.3-mm-) thick stainless steel; with manufacturer's standard machine or self-tapping screw fasteners.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Hager Companies.
b. Rockwood Manufacturing Company.
c. Trimco.

2.19 AUXILIARY DOOR HARDWARE

A. Auxiliary Hardware: BHMA A156.16.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Hager Companies.
    b. Rockwood Manufacturing Company.
    c. Stanley Commercial Hardware; Div. of The Stanley Works.
    d. Trimco.

2.20 AUXILIARY ELECTRIFIED DOOR HARDWARE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Securitron Magnalock Corporation; an ASSA ABLOY Group company.
2. Hanchett Entry Systems, Inc.; an ASSA ABLOY Group company.
3. Trine Access Technology.

2.21 FABRICATION

A. Fasteners: Provide door hardware manufactured to comply with published templates prepared for machine, wood, and sheet metal screws. Provide screws that comply with commercially recognized industry standards for application intended, except aluminum fasteners are not permitted. Provide Phillips flat-head screws with finished heads to match surface of door hardware, unless otherwise indicated.

1. Concealed Fasteners: For door hardware units that are exposed when door is closed, except for units already specified with concealed fasteners. Do not use through bolts for installation where bolt head or nut on opposite face is exposed unless it is the only means of securely attaching the door hardware. Where through bolts are used on hollow door and frame construction, provide sleeves for each through bolt.
2. Fire-Rated Applications:

    a. Wood or Machine Screws: For the following:

        1) Hinges mortised to doors or frames; use threaded-to-the-head wood screws for wood doors and frames.
        2) Strike plates to frames.
        3) Closers to doors and frames.

    b. Steel Through Bolts: For the following unless door blocking is provided:

        1) Surface hinges to doors.
        2) Closers to doors and frames.
        3) Surface-mounted exit devices.

3. Spacers or Sex Bolts: For through bolting of hollow-metal doors.
4. Fasteners for Wood Doors: Comply with requirements in DHI WDHS.2, "Recommended Fasteners for Wood Doors."
5. Gasketing Fasteners: Provide noncorrosive fasteners for exterior applications and elsewhere as indicated.

2.22 FINISHES

A. Provide finishes complying with BHMA A156.18 as indicated in door hardware schedule.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Steel Doors and Frames: For surface applied door hardware, drill and tap doors and frames according to ANSI/SDI A250.6.

B. Wood Doors: Comply with DHI WDHS.5 "Recommended Hardware Reinforcement Locations for Mineral Core Wood Flush Doors."

C. Mounting Heights: Mount door hardware units at heights to comply with the following unless otherwise indicated or required to comply with governing regulations.

1. Standard Steel Doors and Frames: ANSI/SDI A250.8.
2. Wood Doors: DHI WDHS.3, "Recommended Locations for Architectural Hardware for Wood Flush Doors."

D. Install each door hardware item to comply with manufacturer's written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work. Do not install surface-mounted items until finishes have been completed on substrates involved.

1. Set units level, plumb, and true to line and location. Adjust and reinforce attachment substrates as necessary for proper installation and operation.
2. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.

E. Hinges: Install types and in quantities indicated in door hardware schedule but not fewer than the number recommended by manufacturer for application indicated or one hinge for every 30 inches (750 mm) of door height, whichever is more stringent, unless other equivalent means of support for door, such as spring hinges or pivots, are provided.

F. Lock Cylinders: Install construction cores to secure building and areas during construction period.

1. Replace construction cores with permanent cores as directed by Owner.

G. Key Control System: Tag keys and place them on markers and hooks in key control system cabinet, as determined by final keying schedule.

H. Boxed Power Supplies: Locate power supplies as indicated or, if not indicated, in equipment room. Verify location with Architect.

1. Configuration: Provide least number of power supplies required to adequately serve doors with electrified door hardware.

I. Thresholds: Set thresholds for exterior doors and other doors indicated in full bed of sealant complying with requirements specified in Section 079200 "Joint Sealants."

J. Stops: Provide floor stops for doors unless wall or other type stops are indicated in door hardware schedule. Do not mount floor stops where they will impede traffic.

K. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.

L. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.

M. Door Bottoms: Apply to bottom of door, forming seal with threshold when door is closed.

N. Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

3.2 DOOR HARDWARE SCHEDULE

HARDWARE SET 1

1	EA	CONTINUOUS HINGE	780-112HD	628	HAG
1	EA	ELECTRIC STRIKE	9600	630	HES
1	EA	SMART PAC	2005M3		HES
1	EA	EXIT DEVICE	2103CD X CA-03	630	PRE
2	EA	CYLINDER	AS REQUIRED	626	BES
1	EA	PULL	BF157	630	ROC
1	EA	OVERHEAD STOP	1000	630	ABH
1	EA	AUTO OPERATOR	MAC-LL1C-R	628	MOT
1	EA	ACTUATOR	10PBS1	630	BEA
1	EA	WEATHER RING	10WRSQ475		BEA
1	EA	BOLLARD	10BOLLARDSLV	689	BEA
1	EA	THRESHOLD	8425	719	NGP
1	EA	SWEEP	200NA	628	NGP
1	SET	WEATHERSTRIPPING	BY DOOR AND FRAME MANUFACTURER		
1	EA	CARD READER	BY SECURITY CONTRACTOR		

OPERATIONAL DESCRIPTION: Door normally closed, locked and exterior actuator is deactivated. Valid credential allows entry and use of exterior actuator. Vestibule actuator always active for use. Door remains closed and locked upon loss of power. Free egress at all times.

HARDWARE SET 2

1	EA	CONTINUOUS HINGE	780-112HD	628	HAG
1	EA	DUMMY BAR	674DR	630	PRE
1	EA	PULL	BF157	630	ROC
1	EA	AUTO OPERATOR	MAC-ML1C-R	628	MOT
1	EA	ACTUATOR	10PBDGP1	630	BEA
1	EA	ACTUATOR	10PBS1	630	BEA
2	EA	MOUNTING BOX	10BOX475SQFM	BLK	BEA
1	EA	WALL STOP	403	626	ROC

HARDWARE SET 3

1	EA	CONTINUOUS HINGE	780-224HD	628	HAG
1	EA	ELECTRIC STRIKE	1500	630	HES
1	EA	STOREROOM	9K3 7D 14C S3	626	BES
1	EA	CLOSER	D-4551	689	STA
1	EA	KICK PLATE	10” X 2” LDW	630	ROC
1	EA	WALL STOP	403	626	ROC
1	EA	CARD READER	BY SECURITY CONTRACTOR		

OPERATIONAL DESCRIPTION: Door normally closed and locked. Valid credential allows entry. Door remains closed and locked upon loss of power. Free egress at all times.

HARDWARE SET 4

HARDWARE BY DOOR SUPPLIER

HARDWARE SET 5

1	EA	CONTINUOUS HINGE	780-224HD	628	HAG
1	EA	PRIVACY	9K3 0L 14C S3	626	BES
1	EA	WALL STOP	403	626	ROC

HARDWARE SET 6

1	EA	CONTINUOUS HINGE	780-224HD	628	HAG
1	EA	OFFICE	9K3 7AB 14C S3	626	BES
1	EA	WALL STOP	403	626	ROC
1	SET	SEALS	5050	BLK	NGP

HARDWARE SET 7

1	EA	CONTINUOUS HINGE	780-224HD	628	HAG
1	EA	STOREROOM	9K3 7D 14C S3	626	BES
1	EA	CLOSER	D-4551	689	STA
1	EA	KICK PLATE	10” X 2” LDW	630	ROC
1	EA	WALL STOP	403	626	ROC

HARDWARE SET 8

1	EA	CONTINUOUS HINGE	780-112HD	628	HAG
1	EA	ELECTRIC STRIKE	9600	630	HES
1	EA	SMART PAC	2005M3		HES
1	EA	EXIT DEVICE	2103CD X CA-03	630	PRE
2	EA	CYLINDER	AS REQUIRED	626	BES
1	EA	PULL	BF157	630	ROC
1	EA	OVERHEAD STOP	1000	630	ABH
1	EA	DROP PLATE	P45-180	689	STA
1	EA	CLOSER	D-4550	689	STA
1	EA	THRESHOLD	8425	719	NGP
1	EA	SWEEP	200NA	628	NGP
1	SET	WEATHERSTRIPPING	BY DOOR AND FRAME MANUFACTURER		
1	EA	CARD READER	BY SECURITY CONTRACTOR		

OPERATIONAL DESCRIPTION: Door normally closed and locked. Valid credential allows entry. Door remains closed and locked upon loss of power. Free egress at all times.

HARDWARE SET 9

1	EA	CONTINUOUS HINGE	780-224HD	628	HAG
1	EA	STOREROOM	9K3 7D 14C S3	626	BES
1	EA	CLOSER	D-4550 CS	689	STA
1	EA	KICK PLATE	10” X 2” LDW	630	ROC
1	EA	THRESHOLD	8425	719	NGP
1	EA	SWEEP	200NA	628	NGP
1	SET	WEATHERSTRIPPING	9700A	628	NGP
1	EA	DRIP CAP	16A	628	NGP

HARDWARE SET 10

1	EA	CONTINUOUS HINGE	780-224HD	628	HAG
1	EA	CLASSROOM	9K3 7R 14C S3	626	BES
1	EA	KICK PLATE	10” X 2” LDW	630	ROC
1	EA	WALL STOP	403	626	ROC

HARDWARE SET 11

1	EA	CONTINUOUS HINGE	780-224HD	628	HAG
1	EA	PASSAGE	9K3 0N 14C S3	626	BES
1	EA	CLOSER	D-4551 DA H	689	STA
1	EA	KICK PLATE	10" X 2" LDW	630	ROC
1	EA	WALL STOP	403	626	ROC

HARDWARE SET 12

1	EA	CONTINOUS HINGE	780-224HD	628	HAG
1	EA	PUSH PLATE	70F 8" X 16" LDW	630	ROC
1	EA	PULL PLATE	BF111 X 70C 4" X 16" LDW	630	ROC
1	EA	OVERHEAD STOP	4400	630	ABH
1	EA	CLOSER	D-4551	689	STA
1	EA	KICK PLATE	10" X 2" LDW	630	ROC
1	SET	SEALS	5050	BLK	NGP
1	EA	AUTO DOOR BOTTOM	423N	628	NGP

HARDWARE SET 13

1	EA	CONTINUOUS HINGE	780-224HD	628	HAG
1	EA	EXIT DEVICE	2101	630	PRE
1	EA	CLOSER	D-4550 CS	689	STA
1	EA	KICK PLATE	10" X 2" LDW	630	ROC
1	EA	THRESHOLD	8425	719	NGP
1	EA	SWEEP	200NA	628	NGP
1	SET	WEATHERSTRIPPING	9700	628	NGP
1	EA	DRIP CAP	16A	628	NGP

HARDWARE SET 14

2	EA	CONTINUOUS HINGE	780-224HD	628	HAG
1	EA	FLUSH BOLT	555	626	ROC
1	EA	CLASSROOM	9K3 7R 14C S3	626	BES
2	EA	OVERHEAD STOP	4400	630	ABH

HARDWARE SET 15

1	EA	CONTINUOUS HINGE	780-224HD	628	HAG
1	EA	DEADLATCH	2190-4-1-1-1-01	630	ADA
1	EA	CYLINDER	AS REQUIRED	626	BES
1	EA	ADA THUMBTURN CYLINDER	AS REQUIRED	626	BES
1	EA	OVERHEAD HOLDER	1000	630	ABH
1	EA	DROP PLATE	P45-180	689	STA
1	EA	CLOSER	D-4550	689	STA
1	EA	THRESHOLD	8425	719	NGP
1	EA	SWEEP	200NA	628	NGP
1	SET	WEATHERSTRIPPING	BY DOOR AND FRAME MANUFACTURER		

HARDWARE SET 16

1	EA	CONTINUOUS HINGE	780-224HD	628	HAG
1	EA	CLASSROOM	9K3 7R 14C S3	626	BES
1	EA	CLOSER	D-4551	689	STA
1	EA	WALL STOP	403	626	ROC
1	EA	SWEEP	198NA	628	NGP
1	SET	WEATHERSTRIPPING	BY DOOR AND FRAME MANUFACTURER		

HARDWARE SET 17

1	EA	CONTINUOUS HINGE	780-224HD	628	HAG
1	EA	ELECTRIC STRIKE	1500	630	HES
1	EA	STOREROOM	9K3 7D 14C S3	626	BES
1	EA	CLOSER	D-4551	689	STA
1	EA	WALL STOP	403	626	ROC
1	EA	CARD READER	BY SECURITY CONTRACTOR		

OPERATIONAL DESCRIPTION: Door normally closed and locked. Valid credential allows entry. Door remains closed and locked upon loss of power. Free egress at all times.

HARDWARE SET 18

2	EA	CONTINUOUS HINGE	780-224HD	628	HAG
1	EA	FLUSH BOLT	555	626	ROC
1	EA	STOREROOM	9K3 7D 14C S3	626	BES
2	EA	OVERHEAD STOP	4400	630	ABH

HARDWARE SET 19

1	EA	CONTINUOUS HINGE	780-224HD	628	HAG
1	EA	PRIVACY	9K3 0L 14C S3	626	BES
1	EA	OVERHEAD STOP	4400	630	ABH

HARDWARE SET 20

1	EA	BYPASS HARDWARE	HBP200A	628	PEM
1	EA	BYPASS FASCIA	F134C	628	PEM
2	EA	FLUSH PULL	BF97L	630	ROC

HARDWARE SET 21

1	EA	CONTINUOUS HINGE	780-224HD	628	HAG
1	EA	EXIT DEVICE	2108CD X 4908D	630	PRE
2	EA	CYLINDER	AS REQUIRED	626	BES
1	EA	CLOSER	D-4550 CS	689	STA
1	EA	KICK PLATE	10” X 2” LDW	630	ROC

HARDWARE SET 22

1	EA	CONTINUOUS HINGE	780-224HD	628	HAG
1	EA	ELECTRIC STRIKE	9600	630	HES
1	EA	SMART PAC	2005M3		HES
1	EA	EXIT DEVICE	2103CD X CA-03	630	PRE
2	EA	CYLINDER	AS REQUIRED	626	BES
1	EA	PULL	BF157	630	ROC
1	EA	CLOSER	D-4550 CS	689	STA
1	EA	THRESHOLD	8425	719	NGP
1	EA	SWEEP	200NA	628	NGP
1	SET	WEATHERSTRIPPING	9700A	628	NGP
1	EA	DRIP CAP	16A	628	NGP
1	EA	CARD READER	BY SECURITY CONTRACTOR		

OPERATIONAL DESCRIPTION: Door normally closed and locked. Valid credential allows entry. Door remains closed and locked upon loss of power. Free egress at all times.

END OF SECTION 087100

SECTION 08 80 00

GLAZING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Insulating glass units.

B. Glazing units.

C. Plastic films.

D. Glazing compounds and accessories.

1.2 RELATED REQUIREMENTS

A. Section 08 11 13 - Hollow Metal Doors and Frames: Glazed lites in doors and borrowed lites.

B. Section 08 14 16 - Flush Wood Doors: Glazed lites in doors.

C. Section 08 43 13 - Aluminum-Framed Storefronts: Glazing furnished as part of storefront assembly.

D. Section 08 44 13 - Glazed Aluminum Curtain Walls: Glazing furnished as part of wall assembly.

1.3 REFERENCE STANDARDS

A. 16 CFR 1201 - Safety Standard for Architectural Glazing Materials; current edition.

B. ANSI Z97.1 - American National Standard for Safety Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test; 2015.

C. ASTM C864 - Standard Specification for Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers; 2005 (Reapproved 2015).

D. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2014a.

E. ASTM C1036 - Standard Specification for Flat Glass; 2016.

F. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass; 2012.

G. ASTM C1193 - Standard Guide for Use of Joint Sealants; 2016.

H. ASTM C1376 - Standard Specification for Pyrolytic and Vacuum Deposition Coatings on Flat Glass; 2015.

I. ASTM E1300 - Standard Practice for Determining Load Resistance of Glass in Buildings; 2016.

J. ASTM E2190 - Standard Specification for Insulating Glass Unit Performance and Evaluation; 2010.

K. GANA (GM) - GANA Glazing Manual; 2009.

L. GANA (SM) - GANA Sealant Manual; 2008.

M. ITS (DIR) - Directory of Listed Products; current edition.

N. NFRC 100 - Procedure for Determining Fenestration Product U-factors; 2014.

O. NFRC 200 - Procedure for Determining Fenestration Product Solar Heat Gain Coefficient and Visible Transmittance at Normal Incidence; 2014.

P. NFRC 300 - Test Method for Determining the Solar Optical Properties of Glazing Materials and Systems; 2014.

Q. UL (DIR) - Online Certifications Directory; current listings at database.ul.com.

1.4 SUBMITTALS

A. Product Data on Insulating Glass Unit, Glazing Unit, and Plastic Film Glazing Types: Provide structural, physical and environmental characteristics, size limitations, special handling and installation requirements.

B. Product Data on Glazing Compounds and Accessories: Provide chemical, functional, and environmental characteristics, limitations, special application requirements. Identify available colors.

C. Samples: Submit two samples 12 by 12 inch in size of glass units.

D. Certificate: Certify that products of this section meet or exceed specified requirements.

E. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with GANA (GM) and GANA (SM) for glazing installation methods.

B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years documented experience.

1.6 PRECONSTRUCTION TESTING

A. Preconstruction Adhesion and Compatibility Testing: Test each glazing material type, tape sealant, gasket, glazing accessory, and glass-framing member for adhesion to and compatibility with elastomeric glazing sealants.
   1. Testing will not be required if data are submitted based on previous testing of current sealant products and glazing materials matching those submitted.

1.7 WARRANTY

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Float Glass Manufacturers:
   1. Cardinal Glass Industries: www.cardinalcorp.com.
   2. Guardian Industries Corp: www.sunguardglass.com.
   3. Pilkington North America Inc: www.pilkington.com/na.
   4. PPG Industries, Inc: www.ppgideascapes.com.

B. Fire-Protection-Rated Glass Manufacturers: Provide products as required to achieve indicated fire-rating period.
   1. SAFTIFIRST, a division of O'Keeffe's Inc; SuperLite I-XL: www.safti.com/sle.
   2. Technical Glass Products; FireLite Plus: www.fireglass.com.

2.2 PERFORMANCE REQUIREMENTS - EXTERIOR GLAZING ASSEMBLIES

A. Provide type and thickness of exterior glazing assemblies to support assembly dead loads, and to withstand live loads caused by positive and negative wind pressure acting normal to plane of glass.
   1. Comply with ASTM E1300 for design load resistance of glass type, thickness, dimensions, and maximum lateral deflection of supported glass.
   2. Provide glass edge support system sufficiently stiff to limit the lateral deflection of supported glass edges to less than 1/175 of their lengths under specified design load.
   3. Glass thicknesses listed are minimum.

B. Vapor Retarder and Air Barrier Seals: Provide completed assemblies that maintain continuity of building enclosure vapor retarder and air barrier.
   1. In conjunction with vapor retarder and joint sealer materials described in other sections.

C. Thermal and Optical Performance: Provide glass products with performance properties as indicated. Performance properties are in accordance with manufacturer's published data as determined with the following procedures and/or test methods:
   1. Center of Glass U-Value: Comply with NFRC 100 using Lawrence Berkeley National Laboratory (LBNL) WINDOW 6.3 computer program.
   2. Center of Glass Solar Heat Gain Coefficient (SHGC): Comply with NFRC 200 using Lawrence Berkeley National Laboratory (LBNL) WINDOW 6.3 computer program.
   3. Solar Optical Properties: Comply with NFRC 300 test method.

2.3 GLASS MATERIALS

A. Float Glass: Provide float glass based glazing unless noted otherwise.
   1. Annealed Type: ASTM C1036, Type I - Transparent Flat, Class 1 - Clear, Quality-Q3.
   2. Heat-Strengthened and Fully Tempered Types: ASTM C1048, Kind HS and FT.
   3. Fully Tempered Safety Glass: Complies with ANSI Z97.1 and 16 CFR 1201 criteria.
   4. Thicknesses: As indicated; provide greater thickness as required for exterior glazing wind load design.

2.4 INSULATING GLASS UNITS

A. Manufacturers:
   1. Fabricator certified by glass manufacturer for type of glass, coating, and treatment involved and capable of providing specified warranty.
   2. Cardinal Glass Industries: www.cardinalcorp.com.
   3. Guardian Industries Corp: www.sunguardglass.com.
   4. Pilkington North America Inc: www.pilkington.com/na.
   5. PPG Industries, Inc: www.ppgideascapes.com.
   6. Viracon, Apogee Enterprises, Inc: www.viracon.com.

B. Insulating Glass Units: Types as indicated.
   1. Durability: Certified by an independent testing agency to comply with ASTM E2190.
   2. Coated Glass: Comply with requirements of ASTM C1376 for pyrolytic (hard-coat) or magnetic sputter vapor deposition (soft-coat) type coatings on flat glass; coated vision glass, Kind CV; coated overhead glass, Kind CO; or coated spandrel glass, Kind CS.
   3. Metal Edge Spacers: Aluminum, bent and soldered corners.
   4. Spacer Color: Aluminum.
   5. Edge Seal:
      a. Dual-Sealed System: Provide polyisobutylene sealant as primary seal applied between spacer and glass panes, and silicone, polysulfide, or polyurethane sealant as secondary seal applied around perimeter.
   6. Color: Black.
   7. Purge interpane space with dry air, hermetically sealed.

2.5 INSULATING GLASS UNITS

A. Insulating Glass Units: Vision glazing, with Low-E coating.
   1. Applications: Exterior insulating glass glazing unless otherwise indicated.
   2. Space between lites filled with air.
   3. Total Thickness: 1 inch.
   4. Thermal Transmittance (U-Value), Winter - Center of Glass: 0.29, nominal.
   5. Visible Light Transmittance (VLT): 70 percent, nominal.
   6. Solar Heat Gain Coefficient (SHGC): 0.39, nominal.
   7. Glazing Method: Dry glazing method, gasket glazing.
   8. Basis of Design - PPG Industries, Inc: www.ppgideascapes.com.
   9. Outboard Lite: Heat-strengthened float glass, 1/4 inch thick, minimum. Provide fully tempered units where saftety glass is required.
      a. Low-E Coating: PPG Solarban 60 on #2 surface.
   10. Inboard Lite: Heat-strengthened float glass, 1/4 inch thick. Provide fully tempered units where saftety glass is required.
      a. Coating: No coating on inboard lite.

2.6 GLAZING UNITS

A. Fire-Protection-Rated Glazing: Type, thickness, and configuration of glazing that contains flame, smoke, and does not block radiant heat, as required to achieve indicated fire-rating period of 45 minutes or less.
   1. Applications:
      a. Glazing in fire-rated door assembly.
      b. Glazing in fire-rated window assembly.
      c. Other locations as indicated on drawings.
   2. Provide products listed by ITS (DIR) or UL (DIR) and approved by authorities having jurisdiction.
   3. Safety Glazing Certification: 16 CFR 1201 Category II.
   4. Fire-Rating Period: As indicated on drawings.
   5. Manufacturers:
      a. SAFTIFIRST, a division of O'Keeffe's Inc; SuperLite I: www.safti.com/sle.
      b. SCHOTT North America Inc; Pyran Platinum: www.us.schott.com.
      c. Technical Glass Products; Firelite Plus: www.fireglass.com.

B. Monolithic Safety Glazing: Non-fire-rated.

1. Applications:
   a. Glazed lites in doors, except fire doors.
   b. Glazed sidelights to doors, except in fire-rated walls and partitions.
   c. Other locations required by applicable federal, state, and local codes and regulations.
   d. Other locations indicated on drawings.
2. Glass Type: Fully tempered safety glass as specified.
3. Tint: Clear.
4. Thicknesses:
   a. For glass units with fully captured edges: 1/4" unless otherwise indicated.
   b. For glass units with top and bottom captured edges, butt-glazed sides:
      1) Up to 5' in height: 1/4".
      2) Over 5' up to 8' in height: 3/8"
      3) Over 8' up to 10' in height:1/2"
      4) Over 10' up to 12' in height: 5/8"
      5) Over 12' up to 14' in height: 3/4"
      6) Over 14' up to 16' in height: 7/8"
      7) Over 16' up to 18' in height: 1"

2.7 GLAZING COMPOUNDS

A. Silicone Sealant: Single component; neutral curing; capable of water immersion without loss of properties; non-bleeding, non-staining; ASTM C920, Type S, Grade NS, Class 25, Uses M, A, and G; with cured Shore A hardness range of 15 to 25; color as selected.

2.8 ACCESSORIES

A. Setting Blocks: Silicone, with 80 to 90 Shore A durometer hardness; ASTM C864 Option II. Length of 0.1 inch for each square foot of glazing or minimum 4 inch x width of glazing rabbet space minus 1/16 inch x height to suit glazing method and pane weight and area.

B. Spacer Shims: Neoprene, 50 to 60 Shore A durometer hardness; ASTM C864 Option II. Minimum 3 inch long x one half the height of the glazing stop x thickness to suit application, self adhesive on one face.

C. Glazing Tape: Closed cell polyvinyl chloride (PVC) foam, coiled on release paper over adhesive on two sides, maximum water absorption by volume of 2 percent, designed for compression of 25 percent to effect an air barrier and vapor retarder seal.

D. Glazing Splines: Resilient silicone extruded shape to suit glazing channel retaining slot; ASTM C864 Option II; color black.

E. Glazing Clips: Manufacturer's standard type.

PART 3 EXECUTION

3.1 PREPARATION

A. Clean contact surfaces with appropriate solvent and wipe dry within maximum of 24 hours before glazing. Remove coatings that are not tightly bonded to substrates.

B. Seal porous glazing channels or recesses with substrate compatible primer or sealer.

C. Prime surfaces scheduled to receive sealant where required for proper sealant adhesion.

3.2 INSTALLATION, GENERAL

A. Install glazing in compliance with written instructions of glass, gaskets, and other glazing material manufacturers, unless more stringent requirements are indicated, including those in glazing referenced standards.

B. Install glazing sealants in accordance with ASTM C1193, GANA (SM), and manufacturer's instructions.

C. Do not exceed edge pressures around perimeter of glass lites as stipulated by glass manufacturer.

D. Set glass lites of system with uniform pattern, draw, bow, and similar characteristics.

E. Set glass lites in proper orientation so that coatings face exterior or interior as indicated.

F. Prevent glass from contact with any contaminating substances that may be the result of construction operations such as, and not limited to the following; weld splatter, fire-safing, plastering, mortar droppings, etc.

3.3 INSTALLATION - DRY GLAZING METHOD (GASKET GLAZING)

A. Application - Exterior and/or Interior Glazed: Set glazing infills from either the exterior or the interior of the building.

B. Place setting blocks at 1/4 points with edge block no more than 6 inch from corners.

C. Rest glazing on setting blocks and push against fixed stop with sufficient pressure on gasket to attain full contact.

D. Install removable stops without displacing glazing gasket; exert pressure for full continuous contact.

3.4 INSTALLATION - PRESSURE GLAZED SYSTEMS

A. Application - Exterior Glazed: Set glazing infills from the exterior of the building.

B. Place setting blocks at 1/4 points with edge block no more than 6 inch from corners.

C. Rest glazing on setting blocks and push against fixed stop with sufficient pressure on gasket to attain full contact.

D. Install pressure plates without displacing glazing gasket; exert pressure for full continuous contact.

3.5 INSTALLATION - STRUCTURAL SILICONE GLAZING

A. Follow basic guidelines of structural silicone glazing for glazing application.
   1. Two-Sided Structural: Glass structurally adhered to vertical mullions with horizontal sides captured in glazing pockets.

B. Provide design review of the glazing system and project details, adhesion testing, proper surface preparation, training and a quality service program.

C. Provide only structural silicone sealant, tested and manufactured for structural glazing.

END OF SECTION

SECTION 08 83 00

MIRRORS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Glass mirrors.

1.2 RELATED REQUIREMENTS

A. Section 06 20 00 - Finish Carpentry: Wood mirror frames.

1.3 REFERENCE STANDARDS

A. ASTM C1036 - Standard Specification for Flat Glass; 2016.

B. ASTM C1503 - Standard Specification for Silvered Flat Glass Mirror; 2008 (Reapproved 2013).

C. GANA (TIPS) - Mirrors: Handle with Extreme Care (Tips for the Professional on the Care and Handling of Mirrors); 2011.

1.4 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data on Mirror Types: Submit structural, physical and environmental characteristics, size limitations, special handling and installation requirements.

1.5 WARRANTY

A. Provide five year manufacturer warranty for reflective coating on mirrors and replacement of same.

PART 2 PRODUCTS

2.1 MATERIALS

A. Mirror Design Criteria: Select materials and/or provide supports as required to limit mirror material deflection to 1/200, or to the flexure limit of glass, with full recovery of glazing materials, whichever is less.

B. Mirror Glass: ASTM C1036, Type 1 - Transparent Flat, Class 1 - Clear, Quality - Q1 (high-quality mirrors); silvering, protective coating, and quality requirements in compliance with ASTM C1503.
   1. Size: As noted on drawings.
   2. Provide polished edges with no sharp edges.

2.2 ACCESSORIES

A. Mirror Adhesive: Chemically compatible with mirror coating and wall substrate.

PART 3 EXECUTION

3.1 PREPARATION

3.2 INSTALLATION

A. Install mirrors in accordance with GANA (TIPS) and manufacturers recommendations.

B. Set mirrors plumb and level, and free of optical distortion.

C. Set mirrors with edge clearance free of surrounding construction including countertops or backsplashes.

D. Frameless Mirrors: Set mirrors in proper place with adhesive, applied in accordance with adhesive manufacturer's instructions.

3.3 CLEANING

A. Remove labels after work is complete.

B. Clean mirrors and adjacent surfaces.

3.4 PROTECTION

A. After installation, mark pane with an 'X' by using removable plastic tape or paste.

END OF SECTION

SECTION 09 21 16

GYPSUM BOARD ASSEMBLIES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Performance criteria for gypsum board assemblies.

B. Metal stud wall framing.

C. Metal channel ceiling framing.

D. Acoustic insulation.

E. Gypsum wallboard.

F. Joint treatment and accessories.

1.2 RELATED REQUIREMENTS

A. Section 06 10 00 - Rough Carpentry: Wood blocking product and execution requirements.

1.3 REFERENCE STANDARDS

A. AISI S100-12 - North American Specification for the Design of Cold-Formed Steel Structural Members; American Iron and Steel Institute; 2012.

B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.

C. ASTM C475/C475M - Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board; 2015.

D. ASTM C645 - Standard Specification for Nonstructural Steel Framing Members; 2014.

E. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products; 2017.

F. ASTM C840 - Standard Specification for Application and Finishing of Gypsum Board; 2016.

G. ASTM C954 - Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs From 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness; 2015.

H. ASTM C1002 - Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs; 2016.

I. ASTM C1047 - Standard Specification for Accessories For Gypsum Wallboard and Gypsum Veneer Base; 2014a.

J. ASTM C1396/C1396M - Standard Specification for Gypsum Board; 2014a.

K. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2009 (Reapproved 2016).

L. ASTM E413 - Classification for Rating Sound Insulation; 2016.

M. GA-216 - Application and Finishing of Gypsum Board; 2016.

N. UL (FRD) - Fire Resistance Directory; current edition.

1.4 SUBMITTALS

A. Product Data: Provide data on metal framing, gypsum board, accessories, and joint finishing system.

B. Product Data: Provide manufacturer's data on partition head to structure connectors, showing compliance with requirements.

PART 2 PRODUCTS

2.1 GYPSUM BOARD ASSEMBLIES

A. Provide completed assemblies complying with ASTM C840 and GA-216.

B. Interior Partitions, Indicated as Acoustic: Provide completed assemblies with the following characteristics:

1. Acoustic Attenuation: STC of 45-49 calculated in accordance with ASTM E413, based on tests conducted in accordance with ASTM E90.

C. Fire Rated Assemblies: Provide completed assemblies complying with applicable code.
   1. UL Assembly Numbers: Provide construction equivalent to that listed for the particular assembly in the current UL Fire Resistance Directory.

2.2 METAL FRAMING MATERIALS

A. Non-Loadbearing Framing System Components: ASTM C645; galvanized sheet steel, of size and properties necessary to comply with ASTM C754 for the spacing indicated, with maximum deflection of wall framing of L/240 at 5 psf. All wall locations to recieve tiling, maximum wall deflection shall be L/360 at 5 psf.
   1. Exception: The minimum metal thickness and section properties requirements of ASTM C645 are waived provided steel of 40 ksi minimum yield strength is used, the metal is continuously dimpled, the effective thickness is at least twice the base metal thickness, and maximum stud heights are determined by testing in accordance with ASTM E72 using assemblies specified by ASTM C754.
   2. Studs: "C" shaped with flat or formed webs.
   3. Runners: U shaped, sized to match studs.
   4. Ceiling Channels: C shaped.

B. Grid Suspension System for Gypsum Board Ceiling: ASTM C 645, direct-hung system composed of main beams and cross-furring members that interlock.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Armstrong World Industries, Inc.; Drywall Grid Systems.
      b. Chicago Metallic Corporation; Drywall Grid System.
      c. USG Corporation; Drywall Suspension System.

C. Partition Head to Structure Connections: Provide mechanical anchorage devices that accommodate deflection using slotted holes, screws and anti-friction bushings, preventing rotation of studs while maintaining structural performance of partition.
   1. Structural Performance: Maintain lateral load resistance and vertical movement capacity required by applicable code, when evaluated in accordance with AISI S100-12.
   2. Material: ASTM A653/A653M steel sheet, SS Grade 50/340, with G60/Z180 hot dipped galvanized coating.
   3. Provide components UL-listed for use in UL-listed fire-rated head of partition joint systems of fire rating and movement required.
   4. Deflection and Firestop Track:
      a. Provide mechanical anchorage devices as described above that accommodate deflection while maintaining the fire-rating of the wall assembly.
      b. Products:
         1) FireTrak Corporation; Posi Klip.
         2) Metal-Lite, Inc.; The System.

2.3 BOARD MATERIALS

A. Manufacturers - Gypsum-Based Board:
   1. CertainTeed Corporation: www.certainteed.com.
   2. Georgia-Pacific Gypsum: www.gpgypsum.com.
   3. National Gypsum Company: www.nationalgypsum.com.
   4. USG Corporation: www.usg.com.

B. Gypsum Wallboard: Paper-faced gypsum panels as defined in ASTM C 1396/C 1396M; sizes to minimize joints in place; ends square cut.
   1. Application: Use for vertical surfaces and ceilings, unless otherwise indicated.
   2. Unfaced fiber-reinforced gypsum panels as defined in ASTM C1278/C1278M, suitable for paint finish, of the same core type and thickness may be substituted for paper-faced board.
   3. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
   4. At Assemblies Indicated with Fire-Rating: Use type required by indicated tested assembly; if no tested assembly is indicated, use Type X board, UL or WH listed.
   5. Thickness:
      a. Vertical Surfaces: 5/8 inch.
      b. Multi-Layer Assemblies: Thicknesses as indicated on drawings.

2.4 ACCESSORIES

A. Acoustic Insulation: ASTM C665; preformed glass fiber, friction fit type, unfaced. Thickness: _____ inch.

B. Acoustic Insulation: Preformed glass fiber, friction fit type, unfaced, thickness as required to fill width of wall cavity.

C. Acoustic Sealant: As specified in Section 07 92 00.

D. Finishing Accessories: ASTM C1047, galvanized steel or rolled zinc, unless noted otherwise.
   1. Types: As detailed or required for finished appearance.
   2. Special Shapes: In addition to conventional corner bead and control joints, provide U-bead at exposed panel edges.

E. Aluminum Reveal Trim: Extruded accessories of profiles and dimensions indicated.
   1. Acceptable Manufacturers:
      a. Fry Reglet.
      b. Gordon, Inc.
      c. Pittcon Industries.
   2. Aluminum: Alloy and temper with not less than the strength and durability properties of ASTM B 221, Alloy 6063-T5.
   3. Finish: Corrosion-resistant primer compatible with joint compound and finish materials specified.

F. Joint Materials: ASTM C475/C475M and as recommended by gypsum board manufacturer for project conditions.
   1. Tape: 2 inch wide, creased paper tape for joints and corners.

G. Joint Compound for Interior Gypsum Wallboard: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.
   1. Prefilling: At open joints and damaged surface areas, use setting-type taping compound.
   2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use setting-type taping compound.
   3. Fill Coat: For second coat, use setting-type, sandable topping compound.
   4. Finish Coat: For third coat, use drying-type, all-purpose compound.

H. Screws for Fastening of Gypsum Panel Products to Cold-Formed Steel Studs Less than 0.033 inch in Thickness and Wood Members: ASTM C1002; self-piercing tapping screws, corrosion resistant.

I. Screws for Fastening of Gypsum Panel Products to Steel Members from 0.033 to 0.112 inch in Thickness: ASTM C954; steel drill screws, corrosion resistant.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that project conditions are appropriate for work of this section to commence.

3.2 FRAMING INSTALLATION

A. Metal Framing: Install in accordance with ASTM C754 and manufacturer's instructions.

B. Suspended Ceilings and Soffits: Space framing and furring members as indicated.
   1. Level ceiling system to a tolerance of 1/1200.
   2. Laterally brace entire suspension system.

C. Studs: Space studs at 16 inches on center unless otherwise indicated.
   1. Extend partition framing to structure where indicated and to ceiling in other locations.
   2. Partitions Terminating at Ceiling: Attach ceiling runner securely to ceiling track in accordance with manufacturer's instructions.
   3. Partitions Terminating at Structure: Attach top runner to structure, maintain clearance between top of studs and structure, and connect studs to track using specified mechanical devices in accordance with manufacturer's instructions; verify free movement of top of stud connections; do not leave studs unattached to track.

D. Openings: Reinforce openings as required for weight of doors or operable panels, using not less than double studs at jambs.

E. Blocking: Install wood blocking specified in Division 6 Section "Rough Carpentry".

3.3 ACOUSTIC ACCESSORIES INSTALLATION

A. Acoustic Insulation: Place tightly within spaces, around cut openings, behind and around electrical and mechanical items within partitions, and tight to items passing through partitions.

B. Acoustic Sealant: Install in accordance with manufacturer's instructions.
   1. Place continuous bead at perimeter of each layer of gypsum board.

3.4 BOARD INSTALLATION

A. Comply with ASTM C840, GA-216, and manufacturer's instructions. Install to minimize butt end joints, especially in highly visible locations.

B. Single-Layer Non-Rated: Install gypsum board in most economical direction, with ends and edges occurring over firm bearing.

C. Install panels with face side out. Butt panels together for a light contract as edges and ends with not more than 1/16 inch of open space between panels. Do not force into place.

D. Cover both faces of support framing with gypsum in concealed spaces (above ceilings, etc.), except in chases braced internally.
   1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. in area.
   2. Fit gypsum panels around ducts, pipes, and conduits.
   3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4- to 3/8-inch-wide joints to install sealant.

E. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.

F. Install sound attenuation blankets before installing gypsum panels. Seal joints between edges and abutting structural surfaces with acoustical sealant.

G. Form control and expansion joints with space between edges of adjoining gypsum panels.

H. Fire-Rated Construction: Install gypsum board in strict compliance with requirements of assembly listing.

I. Installation on Metal Framing: Use screws for attachment of all gypsum board .

3.5 INSTALLATION OF TRIM AND ACCESSORIES

A. Control Joints: Place control joints consistent with lines of building spaces and as indicated.
   1. Not more than 30 feet apart on walls and ceilings over 50 feet long.

B. Corner Beads: Install at external corners, using longest practical lengths.

C. Edge Trim: Install at locations where gypsum board abuts dissimilar materials.

3.6 JOINT TREATMENT

A. Joint Compound for Interior Gypsum Wallboard: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.
   1. Prefilling: At open joints and damaged surface areas, use setting-type taping compound.
   2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use setting-type taping compound.
   3. Fill Coat: For second coat, use setting-type, sandable topping compound.
   4. Finish Coat: For third coat, use drying-type, all-purpose compound.
   5. Skim Coat: For final coat of Level 5 finish, use drying-type, all-purpose compound.

B. Finish gypsum board in accordance with levels defined in ASTM C840, as follows:
   1. Level 4: Walls and ceilings to receive paint finish or wall coverings, unless otherwise indicated.
   2. Level 1: Fire rated wall areas above finished ceilings, whether or not accessible in the completed construction.

C. Tape, fill, and sand exposed joints, edges, and corners to produce smooth surface ready to receive finishes.
   1. Feather coats of joint compound so that camber is maximum 1/32 inch.

D. Fill and finish joints and corners of cementitious backing board as recommended by manufacturer.

3.7 PROTECTION

A. Protect installed products from damage from weater, condensation, direct sunlight, construction, and other causes during remainder of the construction period.

B. Remove and replace panels that are wet, moisture damaged, and mold damaged.
   1. Indications that panels are wet or moisture damaged include, but are not limited to discoloration, sagging, or irregular shape.
   2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

3.8 TOLERANCES

A. Maximum Variation of Finished Gypsum Board Surface from True Flatness: 1/8 inch in 10 feet in any direction.

END OF SECTION

SECTION 09 30 00

TILING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Tile for floor applications.

B. Tile for wall applications.

C. Cementitious backer board as tile substrate.

D. Ceramic accessories.

E. Non-ceramic trim.

1.2 REFERENCE STANDARDS

A. ANSI A108/A118/A136.1 - American National Standard Specifications for the Installation of Ceramic Tile (Compendium); 2017.
   1. ANSI A108.1a - American National Standard Specifications for Installation of Ceramic Tile in the Wet-Set Method, with Portland Cement Mortar; 2014.
   2. ANSI A108.1b - American National Standard Specifications for Installation of Ceramic Tile on a Cured Portland Cement Mortar Setting Bed with Dry-Set or Latex-Portland Cement Mortar; 1999 (Reaffirmed 2010).
   3. ANSI A108.1c - Specifications for Contractors Option: Installation of Ceramic Tile in the Wet-Set Method with Portland Cement Mortar or Installation of Ceramic Tile on a Cured Portland Cement Mortar Bed with Dry-Set or Latex-Portland Cement; 1999 (Reaffirmed 2010).
   4. ANSI A108.4 - American National Standard Specifications for Installation of Ceramic Tile with Organic Adhesives or Water Cleanable Tile-Setting Epoxy Adhesive; 2009 (Revised).
   5. ANSI A108.5 - American National Standard Specifications for Installation of Ceramic Tile with Dry-Set Portland Cement Mortar or Latex-Portland Cement Mortar; 1999 (Reaffirmed 2010).
   6. ANSI A108.6 - American National Standard Specifications for Installation of Ceramic Tile with Chemical Resistant, Water Cleanable Tile-Setting and -Grouting Epoxy; 1999 (Reaffirmed 2010).
   7. ANSI A108.10 - American National Standard Specifications for Installation of Grout in Tilework; 1999 (Reaffirmed 2010).
   8. ANSI A108.11> ANSI A108/A118/A136.1 - American National Standard for Interior of Cementitious Backer Units; 2010 (Revised).
   9. ANSI A108.12 - American National Standard for Installation of Ceramic Tile with EGP (Exterior Glue Plywood) Latex-Portland Cement Mortar; 1999 (Reaffirmed 2010).
   10. ANSI A108.13 - American National Standard for Installation of Load Bearing, Bonded, Waterproof Membranes for Thin-Set Ceramic Tile and Dimension Stone; 2005 (Reaffirmed 2010).

B. TCNA (HB) - Handbook for Ceramic, Glass, and Stone Tile Installation; 2016.

1.3 DEFINITIONS

A. Construction Joints: The surface where two successive placements of concrete meet, across which it may be desirable to achieve bond and through which reinforcement may be made continuous.

B. Contraction Joints/Control Joints: Formed, sawed or tooled groove in a concrete structure to create a weakened plane and regulate the location of cracking resulting from the dimensional change of different parts of the structure.

C. Expansion Joints: (1) A separation provided between adjoining parts of a structure to allow movement where expansion is likely to exceed contraction; (2) a separation between pavement slabs on grade, filled with a compressible filler material; (3) an isolation joint intended to allow independent movement between adjoining parts.

D. Isolation Joints: A separation between adjoining parts of a concrete structure, usually a vertical plane, at a designated location such as to interfere least with performance of the structure, yet such as to allow relative movement in three directions and avoid formation of cracks elsewhere in the concrete and through which all or part of the bonded reinforcement is interrupted.

1.4 SUBMITTALS

A. Product Data: Provide manufacturers' data sheets on tile, mortar, grout, and accessories. Include instructions for using grouts and adhesives.

B. Shop Drawings: Indicate tile layout, patterns, color arrangement, perimeter conditions, junctions with dissimilar materials, control and expansion joints, thresholds, ceramic accessories, and setting details.

C. Samples: Mount tile and apply grout on two plywood panels, minimum 18 by 18 inches in size illustrating pattern, color variations, and grout joint size variations.

D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

E. Maintenance Data: Include recommended cleaning methods, cleaning materials, and stain removal methods.

F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. Extra Wall Tile: 1 box (10 pieces) of each color of wall tile.
   2. Extra Floor Tile: 3 percent percent of each size, color, and surface finish combination.

1.5 QUALITY ASSURANCE

A. Maintain one copy of The Tile Council of North America Handbook and ANSI A108 Series/A118 Series on site.

B. Installer Qualifications: Company specializing in performing tile installation, with minimum of five years of documented experience.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect adhesives from freezing or overheating in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.1 TILE

A. Interior Wall Tile: Refer to Drawing Sheet A602 for Finish Material Specification.

B. Interior Floor Tile: Refer to Drawing Sheet A602 for Finish Material Specification.

2.2 TRIM AND ACCESSORIES

A. Ceramic Accessories: Glazed finish, same color and finish as adjacent field tile; same manufacturer as tile.

B. Non-Ceramic Trim: Brushed stainless steel, style and dimensions to suit application, for setting using tile mortar or adhesive.
   1. Applications:
      a. Open edges of floor tile.
      b. Applications as indicated on drawings.

2.3 MORTAR MATERIALS

A. Mortar Bond Coat Materials:
   1. Latex-Portland Cement type: ANSI A118.4.
      a. Provide mortars mixed with liquid latex admixture.
      b. Basis-of-Design: Bostik, Single-Flex FS.

2.4 GROUTS

A. Urethane Grout: Water-based, urethane grout (modified ANSI 118.3-UG).
   1. Colors: To be selected by Architect from manufacturer's full range.
   2. Products:
      a. Basis-of-Design: Bostik, TruColor Pre-Mixed Grout.

2.5 ACCESSORY MATERIALS

A. Crack Isolation Membrane: Comply with ANSI 118.12.
   1. Products:
      a. Basis-of-Design: Bostik, GoldPlus Waterproofing and Antifracture Membrane.

B. Mesh Tape: 2 inch wide self-adhesive fiberglass mesh tape.

C. Tile Cleaner: A neutral cleaner capable of removing soil and residue without harming tile and grout surfaces, specifically approved for materials and installations indicated by tile and grout manufacturers.

2.6 MIXING MORTARS AND GROUT

A. Mix mortars and grouts to comply with referenced standards and mortar and grout manufacturers' written instructions.

B. Add materials, water, and additives in accurate proportions.

C. Obtain and use type of mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures to produce mortars and grouts of uniform quality with optimum performance characteristics for installations indicated.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that sub-floor surfaces are smooth and flat within the tolerances specified for that type of work and are ready to receive tile.

B. Verify that sub-floor surfaces are dust-free and free of substances that could impair bonding of setting materials to sub-floor surfaces.

C. Verify that concrete sub-floor surfaces are ready for tile installation by testing for moisture emission rate and alkalinity; obtain instructions if test results are not within limits recommended by tile manufacturer and setting materials manufacturer.

D. Verify that joints and cracks in tile substrate are coordinated with tile joint locations; if not coordinated, adjust joint locations in consultation with Architect.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Protect surrounding work from damage.

B. Vacuum clean surfaces and damp clean.

C. Seal substrate surface cracks with filler. Level existing substrate surfaces to acceptable flatness tolerances.

3.3 INSTALLATION - GENERAL

A. Install tile, thresholds, and stair treads and grout in accordance with applicable requirements of ANSI A108.1a through ANSI A108.13, manufacturer's instructions, and TCNA (HB) recommendations.

B. Lay tile to pattern indicated. Do not interrupt tile pattern through openings.

C. Cut and fit tile to penetrations through tile, leaving sealant joint space. Form corners and bases neatly. Align floor joints.

D. Extend tile work into recesses and under or behind equipment and fixtures to form complete covering without interuptions, unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without distupting pattern or joint alignments.

E. Place tile joints uniform in width, subject to variance in tolerance allowed in tile size. Make grout joints without voids, cracks, excess mortar or excess grout, or too little grout.

F. Form internal angles square and external angles bullnosed.

G. Install ceramic accessories rigidly in prepared openings.

H. Install non-ceramic trim in accordance with manufacturer's instructions.

I. For installations indicated below, follow procedures in ANSI A108 Series tile installation standards for providing 95 percent mortar coverage.
   1. Tile floors composed of tiles 8 by 8 inch or larger.
   2. Tile floors composed of rib-backed tiles.

J. Sound tile after setting. Replace hollow sounding units.

K. Keep control and expansion joints free of mortar, grout, and adhesive.

L. Install construction joints, perimeter joints and movement joints, as detailed on drawings and as otherwise directed by Architect, in accordance with The Tile Council of North America Handbook "Movement Joint Design Essentials EJ171."

M. Expansion Joints: Locate expansion joints and other sealant-filled joints during installation of setting materials and tile. Do not saw-cut joints after installing tiles.
   1. Locate joints in tile surfaces directly above joints in concrete substrates.

N. Allow tile to set for a minimum of 48 hours prior to grouting.

O. Grout tile joints to comply with requirements of ANSI A108.10, unless otherwise indicated.

P. At changes in plane and tile-to-tile control joints, use tile sealant instead of grout, with either bond breaker tape or backer rod as appropriate to prevent three-sided bonding.

3.4 INSTALLATION - FLOORS - THIN-SET METHODS

A. Over interior concrete substrate, install in accordance with TCA Handbook Method F115 (modified), latex-portland cement mortar and urethane grout.

B. Where cracks occur in new or existing concrete floors, provide crack isolation in accordance with The Tile Council of North America Handbook Method F125 & F125A.

3.5 INSTALLATION - WALL TILE

A. Over interior concrete and masonry install in accordance with TCNA (HB) Method W202 with latex-portland cement mortar and urethane grout.

3.6 CLEANING

A. Clean tile and grout surfaces.

3.7 PROTECTION

A. Do not permit traffic over finished floor surface for 4 days after installation.

END OF SECTION

SECTION 09 51 00

ACOUSTICAL CEILINGS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Suspended metal grid ceiling system.

B. Acoustical units.

1.2 REFERENCE STANDARDS

A. ASTM C635/C635M - Standard Specification for the Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings; 2013a.

B. ASTM C636/C636M - Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels; 2013.

C. ASTM E1264 - Standard Classification for Acoustical Ceiling Products; 2014.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Sequence work to ensure acoustical ceilings are not installed until building is enclosed, sufficient heat is provided, dust generating activities have terminated, and overhead work is completed, tested, and approved.

B. Do not install acoustical units until after interior wet work is dry.

1.4 SUBMITTALS

A. Shop Drawings: Indicate grid layout and related dimensioning, junctions with other ceiling finishes, and mechanical and electrical items installed in the ceiling.

B. Product Data: Provide data on suspension system components and acoustical units.

C. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. Extra Acoustical Units: Provide 2 boxes of each type and size panel provided on project. Provide full size panels.

1.5 FIELD CONDITIONS

A. Maintain uniform temperature of minimum 60 degrees F, and maximum humidity of 40 percent prior to, during, and after acoustical unit installation.

PART 2 PRODUCTS

2.1 ACOUSTICAL UNITS

A. Acoustical Units - General: ASTM E1264, Class A.
   1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product, approved prior to bid, by one of the following:
      a. Armstrong World Industries, Inc.
      b. Chicago Metallic Corporation.
      c. USG Interiors, Inc.
   2. Acoustical Panel (ACP) Products: Refer to drawing sheet A602 for Finish Material Specification.

2.2 SUSPENSION SYSTEM(S)

A. Suspension Systems - General: ASTM C 635; die cut and interlocking components, with clips, splices, and perimeter moldings as required.
   1. Intermediate duty system with main and cross runners roll formed from cold-rolled steels sheet, prepainted, electrolytically zinc coated, or hot-dip galvanized.
   2. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product, approved prior to bid, by one of the following:
      a. Armstrong World Industries, Inc.
      b. Chicago Metallic Corporation.

c. USG Interiors, Inc.

3. Suspension System: Refer to drawing sheet A602 for Finish Material Specification.

2.3 ACCESSORIES

A. Support Channels and Hangers: Galvanized steel; size and type to suit application and ceiling system flatness requirement specified.
   1. Attachment Devices: Size for five times the design load indicated in ASTM C 635, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.
   2. Wire Hangers, Braces and Ties: Zinc-coated carbon-steel wire; ASTM C641, Class 1, zinc coating, soft temper.
      a. Size: Select wire diameter so its stress at 3 times hanger design load (ASTM C 635, Table 1, "Direct Hung") will be less than yield stress of wire, but provide not less than 0.106 inch diameter wire.
   3. Provide acoustic type hangers where indicated on drawings.

B. Perimeter Moldings: Same material and finish as grid.
   1. At Exposed Grid: Provide L-shaped molding for mounting at same elevation as face of grid.

C. Perimeter Trim: Extruded aluminum trim, height as indicated on drawings, white.
   1. Acceptable Products:
      a. Armstrong, Axiom Classic Perimeter Trim.
      b. Alpro, Aviar Perimeter Trim.

D. Touch-up Paint: Type and color to match acoustical and grid units.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that layout of hangers will not interfere with other work.

3.2 INSTALLATION - SUSPENSION SYSTEM

A. Install suspension system in accordance with ASTM C 636/C 636M and manufacturer's instructions and as supplemented in this section.

B. Rigidly secure system, including integral mechanical and electrical components, for maximum deflection of 1:360.

C. Install after major above-ceiling work is complete. Coordinate the location of hangers with other work.

D. Hang suspension system independent of walls, columns, ducts, pipes and conduit. Where carrying members are spliced, avoid visible displacement of face plane of adjacent members.

E. Where ducts or other equipment prevent the regular spacing of hangers, reinforce the nearest affected hangers and related carrying channels to span the extra distance.

F. Do not support components on main runners or cross runners if weight causes total dead load to exceed deflection capability.

G. Support fixture loads using supplementary hangers located within 6 inches of each corner, or support components independently.

H. Do not eccentrically load system or induce rotation of runners.

I. Perimeter Molding: Install at intersection of ceiling and vertical surfaces and at junctions with other interruptions.
   1. Use longest practical lengths. Use longest practical lengths
   2. Overlap and rivet corners.

3.3 INSTALLATION - ACOUSTICAL UNITS

A. Install acoustical units in accordance with manufacturer's instructions.

B. Fit acoustical units in place, free from damaged edges or other defects detrimental to appearance and function.

C. Fit border trim neatly against abutting surfaces.

D. Install units after above-ceiling work is complete.

E. Install acoustical units level, in uniform plane, and free from twist, warp, and dents.

F. Cutting Acoustical Units:
   1. Make field cut edges of same profile as factory edges.
   2. Double cut and field paint exposed reveal edges.

3.4 TOLERANCES

A. Maximum Variation from Flat and Level Surface: 1/8 inch in 10 feet.

B. Maximum Variation from Plumb of Grid Members Caused by Eccentric Loads: 2 degrees.

END OF SECTION

SECTION 09 65 00

RESILIENT FLOORING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Resilient tile flooring.

B. Resilient base.

C. Installation accessories.

1.2 REFERENCE STANDARDS

A. ASTM F1344 - Standard Specification for Rubber Floor Tile; 2015.

B. ASTM F1861 - Standard Specification for Resilient Wall Base; 2008 (Reapproved 2012).

C. RFCI (RWP) - Recommended Work Practices for Removal of Resilient Floor Coverings; Resilient Floor Covering Institute; October 2011.

1.3 SUBMITTALS

A. Product Data: Provide data on specified products, describing physical and performance characteristics; including sizes, patterns and colors available; and installation instructions.

B. Verification Samples: Submit two samples, 4 by 4 inch in size illustrating color and pattern for each resilient flooring product specified.

C. Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning, stripping, and re-waxing.

D. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. Extra Flooring Material: Furnish 1 box for every 50 boxes or fraction thereof, of each type, color, and pattern of floor tile installed.
   2. Extra Wall Base: 10 linear feet of each type and color.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Store all materials off of the floor in an acclimatized, weather-tight space.

B. Protect roll materials from damage by storing on end.

C. Do not double stack pallets.

PART 2 PRODUCTS

2.1 TILE FLOORING

A. Rubber Tile: Type I- Homogeneous, color and pattern throughout thickness; Type II- Heterogeneous, laminated.
   1. Minimum Requirements: Comply with ASTM F1344, of Class corresponding to type specified.
   2. Basis-of-Design Refer to Finish Material Specification on Drawing Sheet A602. Provide the basis-of-design product or a comparable product approved prior to bid.

2.2 RESILIENT BASE

A. Resilient Base: ASTM F1861, Type TS rubber, vulcanized thermoset; top set as indicated on drawings.
   1. Height: 4 inch.
   2. Thickness: 0.125 inch thick.
   3. Length: Roll.
   4. Basis-of-Design Refer to Finish Material Specification on Drawing Sheet A602. Provide the basis-of-design product or a comparable product approved prior to bid.

2.3 ACCESSORIES

A. Primers and Adhesives, and Seaming: Waterproof; types recommended by resilient flooring manufacturer, compatible with materials being adhered; maximum VOC of 50 g/L; CRI Green Label certified

1. Provide adhesives recommended by manufacturer for installation on cementitious sub-floor surface moisture and pH levels present at time of installation.
2. Provide floor sealers for surfaces that test over adhesive manufacurer's maximum recommended moisture/pH levels. Follow adhesive manufacturer's recommendations for sealer products and application as required to meet manufacturer's warranty requirements.

B. Moldings, Transition and Edge Strips: Same material as flooring. Refer to Drawings for profiles.

C. Sealer and Wax: Types recommended by flooring manufacturer.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that surfaces are flat to tolerances acceptable to flooring manufacturer, free of cracks that might telegraph through flooring, clean, dry, and free of curing compounds, surface hardeners, and other chemicals that might interfere with bonding of flooring to substrate.

B. Test moisture emission rates and alkalinity levels in accordance with ASTM F710.

3.2 PREPARATION

A. Remove existing resilient flooring and flooring adhesives; follow the recommendations of RFCI (RWP).

B. Prepare floor substrates as recommended by flooring and adhesive manufacturers.

C. Remove sub-floor ridges and bumps. Fill minor low spots, cracks, joints, holes, and other defects with sub-floor filler to achieve smooth, flat, hard surface.

D. Prohibit traffic until filler is fully cured.

3.3 INSTALLATION - GENERAL

A. Starting installation constitutes acceptance of sub-floor conditions.

B. Install in accordance with manufacturer's written instructions.

C. Spread only enough adhesive to permit installation of materials before initial set.

D. Fit joints and butt seams tightly.

E. Set flooring in place, press with heavy roller to attain full adhesion.

F. Match floor tiles for color and pattern by selecting tiles from cartons in the same sequence as manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed tiles.

G. Where type of floor finish, pattern, or color are different on opposite sides of door, terminate flooring under centerline of door.

H. Install edge strips at unprotected or exposed edges, where flooring terminates, and where indicated.
   1. Resilient Strips: Attach to substrate using adhesive.

I. Scribe flooring to walls, columns, cabinets, floor outlets, and other appurtenances to produce tight joints.

J. Extend floor tiles into toe spaces, door reveals, closets, and similar openings. Extend floor tiles to center of door openings.

K. Install flooring in recessed floor access covers, maintaining floor pattern.

3.4 INSTALLATION - TILE FLOORING

A. Mix tile from container to ensure shade variations are consistent when tile is placed, unless otherwise indicated in manufacturer's installation instructions.

3.5 INSTALLATION - RESILIENT BASE

A. Fit joints tightly and make vertical. Maintain minimum dimension of 18 inches between joints.

B. Miter internal corners. At external corners, use premolded units. At exposed ends, use premolded units.

C. Install base on solid backing. Bond tightly to wall and floor surfaces.

D. Scribe and fit to door frames and other interruptions.

3.6 CLEANING

A. Remove excess adhesive from floor, base, and wall surfaces without damage.

B. Clean in accordance with manufacturer's written instructions.

3.7 PROTECTION

A. Prohibit traffic on resilient flooring for 48 hours after installation.

END OF SECTION

SECTION 09 65 68

RESILIENT ATHLETIC FLOORING

PART 1 – GENERAL

1.1 SECTION INCLUDES

A. Supply and installation of the indoor resilient multipurpose surfacing

B. Application of the game lines

1.2 STANDARDS

A. ASTM F2170 “Standard Test Method for Determining Relative Humidity In Concrete Floor Slabs Using In-Situ Probes”

B. ASTM F710 “Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring”

C. ACI 302.2R-06 “Guideline for Concrete Slabs that Receive Moisture-Sensitive Flooring Materials”

1.3 SUBMITTALS

A. Product Data:
   1. Manufacturer’s promotional brochures, specifications and installation instructions

B. B. Manufacturer Certifications:
   1. Provide certification that accurately identifies the Original Equipment Manufacturer (OEM) of flooring furnished for this project including manufacturer’s name, address and factory location.
   2. Suppliers of private label flooring for this project must identify themselves as such and fully disclose the OEM information listed above.
   3. All “manufacturer” requirements in these specifications must be complied with by the OEM, including warranties, certifications, qualifications, product data, test results, environmental requirements, performance data, etc.

C. Samples:
   1. Submit for selection and approval three (3) sets of the indoor resilient multipurpose surfacing, manufacturer’s brochures, samples or sample boards of all of the available colors, textures and styles.
   2. Submit color samples of all the available game line paint colors for selection and approval.

D. Closeout Submittals:
   1. Submit three (3) copies of the indoor resilient multipurpose surfacing and manufacturer’s maintenance instructions.
   2. Submit three (3) copies of the material and installation warranties as specified.

1.4 QUALITY ASSURANCE

A. Qualifications:
   1. The indoor resilient multipurpose surfacing shall be manufactured in an ISO 9001 certified plant.
   2. 2. The indoor resilient multipurpose surfacing shall be manufactured in an ISO 14001 certified plant.
   3. The indoor resilient multipurpose surfacing supplier shall be an established firm experienced in the field and appointed as a distributor by the manufacturer of the indoor resilient multipurpose surfacing.
   4. The installer of the indoor resilient multipurpose surfacing shall have a minimum of five (5) years experience in the field installing indoor resilient multipurpose surfacing and have worked on at least five (5) projects of similar size and complexity.

B. Certifications:
   1. Installer to submit the indoor resilient surfacing manufacturer’s or distributor’s certification attesting that they are an approved installer of the indoor resilient multipurpose surfacing.
   2. The indoor resilient multipurpose surfacing manufacturer to submit official ISO 9001 certification for the facility in which the indoor resilient multipurpose surfacing is manufactured.
   3. The indoor resilient multipurpose surfacing manufacturer to submit official ISO 14001 certification for the facility in which the indoor resilient multipurpose surfacing is manufactured.

C. Testing:

D. Tests shall be relative for multi-purpose use with certificates from independent testing resources to be made available upon request. Test results shall be no more than 5 years old and performed according to ASTM and/or EN standard testing procedures.

1.5 DELIVERY, STORAGE AND HANDLING

A. Delivery:
   1. Material shall not be delivered until all related work is in place and finished and/or proper storage facilities and conditions can be provided and guaranteed stable according to the manufacturer's recommendations.

1.6 PROJECT/SITE CONDITIONS

A. It is the responsibility of the general contractor/construction manager to maintain project/site conditions acceptable for the installation of the indoor resilient multipurpose flooring.

B. The area in which the indoor resilient multipurpose surfacing will be installed shall be dry and weather tight. Permanent heat, light and ventilation shall be installed and operable.

C. All other trades shall have completed their work prior to the installation of the resilient multipurpose flooring. The general contractor or Construction Manager shall maintain a secure and clean working environment before, during and after the installation. Suspension of other trades' work may be authorized providing their work will not damage the new flooring.

D. Maintain a stable room temperature of at least 65°F for a minimum of one (1) week prior to, during, and thereafter installation.

E. An effective low-permeance vapor barrier is placed directly beneath the concrete subfloor. For "on" or "below grade" installations, it is recommended to provide a permanent vapor barrier resistant to long term hydrostatic pressure/moisture exposure. Protrusions should be sealed to prevent moisture migration into the slab. Moisture should not be allowed to enter the slab after the completed construction.

F. Concrete subfloor surface pH level within the 7 to 10 range dependent upon installation type. Concrete subfloor should be no greater than 1/8" within a 10 ft diameter. This tolerance can be measured in accordance with ASTM E1155.

G. Concrete subfloor must be clean and free of all foreign materials or objects including, but not limited to, curing compounds and sealers.

H. Fill cracks, grooves, voids, depressions, and other minor imperfections with Ardex (or equal) cement-based patching/leveling compounds. Follow the manufacturer's directions. Moveable joints must be treated utilizing specific transitioning joint devices depending upon the architect's recommendations. Follow current ASTM F710 guidelines for the preparation of concrete slabs to receive resilient flooring.

I. Refer to ACI 302.2R "Guidelines for Concrete Slabs that Receive Moisture-Sensitive Flooring Materials" for concrete design and construction.

J. Concrete slab shall be fortified with continual steel reinforcement. Fiber reinforcement alone shall not be considered adequate fortification.

1.7 WARRANTY

A. Materials:
   1. The indoor resilient multipurpose surfacing shall be covered by the manufacturer against product defects for 8 years. The manufacturer of the indoor resilient multipurpose surfacing must provide this warranty upon request.

B. Installation:
   1. The installation of the indoor resilient multipurpose surfacing shall be covered against poor workmanship and faulty installation by a two (2) year written, limited warranty provided by the contractor performing/overseeing the installation.

1.8 ADDITIONAL MATERIALS

A. Furnish to the owner additional materials containing a total of at least 1% of each different color or design of the indoor resilient multipurpose surfacing used on the project.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of Design: EcoPure as manufactured by FieldTurf, USA, Inc.

2.2 MATERIALS.

A. Prefabricated 4.6 mm foam backed linoleum sports surfacing with marbled design and slightly textured surface as supplied by FieldTurf USA, Inc. Product to be naturally bacteriostatic and will not contribute to the proliferation of bacteria or fungus. The material's surface shall be protected with XF X-treme performance finish or equivalent for ease of maintenance. Floor covering requiring waxes or other restorative treatments shall not be considered. Welding rod shall also incorporate the XF X-treme finish or equivalent.
   1. Color: As selected by Architect from manufacturer's full range.
   2. Physical properties of the indoor resilient athletic surfacing shall conform to the following minimums:

Width		6'-6"
Length		85' (25.9m) approx.
Total Thickness		4.6 mm
Vertical Deformation	PASSED	0.6 (EN 14809)
Rolling Load	PASSED	0.30 (EN 1569 11/1999)
Friction	PASSED	83 (EN 13036-4)
Sanitization	Excellent	Naturally Bacteriostatic
Sound Insulation	Excellent	+/= 19 dB (ISO 717/2)
Recycled Content		22%
Surface Finish Effect	PASSED	ASTM F2772 (80 – 110)
Vertical Deformation	PASSED	ASTM F2772
Ball Rebound	PASSED	ASTM F2772 > 90%
Shock Absorption	PASSED	ASTM F2772 Category 1

B. Welding Rod:
   1. As supplied by the indoor resilient surfacing manufacturer or supplier. Color to blend with the indoor resilient surfacing color or design. All seams shall be heat welded. Welding rod shall also incorporate the XF X-treme finish or equivalent.

C. Adhesive:
   1. Multi-Poxy adhesive. Follow adhesive manufacturer's recommendations.

D. Game Line Paint Primer:
   1. As approved by the indoor resilient surfacing manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. It is the responsibility of the general contractor/construction manager to ensure that project/site conditions are acceptable for the installation of the indoor resilient flooring.

B. Verify that the area in which the indoor resilient surfacing will be installed is dry and weather tight. Verify that permanent heat, light and ventilation is installed and operable.

C. Verify that all other work that could cause damage, dirt and dust or interrupt the normal pace of the indoor resilient flooring installation is completed or suspended.

D. Verify that there is a stable room temperature of at least 65°F.

E. Verify that there are no foreign materials or objects on the subfloor and that the subfloor is clean and ready for installation.

F. Direct Full Spread Adhering to Concrete Subfloor Multi-Poxy Adhesive: moisture content less 80 % RH when tested per ASTM F2170.

G. Do not average the results of the tests. Report all field test results in writing to the General Contractor, Architect, and End User prior to installation.

H. Verify that the concrete subfloor surface pH level is within the 7 - 10 range.

I. Document the results indicating the slab is within manufacturer's tolerances for slab deviation.

3.2 PREPARATION OF SURFACES

A. Sand the entire surface of the concrete slab.

B. Sweep the concrete slab so as to remove all dirt and dust. If a sweeping compound is to be used it must be a sweeping compound that does not contain oil or other items that may inhibit the adhesive bond.

C. Slab must be dust free. In the event that dust impairs adhesive bond, priming the slab prior to application of adhesive may be necessary. Follow installation guidelines.

3.3 INSTALLATION

A. The installation area shall be closed to all traffic and activity for a period to be set by the indoor resilient surfacing installer. The indoor resilient surfacing installation shall not begin until the installer is familiar with the existing conditions.

B. All necessary precautions should be taken to minimize noise, smell, dust, the use of hazardous materials and any other items that may inconvenience others.

C. Install the indoor resilient surfacing in strict accordance with the indoor resilient surfacing manufacturer's written instructions.

D. Install the indoor resilient surfacing minimizing cross seams. Provide a seam diagram during the submittal process for approval prior to installation.

E. Paint game lines using approved game line paint primer and game line paint in strict accordance with the game line paint manufacturer's instructions.

F. Install appropriate threshold plates or transition strips where necessary.

3.4 CLEANING

A. Remove all unused materials, tools, and equipment and dispose of any debris properly. Clean the indoor resilient surfacing in accordance with the manufacturer's instructions.

3.5 PROTECTION

A. If required, protect the indoor resilient surfacing from damage using coverings approved by the manufacturer until acceptance of work by the customer or their authorized representative.

END OF SECTION

SECTION 09 67 23

RESINOUS FLOORING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. High-solids flooring system with epoxy primer and light-stable, chemically resistant, satin, urethane topcoat applied over interior concrete floors.

1.2 RELATED REQUIREMENTS

A. Section 03 30 00 - Cast-in-Place Concrete.

1.3 REFERENCE STANDARDS

A. ASTM International (ASTM):
   1. ASTM C 413 - Standard Test Method for Absorption of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings, and Polymer Concretes.
   2. ASTM D 635 - Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position.
   3. ASTM D 695 - Standard Test Method for Compressive Properties of Rigid Plastics.
   4. ASTM D 2047 - Standard Test Method for Static Coefficient of Friction of Polish-Coated Flooring Surfaces as Measured by the James Machine.
   5. ASTM D 2240 - Standard Test Method for Rubber Property-Durometer Hardness.
   6. ASTM D 2244 - Standard Practice for Calculation of Color Tolerances and Color Differences from Instrumentally Measured Color Coordinates.
   7. ASTM D 2370 - Standard Test Method for Tensile Properties of Organic Coatings.
   8. ASTM D 3960 - Standard Practice for Determining Volatile Organic Compound (VOC) Content of Paints and Related Coatings.
   9. ASTM D 4060 - Standard Test Method for Abrasion Resistance of Organic Coatings by the Taber Abraser.
   10. ASTM D 4366 - Standard Test Methods for Hardness of Organic Coatings by Pendulum Damping Tests.
   11. ASTM D 4541 - Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers.
   12. ASTM D 7234 - Standard Test Method for Pull-Off Adhesion Strength of Coatings on Concrete Using Portable Pull-Off Adhesion Testers.
   13. ASTM F 1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride.
   14. ASTM F 2170 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes.
   15. ASTM G 154 - Standard Practice for Operating Fluorescent Ultraviolet (UV) Lamp Apparatus for Exposure of Nonmetallic Materials.

B. National Floor Safety Institute (NFSI) (www.nfsi.org):
   1. ANSI/NFSI B101.1 - Test Method for Measuring Wet SCOF of Common Hard-Surface Floor Materials.

1.4 PREAPPLICATION MEETINGS

A. Convene preapplication meeting 2 weeks before start of application of flooring system.

B. Require attendance of parties directly affecting work of this Section, including Contractor, Architect, applicator, and manufacturer's representative.

C. Review materials, moisture testing of concrete, protection of in-place conditions, surface preparation, application, protection, and coordination with other work.

1.5 SUBMITTALS

A. Product Data: Submit manufacturer's product data, including surface preparation and application instructions.

B. Samples:
   1. Colorants Added to Materials: Submit manufacturer's samples of colorants.
   2. Flooring Surface: Submit manufacturer's samples of flooring surface showing texture and sheen.

C. Manufacturer's Certification: Submit manufacturer's certification that materials comply with specified requirements and are suitable for intended application.

D. Manufacturer's Project References: Submit manufacturer's list of successfully completed resinous flooring system projects, including project name and location, name of architect, and type and quantity of flooring systems furnished.

E. Applicator's Project References: Submit applicator's list of successfully completed resinous flooring system projects, including project name and location, name of architect, and type and quantity of flooring systems applied.

F. Care and Maintenance Instructions: Submit manufacturer's care and maintenance instructions, including cleaning instructions.

G. Warranty Documentation: Submit manufacturer's standard warranty.

1.6 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Manufacturer regularly engaged, for a minimum of 10 years, in the manufacturing of resinous flooring systems of similar type to that specified.

B. Applicator's Qualifications:
   1. Applicator regularly engaged, for a minimum of 5 years, in application of resinous flooring systems of similar type to that specified.
   2. Employ persons trained for application of resinous flooring systems.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Delivery Requirements: Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying product name, manufacturer, and batch number.

B. Storage and Handling Requirements:
   1. Store and handle materials in accordance with manufacturer's instructions.
   2. Keep materials in manufacturer's original, unopened containers and packaging until application.
   3. Store materials in clean, dry area indoors between 65 and 90 degrees F (18 and 32 degrees C).
   4. Store materials out of direct sunlight.
   5. Keep materials from freezing.
   6. Protect materials during storage, handling, and application to prevent contamination or damage.

1.8 AMBIENT CONDITIONS

A. Apply flooring system under the following ambient conditions:
   1. Ambient, Concrete Floor, and Material Temperatures: Between 65 and 90 degrees F (18 and 32 degrees C).
   2. Relative Humidity: Maximum 80 percent.
   3. Dew Point: Floor temperature more than 5 degrees over dew point.

B. Do not apply flooring system under ambient conditions outside manufacturer's limits.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Manufacturer: Tennant Company, www.tennantco.com <http://www.tennantco.com>. info@tennantco.com <mailto:info@tennantco.com>.

2.2 RESINOUS FLOORING SYSTEM

A. Resinous Flooring System: Tennant HTS.
   1. Description: High-solids flooring system with epoxy primer and light-stable, chemically resistant, satin, urethane topcoat applied over interior concrete floors.

B. System Components:
   1. Primer: Eco-MPE epoxy.
      a. Application Thickness: 3 to 5 wet/dry mils.
      b. Color: Manufacturer's colorants selected by Architect.
   2. Build Coat: Eco-MPE epoxy.

a. Application Thickness: 17 to 19 wet/dry mils.
b. Color: Manufacturer's colorants selected by Architect.

3. Topcoat: Eco-HTS 100 light-stable satin urethane.
   a. Application Thickness: 3 wet/dry mils.
   b. Color: Manufacturer's colorants selected by Architect.

C. Nominal System Thickness: 25 mils.

D. System Properties:
1. VOC Content, ASTM D 3960, Mixed A+B+C: 0.05 lbs per gal (6 g/L).
2. Abrasion Resistance, ASTM D 4060, CS-17 wheel, 1,000-g load, 1,000 revolutions, Eco-HTS: 18 mg loss.
3. Adhesion to Concrete:
   a. ASTM D 4541: 450 psi, concrete failed.
   b. ASTM D 7234: 732 psi, concrete failed.
4. Coefficient of Friction, ASTM D 2047: 0.63.
5. Wet Static Coefficient of Friction, BOT 3000, ANSI/NFSI B101.1: 0.94.
6. Compressive Strength, Epoxy, ASTM D 695: 13,500 psi.
7. Flammability, ASTM D 635: 182 mm/min.
8. Resistance to Yellowing, measured using ASTM D 2244, 1,000 hours UV exposure in QUV, ASTM G 154: Less than 10 increase of yellow units if pigmented topcoat.
9. Tensile Strength, ASTM D 2370: 6,250 psi.
10. Elongation, ASTM D 2370: 6 percent.
11. Hardness, Konig Test, 3 mil/0.08 mm film, topcoat resin, ASTM D 4366: 171.3.
12. Shore D Hardness, Epoxy, ASTM D 2240:
    a. 0 Seconds: 80 to 85.
    b. 15 Seconds: 75 to 80.
13. Water Absorption, 24-Hour Immersion, ASTM C 413: 0.2 percent weight increase.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine concrete surface to receive flooring system.

B. Verify concrete is structurally sound.

C. Moisture Testing of Concrete: Perform at least one of the following two tests to determine moisture in concrete.
1. Calcium Chloride Test:
   a. Measure moisture vapor emission rate of concrete in accordance with ASTM F 1869.
   b. Application of flooring system can start only if test results are below 3 pounds per 1,000 square feet over a 24-hour period.
   c. If test results are above limits, notify Architect and flooring system manufacturer.
2. In-Situ Probe Test:
   a. Measure relative humidity in concrete in accordance with ASTM F 2170.
   b. Application of flooring system can start only if test results are below 75 percent relative internal concrete humidity.
   c. If test results are above limits, notify Architect and flooring system manufacturer.

D. Notify Architect of conditions that would adversely affect application or subsequent use.

E. Do not begin surface preparation or application until unacceptable conditions are corrected.

3.2 PREPARATION

A. Protection of In-Place Conditions: Protect adjacent surfaces and adjoining walls from contact with flooring system materials.

B. Surface Preparation:
1. Prepare concrete surface in accordance with manufacturer's instructions.
2. Remove dirt, dust, debris, oil, grease, curing agents, bond breakers, paint, coatings, sealers, silicones, and other surface contaminants which could adversely affect application of flooring system.
3. Patch depressions, divots, and cracks in concrete in accordance with manufacturer's instructions.

4. Mechanically remove loose, delaminated, and damaged concrete and repair in accordance with manufacturer's instructions.
5. Joints: Fill joints in accordance with manufacturer's instructions.

3.3 APPLICATION

A. Apply flooring system in accordance with manufacturer's instructions at locations indicated on the Drawings.

B. Ensure concrete is dry, clean, and prepared in accordance with manufacturer's instructions.

C. Allow concrete to cure a minimum of 30 days before applying flooring system.

D. Mixing:
1. Mix material components together in accordance with manufacturer's instructions.
2. Mix only enough material that can be applied within working time.
3. Add and mix colorants with materials in accordance with manufacturer's instructions to achieve uniform color.

E. Apply flooring system materials to obtain consistent mil thickness and smooth, uniform appearance and texture.

F. Primer:
1. Apply primer in accordance with manufacturer's instructions.
2. Apply primer to prepared concrete to ensure proper adhesion of flooring system.

G. Build Coat:
1. Apply build coat in accordance with manufacturer's instructions.
2. Apply build coat over primer.

H. Topcoat:
1. Apply topcoat in accordance with manufacturer's instructions.
2. Apply topcoat over build coat.
3. Apply topcoat to match approved samples submitted in accordance with the Submittals Article of this Section.

3.4 PROTECTION

A. Allow flooring system to dry in accordance with manufacturer's instructions before opening to traffic.

B. Allow flooring system to dry a minimum of 1 week before cleaning by mechanical means.

C. Protect completed flooring system from damage during construction.

END OF SECTION

SECTION 09 68 13

TILE CARPETING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Carpet tile, loose laid with self-adhesive spot adhered.

1.2 SUBMITTALS

A. Shop Drawings: Indicate the following:
   1. Columns, doorways, enclosing walls or partitions, built-in cabinets, and locations where cutouts are required in carpet tiles.
   2. Carpet tile type, color, and dye lot.
   3. Type of subfloor.
   4. Type of installation.
   5. Pattern of installation.
   6. Pattern type, location, and direction.
   7. Pile direction.
   8. Type, color, and location of insets and borders.
   9. Type, color, and location of edge, transition, and other accessory strips.
   10. Transition details to other flooring materials.

B. Product Data: Provide data on specified products, describing physical and performance characteristics; sizes, patterns, colors available, and method of installation.

C. Samples: Submit two carpet tiles illustrating color and pattern design for each carpet color selected.

D. Manufacturer's Installation Instructions: Indicate special procedures.

E. Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning.

F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. Extra Carpet Tiles: Quantity equal to 5 percent of total installed of each color and pattern installed.
   2. Self-Adhesive Spot Stickers: Provide roll of one hundred sticker spots.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.
   1. Review methods and procedures related to carpet tile installation including, but not limited to, the following:
      a. Review delivery, storage, and handling procedures.
      b. Review ambient conditions and ventilation procedures.
      c. Review subfloor preparation procedures.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in installing carpet tile with minimum five years documented experience.

B. Environmental Limitations: Do not deliver or install carpet tiles until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at occupancy levels during the remainder of the construction period.

C. Do not install carpet tiles over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive and concrete slabs have pH range recommended by carpet tile manufacturer.

1.5 FIELD CONDITIONS

A. Comply with CRI 104.

1.6 WARRANTY

A. Special Warranty for Carpet Tiles: Manufacturer agrees to repair or replace components of carpet tile installation that fail in materials or workmanship within specified warranty period.
   1. Warranty does not include deterioration or failure of carpet tile due to unusual traffic, failure of substrate, vandalism, or abuse.
   2. Failures include, but are not limited to, more than 10 percent edge raveling, snags, runs, dimensional stability, loss of tuft bind strength, loss of face fiber, and delamination.
   3. Warranty Period: 10 years from date of Substantial Completion.

PART 2 PRODUCTS

2.1 MATERIALS

A. Carpet Tile : Products: Refer to Drawing Sheet A602 Finish Material Specification for carpet types and products..

2.2 ACCESSORIES

A. Sub-Floor Filler: Pre-mix latex; type recommended by flooring material manufacturer.

B. Self-Adhesive Spot Stickers: Manufacturer's pressure sensitive, self-adhesive spot stickers.

C. Metal Edge/Transition Strips: Extruded aluminum with mill finish of profile and width shown, of height required to protect exposed edge of carpet, and of maximum lengths to minimize running joints.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that sub-floor surfaces are smooth and flat within tolerances specified for that type of work and are ready to receive carpet tile.

B. Verify that sub-floor surfaces are dust-free and free of substances that could impair bonding of adhesive materials to sub-floor surfaces.

C. Test moisture emission rates and alkalinity levels in accordance with ASTM F710.

3.2 PREPARATION

A. General: Comply with CRI 104, Section 6.2, "Site Conditions; Floor Preparation," and with carpet tile manufacturer's written installation instructions for preparing substrates indicated to receive carpet tile installation.

B. Prepare floor substrates as recommended by flooring and adhesive manufacturers.

C. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, depressions, and protrusions in substrates. Fill or level cracks, holes and depressions 1/8 inch wide or wider and protrusions more than 1/32 inch unless more stringent requirements are required by manufacturer's written instructions.

D. Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by carpet tile manufacturer.

E. Clean metal substrates of grease, oil, soil and rust, and prime if directed by adhesive manufacturer. Rough sand painted metal surfaces and remove loose paint. Sand aluminum surfaces, to remove metal oxides, immediately before applying adhesive.

F. Broom and vacuum clean substrates to be covered immediately before installing carpet tile.

3.3 INSTALLATION

A. Starting installation constitutes acceptance of sub-floor conditions.

B. Install carpet tile in accordance with manufacturer's instructions and CRI 104 Section 14 "Carpet Modules".

C. Blend carpet from different cartons to ensure minimal variation in color match.

D. Cut carpet tile clean. Fit carpet tight to intersection with vertical surfaces without gaps.

E. Lay carpet tile in square pattern, with pile direction parallel to next unit, set in directions and patterns indicated on drawings.

F. Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.

G. Apply self-adhesive spot stickers to back of carpet tiles with number and pattern as recommended by manufacturer.

H. Trim carpet tile neatly at walls and around interruptions.

I. Complete installation of edge strips, concealing exposed edges.

3.4 CLEANING AND PROTECTION

A. Remove excess adhesive without damage, from floor, base, and wall surfaces.

B. Perform the following operations immediately after installing carpet tile:
   1. Remove excess adhesive, seam sealer, and other surface blemishes using cleaner recommended by carpet tile manufacturer.
   2. Remove yarns that protrude from carpet tile surface.
   3. Vacuum carpet tile using commercial machine with face-beater element.

C. Protect installed carpet tile to comply with CRI 104, Section 16, "Protecting Indoor Installations."

D. Protect carpet tile against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by carpet tile manufacturer.

END OF SECTION

SECTION 09 72 10

CUSTOM DIGITAL WALL COVERINGS

PART 1 GENERAL

1.1 SUMMARY

A. This Section includes the following:
   1. Custom digital wall covering.

1.2 SUBMITTALS

A. Product Data: For each type of digital wallcovering proposed for use on the project, submit certified copies of reports of tests specified, together with complete description of each wallcovering, including: pattern, total weight, fabric backing, tensile strength, tear strength, and fire hazard classification.

B. Architect will provide custom digital wall covering manufacturer with digital graphic file for custom digital wallcovering.

C. Submit samples of all materials specified. Do not order materials until approval is received.
   1. Submit "mini-mural" of complete finished image printed on actual substrate specified.
   2. Submit sample section of final image at 100% resolution printed on actual substrate specified.

D. Shop Drawings: Show location and extent of each wall-covering type. Indicate seams and termination points.

E. Manufacturers' product data for adhesives, including printed statement of VOC content.

F. Maintenance data.

1.3 QUALITY ASSURANCE

A. Submittals other than the specified material shall match the appearance and color of the selected material, and equal or exceed the quality, total weight, fabric backing, tensile and tear strength, fire ratings and mildew resistance of the specified product(s). The decision of the Architect/Designer shall be final.

B. Imperfections such as engraving roller die marks, roller repeat marks or other features deemed not in conformance with the specified materials, will be cause for rejection by the Architect/Designer, if evidenced in either the submitted samples, or the manufactured material delivered to the job.

C. Tests: All tests shall be performed in accordance with Federal Specification CCC-T-191b, except as follows:
   1. Adhesion of vinyl coating to the fabric backing shall be tested in accordance with ASTM D 751.
   2. Materials shall have a zone inhibition rating of "0" on face, and "1" on backing to resist the growth of mildew and bacteria, as determined by test method ASTM G 21.

D. Applicators Qualifications: Work of this section shall be performed by a firm regularly engaged in the installation of vinyl wall coverings of the types and qualities specified, and acceptable to the custom digital wall covering manufactuer and Architect/Designer.

1.4 PROJECT SITE CONDITIONS

A. Temperatures
   1. Maintain substrate surface and ambient temperatures above 65 degrees F, unless required otherwise by manufacturer's instructions.
   2. Do not apply adhesive when substrate surface temperature or ambient temperature is below 65 degrees F.
   3. Maintain these conditions 72 hours before, during, and after installation of vinyl wallcovering.

B. Lighting: Provide not less than 80 foot-candles per square foot minimum, on the surfaces to receive wallcoverings.

C. Wall Condition:
   1. The wall surface should be clean, dry, structurally sound, and free of mildew, grease, dust, or other stains.
   2. Plaster and masonry wall surfaces should not exceed 5.5% moisture when measured by a moisture meter. Gypsum board wall surfaces should not exceed 16% moisture.
   3. Room humidity should not exceed 90%.
   4. Wall surfaces should be primed with a good quality wallcovering primer. Wall surfaces with significant color variation should be primed with a good quality pigmented wallcovering primer.
   5. New plaster should age 60-90 days before painting or installing wallcovering.

1.5 WARRANTY

A. Submit manufacturer's written five year warranty against manufacturing defects.
   1. All wallcovering materials when adhered to a sound surface with the manufacturer's recommended procedures and adhesive, shall be warranted.

PART 2 PRODUCTS

2.1 CUSTOM DIGITAL WALL COVERING

A. Custom Digital Wallcovering as provided by MDC Wallcoverings. Digital wallcovering shall be printed on 53"/54" vinyl wallcovering substrate using piezo drop-on-demand technology incorporating eight colors, CYMK and half density CYMK. Printed image shall be dried from both front and back using combinations of IR and platen heaters to prevent media distortion.
   1. Texture: Digital Stipple.

B. Vinyl wallcovering substrate: supported vinyl material, consisting of a through-pigmented, mildewinhibitorized polyvinyl chloride, adhered to cotton, cotton/blend fabric backing, or a cellulose polyester nonwoven backing. All materials shall be Cadmium and Mercury free, and shall conform to the CFFA-W-101-B, using test methods as outlined in FedSpec CCC-T-191b, except as otherwise specified.
   1. Total Weight: minimum 13 ounces per square yard, 19.5 ounces per linear yard.
   2. Backing Weight: minimum 2 ounces per square yard.
   3. Fabric backing and content: cotton, cotton/blend fabric, or a cellulose polyester non-woven.
   4. Adhesion of coating to fabric: 3 pounds per 1 inch strip (ASTM D751)
   5. Tensile strength: 97 X 92 (W x F).
   6. Tear strength: 55 X 40 (W x F).
   7. Flame Spread (UL): 10 (ASTM E84) or UL 723.
      a. Smoke Developed (UL): 25 (ASTM E84) or UL 723
      b. Tested on reinforced cement board.
   8. Mildew resistance: Zone inhibition rating of "0" on face, "1" on backing (ASTM G21).
   9. Staphylococcus resistance: 100 percent reduction within 24 hours. 1006 NYS Quantitative Bacteria Resistance
   10. Accepted by the City of New York Department of Building MEA 310-89-M.
   11. Meet the State of Washington Purchase Specification for Product Emissions (Formaldehyde and TVOC's) 7 days after installation.
   12. Meet the EPA Headquarters Procurement specification for Product Emission (Total Aldehydes) within 7 days.
   13. Meets Heavy Metal Solubility Requirements of ASTM F-963.
   14. Contains bactericides and mildew inhibitors to protect the product from microbiological and mildew growth, consistent with 40 C.F. R. ß152.25.
   15. Provide the benefit of advanced notice of smoke or fire when used in conjunction with ionized smoke detectors.

2.2 ACCESSORIES

A. Adhesive: Mildew-resistant, nonstaining adhesive, for use with specific wall covering and substrate application, as recommended in writing by wall-covering manufacturer, and with a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Primer/Sealer: Mildew-resistant primer/sealer complying with requirements in Division 9 Section "Painting" and recommended in writing by wall-covering manufacturer for intended substrate.

C. Seam Tape: As recommended in writing by wall-covering manufacturer.

PART 3 EXECUTION

3.1 INSTALLATION

A. Examine surface for any imperfections, do not begin installation until imperfections have been corrected.

B. Install digital wall covering in accordance with the manufacturer's instructions using heavy-duty vinyl wall covering adhesive recommended by the manufacturer (Wheat paste shall not be used).

C. Before cutting, lay out panels in numeric order and examine each panel for color consistency, accuracy and proper image dimension.

D. Install each panel in numerical sequence hanging first panel to a vertical line. Overlap subsequent panels to match crop lines and double cut on the wall. Selvage (excess trimmed edge) should be removed from the wall and the seam closed within one hour.

E. Re-inspect after the application each panel. Request inspection by the Architect/Designer if there are variations in color or pattern that are considered to be excessive. The wall covering distributor or manufacturer's representative shall then be notified for their inspection, before any further wall covering is installed.

F. The wall covering shall be smoothed to the hanging surface, using a stiff bristled sweep brush or a flexible broad-knife to eliminate air bubbles.

G. Remove excess adhesive along finished seams immediately after each wall covering strip is applied. Use clean warm water, a natural sponge and clean towels. Change water often to maintain water cleanliness.

3.2 CLEAN-UP COMPLETION

A. Upon completion of the work, remove surplus materials, rubbish and debris resulting from the wallcovering installation. Leave areas in neat, clean and orderly condition.

END OF SECTION

SECTION 09 84 00

FABRIC WRAPPED PANELS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Fabric-covered fiberglass core panels and mounting accessories.

1.2 REFERENCE STANDARDS

A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2016.

1.3 SUBMITTALS

A. Product Data: Manufacturer's printed data sheets for products specified.

B. Shop Drawings: Fabrication and installation details, panel layout, and fabric orientation.

C. Verification Samples: Fabricated samples of each type of panel specified; 12 by 12 inch, showing construction, edge details, and fabric covering.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Protect acoustical panels from moisture during shipment, storage, and handling. Deliver in factory-wrapped bundles; do not open bundles until panels are needed for installation.

B. Store panels flat, in dry, well-ventilated space; do not stand panels on end.

C. Protect panel edges from damage.

PART 2 PRODUCTS

2.1 TACKABLE WALL PANELS

A. Panels: Prefinished, factory assembled fabric-covered panels.

B. Tackable Panels:
   1. Products: Basis-of-Design: Conwed, Respond TK/AC panels. Subject to compliance with requirements, provide basis-of-design product or a comparable product by one of the following:
      a. Golterman & Sabo.
      b. Panel Solutions, Inc.
   2. Density: 6 - 7 lb/cu ft nominal core density and laminated with 1/8 inch tackable face layer.
   3. Panel Width and Height: As indicated on Drawings.
   4. Panel Thickness: 3/4 inch.
   5. Edges: Perimeter edges reinforced by an aluminum frame or a galvanized steel frame.
   6. Corners: Radiused.
   7. Mounting: Back mounting.

C. Fabric Covering: Seamless fabric facing material, for stretched covering of core material.
   1. Fabric: Refer to Drawing Sheet A602 for Finish Material Specifications. Panel manufacturer must be able to provide panels wrapped with the specified fabric.

2.2 ACOUSTIC WALL PANELS

A. Panels: Prefinished, factory assembled fabric-covered panels.

B. Acoustic Panels:
   1. Products: Basis-of-Design: Conwed, Respond ACT Acoustical Panels. Subject to compliance with requrirements, provide basis-of-design product or a comparable product by one of the following:
      a. Golterman & Sabo.
      b. Panel Solution, Inc.
   2. Density: 6-7 lb/cu ft nominal core density.
   3. Panel Width and Height: As indicated on Drawings.
   4. Panel Thickness: 2 inches.

5. Edges: Perimeter edges reinforced by a formulated resin hardener.
6. Corners: Square.
7. Mounting: Back mounting.
8. Fabric Covering: Seamless fabric facing material, for bonded covering of core material.
    a. Fabric: Refer to Drawing Sheet A602 for Finish Material Specifications. Panel manufacturer must be able to provide panels wrapped in specified fabric.

2.3 FABRICATION

A. General: Fabricate panels to sizes and configurations indicated, with fabric facing stretched straight, on the grain, tight, square and installed without sagging, ripples, wrinkles, sags, blisters, or visible seams.
    1. Provide double thickness of overlay at panel edges.
    2. Where radiused or mitered corners are indicated, install fabric to avoid seams or gathering of material.

B. Tolerances: Fabricate to finished tolerance of plus or minus 1/16 inch for thickness, overall length and width, and squareness from corner to corner.

2.4 ACCESSORIES

A. Back-Mounting Accessories: Manufacturer's standard accessories for concealed support, designed to allow panel removal, and as follows:
    1. Z-clip hanger and magnet system with magnets recessed into panel frame and designed to engage steel mounting plates secured to substrate with screws.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install acoustical panels in locations indicated, following installation recommendations of panel manufacturer. Align panels accurately, with edges plumb and top edges level. Scribe to fit accurately at adjoining work and penetrations.

B. Install panels to construction tolerances of plus or minus 1/16 inch for the following:
    1. Plumb and level.
    2. Flatness.
    3. Variation of Panel Joints from Hairline: Not more than 1/32 inch wide.

3.2 CLEANING

A. Clip loose threads, remove pills and extraneous materials.

B. Clean fabric facing upon completion of installation from dust and other foreign materials, following manufacturer's instructions.

C. Remove surplus materials, trimmed portions of panels, and debris resulting from installation.

3.3 PROTECTION

A. Provide protection of installed acoustical panels until completion of the work.

B. Replace panels that cannot be cleaned and repaired to satisfaction of the Architect.

END OF SECTION

SECTION 09 91 13

EXTERIOR PAINTING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Surface preparation.

B. Field application of paints.

C. Scope: Finish exterior surfaces exposed to view, unless fully factory-finished and unless otherwise indicated.

D. Do Not Paint or Finish the Following Items:
   1. Items factory-finished unless otherwise indicated; materials and products having factory-applied primers are not considered factory finished.
   2. Items indicated to receive other finishes.
   3. Items indicated to remain unfinished.
   4. Fire rating labels, equipment serial number and capacity labels, and operating parts of equipment.
   5. Floors, unless specifically indicated.
   6. Glass.
   7. Concealed pipes, ducts, and conduits.
   8. Data cable.
      a. Painter shall be aware that any amount of paint or overspray of paint on data cable will void the warranty of the data cable. Attempts to remove paint by chemical or physical means from data cable is not allowed. All data cable with paint/overspray shall be required to be fully replaced. Entire run of cable will be replaced. No splicing is allowed.

1.2 REFERENCE STANDARDS

A. SSPC-SP 3 - Power Tool Cleaning; 1982 (Ed. 2004).

1.3 SUBMITTALS

A. Product Data: Provide complete list of products to be used, with the following information for each:
   1. Manufacturer's name, product name and/or catalog number, and general product category (e.g. "alkyd enamel").
   2. Cross-reference to specified paint system(s) product is to be used in; include description of each system.
   3. Manufacturer's installation instructions.

B. Samples: Submit three paper "draw down" samples, 8-1/2 by 11 inches in size, illustrating range of colors available for each finishing product specified.
   1. Where sheen is specified, submit samples in only that sheen.

C. Maintenance Data: Submit data including care and cleaning instructions, touch-up procedures, and repair of painted and finished surfaces.

D. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. Extra Paint and Coating: 1 full quart of each color and sheen.

1.4 QUALITY ASSURANCE

A. Benchmark Samples (Mockups): Provide a full-coat benchmark finish sample for each type of coating and substrate required.
   1. Wall Surfaces: Provide samples on at least 100 sq. ft.
   2. Final approval of colors will be from benchmark samples.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.

B. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.

C. Paint Materials: Store at minimum ambient temperature of 45 degrees F and a maximum of 90 degrees F, in ventilated area, and as required by manufacturer's instructions.

1.6 FIELD CONDITIONS

A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.

B. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.

C. Do not apply exterior paint and finishes during rain or snow, or when relative humidity is outside the humidity ranges required by the paint product manufacturer.

D. Provide lighting level of 80 ft candles measured mid-height at substrate surface.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Provide paints and finishes from the same manufacturer to the greatest extent possible.

B. Substitutions: See Section 01 60 00 - Product Requirements.

2.2 PAINTS AND FINISHES - GENERAL

A. Paints and Finishes: Ready mixed, unless required to be a field-catalyzed paint.
   1. Provide paints and finishes of a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.
   2. Provide materials that are compatible with one another and the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.
   3. For opaque finishes, tint each coat including primer coat and intermediate coats, one-half shade lighter than succeeding coat, with final finish coat as base color.
   4. Supply each paint material in quantity required to complete entire project's work from a single production run.
   5. Do not reduce, thin, or dilute paint or finishes or add materials unless such procedure is specifically described in manufacturer's product instructions.

2.3 PAINT SYSTEMS - EXTERIOR

A. Exterior Galvanized Metal Indicated to be Painted:
   1. Pimer:
      a. Diamond Vogel: Mult-E-Prime 500 Hi-Build Epoxy Primer
      b. Pittsburg Paints; 95-245 Series Pitt-Guard DTR Polymide Epoxy Coating.
      c. Sherwin-Williams: Tile-Clad High Solids.
      d. Tnemec; Series 27 WB Typoxy Polymide Epoxy.
   2. Intermediate Coat:
      a. Diamond Vogel: Mult-E-Poxy 180 Epoxy Mastic.
      b. Pittsburg Paints; 95-8800 Series Pitthane High-Build Urethane Enamel.
      c. Sherwin-Williams; Macropoxy 646.
      d. Tnemec; None required.
   3. Topcoat:
      a. Diamond Vogel; Multi-Thane 330 High Solids Acrylic Polyurethane.
      b. Pittsburg Paints; 95-8800 Series Pitthane High-Build Urethane Enamel.
      c. Sherwin-Williams: Acrolon 218.
      d. Tnemec; Series 1075 Endura-Shield II.

2.4 ACCESSORY MATERIALS

A. Accessory Materials: Provide primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials as required for final completion of painted surfaces.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that surfaces are ready to receive work as instructed by the product manufacturer.

B. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially effect proper application.

C. Test shop-applied primer for compatibility with subsequent cover materials.

3.2 PREPARATION

A. Clean surfaces thoroughly and correct defects prior to application.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

C. Remove or mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces for finishing.

D. Seal surfaces that might cause bleed through or staining of topcoat.

E. Remove mildew from impervious surfaces by scrubbing with solution of tetra-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.

F. Galvanized Surfaces:
   1. Prepare surface according to SSPC-SP 3.

3.3 APPLICATION

A. Apply products in accordance with manufacturer's written instructions.

B. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.

C. Apply each coat to uniform appearance.

D. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.

E. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

3.4 CLEANING

A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.

3.5 PROTECTION

A. Protect finishes until completion of project.

B. Touch-up damaged finishes after Substantial Completion.

END OF SECTION

SECTION 09 91 23

INTERIOR PAINTING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Surface preparation.

B. Field application of paints.

C. Scope: Finish interior surfaces exposed to view, unless fully factory-finished and unless otherwise indicated.
   1. Both sides and edges of plywood backboards for electrical and telecom equipment before installing equipment.
   2. Elevator pit ladders.
   3. Prime surfaces to receive wall coverings.
   4. Mechanical and Electrical:
      a. In finished areas, paint insulated and exposed pipes, conduit, boxes, insulated and exposed ducts, hangers, brackets, collars and supports, mechanical equipment, and electrical equipment, unless otherwise indicated.
   5. Stenciling at Fire/Smoke Walls and Partitions: Provide identification for all fire walls, fire barriers, fire partitions, smoke barriers and smoke partitions. Such identifications shall:
      a. Be located in accessible concealed floor, floor-ceiling or attic spaces;
      b. Be repeated at intervals not exceeding 30 feet measured horizontally along the wall or partition; and
      c. Include lettering not less than 0.5 inch in height, incorporating the suggested wording: "FIRE AND/OR SMOKE BARRIER-PROTECT ALL OPENINGS," or other wording as indicated on drawings.

D. Do Not Paint or Finish the Following Items:
   1. Items factory-finished unless otherwise indicated; materials and products having factory-applied primers are not considered factory finished.
   2. Items indicated to receive other finishes.
   3. Items indicated to remain unfinished.
   4. Fire rating labels, equipment serial number and capacity labels, bar code labels, and operating parts of equipment.
   5. Floors, unless specifically indicated.
   6. Ceramic and other tiles.
   7. Glass.
   8. Concealed pipes, ducts, and conduits.
   9. Data cable.
      a. Painter shall be aware that any amount of paint or overspray of paint on data cable will void the warranty of the data cable. Attempts to remove paint by chemical or physical means from data cable is not allowed. All data cable with paint/overspray shall be required to be fully replaced. Entire run of cable will be replaced. No splicing is allowed.

1.2 REFERENCE STANDARDS

A. MPI (APSM) - Master Painters Institute Architectural Painting Specification Manual; Current Edition, www.paintinfo.com.

B. SSPC-SP 1 - Solvent Cleaning; 2015.

C. SSPC-SP 3 - Power Tool Cleaning; 1982 (Ed. 2004).

D. SSPC-SP 6 - Commercial Blast Cleaning; 2007.

E. SSPC-SP 13 - Surface Preparation of Concrete; (Reaffirmed 2015); 2003.

1.3 SUBMITTALS

A. Product Data: Provide complete list of products to be used, with the following information for each:
   1. Manufacturer's name, product name and/or catalog number, and general product category (e.g. "alkyd enamel").
   2. Cross-reference to specified paint system(s) product is to be used in; include description of each system.

3. Manufacturer's installation instructions.

B. Samples: Submit two paper "draw down" samples, 8-1/2 by 11 inches in size, illustrating range of colors available for each finishing product specified.
   1. Where sheen is specified, submit samples in only that sheen.

C. Manufacturer's Instructions: Indicate special surface preparation procedures.

D. Maintenance Data: Submit data including finish schedule showing where each product/color/finish was used, product technical data sheets, care and cleaning instructions, touch-up procedures, repair of painted and finished surfaces, and color samples of each color and finish used.

E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. Extra Paint and Finish Materials: 1 gallon of each color; from the same product run, store where directed.
   2. Label each container with color in addition to the manufacturer's label.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified, with minimum three years documented experience.

B. Applicator Qualifications: Company specializing in performing the type of work specified with minimum five years experience.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.

B. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.

C. Paint Materials: Store at minimum ambient temperature of 45 degrees F and a maximum of 90 degrees F, in ventilated area, and as required by manufacturer's instructions.

1.6 FIELD CONDITIONS

A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.

B. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.

C. Provide lighting level of 80 ft candles measured mid-height at substrate surface.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Provide paints and finishes used in any individual system from the same manufacturer; no exceptions.

2.2 PAINTS AND FINISHES - GENERAL

A. Paints and Finishes: Ready mixed, unless intended to be a field-catalyzed paint.
   1. Provide paints and finishes of a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.
   2. Supply each paint material in quantity required to complete entire project's work from a single production run.
   3. Do not reduce, thin, or dilute paint or finishes or add materials unless such procedure is specifically described in manufacturer's product instructions.

2.3 PAINT SYSTEMS - INTERIOR

A. Interior Gypsum Board Surfaces to be Painted:
   1. Two top coats and one coat primer.
   2. Top Coats for Walls: Interior Eggshell Latex.
      a. Products:

1) Diamond Vogel, Vantage Plus Interior Latex Eggshell Enamel
2) PPG Paints Ultra-Hide 150 Interior Low Sheen Paint, 1410-XXXXV, Eggshell.
3) Pratt & Lambert Pro-Hide Gold Ultra Interior Latex, Eggshell.
4) Sherwin-Williams ProMar 200 Zero VOC Interior Latex, Eg-Shel.

3. Top Coats for Ceilings: Interior Flat Latex.
   a. Products:
      1) Diamond Vogel, Vantage Plus Interior Latex Flat Enamel.
      2) PPG Paints Ultra-Hide 150 Interior Paint, 1210-XXXXV, Flat.
      3) Pratt & Lambert Pro-Hide Gold Ultra Interior Latex, Flat.
      4) Sherwin-Williams ProMar 200 Zero VOC Interior Latex, Flat.
4. Primer: As recommended by top coat manufacturer for specific substrate.

B. Concrete and Concrete Masonry Units: Interior Semi-Gloss Latex.
   1. Products:
      a. Diamond Vogel, Vantage Plus interior Latex Semi-Gloss Enamel.
      b. PPG Paints Ultra-Hide 150 Interior Paint, 1416-XXXXV, Semi-Gloss.
      c. Pratt & Lambert Pro-Hide Gold Interior Latex, Semi-Gloss.
      d. Sherwin-Williams ProMar 200 Zero VOC Interior Latex, Semi-Gloss.

C. Ferrous and Galvanized Metal Surfaces to be Painted: For surfaces subject to frequent contact by occupants, including metals:
   1. Medium duty applications include doors, door frames, railings, handrails, guardrails, balustrades, and miscellaneous metals.
   2. Two top coats and one coat primer.
   3. Top Coat(s): Interior Light Industrial Coating, Water Based.
      a. Products:
         1) Diamond Vogel, Finium DTM-AT Acrylic Semi-Gloss.
         2) PPG Paints Pitt-Tech Plus, 90-1210 Series, Semi-Gloss.
         3) Sherwin-Williams Pro Industrial Acrylic Coating, Semi-Gloss.

D. Interior Epoxy Coating: Including gypsum board and concrete masonry units.
   1. Primer for gypsum wallboard: As recommended by manufacturer.
   2. Primer for concrete masonry: Masonry filler.
   3. Finish Coatings: Two coats. Provide one of the following:
      a. Diamond Vogel, Eas-E-Poxy Pre-Catalyzed Waterborne Epoxy Semi-Gloss.
      b. Pittsburgh Paints; PITT-GLAZE Water Based Acrylic Epoxy Semi-Gloss.
      c. Pratt & Lambert Acrylic Waterborne Epoxy, Semi-Gloss.
      d. Sherwin-Williams Pro Industrial Pre-Catalyzed Waterbased Epoxy, Semi-Gloss.

E. Dry Fall: Metals; exposed structure and overhead-mounted services, including shop primed steel deck, structural steel, metal fabrications, galvanized ducts, galvanized conduit, and galvanized piping.
   1. One top coat.
   2. Top Coat: Latex Dry Fall.
      a. Products:
         1) Diamond Vogel, Luminance 300 Latex Dri-Mist Flat.
         2) PPG Paints Speedhide Super Tech Water Based Interior Dry-Fog, 6-725XI, Flat. (MPI #118)
         3) Pratt & Lambert Waterborne Dry Fall, Flat.
         4) Sherwin-Williams Waterborne Acrylic Dryfall, Flat.

2.4 ACCESSORY MATERIALS

A. Accessory Materials: Provide primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials as required for final completion of painted surfaces.

B. Patching Material: Latex filler.

C. Fastener Head Cover Material: Latex filler.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that surfaces are ready to receive work as instructed by the product manufacturer.

B. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially effect proper application.

C. Test shop-applied primer for compatibility with subsequent cover materials.

D. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below the following maximums:
   1. Gypsum Wallboard: 12 percent.

3.2 PREPARATION

A. Clean surfaces thoroughly and correct defects prior to application.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

C. Remove or mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces or finishing.

D. Seal surfaces that might cause bleed through or staining of topcoat.

E. Concrete:
   1. Remove release agents, curing compounds, efflorescence, and chalk. Do not coat surfaces if moisture content or alkalinity of surfaces to be coated exceeds that permitted in manufacturer's written instructions.
   2. Prepare surface as recommended by top coat manufacturer and according to SSPC-SP 13.

F. Masonry:
   1. Remove efflorescence and chalk. Do not coat surfaces if moisture content or alkalinity of surfaces or if alkalinity of mortar joints exceed that permitted in manufacturer's written instructions. Allow to dry.
   2. Prepare surface as recommended by top coat manufacturer.

G. Gypsum Board: Fill minor defects with filler compound. Spot prime defects after repair.

H. Galvanized Surfaces:
   1. Prepare surface according to SSPC-SP 3.

I. Ferrous Metal:
   1. Solvent clean according to SSPC-SP 1.
   2. Shop-Primed Surfaces: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces. Re-prime entire shop-primed item.
   3. Remove rust, loose mill scale, and other foreign substances using using methods recommended in writing by paint manufacturer and blast cleaning according to SSPC-SP 6 "Commercial Blast Cleaning". Protect from corrosion until coated.

3.3 APPLICATION

A. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.

B. Apply products in accordance with manufacturer's written instructions.

C. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.

D. Apply each coat to uniform appearance in thicknesses specified by manufacturer.

E. Include areas visible when permanent or built-in fixtues, grilles, convector covers, covers for finned-tube radiation, and similar components are in place. Extend coatings in these areas, as required, to maintain system integrity and provide desired protection.
   1. Paint surfaces behind movable equipment and furniture the same as similar exposed surfaces. Before final installation of equipment, paint surfaces behind permanently fixed equipment or furniture with prime coat only.

2. Paint interior surfaces of ducts with a flat, nonspecular black paint where visible through registers or grilles.
3. Paint back sides of access panels and removable or hinged covers to match exposed surfaces.
4. Finish doors on tops, bottoms, and side edges the same as exterior faces.

F. Minimum Coating Thickness: Apply paint materials no thinner than manufacturer's recommended spreading rate. Provide total dry film thickness of the entire system as recommended by manufacturer.

G. Block Fillers: Apply block fillers to concrete masonry block at a rate to ensure complete coverage with pores filled.

H. Dark Colors and Deep Clear Colors: Regardless of number of coats specified, apply as many coats as necessary for complete hide.

I. Sand wood and metal surfaces lightly between coats to achieve required finish.

J. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.

K. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

L. Concrete Floor Sealer: Follow manufacturer’s instructions for preparation and installation.

3.4 CLEANING

A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.

B. At end of each workday, remove empty cans, rags, rubbish, and other discarded paint materials from Project site.

C. Protect work of other trades, whether being painted or not, against damage from painting. Correct damage by cleaning, repairing or replacing, and repainting

D. Provide "Wet Paint: signs to protect newly painted finishes.

3.5 PROTECTION

A. Protect finishes until completion of project.

B. Touch-up damaged finishes after Substantial Completion.

END OF SECTION

SECTION 10 11 01

VISUAL DISPLAY BOARDS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Markerboards and Tackboards.

1.2 RELATED REQUIREMENTS

A. Section 06 10 00 - Rough Carpentry: Blocking and supports.

1.3 REFERENCE STANDARDS

A. ANSI A135.4 - American National Standard for Basic Hardboard; 2012.

B. ASTM A424/A424M - Standard Specification for Steel, Sheet, for Porcelain Enameling; 2009a (Reapproved 2016).

C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2016.

1.4 SUBMITTALS

A. Product Data: Provide manufacturer's data on markerboard, tackboard, trim, and accessories.

B. Shop Drawings: Indicate wall elevations, dimensions, joint locations.

C. Maintenance Data: Include data on regular cleaning, stain removal .

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.6 WARRANTY

A. Provide five year warranty for markerboard to include warranty against discoloration due to cleaning, crazing or cracking, and staining.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Visual Display Boards:
   1. AJW Architectural Products, www.ajw.com
   2. Best-Rite Manufacturing.
   3. Claridge Products and Equipment, Inc: www.claridgeproducts.com.
   4. Marsh Industries: www.marsh-ind.com.
   5. W. E. Nea Slate Company: www.nealslate.com.

2.2 VISUAL DISPLAY BOARDS

A. Markerboards: Porcelain enamel on steel, laminated to core.
   1. Steel Face Sheet Thickness: 24 gage, 0.0239 inch .
   2. Core: Particleboard, manufacturer's standard thickness, laminated to face sheet.
   3. Backing: Aluminum foil, laminated to core.
   4. Size: As indicated on drawings.
   5. Frame: Extruded aluminum, with concealed fasteners.
   6. Frame Profile: 1-1/2 inch wide, rectangular trim.
   7. Frame Finish: Anodized, natural.
   8. Accessories: Provide chalk tray and map rail.

B. Tackboards: Composition cork.
   1. Cork Thickness: 1/8 inch.
   2. Color: As selected from manufacturer's full range.

3. Backing: Hardboard, 1/4 inch thick, laminated to tack surface.
4. Surface Burning Characteristics: Flame spread index of 25, maximum, and smoke developed index of 450, maximum, when tested in accordance with ASTM E84.
5. Size: As indicated on drawings.
6. Frame: Extruded aluminum, with concealed fasteners.
7. Frame Profile: 1-1/2 inch wide, rectangular trim.
8. Frame Finish: Anodized, natural.

2.3 MATERIALS

A. Porcelain Enameled Steel Sheet: ASTM A424/A424M, Type I, Commercial Steel, with fired-on vitreous finish.

B. Hardboard for Cores: ANSI A135.4, Class 1 - Tempered, S2S (smooth two sides).

C. Foil Backing: Aluminum foil sheet, 0.005 inch thick.

2.4 ACCESSORIES

A. Map Rail: Extruded aluminum, manufacturer's standard profile, with cork insert and runners for accessories; 1 inch wide overall, full width of frame.

B. Chalk Tray: Aluminum, manufacturer's standard profile, one piece full length of chalkboard, molded ends, concealed fasteners, same finish as frame.

C. Mounting Brackets: Concealed.

D. Marker Sets: Provide a four (4) marker set (blue, red, green, black) and a dry eraser for each room where marker boards are installed.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that internal wall blocking is ready to receive work and positioning dimensions are as indicated on shop drawings.

3.2 INSTALLATION

A. Install boards in accordance with manufacturer's instructions.

B. Install visual display surfaces in locations and at mounting heights indicated on Drawings.

C. Visual Display Boards: Attach concealed clips, hangers, and grounds to wall surfaces and to visual display boards with fasteners at not more than 16 inches o.c. Secure both top and bottom of boards to walls.

D. Secure units level and plumb.

3.3 CLEANING

A. Clean board surfaces in accordance with manufacturer's instructions.

END OF SECTION

SECTION 10 14 00

SIGNAGE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Building signage.

B. Flag holders.

1.2 SUBMITTALS

A. Product Data: Manufacturer's printed product literature for each type of sign, indicating sign styles, font, foreground and background colors, locations, overall dimensions of each sign.

B. Samples: Submit one sample of one letter, of size similar to that required for project, illustrating sign style, font, and method of attachment.

C. Manufacturer's Installation Instructions: Include installation templates and attachment devices.

1.3 DELIVERY, STORAGE, AND HANDLING

A. Package signs as required to prevent damage before installation.

PART 2 PRODUCTS

2.1 SIGNAGE APPLICATIONS

A. Exterior Letter Signage and Cutout Graphic:
   1. Use individual cut metal letters and graphics.
   2. Mounting: Flush mount.

2.2 DIMENSIONAL LETTERS

A. Exterior Cut Metal Letters:
   1. Metal: Aluminum, cut sheet.
   2. Finish: Clear anodized.
   3. Color: Match Architect's sample.
   4. Letter Depth: 1/4 inch.
   5. Letter Style and Height: As indicated on drawings.
   6. Basis-of-Design: ASI, Cut Metal Letters.

B. Exterior Cut Metal Graphics:
   1. Metal: Aluminum, cut sheet.
   2. Finish: Clear anodized and baked enamel colors as indicated on drawings.
   3. Graphic Depth: 1/4 inch.
   4. Design: As indicated on drawings.
   5. Basis-of-Design: ASI, Custom Metal Cut Graphics.

2.3 ACCESSORIES

A. Concealed Screws: Stainless steel, galvanized steel, chrome plated, or other non-corroding metal.

2.4 FABRICATION - GENERAL

A. General: Comply with requirements indicated for materials, thicknesses, finishes, colors, designs, shapes, sizes, and details of construction.

B. Design, fabricate, and install sign assemblies to prevent buckling, opening up of joints, and over-stressing of welds and fasteners.

C. Mill joints to a tight, hairline fit. Form joints exposed to the weather to exclude water penetration.

D. Conceal fasteners if possible; otherwise, locate fasteners where they will be inconspicuous.

E. Create signage to required sizes and layout. Comply with requirements indicated for design, dimensions, finish, color, and details of construction.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that substrate surfaces are ready to receive work.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install neatly, with horizontal edges level.

C. Protect from damage until Substantial Completion; repair or replace damaged items.

END OF SECTION

SECTION 10 22 13

WIRE MESH PARTITIONS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Wire mesh system for walls.

1.2 SUBMITTALS

A. Product Data: Provide data for screen materials, finishes.

B. Shop Drawings: Indicate plan and vertical dimensions, elevations, component details; head, jamb, and sill details; location of hardware. Provide component details, anchorage, and type and location of fasteners.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Wire Mesh Partitions:
   1. Acorn Wire and Iron Works, Inc; 130A: www.acornwire.com.
   2. Central Wire and Iron Works; Partition Type 135.

2.2 WIRE MESH PARTITIONS

A. Wire Mesh Partitions: Factory-fabricated modular assemblies of wall panels, doors, anchors, and accessories as required to provide a complete system.
   1. Duty Rating: Heavy.

2.3 MATERIALS

A. Framing Members: ASTM A500/A500M, Grade B cold-formed steel tubing, square and rectangular shaped.

B. Metal Fabric: 1.5 inch diamond mesh galvanized steel wire, interwoven, 10 gage thick, knuckled at top and bottom selvages with wire securelty clinched to framing.

C. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.

2.4 FASTENERS

A. Bolts, Nuts and Washers: Hot dip galvanized.

B. Anchorage Devices: Provide power driven, powder actuated, and drilled expansion bolts.

C. Exposed Mechanical Fastenings: Flush countersunk screws or bolts, unobtrusively located, consistent with design of structure.

2.5 ACCESSORIES

A. Bracing: Formed sheet steel, thickness determined for conditions encountered, manufacturer's standard shapes, same finish as framing members.

B. Plates, Gussets, Clips: Formed sheet steel, thickness determined for conditions encountered, manufacturer's standard shapes, same finish as framing members.

C. Post Caps: Manufacturer's standard.

D. Floor and Ceiling Pilaster Shoe: Manufacturer's standard.

E. Floor Base: Manufacturer's standard.

F. Shop and Touch-Up Primer:
   1. Galvanized Surfaces: SSPC-Paint 20, Type I - Inorganic, complying with VOC limitations of authorities having jurisdiction.

2.6 COMPONENTS

A. End and Corner Posts: 1-1/4 x 1-1/4 inch x 1/8 inch angle.

B. Vertical Frames: 1-1/4 x 5/8 inch "C" type, cold rolled channel.

C. Horizontal Frames: 1 x 1/2 x 1/8 inch channel mortised and tenoned at intersections.

D. Top Rail: 2-1/4 x 1 inch cold rolled channel with 1/4 inch "U" bolts approximately 24" O.C.

E. Center Reinforcement: 2- CR channel, 1 x 3/8 inch bolted each side of mesh.

F. Door Frames: 1-1/4 inch x 1/2 inch x 1/8 inch channel with 1-1.4 inch x 1/8 inch cover plate on four sides.

G. Gate: Comply with ASTM F 654 and the following:
   1. Sliding doors to have: two, 4-wheel trucks hung in enclosed box track and bottom guide channel. Provide hasp at door for user provided padlock.

2.7 FINISHES

A. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.

B. Galvanizing: In accordance with requirements of ASTM A123/A123M.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that substrate surfaces and required openings are ready to receive work.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install items plumb and level, accurately fitted, free from distortion or defects.

C. Anchor partitions to floor with 3/8-inch- diameter, postinstalled expansion anchors through floor shoes located at each post and corner.
   1. Shim anchor clips as required to achieve level and plumb installation.
   2. Adjust wire mesh partition posts in floor shoes to achieve level and plumb installation.

D. Terminal Posts: Locate terminal end, corner, and gate posts per ASTM F 567 and terminal pull posts at changes in horizontal or vertical alignment.

E. Post Bracing and Intermediate Rails: Install according to ASTM F 567. Install braces at end and gate posts and at both sides and corner and pull posts.

F. Top Rail: Install according to ASTM F 567.

G. Bottom Rails: Install, spanning between posts.

H. Wire Mesh Fabric: Apply fabric to enclosing framework.

I. Gate Installation: Install gates according to manufacturer's written instructions, level, plumb, and secure for full opening without interference. Attach fabric as for fencing. Attach hardware using tamper-resistant or concealed means. Adjust hardware for smooth operation and lubricate where necessary.

3.3 TOLERANCES

A. Maximum Variation From Plumb or Level: 1/4 inch.

B. Maximum Misalignment From True Position: 1/4 inch.

3.4 ADJUSTING

A. Adjust hinged doors to achieve free movement.

3.5 CLEANING

A. Remove temporary protection to prefinished surfaces.

END OF SECTION

SECTION 10 22 43

SLIDING GLASS PARTITIONS

PART 1 GENERAL

1.1 SUMMARY

A. Section includes furnishing and installing a top-hung sliding-folding aluminum-framed glass door or storefront system that includes:
   1. Aluminum frame
   2. Threshold
   3. Panels
   4. Sliding-folding and locking hardware
   5. Weatherstripping
   6. Glass and glazing
   7. Insect screen
   8. Accessories as required for a complete working installation.

B. Related Documents and Sections:
   1. Section 06 10 00, Rough Carpentry: Wood framing R.O. and blocking.

1.2 REFERENCES

A. Reference Standards in accordance with Division 01 and current editions from the following:
   1. AAMA. American Architectural Manufacturers Association; www.aamanet.org
      a. AAMA 503, Voluntary Specification for Field Testing of Newly Installed Storefronts, Curtain Walls, and Sloped Glazing Systems
      b. AAMA 611, Voluntary Specification for Anodized Architectural Aluminum
      c. AAMA 920, Operation / Cycling Performance
      d. AAMA 1303.5, Voluntary Specification for Forced Entry Resistant Aluminum Sliding Glass Doors
      e. AAMA 2604, Voluntary Specifications, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels
      f. AAMA 2605, Voluntary Specifications, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels
   2. ANSI. American National Standards Institute; www.ansi.org
      a. ANSI Z97.1, Safety Performance Specifications and Methods of Test for Safety Glazing Material Used In Buildings
   3. ASTM. ASTM International; www.astm.org
      a. ASTM C1048, Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass
      b. ASTM E413, Classification for Rating Sound Insulation
      c. ASTM E1332, Standard Classification for Rating Outdoor-Indoor Sound Attenuation
   4. CPSC. Consumer Product Safety Commission; www.cpsc.gov
      a. CPSC 16CFR-1201, Safety Standard for Architectural Glazing Materials

1.3 SUBMITTALS

A. Product Data: Submit manufacturer’s printed product literature for each Folding Glass Storefront system to be incorporated into the Work. Show performance test results and details of construction relative to materials, dimensions of individual components, profiles and colors.

B. Shop Drawings: Indicate Folding Glass Storefront system component sizes, dimensions and framing R.O., configuration, swing panels, direction of swing, stacking layout, typical head jamb, side jambs and sill details, type of glazing material, handle height and field measurements.

C. Manufacturers' Instructions: Submit manufacturer's installation instructions.

D. Operation and Maintenance Data: Submit Owner’s Manual from manufacturer. Identify with project name, location and completion date, and type and size of unit installed.

E. Submit calculations or measurements for occupant spaces to meet sound transmission class ratings between adjacent spaces and reverberation time requirements within a room.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: Manufacturer capable of providing complete, precision built, engineered, pre-fitted units with a minimum twenty-five (25) years' experience in the sale of folding-sliding door systems for large openings in the North American market.

B. Installer Qualifications: Installer experienced in the installation of manufacturer's products or other similar products for large openings. Installer to provide reference list of at least three (3) projects of similar scale and complexity successfully completed in the last three (3) years.
   1. Installer to be trained and certified by manufacturer.

C. Single Source Responsibility: Furnish Folding Glass Storefront system materials from one manufacturer for entire Project.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Comply with manufacturer's instructions and recommendations, Section 01 60 00 requirements, and as follows:
   1. Deliver materials to job site in sealed, unopened cartons or crates.
      a. Upon receipt, inspect the shipment to ensure it is complete, in good condition and meets project requirements.
   2. Store material under cover in a clean and dry location, protecting units against weather and defacement or damage from construction activities, especially to the edges of panels.

1.6 FIELD CONDITIONS

A. Field Measurements: Contractor to field verify dimensions of rough openings (R.O.) and threshold depressions to receive sill. Mark field measurements on shop drawing submittal.

1.7 WARRANTY

A. Manufacturer Warranty: Provide Folding Glass Storefront system manufacturer's standard limited warranty as per manufacturer's published warranty document in force at time of purchase, subject to change, against defects in materials and workmanship.
   1. Warranty Period beginning with the earliest of 120 days from Date of Delivery or Date of Substantial Completion:
      a. Rollers and Glass Seal Failure: Ten (10) years
      b. All Other Components Except Screens: Ten (10) years

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design: NanaWall SL45 by NANA WALL SYSTEMS, INC.

2.2 PERFORMANCE / DESIGN CRITERIA

A. Performance Criteria (Lab Tested):
   1. Structural Loading (ASTM E330): DP-40 DP-45
      a. Load Structure: At 1.5 times design wind pressure with no glass breakage or permanent damage to fasteners or storefront components.
      b. Design Pressure w/ Reinforced Locking Unit: Positive and Negative at 35 psf (1675 Pa)
   2. Forced Entry (AAMA 1303.5 and AAMA CAWM 300): Meets requirements.
   3. Swing Panel - Operation / Cycling Performance (AAMA 920): 500,000 cycles

B. Design Criteria:
   1. Sizes and Configurations: As indicated by the Drawings for selected number and size of panels, location of swing panels, and location of tracks and stacking bays.
   2. Unit Operation: Adjustable sliding and folding hardware with top and bottom tracks;
      a. inswing type.
      b. outswing type.
      c. center pivot type.
      d. inswing and outswing type.

3. Panel Configuration:
   a. Straight
   b. Segmented curve
   c. 90º angle turn
   d. 135º angle turn.
   e. Window/ door combination.
4. Stack Storage Configuration:
   a. Inside
   b. Outside
   c. Center pivot
   d. Foldflat® against Wall
5. Mounting Type: Top hung
6. Panel Type: Hinged Unhinged
   a. Primary swing panel of paired swing panels, looking from inside, to be on the left right.
   b. Entry/Egress panel hinged to side jamb.
7. Panel Pairing Configuration: See drawings.

2.3 MATERIALS

A. Sliding-Folding Glass Storefront Description: Monumental top-hung system designed for straight runs, segmented angle changes, center pivot, and capable of folding flat against adjacent walls. Manufacturer's standard frame and panel profiles, with head and floor tracks, side jambs and panels with dimensions as shown on Drawings.
   1. Panels:
      a. Single lite.
      b. Horizontal mullion(s) at specified height(s) from the bottom of the panel.
      c. Simulated divided lites in pattern as shown on Drawings.
   2. Panel Size (W x H): As indicated.
   3. Rail Depth: 1-3/4 inch
   4. Head Width: 4-7/8 inch
   5. Head and Jamb Rail Width: 2-1/8 inch
   6. Bottom Rail Width:
      a. 3-9/16 inch overall with 2-1/16 inch rail for standard sill
      b. 2-1/16 inch for Saddle Sill, Flush Sill and Surface mounted Interior Sill
      c. Manufacturer's standard kickplate with height indicated.
   7. Aluminum Extrusion: AlMgSi0.5 alloy, 6063-T5 (F-22 - European standard)
      a. Thickness: 0.078 inch (2.0 mm) nominal
   8. Aluminum Finish (including head track covers):
      a. Anodized (AAMA 611):
         1) Clear
      b. PVDF Coat (AAMA 2605): Fluoropolymer Kynar with color to match custom finish.

B. Glass and Glazing:
   1. Safety Glazing: In compliance with ANSI Z97.1 and CPSC 16CFR 1201.
      a. Glass Acoustical Performance (DIN 52210-3,4):
         1) STC 28; 1/4 inch (6 mm) single, tempered glass
   2. Manufacturer's tempered glass lites dry glazed with glass stops on the inside.
      a. Glass Lite:
         1) Single: 1/4 inch (6 mm) thick.
      b. Glass Treatment:
         1) Standard

C. Locking Hardware and Handles:
   1. Main Entry Panel For Models WITH a Pair of Swing Panel(s): Provide lever handles on the inside and outside with single action, emergency egress, interconnected lock.
   2. Flat Handle - Finish:
      a. Brushed satin stainless steel
   3. Handle Height: 41-3/8 inch centered from bottom of panel or as otherwise indicated.

4. Stainless steel (impact) locking rods with standard fiberglass reinforced polyamide end caps at the top and bottom. Rods to have a stroke of 15/16 inch.

D. Sliding- Folding Hardware: Provide manufacturer's standard combination sliding and folding hardware with top and bottom tracks.
   1. For each pair of folding panels, provide independent cardanic suspension for four (4) wheeled rollers coated with fiberglass reinforced polyamide upper running carriage and lower guide carriage.
   2. Swing Panel Hinges:
      a. Zinc die cast with finish closest match to finish of frame and panels and stainless steel security hinge pins with set-screws.
   3. Adjustment: Provide 1/16 inch in width per hinge adjustments without removing panels from tracks and without needing to remove panels from tracks.
   4. Sill Type:
      a. Standard flush sill (thermally broken)
      b. Alternate flush sill (not thermally broken)
      c. Low profile saddle sill (thermally broken)
      d. Surface mounted interior sill (not thermally broken)
      e. Finish: Aluminum with
         1) a clear anodized finish.
         2) a dark bronze anodized finish.
         3) finish to match panel.
      f. Cover plate over sill NOT acceptable.

E. Weatherstripping: Manufacturer's double layer EPDM between panels, EPDM gasket and Q-lon gasket, or brush seal between panel and frame, or brush seals with a two-layer fiberglass reinforced polyamide fin attached at both inner and outer edge of bottom of door panels with a recessed sill or on frame for sealing between panels and between panel and frame.

F. Fasteners: Stainless steel screws for connecting frame components.

2.4 FABRICATION

A. Extruded aluminum frame and panel profiles, corner connectors and hinges, sliding and folding hardware, locking hardware and handles, glass and glazing and weatherstripping components needed to construct a folding glass wall.
   1. Each unit factory pre-assembled and shipped with all components and installation instructions.
   2. Exposed work to be carefully matched to produce continuity of line and design with all joints.
   3. No raw edges visible at joints.

2.5 ACCESSORIES

A. Provide sidelights, transoms, corner posts, or single or double doors as indicated.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examination and Acceptance of Conditions
   1. Carefully examine rough openings with Installer present, for compliance with requirements affecting Work performance.
      a. Examine surfaces of openings and verify dimensions; verify rough openings are level, plumb, and square with no unevenness, bowing, or bumps on the floor; and other conditions as required by the manufacturer to receive Work.
      b. Verify the structural integrity of the header for deflection with live and dead loads limited to the lesser of L/720 of the span or 1/4 inch. Provide structural support for lateral loads, and both wind load and eccentric load when the panels are stacked open.
   2. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Install Folding Glass Storefront system in accordance with the Drawings, approved submittals, manufacturer's recommendations and installation instructions, and as follows:
   1. Properly flash, waterproof and seal around opening perimeter.

2. Securely attach anchorage devices to rigidly fit frame in place, level, straight, plumb and square. Install frame in proper elevation, plane and location, and in proper alignment with other work
3. When lower track is designed to drain, provide connections to allow for drainage.
4. Install panels, handles, lockset, screens and other accessories in accordance with manufacturer's recommendations and instructions.

3.3 FIELD QUALITY CONTROL

A. Field Tests and Inspections:
   1. Verify the Folding Glass Storefront system operates and functions properly. Adjust hardware for proper operation.

B. Non-Conforming Work: Repair or replace non-conforming work as directed by the Architect; see General and Supplementary Conditions, and Division 01, General Requirements.

3.4 CLEANING AND PROTECTION

A. Keep units closed and protect Folding Glass Storefront installation against damage from construction activities.

B. Remove protective coatings and use manufacturer recommended methods to clean exposed surfaces.

END OF SECTION

SECTION 10 26 01

CORNER GUARDS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Corner guards.

1.2 SUBMITTALS

A. Product Data: Indicate physical dimensions.

B. Manufacturer's installation instructions.

C. Manufacturer's cleaning instructions.

PART 2 PRODUCTS

2.1 COMPONENTS

A. Corner Guards - Surface Mounted:
   1. Material: Type 304 stainless steel, No. 4 finish, 16 gage, 0.06 inch thick.
   2. Width of Wings: 2-1/2 inches.
   3. Corner: Square.
   4. Length: One piece. Height as indicated on drawings.
   5. Mounting: Adhesive.
   6. Product:
      a. Koroseal, GS25 Stainless Steel Corner Guard.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install components in accordance with manufacturer's instructions, level and plumb, secured rigidly in position to wall framing members only.

B. Corner Guards:
   1. Remove excess adhesive using methods and materials recommended in writing by manufacturer.

3.2 CLEANING

A. Clean corner and wall bumpers in accordance with manufacturer's instructions.

END OF SECTION

SECTION 10 28 00

TOILET ACCESSORIES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Toilet accessories.

B. Shower and bath accessories.

1.2 RELATED REQUIREMENTS

A. Section 09 30 00 - Tiling: Ceramic washroom accessories.

B. Section 10 21 13.19 - Plastic Toilet Compartments.

1.3 REFERENCE STANDARDS

A. ASTM A269/A269M - Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service; 2015.

B. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2015.

C. ASTM C1036 - Standard Specification for Flat Glass; 2016.

D. ASTM C1503 - Standard Specification for Silvered Flat Glass Mirror; 2008 (Reapproved 2013).

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordinate the work with the placement of internal wall reinforcement to receive anchor attachments.

1.5 SUBMITTALS

A. Product Data: Provide data on accessories describing size, finish, details of function, attachment methods.

B. Manufacturer's Installation Instructions: Indicate special procedures and conditions requiring special attention.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. All items of each type to be made by the same manufacturer.

2.2 MATERIALS

A. Accessories - General: Shop assembled, free of dents and scratches and packaged complete with anchors and fittings, steel anchor plates, adapters, and anchor components for installation.

B. Keys: Provide six keys for each accessory to Owner; master key all lockable accessories.

C. Stainless Steel Sheet: ASTM A666, Type 304.

D. Stainless Steel Tubing: ASTM A269, Type 304 or 316.

E. Mirror Glass: Annealed float glass, ASTM C1036 Type I, Class 1, Quality Q2, with silvering, protective and physical characteristics complying with ASTM C1503.

F. Adhesive: Two component epoxy type, waterproof.

G. Fasteners, Screws, and Bolts: Hot dip galvanized, tamper-proof, security type.

2.3 FINISHES

A. Stainless Steel: No. 4 satin brushed finish, unless otherwise noted.

2.4 Toilet Accessories

A. Toilet Paper Dispenser:
   1. Product: Owner furnished, contractor installed

B. Surface Mounted Toilet Paper Dispenser:
   1. Product: Owner furnished, contractor installed

C. Waste Receptacle: Stainless steel, freestanding style with swing top.
   1. Liner: Removable, heavy-duty vinyl liner, attached at a minimum of 3 points with stainless steel grommets and hooks.
   2. Minimum capacity: 10 gallons.

D. Soap Dispenser: Owner Furnished, Contractor Installed.

E. Framed Mirrors: Stainless steel framed, 6 mm thick float glass mirror.
   1. Size: As indicated on drawings.
   2. Frame: 0.05 inchchannel shapes, with mitered corners, and tamperproof hanging system; No.4 finish.
   3. Backing: Full-mirror sized, minimum 0.03 inch galvanized steel sheet and nonabsorptive filler material.

F. Grab Bars: Stainless steel, nonslip grasping surface finish.
   1. Standard Duty Grab Bars:
      a. Push/Pull Point Load: 250 pound-force, minimum.
      b. Dimensions: 1-1/2 inch outside diameter, minimum 0.05 inch wall thickness, concealed flange mounting, 1-1/2 inch clearance between wall and inside of grab bar.
      c. Length and Configuration: As indicated on drawings.
      d. Product: Bobrick, B-6806.

G. Surface Mounted Sanitary Napkin Disposal Unit: Stainless steel, surface-mounted, self-closing door with full-length stainless steel piano-type hinge.

2.5 SHOWER ACCESSORIES

A. Shower Curtain Rod: Stainless steel tube, 1-1/4 inch outside diameter, 0.04 inch wall thickness, satin-finished, with 3 inch outside diameter, minimum 0.04 inch thick satin-finished stainless steel flanges, for concealed mounting.

B. Shower Curtain: Manufacturer's standard shower curtain with stainless steel grommets for hook attachment to curtain rod
   1. Material: , 0.006 inch thick, matte finish, flameproof and stain-resistant.
   2. Size: Minimum 12 inches wider than opening by 72 inches high.
   3. Shower curtain hooks: Chrome-plated or stainless steel spring wire designed for snap closure. Provide one hook per curtain grommet.

C. Robe Hook: Heavy-duty stainless steel, double-prong, rectangular-shaped bracket and backplate for concealed attachment, satin finish.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify exact location of accessories for installation.

3.2 PREPARATION

A. Deliver inserts and rough-in frames to site for timely installation.

B. Provide templates and rough-in measurements as required.

3.3 INSTALLATION

A. Install accessories in accordance with manufacturers' instructions in locations indicated on the drawings.

B. Install plumb and level, securely and rigidly anchored to substrate.

C. Mounting Heights: As required by accessibility regulations, unless otherwise indicated.

END OF SECTION

SECTION 10 44 00

FIRE PROTECTION SPECIALTIES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Fire extinguisher cabinets.

B. Accessories.

1.2 REFERENCE STANDARDS

A. NFPA 10 - Standard for Portable Fire Extinguishers; 2013.

1.3 QUALITY ASSURANCE

A. Confirm keying for emergency key cabinet with fire department having jurisdiction prior to final purchase of unit.

1.4 SUBMITTALS

A. Product Data: Provide extinguisher operational features.

B. Shop Drawings: Indicate cabinet physical dimensions.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Fire Extinguishers:
   1. JL Industries, Inc.
   2. Larsen's Manufacturing Co.
   3. Potter-Roemer.

2.2 FIRE EXTINGUISHERS

A. Fire Extinguishers - General: Comply with product requirements of NFPA 10 and applicable codes, whichever is more stringent.

B. Dry Chemical Type Fire Extinguishers: Stainless steel tank, with pressure gage.
   1. Class: A:B:C.
   2. Finish: Baked enamel, color as selected.

2.3 FIRE EXTINGUISHER CABINETS

A. Metal: Formed primed steel sheet; 0.036 inch thick base metal.

B. Cabinet Configuration: Semi-recessed and surface mounted types as required by wall construction. Use semi-recessed cabinets in metal stud wall construction.
   1. Size to accommodate accessories.
   2. Trim for Semi-Recessed: Rolled return with 2-1/2 inch projection.

C. Door: 0.036 inch metal thickness, reinforced for flatness and rigidity with nylon catch. Hinge doors for 180 degree opening with two butt hinge.

D. Door Glazing: Float glass, clear, 1/8 inch thick, and set in resilient channel glazing gasket.

E. Finish of Cabinet Exterior Trim and Door: Stainless Steel No. 4.

F. Finish of Cabinet Interior: White colored enamel.

2.4 ACCESSORIES

A. Extinguisher Brackets: Formed steel, chrome-plated.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify rough openings for cabinet are correctly sized and located.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Secure rigidly in place.

C. Place extinguishers in cabinets and on wall brackets.

END OF SECTION

SECTION 10 51 10

TURNOUT GEAR LOCKERS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Design, fabrication and installation of wall mounted turnout gear lockers as specified herein.

1.2 SUBMITTALS

A. Product Data: Submit manufacturer's product data and installation instructions.

B. Shop Drawings: Submit manufacturer's shop drawings for each individual run of lockers.

C. Samples: Submit manufacturer's standard color samples.

D. Owner's Manual: Provide maintenance manual at closeout.

E. Warranty: Submit manufacturer's standard warranty.

1.3 QUALITY ASSURANCE

A. Manufacturer shall have a minimum of fifteen years experience in the direct manufacture of lockers.

B. Installer Qualifications: Installer shall have experience necessary to assure lockers are installed properly and according to manufacturer's instructions.

C. Reference:
   1. ASTM A513 – Minimum properties of Electric-Resistance-Welded Carbon Allow Steel Mechanical Tubing
   2. ASTM A510 – Minimum properties of Wire Rods and Coarse Round Wire, Carbon Steel and Alloy Steel

1.4 DELIVERY, STORAGE AND HANDLING

A. Delivery: Deliver materials to site in manufacturer's original, unopened containers with labels identifying product and manufacturer's name.

B. Storage: Store materials in a clean dry area.

C. Handling: Protect materials and finish during installation and handling to prevent damage.

PART 2 PRODUCTS

2.1 MANUFACTURER

A. Basis-of-Design:
   1. GearGrid Corporation, GEARGRID Wall Mounted Storage System.

2.2 TURNOUT GEAR LOCKER FABRICATION

A. C. Locker Sizes:
   1. Standard 20": Overall dimension- 74.5" high x 21.25" wide x 20" deep.
      a. Clear Opening Width: 18.75"

B. Construction: Units shall be welded at all applicable joints. Forming of metal shall be completed by standard cold-forming operations. Use of fasteners will only be required to allow for knock-down shipping, securing units to mounting surface and on applicable accessories.

C. Vertical Dividers:
   1. Outer Frames: 1.25" O.D. x 16 gauge wall thickness ASTM A513 steel tubing.
   2. Inner Grid: .25" diameter ASTM 510 cold drawn steel wire resistance welded to a 3" square pattern.
   3. Inner Grid wires must be full length and width of inside vertical divider frame. Wires not running full length or width, thus creating exposed wire ends will not be acceptable.
   4. Inner Grid wires must run horizontally and vertically creating a square or rectangular grid pattern only. Grid wires not creating a square or rectangular grid pattern will not be acceptable.
   5. Inner Grid wires shall intersect and cross all perpendicular wires, and shall be welded at all intersections.

D. Back Panel:

1. Required on each locker to protect the locker contents and wall substrate, as well as provide an additional panel for accessory attachment.
2. Grid: .25" diameter ASTM 510 cold drawn steel wire resistance welded to a 3" square pattern.
3. Back panel must engage and be secured to vertical dividers via horizontal wires which extend into mounting holes pre-drilled in vertical dividers. Back panels are sandwiched between vertical dividers, preventing them from being removed after assembly is complete.
4. Inner Grid wires must be full length and width of inside vertical divider frame. Wires not running full length or width, thus creating exposed wire ends will not be aeptable.
5. Inner Grid wires must run horizontally and vertically creating a square or rectangular grid pattern only. Grid wires not creating a square or rectangular grid pattern will not be acceptable.
6. Inner Grid wires shall intersect and cross all perpendicular wires, and shall be welded at all intersections.

E. Shelves: (1) Upper, (1) Lower. .25" diameter ASTM 510 cold drawn steel wire resistance welded and cold formed. Upper shelf shall include an integrated 20 gauge steel bracket to accept a 2" x 16" name placard, unless doors are selected as an option, in which case the name placard will be integrated into the door.

F. Apparel Hooks: (3) per locker opening. .192" diameter ASTM 510 cold drawn steel wire resistance welded, cold formed and powder coated. Apparel hooks must securely engage and snap onto side or back grid, to prevent unintentional disengagement of hook.

2.3 ACCESSORIES

A. Hang Bar (Optional)
1. Hang Bars must be manufactured to allow each locker user to install at their desired height. Hang Bars that span multiple locker openings are not acceptable.
2. Tube: 1.25"O.D. x 16 gauge 304 stainless steel tubing.
3. Brackets: Allow Hang Bars to be securely attached to each vertical divider, powder coated.

B. Heavy Hanger (optional):
1. .25" diameter 304 stainless steel wire cold formed and resistance welded.
2. Black vinyl coating on hook end.

C. Gear Dryer Hanger (optional):
1. 1. .25" diameter 304 stainless steel wire cold formed and resistance welded. Includes formed loops to prop open sleeves on jackets to promote better circulation throughout the garment.
2. 2. Black vinyl coating on hook end.

D. Glove Drying Hanger (optional):
1. .25" diameter 304 stainless steel wire cold formed and resistance welded.
2. Black vinyl coating on hook end.

E. Helmet Holder (optional, not recommended when Door and Top Cover option or Top Side Storage option is also selected):
1. .25" diameter ASTM 510 cold drawn steel wire resistance welded. Powder coated finish in specified color.

F. Secure Box (optional):
1. 6" wide x 6" high x 12" deep 6061 Aluminum enclosure with hinged, lockable door at outer end. Design shall include an integrated mail slot. Powder coated finish in specified color.

G. Power Bar (optional on 20" and 24"):
1. 16 gauge steel chase integrated into the upper framework of the locker assembly allowing provision for the installation of a 120VAC duplex outlet at each locker location. Powder coated finish in specified color.
   a. a. No outlets or electrical connections included with Power Bars.

H. Top Side Storage (optional):
1. Shelf spanning across the top of the lockers for additional gear storage above lockers. .25" diameter ASTM 510 cold drawn steel wire resistance welded to a 3" square pattern. Powder coated finish in specified color.

2.4 FINISH

A. General: All system components excluding assembly and mounting hardware and stainless steel components are to receive the standard finish.

B. Standard Finish: Components to be cleaned using a phosphatized bath, clear water rinse and electro-statically coated with a durable and UV-stable TGIC powder coating process. Thickness of applied finish shall be 3 – 4 mm for added protection.

C. Color: As selected by Architect from manufacturer's standard colors.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine area to receive lockers. Notify architect if area are not acceptable. Do not begin installation until unacceptable conditions have been corrected.

3.2 INSTALLATION

A. Install lockers in accordance with manufacturer's instructions.

B. Use manufacturer's hardware for assembly.

C. Anchor to mounting surface with proper hardware.

END OF SECTION

SECTION 10 51 13

WELDED METAL LOCKERS

PART 1 GENERAL

1.1 SUMMARY

A. This Section includes the following:
   1. Personal Storage Lockers, Personal Storage Lockers with built-in bench drawers, Personal Storage Lockers with built-in external access drawers and Personal Storage Lockers in Multi-tier Configuration

1.2 REFERENCES

A. American National Standards Institute (ANSI) Standards:
   1. Applicable standards for fasteners used for assembly.

B. American Society for Testing and Materials (ASTM) Standards:
   1. Applicable standards for steel sheet materials used for fabrication
   2. Applicable standards for the testing of electrostatically applied Powder Coat Paint

C. American Institute Of Steel Construction (AISC) Standards:
   1. Applicable standards for steel materials used for fabrication.

1.3 PERFORMANCE REQUIREMENTS

A. Design Requirements:
   1. Limit overall width not to exceed specified nominal width; locker width designed for zero growth.

B. Seismic Performance: Provide Welded Metal Lockers capable of withstanding the effects of earthquake movement when required by applicable building codes.

C. ADA Requirements: Personal Storage Lockers with nominal height of 72 inches meet ADA requirements.

1.4 SUBMITTALS

A. Product Data: Submit manufacturer's product literature and installation instructions for each type of welded metal locker required. Include data substantiating that products to be furnished comply with requirements of the contract documents.

B. Shop Drawings: Show fabrication, assembly, and installation details, including descriptions of procedures and diagrams. Show complete locker installation layout, including quantities, locations and types of accessory units required. Include notations and descriptions of all installation items and components.
   1. Show installation details at non-standard conditions, if any.
   2. Provide layout, dimensions, and identification of each unit, corresponding to sequence of installation procedures.
   3. Provide installation schedule and procedures to ensure proper installation.

C. Samples: Provide minimum 3 inches square example of each color and texture on actual substrate for each component to remain exposed after installation.

D. Maintenance Data: Provide written documentation of the manufacturer’s statement, claiming the maintenance free nature of the product.

E. Reference List: Provide a list of recently installed welded metal lockers to be visited by owner, architect, and contractor. Intent of list is to aid in verifying the suitability of manufacturer's products and comparison with materials and product specified in this section. Include contact name, address, and phone numbers.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Engage an experienced manufacturer who is ISO 9001:2008 certified for the design, production, installation and service of welded metal lockers. Furnish certification attesting ISO 9001:2008 quality system registration.

B. Installer Qualifications: Engage an experienced installer who is the manufacturer's authorized representative for the specified products for installing welded metal lockers.

1. Minimum Qualifications: 1-year experience installing welded metal lockers of comparable size and complexity to specified project requirements.

1.6 DELIVERY, STORAGE AND HANDLING

A. Follow manufacturer's instructions and recommendations for delivery, storage and handling requirements.

1.7 PROJECT CONDITIONS

A. Field Measurements: Verify quantities of welded metal locker units before fabrication. Indicate verified measurements on shop drawings. Coordinate fabrication and delivery to ensure no delay in progress of the work.

B. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating welded metal lockers units without field measurements. Coordinate construction to ensure actual dimensions correspond to established dimensions.

1.8 SEQUENCING AND SCHEDULING

A. Sequence welded metal lockers with other work to minimize possibility of damage and soiling, during remainder of construction period.

B. Schedule installation of specified welded metal lockers after finishing operations, including painting, have been completed.

C. Provide components, which must be built in at a time, which causes no delays in the general progress of the work.

D. Pre-installation Conference: Schedule and conduct conference on project site to review methods and procedures for installing welded Metal Lockers including, but not limited to, the following:
   1. Recommended attendees include:
      a. Owner's Representative.
      b. Prime Contractor or representative.
      c. The Architect.
      d. Manufacturer's representative.
      e. Subcontractors or installers whose work may affect, or be affected by, the work of this section.

1.9 WARRANTY

A. Provide a written warranty, executed by Contractor, Installer, and Manufacturer, agreeing to repair or replace units, which fail in materials or workmanship within the established warranty period. This warranty shall be in addition to, and not a limitation of, other rights the Owner may have under General Condition's provisions of the Contract Documents.

B. Limited Lifetime Warranty: Subject to the terms in the written warranty, warrant the original purchaser exclusively that the locker frames manufactured by it will be free from defects in materials and workmanship for the lifetime of the locker.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design: Spacesaver Corporation, FreeStyle Personal Storage with built-in bench drawers.

2.2 DESCRIPTION

A. General: Welded Metal Lockers only with end-user reconfigurable interior. Specialized lances to provide the flexibility of on-site, end-user reconfiguration/addition of internal components anytime, anywhere, now or in the future.

B. Finishes:
   1. Fabricated Metal Components and Assemblies: All components to be painted with an electro-statically applied Powder Coat paint that can meet or exceed test requirements set out by ASTM standard D3451-06 Standard Guide for Testing Coating Powders and Powder Coatings.

C. Sizes:
   1. Personal Storage Lockers with built-in bench drawers: nominal heights of 84 inches respectively; Built-in bench drawer nominal height of 18 inches and nominal depth of 36 inches.

2.3 MANUFACTURED COMPONENTS

A. Welded Frame:
1. The welded frame must consist of top, bottom, back, and sides constructed of a minimum of 18-gauge steel. All frame components shall be joined using resistance welding. Riveting of structural members will not be permitted.
2. Horizontal front flanges will be a minimum of 2 inches. Vertical front flanges will be a minimum of 1 inch. Horizontal and vertical flanges will overlap and be secured with a minimum two (2) resistance welds per corner.
3. Corner gussets shall be MIG and spot welded in each of the four front corners of the locker for increased stiffness and rigidity.
4. Provide side panel lances evenly spaced on 3 inch centers. Lances to provide the flexibility of on-site, end-user reconfiguration/addition of internal components anytime, anywhere, now or in the future.
5. Bench Housing for built-in bench drawer
   a. Welded frame construction shall consist of top, bottom, and side components joined by using resistance welding. Riveting of bench housing structural members will not be permitted.
   b. Corner gussets shall be welded in the two (2) front bottom corners of the bench housing for increased stiffness and rigidity.
   c. Horizontal front flanges will be a minimum of 1 inch.
   d. Vertical front flanges will be a minimum of 1 inch.
   e. Horizontal and Vertical front flanges will overlap and shall be secured with minimum of one (1) resistance weld per corner.
   f. Side panels – Lances symmetric and evenly spaced to provide optimum component locations (standard based on 3 inch on center vertical placement to match mating locker lance design).
   g. Return flanges on housing to securely fasten housing to welded frame of locker.
   h. Base of bench housing shall include four (4) 3/8”-16 UNC threaded weld-nuts and corresponding leveling feet.
   i. Top of bench housing shall include hole pattern for mating bench seat.
   j. Sides of bench housing shall include mounting holes in the event lockers are ganged together.
   k. Lockers with built-in bench drawer and built-in external access drawer shall have intermediate base shelf with interlocking mechanism for securing drawer when locker door is closed.
   l. Provide four (4) 0.875 inch diameter electrical knock-outs per locker, two (2) located on top of the locker in both right and left rear corners, and two (2) located in the back of locker centered at a distance no greater than 24 inches from the top and bottom. Knock-outs allow end-user flexibility of adding electrical capability to lockers.
   m. Provide a minimum of four (4) duplex receptacle electrical knock-outs per locker; to be used with a UL listed manufactured electrical wiring system as required. This manufactured electrical wiring system is a simple, unique, flexible, and cost effective method of providing electrical capability to the lockers. This electrical system can be added in the future.
      1) Top of the locker shall have four (4) duplex electrical knock-outs.
      2) Top of locker shall have electrical duplex receptacle knock-outs located on both right and left side of locker.
      3) Back panel of locker shall have a minimum of two (2) duplex electrical knock-outs.
      4) Back of locker shall have electrical duplex receptacle knock-outs located on both right and left side of locker and no farther than 24 inches from the top of the locker.
   n. Provide ventilation holes in top of locker to allow mechanically extracted air to be pulled up through the locker system as required. Ventilation shall be controlled by eight (8) evenly spaced 0.625 inch diameter holes. Proper ventilation system ensures unpleasant odors are removed from locker system.
   o. Lockers shall be prepared with mounting holes for attaching necessary trim components
   p. Locker shall be prepared with mounting holes for ganging lockers back-to-back or side-by-side
   q. Base of lockers shall include four (4) 3/8”-16 UNC threaded weld-nuts and corresponding leveling feet.
   r. Base shelf for lockers with built-in external access drawers and bench drawers shall have holes to accommodate double-door lock rod and door stop bracket.
   s. End Panels: End Panels with no exposed fasteners shall be provided on the end of each locker run; thus providing a clean and aesthetically pleasing appearance.
   t. Locker size:

1) Width:
   (a) Personal Storage Locker with built-in bench drawer: 36 inches.
2) Height:
   (a) Personal Storage Locker with built in bench drawer or external access drawer: 84 inches.
3) Depth:
   (a) All lockers 24 inches.
   (b) Bench drawers: 36 inches.
      (1) Bench seat depth 13.0 inches.
      (2) Leading edge of bench seat to extend 1.125 inches from front of bench drawer

B. Ventilation:
   1. Provide ventilation holes in top of locker to allow mechanically extracted air to be pulled up through the locker system as required. Ventilation shall be controlled by eight (8) evenly spaced 0.625 inch diameter holes. Proper ventilation system ensures odors are removed from locker system.
   2. Provide an adjustable air baffle for system balancing when mechanical air extraction is used. Upon balancing system, air baffle shall be secured with a fastener to maintain ventilation setting.
   3. Provide louvered air vents in bottom of the main locker door/s to allow mechanically extracted air to be pulled up through the locker system.
   4. Provide louvered air vents in drawer front when built-in bench drawer or built-in external access drawer models are required.
   5. Minimum 0.500 inch gap between back of shelving components and back of locker to provide uninterrupted air flow up the rear of the locker system.
   6. Minimum 2.00 inches gap between front of shelving and locker door to provide uninterrupted air flow up the front of the locker system.
   7. Provide Multi-Tier ventilation thru door panels.

C. Electrical
   1. Shall provide four (4) electrical knock-outs per locker. This feature provides the end-user the opportunity for hard wire electrical connection points for each locker.
   2. Shall provide a minimum of four (4) duplex receptacle electrical knock-outs per locker.
   3. Shall provide UL Listed manufactured electrical wiring system as required. This manufactured electrical wiring system provides connection for a maximum of 78 receptacles per hardwired power in-feed.

D. Drawers:
   1. Drawer body wrapper shall have welded frame construction. Riveting of structural members will not be permitted.
   2. Drawers for locker with built-in bench drawers and built-in external access drawers shall have box-formed drawer front.
   3. Provide interlock system for securing drawer when main locker doors are closed and provide access only when main locker door/s is opened.
   4. Built-in bench drawer shall have a nominal 36 inches depth.
   5. Provide a flush mounted pull handle.
   6. Drawer Slides: Provide 200 lbs maximum load capacity and pass 50,000 cycle performance testing (Max. load, uniform distribution)
   7. Drawer base minimum 21 inches drawer extension
   8. Bench drawer minimum 26.5 inches drawer extension
   9. Provide louvered air vents in drawer fronts.

E. Bench Seat:
   1. Provide 13.0 inches deep laminated kiln dried maple bench seat; material thickness 1.25 inches.
   2. Front (leading edge) of bench seat to have .625 inch radius bull nose.
   3. Finish of bench seat shall be sanded smooth and have two (2) coats of catalyzed varnish applied.

F. Single-Piece Welded Doors:
   1. Shall be formed from two (2) pieces of minimum 18-gauge cold rolled steel box formed and welded together using modern GMAW techniques. Single-piece door with inner and outer door panels shall have a combined steel thickness of no less than 0.096 inches thick. Welded door design with inner panel optimizes structural integrity of locker door system over and above any single frame door design.
   2. Exterior door panel shall be constructed with formed flanges and return flanges to add stiffness.
   3. Internal door panel shall be constructed with formed flanges for added stiffness.

4. All inner door panel heights shall be minimum 70% of external door height.
5. Single-piece welded door frame shall consist of internal door panel nested inside exterior door panel and welded per the following requirements:
    a. Top / bottom. Exterior and Interior panels to be welded in a minimum of three (3) places with weld spacing not to exceed 6 inches between adjacent welds and 1 inch from any corner.
    b. Sides. Exterior and interior panels to be welded with spacing not to exceed 12 inches between adjacent welds and 1 inch from any corner.
    c. Inner door panel to have peg board style hole pattern, allowing the attachment of Document Holder and any standard peg board accessory.
    d. Inner door panel to have 4 inch rectangular slot centered towards the top of the locker.
    e. External door panel shall have louvers to provide adequate air circulation throughout locker system.
        1) Louvered air vents shall be located at the bottom of the locker door to enhance circulation of mechanically extracted air from the bottom of the locker out of the top.
        2) Louvered air vents shall be approximately 3 inches in width and 0.75 inches in height and spaced on 1 inch centers.
    f. Double door designs shall consist of the following:
        1) Primary door located on the right and the secondary door located on the left-hand side of the locker.
        2) Secondary door locking mechanism shall consist of the following:
            (a) Return flange for supporting primary door.
            (b) Catch bracket.
            (c) One lower lock rod.
    g. All doors shall have neoprene silencers on each door for noise reduction
    h. Door torsional deflection shall not exceed 0.1875 inch with a 20 lb point load.
        1) Provide 16-gauge full length hinge for increased strength and security of locker system.
        2) Hinges to be welded to door frame with spot welds not to exceed 6 inch separation.
    i. Door assembly to be riveted to door frame on factory pre-established hole pattern.
    j. Locking Mechanism.
        1) Provide protective stainless steel cover plate for durability and scratch resistance):
            (a) Combination lock with master and padlock hasp.
        2) Locking mechanisms shall have the capability of locking automatically.
        3) Locking mechanisms shall have master key override.
        4) Combination locking mechanism shall have user changeable preset combinations.
        5) Single door models: Provide three locking options as listed above.
        6) Double door models: Provide three locking options on the primary door and simple secure lift latch mechanism with 0.3125 inch lock rod for secondary door.

G. Interior/Accessory components:
1. All interior components must be constructed of minimum 18-gauge steel.
2. For added security, internal component can be secured utilizing blind rivets, threaded fasteners, or bending specially designed tab.
3. All interior components available at time of order and as post-installation upgrades in the future.
4. Shelves:
    a. Shelf with integral hanger bracket
        1) Size specified by locker width
        2) Hanger bracket designed with perforations on approximately 3 inch centers to insure clothing separation for optimum ventilation.
        3) Performance: Uniform load rating 300 lbs.
        4) Heavy Duty
            (a) Size specified by locker width
            (b) Performance: Uniform load rating 300 lbs.
        5) Shelf rear return flange stops minimum 0.50 inch short of locker back panel on order to allow air circulation throughout entire locker assembly
    b. Modular Shelf:
        1) Provides storage compartment for smaller items.
        2) Approximate compartment size: 9 inches wide and 12 inches high.
        3) Modular shelves to have tabs to interlock with frame side panel lances.

4) Modular shelves vertical sides to have lances that match with opposing side panel lances.
5) Modular shelves shall have two (2) locations on vertical side panel for attaching hooks, and one (1) location on bottom for attaching double hook accessories.
6) Shelf rear return flange stops approximately 1 inch short of locker back panel on order to allow air circulation throughout modular shelf.
7) Provide modular shelf with slots for connection with file dividers and shelf back stop. File dividers will aid in maintaining a neat and orderly locker system.

c. Provide lockable compartment for small valuables.
1) Lockable compartment shall be integral to modular shelf accessory.
2) Provide a 14-gauge padlock-able compartment door.
3) Provide 0.188 inch or diameter zinc plated steel hinge rod.
4) Door to be mounted with zinc plated steel hinge rod and two shoulder washers for smooth, quiet operation.
5) Provide an 18-gauge hasp bracket for securing lockable compartment door.

d. Hooks
1) Single Hooks – shall have the ability to attach single hooks on the side of the Modular Shelf and on the side panel lances
2) Double Hook – shall have the ability to attach a double hook to the underside of the Modular Shelf

H. Electrical system
1. UL listed manufactured electrical wiring system with plug-in-play component design.
2. Receptacles – standard 20 amp duplex receptacles and 20 amp GFCI duplex receptacles.

I. HVAC
1. All lockers shall be equipped with mechanical air extraction capabilities and adjustable air balancing capabilities.
2. When mechanical air extraction is required, manufacturer shall provide locker system HVAC guidelines and recommendations to aid in overall locker and building system integration. It is the General Contractor and HVAC Contractors' responsibility to establish/balance air flow through locker system according to building HVAC constraints.

J. Locker Tag Numbers
1. Provide locker numbers on each locker.

K. ACCESSORIES:
1. ZeeBase System: Provide manufacturer's standard.
2. Individual Welded Base: Provide manufacturer's standard.
3. Trim and Fillers: Provide manufacturer's standard.
4. Continuous Sloped Top. Provide manufacturer's standard.

2.4 FABRICATION

A. General: Coordinate fabrication and delivery to ensure no delay in progress of the work.

2.5 FINISHES

A. Colors: Selected by Architect from manufacturer's standard available colors.

B. Paint Finish: Provide factory applied electrostatic powder coat paint.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine Lockers scheduled to receive accessories with Installer present for compliance with requirements for installation tolerances and other conditions affecting performance of specified accessory items.

B. Proceed with accessory installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Follow manufacturer's written instructions for installation of each type of accessory item specified.

3.3 FIELD QUALITY CONTROL

A. Verify accessory unit alignment and plumb after installation. Correct if required, following manufacturer's instructions.

B. Remove components that are chipped, scratched, or otherwise damaged and which do not match adjoining work. Replace with new matching units, installed as specified and in manner to eliminate evidence of replacement.

3.4 ADJUSTING

A. Adjust all accessories to provide smoothly operating, visually acceptable installation.

3.5 CLEANING

A. Immediately upon completion of installation, clean components and surfaces. Remove surplus materials, rubbish and debris, resulting from installation, upon completion of work and leave areas of installation in neat, clean condition.

3.6 DEMONSTRATION/TRAINING

A. Schedule and conduct demonstration of installed accessory items and features with Owner's personnel.

B. Schedule and conduct maintenance training with Owner's maintenance personnel. Training session should include lecture and demonstration of all maintenance and repair procedures that end-user personnel would normally perform.

3.7 PROTECTION

A. Protect system against damage during remainder of construction period. Advise owner of additional protection needed to ensure that system will be without damage or deterioration at time of substantial completion.

END OF SECTION

SECTION 10 75 00

FLAGPOLES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Aluminum Flagpoles.

1.2 RELATED REQUIREMENTS

A. Section 03 30 00 - Cast-in-Place Concrete: Concrete foundation construction.

1.3 REFERENCE STANDARDS

A. AASHTO M 36 - Standard Specification for Corrugated Steel Pipe, Metallic-Coated, for Sewers and Drains; 2016.

B. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2012.

C. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2015.

D. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2014.

E. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2013.

F. ASTM B241/B241M - Standard Specification for Aluminum and Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube; 2016.

G. NAAMM FP 1001 - Guide Specifications for Design Loads of Metal Flagpoles; 2007.

1.4 SUBMITTALS

A. Product Data: Provide data on pole, accessories, and configurations.

B. Shop Drawings: Indicate detailed dimensions, base details, anchor requirements, and imposed loads.

C. Operation Data: Provide operating instruction literature..

D. Maintenance Data: Provide lubrication and periodic maintenance requirement schedules.

1.5 QUALITY ASSURANCE

A. Designer Qualifications: Design flagpole foundation under direct supervision of a Professional Structural Engineer experienced in design of this Work and licensed the State in which the Project is located.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Spiral wrap flagpole with protective covering and pack in protective shipping tubes or containers.

B. Protect flagpole and accessories from damage or moisture.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Flagpoles - Basis of Design Product:
   1. American Flagpole; www.americanflagpole.com

2.2 FLAGPOLES

A. Flagpoles: Aluminum.
   1. Design: Step tapered.
   2. Mounting: Ground mounted type.
   3. Outside Butt Diameter: 6 inches.
   4. Outside Top Diameter: 3.5 inches.

5. Nominal Wall Thickness:.188 inches.
6. Nominal Height: 35 ft; measured from nominal ground elevation.
7. Halyard: Interior, with removable winch handle.

B. Performance Requirements:
1. Flagpole With Flags Flying: Resistant without permanent deformation to 120 mph miles/hr wind velocity; non-resonant, safety design factor of 2.5.
2. Flagpole Without Flags: Resistant without permanent deformation to 195 mph miles/hr wind velocity; non-resonant, safety design factor of 2.5.

2.3 POLE MATERIALS

A. Aluminum: ASTM B241/B241M, 6063 alloy, T6 temper.

2.4 ACCESSORIES

A. Finial Ball: Clear anodized, 6 inch diameter.

B. Truck Assembly: Cast aluminum; revolving, stainless steel ball bearings, non-fouling.

C. Flags: Provided by owner
1. US Flag, 5' x 8'
2. City of Madison Flag, 4' x 6'

D. Halyard: 5/16 inch diameter stainless steel aircraft cable.

E. Spun Aluminum Collor: Standard

F. Counterbalance: Counterweight with beaded retainer sling.

2.5 OPERATORS

A. Manually Operated Winch: Postive locking at any position, removable winch handle

B. Flush Access Door: Reinforced door frame, compression lock

2.6 MOUNTING COMPONENTS

A. Foundation Tube Sleeve: AASHTO M 36M, corrugated 16 gage, 0.0598 inch steel, galvanized, depth of 36" inches as indicated.

B. Steel Plate Welded to Sleeve: 3/16"

C. Lightning Spike: 3/4" diameter

2.7 FINISHING

A. Metal Surfaces in Contact With Concrete: Asphaltic paint.

B. Concealed Steel Surfaces: Galvanized to ASTM A123/A123M requirements.

C. Aluminum: Satin finish

D. Finial: Clear anodized finish.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that concrete foundation is ready to receive work and dimensions are as indicated on shop drawings.

3.2 PREPARATION

A. Coat metal sleeve surfaces below grade and surfaces in contact with dissimilar materials with asphaltic paint.

3.3 INSTALLATION

A. Install flagpole, base assembly, and fittings in accordance with manufacturer's instructions.

B. Install Owner provided flags.

3.4 TOLERANCES

A. Maximum Variation From Plumb: 1 inch.

3.5 ADJUSTING

A. Adjust operating devices so that halyard and flag function smoothly.

END OF SECTION

SECTION 12 24 13

ROLLER WINDOW SHADES

PART 1 GENERAL

1.1 SUMMARY

A. This Section includes roller shades.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Include plans, elevations, sections, details, details of installation, operational clearances, and relationship to adjoining Work.
   1. Verify dimensions by field measurements before fabrication and indicate measurements on Shop Drawings.

C. Samples: Provide 8" x 8" fabric samples for each type and color of shade fabric.

D. Window Treatment Schedule: Use same designations indicated on Drawings.

E. Maintenance data.

1.3 QUALITY ASSURANCE

A. Installer Qualifications: Fabricator of products.

B. Fire-Test-Response Characteristics: Provide products passing flame-resistance testing according to NFPA 701 by a testing agency acceptable to authorities having jurisdiction.

C. Comply with WCMA A 100.1.

PART 2 PRODUCTS

2.1 ROLLER SHADES

A. Acceptable Products:
   1. Manual Shades:
      a. Lutron, Manual Roller Shades.
   2. Motorized Shades:
      a. Lutron, Sivoia QED.

B. Shade Fabric:
   1. Shade Fabric: Refer to Drawing Sheet A602 for Finish Material Specification.

C. Rollers: Electrogalvanized or epoxy primed steel or extruded-aluminum tube of diameter and wall thickness required to support and fit internal components of operating system and the weight and width of shade band material without sagging; designed to be easily removable from support brackets. Provide capacity for one roller shade band(s) per roller.

D. Direction of Roll: As indicated on drawings.

E. Mounting Brackets: Powder coated steel.

F. Bottom Bar: Steel or extruded aluminum, with plastic or metal capped ends. Provide concealed, by pocket of shade material, internal-type.

G. Mounting: Bracket mount as indicated on drawings, permitting easy removal and replacement without damaging roller shade or adjacent surfaces and finishes.

H. Exposed Headbox: Rectangular, extruded-aluminum enclosure including front fascia, top and back covers, endcaps, and removable bottom closure as indicated on drawings.
   1. Height: Manufacturer's standard height required to enclose roller and shadeband when shade is fully open, but not less than height indicated on Drawings.
   2. Endcap Covers: To cover exposed endcaps.

I. Shade Operation:
   1. Manual; with continuous-loop bead-chain, clutch, and cord tensioner and bracket lift operator.
   2. Motorized, with Wall Switch Controls: Operator size as required for operation and size of shade.

2.2 ROLLER SHADE FABRICATION

A. Product Description: Roller shade consisting of roller, a means of supporting roller, flexible sheet or band of material carried by roller, a means of attaching material to roller, bottom bar and operating mechanism that lifts and lowers the shade.

B. Provide side channels at sloped windows.

C. Unit Sizes: Obtain units fabricated in sizes to cover window and other openings as indicated on drawings.

D. Provide mounting as indicated on drawings.

E. Installation Brackets: Designed for easy removal and reinstallation of shade, for supporting roller, and operating hardware and for hardware position and shade mounting method indicated.

F. Installation Fasteners: No fewer than two fasteners per bracket, fabricated from metal noncorrosive to shade hardware and adjoining construction; type designed for securing to supporting substrate; and supporting shades and accessories under conditions of normal use.

2.3 MOTORIZED ROLLER SHADE OPERATORS

A. Motorized Operating System: Provide factory-assembled, shade-operator system of size and capacity and with features, characteristics, and accessories suitable for conditions indicated, complete with electric motor and factory-prewired motor controls, power disconnect switch, enclosures protecting controls and operating parts, and accessories required for reliable operation without malfunction. Include wiring from motor controls to motors. Coordinate operator wiring requirements and electrical characteristics with building electrical system.

B. Electrical Components: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Electric Motor: Manufacturer's standard tubular, enclosed in roller.

D. Electrical Characteristics: If electrical requirements for a manufacturer's motorized roller shades differ from those indicated on the drawings, the roller shade provider shall be responsible for all electrical modifications, additional transformers, wiring, equipment, etc. required for installation and operation of that manufacturer's products.
   1. Lutron: Single phase, 110 V, 60 Hz.

E. Remote Controls: As indicated on drawings.
   1. Wall Switch Control: Electric controls with NEMA ICS 6, Type 1 enclosure recessed mounting. Rocker-style, group-control wall switch.
      a. Group all shades in room to a single control.
      b. Wall switch color shall be selected by Architect from manufacturer’s full range of colors.
      c. Wall switch shall have:
         1) Wall Switches, unless noted otherwise: “Open”, 3 Programmable Presets, “Close” and Raise/Lower buttons.

F. Limit Switches: Adjustable switches, interlocked with motor controls and set to automatically stop shade at fully raised and fully lowered positions.

PART 3 EXECUTION

3.1 ROLLER SHADE INSTALLATION

A. Install roller shades level, plumb, and aligned with adjacent units according to manufacturer's written instructions. Allow clearances for window operation hardware.

B. Adjust and balance roller shades to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range.

C. Clean roller shade surfaces after installation, according to manufacturer's written instructions.

D. Connections: Connect motorized operators to building electrical system.

3.2 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain systems.

END OF SECTION

SECTION 12 31 00

MANUFACTURED METAL CASEWORK

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Stainless steel cabinets .

B. Stainless steel counter tops .

C. Service fittings and outlets.

1.2 REFERENCE STANDARDS

A. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2015.

B. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.

1.3 SUBMITTALS

A. Product Data: Provide component dimensions, configurations, construction details, joint details, and attachments, utility and service requirements and locations.

B. Shop Drawings: Indicate casework locations, large scale plans, elevations, cross sections, rough-in and anchor placement dimensions and tolerances, clearances required.

1.4 MOCK-UP

A. Provide full size base cabinet complete with drawers, door, adjustable shelf and counter top.

B. Locate where directed.

C. Approved mock-up may remain as part of the Work.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Accept casework on site. Inspect on arrival for damage.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Metal Casework:
   1. Basis-of-Design: Stainless Steel Kitchens, Inc., Designer MP-Series Steel and Marine Plywood Cabinets and Countertops.

2.2 MATERIALS

A. Stainless Steel Sheet: ASTM A666 Type 304.

B. Plastic Laminate Finish: NEMA LD 3, HGP; acid resistant, grey color.

C. Plywood: Heavy duty marine grade plywood.

2.3 HARDWARE

A. Drawer and Door Pulls: Stainless Steel Rod Handles.

B. Drawer Slides: Blumotion full extension drawer slides, with stainless steel drawer sides. Soft close feature.

C. Hinges: Blumotion “clip top” (removable without tools). Concealed, 125 degree open.
   1. All metal (nickel plate)
   2. Adjustable X, Y, Z axis.
   3. Rated 200,000 cycles
   4. Soft close feature.

2.4 FABRICATION - GENERAL

A. Fabricate casework, assembled and welded.

B. Fabricate corners and joints without gaps or inaccessible spaces or areas where dirt or moisture could accumulate.

C. Cabinet Style: Frameless, with full overlay doors and drawers.

D. Cabinet Body/Cores: Fabricate from heavy duty 5/8" marine plywood, with laminate finish.

E. Cabinet Doors, Drawers and Exposed Surfaces: 18 ga, 304 #4 stainless steel.

F. Interior Shelves: Marine grade plywood with laminate finish.

G. All components securely assembled using stainless steel fasteners and corner stiffeners. Very rigid cabinet. Fully assembled and ready to install. Dimensions and quantity per drawings.

H. Countertops:
   1. Fabricate from 16 ga., 304 #4 (brushed) finish stainless steel (with protective PVC plastic that will be removed) backed with 5/8" marine plywood.
   2. Thickness: 1-1/2"
   3. Edges: Non-drip. 90 degree corners.
   4. Sinks: Integrated, welded into countertop, undermount, SINGLE bowl, brushed finish, 18 gauge 304 SS. Full undercoating and insulation pad. Content: 18% Chrome/ 10% Nickel.Provide two sinks per plans Nominal Size: 31"X18"X11"
   5. Provide 4" integral backsplash where backsplash are indicated on drawings.

I. Finish all welds, grounded and blended to a satin finish.

J. Install fixtures and fittings built into or part of casework. Provide access panels for maintenance of utility service and mechanical and electrical components.

2.5 FINISHES

A. Stainless Steel: No. 4 finish.

B. Shop finish all components.

C. Coat metal surfaces in contact with cementitious materials with bituminous paint.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install casework, components and accessories in accordance with manufacturer's instructions.

B. Use anchoring devices to suit conditions and substrate materials encountered.

C. Set casework items plumb and square, securely anchored to building structure.

3.2 ADJUSTING

A. Adjust doors, drawers, hardware, fixtures, and other moving or operating parts to function smoothly.

3.3 CLEANING

A. Clean casework, counters, shelves, legs, hardware, fittings and fixtures.

3.4 PROTECTION

A. Do not permit finished casework to be exposed to continued construction activity.

END OF SECTION

SECTION 12 36 00

COUNTERTOPS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Countertops for architectural cabinet work.

B. Wall-hung counters and vanity tops.

C. Sinks molded into countertops.

1.2 RELATED REQUIREMENTS

A. Section 06 41 00 - Architectural Wood Casework.

B. refer to section 12 31 00 for stainless steel countertops in kitchen areas

1.3 REFERENCE STANDARDS

A. ANSI A208.1 - American National Standard for Particleboard; 2009.

B. ANSI A208.2 - American National Standard for Medium Density Fiberboard for Interior Use; 2009.

C. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards; 2014.

D. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards, U.S. Version 3.0; 2016.

E. IAPMO Z124 - Plastic Plumbing Fixtures; 2017.

F. ISFA 2-01 - Classification and Standards for Solid Surfacing Material; 2013.

G. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.

H. PS 1 - Structural Plywood; 2009.

1.4 SUBMITTALS

A. Product Data: Manufacturer's data sheets on each product to be used, including:
   1. Preparation instructions and recommendations.
   2. Storage and handling requirements and recommendations.
   3. Specimen warranty.

B. Shop Drawings: Complete details of materials and installation; combine with shop drawings of cabinets and casework specified in other sections.

C. Verification Samples: For each finish product specified, minimum size 6 inches square, representing actual product, color, and patterns.

D. Test Reports: Chemical resistance testing, showing compliance with specified requirements.

E. Maintenance Data: Manufacturer's instructions and recommendations for maintenance and repair of countertop surfaces.

1.5 QUALITY ASSURANCE

A. Fabricator of this section must also provide work specified in Division 6 Section "Wood-Veneer Paneling".

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.

1.7 FIELD CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

PART 2 PRODUCTS

2.1 COUNTERTOPS

A. Quality Standard: Custom Grade, in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), unless noted otherwise.

B. Plastic Laminate Countertops: High-pressure decorative laminate (HPDL) sheet bonded to substrate.
   1. Laminate Sheet: NEMA LD 3, Grade HGS, 0.048 inch nominal thickness.
      a. Laminate Core Color: Same as decorative surface.
      b. Surface Color and Pattern: Refer to drawing sheet A602 for Finish Specification.
   2. Exposed Edge Treatment: Square, substrate built up to minimum 1-1/4 inch thick; covered with matching laminate.
   3. Back and End Splashes: Same material, same construction.
   4. Fabricate in accordance with AWI/AWMAC/WI (AWS), Section 11 - Countertops, Custom Grade.
   5. Use exterior grade plywood at sink locations.

C. Solid Surfacing Countertops and Shower Surround Sheets: Solid surfacing sheet or plastic resin casting.
   1. Solid Surfacing Sheet and Plastic Resin Castings: Complying with ISFA 2-01 and NEMA LD 3; acrylic or polyester resin, mineral filler, and pigments; homogenous, non-porous and capable of being worked and repaired using standard woodworking tools; no surface coating; color and pattern consistent throughout thickness.
      a. Sinks and Bowls: Integral castings; minimum 3/4 inch wall thickness; comply with IAPMO Z124 and ADA size and clearance requirements.
   2. Other Components Thickness: 1/2 inch, minimum.
   3. Back Splashes: Same sheet material, square top; minimum 4 inches high unless otherwise indicated on drawings.

2.2 MATERIALS

A. Plywood for Supporting Substrate: PS 1 Exterior Grade, A-C veneer grade with no added urea formaldehyde, minimum 5-ply; minimum 3/4 inch thick; join lengths using metal splines.

B. Particleboard for Supporting Substrate: ANSI A208.1 Grade M-2 with no added urea formaldehyde, 45 pcf minimum density; minimum 3/4 inch thick; join lengths using metal splines.

C. Medium Density Fiberboard for Supporting Substrate: ANSI A208.2, Grade 130 with no added urea formaldehyde; 3/4 inch thick; join lengths using metal splines.

D. Adhesives: Chemical resistant waterproof adhesive as recommended by manufacturer of materials being joined.

2.3 FABRICATION

A. Fabricate tops and splashes in the largest sections practicable, with top surface of joints flush.
   1. Join lengths of tops using best method recommended by manufacturer.
   2. Fabricate to overhang fronts and ends of cabinets 1 inch except where top butts against cabinet or wall.
   3. Prepare all cutouts accurately to size; replace tops having improperly dimensioned or unnecessary cutouts or fixture holes.

B. Provide back/end splash wherever counter edge abuts vertical surface unless otherwise indicated.
   1. Secure to countertop with concealed fasteners and with contact surfaces set in waterproof glue.
   2. Height: 4 inches, unless otherwise indicated.

C. Solid Surfacing: Fabricate tops up to 144 inches long in one piece; join pieces with adhesive sealant in accordance with manufacturer's recommendations and instructions.
   1. Where sinks are indicated in solid surface countertops, provide integral bowls.

D. Wall-Mounted Counters: Provide skirts, aprons, brackets, and braces as indicated on drawings, finished to match.

PART 3 EXECUTION

3.1 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.

B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

C. Verify that wall surfaces have been finished and mechanical and electrical services and outlets are installed in proper locations.

3.2 INSTALLATION

A. Securely attach countertops to cabinets using concealed fasteners. Make flat surfaces level; shim where required.

B. Attach plastic laminate countertops using screws with minimum penetration into substrate board of 5/8 inch.

C. Seal joint between back/end splashes and vertical surfaces.

3.3 TOLERANCES

A. Variation From Horizontal: 1/8 inch in 10 feet, maximum.

B. Offset From Wall, Countertops: 1/8 inch maximum; 1/16 inch minimum.

C. Field Joints: 1/8 inch wide, maximum.

3.4 CLEANING

3.5 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Date of Substantial Completion.

END OF SECTION

Project Manual

Madison Fire Station 14

City of Madison Fire Department

Bid Documents

Volume 2 of 2

November 3, 2017

Madison Project No. 17451
Madison Contract No. 8027
OPN Project No. 17207000

OPN ARCHITECTS

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SECTION 21 05 00
BASIC FIRE SUPPRESSION REQUIREMENTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Requirements applicable to all Division 21 Sections. Also refer to Division 1 - General Requirements.

B. All materials and installation methods shall conform to the applicable standards, guidelines and codes referenced in the specification section.

1.2 SCOPE OF WORK

A. This Specification and the associated drawings govern the furnishing, installing, testing and placing into satisfactory operation the Mechanical Systems.

B. Each Contractor shall provide all new materials indicated on the drawings and/or in these specifications, and all items required to make his portion of the Mechanical Work a finished and working system.

C. All work will be awarded under a single General Contract.

1.3 DIVISION OF WORK BETWEEN MECHANICAL, ELECTRICAL & CONTROL CONTRACTORS

A. Definitions:

1. "Mechanical Contractors" refers to the following:

   a. Plumbing Contractor.
   b. Heating Contractor.
   c. Air Conditioning and Ventilating Contractor.
   d. Temperature Control Contractor.
   e. Fire Protection Contractor.
   f. Testing, Adjusting, and Balancing Contractor.

2. Motor Control Wiring: The wiring associated with the remote operation of the magnetic coils of magnetic motor starters or relays, or the wiring that permits direct cycling of motors by means of devices in series with the motor power wiring. In the latter case the devices are usually single phase and are usually connected to the motor power wiring through a manual motor starter having "Manual-Off-Auto" provisions.

3. Control devices such as start-stop push buttons, thermostats, pressure switches, flow switches, relays, etc., generally represent the types of equipment associated with motor control wiring.

4. Motor control wiring is single phase and usually 120 volts. In some instances, the voltage will be the same as the motor power wiring. Generally, where the motor power wiring exceeds 120 volts, a control transformer is used to give a control voltage of 120 volts.

5. Temperature Control Wiring: The wiring associated with the operation of a motorized damper, solenoid valve or motorized valve, etc., either modulating or two-position, as opposed to wiring which directly powers or controls a motor used to drive equipment such as fans, pumps, etc.

   a. This wiring will be from a 120 volt source and may continue as 120 volt, or be reduced in voltage (24 volt) in which case a control transformer shall be furnished as part of the temperature control wiring.

6. Control Motor: An electric device used to operate dampers, valves, etc. It may be two-position or modulating. Conventional characteristics of such a motor are 24 volts, 60 cycles, 1 phase, although other voltages may be encountered.

B. General:

1. The purpose of these Specifications is to outline the Electrical and Mechanical Contractor's responsibilities related to electrical work required for items such as temperature controls, mechanical equipment, fans, chillers, compressors and the like. The exact wiring requirements for much of the equipment cannot be determined until the systems have been selected and submittals reviewed. Therefore, the electrical drawings show only known wiring related to such items. All wiring not shown on the electrical drawings, but required for mechanical systems, is the responsibility of the Mechanical Contractor.

2. Where the drawings require the Electrical Contractor to wire between equipment furnished by the Mechanical Contractor, such wiring shall terminate at terminals provided in the equipment. The Mechanical Contractor shall provide complete wiring diagrams and supervision to the Electrical Contractor and designate the terminal numbers for correct wiring.

3. All electrical work shall conform to the National Electrical Code. All provisions of the Electrical Specifications concerning wiring, protection, etc., apply to wiring provided by the Mechanical Contractor unless noted otherwise.

C. Mechanical Contractor's Responsibility:

1. Assumes responsibility for internal wiring of all equipment provided by the Mechanical Contractor, for example:

   a. Burners.
   b. Condensing Units.
   c. Makeup Air Units.
   d. Gas Trains.
   e. Air Handling Units.

2. Assumes all responsibility for the Temperature Control wiring, when the Temperature Control Contractor is a Subcontractor to the Mechanical Contractor.

3. Temperature Control Subcontractor's Responsibility:

   a. Wiring of all devices needed to make the Temperature Control System functional.

   b. Verifying any control wiring on the electrical drawings as being by the Electrical Contractor. All wiring required for the Control System, but not shown on the electrical drawings, is the responsibility of the Temperature Control Subcontractor.

   c. Coordinating equipment locations (such as relays, transformers, etc.) with the Electrical Contractor, where wiring of the equipment is by the Electrical Contractor.

4. This Contractor is responsible for coordination of utilities with all other Contractors. If any field coordination conflicts are found, the Contractor shall coordinate with other Contractors to determine a viable layout.

D. Electrical Contractor's Responsibility:

1. Provides all combination starters, manual starters and disconnect devices shown on the Electrical Drawings or indicated to be by the Electrical Contractor on the Mechanical Drawings or Specifications.

2. Installs and wires all remote control devices furnished by the Mechanical Contractor or Temperature Control Subcontractor when so noted on the Electrical Drawings.

3. Provides motor control and temperature control wiring, where so noted on the drawings.

4. Furnishes, installs and connects all relays, etc., for automatic shutdown of certain fans upon actuation of the Fire Alarm System as indicated and specified in Division 28.

5. This Contractor is responsible for coordination of utilities with all other Contractors. If any field coordination conflicts are found, the Contractor shall coordinate with other Contractors to determine a viable layout.

1.4 COORDINATION DRAWINGS

A. Definitions:

1. Coordination Drawings: A compilation of the pertinent layout and system drawings that show the sizes and locations, including elevations, of system components and required access areas to ensure that no two objects will occupy the same space.

a. Mechanical trades shall include, but are not limited to, mechanical equipment, ductwork, fire protection systems, plumbing piping, hydronic piping, and any item that may impact coordination with other disciplines.

b. Electrical trades shall include, but are not limited to, electrical equipment, conduit 1.5" and larger, conduit racks, cable trays, pull boxes, transformers, raceway, busway, lighting, ceiling-mounted devices, and any item that may impact coordination with other disciplines.

c. Technology trades shall include, but are not limited to, technology equipment, racks, conduit 1.5" and larger, conduit racks, cable trays, ladder rack, pull boxes, raceway, ceiling-mounted devices, and any item that may impact coordination with other disciplines.

d. Maintenance clearances and code-required dedicated space shall be included.

e. The coordination drawings shall include all underground, underfloor, in-floor, in chase, and vertical trade items.

2. The contractors shall use the coordination process to identify the proper sequence of installation of all utilities above ceilings and in other congested areas, to ensure an orderly and coordinated end result, and to provide adequate access for service and maintenance.

B. Participation:

1. The contractors and subcontractors responsible for work defined above shall participate in the coordination drawing process.

2. One contractor shall be designated as the Coordinating Contractor for purposes of preparing a complete set of composite electronic CAD coordination drawings that include all applicable trades, and for coordinating the activities related to this process. The Coordinating Contractor for this project shall be the HVAC Contractor.

a. The Coordinating Contractor shall utilize personnel familiar with requirements of this project and skilled as draftspersons/CAD operators, competent to prepare the required coordination drawings.

3. Electronic CAD drawings shall be submitted to the Coordinating Contractor for addition of work by other trades. KJWW will provide electronic file copies of ventilation drawings for contractor's use if the contractor signs and returns an "Electronic File Transfer" waiver provided by KJWW. KJWW will not consider blatant reproductions of original file copies an acceptable alternative for coordination drawings.

C. General:

1. Coordination drawing files shall be made available to the A/E and Owner's Representative. The A/E will only review identified conflicts and give an opinion, but will not perform as a coordinator.

2. A plotted set of coordination drawings shall be available at the project site.

3. Coordination drawings are not shop drawings and shall not be submitted as such.

4. The contract drawings are schematic in nature and do not show every fitting and appurtenance for each utility. Each contractor is expected to have included in his/her bid sufficient fittings, material, and labor to allow for adjustments in routing of utilities made necessary by the coordination process and to provide a complete and functional system.

5. The contractors will not be allowed additional costs or time extensions due to participation in the coordination process.

6. The contractors will not be allowed additional costs or time extensions for additional fittings, reroutings or changes of duct size, that are essentially equivalent sizes to those shown on the drawings and determined necessary through the coordination process.

7. The A/E reserves the right to determine space priority of equipment in the event of spatial conflicts or interference between equipment, piping, conduit, ducts, and equipment provided by the trades.

8. Changes to the contract documents that are necessary for systems installation and coordination shall be brought to the attention of the A/E.

9. Access panels shall preferably occur only in gypsum board walls or plaster ceilings where indicated on the drawings.

   a. Access to mechanical, electrical, technology, and other items located above the ceiling shall be through accessible lay-in ceiling tile areas.

   b. Potential layout changes shall be made to avoid additional access panels.

   c. Additional access panels shall not be allowed without written approval from the A/E at the coordination drawing stage.

   d. Providing additional access panels shall be considered after other alternatives are reviewed and discarded by the A/E and the Owner's Representative.

   e. When additional access panels are required, they shall be provided without additional cost to the Owner.

10. Complete the coordination drawing process and obtain sign off of the drawings by all contractors prior to installing any of the components.

11. Conflicts that result after the coordination drawings are signed off shall be the responsibility of the contractor or subcontractor who did not properly identify their work requirements, or installed their work without proper coordination.

12. Updated coordination drawings that reflect as-built conditions may be used as record documents.

1.5 QUALITY ASSURANCE

A. Contractor's Responsibility Prior to Submitting Pricing Data:

1. The Contractor is responsible for constructing complete and operating systems. The Contractor acknowledges and understands that the Contract Documents are a two-dimensional representation of a three-dimensional object, subject to human interpretation. This representation may include imperfect data, interpreted codes, utility guidelines, three-dimensional conflicts, and required field coordination items. Such deficiencies can be corrected when identified prior to ordering material and starting installation. The Contractor agrees to carefully study and compare the individual Contract Documents and report at once in writing to the Design Team any deficiencies the Contractor may discover. The Contractor further agrees to require each subcontractor to likewise study the documents and report at once any deficiencies discovered.

2. The Contractor shall resolve all reported deficiencies with the Architect/Engineer prior to awarding any subcontracts, ordering material, or starting any work with the Contractor's own employees. Any work performed prior to receipt of instructions from the Design Team will be done at the Contractor's risk.

B. Qualifications:

1. Only products of reputable manufacturers are acceptable.

2. All Contractors and subcontractors shall employ only workers skilled in their trades.

C. Compliance with Codes, Laws, Ordinances:

1. Conform to all requirements of the City of Madison, Wisconsin Codes, Laws, Ordinances and other regulations having jurisdiction.

2. Conform to all State Codes.

3. If there is a discrepancy between the codes and regulations and these specifications, the Architect/Engineer shall determine the method or equipment used.

4. If the Contractor notes, at the time of bidding, any parts of the drawings or specifications that do not comply with the codes or regulations, he shall inform the Architect/Engineer in writing, requesting a clarification. If there is insufficient time for this procedure, he shall submit with his proposal a separate price to make the system comply with the codes and regulations.

5. All changes to the system made after letting of the contract, to comply with codes or requirements of Inspectors, shall be made by the Contractor without cost to the Owner.

6. If there is a discrepancy between manufacturer's recommendations and these specifications, the manufacturer's recommendations shall govern.

7. All rotating shafts and/or equipment shall be completely guarded from all contact. Partial guards and/or guards that do not meet all applicable OSHA standards are not acceptable. Contractor is responsible for providing this guarding if it is not provided with the equipment supplied.

D. Permits, Fees, Taxes, Inspections:

1. Procure all applicable permits and licenses.

2. Abide by all laws, regulations, ordinances, and other rules of the State or Political Subdivision where the work is done, or as required by any duly constituted public authority.

3. Pay all charges for permits or licenses.

4. Pay all fees and taxes imposed by the State, Municipal and/or other regulatory bodies.

5. Pay all charges arising out of required inspections by an authorized body.

6. Pay all charges arising out of required contract document reviews associated with the project and as initiated by the Owner or authorized agency/consultant.

7. Where applicable, all fixtures, equipment and materials shall be approved or listed by Underwriter's Laboratories, Inc.

E. Examination of Drawings:

1. The drawings for the fire protection work are completely diagrammatic, intended to convey the scope of the work and to indicate the general arrangements and locations of equipment, outlets, etc., and the approximate sizes of equipment.

2. Contractor shall determine the exact locations of equipment and rough-ins, and the exact routing of pipes and ducts to best fit the layout of the job.

3. Scaling of the drawings is not sufficient or accurate for determining these locations.

4. Where job conditions require reasonable changes in indicated arrangements and locations, such changes shall be made by the Contractor at no additional cost to the Owner.

5. Because of the scale of the drawings, certain basic items, such as fittings, boxes, valves, unions, etc., may not be shown, but where required by other sections of the specifications or required for proper installation of the work, such items shall be furnished and installed.

6. If an item is either on the drawings or in the specifications, it shall be included in this contract.

7. Determination of quantities of material and equipment required shall be made by the Contractor from the documents. Where discrepancies arise between drawings, schedules and/or specifications, the greater number shall govern.

8. Where used in fire protection documents, the word "furnish" shall mean supply for use, the word "install" shall mean connect complete and ready for operation, and the word "provide" shall mean to supply for use and connect complete and ready for operation.

   a. Any item listed as furnished shall also be installed, unless otherwise noted.

   b. Any item listed as installed shall also be furnished, unless otherwise noted.

F. Field Measurements:

1. Verify all pertinent dimensions at the job site before ordering any materials or fabricating any supports, pipes or ducts.

G. Electronic Media/Files:

1. Construction drawings for this project have been prepared utilizing Revit.

2. Contractors and Subcontractors may request electronic media files of the contract drawings and/or copies of the specifications. Specifications will be provided in PDF format.

3. Upon request for electronic media, the Contractor shall complete and return a signed "Electronic File Transmittal" form provided by KJWW.

4. If the information requested includes floor plans prepared by others, the Contractor will be responsible for obtaining approval from the appropriate Design Professional for use of that part of the document.

5. The electronic contract documents can be used for preparation of shop drawings and as-built drawings only. The information may not be used in whole or in part for any other project.

6. The drawings prepared by KJWW for bidding purposes may not be used directly for ductwork layout drawings or coordination drawings.

7. The use of these electronic files by the Contractor does not relieve them from their responsibility for coordination of work with other trades and verification of space available for the installation.

8. The information is provided to expedite the project and assist the Contractor with no guarantee by KJWW as to the accuracy or correctness of the information provided. KJWW accepts no responsibility or liability for the Contractor's use of these documents.

1.6 SUBMITTALS

A. Submittals shall be required for the following items, and for additional items where required elsewhere in the specifications or on the drawings.

1. Submittals list:

Referenced Specification Section	Submittal Item
21 05 00	Owner Training Agenda
21 13 00	Sprinkler Systems
21 13 00	Fire Protection Equipment

B. General Submittal Procedures: In addition to the provisions of Division 1, the following are required:

1. Transmittal: Each transmittal shall include the following:

   a. Date
   b. Project title and number
   c. Contractor's name and address
   d. Division of work (e.g., plumbing, heating, ventilating, etc.)
   e. Description of items submitted and relevant specification number
   f. Notations of deviations from the contract documents
   g. Other pertinent data

2. Submittal Cover Sheet: Each submittal shall include a cover sheet containing:

   a. Date
   b. Project title and number
   c. Architect/Engineer
   d. Contractor and subcontractors' names and addresses
   e. Supplier and manufacturer's names and addresses
   f. Division of work (e.g., plumbing, heating, ventilating, etc.)
   g. Description of item submitted (using project nomenclature) and relevant specification number
   h. Notations of deviations from the contract documents
   i. Other pertinent data
   j. Provide space for Contractor's review stamps

3. Composition:

   a. Submittals shall be submitted using specification sections and the project nomenclature for each item.

   b. Individual submittal packages shall be prepared for items in each specification section. All items within a single specification section shall be packaged together where possible. An individual submittal may contain items from multiple specifications sections if the items are intimately linked (e.g., pumps and motors).

   c. All sets shall contain an index of the items enclosed with a general topic description on the cover.

4. Content: Submittals shall include all fabrication, erection, layout, and setting drawings; manufacturers' standard drawings; schedules; descriptive literature, catalogs and brochures; performance and test data; wiring and control diagrams; dimensions; shipping and operating weights; shipping splits; service clearances; and all other drawings and descriptive data of materials of construction as may be required to show that the materials, equipment or systems and the location thereof conform to the requirements of the contract documents.

5. Contractor's Approval Stamp:

   a. The Contractor shall thoroughly review and approve all shop drawings before submitting them to the Architect/Engineer. The Contractor shall stamp, date and sign each submittal certifying it has been reviewed.

   b. Unstamped submittals will be rejected.

   c. The Contractor's review shall include, but not be limited to, verification of the following:

      1.) Only approved manufacturers are used.
      2.) Addenda items have been incorporated.
      3.) Catalog numbers and options match those specified.
      4.) Performance data matches that specified.
      5.) Electrical characteristics and loads match those specified.
      6.) Equipment connection locations, sizes, capacities, etc. have been coordinated with other affected trades.
      7.) Dimensions and service clearances are suitable for the intended location.
      8.) Equipment dimensions are coordinated with support steel, housekeeping pads, openings, etc.
      9.) Constructability issues are resolved (e.g., weights and dimensions are suitable for getting the item into the building and into place, sinks fit into countertops, etc.).

   d. The Contractor shall review, stamp and approve all subcontractors' submittals as described above.

   e. **The Contractor's approval stamp is required on all submittals. Approval will indicate the Contractor's review of all material and a complete understanding of exactly what is to be furnished. Contractor shall clearly mark all deviations from the contract documents on all submittals. If deviations are not marked by the Contractor, then the item shall be required to meet all drawing and specification requirements.**

6. Submittal Identification and Markings:

   a. The Contractor shall clearly mark each item with the same nomenclature applied on the drawings or in the specifications.

b. The Contractor shall clearly indicate the size, finish, material, etc.

c. Where more than one model is shown on a manufacturer's sheet, the Contractor shall clearly indicate exactly which item and which data is intended.

d. All marks and identifications on the submittals shall be unambiguous.

7. Schedule submittals to expedite the project. Coordinate submission of related items.

8. Identify variations from the contract documents and product or system limitations that may be detrimental to the successful performance of the completed work.

9. Reproduction of contract documents alone is not acceptable for submittals.

10. Incomplete submittals will be rejected without review. Partial submittals will only be reviewed with prior approval from the Architect/Engineer.

11. Submittals not required by the contract documents may be returned without review.

12. The Architect/Engineer's responsibility shall be to review one set of shop drawing submittals for each product. If the first submittal is incomplete or does not comply with the drawings and/or specifications, the Contractor shall be responsible to bear the cost for the Architect/Engineer to recheck and handle the additional shop drawing submittals.

13. Submittals shall be reviewed and approved by the Architect/Engineer **before** releasing any equipment for manufacture or shipment.

14. Contractor's responsibility for errors, omissions or deviation from the contract documents in submittals is not relieved by the Architect/Engineer's approval.

C. Electronic Submittal Procedures:

1. Distribution: Email submittals as attachments to all parties designated by the Architect/Engineer, unless a web-based submittal program is used.

2. Transmittals: Each submittal shall include an individual electronic letter of transmittal.

3. Format: Electronic submittals shall be in PDF format only. Scanned copies, in PDF format, of paper originals are acceptable. Submittals that are not legible will be rejected. Do not set any permission restrictions on files; protected, locked, or secured documents will be rejected.

4. File Names: Electronic submittal file names shall include the relevant specification section number followed by a description of the item submitted, as follows. Where possible, include the transmittal as the first page of the PDF instead of using multiple electronic files.

a. Submittal file name: 21 XX XX.description.YYYYMMDD
b. Transmittal file name: 21 XX XX.description.YYYYMMDD

5. File Size: Electronic file size shall be limited to a maximum of 4MB. Larger files shall be transmitted via a pre-approved method.

1.7 PRODUCT DELIVERY, STORAGE, HANDLING & MAINTENANCE

A. Exercise care in transporting and handling to avoid damage to materials. Store materials on the site to prevent damage. Keep materials clean, dry and free from harmful conditions. Immediately remove any materials that become wet or that are suspected of becoming contaminated with mold or other organisms.

B. Keep all bearings properly lubricated and all belts properly tensioned and aligned.

C. Coordinate the installation of heavy and large equipment with the General Contractor and/or Owner. If the Mechanical Contractor does not have prior documented experience in rigging and lifting similar equipment, he/she shall contract with a qualified lifting and rigging service that has similar documented experience. Follow all equipment lifting and support guidelines for handling and moving.

D. Contractor is responsible for moving equipment into the building and/or site. Contractor shall review site prior to bid for path locations and any required building modifications to allow movement of equipment. Contractor shall coordinate his/her work with other trades.

1.8 WARRANTY

A. Refer to Division 01 specification for requirements.

1.9 INSURANCE

A. Contractor shall maintain insurance coverage as set forth in Division 0 of these specifications.

1.10 MATERIAL SUBSTITUTION

A. Refer to Division 01 specification for requirements.

1.11 LEED REQUIREMENTS

A. This project is pursuing a LEED Silver certification in accordance with USGBC LEED Rating System for New Construction Version 2009. The Contractor shall provide all services and documentation necessary to achieve this rating.

B. Refer to Division 01 specification for additional requirements.

1.12 PROJECT COMMISSIONING

A. The Contractor shall work with the Commissioning Agent (CxA) as described in Division 01 specifications, and provide all services necessary for compliance with LEED Prerequisite EAp1, Fundamental Commissioning, and EAc3 Enhanced Commissioning.

PART 2 - PRODUCTS

NOT APPLICABLE

PART 3 - EXECUTION

3.1 JOBSITE SAFETY

A. Neither the professional activities of the Architect/Engineer, nor the presence of the Architect/Engineer or his or her employee and subconsultants at a construction site, shall relieve the Contractor and other entity of their obligations, duties and responsibilities including, but not limited to, construction means, methods, sequence, techniques or procedures necessary for performing, superintending or coordinating all portions of the work of construction in accordance with the contract documents and any health or safety precautions required by any regulatory agencies. The Architect/Engineer and his or her personnel have no authority to exercise any control over any construction contractor or other entity or their employees in connection with their work or any health or safety precautions. The Contractor is solely responsible for jobsite safety. The Architect/Engineer and the Architect/Engineer's consultants shall be indemnified and shall be made additional insureds under the Contractor's general liability insurance policy.

3.2 OPERATION AND MAINTENANCE MANUALS

A. Refer to Division 01 specification for requirements.

3.3 INSTRUCTING THE OWNER'S REPRESENTATIVES

A. Adequately instruct the Owner's designated representatives in the maintenance, care, and operation of all systems installed under this contract per specification 01 79 00.

B. The instructions shall include:

1. Explanation of all system flow diagrams.
2. Maintenance of equipment.
3. Start-up procedures for all major equipment.
4. Description of emergency system operation.

C. Minimum hours of instruction for each item shall be:

1. Sprinkler System(s) - 1 hour.

3.4 SYSTEM COMMISSIONING

A. The fire protection systems shall be complete and operating. System start-up, testing, balancing, and satisfactory system performance is the responsibility of the Contractor. This includes calibration and adjustments of all controls, noise level adjustments and final comfort adjustments as required.

B. All operating conditions and control sequences shall be tested during the start-up period. Test all interlocks, safety shutdowns, controls, and alarms.

C. The Contractor, subcontractors, and equipment suppliers shall have skilled technicians to ensure that all systems perform properly. If the Architect/Engineer is requested to visit the job site for trouble shooting, assisting in start-up, obtaining satisfactory equipment operation, resolving installation and/or workmanship problems, equipment substitution issues or unsatisfactory system performance, including call backs during the warranty period, through no fault of the design; the Contractor shall reimburse the Owner on a time and materials basis for services rendered at the Architect/Engineer's standard hourly rates in effect when the services are requested. The Contractor shall pay the Owner for services required that are product, installation or workmanship related. Payment is due within 30 days after services are rendered.

3.5 RECORD DOCUMENTS

A. The following paragraph supplements Division 1 requirements:

Contractor shall maintain at the job site a separate and complete set of fire protection drawings and specifications on which he shall clearly and permanently mark in complete detail all changes made to the fire protection systems.

B. Mark drawings to indicate revisions to piping size and location, both exterior and interior; including locations of other control devices, and other units requiring periodic maintenance or repair; actual equipment locations, dimensioned from column lines; actual inverts and locations of underground piping; concealed equipment, dimensioned from column lines; mains and branches of piping systems, with valves and control devices located and numbered, concealed unions located, and with items requiring maintenance located; Change Orders; concealed control system devices.

C. Mark specifications to show approved substitutions; Change Orders, and actual equipment and materials used.

D. Record changes daily and keep the marked drawings available for the Architect/Engineer's examination at any normal work time.

E. Upon completing the job, and before final payment is made, give the marked-up drawings to the Architect/Engineer.

3.6 ADJUST AND CLEAN

A. Thoroughly clean all equipment and systems prior to the Owner's final acceptance of the project. Clean all foreign paint, grease, oil, dirt, labels, stickers, and other foreign material from all equipment.

B. Clean all areas where moisture is present. Immediately report any mold, biological growth, or water damage.

C. Remove all rubbish, debris, etc., accumulated during construction from the premises.

3.7 CONSTRUCTION WASTE MANAGEMENT

A. This Contractor shall comply with all construction and demolition waste disposal and recycling requirements outlined in LEED MRc2: Construction Waste Management (follow latest edition at the time of bidding or as referenced in these specifications).

1. This Contractor shall coordinate with the General Contractor to develop and implement a construction waste management plan that, at a minimum, identifies the materials to be diverted from disposal and whether the materials will be sorted on-site or co-mingled.

2. The Contractor shall track waste disposal and recycling efforts throughout the construction process for all materials associated with this Contractor's scope of work. The Contractor shall provide this information to the General Contractor so that it can be incorporated with similar information from all other contractors for the project.

    a. Calculations for waste and recycled material can be done by weight or volume, but they must be consistent throughout the project. The Contractor shall coordinate with the General Contractor to establish the preferred calculation method and report the results accordingly.

    b. Excavated soil and land-clearing debris do not count towards the waste disposal or recycled material.

3. At a minimum, 50% of the construction and demolition debris for this project must be recycled or salvaged.

END OF SECTION

READINESS CERTIFICATION PRIOR TO FINAL JOBSITE OBSERVATION

In order to prevent the final job observation from occurring too early, we require that the Contractor review the completion status of the project and, by copy of this document, certify that the job is indeed ready for the final job observation. The following is a typical list of items that represent the degree of job completeness expected prior to your requesting a final job observation.

1. Penetrations fire sealed and labeled in accordance with specifications.
2. Fire protection system operational.
3. Pipes labeled.

Accepted by:

Prime Contractor _____

By _____ Date _____

Upon Contractor certification that the project is complete and ready for a final job observation, we require the Contractor to sign this agreement and return it to the Architect/Engineer so that the final observation can be scheduled.

It is understood that if the Architect/Engineer finds the job not ready for the final observation and that additional trips and observations are required to bring the project to completion, the costs incurred by the Architect/Engineers for additional time and expenses will be deducted from the Contractor's contract retainage prior to final payment at the completion of the job.

* * * * *

SECTION 21 05 29
FIRE SUPPRESSION SUPPORTS AND ANCHORS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Hangers, Supports, and Associated Anchors.
B. Equipment Bases and Supports.
C. Sleeves and Seals.
D. Flashing and Sealing of Equipment and Pipe Stacks.
E. Cutting of Openings.
F. Escutcheon Plates and Trim.

1.2 QUALITY ASSURANCE

A. Support Sprinkler Piping in conformance with NFPA 13.

B. Support Standpipes in conformance with NFPA 14.

1.3 SUBMITTALS

A. Submit shop drawings and product data under provisions of Section 21 05 00.

1.4 WORK FURNISHED BUT INSTALLED UNDER OTHER SECTIONS

A. Furnish sleeves and hanger inserts to General Contractor for placement into formwork.

PART 2 - PRODUCTS

2.1 SEISMIC RESTRAINTS

A. Refer to Section 21 05 50 for additional requirements for seismic restraints.

2.2 HANGER RODS

A. Hanger rods for single rod hangers shall conform to the following:

Pipe Size	Hanger Rod Diameter	
	Column #1	Column #2
2" and smaller	3/8"	3/8"
2-1/2" through 3-1/2"	1/2"	1/2"
4" and 5"	5/8"	1/2"
6"	3/4"	5/8"
8" through 12"	7/8"	3/4"
14"	1"	7/8"
16" and 18"	1"	N/A
20" and 24"	1-1/4"	N/A

Column #1: Steel pipe.
Column #2: Copper and plastic pipe.

B. Rods for double rod hangers may be reduced one size. Minimum rod diameter is 3/8 inches.

C. Hanger rods and accessories used in mechanical spaces or otherwise dry areas shall have ASTM B633 electro-plated zinc finish.

2.3 PIPE HANGERS AND SUPPORTS

A. All pipe hangers, clamps, and supports shall conform to Manufacturers Standardization Society MSS-SP-58 and 127 (where applicable).

B. Support and laterally brace vertical pipes at every floor level in multi-story structures, and more frequently when required by applicable codes, but never at intervals over 15 feet. Support vertical pipes with riser clamps installed below hubs, couplings or lugs. Provide sufficient flexibility to accommodate expansion and contraction without compromising fire barrier penetrations and other fixed takeoff locations.

Acceptable Products:

Anvil -	Fig. CT121
Cooper/B-Line -	Fig. B3373CT
Erico -	Model 510
Nibco/Tolco -	Fig. 82

C. Hangers in direct contact with copper pipe shall be coated with plastic with appropriate temperature range. HYDRA-ZORB clamps are permitted for this application for bare pipes within their temperature limits of -65°F to +275°F.

D. Unless otherwise indicated, hangers shall be as follows:

1. Clevis Type:
Service: Bare Metal Pipe

Acceptable Products:	Bare Steel, Plastic or Insulated Pipe	Bare Copper Pipe
Anvil	Fig. 260	Fig. CT65
Cooper/B-Line	Fig. 3100	Fig. B3104CT
Erico	Model 400	Model 402
Nibco/Tolco	Fig. 1	Fig. 81

2. Adjustable Swivel Ring Type:
Service: Bare Metal Pipe - 4 inches and Smaller

Acceptable Products:	Bare Steel Pipe	Bare Copper Pipe
Anvil	Fig. 69	Fig. CT69
Cooper/B-Line	Fig. B3170NF	Fig. B170CT
Erico	Model FCN	
Nibco/Tolco	Fig. 200	Fig. 202

E. Support may be fabricated from U-Channel strut or similar shapes. Piping less than 4" in diameter shall be secured to strut with clamps of proper design and capacity as required to maintain spacing and alignment. Strut shall be independently supported from hanger drops or building structure. Size and support shall be per manufacturer's installation requirements for structural support of piping. Clamps shall not interrupt piping insulation.

1. Strut used in mechanical spaces or otherwise dry areas shall have ASTM B633 electro-plated zinc finish.

2. Strut used in damp areas listed in hanger rods shall have ASTM A123 hot-dip galvanized finish applied after fabrication.

F. Unless otherwise indicated, pipe supports for use with struts shall be as follows:

1. Clamp Type:
Service: Bare Metal Pipe

a. Clamps in direct contact with copper pipe shall be plastic coated.

b. Pipes subject to expansion and contraction shall have clamps slightly oversized to allow limited pipe movement.

Acceptable Products:	Bare Steel, Plastic or Insulated Pipe	Bare Copper Pipe
Unistrut	Fig. P1100 or P2500	
Cooper/B-Line	Fig. B2000 or B2400	Fig. BVT
Nibco/Tolco	Fig. A-14 or 2STR	

G. Unless otherwise shown, upper attachments for hanger rods or support struts shall be as follows:

1. Beam Clamps:

Acceptable Products:	
Anvil	Fig. 228, 292
Cooper/B-Line	Fig. B3054
Erico	Model 360
Nibco/Tolco	Fig. 329

2. Concrete Inserts, Single Rod Galvanized:

Acceptable Products:	
Anvil	Fig. 282
Cooper/B-Line	Fig. B3014
Erico	Model 355
Nibco/Tolco	Fig. 310

3. Concrete Inserts, Continuous Strip Galvanized:

Acceptable Products:	
Unistrut Corp	P3200 Series
Cooper/B-Line	Fig. B22-J
Erico	CONCT

4. Concrete Anchors: Fasten to concrete using cast-in or post-installed anchors designed per the requirements of Appendix D of ACI 318-14. Post-installed anchors shall be qualified for use in cracked concrete by ACI-355.2.

5. Masonry Anchors: Fasten to concrete masonry units with expansion anchors or self-tapping masonry screws. For expansion anchors into hollow concrete block, use sleeve-type anchors designed for the specific application. Do not fasten in masonry joints. Do not use powder actuated fasteners, wooden plugs, or plastic inserts.

H. Wall supports shall be used where vertical height of structure exceeds minimum spacing requirements. Install wall supports at same spacing as hangers or strut supports along vertical length of pipe runs.

I. Welding:

1. Unless otherwise noted, hangers, clips, and auxiliary support steel may be welded in lieu of bolting, clamping, or riveting to the building structural frame. Take adequate precautions during all welding operations for fire prevention and for protecting walls and ceilings from being damaged by smoke.

2.4 FOUNDATIONS, BASES, AND SUPPORTS

A. Basic Requirements:

1. Furnish and install foundations, bases, and supports (not specifically indicated on the Drawings or in the Specifications of either the General Construction or Mechanical work as provided by another Contractor) for mechanical equipment.

2. All concrete foundations, bases and supports, shall be reinforced. All steel bases and supports shall receive a prime coat of zinc chromate or red metal primer. After completion of work, give steel supports a final coat of gray enamel.

B. Supports:

1. Provide sufficient clips, inserts, hangers, racks, rods, and auxiliary steel to securely support all suspended material, equipment and conduit without sag.

2. Hang heavy equipment from concrete floors or ceilings with Architect-approved concrete inserts, furnished and installed by the Contractor whose work requires them, except where indicated otherwise.

C. Grout:

1. Grout shall be non-shrinking premixed (Master Builders Company "Embecco"), unless otherwise indicated on the drawings or approved by the Architect/Engineer.

2. Use Mix No. 1 for clearances of 1" or less, and Mix No. 2 for all larger clearances.

3. Grout under equipment bases, around pipes, at pipe sleeves, etc., and where shown on the drawings.

2.5 OPENINGS IN FLOORS, WALLS AND CEILINGS

A. Exact locations of all openings for the installation of materials shall be determined by the Contractor and given to the General Contractor for installation or construction as the structure is built.

B. Coordinate all openings with other Contractors.

C. Hire the proper tradesman and furnish all labor, material and equipment to cut openings in or through existing structures, or openings in new structures that were not installed, or additional openings. Repair all spalling and damage to the satisfaction of the Architect/Engineer. Make saw cuts before breaking out concrete to ensure even and uniform opening edges.

D. Said cutting shall be at the complete expense of each Contractor. Failure to coordinate openings with other Contractors shall not exempt the Contractor from providing openings at his expense.

E. Do not cut structural members without written approval of the Architect or Structural Engineer.

2.6 PIPE SLEEVES AND LINTELS

A. Each Contractor shall provide pipe sleeves and lintels for all openings required for the Contractor’s work in masonry walls and floors, unless specifically shown as being by others.

B. Fabricate all sleeves from standard weight black steel pipe or as indicated on the drawings. Provide continuous sleeve. Cut or split sleeves are not acceptable.

C. Fabricate all lintels for masonry walls from structural steel shapes or as indicated on the drawings. Have all lintels approved by the Architect or Structural Engineer.

D. Sleeves through the floors on exposed risers shall be flush with the ceiling, with planed squared ends extending 1" above the floor in unfinished areas, and flush with the floor in finished areas, to accept spring closing floor plates.

E. Sleeves shall not penetrate structural members or masonry walls without approval from the Structural Engineer. Sleeves shall then comply with the Engineer's design.

F. Openings through unexcavated floors and/or foundation walls below the floor shall have a smooth finish with sufficient annular space around material passing through opening so slight settling will not place stress on the material or building structure.

G. Install all sleeves concentric with pipes. Secure sleeves in concrete to wood forms. This Contractor is responsible for sleeves dislodged or moved when pouring concrete.

H. Where pipes rise through concrete floors that are on earthen grade, provide 3/4" resilient expansion joint material (asphalt and cork) wrapped around the pipe, the full depth of concrete, at the point of penetration. Secure to prevent shifting during concrete placement and finishing.

I. Size sleeves large enough to allow expansion and contraction movement. Provide continuous insulation wrapping.

2.7 ESCUTCHEON PLATES AND TRIM

A. Fit escutcheons to all insulated or uninsulated exposed pipes passing through walls, floors, or ceilings of finished rooms.

B. Escutcheons shall be heavy gauge, cold rolled steel, copper coated under a chromium plated finish, heavy spring clip, rigid hinge and latch.

C. Install galvanized steel (unless otherwise indicated) trim strip to cover vacant space and raw construction edges of all rectangular openings in finished rooms. This includes duct and pipe openings.

2.8 PIPE PENETRATIONS

A. Seal all pipe penetrations. Seal non-rated walls and floor penetrations with grout or caulk. Backing material may be used.

B. Seal fire rated wall and floor penetrations with fire seal system as specified.

2.9 PIPE ANCHORS

A. Provide all items needed to allow adequate expansion and contraction of all piping. All piping shall be supported, guided, aligned, and anchored as required.

B. Repair all piping leaks and associated damage. Pipes shall not rub on any part of the building.

2.10 FINISH

A. Prime coat exposed steel hangers and supports. Hangers and supports in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

PART 3 - EXECUTION

3.1 FIRE SUPPRESSION SUPPORTS AND ANCHORS

A. General Installation Requirements:

1. Install all items per manufacturer's instructions.

2. Coordinate the location and method of support of piping systems with all installations under other Divisions and Sections of the Specifications.

3. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.

B. Supports Requirements:

1. Install roof pipe supports to resist wind movement per manufacturer's recommendations. Method of securing base to roof shall be compatible with roofing materials.

2. Where building structural steel is fireproofed, all hangers, clamps, auxiliary steel, etc., which attach to it shall be installed prior to application of fireproofing. Repair all fireproofing damaged during pipe installation.

3. Set all concrete inserts in place before pouring concrete.

4. Furnish, install and prime all auxiliary structural steel for support of piping systems that are not shown on the Drawings as being by others.

5. Install hangers and supports complete with lock nuts, clamps, rods, bolts, couplings, swivels, inserts and required accessories.

6. Hangers for horizontal piping shall have adequate means of vertical adjustment for alignment.

C. Pipe Requirements:

1. Support all piping and equipment, including valves, strainers, and other specialties and accessories to avoid objectionable or excessive stress, deflection, swaying, sagging or vibration in the piping or building structure during erection, cleaning, testing and normal operation of the systems.

2. Do not, however, restrain piping to cause it to snake or buckle between supports or to prevent proper movement due to expansion and contraction.

3. Support piping at equipment and valves so they can be disconnected and removed without further supporting the piping.

4. Piping shall not introduce strains or distortion to connected equipment.

5. Parallel horizontal pipes may be supported on trapeze hangers made of structural shapes and hanger rods; otherwise, pipes shall be supported with individual hangers.

6. Trapeze hangers may be used where ducts interfere with normal pipe hanging.

7. Provide additional supports where pipe changes direction, adjacent to flanged valves and strainers, at equipment connections and heavy fittings.

8. Provide at least one hanger adjacent to each joint in grooved end steel pipe with mechanical couplings.

D. Provided the installation complies with all loading requirements of truss and joist manufacturers, the following practices are acceptable:

1. Loads of 100 lbs. or less may be attached anywhere along the top or bottom chords of trusses or joists with a minimum 3'spacing between loads.

2. Loads greater than 100 lbs. must be hung concentrically and may be hung from top or bottom chord, provided one of the following conditions is met:

a. The hanger is attached within 6” from a web/chord joint.

b. Additional L2x2x1/4 web reinforcement is installed per manufacturer’s requirements.

3. It is prohibited to cantilever a load using an angle or other structural component that is attached to a truss or joist in such a fashion that a torsional force is applied to that structural member.

4. If conditions cannot be met, coordinate installation with truss or joist manufacturer and contact Architect/Engineer.

E. After piping and insulation installation are complete, cut hanger rods back at trapeze supports so they do not extend more than 3/4" below bottom face of lowest fastener and blunt any sharp edges.

F. Do not exceed 25 lbs. per hanger and a minimum spacing of 2’-0” on center when attaching to metal roof decking (limitation not required with concrete on metal deck). This 25 lbs. load and 2’-0” spacing include adjacent electrical and architectural items hanging from deck. If the hanger restrictions cannot be achieved, supplemental framing off steel framing will need to be added.

G. Do not exceed the manufacturer's recommended maximum load for any hanger or support.

H. Spacing of Hangers shall not exceed the compressive strength of the insulation inserts, and in no case shall exceed the following:

	Pipe Material	Maximum Spacing
1.	Steel (Std. Weight or Heavier – Liquid Service):	
	1-1/4" & under	7'-0"
	1-1/2"	9'-0"
	2"	10'-0"
	2-1/2"	11'-0"
	3"	12'-0"
	4" & larger	12'-0"
2.	Hard Drawn Copper & Brass (Liquid Service):	
	3/4" and under	5'-0"
	1"	6'-0"
	1-1/4"	7'-0"
	1-1/2"	8'-0"
	2"	8'-0"
	2-1/2"	9'-0"
	3"	10'-0"
	4"	12'-0"
	6"	12'-0"

3. Rigid Plastic Pipe:

a. Space hangers at 4’-0” maximum centers.

4. Installation of hangers shall conform to MSS SP-58 and applicable NFPA standards.

END OF SECTION

SECTION 21 05 53
FIRE SUPPRESSION IDENTIFICATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Identification of products installed under Division 21.

1.2 REFERENCES

A. ANSI/ASME A13.1 - Scheme for the Identification of Piping Systems.

B. ASTM B-1, B-3, and B-8 for copper conductors.

C. ASTM D-1248 for Polyethylene Extrusion Materials, ICEA S-70-547 Weatherproof Resistant Polyethylene Conductors, ICEA S-61-402/NEMA WC5 Thermoplastic Insulated Wire & Cable, ICEA S-95-658/NEMA WC70 Non-Shielded 0 – 2kv Cables.

D. UL 1581 Standard for Electrical Wires, Cables, and Flexible Cords.

1.3 SUBMITTALS

A. Submit shop drawings under provisions of Section 21 05 00. Include list of items identified, wording, letter sizes, and color coding.

B. Include valve chart and schedule listing valve tag number, location, function, and valve manufacturer's name and model number.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. 3M, Bunting, Calpico, Craftmark, Emedco, Kolbi Industries, Seton, W.H. Brady, Marking Services.

2.2 MATERIALS

A. All pipe markers (purchased or stenciled) shall conform to ANSI A13.1. Marker lengths and letter sizes shall be at least the following:

O.D. of Pipe or insulation	Marker Length	Size of Letters
Up to and including 1-1/4”	8”	1/2”
1-1/2” to 2”	8”	3/4”
2-1/2” to 6”	12”	1-1/4
8” to 10”	24”	2-1/2”
Over 10”	32”	3-1/2”

Plastic tags may be used for outside diameters under 3/4".

B. Plastic Nameplates: Laminated three-layer phenolic with engraved black, 1/4" minimum letters on light contrasting background.

C. Aluminum Nameplates: Black enamel background with natural aluminum border and engraved letters furnished with two mounting holes and screws.

D. Plastic Tags: Minimum 1-1/2" square or round laminated three-layer phenolic with engraved, 1/4” minimum black letters on light contrasting background.

E. Brass Tags: Brass background with engraved black letters. Tag size minimum 1-1/2" square or 1-1/2" round.

F. Plastic Pipe Markers: Semi-rigid plastic, preformed to fit around pipe or pipe covering; indicating flow direction and fluid conveyed.

G. Vinyl Pipe Markers: Colored vinyl with permanent pressure sensitive adhesive backing.

H. Stencil Painted Pipe Markers: Use industrial enamel spray paint per ANSI Standard A13.1. Indicate fluid conveyed and flow direction.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install all products per manufacturer’s recommendations.

B. Degrease and clean surfaces to receive adhesive for identification materials.

C. Valves:

1. All valves (except shutoff valves at equipment) shall have numbered tags.

2. Provide or replace numbered tags on all existing valves that are connected to new systems or that have been revised.

3. Provide all existing valves used to extend utilities to this project with numbered tags. Review tag numbering sequence with the Owner prior to ordering tags.

4. Secure tags with heavy duty key chain and brass "S" link or with mechanically fastened plastic straps.

5. Attach to handwheel or around valve stem. On lever operated valves, drill the lever to attach tags.

6. Number all tags and show the service of the pipe.

7. Provide two sets of laminated 8-1/2" x 11" copies of a valve directory listing all valves, with respective tag numbers, uses, and locations. The directory shall be reviewed by the Owner and Architect/Engineer prior to laminating final copies. Laminated copies shall have brass eyelet in at least one corner for easy hanging.

D. Pipe Markers:

1. Adhesive Backed Markers: Use Brady Style 1, 2, or 3 on pipes 3" diameter and larger. Use Brady Style 4, 6, or 8 on pipes under 3" diameter. Similar styles by other listed manufacturers are acceptable. Secure all markers at both ends with a wrap of pressure sensitive tape completely around the pipe.

2. Snap-on Markers: Use Seton "Setmark" on pipes up to 5-7/8" OD. Use Seton "Setmark" with nylon or Velcro ties for pipes 6" OD and over. Similar styles by other listed manufacturers are acceptable.

3. Stencil Painted Pipe Markers:

   a. Remove rust, grease, dirt, and all foreign substances from the pipe surface.
   b. Apply primer on non-insulated pipes before painting.
   c. Use background and letter colors as scheduled later in this section.

4. Apply markers and arrows in the following locations where clearly visible:

   a. At each valve.
   b. On both sides of walls that pipes penetrate.
   c. At least every 20 feet along all pipes.
   d. On each riser and each leg of each "T" joint.
   e. At least once in every room and each story traversed.

E. Equipment:

1. All equipment not easily identifiable such as controls, relays, gauges, etc.; and all equipment in an area remote from its function shall have nameplates or plastic tags listing name, function, and drawing symbol. Do not label exposed equipment in public areas.

2. Fasten nameplates or plastic tags with stainless steel self-tapping screws or permanently bonding cement.

3. Mechanical equipment that is not covered by the U.S. National Appliance Energy Conservation Act (NAECA) of 1987 shall carry a permanent label installed by the manufacturer stating that the equipment complies with the requirements of ASHRAE 90.1.

3.2 SCHEDULE

A. Pipes to be marked shall be labeled with the text as shown in the following table regardless of which method or material is used:

Pipe Service	Lettering Color	Background Color
FIRE PROTECTION WATER	White	Red

END OF SECTION

SECTION 21 13 00
FIRE PROTECTION SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Pipe, Fittings, Valves, and Connections for Fire Protection System.
B. Wet-Pipe Sprinkler System.

1.2 QUALITY ASSURANCE

A. Welding Materials and Procedures: Conform to ASME Code.

B. Equipment and Components: Bear UL label or marking.

C. Valves: Bear UL label or marking. Provide manufacturer's name and pressure rating marked on valve body. Pressure rating shall match specified pipe system pressure rating. Remanufactured valves are not acceptable.

D. Specialist Firm: Company specializing in sprinkler systems with minimum three years experience.

E. Sprinkler design drawings submitted by the Contractor shall be prepared by a NICET Water-Based Fire Protection Systems Layout Level III or Level IV designer or PE, and signed and sealed by a Professional Engineer licensed in the state where the project is located.

1.3 SUBMITTALS

A. Submit shop drawings per Section 21 05 00. Indicate pipe materials, joining methods, supports, floor and wall penetration seals, sprinklers, equipment data and ratings, and hydraulic calculations.

B. Submit detailed pipe and sprinkler layout and other calculations and forms as described in NFPA 13.

C. Submit detailed working drawings and obtain review of them in the following order:

1. Engineer/Architect.
2. Local Fire Department
3. Owner’s Insurance Company

Begin construction after all approvals are received.

D. Working drawings shall include piping and sprinkler layout, sprinkler types and ratings, sections and elevations at critical points. Show coordination with lighting, ductwork, and diffusers, and indicate basic flow and hydraulic design information, including main location and date that the test was taken.

E. Submit dry-pipe calculations including water delivery time and air supply refill defined in NFPA 13. Water delivery time and air supply shall meet the requirements set forth in NFPA 13.

F. Provide the Owner with one copy of NFPA 25. *Standard for the Inspection Testing and Maintenance of Water-based Fire Protection Systems.*

1.4 EXTRA STOCK

A. Provide metal storage cabinet, wrenches for each sprinkler type, and extra sprinklers per NFPA 13 and applicable building code.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store valves and sprinklers in shipping containers, with labels in place.

B. Provide temporary protective coating on iron and steel valves.

C. Maintain temporary end caps and closures in place until installation.

1.6 WORK FURNISHED BUT INSTALLED UNDER OTHER SECTIONS

A. Furnish sleeves to General Contractor for placement in walls and floors. Sleeve location to be determined by the Fire Protection Contractor prior to construction. If additional sleeves are required, they shall be core drilled by the Fire Protection Contractor.

1.7 SYSTEM DESCRIPTION

A. System shall cover building areas noted.

B. System shall interface with building fire alarm system. Provide all required wiring.

C. Provide wet pipe sprinkler system to NFPA 13 and building code requirements as required by Owner's insurance company and as shown on the drawings.

D. Provide a Fire Department connection.

1.8 REGULATORY REQUIREMENTS

A. All material, equipment, and installation shall be approved by the Authorities Having Jurisdiction and the Owner's Insurance Company.

B. The Authorities Having Jurisdiction and the Owner's Insurance Company shall have precedence over the drawings and specifications in case of discrepancies.

C. The entire installation shall comply with all applicable codes.

1.9 SYSTEM DESIGN

A. Design and install a complete, hydraulically calculated wet-pipe sprinkler system for the entire building.

B. Provide all required equipment and accessories.

C. System shall include a 5 psi allowance for future decrease in available pressure and an allowance for inside and outside hose streams.

D. Provide monitor switches on all shutoff valves.

E. Install sprinkler riser in location shown on drawings or as approved by the Architect/Engineer.

F. Provide pressure gauge with valve in the main riser.

G. Provide main drain valve piped to outside the building. Locate so discharge does not damage lawn or other surfaces.

H. Provide flow switch in the main riser and as indicated on drawings.

I. Provide horn and strobe and all required wiring.

1.10 COORDINATION DRAWINGS

A. Reference Coordination Drawings article in Section 21 05 00 for required fire protection systems electronic CAD drawings to be provided to Coordinating Contractor for inclusion into composite coordination drawings.

1.11 OPERATION AND MAINTENANCE DATA

A. Submit manufacturers' operation and maintenance data. Include written maintenance data on components of system, servicing requirements, and record drawings.

1.12 JOB CONDITIONS

A. Fire Protection Contractor shall determine the flow and pressure available at the service connection. The Fire Protection Contractor is responsible to verify this information and make all tests required. Base all pipe sizing and hydraulic calculations on flow test data no older than 18 months.

B. Pipe sizing shown on drawings for service entrance and main risers is preliminary for coordination purposes only. Contractor is responsible for final sizing from hydraulic calculations.

PART 2 - PRODUCTS

2.1 PIPE AND FITTINGS

A. Steel Pipe (Inside Building-Above Grade):

1. Pipe: 2" and Under - Schedule 40, black steel, ASTM A53. Threaded and coupled or flanged.
2. Joints: 2" and under - screwed or flanged.
3. Fittings: Screwed - cast iron, 125 lb., black, ANSI/ASME B16.4 or malleable iron, 150 lb., black, ANSI/ASME B16.3. Flanged-cast iron, 125 lb., ANSI/ASME B16.1.

B. Steel Pipe (Inside Building-Above Grade):

1. Pipe: 2-1/2" and Over - Schedule 10, black steel, grooved, ASTM A135.
2. Joints: Mechanically coupled grooved.
3. Fittings: 500 lb. WOG, black, malleable iron, ASTM A47.
4. Plain end fittings and couplings are not acceptable.

C. Fire Protection Service to Building

1. Refer to civil plans and plumbing plans.

2.2 FLEXIBLE SPRINKLER HOSE WITH THREADED END FITTINGS

A. UL listed per UL 2443.

B. Construction:

1. Hose:
   a. Type 304 stainless steel.
   b. Straight or elbow hose - maximum six (6)-foot hose length.
   c. 1/2" or 3/4" outlet.

d. 175 psi rated pressure.
e. Leak-tested minimum 7/8".
f. Minimum 7/8" hose.
g. O-ring sealed joints are not acceptable.

2. Ceiling Bracket:

a. Zinc plated or galvanized steel – 24" and 48" sizes.
b. Flexible hose attachment: Open hub or set screw.

3. Unit may be prepackaged with sprinkler head.

C. Acceptable Manufacturers: FlexHead Industries, Victaulic Aquaflex.

2.3 UNIONS AND COUPLINGS

A. Unions: 175 psi malleable iron for threaded ferrous piping.

B. Mechanical Grooved Couplings: Malleable iron housing clamps to engage and lock, designed to permit some angular and longitudinal deflection; "C" shaped composition sealing gasket, steel bolts, nuts, and washers. 175 psi, ASTM A47. Plain end fittings and couplings are not acceptable. Rolled groove couplings for Schedule 10 pipe. Cut groove couplings for Schedule 40 pipe. Couplings shall be enamel coated for wet systems. Acceptable Manufacturers: Victaulic, ITT, Grinnell, Central, Anvil GruvLok, Star Fittings.

C. Couplings used in seismic areas shall be "flexible" type.

D. Coupling gaskets for wet systems shall be Grade "E" EDPM Type A.

2.4 VALVE OPERATORS

A. Provide handwheels for gate valves. Provide gear operators for butterfly valves.

2.5 VALVE CONNECTIONS

A. Provide all connections to match pipe joints. Valves shall be same size as pipe.

2.6 BACKFLOW PREVENTERS

A. Provide backflow preventers as required by code and as specified on the drawings.

2.7 EQUIPMENT

A. Equipment shall be as scheduled on the drawings.

PART 3 - EXECUTION

3.1 INSTALLATION - PIPING

A. General Installation Requirements:

1. Coordinate piping and sprinkler locations with all other trades. Ductwork, diffusers and light fixture locations shall have priority over sprinkler piping and sprinklers.

2. Ream pipe and tube ends to full inside diameter. Remove burrs. Remove scale and foreign material, inside and outside, before assembly.

3. Die cut screw joints with full cut standard taper pipe threads.

4. Coat threads with pipe joint compound or wrap with Teflon tape.

5. Locate piping to minimize obstruction of other work.

6. Route piping in concealed spaces above finished ceiling.

7. Use full and double lengths of pipe wherever possible.

8. Slope all piping for complete drainage. Install auxiliary drains for all trapped piping per NFPA 13.

9. Reducers are generally not shown. Where pipe sizes change at tee, the tee shall be the size of the largest pipe shown connecting to it.

10. Comply with manufacturer's installation instructions.

B. Steel Piping:

1. In steel piping, main sized saddle branch connections or direct connection of branches to main is permitted if main is one pipe size larger than the branch for up to 6" mains and if main is two pipe sizes larger than branch for 8" and larger mains. Do not project branch pipes into main pipes.

C. Wall/Floor Penetration:

1. Provide sleeves when penetrating floors and walls.

2. Seal pipes passing through exterior walls with a wall seal per Section 21 05 29. Provide Schedule 40 galvanized sleeve at least 2 pipe sizes larger than the pipe. Sleeves through floors shall extend minimum 1.5" above finished floor.

3. Fire seal all pipe and sleeve penetrations (both wall and floor) to maintain fire separation required without restraining pipe.

D. Installation Requirements in Electrical Rooms:

1. Do not install piping or other equipment above electrical switchboards or panelboards. This includes a dedicated space extending 25 feet from the floor to the structural ceiling with width and depth equal to the equipment. Fire protection equipment dedicated to the electrical equipment room or space may be installed above equipment if other alternatives are not available.

E. Hangers and Supports:

1. Provide hangers and supports as required by NFPA 13 and UL, with the following exceptions:

a. Do not use powder driven devices, explosive devices, wooden plugs, or plastic inserts.

b. Do not install fasteners to carry the load in tension, unless absolutely necessary.

F. Exposed Piping:

1. Install chrome plated steel escutcheons where exposed pipes penetrate walls or floors.

3.2 INSTALLATION - VALVES

A. Install gate valves with stems upright or horizontal, not inverted.

B. Backflow Preventer:

1. Units shall be field tested and tagged in accordance with manufacturer's instructions by a certified tester before initial operation.

2. Install unit between 12" and 60" above finish floor.

C. Shutoff Valve:

1. Install buried shutoff valves in valve boxes. Provide post indicators.

2. Provide drain valves at main shutoff valves, low points of piping and apparatus.

3.3 INSTALLATION - EQUIPMENT

A. Coordinate piping and sprinkler locations with all other trades. Ductwork, diffusers and light fixture locations shall have priority over system equipment and sprinklers.

B. Fire Department Connection:

1. Locate fire department connection in an accessible location as approved by the local fire department with sufficient clearance from walls, obstructions, and adjacent Siamese connectors to allow full swing of fire department wrench handle.

C. Horn and Strobe:

1. Locate outside horn and strobe on building wall as shown on drawings.

2. Wire all horn and strobes, flow switches and supervisory switches to fire alarm system. All wiring shall be in conduit and meet the requirements of the electrical specifications.

D. Test Valves:

1. Install test valves where required. Pipe to outdoors or drain. Test connection shall have flow equivalent to the smallest K-factor sprinkler.

E. Sprinklers:

1. Locate sprinklers to clear lights, ducts and diffusers. Do not run sprinkler pipes through ducts. Ductwork has priority over sprinkler pipes. Offset pipes as needed.

2. Center sprinklers in two directions in ceiling tiles and provide offsets as required.

3. Do not allow concealed sprinkler cover plates to be painted. Sprinkler cover plates are to be factory painted only. Do not field paint.

4. Apply strippable or paper covers so concealed sprinkler cover plates do not receive field paint finish.

3.4 SYSTEMS CLEANING AND TESTING

A. General Requirement:

1. All water used for testing and remaining in the piping system shall be obtained from a potable water source.

B. Underground Piping:

1. Flush all underground piping with minimum flow equal to the system design flow but not less than the following:

   a. 390 gpm for 4" pipes.
   b. 880 gpm for 6" pipes.
   c. 1560 gpm for 8" pipes.
   d. 2440 gpm for 10" pipes.

2. Branches from existing or new underground mains to sprinkler risers shall be flushed out through two 2-1/2" hoses (with flow through open hose butts) attached to the riser with 4" temporary piping. Flushing through the drain of an alarm check or dry pipe valve is not acceptable.

C. Interior Piping:

1. Verify adequate water flow at the inspector's test connection.

2. Flush all interior piping to remove scale and other foreign material before placing system into service.

3. Hydrostatically test the entire interior piping system at a minimum of 200 psig or 50 psig in excess of the normal system working pressure for systems subjected to pressures in excess of 150 psig. Maintain test pressure for 2 hours without loss of pressure.

D. Fire Alarm System:

1. Test the alarm system by operating the inspector's test connection or the alarm test valves. Verify that the building fire alarm system activates.

2. Adjust all monitor switches for proper operation.

END OF SECTION

SECTION 22 05 00
BASIC PLUMBING REQUIREMENTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Requirements applicable to all Division 22 Sections. Also refer to Division 1 - General Requirements.

B. All materials and installation methods shall conform to the applicable standards, guidelines and codes referenced in the specification section.

1.2 DIVISION OF WORK BETWEEN MECHANICAL, ELECTRICAL & CONTROL CONTRACTORS

A. Definitions:

1. "Mechanical Contractors" refers to the following:

   a. Plumbing Contractor.
   b. Heating Contractor.
   c. Air Conditioning and Ventilating Contractor.
   d. Temperature Control Contractor.
   e. Fire Protection Contractor.
   f. Testing, Adjusting, and Balancing Contractor.

2. Motor Control Wiring: The wiring associated with the remote operation of the magnetic coils of magnetic motor starters or relays, or the wiring that permits direct cycling of motors by means of devices in series with the motor power wiring. In the latter case the devices are usually single phase and are usually connected to the motor power wiring through a manual motor starter having "Manual-Off-Auto" provisions.

3. Control devices such as start-stop push buttons, thermostats, pressure switches, flow switches, relays, etc., generally represent the types of equipment associated with motor control wiring.

4. Motor control wiring is single phase and usually 120 volts. In some instances, the voltage will be the same as the motor power wiring. Generally, where the motor power wiring exceeds 120 volts, a control transformer is used to give a control voltage of 120 volts.

5. Temperature Control Wiring: The wiring associated with the operation of a motorized damper, solenoid valve or motorized valve, etc., either modulating or two-position, as opposed to wiring which directly powers or controls a motor used to drive equipment such as fans, pumps, etc.

   a. This wiring will be from a 120 volt source and may continue as 120 volt, or be reduced in voltage (24 volt) in which case a control transformer shall be furnished as part of the temperature control wiring.

6. Control Motor: An electric device used to operate dampers, valves, etc. It may be two-position or modulating. Conventional characteristics of such a motor are 24 volts, 60 cycles, 1 phase, although other voltages may be encountered.

B. General:

1. The purpose of these Specifications is to outline the Electrical and Mechanical Contractor's responsibilities related to electrical work required for items such as temperature controls, mechanical equipment, fans, chillers, compressors and the like. The exact wiring requirements for much of the equipment cannot be determined until the systems have been selected and submittals reviewed. Therefore, the electrical drawings show only known wiring related to such items. All wiring not shown on the electrical drawings, but required for mechanical systems, is the responsibility of the Mechanical Contractor.

2. Where the drawings require the Electrical Contractor to wire between equipment furnished by the Mechanical Contractor, such wiring shall terminate at terminals provided in the equipment. The Mechanical Contractor shall provide complete wiring diagrams and supervision to the Electrical Contractor and designate the terminal numbers for correct wiring.

3. All electrical work shall conform to the National Electrical Code. All provisions of the Electrical Specifications concerning wiring, protection, etc., apply to wiring provided by the Mechanical Contractor unless noted otherwise.

C. Mechanical Contractor's Responsibility:

1. Assumes responsibility for internal wiring of all equipment provided by the Mechanical Contractor, for example:

   a. Burners.
   b. Condensing Units.
   c. Makeup Air Units.
   d. Gas Trains.
   e. Air Handling Units.

2. Assumes all responsibility for the Temperature Control wiring, when the Temperature Control Contractor is a Subcontractor to the Mechanical Contractor.

3. Temperature Control Subcontractor's Responsibility:

   a. Wiring of all devices needed to make the Temperature Control System functional.

   b. Verifying any control wiring on the electrical drawings as being by the Electrical Contractor. All wiring required for the Control System, but not shown on the electrical drawings, is the responsibility of the Temperature Control Subcontractor.

   c. Coordinating equipment locations (such as relays, transformers, etc.) with the Electrical Contractor, where wiring of the equipment is by the Electrical Contractor.

4. This Contractor is responsible for coordination of utilities with all other Contractors. If any field coordination conflicts are found, the Contractor shall coordinate with other Contractors to determine a viable layout.

D. Electrical Contractor's Responsibility:

1. Provides all combination starters, manual starters and disconnect devices shown on the Electrical Drawings or indicated to be by the Electrical Contractor on the Mechanical Drawings or Specifications.

2. Installs and wires all remote control devices furnished by the Mechanical Contractor or Temperature Control Subcontractor when so noted on the Electrical Drawings.

3. Provides motor control and temperature control wiring, where so noted on the drawings.

4. Furnishes, installs and connects all relays, etc., for automatic shutdown of certain fans upon actuation of the Fire Alarm System as indicated and specified in Division 28.

5. This Contractor is responsible for coordination of utilities with all other Contractors. If any field coordination conflicts are found, the Contractor shall coordinate with other Contractors to determine a viable layout.

1.3 COORDINATION DRAWINGS

A. Definitions:

1. Coordination Drawings: A compilation of the pertinent layout and system drawings that show the sizes and locations, including elevations, of system components and required access areas to ensure that no two objects will occupy the same space.

   a. Mechanical trades shall include, but are not limited to, mechanical equipment, ductwork, fire protection systems, plumbing piping, hydronic piping, and any item that may impact coordination with other disciplines.

   b. Electrical trades shall include, but are not limited to, electrical equipment, conduit 1.5" and larger, conduit racks, cable trays, pull boxes, transformers, raceway, busway, lighting, ceiling-mounted devices, and any item that may impact coordination with other disciplines.

   c. Technology trades shall include, but are not limited to, technology equipment, racks, conduit 1.5" and larger, conduit racks, cable trays, ladder rack, pull boxes, raceway, ceiling-mounted devices, and any item that may impact coordination with other disciplines.

   d. Maintenance clearances and code-required dedicated space shall be included.

   e. The coordination drawings shall include all underground, underfloor, in-floor, in chase, and vertical trade items.

2. The contractors shall use the coordination process to identify the proper sequence of installation of all utilities above ceilings and in other congested areas, to ensure an orderly and coordinated end result, and to provide adequate access for service and maintenance.

B. Participation:

1. The contractors and subcontractors responsible for work defined above shall participate in the coordination drawing process.

2. One contractor shall be designated as the Coordinating Contractor for purposes of preparing a complete set of composite electronic CAD coordination drawings that include all applicable trades, and for coordinating the activities related to this process. The Coordinating Contractor for this project shall be the HVAC Contractor.

   a. The Coordinating Contractor shall utilize personnel familiar with requirements of this project and skilled as draftspersons/CAD operators, competent to prepare the required coordination drawings.

3. Electronic CAD drawings shall be submitted to the Coordinating Contractor for addition of work by other trades. KJWW will provide electronic file copies of ventilation drawings for contractor's use if the contractor signs and returns an "Electronic File Transfer" waiver provided by KJWW. KJWW will not consider blatant reproductions of original file copies an acceptable alternative for coordination drawings.

C. General:

1. Coordination drawing files shall be made available to the A/E and Owner's Representative. The A/E will only review identified conflicts and give an opinion, but will not perform as a coordinator.

2. A plotted set of coordination drawings shall be available at the project site.

3. Coordination drawings are not shop drawings and shall not be submitted as such.

4. The contract drawings are schematic in nature and do not show every fitting and appurtenance for each utility. Each contractor is expected to have included in his/her bid sufficient fittings, material, and labor to allow for adjustments in routing of utilities made necessary by the coordination process and to provide a complete and functional system.

5. The contractors will not be allowed additional costs or time extensions due to participation in the coordination process.

6. The contractors will not be allowed additional costs or time extensions for additional fittings, reroutings or changes of duct size, that are essentially equivalent sizes to those shown on the drawings and determined necessary through the coordination process.

7. The A/E reserves the right to determine space priority of equipment in the event of spatial conflicts or interference between equipment, piping, conduit, ducts, and equipment provided by the trades.

8. Changes to the contract documents that are necessary for systems installation and coordination shall be brought to the attention of the A/E.

9. Access panels shall preferably occur only in gypsum board walls or plaster ceilings where indicated on the drawings.

   a. Access to mechanical, electrical, technology, and other items located above the ceiling shall be through accessible lay-in ceiling tile areas.

   b. Potential layout changes shall be made to avoid additional access panels.

   c. Additional access panels shall not be allowed without written approval from the A/E at the coordination drawing stage.

   d. Providing additional access panels shall be considered after other alternatives are reviewed and discarded by the A/E and the Owner's Representative.

   e. When additional access panels are required, they shall be provided without additional cost to the Owner.

10. Complete the coordination drawing process and obtain sign off of the drawings by all contractors prior to installing any of the components.

11. Conflicts that result after the coordination drawings are signed off shall be the responsibility of the contractor or subcontractor who did not properly identify their work requirements, or installed their work without proper coordination.

12. Updated coordination drawings that reflect as-built conditions may be used as record documents.

1.4 QUALITY ASSURANCE

A. Contractor’s Responsibility Prior to Submitting Pricing Data:

1. The Contractor is responsible for constructing complete and operating systems. The Contractor acknowledges and understands that the Contract Documents are a two-dimensional representation of a three-dimensional object, subject to human interpretation. This representation may include imperfect data, interpreted codes, utility guidelines, three-dimensional conflicts, and required field coordination items. Such deficiencies can be corrected when identified prior to ordering material and starting installation. The Contractor agrees to carefully study and compare the individual Contract Documents and report at once in writing to the Design Team any deficiencies the Contractor may discover. The Contractor further agrees to require each subcontractor to likewise study the documents and report at once any deficiencies discovered.

2. The Contractor shall resolve all reported deficiencies with the Architect/Engineer prior to awarding any subcontracts, ordering material, or starting any work with the Contractor's own employees. Any work performed prior to receipt of instructions from the Design Team will be done at the Contractor's risk.

B. Qualifications:

1. Only products of reputable manufacturers are acceptable.

2. All Contractors and subcontractors shall employ only workers skilled in their trades.

C. Compliance with Codes, Laws, Ordinances:

1. Conform to all requirements of the City of Madison, Wisconsin Codes, Laws, Ordinances and other regulations having jurisdiction.

2. Conform to all State Codes.

3. Conform to Federal Act S.3874 requiring the reduction of lead in drinking water.

4. If there is a discrepancy between the codes and regulations and these specifications, the Architect/Engineer shall determine the method or equipment used.

5. If the Contractor notes, at the time of bidding, any parts of the drawings or specifications that do not comply with the codes or regulations, he shall inform the Architect/Engineer in writing, requesting a clarification. If there is insufficient time for this procedure, he shall submit with his proposal a separate price to make the system comply with the codes and regulations.

6. All changes to the system made after letting of the contract, to comply with codes or requirements of Inspectors, shall be made by the Contractor without cost to the Owner.

7. If there is a discrepancy between manufacturer's recommendations and these specifications, the manufacturer's recommendations shall govern.

8. All rotating shafts and/or equipment shall be completely guarded from all contact. Partial guards and/or guards that do not meet all applicable OSHA standards are not acceptable. Contractor is responsible for providing this guarding if it is not provided with the equipment supplied.

D. Permits, Fees, Taxes, Inspections:

1. Procure all applicable permits and licenses.

2. Abide by all laws, regulations, ordinances, and other rules of the State or Political Subdivision where the work is done, or as required by any duly constituted public authority.

3. Pay all charges for permits or licenses.

4. Pay all fees and taxes imposed by the State, Municipal and/or other regulatory bodies.

5. Pay all charges arising out of required inspections by an authorized body.

6. Pay all charges arising out of required contract document reviews associated with the project and as initiated by the Owner or authorized agency/consultant.

7. Where applicable, all fixtures, equipment and materials shall be approved or listed by Underwriter's Laboratories, Inc.

E. Examination of Drawings:

1. The drawings for the plumbing work are completely diagrammatic, intended to convey the scope of the work and to indicate the general arrangements and locations of equipment, outlets, etc., and the approximate sizes of equipment.

2. Contractor shall determine the exact locations of equipment and rough-ins, and the exact routing of pipes and ducts to best fit the layout of the job.

3. Scaling of the drawings is not sufficient or accurate for determining these locations.

4. Where job conditions require reasonable changes in indicated arrangements and locations, such changes shall be made by the Contractor at no additional cost to the Owner.

5. Because of the scale of the drawings, certain basic items, such as fittings, boxes, valves, unions, etc., may not be shown, but where required by other sections of the specifications or required for proper installation of the work, such items shall be furnished and installed.

6. If an item is either on the drawings or in the specifications, it shall be included in this contract.

7. Determination of quantities of material and equipment required shall be made by the Contractor from the documents. Where discrepancies arise between drawings, schedules and/or specifications, the greater number shall govern.

8. Where used in mechanical documents, the word "furnish" shall mean supply for use, the word "install" shall mean connect complete and ready for operation, and the word "provide" shall mean to supply for use and connect complete and ready for operation.

   a. Any item listed as furnished shall also be installed, unless otherwise noted.

   b. Any item listed as installed shall also be furnished, unless otherwise noted.

F. Field Measurements:

1. Verify all pertinent dimensions at the job site before ordering any materials or fabricating any supports, pipes or ducts.

G. Electronic Media/Files:

1. Construction drawings for this project have been prepared utilizing Revit.

2. Contractors and Subcontractors may request electronic media files of the contract drawings and/or copies of the specifications. Specifications will be provided in PDF format.

3. Upon request for electronic media, the Contractor shall complete and return a signed “Electronic File Transmittal” form provided by KJWW.

4. If the information requested includes floor plans prepared by others, the Contractor will be responsible for obtaining approval from the appropriate Design Professional for use of that part of the document.

5. The electronic contract documents can be used for preparation of shop drawings and as-built drawings only. The information may not be used in whole or in part for any other project.

6. The drawings prepared by KJWW for bidding purposes may not be used directly for coordination drawings.

7. The use of these electronic files by the Contractor does not relieve them from their responsibility for coordination of work with other trades and verification of space available for the installation.

8. The information is provided to expedite the project and assist the Contractor with no guarantee by KJWW as to the accuracy or correctness of the information provided. KJWW accepts no responsibility or liability for the Contractor's use of these documents.

1.5 SUBMITTALS

A. Submittals shall be required for the following items, and for additional items where required elsewhere in the specifications or on the drawings.

1. Submittals List:

Referenced Specification Section	Submittal Item
22 30 00	Water Softeners
22 33 39	Solar Water Heating Systems
Refer to drawings	Plumbing Material List Items

B. General Submittal Procedures: In addition to the provisions of Division 1, the following are required:

1. Transmittal: Each transmittal shall include the following:

   a. Date
   b. Project title and number
   c. Contractor's name and address
   d. Division of work (e.g., plumbing, heating, ventilating, etc.)
   e. Description of items submitted and relevant specification number
   f. Notations of deviations from the contract documents
   g. Other pertinent data

2. Submittal Cover Sheet: Each submittal shall include a cover sheet containing:

   a. Date
   b. Project title and number
   c. Architect/Engineer
   d. Contractor and subcontractors' names and addresses
   e. Supplier and manufacturer's names and addresses
   f. Division of work (e.g., plumbing, heating, ventilating, etc.)
   g. Description of item submitted (using project nomenclature) and relevant specification number
   h. Notations of deviations from the contract documents
   i. Other pertinent data
   j. Provide space for Contractor's review stamps

3. Composition:

   a. Submittals shall be submitted using specification sections and the project nomenclature for each item.

   b. Individual submittal packages shall be prepared for items in each specification section. All items within a single specification section shall be packaged together where possible. An individual submittal may contain items from multiple specifications sections if the items are intimately linked (e.g., pumps and motors).

   c. All sets shall contain an index of the items enclosed with a general topic description on the cover.

4. Content: Submittals shall include all fabrication, erection, layout, and setting drawings; manufacturers' standard drawings; schedules; descriptive literature, catalogs and brochures; performance and test data; wiring and control diagrams; dimensions; shipping and operating weights; shipping splits; service clearances; and all other drawings and descriptive data of materials of construction as may be required to show that the materials, equipment or systems and the location thereof conform to the requirements of the contract documents.

5. Contractor's Approval Stamp:

   a. The Contractor shall thoroughly review and approve all shop drawings before submitting them to the Architect/Engineer. The Contractor shall stamp, date and sign each submittal certifying it has been reviewed.

   b. Unstamped submittals will be rejected.

   c. The Contractor's review shall include, but not be limited to, verification of the following:

      1) Only approved manufacturers are used.
      2) Addenda items have been incorporated.
      3) Catalog numbers and options match those specified.
      4) Performance data matches that specified.
      5) Electrical characteristics and loads match those specified.
      6) Equipment connection locations, sizes, capacities, etc. have been coordinated with other affected trades.
      7) Dimensions and service clearances are suitable for the intended location.
      8) Equipment dimensions are coordinated with support steel, housekeeping pads, openings, etc.
      9) Constructability issues are resolved (e.g., weights and dimensions are suitable for getting the item into the building and into place, sinks fit into countertops, etc.).

   d. The Contractor shall review, stamp and approve all subcontractors' submittals as described above.

   e. **The Contractor's approval stamp is required on all submittals. Approval will indicate the Contractor's review of all material and a complete understanding of exactly what is to be furnished. Contractor shall clearly mark all deviations from the contract documents on all submittals. If deviations are not marked by the Contractor, then the item shall be required to meet all drawing and specification requirements.**

6. Submittal Identification and Markings:

   a. The Contractor shall clearly mark each item with the same nomenclature applied on the drawings or in the specifications.

   b. The Contractor shall clearly indicate the size, finish, material, etc.

   c. Where more than one model is shown on a manufacturer's sheet, the Contractor shall clearly indicate exactly which item and which data is intended.

   d. All marks and identifications on the submittals shall be unambiguous.

7. Schedule submittals to expedite the project. Coordinate submission of related items.

8. Identify variations from the contract documents and product or system limitations that may be detrimental to the successful performance of the completed work.

9. Reproduction of contract documents alone is not acceptable for submittals.

10. Incomplete submittals will be rejected without review. Partial submittals will only be reviewed with prior approval from the Architect/Engineer.

11. Submittals not required by the contract documents may be returned without review.

12. The Architect/Engineer's responsibility shall be to review one set of shop drawing submittals for each product. If the first submittal is incomplete or does not comply with the drawings and/or specifications, the Contractor shall be responsible to bear the cost for the Architect/Engineer to recheck and handle the additional shop drawing submittals.

13. Submittals shall be reviewed and approved by the Architect/Engineer **before** releasing any equipment for manufacture or shipment.

14. Contractor's responsibility for errors, omissions or deviation from the contract documents in submittals is not relieved by the Architect/Engineer's approval.

C. Electronic Submittal Procedures:

1. Distribution: Email submittals as attachments to all parties designated by the Architect/Engineer, unless a web-based submittal program is used.

2. Transmittals: Each submittal shall include an individual electronic letter of transmittal.

3. Format: Electronic submittals shall be in PDF format only. Scanned copies, in PDF format, of paper originals are acceptable. Submittals that are not legible will be rejected. Do not set any permission restrictions on files; protected, locked, or secured documents will be rejected.

4. File Names: Electronic submittal file names shall include the relevant specification section number followed by a description of the item submitted, as follows. Where possible, include the transmittal as the first page of the PDF instead of using multiple electronic files.

   a. Submittal file name: 22 XX XX.description.YYYYMMDD
   b. Transmittal file name: 22 XX XX.description.YYYYMMDD

5. File Size: Electronic file size shall be limited to a maximum of 4MB. Larger files shall be transmitted via a pre-approved method.

1.6 PRODUCT DELIVERY, STORAGE, HANDLING & MAINTENANCE

A. Exercise care in transporting and handling to avoid damage to materials. Store materials on the site to prevent damage. Keep materials clean, dry and free from harmful conditions. Immediately remove any materials that become wet or that are suspected of becoming contaminated with mold or other organisms.

B. Keep all bearings properly lubricated and all belts properly tensioned and aligned.

C. Coordinate the installation of heavy and large equipment with the General Contractor and/or Owner. If the Mechanical Contractor does not have prior documented experience in rigging and lifting similar equipment, he/she shall contract with a qualified lifting and rigging service that has similar documented experience. Follow all equipment lifting and support guidelines for handling and moving.

D. Contractor is responsible for moving equipment into the building and/or site. Contractor shall review site prior to bid for path locations and any required building modifications to allow movement of equipment. Contractor shall coordinate his/her work with other trades.

1.7 WARRANTY

A. Refer to Division 01 specification for requirements.

1.8 INSURANCE

A. Contractor shall maintain insurance coverage as set forth in Division 0 of these specifications.

1.9 MATERIAL SUBSTITUTION

A. Refer to Division 01 specification for requirements.

1.10 LEED REQUIREMENTS

A. This project is pursuing a LEED Silver certification in accordance with USGBC LEED Rating System for New Construction Version 2009. The Contractor shall provide all services and documentation necessary to achieve this rating.

B. Refer to Division 01 specification for LEED credits being attempted on the project.

1.11 PROJECT COMMISSIONING

A. The Contractor shall work with the Commissioning Agent (CxA) as described in Division 01 specifications, and provide all services necessary for compliance with LEED Prerequisite EAp1, Fundamental Commissioning, and EAc3 Enhanced Commissioning.

PART 2 - PRODUCTS

NOT APPLICABLE

PART 3 - EXECUTION

3.1 JOBSITE SAFETY

A. Neither the professional activities of the Architect/Engineer, nor the presence of the Architect/Engineer or his or her employee and subconsultants at a construction site, shall relieve the Contractor and other entity of their obligations, duties and responsibilities including, but not limited to, construction means, methods, sequence, techniques or procedures necessary for performing, superintending or coordinating all portions of the work of construction in accordance with the contract documents and any health or safety precautions required by any regulatory agencies. The Architect/Engineer and his or her personnel have no authority to exercise any control over any construction contractor or other entity or their employees in connection with their work or any health or safety precautions. The Contractor is solely responsible for jobsite safety. The Architect/Engineer and the Architect/Engineer's consultants shall be indemnified and shall be made additional insureds under the Contractor's general liability insurance policy.

3.2 EXCAVATION, FILL, BACKFILL, COMPACTION

A. General:

1. Prior to the commencement of any excavation or digging, the Contractor shall verify all underground utilities with the regional utility locator. Provide prior notice to the locator before excavations. Contact information for most regional utility locaters can be found by calling 811.

2. The Contractor shall do all excavating, filling, backfilling and compacting associated with his work.

B. Excavation:

1. Make all excavations to accurate, solid, undisturbed earth, and to proper dimensions.

2. Where excavations are made in error below foundations, concrete of same strength as specified for the foundations or thoroughly compacted sand-gravel fill, as determined by the Architect/Engineer, shall be placed in such excess excavations. Place thoroughly compacted, clean, stable fill in excess excavations under slabs on grade, at the Contractor's expense.

3. Trim bottom and sides of excavations to grades required for foundations.

4. Protect excavations against frost and freezing.

5. Take care in excavating not to damage surrounding structures, equipment or buried pipe. Do not undermine footing or foundation.

6. Perform all trenching in a manner to prevent cave-ins and risk to workmen.

7. Where original surface is pavement or concrete, the surface shall be saw cut to provide clean edges and assist in the surface restoration.

8. Where satisfactory bearing soil for foundations is not found at the indicated levels, the Architect/Engineer or their representative shall be notified immediately, and no further work shall be done until further instructions are given by the Architect/Engineer or their representative.

C. Dewatering:

1. Contractor shall furnish, install, operate and remove all dewatering pumps and pipes needed to keep trenches and pits free of water.

D. Underground Obstructions:

1. Known underground piping, foundations, and other obstructions in the vicinity of construction are shown on the drawings. Use great care in making installations near underground obstruction.

2. If objects not shown on the drawings are encountered, remove, relocate, or perform extra work as directed by the Architect/Engineer.

E. Fill and Backfilling:

1. Prior to backfilling all inspections and testing shall be completed.

2. No rubbish or waste material is permitted for fill or backfill.

3. Provide all necessary sand for backfilling.

4. Dispose of the excess excavated earth as directed.

5. Backfill materials shall be suitable for required compaction, clean and free of perishable materials and stones greater than 4 inches in diameter. Water shall not be permitted to rise in unbackfilled trenches. No material shall be used for backfilling that contains frozen earth, debris or earth with a high void content.

6. Backfill all trenches and excavations immediately after installing pipes, or removal of forms, unless other protection is provided.

7. Around piers and isolated foundations and structures, backfill and fill shall be placed and consolidated simultaneously on all sides to prevent wedge action and displacement. Fill and backfill materials shall be spread in 6 inch uniform horizontal layers with each layer compacted separately to required density.

8. Lay all piping on a compacted bed of sand at least 3 inches deep. Backfill around pipes with sand, 6 inch layers, and compact each layer.

9. Use sand for backfill up to grade for all piping under slabs or paved areas. All other piping shall have sand backfill to 6 inches above the top of the pipe.

10. Place all backfill above the sand in uniform layers not exceeding 6 inches deep. Each layer shall be placed, then carefully and uniformly tamped, to eliminate lateral or vertical displacement.

11. Where the fill and backfill will ultimately be under a building, floor or paving, each layer of fill shall be compacted to 95% of the maximum density determined by AASHTO Designation T-99 or ASTM Designation D-698. Moisture content of soil at time of compaction shall not exceed plus or minus 2% of optimum moisture content determined by AASHTO T-99 or ASTM D-698 test.

F. Surface Restoration:

1. Where trenches are cut through graded, planted or landscaped areas, the areas shall be restored to the original condition. Replace all planting removed or damaged to its original condition. A minimum of 6 inches of topsoil shall be applied where disturbed areas are to be seeded or sodded.

2. Concrete or asphalt type pavement, seal coat, rock, gravel or earth surfaces removed or damaged shall be replaced with comparable materials and restored to original condition.

3.3 OPERATION AND MAINTENANCE MANUALS

A. Refer to Division 01 specification for requirements.

3.4 INSTRUCTING THE OWNER'S REPRESENTATIVES

A. Adequately instruct the Owner's designated representatives in the maintenance, care, and operation of all systems installed under this contract per specification 01 79 00.

B. The instructions shall include:

1. Explanation of all system flow diagrams.

2. Maintenance of equipment.

3. Start-up procedures for all major equipment.

4. Description of emergency system operation.

C. Minimum hours of instruction for each item shall be:

1. Domestic Hot Water System - 1 hour.

2. Water Softener System - 1 hour.

3.5 SYSTEM COMMISSIONING

A. Refer to Division 01 91 00 specification for additional requirements.

B. The plumbing systems shall be complete and operating. System start-up, testing, balancing, and satisfactory system performance is the responsibility of the Contractor. This includes calibration and adjustments of all controls, noise level adjustments and final adjustments as required.

C. Contractor shall adjust the plumbing systems and controls at season changes during the one year warranty period, as required, to provide satisfactory operation and to prove performance of all systems in all seasons.

D. All operating conditions and control sequences shall be tested during the start-up period. Test all interlocks, safety shutdowns, controls, and alarms.

E. The Contractor, subcontractors, and equipment suppliers shall have skilled technicians to ensure that all systems perform properly. If the Architect/Engineer is requested to visit the job site for trouble shooting, assisting in start-up, obtaining satisfactory equipment operation, resolving installation and/or workmanship problems, equipment substitution issues or unsatisfactory system performance, including call backs during the warranty period, through no fault of the design; the Contractor shall reimburse the Owner on a time and materials basis for services rendered at the Architect/Engineer's standard hourly rates in effect when the services are requested. The Contractor shall pay the Owner for services required that are product, installation or workmanship related. Payment is due within 30 days after services are rendered.

3.6 RECORD DOCUMENTS

A. The following paragraph supplements Division 1 requirements:

Contractor shall maintain at the job site a separate and complete set of plumbing drawings and specifications on which he shall clearly and permanently mark in complete detail all changes made to the plumbing systems.

B. Mark drawings to indicate revisions to piping size and location, both exterior and interior; including locations devices, requiring periodic maintenance or repair; actual equipment locations, dimensioned from column lines; actual inverts and locations of underground piping; concealed equipment, dimensioned from column lines; mains and branches of piping systems, with valves and control devices located and numbered, concealed unions located, and with items requiring maintenance located; Change Orders; concealed control system devices.

C. Mark specifications to show approved substitutions; Change Orders, and actual equipment and materials used.

D. Record changes daily and keep the marked drawings available for the Architect/Engineer's examination at any normal work time.

E. Upon completing the job, and before final payment is made, give the marked-up drawings to the Architect/Engineer.

3.7 ADJUST AND CLEAN

A. Thoroughly clean all equipment and systems prior to the Owner's final acceptance of the project. Clean all foreign paint, grease, oil, dirt, labels, stickers, and other foreign material from all equipment.

B. Clean all areas where moisture is present. Immediately report any mold, biological growth, or water damage.

C. Remove all rubbish, debris, etc., accumulated during construction from the premises.

3.8 CONSTRUCTION WASTE MANAGEMENT

A. This Contractor shall comply with all construction and demolition waste disposal and recycling requirements outlined in LEED MRc2: Construction Waste Management (follow latest edition at the time of bidding or as referenced in these specifications).

1. This Contractor shall coordinate with the General Contractor to develop and implement a construction waste management plan that, at a minimum, identifies the materials to be diverted from disposal and whether the materials will be sorted on-site or co-mingled.

2. The Contractor shall track waste disposal and recycling efforts throughout the construction process for all materials associated with this Contractor’s scope of work. The Contractor shall provide this information to the General Contractor so that it can be incorporated with similar information from all other contractors for the project.

a. Calculations for waste and recycled material can be done by weight or volume, but they must be consistent throughout the project. The Contractor shall coordinate with the General Contractor to establish the preferred calculation method and report the results accordingly.

b. Excavated soil and land-clearing debris do not count towards the waste disposal or recycled material.

3. At a minimum, 50% of the construction and demolition debris for this project must be recycled or salvaged.

END OF SECTION

READINESS CERTIFICATION PRIOR TO FINAL JOBSITE OBSERVATION

In order to prevent the final job observation from occurring too early, we require that the Contractor review the completion status of the project and, by copy of this document, certify that the job is indeed ready for the final job observation. The following is a typical list of items that represent the degree of job completeness expected prior to your requesting a final job observation.

1. Penetrations fire sealed and labeled in accordance with specifications.
2. All pumps operating and balanced.
3. All plumbing fixtures installed and caulked.
4. Pipe insulation complete, pipes labeled and valves tagged.

Accepted by:

Prime Contractor _____

By _____ Date _____

Upon Contractor certification that the project is complete and ready for a final job observation, we require the Contractor to sign this agreement and return it to the Architect/Engineer so that the final observation can be scheduled.

It is understood that if the Architect/Engineer finds the job not ready for the final observation and that additional trips and observations are required to bring the project to completion, the costs incurred by the Architect/Engineers for additional time and expenses will be deducted from the Contractor's contract retainage prior to final payment at the completion of the job.

* * * * *

SECTION 22 05 29
PLUMBING SUPPORTS AND ANCHORS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Hangers, Supports, and Associated Anchors.
B. Equipment Bases and Supports.
C. Sleeves and Seals.
D. Flashing and Sealing of Equipment and Pipe Stacks.
E. Cutting of Openings.
F. Escutcheon Plates and Trim.

1.2 REFERENCES

A. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation.
B. MSS SP-127 – Bracing for Piping Systems Seismic-Wind-Dynamic Design, Selection, Application

1.3 SUBMITTALS

A. Submit shop drawings and product data under provisions of Section 22 05 00.

1.4 WORK FURNISHED BUT INSTALLED UNDER OTHER SECTIONS

A. Furnish sleeves and hanger inserts to General Contractor for placement into formwork.

PART 2 - PRODUCTS

2.1 SEISMIC RESTRAINTS

A. Refer to Section 22 05 50 for additional requirements for seismic restraints.

2.2 HANGER RODS

A. Hanger rods for single rod hangers shall conform to the following:

Pipe Size	Hanger Rod Diameter	
	Column #1	Column #2
2" and smaller	3/8"	3/8"
2-1/2" through 3-1/2"	1/2"	1/2"
4" and 5"	5/8"	1/2"
6"	3/4"	5/8"
8" through 12"	7/8"	3/4"

Column #1: Steel and cast iron pipe.
Column #2: Copper and plastic pipe.

B. Rods for double rod hangers may be reduced one size. Minimum rod diameter is 3/8 inches.

C. Hanger rods and accessories used in mechanical spaces or otherwise dry areas shall have ASTM B633 electro-plated zinc finish.

2.3 PIPE HANGERS AND SUPPORTS

A. All pipe hangers, clamps, and supports shall conform to Manufacturers Standardization Society MSS-SP-58 and 127 (where applicable).

B. Oversize all hangers, clamps, and supports on insulated piping to allow insulation and jacket to pass through unbroken. This applies to both hot and cold pipes.

C. Ferrous hot piping 2-1/2 inches and larger shall have steel saddles tack welded to the pipe at each support at a depth not less than the specified insulation. Factory fabricated inserts may be used.

Acceptable Products:

Anvil -	Fig. 160, 161, 162, 163, 164, 165
Cooper/B-Line -	Fig. 3160, 3161, 3162, 3163, 3164, 3165
Erico -	Model 630, 631, 632, 633, 634, 635
Nibco/Tolco -	Fig. 260-1, 261-1 1/2, 262-2, 263-2 1/2, 264-3, 265-4

D. On all insulated piping, provide a semi-cylindrical metallic shield and fire resistant vapor barrier jacket.

E. As an alternative to separate pipe insulation insert and saddle, properly sized integral rigid insulation sections may be used for this application.

Acceptable Products:

Cooper/B-Line -	Fig. B3380 through B3384
Pipe Shields -	A1000, A2000
Erico -	Model 124, 127

F. Support and laterally brace vertical pipes at every floor level in multi-story structures, and more frequently when required by applicable codes (the Illinois Plumbing Code requires 10 foot maximum spacing for support of copper risers), but never at intervals over 15 feet. Support vertical pipes with riser clamps installed below hubs, couplings or lugs welded to the pipe. Provide sufficient flexibility to accommodate expansion and contraction without compromising fire barrier penetrations and other fixed takeoff locations.

Acceptable Products:

Anvil -	Fig. CT121
Cooper/B-Line -	Fig. B3373CT
Erico -	Model 510
Nibco/Tolco -	Fig. 82

G. Place restrained neoprene mounts beneath vertical pipe riser clamps to prevent sweating of cold pipes. Insulate over mounts.

Acceptable Products: Mason RBA, RCA, or BR.

H. Hangers in direct contact with copper pipe shall be coated with plastic with appropriate temperature range. HYDRA-ZORB clamps are permitted for this application for bare pipes within their temperature limits of -65°F to +275°F.

I. Unless otherwise indicated, hangers shall be as follows:

1. Clevis Type:

Service:	Bare Metal Pipe
	Rigid Plastic Pipe
	Insulated Cold Pipe
	Insulated Hot Pipe - 3 inches & Smaller

Acceptable Products:	Bare Steel, Plastic or Insulated Pipe	Bare Copper Pipe
Anvil	Fig. 260	
Cooper/B-Line	Fig. 3100	Fig. B3100C
Erico	Model 400	
Nibco/Tolco	Fig. 1	Fig. 81PVC

2. Roller Type:
Service: Insulated Hot Pipe - 4 inches and Larger

Acceptable Products:	4" through 6"	8" and Above
Anvil	Fig. 181, 271	Fig. 171, 271
Cooper/B-Line	Fig. 3110, 3117	Fig. 3114, 3117
Erico	Model 610	Model 605
Nibco/Tolco	Fig. 324, 327	Fig. 322, 327

3. Padded Clevis Type:
Service: Glass Pipe

Acceptable Products:	Hangers	Pads
Anvil	Fig. 260	Fig. 3195
Cooper/B-Line	Fig. 3100	
Erico	Model 400	
Nibco/Tolco	Fig. 1	

4. Continuous Channel with Clevis Type:
Service: Plastic Tubing
Flexible Hose
Soft Copper Tubing

Acceptable Products:

Cooper/B-Line - Fig. B3106, with Fig. B3106V
Erico - Model 104, with Model 104V
Nibco/Tolco - Fig. 1V

5. Adjustable Swivel Ring Type:
Service: Bare Metal Pipe - 4 inches and Smaller

Acceptable Products:	Bare Steel Pipe	Bare Copper Pipe
Anvil	Fig. 69	
Cooper/B-Line	Fig. B3170NF	Fig. B3170CTC
Erico	Model FCN	102A0 Series
Nibco/Tolco	Fig. 200	Fig. 203

J. Support may be fabricated from U-Channel strut or similar shapes. Piping less than 4" in diameter shall be secured to strut with clamps of proper design and capacity as required to maintain spacing and alignment. Strut shall be independently supported from hanger drops or building structure. Size and support shall be per manufacturer's installation requirements for structural support of piping. Clamps shall not interrupt piping insulation.

1. Strut used in mechanical spaces or otherwise dry areas shall have ASTM B633 electro-plated zinc finish.

2. Strut used in damp areas listed in hanger rods shall have ASTM A123 hot-dip galvanized finish applied after fabrication.

K. Unless otherwise indicated, pipe supports for use with struts shall be as follows:

1. Clamp Type:

Service: Bare Metal Pipe
Rigid Plastic Pipe
Insulated Cold Pipe
Insulated Hot Pipe - 3 inches and smaller

a. Clamps in direct contact with copper pipe shall be plastic coated.

b. Pipes subject to expansion and contraction shall have clamps slightly oversized to allow limited pipe movement.

Acceptable Products:	Bare Steel, Plastic or Insulated Pipe	Bare Copper Pipe
Unistrut	Fig. P1100 or P2500	
Cooper/B-Line	Fig. B2000 or B2400	Fig. BVT
Nibco/Tolco	Fig. A-14 or 2STR	

2. Roller Type:

Service: Insulated Hot Pipe - 4 inches and larger.

Acceptable Products:	4" through 6"	8" and Above
Unistrut	Fig. P2474	Fig. P2474-1
Cooper/B-Line	Fig. B218	Fig. B219
Nibco/Tolco	Fig. ROL-12	Fig. ROL-13

L. Unless otherwise shown, upper attachments for hanger rods or support struts shall be as follows:

1. Beam Clamps:

Acceptable Products:	
Anvil	Fig. 228, 292
Cooper/B-Line	Fig. B3054
Erico	Model 360
Nibco/Tolco	Fig. 329

2. Concrete Inserts, Single Rod Galvanized:

Acceptable Products:	
Anvil	Fig. 282
Cooper/B-Line	Fig. B3014
Erico	Model 355
Nibco/Tolco	Fig. 310

3. Concrete Inserts, Continuous Strip Galvanized:

Acceptable Products:	
Unistrut Corp	P3200 Series
Cooper/B-Line	Fig. B22-J
Erico	CONCT

4. Concrete Anchors: Fasten to concrete using cast-in or post-installed anchors designed per the requirements of Appendix D of ACI 318-14. Post-installed anchors shall be qualified for use in cracked concrete by ACI-355.2.

5. Masonry Anchors: Fasten to concrete masonry units with expansion anchors or self-tapping masonry screws. For expansion anchors into hollow concrete block, use sleeve-type anchors designed for the specific application. Do not fasten in masonry joints. Do not use powder actuated fasteners, wooden plugs, or plastic inserts.

M. Copper piping located in an exposed area, including indirect waste piping in kitchens and janitors closets, shall use split ring standoff hangers for copper tubing. Support shall have copper electroplating for corrosion resistance. Use electro-galvanized or more corrosion resistant and threaded rod for floor applications. Use anchors applicable to the wall type with corrosion resistant threaded rod for wall applications.

Acceptable Products:	
Erico/M-Co	Model #456
B-Line	Fig. 3198HCT
Anvil	Fig. CT138R
Nibco/Tolco	Fig. 301CT

N. Wall supports shall be used where vertical height of structure exceeds minimum spacing requirements. Install wall supports at same spacing as hangers or strut supports along vertical length of pipe runs.

O. Welding:

1. Unless otherwise noted, hangers, clips, and auxiliary support steel may be welded in lieu of bolting, clamping, or riveting to the building structural frame. Take adequate precautions during all welding operations for fire prevention and for protecting walls and ceilings from being damaged by smoke.

2.4 FOUNDATIONS, BASES, AND SUPPORTS

A. Basic Requirements:

1. Furnish and install foundations, bases, and supports (not specifically indicated on the Drawings or in the Specifications of either the General Construction or Mechanical work as provided by another Contractor) for mechanical equipment.

2. All concrete foundations, bases and supports, shall be reinforced. All steel bases and supports shall receive a prime coat of zinc chromate or red metal primer. After completion of work, give steel supports a final coat of gray enamel.

B. Concrete Bases (Housekeeping Pads):

1. Refer to Section 22 05 50 for additional requirements for concrete bases in seismic applications.

2. Unless shown otherwise on the drawings, concrete bases shall be nominal 4 inches thick and shall extend 3 inches on all sides of the equipment (6 inches larger than factory base).

3. Where a base is less than 12 inches from a wall, extend the base to the wall to prevent a “dirt-trap”.

4. Concrete materials and workmanship required for the Contractor's work shall be provided by him. Materials and workmanship shall conform to the applicable standards of the Portland Cement Association. Reinforce with 6” x 6”, W1.4-W1.4 welded wire fabric. Concrete shall withstand 3,000 pounds compression per square inch at 28 days.

5. Equipment requiring bases is as follows:

a. Water Heater
b. Water Softener

C. Roof Pipe Supports:

1. Provide pre-fabricated roof pipe supports for all piping installed on the roof.

2. Support shall guide and align pipe while permitting longitudinal expansion.

3. The base shall be rounded to prevent damage to the roof, and drainage holes shall prevent ponding of water in the support.

4. Support shall be UV, corrosion and freeze/thaw resistant.

5. Support shall include orange paint, reflective safety orange accents or similar markings for increased visibility.

6. The strut system shall have galvanized aluminum finish.

7. Acceptable Products: Anvil International HBS-Base Series, Cooper B-Line Dura-Blok, Erico Caddy Pyramid 50, 150, 300, or 600 (to match load), Miro Industries 1.5, 3-R, 4-R or 5-R (to match pipe).

D. Supports:

1. Provide sufficient clips, inserts, hangers, racks, rods, and auxiliary steel to securely support all suspended material, equipment and conduit without sag.

2. Hang heavy equipment from concrete floors or ceilings with Architect/Engineer-approved concrete inserts, furnished and installed by the Contractor whose work requires them, except where indicated otherwise.

E. Grout:

1. Grout shall be non-shrinking premixed (Master Builders Company "Embecco"), unless otherwise indicated on the drawings or approved by the Architect/Engineer.

2. Use Mix No. 1 for clearances of 1" or less, and Mix No. 2 for all larger clearances.

3. Grout under equipment bases, around pipes, at pipe sleeves, etc., and where shown on the drawings.

2.5 OPENINGS IN FLOORS, WALLS AND CEILINGS

A. Exact locations of all openings for the installation of materials shall be determined by the Contractor and given to the General Contractor for installation or construction as the structure is built.

B. Coordinate all openings with other Contractors.

C. Hire the proper tradesman and furnish all labor, material and equipment to cut openings in or through existing structures, or openings in new structures that were not installed, or additional openings. Repair all spalling and damage to the satisfaction of the Architect/Engineer. Make saw cuts before breaking out concrete to ensure even and uniform opening edges.

D. Said cutting shall be at the complete expense of each Contractor. Failure to coordinate openings with other Contractors shall not exempt the Contractor from providing openings at his expense.

E. Do not cut structural members without written approval of the Architect or Structural Engineer.

2.6 ROOF PENETRATIONS

A. Seal pipes with surface temperature below 150ºF penetrating single-ply roofs with conical stepped pipe flashings and stainless steel clamps equal to Portals Plus Pipe Boots. Material shall match roofing membrane.

B. Break insulation only at the clamp for pipes between 60ºF and 150ºF. Seal outdoor insulation edges watertight.

2.7 PIPE SLEEVES AND LINTELS

A. Each Contractor shall provide pipe sleeves and lintels for all openings required for the Contractor's work in masonry walls and floors.

B. Fabricate all sleeves from standard weight black steel pipe or as indicated on the drawings. Provide continuous sleeve. Cut or split sleeves are not acceptable.

C. Fabricate all lintels for masonry walls from structural steel shapes or as indicated on the drawings. Have all lintels approved by the Architect or Structural Engineer.

D. Sleeves through the floors on exposed risers shall be flush with the ceiling, with planed squared ends extending 1" above the floor in unfinished areas, and flush with the floor in finished areas, to accept spring closing floor plates.

E. Sleeves shall not penetrate structural members or masonry walls without approval from the Structural Engineer. Sleeves shall then comply with the Architect/Engineer's design.

F. Openings through unexcavated floors and/or foundation walls below the floor shall have a smooth finish with sufficient annular space around material passing through opening so slight settling will not place stress on the material or building structure.

G. Install all sleeves concentric with pipes. Secure sleeves in concrete to wood forms. This Contractor is responsible for sleeves dislodged or moved when pouring concrete.

H. Where pipes rise through concrete floors that are on earthen grade, provide 3/4" resilient expansion joint material (asphalt and cork) wrapped around the pipe, the full depth of concrete, at the point of penetration. Secure to prevent shifting during concrete placement and finishing.

I. Size sleeves large enough to allow expansion and contraction movement. Provide continuous insulation wrapping.

2.8 ESCUTCHEON PLATES AND TRIM

A. Fit escutcheons to all insulated or uninsulated exposed pipes passing through walls, floors, or ceilings of finished rooms.

B. Escutcheons shall be heavy gauge, cold rolled steel, copper coated under a chromium plated finish, heavy spring clip, rigid hinge and latch.

C. Install galvanized steel (unless otherwise indicated) trim strip to cover vacant space and raw construction edges of all rectangular openings in finished rooms. This includes pipe openings.

2.9 PIPE PENETRATIONS

A. Seal all pipe penetrations. Seal non-rated walls and floor penetrations with grout or caulk. Backing material may be used.

B. Seal fire rated wall and floor penetrations with fire seal system as specified.

2.10 PIPE ANCHORS

A. Provide all items needed to allow adequate expansion and contraction of all piping. All piping shall be supported, guided, aligned, and anchored as required.

B. Repair all piping leaks and associated damage. Pipes shall not rub on any part of the building.

2.11 FINISH

A. Prime coat exposed steel hangers and supports. Hangers and supports in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

PART 3 - EXECUTION

3.1 PLUMBING SUPPORTS AND ANCHORS

A. General Installation Requirements:

1. Install all items per manufacturer's instructions.

2. Coordinate the location and method of support of piping systems with all installations under other Divisions and Sections of the Specifications.

3. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.

B. Supports Requirements:

1. Install roof pipe supports to resist wind movement per manufacturer’s recommendations. Method of securing base to roof shall be compatible with roofing materials.

2. Where building structural steel is fireproofed, all hangers, clamps, auxiliary steel, etc., which attach to it shall be installed prior to application of fireproofing. Repair all fireproofing damaged during pipe installation.

3. Set all concrete inserts in place before pouring concrete.

4. Furnish, install and prime all auxiliary structural steel for support of piping systems.

5. Install hangers and supports complete with lock nuts, clamps, rods, bolts, couplings, swivels, inserts and required accessories.

6. Hangers for horizontal piping shall have adequate means of vertical adjustment for alignment.

C. Pipe Requirements:

1. Support all piping and equipment, including valves, strainers, traps and other specialties and accessories to avoid objectionable or excessive stress, deflection, swaying, sagging or vibration in the piping or building structure during erection, cleaning, testing and normal operation of the systems.

2. Do not, however, restrain piping to cause it to snake or buckle between supports or to prevent proper movement due to expansion and contraction.

3. Support piping at equipment and valves so they can be disconnected and removed without further supporting the piping.

4. Piping shall not introduce strains or distortion to connected equipment.

5. Parallel horizontal pipes may be supported on trapeze hangers made of structural shapes and hanger rods; otherwise, pipes shall be supported with individual hangers.

6. Trapeze hangers may be used where ducts interfere with normal pipe hanging.

7. Provide additional supports where pipe changes direction, adjacent to flanged valves and strainers, at equipment connections and heavy fittings.

8. Provide at least one hanger adjacent to each joint in cast iron soil pipe, grooved end steel pipe with mechanical couplings, and glass pipe.

D. Provided the installation complies with all loading requirements of truss and joist manufacturers, the following practices are acceptable:

1. Loads of 100 lbs.. or less may be attached anywhere along the top or bottom chords of trusses or joists with a minimum 3’ spacing between loads.

2. Loads greater than 100 lbs. must be hung concentrically and may be hung from top or bottom chord, provided one of the following conditions is met:

a. The hanger is attached within 6” from a web/chord joint.

b. Additional L2x2x1/4 web reinforcement is installed per manufacturer’s requirements.

3. It is prohibited to cantilever a load using an angle or other structural component that is attached to a truss or joist in such a fashion that a torsional force is applied to that structural member.

4. If conditions cannot be met, coordinate installation with truss or joist manufacturer and contact Architect/Engineer.

E. After piping and insulation installation are complete, cut hanger rods back at trapeze supports so they do not extend more than 3/4" below bottom face of lowest fastener and blunt any sharp edges.

F. Do not exceed 25 lbs. per hanger and a minimum spacing of 2’-0” on center when attaching to metal roof decking (limitation not required with concrete on metal deck). This 25 lbs. load and 2’-0” spacing include adjacent electrical and architectural items hanging from deck. If the hanger restrictions cannot be achieved, supplemental framing off steel framing will need to be added.

G. Do not exceed the manufacturer's recommended maximum load for any hanger or support.

H. Spacing of Hangers shall not exceed the compressive strength of the insulation inserts, and in no case shall exceed the following:

	Pipe Material	Maximum Spacing
1.	Steel (Std. Weight or Heavier – Liquid Service):	
	1-1/4" & under	7'-0"
	1-1/2"	9'-0"
	2"	10'-0"
	2-1/2"	11'-0"
	3"	12'-0"
	4" & larger	12'-0"
2.	Steel (Std. Weight or Heavier – Vapor Service):	
	1-1/4" and under	9'-0"
	1-1/2"	12'-0"
	2" & larger	12'-0"

	Pipe Material	Maximum Spacing
3.	Hard Drawn Copper & Brass (Liquid Service):	
	3/4" and under	5'-0"
	1"	6'-0"
	1-1/4"	7'-0"
	1-1/2"	8'-0"
	2"	8'-0"
	2-1/2"	9'-0"
	3"	10'-0"
	4"	12'-0"
	6"	12'-0"
4.	Hard Drawn Copper & Brass (Vapor Service):	
	3/4" & under	7'-0"
	1"	8'-0"
	1-1/4"	9'-0"
	1-1/2"	10'-0"
	2"	11'-0"
	2-1/2" & larger	12'-0"
5.	Cast Iron Soil Pipe - All Sizes:	
	Over 5' pipe lengths	10'-0"
	Less than 5' pipe lengths	5'-0"
	Support all direction changes and branch connections.	

6. Rigid Plastic Pipe:

   a. Space hangers at 4’-0” maximum centers.

7. Installation of hangers shall conform to MSS SP-58 and the applicable Plumbing Code.

END OF SECTION

SECTION 22 05 53
PLUMBING IDENTIFICATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Identification of products installed under Division 22.

1.2 SUBMITTALS

A. Submit shop drawings under provisions of Section 22 05 00. Include list of items identified, wording, letter sizes, and color coding.

B. Include valve chart and schedule listing valve tag number, location, function, and valve manufacturer's name and model number.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. 3M, Bunting, Calpico, Craftmark, Emedco, Kolbi Industries, Seton, W.H. Brady, Marking Services.

2.2 MATERIALS

A. All pipe markers (purchased or stenciled) shall conform to ANSI A13.1. Marker lengths and letter sizes shall be at least the following:

O.D. of Pipe or insulation	Marker Length	Size of Letters
Up to and including 1-1/4”	8”	1/2”
1-1/2” to 2”	8”	3/4”
2-1/2” to 6”	12”	1-1/4
8” to 10”	24”	2-1/2”
Over 10”	32”	3-1/2”

Plastic tags may be used for outside diameters under 3/4".

B. Plastic Nameplates: Laminated three-layer phenolic with engraved black, 1/4" minimum letters on light contrasting background.

C. Aluminum Nameplates: Black enamel background with natural aluminum border and engraved letters furnished with two mounting holes and screws.

D. Plastic Tags: Minimum 1-1/2" square or round laminated three-layer phenolic with engraved, 1/4" minimum black letters on light contrasting background.

E. Brass Tags: Brass background with engraved black letters. Tag size minimum 1-1/2" square or 1-1/2" round.

F. Plastic Pipe Markers: Semi-rigid plastic, preformed to fit around pipe or pipe covering; indicating flow direction and fluid conveyed.

G. Vinyl Pipe Markers: Colored vinyl with permanent pressure sensitive adhesive backing.

H. Stencil Painted Pipe Markers: Use industrial enamel spray paint per ANSI Standard A13.1. Indicate fluid conveyed and flow direction.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install all products per manufacturer's recommendations.

B. Degrease and clean surfaces to receive adhesive for identification materials.

C. Valves:

1. All valves (except shutoff valves at equipment) shall have numbered tags.

2. Provide or replace numbered tags on all existing valves that are connected to new systems or that have been revised.

3. Provide all existing valves used to extend utilities to this project with numbered tags. Review tag numbering sequence with the Owner prior to ordering tags.

4. Secure tags with heavy duty key chain and brass "S" link or with mechanically fastened plastic straps.

5. Attach to handwheel or around valve stem. On lever operated valves, drill the lever to attach tags.

6. Number all tags and show the service of the pipe.

7. Provide two sets of laminated 8-1/2" x 11" copies of a valve directory listing all valves, with respective tag numbers, uses, and locations. The directory shall be reviewed by the Owner and Architect/Engineer prior to laminating final copies. Laminated copies shall have brass eyelet in at least one corner for easy hanging.

D. Pipe Markers:

1. Adhesive Backed Markers: Use Brady Style 1, 2, or 3 on pipes 3" diameter and larger. Use Brady Style 4, 6, or 8 on pipes under 3" diameter. Similar styles by other listed manufacturers are acceptable. Secure all markers at both ends with a wrap of pressure sensitive tape completely around the pipe.

2. Snap-on Markers: Use Seton "Setmark" on pipes up to 5-7/8" OD. Use Seton "Setmark" with nylon or Velcro ties for pipes 6" OD and over. Similar styles by other listed manufacturers are acceptable.

3. Stencil Painted Pipe Markers:

   a. Remove rust, grease, dirt, and all foreign substances from the pipe surface.
   b. Apply primer on non-insulated pipes before painting.
   c. Use background and letter colors as scheduled later in this section.

4. Apply markers and arrows in the following locations where clearly visible:

   a. At each valve.
   b. On both sides of walls that pipes penetrate.
   c. At least every 20 feet along all pipes.
   d. On each riser and each leg of each "T" joint.
   e. At least once in every room and each story traversed.

5. Underground Pipe Markers: Install 8" to 10" below grade, directly above buried pipes.

E. Equipment:

1. All equipment not easily identifiable such as controls, relays, gauges, etc.; and all equipment in an area remote from its function shall have nameplates or plastic tags listing name, function, and drawing symbol. Do not label exposed equipment in public areas.

2. Provide engraved plastic tags at all hydronic or steam system makeup water meters.

3. Mechanical equipment that is not covered by the U.S. National Appliance Energy Conservation Act (NAECA) of 1987 shall carry a permanent label installed by the manufacturer stating that the equipment complies with the requirements of ASHRAE 90.1.

3.2 SCHEDULE

A. Pipes to be marked shall be labeled with the text as shown in the following table regardless of which method or material is used:

Pipe Service	Lettering Color	Background Color
DOMESTIC COLD WATER	White	Green
DOMESTIC HOT WATER - 115°F	Black	Yellow
DOMESTIC HOT WATER CIRCULATING - 115°F	Black	Yellow
SANITARY SEWER	Black	Yellow
VENT	Black	Yellow
STORM SEWER (PRIMARY AND SECONDARY)	White	Green
NATURAL GAS	Black	Yellow

END OF SECTION

SECTION 22 07 19
PLUMBING PIPING INSULATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Piping Insulation.
B. Insulation Jackets.

1.2 QUALITY ASSURANCE

A. Applicator: Company specializing in piping insulation application with five years minimum experience.

B. Materials: Flame spread/smoke developed rating of 25/50 in accordance with ASTM E84, NFPA 255, or UL 723 (where required).

C. In accordance with LEED EQc4.1, Low-Emitting Materials - Adhesives and Sealants, all adhesives and sealants used on the interior of the building must comply with the following requirements:

1. Adhesives, sealants and sealant primers must comply with South Coast Air Quality Management District (SCAQMD) Rule #1168.

2. Aerosol adhesives must comply with Green Seal Standard for Commercial Adhesives GS-36 requirements in effect on October 19, 2000.

1.3 SUBMITTALS

A. Submit shop drawings per Section 22 05 00. Include product description, list of materials and thickness for each service, and locations.

PART 2 - PRODUCTS

2.1 INSULATION

A. Type A: Glass fiber; ANSI/ASTM C547; 0.24 maximum 'K' value at 75ºF; non-combustible. All purpose, white kraft jacket bonded to aluminum foil and reinforced with fiberglass yarn, 25/50 flame spread/smoke developed rating when tested in accordance with ASTM E84 (UL 723).

B. Type B: Elastomeric cellular foam; ANSI/ASTM C534; flexible plastic; 0.27 maximum 'K' value at 75ºF, 25/50 flame spread/smoke developed rating when tested in accordance with ASTM E84 (UL 723). Maximum 3/4" thick per layer where multiple layers are specified.

C. Type C: Molded rigid cellular glass; ANSI/ASTM C-552; 0.35 maximum 'K' value at 75ºF; moisture resistant, non-combustible; suitable for -100ºF to +900ºF. For below grade installations use asphaltic mastic paper vapor barrier jacket. Use self-seal all-purpose white kraft jacket for above grade installations.

2.2 VAPOR BARRIER JACKETS

A. Kraft reinforced foil vapor barrier with self-sealing adhesive joints. Beach puncture resistance ratio of at least 50 units. Tensile strength: 35 psi minimum. Single, self-seal acrylic adhesive on longitudinal jacket laps and butt strips.

B. Polyvinylidene Chloride (PVDC or Saran) film and tape: Durable and highly moisture and moisture vapor resistant. Please refer to manufacturer's recommended installation guidelines.

2.3 JACKET COVERINGS

A. Plastic Jackets and Fitting Covers: High impact, glossy white, 0.030" thick, self-extinguishing plastic. Suitable for use indoors or outdoors with ultraviolet inhibitors. Suitable for -40ºF to 150ºF. 25/50 maximum flame spread/smoke developed.

PART 3 - EXECUTION

3.1 PREPARATION

A. Install insulation after piping has been tested. Pipe shall be clean, dry and free of rust before applying insulation.

3.2 INSTALLATION

A. General Installation Requirements:

1. Install materials per manufacturer's instructions, building codes and industry standards.

2. Continue insulation with vapor barrier through penetrations. This applies to all insulated piping. Maintain fire rating of all penetrations.

3. On all insulated piping, provide at each support an insert of same thickness and contour as adjoining insulation, between the pipe and insulation jacket, to prevent insulation from sagging and crushing. The insert shall be suitable for planned temperatures, be suitable for use with specific pipe material, and shall be a 180° cylindrical segment the same length as metal shields. Inserts shall be a cellular glass (for all temperature ranges) or molded hydrous calcium silicate (for pipe with operating temperatures above 70°F), with a minimum compressive strength of 50 psi. Factory fabricated inserts may be used. Rectangular blocks, plugs, or wood material are not acceptable. Temporary wood blocking may be used by the Piping Contractor for proper height; however, these must be removed and replaced with proper inserts by the Insulation Contractor.

4. Neatly finish insulation at supports, protrusions, and interruptions.

5. Install metal shields between all hangers or supports and the pipe insulation. Shields shall be galvanized sheet metal, half-round with flared edges. Adhere shields to insulation. On cold piping, seal the shields vapor-tight to the insulation as required to maintain the vapor barrier, or add separate vapor barrier jacket.

6. Shields shall be at least the following lengths and gauges:

	Pipe Size	Shield Size
a.	1/2" to 3-1/2"	12" long x 18 gauge
b.	4"	12" long x 16 gauge
c.	5” to 6"	18" long x 16 gauge
d.	8” to 14"	24" long x 14 gauge
e.	16” to 24"	24" long x 12 gauge

7. All piping and insulation that does not meet 25/50 that is located in an air plenum shall have written approval from the Authority Having Jurisdiction and the local fire department for authorization and materials approval. If approval has been allowed, the non-rated material shall be wrapped with a product that has passed ASTM E84 and/or NFPA 255 testing with a rating of 25/50 or below.

8. On 1" and smaller piping routed through metal wall studs, provide a plastic grommet to protect the piping. The piping shall be insulated between the wall studs, and the insulation shall butt up to each stud.

B. Insulated Piping Operating Below 60°F:

1. Insulate fittings, valves, unions, flanges, strainers, flexible connections, flexible hoses, and expansion joints. Seal all penetrations of vapor barrier.

2. On piping operating below 60ºF in locations that are not mechanically cooled (e.g., penthouses, mechanical rooms, tunnels, chases at exterior walls, etc.), Type B insulation shall be used.

3. All balance valves with fluid operating below 60°F shall be insulated with a removable plug wrapped with vapor barrier tape to allow reading and adjusting of the valve.

C. Insulated Piping Operating Between 60°F and 140°F:

1. Do not insulate flanges and unions, but bevel and seal ends of insulation at such locations. Insulate all fittings, valves and strainers.

D. Exposed Piping:

1. Locate and cover seams in least visible locations.

2. Where exposed insulated piping extends above the floor, provide a sheet metal guard around the insulation extending 12" above the floor. Guard shall be 0.016" cylindrical smooth or stucco aluminum and shall fit tightly to the insulation.

3. On exposed piping serving kitchen equipment or plumbing fixtures, the piping does not need to be insulated if less than four feet in developed length. If piping is longer than four feet in developed length, the piping shall be insulated and have a plastic jacket.

3.3 INSULATION

A. Type A Insulation:

1. All Service Jackets: Seal all longitudinal joints with self-seal laps using a single pressure sensitive adhesive system. Do not staple.

2. Insulation without self-seal lap may be used if installed with Benjamin Foster 85-20 or equivalent Chicago Mastic, 3M or Childers lap adhesive.

3. Apply insulation with laps on top of pipe.

4. Fittings, Valve Bodies and Flanges: For 4" and smaller pipes, insulate with 1 lb. density insulation wrapped under compression to a thickness equal to the adjacent pipe insulation. For pipes over 4", use mitered segments of pipe insulation. Finish with preformed plastic fitting covers. Secure fitting covers with pressure sensitive tape at each end. Overlap tape at least 2" on itself. For pipes operating below 60ºF, seal fitting covers with vapor retarder mastic in addition to tape.

B. Type B Insulation:

1. Elastomeric Cellular Foam: Where possible, slip insulation over the open end of pipe without slitting. Seal all butt ends, longitudinal seams, and fittings with adhesive. At elbows and tees, use mitered connections. Do not compress or crush insulation at cemented joints. Joints shall be sealed completely and not pucker or wrinkle. Paint the outside of outdoor insulation with two coats of latex enamel paint recommended by the manufacturer.

2. Self-seal insulation may be used on pipes operating below 170ºF.

C. Type C Insulation:

1. Seal all longitudinal joints with manufacturer approved adhesive. Secure butt joint strips in a similar manner.

2. Insulate fittings with prefabricated fittings.

3.4 JACKET COVER INSTALLATION

A. Plastic Covering:

1. Provide vapor barrier as specified for insulation type. Cover with plastic jacket covering. Position seams to shed water.

2. Solvent weld all joints with manufacturer recommended cement.

3. Overlap all laps and butt joints 1-1/2" minimum. Repair any loose ends that do not seal securely. Solvent weld all fitting covers in the same manner. Final installation shall be watertight.

4. All joints in areas noted shall meet USDA standards for Totally Sealed Systems, including overlaps of 1” on circumferential and 1.5” to 2” on longitudinal seams.

5. Use plastic insulation covering on all exposed pipes including, but not limited to:

   a. All exterior piping.
   b. All exposed piping below 8'-0" above floor.
   c. All piping in mechanical rooms and/or tunnels that is subject to damage from normal operations. (Example: Piping that must be stepped over routinely.)

3.5 SCHEDULE

	Piping System	Insulation Type/Thickness
A.	Domestic Hot Water & Circulating - Potable and Non-Potable - up to 140°F	
	Up to 1-1/2" Pipe Size	A / 1”
	Above 1-1/2" Pipe Size	A / 1-1/2”
B.	Domestic Cold Water - Potable and Non-Potable	B / 1”
C.	Plumbing Vents Within 10' from Roof Penetration	A / 1/2”
D.	Insulation Inserts at hangers	C - Match pipe insulation thickness

END OF SECTION

SECTION 22 09 00
INSTRUMENTATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Pressure Gauge.
B. Pressure Gauge Accessories.
C. Thermometers.
D. Test Plugs.

1.2 SUBMITTALS

A. Submit shop drawings per Section 22 05 00. Include list that indicates use, operating range, total range and location for manufactured components.

PART 2 - PRODUCTS

2.1 PRESSURE GAUGES

A. Gauges shall be 4-1/2" diameter with aluminum or stainless steel case with phosphor bronze bourdon tube, brass socket for water or oil application, 1/4" or 1/2" bottom connection. Gauges shall be 1% full scale accurate with bronze bushed brass movement and adjustable pointer. Standard ranges to be either pressure or pressure and vacuum as required of application.

B. Acceptable Manufacturers: Ashcroft, Marsh, Marshalltown, Miljoco, Trerice, U.S. Gauge Figure 1901, Weiss, Weksler, Wika.

2.2 PRESSURE GAUGE ACCESSORIES

A. All pressure gauges shall have valves and pressure snubbers. All pressure gauges on steam shall have pigtail syphon.

B. Shutoff Valve: 1/4" ball valve as specified for each piping system.

C. Pressure snubber, brass with 1/4" connections, porous metal type.

2.3 THERMOMETERS

A. Dial Type:

1. 4-1/2" diameter, hermetically sealed case. Stainless steel case and stem. Accuracy of 1% full scale with external recalibrator.

2. Select thermometers for appropriate temperature range. Adjustable elbow joint with locking device to allow rotation of thermometer to any angle.

3. Stem lengths as required for application with minimum insertion of 2-1/2".

4. Thermometers for water, steam, or oil shall have brass or steel separable socket. Socket shall extend through insulation.

5. Acceptable Manufacturer: Ashcroft, Marsh, Marshalltown, Miljoco, Tel-Tru, Trerice, U.S. Gauge, Weiss, Weksler, Wika.

B. Select scales to cover expected range of temperatures.

2.4 TEST PLUGS

A. Test Plug: 1/4" or 1/2" brass fitting and cap, with Nordel core for temperatures up to 275°F, for receiving 1/8" outside diameter pressure or temperature probe. Plugs shall be rated for zero leakage from vacuum to 500 psi.

B. Provide extended units for all plugs installed in insulated piping.

C. Test Kit: Carrying case, internally padded and fitted containing one 3-1/2" diameter pressure gauge with 0-100 psi range, one gauge adapter with 1/8" probes, two 1-1/2" dial thermometers with 0° to 220°F and -25°F to 125°F ranges and 5" stems.

D. Acceptable Manufacturers: Sisco, Flow Design, or Peterson Equipment.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General Installation Requirements:

1. Install per manufacturer's instructions.

2. Coil and conceal excess capillary on remote element instruments.

3. Install gauges and thermometers in locations where they are easily read from normal operating level.

4. Do not install instrumentation when areas are under construction, except for required rough-in, taps, supports and test plugs.

B. Pressure Gauges:

1. Connect pressure gauges to suction and discharge side of all pumps.

2. Provide snubber for each pressure gauge.

3. Provide coil syphon for each pressure gauge connected to steam piping.

C. Thermometers:

1. Install thermometers in piping systems in sockets in short couplings. Enlarge pipes smaller than 2-1/2" for installation of thermometer sockets.

2. Install thermometer sockets adjacent to control system thermostat, transmitter and sensor sockets.

END OF SECTION

SECTION 22 10 00
PLUMBING PIPING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Pipe and Pipe Fittings.
B. Valves.
C. Domestic Water Piping System.
D. Sanitary Drainage and Vent Piping System.
E. Storm Drainage Piping System.

1.2 QUALITY ASSURANCE

A. Valves: Manufacturer's name and pressure rating marked on valve body. Remanufactured valves are not acceptable.

B. Welding Materials and Procedures: Conform to ASME Code and applicable state labor regulations.

C. Welders Certification: In accordance with ANSI/ASME Sec 9 or ANSI/AWS D1.1.

D. Piping, Fittings, Valves, and Flux for Potable Water Systems: All components shall be lead free per Federal Act S.3874, Reduction of Lead in Drinking Water Act.

1.3 SUBMITTALS

A. Submit shop drawings per Section 22 05 00.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store valves in shipping containers with labeling in place.

1.5 COORDINATION DRAWINGS

A. Reference Coordination Drawings article in Section 22 05 00 for required plumbing systems electronic CAD drawings to be provided to Coordinating Contractor for inclusion into composite coordination drawings.

PART 2 - PRODUCTS

2.1 COLD WATER - POTABLE AND NON-POTABLE
HOT WATER - POTABLE AND NON-POTABLE

A. Design Pressure: 175 psi.
Maximum Design Temperature: 200°F.

B. Piping - All Sizes:

1. Tubing: Type L hard drawn seamless copper tube, ASTM B88.

2. Joints: Solder with 100% lead-free solder and flux, ASTM B32.

3. Fittings: Wrought copper solder joint, ANSI B16.22.

C. Shutoff Valves:

1. Butterfly Valves:

a. BF-1:

1) 2-1/2" thru 6", 175 psi CWP, elastomers rated for 20°F to 250°F at 125 psig, fully lugged end, ductile or cast iron body (not in contact with fluid); bronze, aluminum-bronze or EPDM coated ductile iron disc; EPDM seat, stainless steel stem, extended neck, 175 psi bubble-tight, bi-directional dead-end shutoff without backing flange or nuts and with cap screws extending to centerline of valve body (for pipe extension without draining system), 10 position locking operator up to 6" size. Cv of at least 1580 in 6" size. Center Line Series 200, Keystone #222, Watts #DBF-03-121-1P, Stockham LD712-B&3-E, Nibco LD2000N Series, Milwaukee CL series, Hammond 5200 series.

2. Ball Valves:

a. BA-1:

1) 3" and under, 150 psi saturated steam, 600 psi CWP, full port, screwed or solder ends (acceptable only if rated for soldering in line with 470°F melting point of lead-free solder), bronze body of a copper alloy containing less than 15% zinc, stainless steel ball and trim, Teflon seats and seals. Apollo #77C-140, Stockham #S-255-FB-P-UL BR1-R, Milwaukee #BA-400, Watts, Nibco #585-70-66, National Utilities Co., RUB.

NOTES:

a) Provide extended shaft for all valves in insulated piping.

b) Provide lock out trim for all valves opening to atmosphere installed in domestic water piping over 120°F, heating water piping over 120°F, steam, condensate, boiler feed water piping, compressed air piping and gasoline/kerosene piping, and as indicated on the drawings. Solid extended shaft is not required on valves with lock out trim.

D. Check Valves:

1. CK-1: 2" and under, 125# steam @ 406ºF, 200# CWP @ 150ºF, screwed, bronze, horizontal swing. Crane #37, Hammond #IB904, Stockham #B319-Y, Walworth #3406, Milwaukee #509, Watts #G-5000, Nibco T-413B.

2. CK-14: 2-1/2" thru 12", 200# CWP, double disc wafer type, bronze or iron body, bronze trim, metal-to-metal or Viton seat, 316 SS shaft, Inconel 600 spring. Mission Duo Chek #12HPP (with Inconel springs), Mueller Steam Specialty Co. #71-AHB-K-W, Stockham #WG-961-EPDM or #WG-970-BUNA, Nibco w-920-W.

2.2 COMBINATION WATER AND FIRE PROTECTION SERVICE

A. Piping:

1. Pipe: Ductile iron pressure water pipe, ANSI/AWWA C151/A21.51, 200 psi pressure class, cement-mortar lined per ANSI/AWWA C104/A21.4.

2. Fittings: Ductile iron, ANSI/AWWA C110/A21.10, or ANSI/AWWA C153/A21.53, 200 psi pressure class, cement-mortar lined per ANSI/AWWA C104/A21.4, mechanical joints.

3. Joint: Mechanical joint with glands and gaskets and steel bolts. ANSI/AWWAC111/A21.11.

2.3 SANITARY DRAINAGE (ABOVE GROUND)
SANITARY INDIRECT DRAINAGE (ABOVE GROUND)
SANITARY VENT (ABOVE GROUND)
STORM DRAINAGE/CLEAR WATER WASTE (ABOVE GROUND)
CONDENSATE DRAINAGE (ABOVE GROUND)
GREASE SANITARY VENT (ABOVE GROUND – INSIDE BUILDING)

A. Design Pressure: Gravity
Maximum Design Temperature: 180ºF

B. Piping - 1-1/2" through 15":

1. Pipe and Fittings: Standard weight cast iron soil pipe, corrosion protective coating inside and outside, CISPI 301 or ASTM A888.

2. Joints: Heavy duty, neoprene sleeve gasket, ASTM C-564, 300 Series stainless steel shield, clamp, and screws with at least four screw type clamps, FM 1680 or ASTM C1540.

3. Adapters: Transitions from cast iron soil pipe to other pipe materials with manufactured adapters. Heavy duty neoprene sleeve gasket, ASTM C-564, 300 Series stainless steel shield, clamp, and screws with not less than four screw type clamps, FM 1680 or ASTM C1540.

C. Vent Flashing: Flash vents with premolded EPDM pipe flashing cones for single-ply membrane roofs.

D. Piping that is fully enclosed in walls (not open to the return air plenum system) is allowed to be meet requirements of below ground piping (PVC piping).

2.4 SANITARY DRAINAGE (BELOW GROUND - INSIDE BUILDING)
SANITARY VENT (BELOW GROUND - INSIDE BUILDING)
STORM DRAINAGE & CLEAR WATER WASTE (BELOW GROUND - INSIDE BUILDING)

A. Design Pressure: Gravity

B. Piping - 1-1/4” through 16” (Maximum Design Temperature: 140°F):

1. Pipe: Schedule 40 rigid, unplasticized PVC-DWV, or ABS-DWV, normal impact Type I, with plain ends, conforming to ASTM Standards D2665 or D2661. Cellular core piping is not acceptable.

2. Joints: Solvent-weld socket type with solvent recommended by pipe manufacturer.

3. Fittings: Unplasticized PVC-DWV, or ABS-DWV, normal impact Type I, with solvent-weld socket ends for Schedule 40 pipe.

4. Use: Use PVC or ABS only where allowed by local jurisdiction. Comply with all special requirements or limitations.

2.5 GREASE SANITARY DRAINAGE (BELOW GROUND – INSIDE BUILDING)
GREASE SANITARY DRAINAGE (ABOVE GROUND – INSIDE BUILDING)
GREASE SANITARY VENT (BELOW GROUND – INSIDE BUILDING)

A. Design Pressure: Gravity.

B. Piping - 1-1/4” through 16” (Maximum Design Temperature: 140°F):

1. Pipe: Schedule 40 rigid, unplasticized PVC-DWV, or ABS-DWV, normal impact Type I, with plain ends, conforming to ASTM Standards D2665 or D2661. Cellular core piping is not acceptable.

2. Joints: Solvent-weld socket type with solvent recommended by pipe manufacturer.

3. Fittings: Unplasticized PVC-DWV, or ABS-DWV, normal impact Type I, with solvent-weld socket ends for Schedule 40 pipe.

4. Use: Use PVC only where allowed by local jurisdiction. Comply with all special requirements or limitations.

2.6 UNIONS

A. Copper pipe - wrought copper fitting - ground joint.

2.7 AIR VENTS

A. Provide means for venting air at all high points in the piping system and at all other points where air may be trapped.

B. At end of main and other points where large volume of air may be trapped - Use 1/4" globe valve, angle type, 125 psi, Crane #89, attached to coupling in top of main, 1/4" discharge pipe turned down with cap.

2.8 RELIEF VALVES

A. RV-4: (Domestic Hot Water) Pressure and Temperature relief, cast bronze body and internal parts, stainless steel spring, test lever, threaded inlet and outlet. Maximum setting of 150 psi and 210ºF temperature. Capacities ASME certified and labeled. Acceptable Manufacturers: Cash Series FV, Watts #40, #120, #N240, #340.

2.9 BALANCING VALVE

A. Rated for 125 psi working pressure and 250ºF operating temperature, taps for determining flow with a portable meter, positive shutoff valves for each meter connection, memory feature, tight shutoff, and a permanent pressure drop between 1' and 2' water column at full flow with valve 100% open. Furnish with molded, removable insulation covers.

B. Provide a nomograph to determine flow from meter reading (and valve position on units which sense pressure across a valve). Graph shall extend below the specified minimum flow.

C. Flow rate of 0.5 GPM or larger: Valves in copper piping shall be brass or bronze. Acceptable Manufacturers: Flow Design “Accusetter”, Preso “B+”, Armstrong "CVB", Bell & Gossett "Circuit Setter Plus", Griswold “Quickset”, Gerand “Balvalve Venturi” or Nibco Globe Style balancing valve.

D. Flow rate less than 0.5 GPM: Valves in copper piping shall be brass or bronze. Cv value shall be less than 1.0 when valve is completely open, and minimum balanceable flow rate shall not exceed 0.1 GPM with a meter reading of at least 2.5 feet. Acceptable manufacturers: Bell & Gossett "Circuit Setter RF", Flow Design, Preso, Armstrong, Griswold, Gerand, or Nibco balancing valve.

E. Manufacturer shall size balancing valves for the scheduled flow rate. Flow rate shall be measurable on manufacturer's standard meters.

2.10 DRAIN VALVES

A. Drain valves shall be shutoff valves as specified for the intended service with added 3/4” male hose thread outlet and cap.

2.11 CONNECTIONS BETWEEN DISSIMILAR METALS

A. Connections between dissimilar metals shall be insulating dielectric types that provide a water gap between the connected metals, and that either allow no metal path for electron transfer or that provide a wide water gap lined with a non-conductive material to impede electron transfer through the water path.

B. Joints shall be rated for the temperature, pressure, and other characteristics of the service in which they are used, including testing procedure.

C. Aluminum, iron, steel, brass, copper, bronze, and stainless steel are commonly used and require isolation from each other with the following exceptions:

1. Iron, steel, and stainless steel connected to each other.

2. Brass, copper, and bronze connected to each other.

3. Brass or bronze valves and specialties connected in closed systems with steel, iron, or stainless steel on both sides of the brass or bronze valves and specialties. Where two or more brass or bronze items occur together, they shall be connected with brass nipples. Brass or bronze valves and specialties cannot be used as a dielectric separation between pipe materials.

D. Dielectric protection is required at connections to equipment of a material different than the piping.

E. Screwed Joints (acceptable up to 2" size):

1. Dielectric waterway rated for 300 psi CWP and 225°F.

2. Acceptable Manufacturers: Elster Group ClearFlow fittings, Victaulic Series 47, Grinnell Series 407, Matco-Norca.

F. Flanged Joints (any size):

1. Use 1/8" minimum thickness, non-conductive, full-face gaskets.

2. Employ one-piece molded sleeve-washer combinations to break the electrical path through the bolts.

3. Sleeve-washers are required on one side only, with sleeves minimum 1/32" thick and washers minimum 1/8" thick.

4. Install steel washers on both sides of flanges to prevent damage to the sleeve-washer.

5. Separate sleeves and washers may be used only if the sleeves are manufactured to exact lengths and installed carefully so the sleeves must extend partially past each steel washer when tightened.

6. Acceptable Manufacturers: EPCO, Central Plastics, Pipeline Seal and Insulator, F. H. Maloney, or Calpico.

2.12 LOCK OUT TRIM

A. Provide lock out trim for all quarter turn shutoff valves opening to atmosphere and installed in domestic water piping over 120°F, in compressed air piping, and as indicated on the drawings.

2.13 VALVE OPERATORS

A. Provide handwheels for gate valves and gear operators for butterfly valves.

2.14 VALVE CONNECTIONS

A. Provide all connections to match pipe joints. Valves shall be same size as pipe unless noted otherwise.

PART 3 - EXECUTION

3.1 PREPARATION

A. Install all products per manufacturer's recommendations.

B. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

C. Remove scale and dirt, on inside and outside, before assembly.

D. Connect to equipment with flanges or unions.

E. Use only piping materials rated for the maximum temperature of the application, e.g., do not use PVC for dishwasher drainage or piping that receives boiler blowdown.

3.2 TESTING PIPING

A. Sanitary Drainage:
Sanitary Vent:
Storm Drainage:

1. Test all piping with water to prove tight.

2. Test piping before insulation is applied.

3. Hydrostatically test all soil, waste, and vent piping inside of building with 10 feet head of water for 15 minutes. Inspect before fixtures are connected. If leaks appear, repair them and repeat the test.

4. Hydrostatically test interior downspouts with 10 feet head of water for 15 minutes with no leaks.

5. A smoke/air test at the same pressure may be used in lieu of the hydrostatic water test. Exception: Smoke/air test shall not be performed on plastic piping.

6. Test force mains with water at 105% of the operating pump discharge pressure for 15 minutes.

7. Test pressures stated above shall be as listed or as required by the Authority Having Jurisdiction, whichever is most stringent.

B. Hot Water - Potable and Non-Potable:
Cold Water - Potable and Non-Potable:
Service Water:

1. Test pipes underground or in chases and walls before piping is concealed.

2. Test all pipes before the insulation is applied. If insulation is applied before the pipe is tested and a leak develops which ruins the insulation, replace damaged insulation.

3. Test the pipe with 100 psig water pressure or equal inert gas such as nitrogen.

4. Hold test pressure for at least 2 hours.

5. Test to be witnessed by the Architect/Engineer's representative, if requested by the Architect/Engineer.

C. Fire Service:

1. Hydrostatically test the entire system for two hours at 200 psig. Maximum leakage shall be:

a. Interior Piping: 0 quarts per hour.

b. Underground Piping: 2 quarts per 100 joints per hour.

D. All Other Piping:

1. Test piping at 150% of normal operating pressure.

2. Piping shall hold this pressure for one hour with no drop in pressure.

3. Test piping using water, nitrogen, or air as compatible with the final service of the pipe. Do not use combustible fluids.

4. Drain and clean all piping after testing is complete.

3.3 CLEANING PIPING

A. Assembly:

1. Before assembling pipe systems, remove all loose dirt, scale, oil and other foreign matter on internal or external surfaces by means consistent with good piping practice subject to approval of the Architect/Engineer's representative. Blow chips and burrs from machinery or thread cutting operation out of pipe before assembly. Wipe cutting oil from internal and external surfaces.

2. During fabrication and assembly, remove slag and weld spatter from both internal and external joints by peening, chipping and wire brushing.

3. Notify the Architect/Engineer's representative before starting any post erection cleaning in sufficient time to allow witnessing the operation. Consult with and obtain approval from the Architect/Engineer's representative with regard to specific procedures and scheduling. Dispose of cleaning and flushing fluids properly.

4. Prior to blowing or flushing erected piping systems, disconnect all instrumentation and equipment, open wide all valves, and be certain all strainer screens are in place.

B. All Water Piping:

1. Flush all piping using faucets, flush valves, etc. until the flow is clean.

2. After flushing, thoroughly clean all inlet strainers, aerators, and other such devices.

3. If necessary, remove valves to clean out all foreign material.

C. Fire Service:

1. Flush all underground piping with minimum flow equal to the system design flow but not less than the following:

a. 390 gpm for 4" pipes.
b. 880 gpm for 6" pipes.
c. 1560 gpm for 8" pipes.
d. 2440 gpm for 10" pipes.
e. 3500 gpm for 12" pipes.

3.4 INSTALLATION

A. General Installation Requirements:

1. Provide dielectric connections between dissimilar metals.

2. Route piping in orderly manner and maintain gradient. Install to conserve building space.

3. Group piping whenever practical at common elevations.

4. Install piping to allow for expansion and contraction without stressing pipe, joints, or equipment.

5. Slope water piping and arrange to drain at low points.

6. Install bell and spigot piping with bells upstream.

7. Where pipe supports are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welds.

8. Seal pipes passing through exterior walls with a wall seal per Section 22 05 29. Provide Schedule 40 galvanized sleeve at least 2 pipe sizes larger than the pipe.

9. All non-potable outlets shall be clearly marked with a permanently affixed laminated sign with 3/8" high lettering saying "Non-Potable Water Not for Human Consumption." Sign shall have black lettering on a yellow background.

10. All vertical pipe drops to sinks or other equipment installed below the ceiling shall be routed within a wall cavity, unless specifically noted otherwise to be surface mounted.

B. Installation Requirements In Electrical Rooms:

1. Do not install piping or other equipment above electrical switchboards or panelboards. This includes a dedicated space extending 25 feet from the floor to the structural ceiling with width and depth equal to the equipment.

C. Valves/Fittings and Accessories:

1. Install shutoff valves that permit the isolation of equipment/fixtures in each room without isolating any other room or portion of the building. Individual fixture angle stops do not meet this requirement. Exception: Back-to-back rooms in no more than two adjacent rooms.

2. Provide clearance for installation of insulation and access to valves and fittings.

3. Provide access doors for concealed valves and fittings.

4. Install valve stems upright or horizontal, not inverted.

5. Provide one plug valve wrench for every ten plug valves 2" and smaller, minimum of one. Provide each plug valve 2-1/2" and larger with a wrench with set screw.

6. Install balancing valves with straight, unobstructed pipe section both upstream and downstream as required, per manufacturer's installation instructions.

7. Install corrugated, stainless steel tubing system according to manufacturer's written instructions. Include striker plates to protect tubing from puncture where tubing is restrained and cannot move.

D. Underground Piping:

1. Install buried water piping outside the building with at least 5 feet of cover.

2. Underground fire protection service piping shall have at least 6-1/2 feet of cover, or as recommended by NFPA 24, whichever is greater.

3. Install thrust blocking and restraints on all underground fire protection service piping per NFPA 24 and as shown on drawings.

4. Install underground, sleeved, corrugated, stainless steel tubing system according to manufacturer's written instructions. Extend vent from sleeve to exterior of building and terminate with screened elbow.

5. Lay all underground piping in trenches. Provide and operate pumping equipment to keep trenches free of water.

6. For all underground piping, provide a foundation (the layer below the bedding) if the trench bottom is unstable. Lay underground plastic piping on 4" to 6" of sand bedding. When the trench is in rock, lay underground metallic piping on 6" of sand bedding. Provide recessed areas for pipe bells and joints. After joints are made, any misalignment in elevation shall be corrected by tamping sand around the pipe. Backfill with sand in uniform layers not over 6" deep to the spring line of all underground pipes, and carefully compact each layer to 90 percent Standard Proctor density. Backfill with sand up to 6" above pipe for landscaped areas. Remaining backfill may be soil. Under paving and buildings, the remaining backfill shall be sand and compacted to 98 percent Standard Proctor density.

E. Sanitary and Storm Piping:

1. Install all sanitary piping inside the building with a slope of at least the following:

Pipe Size	Minimum Slope
3" and under	- 0.25" per foot
4" and over	- 0.125" per foot

a. All sanitary systems transporting grease laden waste shall be sloped a minimum of 0.25" per foot regardless of size.

2. Install all storm piping inside the building with a slope of at least 0.125" per foot unless noted otherwise.

3. Install horizontal offset at all connections to roof drains to allow for pipe expansion.

4. Slope sanitary and storm piping outside the building to meet invert elevations shown on drawings and to maintain a minimum velocity of 3 feet per second.

5. All sanitary and storm piping shall have at least 42" of cover when leaving the building.

3.5 PIPE ERECTION AND LAYING

A. Carefully inspect all pipe, fittings, valves, equipment and accessories before installation. Any items that are unsuitable, cracked or otherwise defective shall be removed from the job immediately.

B. All pipe, fittings, valves, equipment and accessories shall have factory applied markings, stampings, or nameplates with sufficient data to determine their conformance with specified requirements.

C. Exercise care at every stage of storage, handling, laying and erecting to prevent entry of foreign matter into piping, fittings, valves, equipment and accessories. Do not install any item that is not clean.

D. Until system is fully operational, all openings in piping and equipment shall be kept closed except when actual work is being performed on that item or system. Closures shall be plugs, caps, blind flanges or other items specifically designed and intended for this purpose.

E. Run pipes straight and true, parallel to building lines with minimum use of offsets and couplings. Provide only offsets required to provide needed headroom or clearance and to provide needed flexibility in pipe lines.

F. Make changes in direction of pipes only with fittings or pipe bends. Changes in size only with fittings. Do not use miter fittings, face or flush bushings, or street elbows. All fittings shall be of the long radius type, unless otherwise shown on the drawings or specified.

G. Provide flanges or unions at all final connections to equipment, traps and valves.

H. Arrange piping and connections so equipment served may be totally removed without disturbing piping beyond final connections and associated shutoff valves.

I. Use full and double lengths of pipe wherever possible.

J. Unless otherwise indicated, install all piping, including shutoff valves and strainers, to coils, pumps and other equipment at line size with reduction in size being made only at control valve or equipment.

K. Cut all pipe to exact measurement and install without springing or forcing except in the case of expansion loops where cold springing is indicated on the drawings.

L. Underground pipe shall be laid in dry trenches maintained free of accumulated water. Provide and operate sufficient pumping equipment to maintain excavations, trenches and pits free of water. Dispose of pumped water so operation areas and other facilities are not flooded. Pipe laying shall follow excavating as closely as possible.

M. Unless otherwise indicated, branch take-offs shall be from top of mains or headers at either a 45º or 90º angle from the horizontal plane for air lines, and from top, bottom or side for liquids.

3.6 DRAINING AND VENTING

A. Unless otherwise indicated on the drawings, all horizontal water and compressed air lines, including branches, shall pitch 1" in 40 feet to low points for complete drainage, removal of condensate and venting.

B. Maintain accurate grade where pipes pitch or slope for venting and drainage. No pipes shall have pockets due to changes in elevation.

C. Provide drain valves at all low points of water piping systems for complete or sectionalized draining.

D. Provide drip legs at low points and at the base of all risers in compressed air pipes. Drip legs shall be full line size on pipes through 4" and at least 4", but not less than half line size over 4". Drip legs shall be 12" minimum length, capped with a reducer to a drain valve.

E. Use eccentric reducing fittings on horizontal runs when changing size of pipes for proper drainage and venting. Install compressed air and gravity drain pipes with bottom of pipe and eccentric reducers in a continuous line; all other liquid lines with top of pipe and eccentric reducers in a continuous line.

F. Provide air vents at high points and wherever else required to eliminate air in all water piping systems.

G. Install air vents in accessible locations. If necessary to trap and vent air in a remote location, install an 1/8" pipe from the tapping location to an accessible location and terminate with a venting device.

H. All vent and drain piping shall be of same materials and construction for the service involved.

3.7 PLUMBING VENTS

A. Vent as shown on the drawings and in accordance with all codes having jurisdiction.

B. Extend the high side of the soil and waste stacks at least 12" above roof.

C. Flash pipes at roof with premolded EPDM pipe flashing cones adhered to roof membrane by General Contractor. Secure top of cone with stainless steel clamp and seal watertight.

D. Increase vent pipes through the roof two pipe sizes with long increasers located at least 12" below the roof.

E. In no case shall the vent through the roof be less than 4" in diameter.

F. Vent pipes through the roof shall be located a minimum of 15 feet from any air intake or exhaust opening on the roof.

3.8 BRANCH CONNECTIONS

A. For domestic water and vent systems only, make branch connections with standard tee or cross fittings of the type required for the service.

B. Reducers are generally not shown. Where pipe sizes change at tee, the tee shall be the size of the largest pipe shown connecting to it.

C. Do not use double wye or double combination wye and eighth bend DWV fittings in horizontal piping.

D. Branch connections from the headers and mains may be mechanically formed using an extraction device. The branch piping connection shall be brazed connection for the following services only:

1. Domestic water piping above grade.

E. Branch connections from headers and mains may be cut into black steel pipe using forged weld-on fittings.

F. Forged weld-on fittings are limited as follows:

1. Must have at least same pressure rating as the main.
2. Main must be 2-1/2" or larger.
3. Branch line is at least two pipe sizes under main size.

3.9 JOINING OF PIPE

A. Solder Joints:

1. Make up joints with 100% lead-free solder, ASTM B32. Cut tubing so ends are perfectly square and remove all burrs inside and outside. Thoroughly clean sockets of fittings and ends of tubing to remove all oxide, dirt and grease just prior to soldering. Apply flux evenly, but sparingly, over all surfaces to be joined. Heat joints uniformly so solder will flow to all mated surfaces. Wipe excess solder, leaving a uniform fillet around cup of fitting.

2. Flux shall be non-acid type.

3. Solder end valves may be installed directly in the piping system if the entire valve is suitable for use with 470ºF melting point solder. Remove discs and seals during soldering if they are not suitable for 470ºF.

B. Solvent Weld Joints (PVC):

1. Make joints with a two-step process. Use primer conforming to ASTM F656 and solvent cement conforming to ASTM D2564.

C. Sleeve Gaskets (No-Hub) (Sanitary and Storm Pipe):

1. Gasket shall be heavy weight class, conforming to ASTM C564.

2. The gasket shall have an internal center stop.

3. The gasket shall be covered by a stainless steel band secured with a minimum of four stainless steel bands per fitting/joint.

4. Sleeve gaskets shall be installed in accordance with the manufacturer's installation instructions.

3.10 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM

A. Provide necessary connections at the start of individual sections of mains for adding chlorine.

B. Before starting work, verify system is complete, flushed and clean.

C. Ensure pH of water to be treated is between 7.4 and 7.6 by adding alkali (caustic soda or soda ash) or acid (hydrochloric).

D. Inject disinfectant, free chlorine in liquid, powder, tablet or gas form, throughout system to obtain 50 to 80 mg/L residual.

E. Bleed water from all outlets to ensure chlorine distribution throughout the entire domestic water system.

F. Verify initial chlorination levels by testing at minimum 15% of outlets located throughout entire building, including the last fixture connected to each main and each branch extending over 50 feet from a main.

G. Maintain disinfectant in system for 24 hours, after which test at minimum 15% of outlets located throughout entire building, including the last fixture connected to each main and each branch extending over 50 feet from a main. If final disinfectant residual tests less than 25 mg/L at any one of the tested outlets, flush the entire system and repeat disinfection and testing procedure.

H. After final disinfectant residuals test at or above 25 mg/L after a minimum 24-hour duration, flush disinfectant from system at a minimum velocity of 3.0 feet/second until residual is equal to that of incoming water or 1.0 mg/L.

I. Take water samples, no sooner than 24 hours after flushing, from 2% of outlets and from water entry. Obtain, analyze, and test samples in accordance with AWWA C651, Section 5 - Verification.

3.11 SERVICE CONNECTIONS

A. Provide new sanitary and/or storm sewer services. Before commencing work check invert elevations needed for sewer connections, confirm inverts and verify these can be properly connected with slope for drainage and cover to avoid freezing.

B. Provide new water service with water meter with bypass valves. Provide sleeve in wall for service main per Section 22 05 29.

END OF SECTION

SECTION 22 10 23
NATURAL GAS AND PROPANE PIPING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Pipe and Pipe Fittings.
B. Valves.
C. Natural Gas Piping System.
D. Propane Piping System.

1.2 QUALITY ASSURANCE

A. Valves: Manufacturer's name and pressure rating marked on valve body. Remanufactured valves are not acceptable.

B. Welding Materials, Procedures, and Operators: Conform to ASME Section 9, ANSI/AWS D1.1, and applicable state labor regulations.

C. Welders Certification: In accordance with ANSI/ASME Sec 9 or ANSI/AWS D1.1.

1.3 SUBMITTALS

A. Submit product data under provisions of Section 22 05 00. Include data on pipe materials, fittings, valves, and accessories.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Store and protect piping to prevent entrance of foreign matter into pipe and to prevent exterior corrosion.

B. Deliver and store valves in shipping containers with labeling in place.

1.5 COORDINATION DRAWINGS

A. Reference Coordination Drawings article in Section 22 05 00 for the required natural gas piping system electronic CAD drawings to be provided to Coordinating Contractor for inclusion into composite coordination drawings.

PART 2 - PRODUCTS

2.1 NATURAL GAS (0 TO 125 PSI)
PROPANE (0 TO 125 PSI)

A. Design Pressure: 125 psi.
Maximum Design Temperature: 350ºF

B. Piping - 2" and Under:

1. Pipe: Standard weight steel, threaded and coupled, ASTM A53.

2. Joints: Screwed. (NOTE: For below ground, all sizes to have welded joints.)

3. Fittings: 150# steam - 300# CWP, black malleable iron, banded, ASTM A197, ANSI B16.3.

4. Unions: 250# - 500# CWP, black malleable iron, ANSI B16.39, ground joint with brass seat.

C. Piping – 2" and Under:

1. Pipe: Corrugated stainless steel tubing, ASTM A240 Series 300 stainless steel, ANSI AGA-LC1.

2. Jacket: UV resistant, electrically conductive polyethylene, color: black, ASTM E84 25-50 flame and smoke.

3. Fittings: Brass with mechanical ends to fit tubing. ASME B1.20.1 threaded ends for connections to threaded pipes and components.

4. Striker Plates: Minimum 16 gaugehardened steel, corrosion resistant, primed and zinc coated. Install to protect tubing from penetrations.

5. Limits: 5 psi or less. For use only at termination to fixed outlets or equipment, maximum length: 48". Provide malleable iron, flange mounted, straight or 90 fitting at wall termination with maximum 12" length of tubing on inlet of flange.

6. Manufacturer: TracPipe, Gastite, Parker PGP2.

D. Piping – 2" and Under:

1. Pipe: Corrugated stainless steel tubing, ASTM A240 Series 300 stainless steel, ANSI AGA-LC1.

2. Jacket: UV resistant, electrically conductive polyethylene, color: black, ASTM E84 25-50 flame and smoke.

3. Sleeve: Polyethylene, pre-sleeved from factory with field installed vent tees and water/gas tight heat shrink cuffs on each end.

4. Fittings: Brass with mechanical ends to fit tubing. ASME B1.20.1 threaded ends for connection to threaded pipes and components.

5. Limits: 5 psi or less. Below ground – inside building.

6. Manufacturer: TracPipe.

E. Piping - 2-1/2" and Over:

1. Pipe: Standard weight black steel, beveled ends, ASTM A53.

2. Joints: Butt welded and flanged.

3. Fittings: Standard weight seamless steel, butt weld type, ASTM A234, Grade I, ANSI B16.9.

4. Flanges: 150# forged steel, weld neck or slip-on, ASTM A181, Grade I, ANSI B16.5.

F. Shutoff Valves/Throttling Valves:

1. BA-13: 2" and under, threaded 600 psi CWP; UL listed for 250# LP, flammable liquid, heating oil, natural and manufactured gases, 150 psi steam, bronze body and chrome plated brass ball, Teflon seats and packing. Apollo #80-100, Nibco #T580-70-UL or #T585-70-UL, Watts #B-6000.

2. PL-1: 2" and under, 125# steam @ 450ºF, 175# CWP @ 180ºF, cast iron body, screwed, full port. Walworth #1700, DeZurik #425, S-RS49.

3. PL-2: 2-1/2" thru 4", 125# steam @ 450ºF, 175# CWP @ 180ºF, flanged, cast iron body, full port. Walworth #1700F, DeZurik #425, F-RS49.

2.2 DRAIN VALVES AND BLOWDOWN VALVES

A. Drain valve and blowdown valve shall mean a shutoff valve as specified for the intended service with added 3/4" male hose thread outlet, cap, and retaining chain.

PART 3 - EXECUTION

3.1 PREPARATION

A. Ream pipe and tube ends, remove burrs, bevel plain end ferrous pipe.

B. Remove scale and dirt on inside and outside before assembly.

C. Connect to all equipment with flanges or unions.

D. After completion, fill, clean, and treat systems. Refer to Section 23 25 00 for treatment.

3.2 TESTING PIPING

A. Low Pressure - Up to 1 psi:

1. Test piping with 20 psi air pressure. System must hold this pressure without adding air for two hours.

B. High Pressure - Above 1 psi:

1. Test piping with compressed air at twice the operating gas pressure, but at least 20 psi. System must hold this pressure without adding air for two hours.

C. A non-combustible odorant, such as oil of wintergreen, may be added to help locate leaks.

3.3 CLEANING PIPING

A. Assembly:

1. Prior to assembly of pipe and piping components, remove all loose dirt, scale, oil and other foreign matter on internal or external surfaces by means consistent with good piping practice subject to approval of the Architect/Engineer. Blow chips and burrs out of pipe before assembly. Wipe cutting oil from internal and external surfaces.

2. During fabrication and assembly, remove slag and weld spatter from both internal and external joints by peening, chipping and wire brushing to the degree consistent with good piping practices.

3. Notify the Architect/Engineer prior to starting any post erection cleaning operation in time to allow witnessing the operation. Properly dispose of cleaning and flushing fluids.

4. Prior to blowing or flushing erected piping systems, disconnect all instrumentation and equipment, open wide all valves, control valves, and balance valves, and verify all strainer screens are in place.

3.4 INSTALLATION

A. Route piping in orderly manner, straight, plumb, with consistent pitch, parallel to building structure, with minimum use of offsets and couplings. Provide only offsets required for needed headroom or clearance and needed flexibility in pipe system.

B. Install piping to conserve building space, and not interfere with other work.

C. Do not install piping or other equipment above electrical switchboards or panelboards. This includes a dedicated space extending 25 feet from the floor to the structural ceiling with width and depth equal to the equipment.

D. Group piping whenever practical at common elevations.

E. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

F. Provide valve position indicator on all valves 10'-0" or greater above finish floor and not located above ceiling.

G. Provide clearance for access to valves and fittings.

H. Provide access doors where valves are not exposed.

I. Prepare pipe, fittings, supports, and accessories for finish painting.

J. Install valves with stems upright or horizontal, not inverted.

K. Provide shutoff valves and flanges or unions at all connections to equipment, traps, and items that require servicing.

L. Arrange piping and piping connections so equipment may be serviced or totally removed without disturbing piping beyond final connections and associated shutoff valves.

M. Reducers are generally not shown. Where pipe sizes change at tee, the tee shall be the size of the largest pipe shown connecting to it. Where pipe sizes are not shown, the larger size in either direction shall continue through the fitting nearest to the indication of a smaller pipe size.

N. Lay all underground piping in trenches. Provide and operate pumping equipment to keep trenches free of water.

O. Provide flanges or unions at all final connections to equipment, traps and valves.

P. Seal pipes passing through exterior walls with a wall seal per Section 23 05 29. Provide Schedule 40 galvanized sleeve at least 2 pipe sizes larger than the pipe.

Q. For all underground piping, provide a foundation (the layer below the bedding) if the trench bottom is unstable. Lay underground plastic piping on 4" to 6" of sand bedding. When the trench is in rock, lay underground metallic piping on 6" of sand bedding. Provide recessed areas for pipe bells and joints. After joints are made, any misalignment in elevation shall be corrected by tamping sand around the pipe. Backfill with sand in uniform layers not over 6" deep to the spring line of all underground pipes, and carefully compact each layer to 90 percent Standard Proctor density. Backfill with sand up to 6" above pipe for landscaped areas. Remaining backfill may be soil. Under paving and buildings, the remaining backfill shall be sand and compacted to 98 percent Standard Proctor density.

R. All vertical pipe drops to equipment installed below the ceiling shall be routed within a wall cavity, unless specifically noted otherwise to be surface mounted.

S. Install underground plastic pipe with an electrically continuous corrosion-resistant tracer wire (minimum AWG 14) or tape per section 22 05 53 to facilitate locating. One end of the tracer wire or tape shall be brought aboveground at a building wall or riser.

T. Install corrugated, stainless steel tubing system according to manufacturer's written instructions. Include striker plates to protect tubing from puncture where tubing is restrained and cannot move.

U. Install underground, sleeved, corrugated, stainless steel tubing system according to manufacturer's written instructions. Extend vent from sleeve to exterior of building and terminate with screened elbow.

V. Each above ground portion of a corrugated stainless steel tubing gas piping systems shall be bonded to the electrical service grounding electrode system. The bonding jumper shall connect to a metallic pipe or fitting between the point of delivery and the first downstream corrugated stainless steel tube fitting. The bonding jumper shall not be smaller than 6 AWG copper wire or equivalent. Gas piping systems that contain one or more segments of corrugated stainless steel tubing shall be bonded in accordance with this section.

W. Each above ground portion of a gas piping system, other than corrugated stainless steel tubing systems, that is likely to become energized shall be electrically continuous and bonded to an effective ground-fault current path. Gas piping, other than corrugated stainless steel tubing, shall be considered to be bonded when it is connected to appliances that are connected to the appliance grounding conductor of the circuit supplying that appliance.

X. Gas piping shall not be used as a grounding conductor or electrode.

Y. Where a lightning protection system is installed, the bonding of the gas piping shall be in accordance with NFPA 780, Standard for the Installation of Lightning Protection Systems.

3.5 PIPE ERECTION AND LAYING

A. Carefully inspect all pipe, fittings, valves, equipment and accessories prior to installation. Immediately reject and remove from the job any items which are unsuitable, cracked or otherwise defective.

B. All pipe, fittings, valves, equipment and accessories shall have factory-applied markings, stampings, or nameplates sufficient to determine their conformance with specified requirements.

C. Exercise care at every stage of storage, handling, laying and erecting to prevent entry of foreign matter into piping, fittings, valves, equipment and accessories. Do not erect or install any unclean item.

D. During construction, until system is fully operational, keep all openings in piping and equipment closed at all times except when actual work is being performed on that item. Closures shall be plugs, caps, blind flanges or other items designed for this purpose.

E. Change direction of pipes only with fittings or pipe bends. Change size only with fittings. Do not use miter fittings, face or flush bushings, or street elbows. **All fittings shall be long radius type**, unless otherwise shown on the drawings or specified. Construct welded elbows of angles not available as standard fittings by cutting and welding standard elbows to form smooth, long radius fittings.

F. Use full and double lengths of pipe wherever possible.

G. Cut all pipe to exact measurement and install without springing or forcing.

H. Do not create, even temporarily, undue loads, forces or strains on valves, equipment or building elements.

I. Underground pipe shall be laid in dry trenches maintained free of accumulated water. Provide and operate sufficient pumping equipment to maintain excavations, trenches and pits free of water. Dispose of pumped water so operation areas and other facilities are not flooded. Pipe laying shall follow excavating as closely as possible.

3.6 DRAINING AND VENTING

A. Unless otherwise indicated on the drawings, all horizontal pipes, including branches, shall pitch 1" in 40 feet to low points for complete drainage.

B. Use eccentric reducing fittings on horizontal runs when changing size for proper drainage and venting. Install gas pipes with bottom of pipe and eccentric reducers in a continuous line.

C. Provide drip legs at low points and at the base of all risers in gas pipes. Drip legs shall be full line size on pipes through 4" and at least 4", but not less than half line size over 4". Drip legs shall be 12" minimum length, capped with a reducer to a drain valve.

3.7 BRANCH CONNECTIONS

A. Make branch connections with standard tee or cross fittings of the type required for the service unless otherwise specified herein or detailed on the drawings.

B. At the option of the Contractor, branch connections from headers and mains may be cut into black steel pipe using forged weld-on fittings.

C. Use of forged weld-on fittings is also limited as follows:

1. Must have at least same pressure rating as the main.
2. Header or main must be 2-1/2" or over.
3. Branch line is at least two pipe sizes under header or main size.

D. Reducers are generally not shown. Where pipe sizes change at tee, the tee shall be the size of the largest pipe shown connecting to it.

E. All branch piping connections for natural gas shall take off on the top or on the side of the main.

3.8 JOINING OF PIPE

A. Threaded Joints:

1. Ream pipe ends and remove all burrs and chips.
2. Protect plated pipe and valve bodies from wrench marks when making up joints.
3. Apply Teflon tape to male threads.

B. Flanged Joints:

1. Steel flanges shall be raised face.

2. Bolting for services up to 500ºF shall be ASTM A307 Grade B with square head bolts and heavy hexagonal nuts conforming to ANSI B18.2.1 "Square and Hex Bolts" and B18.2.2 "Square and Hex Nuts".

3. Torque bolts in at least three passes, tightening to 1/3, 2/3, and final torque in a cross pattern with an indicating torque wrench for equal tension in all bolts.

4. Gaskets for flat face flanges shall be full face type. Gaskets for raised faced flanges shall conform to requirements for "Group I Gaskets" in ANSI B16.5. Unless otherwise specified gaskets shall meet the following requirements:

   a. Gasket material and thickness approved by manufacturer for intended service, chemical compatibility, pipe system test pressure, and operating temperature range.

   b. Maximum pressure rating of at least 250 psig.

   c. Minimum temperature rating: -10°F.

   d. Maximum temperature rating of at least 170°F for water systems operating 140°F and less.

C. Welded Joints:

1. Welding of all pipe joints, both as to procedures and qualification of welders, shall be in accordance with Section IX, ASME "Boiler & Pressure Vessel Code" unless local codes take precedence.

2. Furnish certificates qualifying each welder to the Owner's Representative prior to start of work.

3. The Owner's Representative reserves the right to require qualifying demonstration, at the Contractor's expense, of any welders assigned to the job.

4. Ends of pipe and fittings to be joined by butt-welding shall be beveled, cleaned to bare metal and internal diameters aligned before tack welding.

5. Backing rings shall be used for all butt weld joints 3" size and over, and for all sizes where operating pressure is over 200 psig and/or temperature is over 400ºF. Backing rings shall be of the material being welded.

3.9 PAINTING EXPOSED PIPE

A. Paint all outdoor exposed natural gas piping the color selected by Owner or Architect/Engineer.

3.10 SERVICE CONNECTIONS

A. Provide new gas service complete with gas meter and regulators. Verify gas service pressure with the Utility Company. Gas meter shall have pulse output to allow monitoring by building management system.

END OF SECTION

SECTION 22 10 30
PLUMBING SPECIALTIES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Floor Drains.
B. Cleanouts.
C. Traps.
D. Backflow Preventers.
E. Water Hammer Arresters and Air Chambers.

1.2 QUALITY ASSURANCE

A. Manufacturer: For each product specified, provide components by same manufacturer throughout.

1.3 SUBMITTALS

A. Submit shop drawings under provisions of Section 22 05 00.

B. Include sizes, rough-in requirements, service sizes, and finishes.

PART 2 - PRODUCTS

2.1 CLEANOUTS

A. Provide cleanouts as shown and specified on the drawings as well as required by code.

B. Coordinate floor cleanout cover with surrounding floor finish. Provide either solid, recessed for tile or terrazzo or carpet marker as applicable.

C. Cleanouts on exposed pipes shall be cast iron with heavy duty cast brass plug with raised head.

D. Cleanout shall be same size as the pipe up to 6" and 6" for larger pipes.

2.2 YARD CLEANOUTS

A. Provide yard cleanouts as shown and specified on the drawings as well as required by code.

B. Cleanout shall be same size as pipe up to 6" and 6" for larger pipes.

2.3 TRAPS

A. Provide all individual connections to the sanitary system with P-traps, except where such drains discharge directly into a properly trapped collection basin or sump. Unless otherwise specified or shown, traps shall be:

1. Chromium plated cast brass when used with plumbing fixtures or when installed exposed in finished spaces.

2. Insulated at accessible lavatories.

3. Cast iron, deep-seal pattern where concealed above ceiling, below grade or in unfinished areas.

4. Deep-seal pattern of the same material and/or coating where drainage lines are of special materials or coatings such as polypropylene, PVDF, CPVC, etc.

B. All traps shall have accessible, removable cleanouts, except where installed on floor drains with removable strainers.

C. Each trap shall be completely filled with water at the end of construction but before building turnover to the Owner. All floor drains, floor sinks, trench drains, etc. shall be filled with water and a 1/2" minimum layer of mineral oil.

2.4 FLOOR DRAINS AND SINKS

A. Provide floor drains and sinks as shown and specified on the drawings as well as required by code.

2.5 BACKFLOW PREVENTERS

A. Provide backflow preventers as shown and specified on the drawings as well as required by code.

2.6 WATER HAMMER ARRESTERS AND AIR CHAMBERS

A. Provide water hammer arresters as shown and specified on the drawings as well as required by code.

B. ANSI A112.26.1; sized and located in accordance with PDI WH-201, precharged for operation between -100ºF and 300ºF and maximum 250 psig working pressure.

C. Air chambers shall meet the requirements of the applicable plumbing code. Minimum 12" long at fixtures and minimum 24" long on risers. Air chambers shall be the same size or larger than the piping it is connected to.

PART 3 - EXECUTION

3.1 INSTALLATION AND APPLICATION

A. Coordinate construction to receive drains at required invert elevations.

B. Install all items per manufacturer's instructions.

C. Water Hammer Arresters and Air Chambers:

1. Install water hammer arresters in accessible locations. Provide access doors as required. Coordinate type with Architect/Engineer/Owner.

2. Water hammer arrestors shall be installed in cold and hot water lines upstream of all plumbing fixtures or equipment, with a quick acting valve or multiple quick acting valves. Quick acting valves shall be defined as solenoid actuated valves, manual flush valves, sensor activated faucets and flush valves, squeeze handle spray faucets, and other similar type valves.

3. Install multiple water hammer arrestors in toilet group branch piping greater than 20 feet in developed length from the cold and hot water mains.

4. Install air chambers at each fixture not protected by a water hammer arrester.

D. Cleanouts:

1. Provide cleanouts where shown on the drawings and as required by code, but in no case farther apart than 50 feet in pipe less than 6" size and 75 feet apart in 6" and larger pipes inside the building.

2. Provide cleanouts at bases of all sanitary and storm risers as shown on the drawings and as required by code.

3. Extend cleanouts to the floor with long sweep elbows.

4. Install a full size, two-way cleanout within 5 feet of the foundation inside or outside of building.

5. Extend cleanouts to finished floor or wall surface. Lubricate threaded cleanout plugs with graphite and linseed oil. Ensure clearance at cleanouts for rodding of drainage system.

6. Wall cleanouts shall be installed above the flow line of the pipe they serve, but no less than 12" above the finished floor.

E. Yard Cleanouts:

1. Install cleanouts on maximum 90 foot centers (including riser) for pipes 8" and smaller.

2. Extend cleanout to grade. Encase cleanout in 5" thick concrete pad extending 6" beyond cleanout, set low enough not to interfere with lawn mowers.

F. Floor Drains:

1. Drains in upper floors shall have a flashing of EPDM or similar membrane sheet. The sheet shall be at least 36" X 36" square with the drain in the center. Clamp membrane in auxiliary clamping ring of floor drain.

2. Use alternate sealing method when installing drains in existing floor slabs.

3. Coordinate sloping requirements with the architectural plans and specifications.

G. Backflow Preventer:

1. Provide an air gap fitting and piping to drain. On 2-1/2" and larger units, install a tail piece from air gap fitting to drain to prevent water from spraying out of drain air gap receptor. Maintain air gap distance required by Code.

2. Units shall be field tested and tagged in accordance with manufacturer's instructions and applicable codes by a certified tester before initial operation.

3. Install unit between 12" and 60" above finish floor.

END OF SECTION

SECTION 22 30 00
PLUMBING EQUIPMENT

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Water Heaters.
B. Water Softeners.

1.2 QUALITY ASSURANCE

A. Products and installation of specified products shall conform to recommendations and requirements of the following organizations:

1. American Gas Association (AGA).
2. National Sanitation Foundation (NSF).
3. American Society of Mechanical Engineers (ASME).
4. National Board of Boiler and Pressure Vessel Inspectors (NBBPVI).
5. National Electrical Manufacturers' Association (NEMA).
6. Underwriters' Laboratories (UL).

1.3 SUBMITTALS

A. Submit shop drawings under provisions of Section 22 05 00.

B. Include dimension drawings of water heaters indicating components and connections to other equipment and piping.

C. Include heat exchanger dimensions, size of tappings, and performance data.

D. Include dimensions of tanks, tank lining methods, anchors, attachments, lifting points, tappings, and drains.

E. For equipment connected to an electric power source, submit short circuit rating (SCCR) of integrated unit.

F. Submit manufacturer's installation instructions including control and wiring diagrams.

G. Submit manufacturer's certificate that pressure vessels meet or exceed specified requirements.

H. Submit operation, maintenance, and inspection data, replacement part numbers and availability, and service depot location and telephone number.

I. Submit a current water analysis from the actual water source serving the project site for softening equipment verification before sending shop drawings to the Architect/Engineer.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Provide temporary inlet and outlet caps. Maintain caps in place until installation.

1.5 REGULATORY REQUIREMENTS

A. Water heaters shall conform to AGA, ANSI/NFPA 54, ANSI/NFPA 70, ANSI/UL 1453 as applicable.

B. Conform to ANSI/ASME Section 8 Division 1 for fabrication of steel pressure vessels.

C. Conform to ANSI/ASME Section 10 for manufacture of fiber-reinforced plastic pressure vessels.

PART 2 - PRODUCTS

2.1 WATER HEATERS

A. All water heaters shall be as scheduled on the drawings and per 23 33 39 specification.

2.2 COMMERCIAL WATER SOFTENER

A. Automatic duplex water softener to remove hardness to no more than 1.0 grains per gallon as determined by an ASTM Standard Soap Test Method.

B. Incoming water contains approximately 21 grains per gallon based on information obtained from the local utility. Obtain a current water sample from the water source serving that will be serving the project and have it analyzed to make sure equipment can perform as designed. Provide report to the Architect/Engineer before providing shop drawings.

C. Softener Tanks: Fiberglass reinforced polyester, designed for a minimum working pressure of 100 psig, hydrostatically tested at 150% of working pressure. Sideshell height to allow a minimum freeboard space of 50% of the mineral bed depth for adequate expansion during backwashing. Softener tank not over 13 inches diameter, 54 inches sideshell height. Tank bottom will be supported with a molded structural base. The top opening will be 1.5 inches with a threaded connection.

D. Distribution System: Soft water collector and backwash distributor, hub and arm radial or healer lateral type lower distribution system. Distribution shall be covered with a single layer of washed inorganic media to evenly distribute the service and backwash water and support the mineral bed tank.

E. Brine Tank: Rigid polyethylene or fiberglass with tight fitting cover, size not over 18 inches diameter, 40 inches height, corrosion-free elevated salt platform, float-operated plastic fitted brine valve to control brine withdrawal and freshwater refill. The brine valve shall provide positive shutoff to prevent air from entering the system. Brine eductor shall dilute brine flow to softener. Brine shall be provided with a float-operated shutoff valve to keep the tank from overfilling.

1. Provide initial fill of brine tank with manufacturer recommended salt product. Tank shall be full at time the Owner is given occupancy.

F. Softener Ion Exchange Resin: Virgin, high capacity, standard mesh of sulfonated polystyrene type stable over the entire PH range, with good resistance to bead fracture from attrition or osmotic shock. Solid resin, of the proper particle size of 20 to 50 mesh, U.S. standard screen, and will contain no agglomerates, shells, plates, or other shapes to interfere with normal function of water softener. The system shall include 2 cubic feet of exchange resin per vessel and a total of 4 cubic feet of resin for the system.

G. System Efficiency: System shall have minimum efficiency of 4000 grains of hardness removed per pound of salt usage. Include brine reclaim if required to meet the efficiency requirements if normal system does not have this minimum efficiency requirement.

H. Pipes, Valves and Fittings: Pipe shall be galvanized, standard weight steel, Type L copper, or Schedule 5 stainless steel. Fittings shall be 125 lb. Class malleable iron for steel, Type L for copper, and Schedule 5 for stainless steel. All piping shipped assembled shall be hydrostatically tested for leaks at the factory.

I. Water Testing Equipment: Complete with sample cock installed to obtain samples of effluent water. Furnish a complete test kit for conducting soap tests.

J. Automatic Controls:

1. System design shall use Demand Recall controls.

2. The main control shall be a fully automatic, top-mounted brass control and sized with 1.5 inch NPT inlet and outlet connections. The top-mounted main control design will be motor driven, mechanically activated, with five pistons to accomplish the regeneration steps of backwash, brine draw/rinse, fast rinse, and brine refill, in addition to the service position.

3. The main control shall incorporate self-adjusting flow regulators to control the rate of flow and prevent resin loss during backwash, regardless of the system pressure fluctuations between 30 and 120 psig.

4. Valves shall be controlled by integral electronic controls. Controls shall display status of each unit with respect to service and regeneration. Controls for multi-tank systems shall be capable of operating units simultaneously, alternating unit service, or progressively bringing additional units on and off line as needed to maintain flow rates and reduce risk of channeling.

5. Regeneration shall be initiated by volume programmed so units are unable to regenerate simultaneously.

6. The unit shall be supplied so that the valve will allow automatic bypass of untreated water during regeneration. The bypass shall be integral to the main control.

7. All control mechanisms shall be enclosed in a UL listed NEMA 3 enclosure. A fully integrated, programmable, microprocessor-driven electronic controller shall be provided to automatically cycle the main control through the regeneration sequence.

8. Each controller shall be provided with dry contacts that will be able to send alarms to the building automation system.

9. Electrical Requirements: Each valve shall be prewired with a plug and cord and an inline breaker to plug into a standard receptacle or wired to a common control panel so a single electrical connection can be provided. 120 volt-single phase. Electric power shall not be needed for manual regeneration. Inlet hydraulic pressure shall be required.

K. Extra Stock:

1. Furnish extra materials as listed below that match products installed and that are packaged and labeled for storage.

   a. Provide 200 lbs. additional salt in the same form as the original load. Salt shall be delivered and stored on pallet(s). Locate the pallet(s) per the Owner's direction.

   b. Provide one additional gasket for each handhole and manway.

L. Warranty:

1. Provide a standard one-year warranty on the entire unit from the date of final acceptance.

2. Provide a standard two-year warranty on the control valve internal parts, the brine valve and associated parts, and the salt storage container internal components.

3. Provide a standard five-year warranty on the control valve body, fiberglass wound container(s) (if applicable), salt storage container(s) (if applicable), and epoxy lined steel conditioner tank(s) (if applicable).

M. Acceptable Manufacturers: Hellenbrand, Capitol Water Softener, Sterling, Avid.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install all items in accordance with manufacturer's instructions.

3.2 WATER HEATER INSTALLATION

A. Install water heaters on concrete bases. Coordinate sizes and locations of concrete bases. Refer to Section 22 05 29.

B. Install water heaters level and plumb, according to drawings, manufacturer's instructions, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.

C. Install combination temperature and pressure relief valves in top portion of storage tanks. Use relief valves with sensing elements that extend into tanks. Extend drain piping full size from relief valve and discharge by positive air gap onto closest floor drain. Discharge pipe material shall be same as domestic water piping.

D. Install gas water heaters according to NFPA 54.

3.3 WATER SOFTENER INSTALLATION

A. Verify connection sizes and piping type with cold water and soft cold water piping. Provide dielectric connection between dissimilar metals. Pressure gauges are required at hard water inlet and soft water outlet of each softener.

B. Provide system start-up and subsequent service, with stocking of spare parts by authorized dealer or factory trained personnel.

C. Provide complete instructions covering installation and operation of the softening system in booklet form. All components shall be easily identified, in exploded views, by individual part number.

D. Provide six hours of instruction and orientation to the Owner's maintenance staff by factory trained personnel. System walk-through, including programming of any system controllers shall be included in training.

END OF SECTION

SECTION 22 33 39
SOLAR WATER HEATING SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Solar System Piping and Insulation
B. Solar Collector Subsystem
C. Solar Collector Array
D. Solar Equipment
E. Control and Instrumentation Subsystem

1.2 QUALITY ASSURANCE

A. Installer shall be NABCEP certified. Exceptions can be made if installer is member of NABCEP Exam Committee, which prohibits him/her from participating in the exam, and if he/she can show experience of being the lead worker on five (5) solar thermal projects, where at least two (2) of them must have been commercial projects. Exceptions also can be made for participants of the most recent NABCEP certification test if the installer passed the test but certification is not yet issued. The qualified and certified installer has to be the supervisor and at the job site during installation.

1.3 SUBMITTALS

A. Submit shop drawings under provisions of Section 22 05 00.

B. Include products data with performance charts and curves for all equipment and components. Annotate descriptive data to show the specific model, type, and size of each item.

C. Include modeling report completed by Contractor. Modeling report shall be a Focus On Energy recognized modeling report equivalent to RetScreen, demonstrating the solar energy delivered with submitted equipment. Report to include 3% losses, 80% heat exchanger effectiveness.

1. Statements:

a. Prior to installation, submit data showing that this Contractor has successfully installed systems of the same type and design as specified herein.

2. Final Drawings and Data:

a. Collector Array Structural Information:

1) Prepare and submit shop drawings detailing the fabrication and erection of each solar collector and array. Include plans, elevations, sections, and details of the fabrications and their connections. Submittal shall include the seal of a qualified Professional Engineer who was responsible for their preparation.

b. Operating and Maintenance Manuals:

1) Submit manuals that detail the step-by-step procedures required for system filling, startup, operation, and shutdown. Include in the manuals the manufacturer's name, model number, service manual, parts list, and brief descriptions of all equipment and its basic operating features. List routine maintenance procedures, possible breakdowns and repairs, recommended spare parts, troubleshooting guide, piping and equipment layout, balanced fluid flow rates, and simplified wiring and control diagrams of the system as installed.

3. Field Test Reports:

a. Submit reports of piping hydraulic pressure test.
b. Submit reports of water potability test.
c. Submit results of system performance testing.

1.4 DEFINITIONS

A. The term "solar" for the purposes of this specification covers systems that intercept solar radiation and convert it to thermal energy. The thermal energy is collected by a heat transfer fluid and transferred through a heat exchanger to a thermal energy storage tank for use.

1.5 SYSTEM DESCRIPTION

A. Design Requirements:

1. Furnish and install new solar water heating (SHW) system for the pre-heating of domestic water. System types incorporating both freeze protection and overheat protection are required. Supplied equipment must be rated and warranted to withstand and operate below lowest-record-low and above highest-record-high temperature for the location.

2. Solar collectors are to be mounted where indicated on plans. System must be of a type suitable to the climate of the site.

3. Include, with system, components that consist of solar collector arrays, array support structure, storage tank, interconnecting piping and fittings, flush-and-fill valves, pressure relief valves, and, as required by the system type, any necessary pumps, controls or heat exchangers, as well as all other accessories and equipment required for the proper operation of the solar system.

4. Include with system all labor, supervision, equipment inside and outside the building, tools, materials, and incidentals necessary to design, procure, install, checkout, and place into operation a complete solar water heating system ready for use for the building.

B. Performance Requirements:

1. Solar water heating systems must be safe, reliable, require no operator intervention for normal operation, be visually unobtrusive, and be designed and installed in accordance with Focus On Energy Standards and Guidelines for solar water heating systems and all applicable state and local codes. The Contractor shall be responsible for providing a complete working solar system.

PART 2 - PRODUCTS

2.1 GENERAL EQUIPMENT REQUIREMENTS

A. Standard or Pre-approved Products:

1. Furnish materials and equipment that are the standard products of a manufacturer regularly engaged in the manufacture of such products and that essentially duplicate items that have been in satisfactory use for at least six (6) months prior to bid opening. Collectors must be OG-100 rated, and packages must be OG-300 rated (SRCC).

B. Nameplates:

1. Secure to each major item of equipment a plate with the manufacturer's name, address, type or style, model or serial number, and catalog number.

2.2 PIPING SYSTEM

A. Provide a piping system complete with pipe, pipe fittings, valves, strainers, expansion loops, pipe hangers, inserts, supports, anchors, guides, sleeves, and accessories in accordance with this section and the drawings.

B. Pipe Material:

1. Tubing: Type L hard drawn seamless copper tube, ASTM B88.

2. Joints: Solder with 100% lead-free solder and flux, ASTM B32.

3. Fittings: Wrought copper solder joint, ANSI B16.22.

4. Valves and Accessories: Refer to Section 22 10 00 for performance requirements.

C. Pipe and Equipment Insulation:

1. Refer to Section 22 17 19 for insulation requirements on domestic water side of solar system.

2. Solar water supply and return piping shall be insulated as follows:

a. Provide elastomeric cellular foam insulation rated for 300°F. ANSI/ASTM C534; flexible plastic; 0.28 maximum 'K' value at 75ºF, 25/50 flame spread/smoke developed rating. Maximum 3/4" thick per layer where multiple layers are specified.

b. Where exposed to the outdoors, provide aluminum jacketing, plastic jacketing, or a Kraft-reinforced foil vapor barrier meeting the following requirements.

1) Aluminum Jackets: ASTM B209; 0.016" thick; stucco embossed finish with Z edge seams and aluminum bands for outdoor use. Where colored jacket covers are called for, provide factory-applied hard film acrylic paint in color selected by Architect.

2) Plastic Jackets and Fitting Covers: High impact, glossy white, 0.020” thick, self-extinguishing plastic. Suitable for use indoors or outdoors with ultraviolet inhibitors. Suitable for -40ºF to 150ºF. 25/50 maximum flame spread/smoke developed.

3) Kraft-reinforced foil vapor barrier with self-sealing adhesive joints. Beach puncture resistance ratio of at least 50 units. Tensile strength: 35 psi minimum. Single, self-seal acrylic adhesive on longitudinal jacket laps and butt strips.

4) Provide interior pipe insulation and coverings such as Armaflex, Insul-Tube, Rubatex, or approved equivalent. Provide outside array piping insulation with a capability of withstanding 250°F, except that piping insulation within 1.5 feet of collector connections shall be capable of withstanding 400°F. Protect outside piping insulation from water damage and ultraviolet degradation with a suitable outer coating manufactured for this purpose (aluminum, sunlight resistant PVC, Venture clad or approved equal).

D. Installation:

1. Provide, install, and test the piping and insulation in accordance with the following sections:

Section 22 05 00	Basic Plumbing Requirements
Section 22 05 29	Plumbing Supports and Anchors
Section 22 05 53	Plumbing Identification
Section 22 07 19	Plumbing Piping Insulation
Section 22 09 00	Instrumentation
Section 22 10 00	Plumbing Piping
Section 22 10 30	Plumbing Specialties

2.3 COLLECTOR SUBSYSTEM

A. Solar Collector Construction:

1. Collectors:

a. Manufacturers: Solar Skies, HTP, SunEarth, Alternate Energy Technologies, Heliodyne, Viessmann, or approved equal.
b. Type: Flat plate, SRCC approved; must be listed in RETScreen manufacturer list; SRCC clear day rating of at least 990 BTU/sq.ft of collector gross area at the "C" rating.
c. Absorber Coating: Blue-sputtered or selective surface (not black paint).
d. Glazing: Low iron tempered glass; with rubber gasket fitted to the edges; anti-glare finish.
e. Glazing Support: Fastener independent, compression type.
f. Glazing Gasket: Continuous U-shaped EPDM with molded corners.
g. Frame: All anodized extruded aluminum.
h. Backing: Aluminum sheet.
i. Fasteners: Stainless steel screws and other fastening hardware.
j. Header Connection: 1' machined brass Dyn-O-Seal unions with captive O-ring.
k. Header Grommets: Deep-grooved, wide-overlap EPDM.
l. Ventilation: Rain-shielded weep slots.
m. Insulation: Fiberglass over aluminum backed polyisocyanurate.
n. Mounting: Built-in mounting flange all around the perimeter.

2. Mounting Hardware:

a. Non-corroding aluminum for rails and stainless steel for washers, nuts, and bolts is to be used. Use all by manufacturer of collector and/or mounting hardware recommended parts.
b. Use manufacturer hardware for seam roof mounting, side rack mounting, vertical surface, and horizontal surface mounting.
c. Ballasted racks must be made of aluminum with stainless steel fasteners.

3. Furnish collectors of weathertight construction and with an aluminum casing. Provide aluminum or stainless steel mounting brackets and hinges. Furnish stainless steel assembly hardware including all bolts, washers, and nuts. Install collectors such that tubes on the absorber plate drain by gravity. Provide cover glazing completely replaceable from the front of the collector without disturbing the piping or adjacent collectors.

B. Collector Warranty:

1. Provide a minimum 10-year warranty against the following: failure of manifold or riser tubing, joints or fittings; degradation of absorber plate selective surface; rusting or discoloration of collector hardware; and embrittlement of header manifold seals. Include with the warranty full repair or replacement of defective materials or equipment.

C. Solar Collector Performance:

1. Plot thermal performance on the thermal efficiency curve in accordance with ASHRAE 93 showing the product of glazing transmittance and plate absorptivity and also the thermal loss coefficient (btu/hr/F) of the solar collector. Show manufacturer's recommended volumetric flow rate and the design pressure drop at the recommended flow rate. Indicate the manufacturer's recommendations for the number of collectors to be joined per bank while providing for balanced flow and for thermal expansion considerations.

2.4 SOLAR COLLECTOR ARRAY

A. Net Absorber Area and Array Layout:

1. Collector array shall be oriented so that all collectors face the same direction. Space collectors arranged in multiple rows so that no shading from other collectors is evident between 900 hours and 1500 hours solar time on December 21. Collectors should be south-facing and a tilt equal to or greater than the local latitude, but other orientations may be considered for approval. Collectors shall be tilted enough to prohibit snow accumulation.

B. Piping:

1. Connect interconnecting array piping between solar collectors in a reverse-return configuration, with approximately equal pipe length for any possible flow path. Indicate flow rate through the collector array. Provide each collector bank isolated by valves with a pressure relief valve and with the capability of being drained. Locate manually operated air vents at system high points, and pitch array piping so that piping can be drained by gravity. Supply calibrated balancing valves at the inlet of each collector bank as indicated.

2. All vents to have 1/4 turn shutoff ball valve. All vents and manual shutoff to be rated at 320°F or higher.

C. Supports for Solar Collector Array:

1. Provide support structure for the collector array of aluminum, stainless steel, hot dipped galvanized, or other corrosion-resistant approved material. Furnish a support structure that secures the collector array at the proper tilt angle with respect to horizontal and orientation with respect to true south. Provide a support structure that will withstand the static weight of filled collectors and piping, wind, and other anticipated loads without damage. System shall meet local and state building codes for wind and seismic loading for area of installation. Provide a support structure that allows access to all equipment for maintenance, repair, and replacement. Neoprene or EPDM washers shall separate all dissimilar metals. Coordinate support structure with Structural Engineer prior to ordering or fabricating.

2. Support system shall be design by a qualified Professional Engineer. Refer to Submittals section for requirements.

2.5 SOLAR EQUIPMENT

A. Domestic Hot Water Storage Tank – Glass Lined:

1. Tank: Steel, 125 psi working pressure, ASME stamped, with screwed stainless steel connections.

2. Line interior with corrosion resistant glass lining a minimum thickness of 0.39” thick.

3. Provide 11" x 15" access opening and steel support saddles or legs.

4. Provide tappings for accessories. Include tank drain, water inlet and outlet, 30°F to 200°F thermometer, and pressure relief valve suitable for maximum working pressure. Refer to drawings for additional tank openings.

5. Unit shall contain an integral heat exchanger as scheduled.

6. Acceptable Manufacturers: Heat Transfer Products, Badgerland, AO Smith, or approved equal.

B. Drainback Tank:

1. Tank: 304 stainless steel, 50 psig working pressure. Dent resistant plastic covering.

2. Provide site glass to monitor water level.

3. Provide tappings for accessories. Include water inlet and outlet, fill port, and sight window connections.

4. Acceptable Manufacturers: Solar Skies, Heat Transfer Products, Rheem, or approved equal.

C. Circulating Pumps:

1. Electrically-driven, single-stage, centrifugal type circulating pump. Support pumps on a concrete foundation or mounting intended for the purpose, or by the piping on which installed if appropriate to the size. Construct the pump shaft of corrosion resistant alloy steel with a mechanical seal. Control motors with switches that can be activated by either the differential temperature controller or by manual override (Hand-Off-Automatic). Pumps shall be installed with isolation valves so the pump can be serviced without draining the system.

2. Acceptable Manufacturers: B&G, Grundfos, Armstrong, or approved equal.

D. Air Separators:

1. Separators shall be ASME constructed and stamped for 125 psi working pressure and 350ºF operating temperature.

2. Air shall be separated by centrifugal force or coalescing action.

3. Provide openings for inlet, outlet, blowdown, and expansion tank.

4. Separators shall be line size or larger, with maximum pressure drop of 1 psi. Refer to drawing for separator sizing.

5. Acceptable Manufacturers: Amtrol, Armstrong, Spirotherm, Bell & Gossett, Wheatley, Patterson.

E. Heat Transfer Fluid:

1. Fluid shall be non-toxic (food grade) propylene glycol diluted with distilled water to 50% solution. Pure fluid has to be rated to withstand 350°F. Fluid must contain buffers to avoid acid build up as fluid deteriorates.

2. Acceptable Manufacturers: Dow frost HD or approved equal.

2.6 CONTROL AND INSTRUMENTATION SUBSYSTEM

1. Solar system will be controlled by the Facility Management Control System. Refer to mechanical drawings for additional information.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Provide, install and test the systems in accordance with the following sections:

Section 22 05 29	Plumbing Supports and Anchors
Section 22 05 53	Plumbing Identification
Section 22 07 19	Plumbing Piping Insulation
Section 22 09 00	Instrumentation
Section 22 10 00	Plumbing Piping
Section 22 10 30	Plumbing Specialties

B. System Flushing and Disinfection:

1. Flush the piping system.

C. Collector Array:

1. Install solar collector array at the proper tilt angle, orientation, and elevation above roof. Install the solar collectors with the ability to be removed for maintenance, repair, or replacement.

2. Install expansion arm of 6” copper pipe to buffer header expansion.

3. Bottom of collectors shall be a minimum of 2 feet above finished roof.

D. Array Piping:

1. Install collector array piping in a reverse-return configuration so that path lengths of collector supply and return are of approximately equal length. Install air vents in the high points of the collector array piping. Provide proper pitch for draining of collector array.

E. Array Support:

1. Install array support in accordance with the recommendations of the collector manufacturer.

F. Pipe Expansion:

1. Provide for the expansion and contraction of supply and return piping with changes in the direction of the run of pipe or by expansion loops. Do not use expansion joints in the system piping.

G. Valves:

1. Install ball valves at the inlet and outlet of each bank of manifolded collectors. Install calibrated balancing valves at the inlet of each collector bank and mark final settings on each valve. Balance flow through the collector piping with at least one balancing valve left in the open position.

H. Roof Penetrations:

1. All roof penetrations shall be made permanently waterproof. Copper or other approved flashing shall be used.

2. This Contractor shall provide a five (5)-year warranty on materials and labor, including consequential damages, for any roof leaks due to or arising out of the solar water heating system installation.

3. All pipe penetrations shall be protected with a UV-resistant rubber boot seal.

3.2 INSPECTION AND TESTING

A. Testing:

1. Refer to Section 22 10 00 for testing of the piping system.

B. Instructions:

1. Provide instructions for the system type. Include in these instructions a system schematic, and wiring and control diagrams showing the complete layout of the solar system. Prepare condensed operating instructions explaining preventative maintenance procedures, balanced flow rates, methods of checking the system for normal safe operation, and procedures for safely starting and stopping the system, in typed form, framed as specified above, and posted beside the diagrams. Post the framed instructions before acceptance testing of each system.

C. Operational Test:

1. Operationally test the system over a period of 48 consecutive hours with sufficient solar radiation to cause activation of the solar energy system during daylight hours.

D. Overall System Operations:

1. Demonstrate each solar energy system will operate properly while unattended for a period of at least 72 hours. As required by system design, demonstrate the system controller will start the pumps after being warmed by the sun and that it will properly shut down during cloudy weather or in the evening over a minimum of three complete cycles. It is permissible to manipulate the temperature of the storage tank by the introduction of cold water.

E. Temperature Sensor Diagnostics:

1. As required by system design, demonstrate the controller will correctly identify open and short circuits on both the solar collector temperature sensor circuit and the storage tank sensor circuit.

3.3 CLEANING

A. Refer to Section 22 10 00 for cleaning, installing, draining, venting, joining, and disinfecting of pipe.

3.4 FIELD TRAINING

A. Provide a field training course for operating and maintenance staff members after the system is functionally complete. Include in the training a discussion of the system design and layout, and demonstrate routine operation, maintenance and troubleshooting procedures.

END OF SECTION

SECTION 22 40 00
PLUMBING FIXTURES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. All plumbing fixtures.

1.2 SUBMITTALS

A. Submit product data under provisions of Section 22 05 00. Submittals shall include fixture carriers for record purposes only. Architect/Engineer does not review or approve carriers except for manufacturer.

B. Include fixtures, sizes, rough-in dimensions, utility sizes, trim, and finishes.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Wall Hung Fixture Carriers:

1. Material: All Metal, ASME/ANSI A112.6.1M.

2. Acceptable Manufacturers: Zurn, Smith, Wade, Josam, Watts, Mifab.

3. Water closet carrier shall be rated to support 500 lbs. unless noted otherwise on the drawings.

B. All fixtures shall be as scheduled on the drawings.

C. All china shall be from the same manufacturer where possible.

D. All lavatory and sink trim shall be from the same manufacturer where possible.

E. All fixtures shall be lead free. Faucets, traps, stops, and other fixture accessories shall not contain more lead than allowed per the latest State or Federal Act.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General Installation Requirements:

1. Review millwork shop drawings. Confirm location and size of fixtures and openings before rough-in and installation.

2. Install each fixture with trap easily removable for servicing and cleaning. Use screwed tailpiece couplings. Connect fixture waste to stack with slip fitting.

3. Provide fixtures with chrome plated rigid or flexible supplies, loose key stops, reducers, and escutcheons.

4. Install components level and plumb.

5. Caulk joint between finish floor and floor mounted fixtures and between finish walls and wall mounted fixtures with silicon caulk. Caulk the joint, between rim and fixture where a fixture builds into a counter top, with caulking compound. Refer to DIVISION 7 for "Caulking" requirements. Color to match fixture.

6. Where there is a possibility of water following pipe brackets, etc., into a wall; caulk escutcheons, space around brackets, etc., to exclude water. Refer to DIVISION 7 for "Caulking" requirements.

7. Refer to Plumbing Material List for fixture mounting heights.

8. All non-potable outlets shall be clearly marked with a permanently affixed laminated sign with 3/8" high lettering saying "Non-Potable Water Not for Human Consumption." Sign shall have black lettering on a yellow background.

B. Wall-Mounted Fixture Requirements:

1. All wall-mounted fixtures shall have compatible carriers designed for their intended service and suitable for the space available and configuration of fixtures. All carriers shall extend to the floor and be anchored to the slab.

C. Floor-Mounted Fixture Requirements:

1. Where floor mounted fixtures are installed on a sloped floor, the open void below the fixture shall be grouted, leveled, and caulked to eliminate stress on the fixture and to prevent water migration to the floor below.

D. Exposed or Inside Accessible Cabinets Traps, Valve and Pipe Requirements:

1. All traps exposed under fixtures or inside accessible cabinets shall be chrome plated brass.

2. All water or waste piping for plumbing fixtures that is exposed or inside cabinets shall be chrome plated.

3. All exposed flush valves for water closets and urinals shall have a chrome plated hanger to anchor the piping to the wall.

4. All exposed water supply piping and fittings in a finished space to a shower valve, hose bibb, or other water outlet shall be chrome plated.

E. ADA Lavatory Requirements:

1. All handicapped accessible lavatory traps, piping and angle stops shall be installed with an insulating kit specially manufactured for this installation. Armaflex with duct tape is not acceptable.

F. ADA Water Closet Requirements:

1. Handicapped accessible water closet flush valve handles shall face the center of the stall.

2. Coordinate flush valves in handicap accessible locations with grab bars installed by the General Contractor. Make modifications required to flush valve after review by Architect/Engineer.

3.2 ADJUSTING AND CLEANING

A. Adjust stops or valves for intended water flow rate to fixtures without splashing, noise, or overflow.

B. At completion, clean plumbing fixtures, equipment, and faucet aerator screens.

3.3 FIXTURE ROUGH-IN SCHEDULE

A. Rough-in fixture piping connections in accordance with table on plumbing drawings of minimum sizes for particular fixtures.

END OF SECTION

SECTION 23 05 00
BASIC HVAC REQUIREMENTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Requirements applicable to all Division 23 Sections. Also refer to Division 1 - General Requirements.

B. All materials and installation methods shall conform to the applicable standards, guidelines and codes referenced in the specification section.

1.2 SCOPE OF WORK

A. This Specification and the associated drawings govern the furnishing, installing, testing and placing into satisfactory operation the Mechanical Systems.

B. Each Contractor shall provide all new materials indicated on the drawings and/or in these specifications, and all items required to make his portion of the Mechanical Work a finished and working system.

C. All work will be awarded under a single General Contract. The division of work listed below is for the Contractor's convenience and lists normal breakdown of the work.

1.3 DIVISION OF WORK BETWEEN MECHANICAL, ELECTRICAL & CONTROL CONTRACTORS

A. Definitions:

1. "Mechanical Contractors" refers to the following:

   a. Plumbing Contractor.
   b. Heating Contractor.
   c. Air Conditioning and Ventilating Contractor.
   d. Temperature Control Contractor.
   e. Fire Protection Contractor.
   f. Testing, Adjusting, and Balancing Contractor.

2. Motor Control Wiring: The wiring associated with the remote operation of the magnetic coils of magnetic motor starters or relays, or the wiring that permits direct cycling of motors by means of devices in series with the motor power wiring. In the latter case the devices are usually single phase and are usually connected to the motor power wiring through a manual motor starter having "Manual-Off-Auto" provisions.

3. Control devices such as start-stop push buttons, thermostats, pressure switches, flow switches, relays, etc., generally represent the types of equipment associated with motor control wiring.

4. Motor control wiring is single phase and usually 120 volts. In some instances, the voltage will be the same as the motor power wiring. Generally, where the motor power wiring exceeds 120 volts, a control transformer is used to give a control voltage of 120 volts.

5. Temperature Control Wiring: The wiring associated with the operation of a motorized damper, solenoid valve or motorized valve, etc., either modulating or two-position, as opposed to wiring which directly powers or controls a motor used to drive equipment such as fans, pumps, etc.

   a. This wiring will be from a 120 volt source and may continue as 120 volt, or be reduced in voltage (24 volt) in which case a control transformer shall be furnished as part of the temperature control wiring.

6. Control Motor: An electric device used to operate dampers, valves, etc. It may be two-position or modulating. Conventional characteristics of such a motor are 24 volts, 60 cycles, 1 phase, although other voltages may be encountered.

B. General:

1. The purpose of these Specifications is to outline the Electrical and Mechanical Contractor's responsibilities related to electrical work required for items such as temperature controls, mechanical equipment, fans, chillers, compressors and the like. The exact wiring requirements for much of the equipment cannot be determined until the systems have been selected and submittals reviewed. Therefore, the electrical drawings show only known wiring related to such items. All wiring not shown on the electrical drawings, but required for mechanical systems, is the responsibility of the Mechanical Contractor.

2. Where the drawings require the Electrical Contractor to wire between equipment furnished by the Mechanical Contractor, such wiring shall terminate at terminals provided in the equipment. The Mechanical Contractor shall provide complete wiring diagrams and supervision to the Electrical Contractor and designate the terminal numbers for correct wiring.

3. All electrical work shall conform to the National Electrical Code. All provisions of the Electrical Specifications concerning wiring, protection, etc., apply to wiring provided by the Mechanical Contractor unless noted otherwise.

C. Mechanical Contractor's Responsibility:

1. Assumes responsibility for internal wiring of all equipment provided by the Mechanical Contractor, for example:

   a. Burners.
   b. Condensing Units.
   c. Makeup Air Units.
   d. Gas Trains.
   e. Package Air Handling Units.

2. Assumes all responsibility for the Temperature Control wiring, when the Temperature Control Contractor is a Subcontractor to the Mechanical Contractor.

3. Temperature Control Subcontractor's Responsibility:

   a. Wiring of all devices needed to make the Temperature Control System functional.

   b. Verifying any control wiring on the electrical drawings as being by the Electrical Contractor. All wiring required for the Control System, but not shown on the electrical drawings, is the responsibility of the Temperature Control Subcontractor.

   c. Coordinating equipment locations (such as relays, transformers, etc.) with the Electrical Contractor, where wiring of the equipment is by the Electrical Contractor.

4. This Contractor is responsible for coordination of utilities with all other Contractors. If any field coordination conflicts are found, the Contractor shall coordinate with other Contractors to determine a viable layout.

D. Electrical Contractor's Responsibility:

1. Provides all combination starters, manual starters and disconnect devices shown on the Electrical Drawings or indicated to be by the Electrical Contractor on the Mechanical Drawings or Specifications.

2. Installs and wires all remote control devices furnished by the Mechanical Contractor or Temperature Control Subcontractor when so noted on the Electrical Drawings.

3. Provides motor control and temperature control wiring, where so noted on the drawings.

4. Furnishes, installs and connects all relays, etc., for automatic shutdown of certain fans upon actuation of the Fire Alarm System as indicated and specified in Division 28.

5. This Contractor is responsible for coordination of utilities with all other Contractors. If any field coordination conflicts are found, the Contractor shall coordinate with other Contractors to determine a viable layout.

1.4 COORDINATION DRAWINGS

A. Definitions:

1. Coordination Drawings: A compilation of the pertinent layout and system drawings that show the sizes and locations, including elevations, of system components and required access areas to ensure that no two objects will occupy the same space.

a. Mechanical trades shall include, but are not limited to, mechanical equipment, ductwork, fire protection systems, plumbing piping, hydronic piping, and any item that may impact coordination with other disciplines.

b. Electrical trades shall include, but are not limited to, electrical equipment, conduit 1.5" and larger, conduit racks, cable trays, pull boxes, transformers, raceway, busway, lighting, ceiling-mounted devices, and any item that may impact coordination with other disciplines.

c. Technology trades shall include, but are not limited to, technology equipment, racks, conduit 1.5" and larger, conduit racks, cable trays, ladder rack, pull boxes, raceway, ceiling-mounted devices, and any item that may impact coordination with other disciplines.

d. Maintenance clearances and code-required dedicated space shall be included.

e. The coordination drawings shall include all underground, underfloor, in-floor, in chase, and vertical trade items.

2. The contractors shall use the coordination process to identify the proper sequence of installation of all utilities above ceilings and in other congested areas, to ensure an orderly and coordinated end result, and to provide adequate access for service and maintenance.

B. Participation:

1. The contractors and subcontractors responsible for work defined above shall participate in the coordination drawing process.

2. One contractor shall be designated as the Coordinating Contractor for purposes of preparing a complete set of composite electronic CAD coordination drawings that include all applicable trades, and for coordinating the activities related to this process. The Coordinating Contractor for this project shall be the HVAC Contractor.

a. The Coordinating Contractor shall utilize personnel familiar with requirements of this project and skilled as draftspersons/CAD operators, competent to prepare the required coordination drawings.

3. Electronic CAD drawings shall be submitted to the Coordinating Contractor for addition of work by other trades. KJWW will provide electronic file copies of ventilation drawings for contractor's use if the contractor signs and returns an "Electronic File Transfer" waiver provided by KJWW. KJWW will not consider blatant reproductions of original file copies an acceptable alternative for coordination drawings.

C. General:

1. Coordination drawing files shall be made available to the A/E and Owner's Representative. The A/E will only review identified conflicts and give an opinion, but will not perform as a coordinator.

2. A plotted set of coordination drawings shall be available at the project site.

3. Coordination drawings are not shop drawings and shall not be submitted as such.

4. The contract drawings are schematic in nature and do not show every fitting and appurtenance for each utility. Each contractor is expected to have included in his/her bid sufficient fittings, material, and labor to allow for adjustments in routing of utilities made necessary by the coordination process and to provide a complete and functional system.

5. The contractors will not be allowed additional costs or time extensions due to participation in the coordination process.

6. The contractors will not be allowed additional costs or time extensions for additional fittings, reroutings or changes of duct size, that are essentially equivalent sizes to those shown on the drawings and determined necessary through the coordination process.

7. The A/E reserves the right to determine space priority of equipment in the event of spatial conflicts or interference between equipment, piping, conduit, ducts, and equipment provided by the trades.

8. Changes to the contract documents that are necessary for systems installation and coordination shall be brought to the attention of the A/E.

9. Access panels shall preferably occur only in gypsum board walls or plaster ceilings where indicated on the drawings.

   a. Access to mechanical, electrical, technology, and other items located above the ceiling shall be through accessible lay-in ceiling tile areas.

   b. Potential layout changes shall be made to avoid additional access panels.

   c. Additional access panels shall not be allowed without written approval from the A/E at the coordination drawing stage.

   d. Providing additional access panels shall be considered after other alternatives are reviewed and discarded by the A/E and the Owner's Representative.

   e. When additional access panels are required, they shall be provided without additional cost to the Owner.

10. Complete the coordination drawing process and obtain sign off of the drawings by all contractors prior to installing any of the components.

11. Conflicts that result after the coordination drawings are signed off shall be the responsibility of the contractor or subcontractor who did not properly identify their work requirements, or installed their work without proper coordination.

12. Updated coordination drawings that reflect as-built conditions may be used as record documents.

1.5 QUALITY ASSURANCE

A. Contractor's Responsibility Prior to Submitting Pricing Data:

1. The Contractor is responsible for constructing complete and operating systems. The Contractor acknowledges and understands that the Contract Documents are a two-dimensional representation of a three-dimensional object, subject to human interpretation. This representation may include imperfect data, interpreted codes, utility guidelines, three-dimensional conflicts, and required field coordination items. Such deficiencies can be corrected when identified prior to ordering material and starting installation. The Contractor agrees to carefully study and compare the individual Contract Documents and report at once in writing to the Design Team any deficiencies the Contractor may discover. The Contractor further agrees to require each subcontractor to likewise study the documents and report at once any deficiencies discovered.

2. The Contractor shall resolve all reported deficiencies with the Architect/Engineer prior to awarding any subcontracts, ordering material, or starting any work with the Contractor's own employees. Any work performed prior to receipt of instructions from the Design Team will be done at the Contractor's risk.

B. Qualifications:

1. Only products of reputable manufacturers are acceptable.

2. All Contractors and subcontractors shall employ only workers skilled in their trades.

C. Compliance with Codes, Laws, Ordinances:

1. Conform to all requirements of the City of Madison, Wisconsin Codes, Laws, Ordinances and other regulations having jurisdiction.

2. Conform to all State Codes.

3. If there is a discrepancy between the codes and regulations and these specifications, the Architect/Engineer shall determine the method or equipment used.

4. If the Contractor notes, at the time of bidding, any parts of the drawings or specifications that do not comply with the codes or regulations, he shall inform the Architect/Engineer in writing, requesting a clarification. If there is insufficient time for this procedure, he shall submit with his proposal a separate price to make the system comply with the codes and regulations.

5. All changes to the system made after letting of the contract, to comply with codes or requirements of Inspectors, shall be made by the Contractor without cost to the Owner.

6. If there is a discrepancy between manufacturer's recommendations and these specifications, the manufacturer's recommendations shall govern.

7. All rotating shafts and/or equipment shall be completely guarded from all contact. Partial guards and/or guards that do not meet all applicable OSHA standards are not acceptable. Contractor is responsible for providing this guarding if it is not provided with the equipment supplied.

D. Permits, Fees, Taxes, Inspections:

1. Procure all applicable permits and licenses.

2. Abide by all laws, regulations, ordinances, and other rules of the State or Political Subdivision where the work is done, or as required by any duly constituted public authority.

3. Pay all charges for permits or licenses.

4. Pay all fees and taxes imposed by the State, Municipal and/or other regulatory bodies.

5. Pay all charges arising out of required inspections by an authorized body.

6. Pay all charges arising out of required contract document reviews associated with the project and as initiated by the Owner or authorized agency/consultant.

7. Where applicable, all fixtures, equipment and materials shall be approved or listed by Underwriter's Laboratories, Inc.

E. Examination of Drawings:

1. The drawings for the mechanical work are completely diagrammatic, intended to convey the scope of the work and to indicate the general arrangements and locations of equipment, outlets, etc., and the approximate sizes of equipment.

2. Contractor shall determine the exact locations of equipment and rough-ins, and the exact routing of pipes and ducts to best fit the layout of the job.

3. Scaling of the drawings is not sufficient or accurate for determining these locations.

4. Where job conditions require reasonable changes in indicated arrangements and locations, such changes shall be made by the Contractor at no additional cost to the Owner.

5. Because of the scale of the drawings, certain basic items, such as fittings, boxes, valves, unions, etc., may not be shown, but where required by other sections of the specifications or required for proper installation of the work, such items shall be furnished and installed.

6. If an item is either on the drawings or in the specifications, it shall be included in this contract.

7. Determination of quantities of material and equipment required shall be made by the Contractor from the documents. Where discrepancies arise between drawings, schedules and/or specifications, the greater number shall govern.

8. Where used in mechanical documents, the word "furnish" shall mean supply for use, the word "install" shall mean connect complete and ready for operation, and the word "provide" shall mean to supply for use and connect complete and ready for operation.

   a. Any item listed as furnished shall also be installed, unless otherwise noted.

   b. Any item listed as installed shall also be furnished, unless otherwise noted.

F. Field Measurements:

1. Verify all pertinent dimensions at the job site before ordering any materials or fabricating any supports, pipes or ducts.

G. Electronic Media/Files:

1. Construction drawings for this project have been prepared utilizing Revit.

2. Contractors and Subcontractors may request electronic media files of the contract drawings and/or copies of the specifications. Specifications will be provided in PDF format.

3. Upon request for electronic media, the Contractor shall complete and return a signed "Electronic File Transmittal" form provided by KJWW.

4. If the information requested includes floor plans prepared by others, the Contractor will be responsible for obtaining approval from the appropriate Design Professional for use of that part of the document.

5. The electronic contract documents can be used for preparation of shop drawings and as-built drawings only. The information may not be used in whole or in part for any other project.

6. The drawings prepared by KJWW for bidding purposes may not be used directly for ductwork layout drawings or coordination drawings.

7. The use of these electronic files by the Contractor does not relieve them from their responsibility for coordination of work with other trades and verification of space available for the installation.

8. The information is provided to expedite the project and assist the Contractor with no guarantee by KJWW as to the accuracy or correctness of the information provided. KJWW accepts no responsibility or liability for the Contractor's use of these documents.

1.6 SUBMITTALS

A. Submittals shall be required for the following items, and for additional items where required elsewhere in the specifications or on the drawings.

1. Submittals list:

Referenced Specification Section	Submittal Item
23 05 00	Owner Training Agenda
23 05 15	Variable Frequency Drives
23 05 48	HVAC Vibration Isolation
23 05 93	Testing, Adjusting, and Balancing
23 09 00	Controls
23 21 23	HVAC Pumps
23 25 00	Chemical Treatment Systems
23 36 00	Terminal Air Boxes
23 37 00	Commercial Type 1 Kitchen Hood
23 37 00	Grilles, Registers, and Diffusers
23 37 00	Louvers
23 52 16	Condensing Boilers
23 72 00	Energy Recovery Devices
23 73 13	Indoor Modular Air Handling Units
23 74 23.13	Gas Fired Make-Up Air Units
23 81 46	Packaged Water Source Heat Pumps
23 82 00	Terminal Heat Transfer Equipment
23 83 00	Radiant Floor Heating Systems

B. General Submittal Procedures: In addition to the provisions of Division 1, the following are required:

1. Transmittal: Each transmittal shall include the following:

a. Date
b. Project title and number
c. Contractor's name and address
d. Division of work (e.g., plumbing, heating, ventilating, etc.)
e. Description of items submitted and relevant specification number
f. Notations of deviations from the contract documents
g. Other pertinent data

2. Submittal Cover Sheet: Each submittal shall include a cover sheet containing:

   a. Date
   b. Project title and number
   c. Architect/Engineer
   d. Contractor and subcontractors' names and addresses
   e. Supplier and manufacturer's names and addresses
   f. Division of work (e.g., plumbing, heating, ventilating, etc.)
   g. Description of item submitted (using project nomenclature) and relevant specification number
   h. Notations of deviations from the contract documents
   i. Other pertinent data
   j. Provide space for Contractor's review stamps

3. Composition:

   a. Submittals shall be submitted using specification sections and the project nomenclature for each item.

   b. Individual submittal packages shall be prepared for items in each specification section. All items within a single specification section shall be packaged together where possible. An individual submittal may contain items from multiple specifications sections if the items are intimately linked (e.g., pumps and motors).

   c. All sets shall contain an index of the items enclosed with a general topic description on the cover.

4. Content: Submittals shall include all fabrication, erection, layout, and setting drawings; manufacturers' standard drawings; schedules; descriptive literature, catalogs and brochures; performance and test data; wiring and control diagrams; dimensions; shipping and operating weights; shipping splits; service clearances; and all other drawings and descriptive data of materials of construction as may be required to show that the materials, equipment or systems and the location thereof conform to the requirements of the contract documents.

5. Contractor's Approval Stamp:

   a. The Contractor shall thoroughly review and approve all shop drawings before submitting them to the Architect/Engineer. The Contractor shall stamp, date and sign each submittal certifying it has been reviewed.

   b. Unstamped submittals will be rejected.

   c. The Contractor's review shall include, but not be limited to, verification of the following:

      1) Only approved manufacturers are used.
      2) Addenda items have been incorporated.
      3) Catalog numbers and options match those specified.
      4) Performance data matches that specified.
      5) Electrical characteristics and loads match those specified.
      6) Equipment connection locations, sizes, capacities, etc. have been coordinated with other affected trades.
      7) Dimensions and service clearances are suitable for the intended location.
      8) Equipment dimensions are coordinated with support steel, housekeeping pads, openings, etc.
      9) Constructability issues are resolved (e.g., weights and dimensions are suitable for getting the item into the building and into place, sinks fit into countertops, etc.).

d. The Contractor shall review, stamp and approve all subcontractors' submittals as described above.

e. **The Contractor's approval stamp is required on all submittals. Approval will indicate the Contractor's review of all material and a complete understanding of exactly what is to be furnished. Contractor shall clearly mark all deviations from the contract documents on all submittals. If deviations are not marked by the Contractor, then the item shall be required to meet all drawing and specification requirements.**

6. Submittal Identification and Markings:

a. The Contractor shall clearly mark each item with the same nomenclature applied on the drawings or in the specifications.

b. The Contractor shall clearly indicate the size, finish, material, etc.

c. Where more than one model is shown on a manufacturer's sheet, the Contractor shall clearly indicate exactly which item and which data is intended.

d. All marks and identifications on the submittals shall be unambiguous.

7. Schedule submittals to expedite the project. Coordinate submission of related items.

8. Identify variations from the contract documents and product or system limitations that may be detrimental to the successful performance of the completed work.

9. Reproduction of contract documents alone is not acceptable for submittals.

10. Incomplete submittals will be rejected without review. Partial submittals will only be reviewed with prior approval from the Architect/Engineer.

11. Submittals not required by the contract documents may be returned without review.

12. The Architect/Engineer's responsibility shall be to review one set of shop drawing submittals for each product. If the first submittal is incomplete or does not comply with the drawings and/or specifications, the Contractor shall be responsible to bear the cost for the Architect/Engineer to recheck and handle the additional shop drawing submittals.

13. Submittals shall be reviewed and approved by the Architect/Engineer **before** releasing any equipment for manufacture or shipment.

14. Contractor's responsibility for errors, omissions or deviation from the contract documents in submittals is not relieved by the Architect/Engineer's approval.

C. Electronic Submittal Procedures:

1. Distribution: Email submittals as attachments to all parties designated by the Architect/Engineer, unless a web-based submittal program is used.

2. Transmittals: Each submittal shall include an individual electronic letter of transmittal.

3. Format: Electronic submittals shall be in PDF format only. Scanned copies, in PDF format, of paper originals are acceptable. Submittals that are not legible will be rejected. Do not set any permission restrictions on files; protected, locked, or secured documents will be rejected.

4. File Names: Electronic submittal file names shall include the relevant specification section number followed by a description of the item submitted, as follows. Where possible, include the transmittal as the first page of the PDF instead of using multiple electronic files.

    a. Submittal file name: 23 XX XX.description.YYYYMMDD
    b. Transmittal file name: 23 XX XX.description.YYYYMMDD

5. File Size: Electronic file size shall be limited to a maximum of 4MB. Larger files shall be transmitted via a pre-approved method.

1.7 EQUIPMENT SUPPLIERS' INSPECTION

A. The following equipment shall not be placed in operation until a competent installation and service representative of the manufacturer has inspected the installation and certified that the equipment is properly installed, adjusted and lubricated; that preliminary operating instructions have been given; and that the equipment is ready for operation:

1. Inline Pumps
2. Boilers, Burners and Boiler Trim
3. Water Source Heat Pumps
4. Gas Fired Makeup Air Units
5. Air Handling Units
6. Energy Recovery Units

B. Contractor shall arrange for and obtain supplier's on-site inspection(s) at proper time(s) to assure each phase of equipment installation and/or connection is in accordance with the manufacturer's instructions.

C. Submit copies of start-up reports to the Architect/Engineer and include copies of Owner’s Operation and Maintenance Manuals.

1.8 PRODUCT DELIVERY, STORAGE, HANDLING & MAINTENANCE

A. Exercise care in transporting and handling to avoid damage to materials. Store materials on the site to prevent damage. Keep materials clean, dry and free from harmful conditions. Immediately remove any materials that become wet or that are suspected of becoming contaminated with mold or other organisms.

B. Keep all bearings properly lubricated and all belts properly tensioned and aligned.

C. Coordinate the installation of heavy and large equipment with the General Contractor and/or Owner. If the Mechanical Contractor does not have prior documented experience in rigging and lifting similar equipment, he/she shall contract with a qualified lifting and rigging service that has similar documented experience. Follow all equipment lifting and support guidelines for handling and moving.

D. Contractor is responsible for moving equipment into the building and/or site. Contractor shall review site prior to bid for path locations and any required building modifications to allow movement of equipment. Contractor shall coordinate his/her work with other trades.

1.9 WARRANTY

A. Refer to Division 01 specification for requirements.

1.10 MATERIAL SUBSTITUTION

A. Refer to Division 01 specification for requirements.

1.11 LEED REQUIREMENTS

A. This project is pursuing a LEED Silver certification in accordance with USGBC LEED Rating System for New Construction Version 2009. The Contractor shall provide all services and documentation necessary to achieve this rating.

B. Refer to Division 01 specification for requirements.

1.12 PROJECT COMMISSIONING

A. The Contractor shall work with the Commissioning Agent (CxA) as described in Section 01 91 00, and provide all services necessary for compliance with LEED Prerequisite EAp1, Fundamental Commissioning, and EAc3 Enhanced Commissioning.

PART 2 - PRODUCTS

NOT APPLICABLE

PART 3 - EXECUTION

3.1 JOBSITE SAFETY

A. Neither the professional activities of the Architect/Engineer, nor the presence of the Architect/Engineer or his or her employee and subconsultants at a construction site, shall relieve the Contractor and other entity of their obligations, duties and responsibilities including, but not limited to, construction means, methods, sequence, techniques or procedures necessary for performing, superintending or coordinating all portions of the work of construction in accordance with the contract documents and any health or safety precautions required by any regulatory agencies. The Architect/Engineer and his or her personnel have no authority to exercise any control over any construction contractor or other entity or their employees in connection with their work or any health or safety precautions. The Contractor is solely responsible for jobsite safety. The Architect/Engineer and the Architect/Engineer's consultants shall be indemnified and shall be made additional insureds under the Contractor's general liability insurance policy.

3.2 OPERATION AND MAINTENANCE MANUALS

A. Refer to Division 01 specification for requirements.

3.3 INSTRUCTING THE OWNER'S REPRESENTATIVES

A. Adequately instruct the Owner's designated representatives in the maintenance, care, and operation of all systems installed under this contract per specification 01 79 00.

B. The instructions shall include:

1. Explanation of all system flow diagrams.
2. Explanation of all air handling systems.
3. Temperature control system operation including calibration, adjustment and proper operating conditions of all sensors.
4. Maintenance of equipment.
5. Start-up procedures for all major equipment.
6. Explanation of seasonal system changes.
7. Description of emergency system operation.

C. Minimum hours of instruction for each item shall be:

1. Heating Water System - 4 hours.

2. Refrigeration System - 2 hours.
3. Chemical Treatment System - As defined in Section 23 25 00.
4. Air Handling System(s) - 2 hours.
5. Temperature Controls - As defined in Section 23 09 00.

3.4 SYSTEM COMMISSIONING

A. Refer to specification 01 91 00 for additional requirements.

B. The mechanical systems shall be complete and operating. System start-up, testing, balancing, and satisfactory system performance is the responsibility of the Contractor. This includes calibration and adjustments of all controls, noise level adjustments and final comfort adjustments as required.

C. Operate all HVAC systems continuously for at least one week prior to occupancy to bring construction materials to suitable moisture levels. Areas with mechanical cooling shall be maintained below 60% RH.

D. Contractor shall adjust the mechanical systems and controls at season changes during the one year warranty period, as required, to provide satisfactory operation and to prove performance of all systems in all seasons.

E. All operating conditions and control sequences shall be tested during the start-up period. Test all interlocks, safety shutdowns, controls, and alarms.

F. The Contractor, subcontractors, and equipment suppliers shall have skilled technicians to ensure that all systems perform properly. If the Architect/Engineer is requested to visit the job site for trouble shooting, assisting in start-up, obtaining satisfactory equipment operation, resolving installation and/or workmanship problems, equipment substitution issues or unsatisfactory system performance, including call backs during the warranty period, through no fault of the design; the Contractor shall reimburse the Owner on a time and materials basis for services rendered at the Architect/Engineer's standard hourly rates in effect when the services are requested. The Contractor shall pay the Owner for services required that are product, installation or workmanship related. Payment is due within 30 days after services are rendered.

3.5 RECORD DOCUMENTS

A. The following paragraph supplements Division 1 requirements:

Contractor shall maintain at the job site a separate and complete set of mechanical drawings and specifications on which he shall clearly and permanently mark in complete detail all changes made to the mechanical systems.

B. Mark drawings to indicate revisions to piping and ductwork, size and location, both exterior and interior; including locations of coils, dampers, other control devices, filters, and other units requiring periodic maintenance or repair; actual equipment locations, dimensioned from column lines; actual inverts and locations of underground piping; concealed equipment, dimensioned from column lines; mains and branches of piping systems, with valves and control devices located and numbered, concealed unions located, and with items requiring maintenance located (e.g., traps, strainers, expansion compensators, tanks, etc.); Change Orders; concealed control system devices.

C. Refer to Section 23 09 00 for additional requirements for Temperature Control documents.

D. Mark specifications to show approved substitutions; Change Orders, and actual equipment and materials used.

E. Record changes daily and keep the marked drawings available for the Architect/Engineer's examination at any normal work time.

F. Upon completing the job, and before final payment is made, give the marked-up drawings to the Architect/Engineer.

3.6 ADJUST AND CLEAN

A. Thoroughly clean all equipment and systems prior to the Owner's final acceptance of the project. Clean all foreign paint, grease, oil, dirt, labels, stickers, and other foreign material from all equipment.

B. Clean all drain pans and areas where moisture is present. Immediately report any mold, biological growth, or water damage.

C. Remove all rubbish, debris, etc., accumulated during construction from the premises.

3.7 CONSTRUCTION WASTE MANAGEMENT

A. This Contractor shall comply with all construction and demolition waste disposal and recycling requirements outlined in LEED MRc2: Construction Waste Management (follow latest edition at the time of bidding or as referenced in these specifications).

1. This Contractor shall coordinate with the General Contractor to develop and implement a construction waste management plan that, at a minimum, identifies the materials to be diverted from disposal and whether the materials will be sorted on-site or co-mingled.

2. The Contractor shall track waste disposal and recycling efforts throughout the construction process for all materials associated with this Contractor’s scope of work. The Contractor shall provide this information to the General Contractor so that it can be incorporated with similar information from all other contractors for the project.

    a. Calculations for waste and recycled material can be done by weight or volume, but they must be consistent throughout the project. The Contractor shall coordinate with the General Contractor to establish the preferred calculation method and report the results accordingly.

    b. Excavated soil and land-clearing debris do not count towards the waste disposal or recycled material.

3. At a minimum, 50% of the construction and demolition debris for this project must be recycled or salvaged.

END OF SECTION

READINESS CERTIFICATION PRIOR TO FINAL JOBSITE OBSERVATION

In order to prevent the final job observation from occurring too early, we require that the Contractor review the completion status of the project and, by copy of this document, certify that the job is indeed ready for the final job observation. The following is a typical list of items that represent the degree of job completeness expected prior to your requesting a final job observation.

1. All air handling units operating and balanced.
2. All fans shall be operating and balanced.
3. All pumps, boilers operating and balanced.
4. All miscellaneous mechanical systems (unit heaters, fan coil units, cabinet heaters, etc.) operating.
5. All temperature control systems operating, programmed and calibrated.
6. Pipe insulation complete, pipes labeled and valves tagged.
7. Fire damper and fire/smoke damper access doors labeled in accordance with specifications.

Accepted by:

Prime Contractor _____

By _____ Date _____

Upon Contractor certification that the project is complete and ready for a final job observation, we require the Contractor to sign this agreement and return it to the Architect/Engineer so that the final observation can be scheduled.

It is understood that if the Architect/Engineer finds the job not ready for the final observation and that additional trips and observations are required to bring the project to completion, the costs incurred by the Architect/Engineers for additional time and expenses will be deducted from the Contractor's contract retainage prior to final payment at the completion of the job.

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SECTION 23 05 13
MOTORS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Single Phase and Three Phase Electric Motors.

1.2 DELIVERY, STORAGE, AND HANDLING

A. Protect motors stored on site from weather and moisture by maintaining factory covers and suitable weatherproof coverings. For extended outdoor storage, follow manufacturer's recommendations for equipment and motor.

1.3 OPERATION AND MAINTENANCE DATA

A. Submit operation and maintenance data including assembly drawings, bearing data including replacement sizes, and lubrication instructions.

1.4 QUALIFICATIONS

A. Manufacturer: Company specializing in the manufacture of commercial and industrial motors and accessories, with a minimum of three years documented manufacturing experience.

PART 2 - PRODUCTS

2.1 MOTORS - GENERAL CONSTRUCTION AND REQUIREMENTS

A. Refer to the drawings for required electrical characteristics.

B. Design motors for continuous operation in 40ºC environment, and for temperature rise in accordance with ANSI/NEMA MG 1 limits for insulation class, service factor, and motor enclosure type.

C. Visible Nameplate: Indicating horsepower, voltage, phase, hertz, RPM, full load amps, locked rotor amps, frame size, manufacturer's name and model number, service factor, power factor, insulation class.

D. Electrical Connection: Boxes, threaded for conduit. For fractional horsepower motors where connection is made directly, provide conduit connection in end frame.

E. Unless otherwise indicated, motors 1 HP and larger shall be three phase, 60 hertz, squirrel cage type, NEMA Design Code B (low current in-rush, normal starting torque), totally enclosed fan-cooled type.

F. Each contractor shall set all motors furnished by him.

G. All motors shall have a minimum service factor of 1.15.

H. All motors shall have ball or roller bearings with a minimum L-10 fatigue life of 150,000 hours in direct-coupled applications and 50,000 hours for belted applications. Belted rating shall be based on radial loads and pulley sizes called out in NEMA MG1-14.43.

I. Bearings shall be sealed type for 10 HP and smaller motors. Bearings shall be regreasable type for larger motors.

J. Aluminum end housings are not permitted on motors 15 HP or larger.

K. Provide all belted motors with a means of moving and securing the motor to tighten belts. Motors over 2 HP shall have screw type tension adjustment. Motors over 40 HP shall have dual screw adjusters. Slide bases shall conform to NEMA standards.

L. Motors for fans and pumps 1/12 HP or greater and less than 1 HP shall be electronically-commutated motors or shall have a minimum motor efficiency of 70% when rated in accordance with DOE 10 CFR 431. These motors shall also have the means to adjust motor speed for either balancing or remote control. Belt-driven fans may use sheave adjustments for airflow balancing in lieu of varying motor speed. Motors shall be single phase, 60 hertz.

2.2 PREMIUM EFFICIENCY MOTORS (INCLUDING MOST 3-PHASE GENERAL PURPOSE MOTORS)

A. All motors, unless exempted by EPAct legislation that became federal law on December 19, 2010, shall comply with the efficiencies listed in that standard, which are reprinted below. These match the 2010 NEMA premium efficiency ratings. All ratings listed are nominal full load efficiencies, verified in accordance with IEEE Standard 112, Test Method B. Average expected (not guaranteed minimum) power factors shall also be at least the following:

	Full-Load Efficiencies %					
	Open Drip-Proof			Totally Enclosed Fan Cooled		
HP	1200 rpm	1800 rpm	3600 rpm	1200 rpm	1800 rpm	3600 rpm
1.0	82.5	85.5	77.0	82.5	85.5	77.0
1.5	86.5	86.5	84.0	87.5	86.5	84.0
2.0	87.5	86.5	85.5	88.5	86.5	85.5
3.0	88.5	89.5	85.5	89.5	89.5	86.5
5.0	89.5	89.5	86.5	89.5	89.5	88.5
7.5	90.2	91.0	88.5	91.0	91.7	89.5
10.0	91.7	91.7	89.5	91.0	91.7	90.2
15.0	91.7	93.0	90.2	91.7	92.4	91.0
20.0	92.4	93.0	91.0	91.7	93.0	91.0
25.0	93.0	93.6	91.7	93.0	93.6	91.7
30.0	93.6	94.1	91.7	93.0	93.6	91.7
40.0	94.1	94.1	92.4	94.1	94.1	92.4
50.0	94.1	94.5	93.0	94.1	94.5	93.0
60.0	94.5	95.0	93.6	94.5	95.0	93.6
75.0	94.5	95.0	93.6	94.5	95.4	93.6
100.0	95.0	95.4	93.6	95.0	95.4	94.1
125.0	95.0	95.4	94.1	95.0	95.4	95.0
150.0	95.4	95.8	94.1	95.8	95.8	95.0
200.0	95.4	95.8	95.0	95.8	96.2	95.4
250.0	95.4	95.8	95.0	95.8	96.2	95.8
300.0	95.4	95.8	95.4	95.8	96.2	95.8
350.0	95.4	95.8	95.4	95.8	96.2	95.8
400.0	95.8	95.8	95.8	95.8	96.2	95.8
450.0	96.2	96.2	95.8	95.8	96.2	95.8
500.0	96.2	96.2	95.8	95.8	96.2	95.8

B. Motor nameplate shall be noted with the above ratings.

2.3 MOTORS ON VARIABLE FREQUENCY DRIVES

A. All motors driven by VFDs shall be premium efficiency type.

B. Motors shall be designed for use with VFDs in variable torque applications with 1.15 service factor. Motors shall not be equipped with auxiliary blowers.

C. Motors driven by VFDs shall have Class F or H insulation and be designated by the motor manufacturer to be suitable for inverter duty service in accordance with NEMA MG 1 Section IV, "Performance Standards Applying to All Machines," Part 31 "Definite-Purpose Inverter-Fed Polyphase Motors.

A. All 460 volt motors controlled by VFDs shall be equipped with an alternate discharge path, such as a shaft grounding ring or grounding brush, to divert adverse shaft currents from the motor bearings on the drive end of the motor shaft. Motor shafts 2" and larger require shaft grounding on the drive end and the non-drive end. This Contractor shall ensure (via field observation and measurement) that the shaft is effectively grounded upon startup.

1. Providing grounding rings internal to the motor housing is an acceptable solution, provided the motor is affixed with a label clearly indicating the presence of a grounding assembly. The grounding ring shall be listed for 40,000 hours of motor service and shall be accessible via the drive endplate.

2.4 MOTOR DRIVEN EQUIPMENT

A. No equipment shall be selected or operate above 90% of its motor nameplate rating. Motor size may not be increased to compensate for equipment with efficiency lower than that specified.

B. If a larger motor than specified is required on equipment, the contractor supplying the equipment is responsible for all additional costs due to larger starters, wiring, etc.

2.5 SHEAVES

A. All sheaves shall conform to NEMA Standard MG1-14.42, which lists minimum diameters and maximum overhangs. Locate motors to minimize overhang.

B. When replacing sheaves, use sheaves of at least the originally supplied sizes.

C. Contractor responsible for motor shall also be responsible for replacement sheaves. Coordinate with testing and balancing of the equipment.

PART 3 - EXECUTION

3.1 INSTALLATION

A. All rotating shafts and/or equipment shall be completely guarded from all contact. Partial guards and/or guards that do not meet all applicable OSHA standards are not acceptable. Contractor is responsible for providing this guarding if it is not provided with the equipment supplied.

B. For flexible coupled drive motors, mount coupling to the shafts in accordance with the coupling manufacturer's recommendations. Align shafts to manufacturer's requirements or within 0.002 inch per inch diameter of coupling hub.

C. For belt drive motors, mount sheaves on the appropriate shafts per manufacturer's instructions. Use a straight edge to check alignment of the sheaves. Reposition sheaves as necessary so the straight edge contacts both sheave faces squarely. After sheaves are aligned, loosen the adjustable motor base so the belt(s) can be added, and tighten the base so the belt tension is in accordance with the drive manufacturer's recommendations. Frequently check belt tension and adjust if necessary during the first day of operation and again after 80 hours of operation.

END OF SECTION

SECTION 23 05 15
VARIABLE FREQUENCY DRIVES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Variable frequency drives

1.2 RELATED SECTIONS AND WORK

A. Refer to the Variable Frequency Drive Schedule for rating and configuration.

1.3 SUBMITTALS

A. Submit shop drawings and product data under provisions of Section 23 05 00.

B. Shop Drawings: Include front and side views of enclosures with overall dimensions and weights shown; conduit entrance locations and requirements; and nameplate legends.

C. Product Data: Provide catalog sheets showing voltage, controller size, ratings and size of switching and overcurrent protective devices, short circuit ratings, dimensions, and enclosure details.

D. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of Product.

E. Provide harmonic distortion analysis of total service to prove variable frequency drives proposed do not exceed the latest version of IEEE 519 voltage and current distortion limits as shown in Table 10.2 and 10.3 at the point of common coupling (PCC). The PCC shall be defined as the consumer-utility interface or primary side of the main distribution transformer.

1.4 EXTRA MATERIAL

A. Furnish under provisions of Section 23 05 00.

B. Provide two of each air filter.

C. Provide three of each fuse size and type.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect and handle products to site under provisions of Section 23 05 00.

B. Accept controllers on site in original packing. Inspect for damage.

C. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

D. Handle in accordance with manufacturer's written instructions. Lift only with lugs provided for the purpose. Handle carefully to avoid damage.

1.6 OPERATION AND MAINTENANCE DATA

A. Submit operation and maintenance data under provisions of Section 23 05 00.

B. Maintenance Data: Include spare parts data listing, source and current prices of replacement parts and supplies, and recommended maintenance procedures and intervals.

C. Operation Data: Include instructions for starting and operating controllers, and describe operating limits that may result in hazardous or unsafe conditions.

D. Shop Drawings: For each VFD.

1. Include dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings. Include the following:

a. Each installed unit's type and details.

b. Nameplate legends.

c. Short-circuit current rating of integrated unit.

d. UL listing for series rating of overcurrent protective devices in combination controllers.

e. Features, characteristics, ratings, and factory settings of each motor-control center unit.

2. Wiring Diagrams: Power, signal, and control wiring for VFDs. Provide schematic wiring diagram for each type of VFD.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS: DANFOSS

2.2 DESCRIPTION

A. Converts 60 Hertz input power at voltage specified to a variable AC frequency and voltage for controlling the speed of AC squirrel cage motors. The controller shall be suitable for use with standard NEMA B squirrel cage 1.15 service factor induction motors without requiring any modifications to the motor or the drive.

B. Controller shall have sufficient capacity to provide speed control of the motors shown or noted throughout the specified environmental operating conditions.

C. Controller shall have the functional components listed below:

1. Door interlocked input circuit breaker/fused switch.
2. Input rectifier section to supply fixed DC bus voltage.
3. Smoothing reactor for DC bus.
4. DC bus capacitors.
5. Control transformer.
6. Separate terminal blocks for power and control wiring.
7. Terminal block for operator controls.
8. Sine weighted PWM generating inverter section.

2.3 RATINGS

A. Rated Input Voltage: Refer to mechanical equipment schedule for motor requirements.

B. Motor Nameplate (Drive Output) Voltage: Refer to Mechanical Schedules.

C. Displacement Power Factor: Between 1.0 and 0.95, lagging, over entire range of operating speed and load.

D. Operating Ambient: 0°C to 40°C.

E. Minimum Relative Humidity Range: 5% to 90% (non-condensing).

F. Minimum Elevation without Derating: 3300 feet.

G. Minimum Efficiency at Full Load: 96 percent.

H. Overload Capability: 1.1 times the base load current for 60 seconds; 2.0 times the base load current for 3 seconds or 180% for 0.5 seconds.

I. Starting Torque: 100 percent of rated torque or as indicated.

J. Speed Regulation: Plus or minus 1 percent with no motor derating.

2.4 DESIGN

A. Pulse Width Modulated (PWM) Variable Frequency Drives:

1. Converter shall be of a diode bridge design with a sine-weighted PWM inverter section.

2. Main semi-conductors in the inverter section of controller shall be IGBT transistors capable of a carrier switching frequency of up to 8 kHz. If derating of the inverter is necessary to run at 8kHz, then the unit's derated currents must equal or exceed the motor full load currents listed in NEC Table 430-150.

3. All controllers supplied with semi-conductors capable of switching at less than 8,000 Hertz shall be supplied with a motor acoustic noise reduction filter.

4. Pulse width modulated (PWM) drives shall be supplied with drive input line reactors with a minimum impedance of 3%. Reactors shall be installed to filter entire drive input circuit.

5. Pulse width modulated (PWM) drives shall be supplied with drive input harmonic filter to reduce the total harmonic distortion to less than the IEEE519-1992 limits at the utility service entrance.

6. Drives that are located beyond the manufacturer's recommended maximum distance from the motor shall be provided with dV/dt (long lead) filters.

B. All drives shall have built-in diagnostic capability with status and fault indicators mounted on enclosure door. Complete operating instructions for diagnostics shall be mounted inside of the enclosure door.

C. Drive shall restart after power loss and under-voltage fault. The minimum number of restart attempts required shall be three, field adjustable.

D. The drive shall allow unlimited switching of the output without damage to the drive or motor.

2.5 PRODUCT FEATURES

A. Display: Provide integral digital display to indicate all protection faults and drive status (including overcurrent, overvoltage, undervoltage, ground fault, overtemperature, phase loss, input power ON, output voltage, output frequency, and output current.

B. Protection:

1. Input transient protection by means of surge suppressors.

2. Snubber networks to protect against malfunctions due to system transients,

3. Under- and overvoltage trips; inverter overtemperature, overload, and overcurrent trips.

4. Motor thermal overload relay(s) adjustable and capable of NEMA Class 20 motor protection and sized per motor nameplate data. When multiple motors are connected to the VFD output, each motor shall have a manual starter with properly sized overload protection.

5. Notch filter to prevent operation of the controller-motor-load combination at a natural frequency of the combination.

6. Instantaneous line-to-line and line-to-ground overcurrent trips on input and output.

7. Loss-of-phase protection.

8. Reverse-phase protection.

9. Short-circuit protection (fuses or circuit breaker).

10. Motor overtemperature fault.

C. Acceleration Rate Adjustment: 0.5 - 30 seconds.

D. Deceleration Rate Adjustment: 1 - 30 seconds.

E. Minimum Adjustment Range for the Lower Output Frequency shall be: 0 to 40 Hertz.

F. Minimum Adjustment Range for the Upper Output Frequency Range shall be: 40 to 90 Hertz.

G. Minimum Volts/Hertz Range: 3.7 to 8.6 volts/Hertz.

H. Provide MANUAL-OFF-AUTOMATIC selector switch and manual analog speed control mounted on the front of the enclosure.

I. Safety Interlocks: Provide terminals for remote contact to inhibit starting under both manual and automatic mode.

J. Control Interlocks: Provide terminals for remote contact to allow starting in automatic mode.

K. Provide adjustable skip frequencies on the drive output (minimum of three ranges).

L. Automatic Reset/Restart: Attempts three restarts after controller fault or on return of power after an interruption, and before shutting down for manual reset or fault correction. Bidirectional autospeed search shall be capable of starting into rotating loads spinning in either direction and returning motor to set speed in proper direction, without damage to controller, motor, or load.

M. Power-Interruption Protection: After a power interruption, it prevents the motor from re-energizing until the motor has stopped.

N. Torque Boost: Automatically varies starting and continuous torque to at least 1.5 times the minimum torque to ensure high-starting torque and increased torque at slow speeds.

O. Motor Temperature Compensation at Slow Speeds: Adjustable current fall-back based on output frequency for temperature protection of self-cooled, fan-ventilated motors at slow speeds.

P. Status Lights: Door-mounted LED indicators shall indicate the following conditions:

1. Power on.
2. Run.
3. Overvoltage.

4. Line fault.
5. Overcurrent.
6. External fault.

Q. Panel-Mounted Operator Station: Start-stop and auto-manual selector switches with manual speed control potentiometer and elapsed time meter.

R. Indicating Devices: Meters or digital readout devices and selector switch, mounted flush in controller door and connected to indicate the following controller parameters:

1. Output frequency (Hz).
2. Motor speed (rpm).
3. Motor status (running, stop, fault).
4. Motor current (amperes).
5. Motor torque (percent).
6. Fault or alarming status (code).
7. PID feedback signal (percent).
8. DC-link voltage (VDC).
9. Set-point frequency (Hz).
10. Motor output voltage (V).

S. Control Signal Interface:

1. Electric Input Signal Interface: A minimum of 2 analog inputs (0 to 10 V or 0/4-20 mA) and 6 programmable digital inputs.

2. Remote Signal Inputs: Capability to accept any of the following speed-setting input signals from the BMS or other control systems:

a. 0 to 10-V dc.
b. 0-20 or 4-20 mA.
c. Potentiometer using up/down digital inputs.
d. Fixed frequencies using digital inputs.
e. RS485.
f. Keypad display for local hand operation.

3. Output Signal Interface:

a. A minimum of 1 analog output signal (0/4-20 mA), which can be programmed to any of the following:

1) Output frequency (Hz).
2) Output current (load).
3) DC-link voltage (VDC).
4) Motor torque (percent).
5) Motor speed (rpm).
6) Set-point frequency (Hz).

4. Remote Indication Interface: A minimum of 2 dry circuit relay outputs (120-V ac, 1A) for remote indication of the following:

a. Motor running.
b. Set-point speed reached.
c. Fault and warning indication (overtemperature or overcurrent).
d. PID high- or low-speed limits reached.

T. Communications: Provide a communications card to interface VFD with Facility Management Control System (FMCS). Coordinate interface requirements with the FMCS provided under Section 23 09 00. Interface shall allow all parameter settings of VFD to be programmed via FMCS control and displayed on FMCS operator workstation. Provide capability for VFD to retain these settings within the nonvolatile memory.

U. Three-Contactor Manual Bypass:

1. Provide contactors, motor running overload protection, under-voltage and loss of phase protection, and short circuit protection for full voltage, non-reversing operation of the motor. Include isolation switch or third contactor to allow maintenance of inverter during bypass operation.

2. All bypass circuitry shall be located within the same enclosure as the variable frequency drive.

3. All fire alarm and/or smoke control interconnections (e.g., air handling unit shutdown) shall apply regardless of whether control is through VFD or bypass.

4. Provide a Drive-Bypass Selector Switch.

5. Provide nameplate with instructions for switching from drive to bypass and from bypass to drive. Provide instructions for isolating VFD for maintenance.

V. Control:

1. With the "Manual-Off-Auto" switch in the "Manual" position and, if applicable, the "Drive-Bypass" in the "Drive" position, the drive shall be controlled by the manual speed potentiometer on the drive door.

2. With the "Manual-Off-Auto" switch in the "Auto" position and, if applicable, the "Drive-Bypass" in the "Drive" position, the drive shall be controlled by the input signal from an external source.

3. If applicable, with the "Drive-Bypass" in the "Bypass" position, regardless the position of the "Manual-Off-Auto" switch, the motor shall be connected across the lines and shall be run at full speed.

4. With the "Manual-Off-Auto" switch in the "Off" position, if applicable, the drive run circuit shall be open and the VFD shall not operate.

5. If applicable, signal from the fire alarm control panel shall shut down VFD and bypass.

6. All disconnect switches between VFD and motor(s) shall include an auxiliary contact interlock wired to the VFD fault trip input to shut down the drive upon opening of the disconnect main contacts.

2.6 ACCESSORIES

A. Devices shall be factory installed in controller enclosure, unless otherwise indicated.

B. All VFD supplied for fans shall have dynamic or DC injection braking capability to provide a means of rapid deceleration of the AC motor in not more than one (1) minute. Adjust controls to stop the motor within 30 seconds.

C. Push-Button Stations, Pilot Lights, and Selector Switches: NEMA ICS 2, heavy-duty type.

D. Stop and Lockout Push-Button Station: Momentary-break, push-button station with a factory-applied hasp arranged so padlock can be used to lock push button in depressed position with control circuit open.

E. Control Relays: Auxiliary and adjustable time-delay relays.

F. Standard Displays:

1. Output frequency (Hz).
2. Set-point frequency (Hz).
3. Motor current (amperes).
4. DC-link voltage (VDC).
5. Motor torque (percent).
6. Motor speed (rpm).
7. Motor output voltage (V).

G. Historical Logging Information and Displays:

1. Real-time clock with current time and date.
2. Running log of total power versus time.
3. Total run time.
4. Fault log, maintaining last four faults with time and date stamp for each.

H. Fabrication:

1. Enclosure: NEMA 250, Type 1.
2. Finish: Manufacturer's standard enamel.

PART 3 - EXECUTION

3.1 FACTORY TESTING

A. The VFD manufacturer shall provide certification that heat test has been completed.

B. The Electrical Contractor shall have a factory service engineer present for the start-up, field calibration, and check-out of each VFD installed. Factory service engineer shall be required to return to the site for recalibration or set-up should unit not function as specified during system commissioning. All costs shall be a part of This Contract. Provide tag with date and signature of factory service Engineer on inside cover of each drive.

3.2 INSTALLATION

A. Install variable frequency drive equipment in accordance with the manufacturer's instructions.

B. Floor mount VFD on prefabricated or field fabricated supports with controls no higher than 6'-6" and no lower than 3'-0" AFF. Mount supports on 1/2" thick vibration isolation pads set on concrete housekeeping pads.

C. Provide engraved phenolic nameplates under the provisions of Section 26 05 53.

D. Connections: All conduit connections to the VFD shall be by flexible conduit.

E. Input, output, and control wiring shall each be run in separate conduits.

F. All interlocking required by the drive manufacturer shall be the responsibility of the Electrical Contractor.

3.3 STARTUP AND COMMISSIONING

A. Verify all settings, parameters, and adjustments with other contractors prior to startup. Make all adjustments and setting to coordinate with controls and equipment.

B. Accelerate the motor to full speed and verify operation. Decelerate the motor to a stop and verify operation. Slowly operate the motor over the speed range and check for resonance.

C. Make all adjustments and settings to coordinate with controls and equipment prior to Substantial Completion. Verify that drive is set for auto restart after power loss and undervoltage fault.

D. Document settings in the Operations and Maintenance manual.

END OF SECTION

SECTION 23 05 29
HVAC SUPPORTS AND ANCHORS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Hangers, Supports, and Associated Anchors.
B. Equipment Bases and Supports.
C. Sleeves and Seals.
D. Flashing and Sealing of Equipment and Pipe Stacks.
E. Cutting of Openings.
F. Escutcheon Plates and Trim.

1.2 SUBMITTALS

A. Submit shop drawings and product data under provisions of Section 23 05 00.

1.3 WORK FURNISHED BUT INSTALLED UNDER OTHER SECTIONS

A. Furnish sleeves and hanger inserts to General Contractor for placement into formwork.

PART 2 - PRODUCTS

2.1 HANGER RODS

A. Hanger rods for single rod hangers shall conform to the following:

Pipe Size	Hanger Rod Diameter	
	Column #1	Column #2
2" and smaller	3/8"	3/8"
2-1/2" through 3-5/8”	1/2"	1/2"
4" and 5"	5/8"	1/2"
6"	3/4"	5/8"

Column #1: Steel pipe.
Column #2: Copper or plastic pipe.

B. Rods for double rod hangers may be reduced one size. Minimum rod diameter is 3/8 inches.

C. Hanger rods and accessories used in mechanical spaces or otherwise dry areas shall have ASTM B633 electro-plated zinc finish.

2.2 PIPE HANGERS AND SUPPORTS

A. All pipe hangers, clamps, and supports shall conform to Manufacturers Standardization Society MSS-SP-58 and 127 (where applicable).

B. Oversize all hangers, clamps, and supports on insulated piping to allow insulation and jacket to pass through unbroken. This applies to both hot and cold pipes.

C. Ferrous hot piping 2-1/2 inches and larger shall have steel saddles tack welded to the pipe at each support at a depth not less than the specified insulation. Factory fabricated inserts may be used.

Acceptable Products:

Anvil -	Fig. 160, 161, 162, 163, 164, 165
Cooper/B-Line -	Fig. 3160, 3161, 3162, 3163, 3164, 3165
Erico -	Model 630, 631, 632, 633, 634, 635
Nibco/Tolco -	Fig. 260-1, 261-1 1/2, 262-2, 263-2 1/2, 264-3, 265-4

D. On all insulated piping, provide a semi-cylindrical metallic shield and fire resistant vapor barrier jacket.

E. As an alternative to separate pipe insulation insert and saddle, properly sized integral rigid insulation sections may be used for this application.

Acceptable Products:

Cooper/B-Line -	Fig. B3380 through B3384
Pipe Shields -	A1000, A2000
Erico -	Model 124, 127

F. Support and laterally brace vertical pipes at every floor level in multi-story structures, and more frequently when required by applicable codes (the Illinois Plumbing Code requires 10 foot maximum spacing for support of copper risers), but never at intervals over 15 feet. Support vertical pipes with riser clamps installed below hubs, couplings or lugs. Provide sufficient flexibility to accommodate expansion and contraction without compromising fire barrier penetrations and other fixed take-off locations.

Acceptable Products:

Anvil -	Fig. CT121
Cooper/B-Line -	Fig. B3373CT
Erico -	Model 510
Nibco/Tolco -	Fig. 82

G. Place restrained neoprene mounts beneath vertical pipe riser clamps to prevent sweating of cold pipes. Insulate over mounts.

Acceptable Products: Mason RBA, RCA, or BR.

H. Hangers in direct contact with copper pipe shall be coated with plastic with appropriate temperature range. HYDRA-ZORB clamps are permitted for this application for bare pipes within their temperature limits of -65°F to +275°F.

I. Unless otherwise indicated, hangers shall be as follows:

1. Clevis Type:

Service: Bare Metal Pipe
Rigid Plastic Pipe
Insulated Cold Pipe
Insulated Hot Pipe - 3 inches & Smaller

Acceptable Products:	Bare Steel, Plastic or Insulated Pipe	Bare Copper Pipe
Anvil	Fig. 260	
Cooper/B-Line	Fig. 3100	Fig. B3100C
Erico	Model 400	
Nibco/Tolco	Fig. 1	Fig. 81PVC

2. Roller Type:
Service: Insulated Hot Pipe - 4 inches and Larger

Acceptable Products:	4" through 6"	8" and Above
Anvil	Fig. 181, 271	Fig. 171, 271
Cooper/B-Line	Fig. 3110, 3117	Fig. 3114, 3117
Erico	Model 610	Model 605
Nibco/Tolco	Fig. 324, 327	Fig. 322, 327

3. Continuous Channel with Clevis Type:
Service: Plastic Tubing
Flexible Hose
Soft Copper Tubing

Acceptable Products:
Cooper/B-Line - Fig. B3106, with Fig. B3106V
Erico - Model 104, with Model 104V
Nibco/Tolco - Fig. 1V

4. Adjustable Swivel Ring Type:
Service: Bare Metal Pipe - 4 inches and Smaller

Acceptable Products:	Bare Steel Pipe	Bare Copper Pipe
Anvil	Fig. 69	
Cooper/B-Line	Fig. B3170NF	Fig. B3170CTC
Erico	Model FCN	102A0 Series
Nibco/Tolco	Fig. 200	Fig. 203

J. Support may be fabricated from U-Channel strut or similar shapes. Piping less than 4" in diameter shall be secured to strut with clamps of proper design and capacity as required to maintain spacing and alignment. Strut shall be independently supported from hanger drops or building structure. Size and support shall be per manufacturer's installation requirements for structural support of piping. Clamps shall not interrupt piping insulation.

1. Strut used in mechanical spaces or otherwise dry areas shall have ASTM B633 electro-plated zinc finish.

2. Strut used in damp areas listed in hanger rods shall have ASTM A123 hot-dip galvanized finish applied after fabrication.

K. Unless otherwise indicated, pipe supports for use with struts shall be as follows:

1. Clamp Type:
Service: Bare Metal Pipe
Rigid Plastic Pipe
Insulated Cold Pipe
Insulated Hot Pipe - 3 inches and smaller

a. Clamps in direct contact with copper pipe shall be plastic coated.

b. Pipes subject to expansion and contraction shall have clamps slightly oversized to allow limited pipe movement.

Acceptable Products:	Bare Steel, Plastic or Insulated Pipe	Bare Copper Pipe
Unistrut	Fig. P1100 or P2500	
Cooper/B-Line	Fig. B2000 or B2400	Fig. BVT
Nibco/Tolco	Fig. A-14 or 2STR	

2. Roller Type:

Service: Insulated Hot Pipe - 4 inches and larger.

Acceptable Products:	4" through 6"	8" and Above
Unistrut	Fig. P2474	Fig. P2474-1
Cooper/B-Line	Fig. B218	Fig. B219
Nibco/Tolco	Fig. ROL-12	Fig. ROL-13

L. Unless otherwise shown, upper attachments for hanger rods or support struts shall be as follows:

1. Beam Clamps:

Acceptable Products:	
Anvil	Fig. 228, 292
Cooper/B-Line	Fig. B3054
Erico	Model 360
Nibco/Tolco	Fig. 329

2. Concrete Inserts, Single Rod Galvanized:

Acceptable Products:	
Anvil	Fig. 282
Cooper/B-Line	Fig. B3014
Erico	Model 355
Nibco/Tolco	Fig. 310

3. Concrete Inserts, Continuous Strip Galvanized:

Acceptable Products:	
Unistrut Corp	P3200 Series
Cooper/B-Line	Fig. B22-J
Erico	CONCT

4. Concrete Anchors: Fasten to concrete using cast-in or post-installed anchors designed per the requirements of Appendix D of ACI 318-14. Post-installed anchors shall be qualified for use in cracked concrete by ACI-355.2.

5. Masonry Anchors: Fasten to concrete masonry units with expansion anchors or self-tapping masonry screws. For expansion anchors into hollow concrete block, use sleeve-type anchors designed for the specific application. Do not fasten in masonry joints. Do not use powder actuated fasteners, wooden plugs, or plastic inserts.

M. Wall supports shall be used where vertical height of structure exceeds minimum spacing requirements. Install wall supports at same spacing as hangers or strut supports along vertical length of pipe runs.

N. Welding:

1. Unless otherwise noted, hangers, clips, and auxiliary support steel may be welded in lieu of bolting, clamping, or riveting to the building structural frame. Take adequate precautions during all welding operations for fire prevention and for protecting walls and ceilings from being damaged by smoke.

2.3 FOUNDATIONS, BASES, AND SUPPORTS

A. Basic Requirements:

1. Furnish and install foundations, bases, and supports (not specifically indicated on the Drawings or in the Specifications of either the General Construction or Mechanical work as provided by another Contractor) for mechanical equipment.

2. All concrete foundations, bases and supports, shall be reinforced. All steel bases and supports shall receive a prime coat of zinc chromate or red metal primer. After completion of work, give steel supports a final coat of gray enamel.

B. Concrete Bases (Housekeeping Pads):

1. Unless shown otherwise on the drawings, concrete bases shall be nominal 4 inches thick and shall extend 3 inches on all sides of the equipment (6 inches larger than factory base).

2. Where a base is less than 12 inches from a wall, extend the base to the wall to prevent a “dirt-trap”.

3. Concrete materials and workmanship required for the Contractor's work shall be provided by him. Materials and workmanship shall conform to the applicable standards of the Portland Cement Association. Reinforce with 6”x6”, W1.4-W1.4 welded wire fabric. Concrete shall withstand 3,000 pounds compression per square inch at 28 days.

4. Equipment requiring bases is as follows:

a. Air Handling Unit
b. Boiler
c. Chemical Feed Equipment
d. Expansion Tank
e. Fans
f. Pump

C. Supports:

1. Provide sufficient clips, inserts, hangers, racks, rods, and auxiliary steel to securely support all suspended material, equipment and conduit without sag.

2. Hang heavy equipment from concrete floors or ceilings with Architect/Engineer-approved concrete inserts, furnished and installed by the Contractor whose work requires them, except where indicated otherwise.

D. Grout:

1. Grout shall be non-shrinking premixed (Master Builders Company "Embecco"), unless otherwise indicated on the drawings or approved by the Architect/Engineer.

2. Use Mix No. 1 for clearances of 1" or less, and Mix No. 2 for all larger clearances.

3. Grout under equipment bases, around pipes, at pipe sleeves, etc., and where shown on the drawings.

2.4 OPENINGS IN FLOORS, WALLS AND CEILINGS

A. Exact locations of all openings for the installation of materials shall be determined by the Contractor and given to the General Contractor for installation or construction as the structure is built.

B. Coordinate all openings with other Contractors.

C. Hire the proper tradesman and furnish all labor, material and equipment to cut openings in or through existing structures, or openings in new structures that were not installed, or additional openings. Repair all spalling and damage to the satisfaction of the Architect/Engineer. Make saw cuts before breaking out concrete to ensure even and uniform opening edges.

D. Said cutting shall be at the complete expense of each Contractor. Failure to coordinate openings with other Contractors shall not exempt the Contractor from providing openings at his expense.

E. Do not cut structural members without written approval of the Architect or Structural Engineer.

2.5 ROOF PENETRATIONS

A. Seal pipes with surface temperature below 150ºF penetrating single-ply roofs with conical stepped pipe flashings and stainless steel clamps equal to Portals Plus Pipe Boots. Material shall match roofing membrane.

B. Break insulation only at the clamp for pipes between 60ºF and 150ºF. Seal outdoor insulation edges watertight.

2.6 SLEEVES AND LINTELS

A. Each Contractor shall provide sleeves and lintels for all duct and pipe openings required for the Contractor's work in masonry walls and floors, unless specifically shown as being by others.

B. Fabricate all sleeves from standard weight black steel pipe or as indicated on the drawings. Provide continuous sleeve. Cut or split sleeves are not acceptable.

C. Fabricate all lintels for masonry walls from structural steel shapes or as indicated on the drawings. Have all lintels approved by the Architect or Structural Engineer.

D. Sleeves through the floors on exposed risers shall be flush with the ceiling, with planed squared ends extending 1" above the floor in unfinished areas, and flush with the floor in finished areas, to accept spring closing floor plates.

E. Sleeves shall not penetrate structural members or masonry walls without approval from the Structural Engineer. Sleeves shall then comply with the Architect/Engineer's design.

F. Openings through unexcavated floors and/or foundation walls below the floor shall have a smooth finish with sufficient annular space around material passing through opening so slight settling will not place stress on the material or building structure.

G. Install all sleeves concentric with pipes. Secure sleeves in concrete to wood forms. This Contractor is responsible for sleeves dislodged or moved when pouring concrete.

H. Where pipes rise through concrete floors that are on earthen grade, provide 3/4" resilient expansion joint material (asphalt and cork) wrapped around the pipe, the full depth of concrete, at the point of penetration. Secure to prevent shifting during concrete placement and finishing.

I. Size sleeves large enough to allow expansion and contraction movement. Provide continuous insulation wrapping.

2.7 ESCUTCHEON PLATES AND TRIM

A. Fit escutcheons to all insulated or uninsulated exposed pipes passing through walls, floors, or ceilings of finished rooms.

B. Escutcheons shall be heavy gauge, cold rolled steel, copper coated under a chromium plated finish, heavy spring clip, rigid hinge and latch.

C. Install galvanized steel (unless otherwise indicated) trim strip to cover vacant space and raw construction edges of all rectangular openings in finished rooms. This includes pipe openings.

2.8 PIPE PENETRATIONS

A. Seal all pipe penetrations. Seal non-rated walls and floor penetrations with grout or caulk. Backing material may be used.

B. Seal fire rated wall and floor penetrations with fire seal system as specified.

2.9 PIPE ANCHORS

A. Provide all items needed to allow adequate expansion and contraction of all piping. All piping shall be supported, guided, aligned, and anchored as required.

B. Repair all piping leaks and associated damage. Pipes shall not rub on any part of the building.

2.10 FINISH

A. Prime coat exposed steel hangers and supports. Hangers and supports in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

PART 3 - EXECUTION

3.1 HVAC SUPPORTS AND ANCHORS

A. General Installation Requirements:

1. Install all items per manufacturer's instructions.

2. Coordinate the location and method of support of piping systems with all installations under other Divisions and Sections of the Specifications.

3. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.

B. Supports Requirements:

1. Install roof pipe supports to resist wind movement per manufacturer’s recommendations. Method of securing base to roof shall be compatible with roofing materials.

2. Where building structural steel is fireproofed, all hangers, clamps, auxiliary steel, etc., which attach to it shall be installed prior to application of fireproofing. Repair all fireproofing damaged during pipe installation.

3. Set all concrete inserts in place before pouring concrete.

4. Furnish, install and prime all auxiliary structural steel for support of piping systems that are not shown on the Drawings as being by others.

5. Install hangers and supports complete with lock nuts, clamps, rods, bolts, couplings, swivels, inserts and required accessories.

6. Hangers for horizontal piping shall have adequate means of vertical adjustment for alignment.

C. Pipe Requirements:

1. Support all piping and equipment, including valves, strainers, traps and other specialties and accessories to avoid objectionable or excessive stress, deflection, swaying, sagging or vibration in the piping or building structure during erection, cleaning, testing and normal operation of the systems.

2. Do not, however, restrain piping to cause it to snake or buckle between supports or to prevent proper movement due to expansion and contraction.

3. Support piping at equipment and valves so they can be disconnected and removed without further supporting the piping.

4. Piping shall not introduce strains or distortion to connected equipment.

5. Parallel horizontal pipes may be supported on trapeze hangers made of structural shapes and hanger rods; otherwise, pipes shall be supported with individual hangers.

6. Trapeze hangers may be used where ducts interfere with normal pipe hanging.

7. Provide additional supports where pipe changes direction, adjacent to flanged valves and strainers, at equipment connections and heavy fittings.

8. Provide at least one hanger adjacent to each joint in grooved end steel pipe with mechanical couplings.

D. Provided the installation complies with all loading requirements of truss and joist manufacturers, the following practices are acceptable:

1. Loads of 100 lbs. or less may be attached anywhere along the top or bottom chords of trusses or joists with a minimum 3’ spacing between loads.

2. Loads greater than 100 lbs. must be hung concentrically and may be hung from top or bottom chord, provided one of the following conditions is met:

   a. The hanger is attached within 6” from a web/chord joint.

   b. Additional L2x2x1/4 web reinforcement is installed per manufacturer’s requirements.

3. It is prohibited to cantilever a load using an angle or other structural component that is attached to a truss or joist in such a fashion that a torsional force is applied to that structural member.

4. If conditions cannot be met, coordinate installation with truss or joist manufacturer and contact Architect/Engineer.

E. After piping and insulation installation are complete, cut hanger rods back at trapeze supports so they do not extend more than 3/4" below bottom face of lowest fastener and blunt any sharp edges.

F. Do not exceed 25 lbs. per hanger and a minimum spacing of 2’-0” on center when attaching to metal roof decking (limitation not required with concrete on metal deck). This 25 lbs. load and 2’-0” spacing include adjacent electrical and architectural items hanging from deck. If the hanger restrictions cannot be achieved, supplemental framing off steel framing will need to be added.

G. Do not exceed the manufacturer's recommended maximum load for any hanger or support.

H. Spacing of Hangers shall not exceed the compressive strength of the insulation inserts, and in no case shall exceed the following:

	Pipe Material	Maximum Spacing
1.	Steel and Fiberglass (Std. Weight or Heavier – Liquid Service):	
	1-1/4" & under	7'-0"
	1-1/2"	9'-0"
	2"	10'-0"
	2-1/2"	11'-0"
	3"	12'-0"
	4" & larger	12'-0"

	Pipe Material	Maximum Spacing
2.	Steel (Std. Weight or Heavier – Vapor Service):	
	1-1/4" and under	9'-0"
	1-1/2"	12'-0"
	2" & larger	12'-0"
3.	Hard Drawn Copper & Brass (Liquid Service):	
	3/4" and under	5'-0"
	1"	6'-0"
	1-1/4"	7'-0"
	1-1/2"	8'-0"
	2"	8'-0"
	2-1/2"	9'-0"
	3"	10'-0"
	4"	12'-0"
	6"	12'-0"
4.	Hard Drawn Copper & Brass (Vapor Service):	
	3/4" & under	7'-0"
	1"	8'-0"
	1-1/4"	9'-0"
	1-1/2"	10'-0"
	2"	11'-0"
	2-1/2" & larger	12'-0"

1 5. Installation of hangers shall conform to MSS SP-58 and the applicable Plumbing Code.

2 **END OF SECTION**

SECTION 23 05 48
HVAC VIBRATION ISOLATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Vibration Isolation.
B. Flexible Connectors.

1.2 SUBMITTALS

A. Submit shop drawings per Section 23 05 00 and the Vibration Isolation Submittal Form at the end of this section.

B. Vibration isolation submittals may be included with equipment being isolated, but must comply with this section.

C. Base submittals shall include equipment served, construction, coatings, weights, and dimensions.

D. Isolator submittals shall include:

1. Equipment served
2. Type of Isolator
3. Load in Pounds per Isolator
4. Recommended Maximum Load for Isolator
5. Spring Constants of Isolators (for Spring Isolators)
6. Load vs. Deflection Curves (for Neoprene Isolators)
7. Specified Deflection
8. Deflection to Solid (at least 150% of calculated deflection)
9. Loaded (Operating) Deflection
10. Free Height
11. Loaded Height
12. Kx/Ky (horizontal to vertical stiffness ratio – for spring isolators)
13. Materials and Coatings
14. Spring Diameters

E. Make separate calculations for each isolator on equipment where the load is not equally distributed.

F. Flexible connector shop drawings shall include overall face-to-face length and all specified properties.

PART 2 - PRODUCTS

2.1 BASIC CONSTRUCTION AND REQUIREMENT

A. Vibration isolators shall have either known undeflected heights or other markings so deflection under load can be verified.

B. All isolators shall operate in the linear portion of their load versus deflection curve. The linear portion of the deflection curve of all spring isolators shall extend 50% beyond the calculated operating deflection [e.g., 3" for 2" calculated deflection]. The point of 50% additional deflection shall not exceed the recommended load rating of the isolator.

C. The lateral to vertical stiffness ratio (Kx/Ky) of spring isolators shall be between 0.8 and 2.0.

D. All neoprene shall have UV resistance sufficient for 20 years of outdoor service.

E. All isolators shall be designed or treated for corrosion resistance. Steel bases shall be cleaned of welding slag and primed for interior use, and hot dip galvanized after fabrication for exterior use. All bolts and washers over 3/8" diameter located outdoors shall be hot dip galvanized per ASTM A153. All other bolts, nuts and washers shall be zinc electroplated. All ferrous portions of isolators, other than springs, for exterior use shall be hot dip galvanized after fabrication. Outdoor springs shall be neoprene dipped or hot dip galvanized. All damage to coatings shall be field repaired with two coats of zinc rich coating.

F. Equip all mountings used with structural steel bases with height-saving brackets. Bottoms of the brackets shall be 1-1/2" to 2-1/2" above the floor or housekeeping pad, unless shown otherwise on the drawings. Steel bases shall have at least four points of support.

G. Provide motor slide rails for belt-driven equipment per Section 23 05 13.

H. All isolators, except M1, shall have provision for leveling.

2.2 MOUNTINGS

A. Type M1:

1. 0.75" thick waffled neoprene pad with minimum static deflection of 0.07" at calculated load and 0.11" at maximum load. For loads less than 15 pounds, the deflection at calculated load requirement is waived, but the isolator must have a maximum stiffness of the ratio of 45#/0.35".

2. Units need not be bolted down unless called for or needed to prevent movement. If bolted down, prevent short circuiting with neoprene bushings and washers between bolts and isolators.

3. Acceptable Manufacturers: Mason "Super W", Kinetics "NGS", Amber/Booth "SPNR", Vibration Eliminator Co. "400N".

B. Type M3:

1. Free standing, laterally stable spring isolators without housings and complete with 1/4" neoprene friction pads.

2. Units shall have bolt holes but need not be bolted down unless called for or needed to prevent movement. If bolted down, prevent short circuiting with neoprene bushings and washers between bolts and isolators. Bolt holes shall not be within the springs.

3. All mountings shall have leveling bolts.

4. Acceptable Manufacturers: Mason "SLFH", Kinetics "FDS", Amber/Booth "SW-3, 4", 5"or 6", Vibration Eliminator Co. "OST".

2.3 HANGERS

A. Type H1:

1. Vibration hangers shall consist of a double-deflection neoprene element with a projecting bushing or oversized opening to prevent steel-to-steel contact.

2. Static deflection shall be at least 0.15" at calculated load and 0.35" at maximum rated load.

3. Provide hangers with end connections as required for hanging ductwork or piping.

4. Acceptable Manufacturers: Mason "HD" or "WHD", Kinetics "RH", Aeroflex "RHD", Vibration Eliminator Co. "ALH".

B. Type H2:

1. Vibration hangers shall contain a steel spring in a neoprene cup with a grommet to prevent short circuiting the hanger rod.

2. The cup shall have a steel washer to distribute load on the neoprene and prevent its extrusion.

3. Spring diameters and hanger box lower hole sizes shall be large enough to permit the hanger rod to swing through a 30º arc before contacting the grommet and short circuiting the spring.

4. Provide end connections for hanging ductwork or piping.

5. Acceptable Manufacturers: Mason "30" or "W30", Kinetics "SRH", Amber/Booth "BSRA", Aeroflex "RSH", Vibration Eliminator Co. "SNC".

C. Type H3:

1. Vibration hangers shall have a steel spring in a neoprene cup with a grommet to prevent short circuiting of the hanger rod.

2. The cup shall have a steel washer to distribute load on the neoprene and prevent its extrusion.

3. Spring diameters and hanger box lower hole sizes shall be large enough to permit the hanger rod to swing through a 30º arc before contacting the grommet and short circuiting the spring.

4. Provide end connections for hanging ductwork or piping.

5. Hangers shall be capable of holding the load at a fixed elevation during installation. They shall have a secondary adjustment to transfer the load to the spring and maintain the same position.

6. Deflection shall be indicated by a pointer and scale.

7. Acceptable Manufacturer: Mason "PC30", Kinetics "SFH", Amber/Booth "BSW", Vibration Eliminator Co. "PCS".

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION

A. Install all products per manufacturer's recommendations.

B. Provide vibration isolation as indicated on the drawings and as described herein.

C. Clean the surface below all mountings that are not bolted down and apply adhesive cement equal to Mason Type WG between mounting and floor. If movement occurs, bolt mountings down. Isolate bolts from baseplates with neoprene washers and bushings.

D. All static deflections listed in the drawings and specifications are the minimum acceptable actual deflection of the isolator under the weight of the installed equipment - not the maximum rated deflection of the isolator.

E. Support equipment to be mounted on structural steel frames with isolators under the frames or under brackets welded to the frames. Where frames are not needed, fasten isolators directly to the equipment.

F. Where a specific quantity of hangers is noted in these specifications, it shall mean hanger pairs for support points that require multiple hangers, such as rectangular ducts or pipes supported on a strut rack.

3.2 PIPE ISOLATION

A. The first three hangers from vibration-isolated equipment shall be type H1.

B. Provide sufficient piping flexibility for vibrating refrigerant equipment, or furnish flexible connectors with appropriate temperature and pressure ratings.

C. Vibration isolators shall not cause any change in position of piping that will result in stresses in connections or misalignment of shafts or bearings. Equipment and piping shall be maintained in a rigid position during installation. Do not transfer load to the isolators until the installation is complete and under full operational load. Hanger H3 and Mounting M4 may be used instead of other products for this purpose.

D. Support piping to prevent extension of flexible connectors.

3.3 VIBRATION ISOLATION OF DUCTWORK

A. The first three hangers on all fan systems shall be Type H1 with at least 0.20" minimum static deflection.

3.4 VIBRATION ISOLATION SCHEDULE

EQUIPMENT DESIGNATION	BASE TYPE	ISOLATOR TYPE	STATIC DEFLECTION	FLEXIBLE CONNECTIONS
Inline Pump(s)	NA	M3 or H2 or H3	0.75"	NA
Boilers	NA	NA	NA	FC-1

Note 1: AHU internal fan isolation shall be determined by AHU manufacturer. Isolation selected shall be a minimum of 98% efficient at scheduled CFM and static pressure.

COLUMN 1	2	3	4	5	6	7	8	9	10	11	12
		PROPOSED ISOLATOR							CALCULATIONS		
ITEM SERVED	MIN DEFL (")	TAG	MODEL	MAX LOAD (#)	DEFL @ MAX LOAD (")	DEFL TO SOLID (")	FREE HT (")	Kx/Ky	LOAD (#)	DEFL (")	DEFL RATIO

COLUMN NOTES: Note numbers correspond to the column numbers above.

1. Item served should match designation on the design drawings.
2. List the deflection scheduled or specified in the design documents.
3. List the designation for this isolator. This is most useful when one item has multiple different isolators to support its weight.
4. List the manufacturer's complete model designation for the isolator.
5. List the manufacturer's maximum rated load for the isolator.
6. List the isolator deflection at the maximum rated load in column 5.
7. For spring isolators list the deflection when the springs are solid. This is not normally the same entry as in column 6.
8. List the height of the isolator when unloaded. Shop drawings must show where this is measured.
9. List the rated horizontal to vertical stiffness ratio. This must be between 0.8 and 2.0.
10. List the calculated equipment load on each isolator. For items with unequal weight distribution, calculate each isolator separately.
11. List the calculated deflection under the calculated load. For springs this will be column 10*(column 6 / column 5).
12. List the answer from dividing column 7 by column 11. This must be at least 1.5. If not, select an isolator with more nominal deflection.

GENERAL NOTES:

1. When submitting hangers or supports for a weight range, fill in two rows - one for the maximum and one for the minimum weight.

END OF SECTION

SECTION 23 05 53
HVAC IDENTIFICATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Identification of products installed under Division 23.

1.2 SUBMITTALS

A. Submit shop drawings under provisions of Section 23 05 00. Include list of items identified, wording, letter sizes, and color coding.

B. Include valve chart and schedule listing valve tag number, location, function, and valve manufacturer's name and model number.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. 3M, Bunting, Calpico, Craftmark, Emedco, Kolbi Industries, Seton, W.H. Brady, Marking Services.

2.2 MATERIALS

A. All pipe markers (purchased or stenciled) shall conform to ANSI A13.1. Marker lengths and letter sizes shall be at least the following:

O.D. of Pipe or insulation	Marker Length	Size of Letters
Up to and including 1-1/4”	8”	1/2”
1-1/2” to 2”	8”	3/4”
2-1/2” to 6”	12”	1-1/4”
8” to 10”	24”	2-1/2”
Over 10”	32”	3-1/2”

Plastic tags may be used for outside diameters under 3/4".

B. Plastic Nameplates: Laminated three-layer phenolic with engraved black, 1/4" minimum letters on light contrasting background.

C. Aluminum Nameplates: Black enamel background with natural aluminum border and engraved letters furnished with two mounting holes and screws.

D. Plastic Tags: Minimum 1-1/2" square or round laminated three-layer phenolic with engraved, 1/4" minimum black letters on light contrasting background.

E. Brass Tags: Brass background with engraved black letters. Tag size minimum 1-1/2" square or 1-1/2" round.

F. Plastic Pipe Markers: Semi-rigid plastic, preformed to fit around pipe or pipe covering; indicating flow direction and fluid conveyed.

G. Vinyl Pipe Markers: Colored vinyl with permanent pressure sensitive adhesive backing.

H. Stencil Painted Pipe Markers: Use industrial enamel spray paint per ANSI Standard A13.1. Indicate fluid conveyed and flow direction.

I. Underground Pipe Markers: Bright colored continuously printed plastic ribbon tape 6" wide by 3.5 mils thick, manufactured for direct burial, with aluminum foil core for location by non-ferric metal detectors and bold lettering identifying buried item.

J. Tracer Wire:

1. Single copper conductors shall be solid or stranded annealed or hard uncoated copper per UL83 and ASTM requirements. Tracer tape or copper-coated steel wire is not acceptable.

2. Conductor shall be insulated with HMWPE as specified and applied in a concentric manner. The minimum at any point shall not be less than 90% of the specified average thickness in compliance with UL 83.

3. Tracer wire shall be continuously spark tested at 7500 Volts DC. Other electrical and mechanical tests shall be in accordance with UL 1581.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install all products per manufacturer's recommendations.

B. Degrease and clean surfaces to receive adhesive for identification materials.

C. Valves:

1. All valves (except shutoff valves at equipment) shall have numbered tags.

2. Provide or replace numbered tags on all existing valves that are connected to new systems or that have been revised.

3. Provide all existing valves used to extend utilities to this project with numbered tags. Review tag numbering sequence with the Owner prior to ordering tags.

4. Secure tags with heavy duty key chain and brass "S" link or with mechanically fastened plastic straps.

5. Attach to handwheel or around valve stem. On lever operated valves, drill the lever to attach tags.

6. Number all tags and show the service of the pipe.

7. Provide two sets of laminated 8-1/2" x 11" copies of a valve directory listing all valves, with respective tag numbers, uses, and locations. The directory shall be reviewed by the Owner and Architect/Engineer prior to laminating final copies. Laminated copies shall have brass eyelet in at least one corner for easy hanging.

D. Pipe Markers:

1. Adhesive Backed Markers: Use Brady Style 1, 2, or 3 on pipes 3" diameter and larger. Use Brady Style 4, 6, or 8 on pipes under 3" diameter. Similar styles by other listed manufacturers are acceptable. Secure all markers at both ends with a wrap of pressure sensitive tape completely around the pipe.

2. Snap-on Markers: Use Seton "Setmark" on pipes up to 5-7/8" OD. Use Seton "Setmark" with nylon or Velcro ties for pipes 6" OD and over. Similar styles by other listed manufacturers are acceptable.

3. Stencil Painted Pipe Markers:

   a. Remove rust, grease, dirt, and all foreign substances from the pipe surface.
   b. Apply primer on non-insulated pipes before painting.
   c. Use background and letter colors as scheduled later in this section.

4. Apply markers and arrows in the following locations where clearly visible:

   a. At each valve.
   b. On both sides of walls that pipes penetrate.
   c. At least every 20 feet along all pipes.
   d. On each riser and each leg of each "T" joint.
   e. At least once in every room and each story traversed.

5. Underground Pipe Markers: Install 8" to 10" below grade, directly above buried pipes.

E. Equipment:

1. All equipment not easily identifiable such as controls, relays, gauges, etc.; and all equipment in an area remote from its function such as air handling units, exhaust fans, filters, reheat coils, dampers, etc.; shall have nameplates or plastic tags listing name, function, and drawing symbol. Do not label exposed equipment in public areas.

2. Fasten nameplates or plastic tags with stainless steel self-tapping screws or permanently bonding cement.

3. Mechanical equipment that is not covered by the U.S. National Appliance Energy Conservation Act (NAECA) of 1987 shall carry a permanent label installed by the manufacturer stating that the equipment complies with the requirements of ASHRAE 90.1.

F. Miscellaneous:

1. Attach self-adhesive vinyl labels at all duct access doors used to reset fusible links or actuators on fire, fire/smoke, or smoke dampers. Lettering shall be a minimum of 1/2" high. Labels shall indicate damper type.

2. Provide engraved plastic tags at all hydronic or steam system make-up water meters.

3.2 SCHEDULE

A. Pipes to be marked shall be labeled with the text as shown in the following table regardless of which method or material is used:

Pipe Service	Lettering Color	Background Color
HEATING WATER SUPPLY	Black	Yellow
HEATING WATER RETURN	Black	Yellow
GEOTHERMAL WATER SUPPLY	White	Green
GEOTHERMAL WATER RETURN	White	Green
CONDENSATE DRAIN	Black	Yellow

END OF SECTION

SECTION 23 05 93
TESTING, ADJUSTING, AND BALANCING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Testing, adjusting, and balancing of air systems.
B. Testing, adjusting, and balancing of heating systems.
C. Testing, adjusting, and balancing of plumbing systems.
D. Testing, adjusting, and balancing of energy recovery systems.
E. Measurement of final operating condition of HVAC systems.

1.2 QUALITY ASSURANCE

A. Agency shall be a company specializing in the adjusting and balancing of systems specified in this section with minimum three years' experience. Perform work under supervision of AABC Certified Test and Balance Engineer, NEBB Certified Testing, Balancing and Adjusting Supervisor, SMARTA Certified Air and Hydronic Balancer, or TABB Certified Supervisor.

B. Work shall be performed in accordance with the requirements of the references listed at the start of this section.

1.3 REFERENCES

A. AABC - National Standards for Total System Balance, 2002.

B. ADC – Test Code for Grilles, Registers, and Diffusers.

C. AMCA – Publication 203-90; Field Performance Measurement of Fan Systems.

D. ASHRAE - 2003 HVAC Applications Handbook; Chapter 37, Testing, Adjusting and Balancing.

E. ASHRAE/ANSI - Standard 111-1988; Practices for Measurement, Testing, Adjusting and Balancing of Building HVAC&R Systems.

F. NEBB - Procedural Standards for Testing, Adjusting and Balancing of Environmental Systems, Sixth Edition, 1998.

G. SMACNA - HVAC Systems; Testing, Adjusting and Balancing, Third Edition, 2002.

H. TABB – International Standards for Environmental Systems Balance.

1.4 SUBMITTALS

A. Submit copies of report forms, balancing procedures, and the name and qualifications of testing and balancing agency for approval within 30 days after award of Contract.

B. Submit certified copies of test reports to the Architect/Engineer for approval.

1.5 REPORT FORMS

A. Submit reports on AABC, SMACNA or NEBB forms. Use custom forms approved by the Architect/Engineer when needed to supply specified information.

B. Include in the final report a schematic drawing showing each system component, including balancing devices, for each system. Each drawing shall be included with the test reports required for that system. The schematic drawings shall identify all testing points and cross-reference these points to the report forms and procedures.

C. Refer to PART 4 for required reports.

1.6 WARRANTY/GUARANTEE

A. The TAB Contractor shall include an extended warranty of 90 days after owner receipt of a completed balancing report, during which time the Owner may request a recheck of terminals, or resetting of any outlet, coil, or device listed in the test report. This warranty shall provide a minimum of 24 man-hours of onsite service time. If it is determined that the new test results are not within the design criteria, the balancer shall rebalance the system according to design criteria.

B. Warranty/Guarantee must meet one of the following programs: TABB International Quality Assurance Program, AABC National Project Performance Guarantee, NEBB's Conformance Certification.

1.7 SCHEDULING

A. Coordinate schedule with other trades. Provide a minimum of seven days' notice to all trades and the Architect/Engineer prior to performing each test.

PART 2 - PRODUCTS

NOT APPLICABLE

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS

A. All procedures must conform to a published standard listed in the References article of this section. All equipment shall be adjusted in accordance with the manufacturer's recommendations. Any system not listed in this specification but installed under the contract documents shall be balanced using a procedure from a published standard listed in the References article.

B. Recorded data shall represent actual measured or observed conditions.

C. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary to allow adequate performance of procedures. After testing and balancing is complete, close probe holes and patch insulation with new materials as specified. Restore vapor barrier and finish as specified.

D. Permanently mark setting of valves, dampers, and other adjustment devices allowing for settings to be restored. Set and lock memory stops.

E. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, plugging test holes, and restoring thermostats to specified settings.

F. The Balancing Contractor shall measure terminal air box air flow, and the TCC shall adjust DDC readout to match. Refer to Section 23 09 00 for additional information.

G. Installations with systems consisting of multiple components shall be balanced with all system components operating.

3.2 EXAMINATION

A. Before beginning work, verify that systems are complete and operable. Ensure the following:

1. General Equipment Requirements:

   a. Equipment is safe to operate and in normal condition.
   b. Equipment with moving parts is properly lubricated.
   c. Temperature control systems are complete and operable.
   d. Proper thermal overload protection is in place for electrical equipment.
   e. Direction of rotation of all fans and pumps is correct.
   f. Access doors are closed and end caps are in place.

2. Duct System Requirements:

   a. All filters are clean and in place. If required, install temporary media.
   b. Duct systems are clean and free of debris.
   c. Fire/smoke and manual volume dampers are in place, functional and open.
   d. Air outlets are installed and connected.
   e. Duct system leakage has been minimized.

3. Pipe System Requirements:

   a. Coil fins have been cleaned and combed.
   b. Hydronic systems have been cleaned, filled, and vented.
   c. Strainer screens are clean and in place.
   d. Shutoff, throttling and balancing valves are open.

B. Report any defects or deficiencies to Architect/Engineer.

C. Promptly report items that are abnormal or prevent proper balancing.

D. If, for design reasons, system cannot be properly balanced, report as soon as observed.

E. Beginning of work means acceptance of existing conditions.

3.3 PREPARATION

A. Provide instruments required for testing, adjusting, and balancing operations. Make instruments available to the Architect/Engineer for spot checks during testing.

B. Instruments shall be calibrated within six months of testing performed for project, or more recently if recommended by the instrument manufacturer.

3.4 INSTALLATION TOLERANCES

A. ± 10% of scheduled values:

1. Adjust air inlets and outlets to ± 10% of scheduled values.

2. Adjust piping systems to ± 10% of design values.

B. + 5% of scheduled values

1. Adjust outdoor air intakes to within + 5% of scheduled values.

2. Adjust exhaust air through energy recovery equipment to within +5% of scheduled values.

C. Adjust supply, return, and exhaust air-handling systems to +10% / -5% of scheduled values.

3.5 ADJUSTING

A. After adjustment, take measurements to verify balance has not been disrupted or that disruption has been rectified.

B. Once balancing of systems is complete, at least one damper or valve must be 100% open.

C. After testing, adjusting and balancing are complete, operate each system and randomly check measurements to verify system is operating as reported in the report. Document any discrepancies.

D. Contractor responsible for each motor shall also be responsible for replacement sheaves. Coordinate with contractor.

E. Contractor responsible for pump shall trim impeller or order new impeller to final duty point as instructed by this contractor on all pumps not driven by a VFD. Coordinate with contractor.

3.6 SUBMISSION OF REPORTS

A. Fill in test results on appropriate forms.

PART 4 - SYSTEMS TO BE TESTED, ADJUSTED AND BALANCED

4.1 GENERAL REQUIREMENTS

A. Title Page:

1. Project name.
2. Project location.
3. Project Architect.
4. Project Engineer (KJWW Engineering Consultants).
5. Project General Contractor.
6. TAB Company name, address, phone number.
7. TAB Supervisor's name and certification number.
8. TAB Supervisor's signature and date.
9. Report date.

B. Report Index

C. General Information:

1. Test conditions.
2. Nomenclature used throughout report.
3. Notable system characteristics/discrepancies from design.
4. Test standards followed.
5. Any deficiencies noted.
6. Quality assurance statement.

D. Instrument List:

1. Instrument.
2. Manufacturer, model, and serial number.
3. Range.
4. Calibration date.

4.2 AIR SYSTEMS

A. Air Moving Equipment:

1. General Requirements:
   a. Drawing symbol.
   b. Location.
   c. Manufacturer, model, arrangement, class, discharge.
   d. Fan RPM.
   e. Multiple RPM fan curve with operating point marked. (Obtain from equipment supplier).
   f. Final frequency of motor at maximum flow rate (on fans driven by VFD).
2. Flow Rate:
   a. Supply flow rate (cfm): specified and actual.
   b. Return flow rate (cfm): specified and actual.
   c. Outside flow rate (cfm): specified and actual.
   d. Exhaust flow rate (cfm): specified and actual.
3. Pressure Drop and Pressure:
   a. Filter pressure drop: specified and actual.
   b. Total static pressure: specified and actual. (Indicate if across fan or external to unit).
   c. Inlet pressure.
   d. Discharge pressure.

B. Fan Data:

1. Drawing symbol.
2. Location.
3. Manufacturer and model.
4. Flow rate (cfm): specified and actual.
5. Total static pressure: specified and actual. (Indicate measurement locations).
6. Inlet pressure.
7. Discharge pressure.
8. Fan RPM.

C. Electric Motors:

1. Drawing symbol of equipment served.
2. Manufacturer, Model, Frame.
3. Nameplate: HP, phase, service factor, RPM, operating amps, efficiency.
4. Measured: Amps in each phase.

D. Air Terminal (Inlet or Outlet):

1. Drawing symbol.
2. Room number/location.
3. Terminal type and size.
4. Velocity: specified and actual.
5. Flow rate (cfm): specified and actual.
6. Percent of design flow rate.

E. Air Terminal Unit (Terminal Air Box) Data:

1. General Requirements:
   a. Drawing symbol.
   b. Location.
   c. Manufacturer and model.
   d. Size.
   e. Type: constant, variable, single, dual duct.

2. Flow Rate:
   a. Cooling maximum flow rate (cfm): specified and actual.
   b. Minimum flow rate (cfm): specified and actual.
3. Pressure Drop and Pressure:
   a. Inlet static pressure during testing (maximum and minimum).

F. Air Flow Measuring Station:

1. Drawing symbol.
2. Service.
3. Location.
4. Manufacturer and model.
5. Size.
6. Flow rate (cfm): specified and actual.
7. Pressure drop: specified and actual.

4.3 HEATING SYSTEMS

A. Pump Data (Heating water Loop Pumps):

1. Existing drawing symbol or equipment TAG
2. Service.
3. Manufacturer, size, and model.
4. Impeller size: specified, actual, and final (if trimmed).
5. Flow Rate (gpm): specified and actual.
6. Pump Head: specified, operating and shutoff.
7. Suction Pressure: Operating and shutoff.
8. Discharge Pressure: Operating and shutoff.
9. Final frequency of motor at maximum flow rate (on pumps driven by VFD).

B. Electric Motors (Associated Heating Water Loop Pump Motors):

1. Drawing symbol of equipment served.
2. Manufacturer, Model, Frame.
3. Nameplate: HP, phase, service factor, RPM, operating amps, efficiency.
4. Measured: Amps in each phase.

C. Heating Coils:

1. General Requirements:
   a. Drawing symbol.
   b. Service.
   c. Location.
   d. Manufacturer and model.
   e. Size.
2. Flow Rate:
   a. Flow rate (cfm): specified and actual.
   b. Water flow rate: specified and actual.
3. Temperature:
   a. Entering air temperature: specified and actual.
   b. Leaving air temperature: specified and actual.
   c. Entering water temperature: specified and actual.
   d. Leaving water temperature: specified and actual.
4. Pressure Drop and Pressure:
   a. Air pressure drop: specified and actual.
   b. Steam pressure after valve: specified and actual.
   c. Water pressure drop: specified and actual.

D. Terminal Heat Transfer Units:

1. General Requirement:
   a. Drawing symbol.
   b. Location.
   c. Manufacturer and model.
   d. Include air data only for forced air units.
2. Flow Rate:
   a. Flow rate (cfm): specified and actual.
   b. Water flow rate (gpm): specified and actual.

E. Hot Water Boiler:

1. General Requirements:
   a. Drawing symbol.
   b. Service.
   c. Location.
   d. Manufacturer, model, and identification number.
   e. Control setting: specified and actual.
2. Temperature:
   a. Entering water temperature: specified and actual.
   b. Leaving water temperature: specified and actual.
3. Flow Rate:
   a. Flow rate (gpm): specified and actual.
4. Pressure Drop and Pressure:
   a. Pressure Drop: specified and actual.

4.4 PLUMBING SYSTEMS

A. Pump Data:

1. Drawing symbol.
2. Service.
3. Manufacturer, size, and model.
4. Impeller size: specified, actual, and final (if trimmed).
5. Flow Rate (gpm): specified and actual.
6. Pump Head: specified, operating and shutoff.

B. Balancing Valve:

1. Drawing symbol.
2. Service.
3. Location.
4. Size.
5. Manufacturer and model.
6. Flow rate (gpm): specified and actual.
7. Pressure drop: specified and actual.

C. Gas Fired Water Heater:

1. Drawing symbol.
2. Service.
3. Location.
4. Manufacturer and model.
5. Capacity (Btuh): specified, nameplate, and actual.
6. Entering water temperature: specified and actual.
7. Leaving water temperature: specified and actual.
8. Pressure Drop: specified and actual.

9. Control Setting: specified and actual.

4.5 ENERGY RECOVERY SYSTEMS

A. Air Systems - Air energy recovery devices shall be tested at ambient temperatures of less than 40˚F or greater than 85˚F.

1. Energy Recovery Wheel:

a. General Requirements:
   1) Drawing Symbol.
   2) Location.
   3) Wheel RPM.

b. Primary Air:
   1) Primary Entering Air Temperature.
   2) Primary Leaving Air Temperature.
   3) Primary Air Pressure Drop.
   4) Primary Air Flow Rate (cfm).

c. Secondary Air:
   1) Secondary Entering Air Temperature.
   2) Secondary Leaving Air Temperature.
   3) Secondary Air Pressure Drop.
   4) Secondary Air Flow Rate (cfm).

END OF SECTION

SECTION 23 07 13
DUCTWORK INSULATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Ductwork Insulation.
B. Insulation Jackets.

1.2 QUALITY ASSURANCE

A. Applicator: Company specializing in ductwork insulation application with five years minimum experience. When requested, installer shall submit manufacturer's certificate indicating qualifications.

B. Materials: UL listed in Category HNKT; flame spread/smoke developed rating of 25/50 in accordance with ASTM E84, NFPA 255, or UL 723.

C. Adhesives: UL listed, meeting NFPA 90A/90B requirements.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Type A: Flexible Fiberglass - Outside Wrap; ANSI/ASTM C553; commercial grade; 0.28 maximum 'K' value at 75°F; foil scrim kraft facing, 1.0 lb./cu. ft. density.

B. Type B: Semi-rigid Fiberglass Board Wrap - Outside Application; ANSI/ASTM C612, Class 1; 0.25 maximum 'K' value at 75°F; foil scrim kraft facing, 3 lb./cu. ft. density.

C. Type C: Flexible Fiberglass Liner; ANSI/ASTM C1071; 0.28 maximum 'K' value at 75°F; 1.5 lb/cu ft minimum density; coated air side for 4000 fpm air velocity.

D. Type F: Flexible High Temperature Wrap; ASTM E2336 rating as 2-hour separation with zero clearance to combustible materials over the full length. Material to be totally scrim encapsulated. Material to be a minimum 1-1/2" thick with a minimum core density of 6 pcf. Wrap system should offer zero clearance to combustibles per ASTM E2336 at all locations, comply with all applicable codes, and be approved by AHJ. If system is not rated for zero clearance per ASTM E2336 at all locations with single layer, a two layer system shall be provided with zero clearance per ASTM E2336 at all locations. Material must be tested and listed for installation on grease ducts and installed per listed design. Refer to Section 23 33 00 for prefabricated, pre-insulated access doors required for grease duct systems.

2.2 JACKETS

A. Vapor Barrier Jackets: Kraft reinforced foil scrim vapor barrier with self-sealing adhesive joints. Beach puncture resistance ratio of at least 25 units. Tensile strength: 35 psi minimum. Single, self-seal acrylic adhesive on longitudinal jacket laps and butt strips.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install materials in accordance with manufacturer's instructions, codes, and industry standards.

B. Install materials after ductwork has been tested.

C. Clean surfaces for adhesives.

D. Provide insulation with vapor barrier when air conveyed may be below ambient temperature.

E. Exterior Duct Wrap - Flexible, Type A:

1. Apply with edges tightly butted.

2. Cut slightly longer than perimeter of duct to insure full thickness at corners. Do not wrap excessively tight.

3. Seal joints with adhesive backed tape.

4. Apply so insulation conforms uniformly and firmly to duct.

5. Provide high-density insulation inserts at trapeze duct hangers and straps to prevent crushing of insulation. Maintain continuous vapor barrier through the hanger.

6. Tape all joints with Royal Tapes #RT 350 (216-439-7229), Venture Tape 1525CW, or Compac Type FSK. No substitutions will be accepted without written permission from the Architect/Engineer.

7. Press tape tightly to the duct covering with a squeegee for a tight continuous seal. Fish mouths and loose tape edges are not acceptable.

8. Staples may be used, but must be covered with tape.

9. Vapor barrier must be continuous.

10. Mechanically fasten on 12" centers at bottom of ducts over 24" wide and on all sides of vertical ducts.

F. Semi Rigid Fiberglass Board Wrap - Type B (Indoor Use):

1. Impale on pins welded to the duct and secured with speed clips. Clip pins off close to speed clips.

2. Space pins as needed to hold insulation firmly against duct, but not less than one pin per square foot. Pins must be long enough to avoid compressing the insulation.

3. Seal all joints and speed clips with glass fabric set in adhesive or a 3" wide strip of Royal Tapes #RT 350 (216-439-7229), Venture Tape 1525CW, or Compac Type FSK facing tape.

4. For small areas, secure insulation with adhesive over the entire surface of the duct. Use adhesive in addition to pins as needed to prevent sagging on horizontal surfaces.

G. Interior Insulation - Flexible Duct Liner, Type C:

1. Observation of Duct Lining:

a. After installation of ductwork, Architect/Engineer may select random observation points in each system.

1) At each observation point, cut and remove an 18" x 18" section of ductwork and liner for verification of installation.

2) Random observation points based on one opening per 75 lineal ft. of total duct run.

b. When any of the observation points shows non-compliance, additional points will be designated by the Architect/Engineer, and observation repeated.

c. If 20% of points observed do not comply, remove and replace all lined ducts and repeat tests. Where replacement is not required, correct all non-compliances.

d. At end of observation, repair all duct lining and observation holes by installing standard, insulated, hinged access doors per Section 23 33 00.

e. Paint or finish to match adjacent duct surfaces.

2. Impale on spindle anchors welded or mechanically fastened to the duct. Adhesive or glue fastened anchors are not acceptable. Maximum anchor spacing per SMACNA Duct Construction Standards or manufacturer's recommendations, whichever is more restrictive. Locate pins less than 3" from corners and at intervals not over 6" around the perimeter at leading and trailing edges. Locate pins within 3" of transverse joints and at intervals not over 16" long the length of the duct. Pins must be long enough to prevent compressing the insulation.

3. In addition to anchors, secure liner with UL listed adhesive covering over 90% of the duct surface.

4. Install per the latest edition of the SMACNA Manual.

5. Leading edges shall be covered as follows:

a. For duct velocities below 3000 fpm, coat leading edges with adhesive. Neatly butt liner without gaps at transverse joints. Cut liner flush with end of the duct section for tight joints with no exposed duct. If adhesive is shop installed, field apply additional adhesive to the end of each duct section for complete adhesion of the liner. Protect edges from dirt and debris.

b. For duct velocities above 3000 fpm, cover leading edges with metal nosing. Use nosing on upstream edges of each section of duct. If the duct can be installed in either direction, provide nosing on each end or clearly mark the duct to allow visual verification after installation. Verify duct velocities based on the scheduled air flow rates and determine where metal nosing is required.

c. Install metal nosing in the following locations (regardless of velocity):

1) The first three fittings downstream of all fans.
2) At all duct liner interruptions. This includes fire dampers, access doors, branch connections, and all other locations where the edge of the liner is exposed.
3) Trailing edges of transverse joints do not require metal nosings.

6. Overlap liner at longitudinal joints. Make longitudinal joints at corners of the duct unless the duct size does not allow this. Coat longitudinal joints with adhesive at velocities over 2500 fpm.

7. Seal all damaged duct liner with adhesive and glass cloth. Do not damage duct liner surface coatings.

8. Duct dimensions given are net inside dimensions. Increase sheet metal to allow for insulation thickness.

H. Exterior Fire Protection, Flexible Type - Type F:

1. Cut and secure duct wrap around ductwork, support angles, and hangers per manufacturer’s recommendations.

2. Seal all joints as required to maintain enclosure rating.

3. Installation shall be rated for 2 hours, unless otherwise noted.

4. Provide manufacturer's recommended assembly to protect all access doors to maintain enclosure rating and to permit easy replacement of insulation.

I. Continue insulation with vapor barrier through penetrations unless code prohibits.

J. Provide 2" wide, 24" high, 26 gauge, galvanized sheet metal corner protection angles for all externally insulated ductwork extending to a floor or curb.

3.2 SCHEDULE

A. Refer to Section 23 31 00 for scheduling of insulation.

END OF SECTION

SECTION 23 07 16
HVAC EQUIPMENT INSULATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Equipment Insulation.
B. Equipment Insulation Finishes.

1.2 QUALITY ASSURANCE

A. Applicator: Company specializing in insulation application with five years minimum experience.

B. Materials: Flame spread/smoke developed rating of 25/50 in accordance with ASTM E84, NFPA 255, or UL 723 (where required).

C. In accordance with LEED EQc4.1, Low-Emitting Materials - Adhesives and Sealants, all adhesives and sealants used on the interior of the building must comply with the following requirements:

1. Adhesives, sealants and sealant primers must comply with South Coast Air Quality Management District (SCAQMD) Rule #1168.

2. Aerosol adhesives must comply with Green Seal Standard for Commercial Adhesives GS-36 requirements in effect on October 19, 2000.

PART 2 - PRODUCTS

2.1 INSULATION

A. Type E: Cellular Flexible Elastomeric Foam Sheet; ANSI/ASTM C534; 0.28 maximum 'K' value at 75ºF; 25/50 flame spread/smoke developed when tested in accordance with ASTM E84 (UL 723).

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install all materials per manufacturer's instructions, codes and industry standards.

B. Maintain ambient temperatures and conditions required by manufacturers of adhesive and insulation.

C. Do not insulate factory insulated equipment.

D. Apply insulation as close as possible to equipment by grooving, scoring, and bevelling insulation. Secure to equipment with studs, pins, clips, adhesive, wires, or bands.

E. Fill joints, cracks, seams, and depressions with bedding compound to form smooth surface. On cold equipment, use vapor barrier mastic.

F. Do not insulate over nameplates or ASME stamps. Bevel and seal insulation around such, unless omitting insulation would cause condensation problem. When such is the case, appropriate tagging shall be provided to identify the presence of these items.

G. When equipment with insulation requires periodic opening for maintenance, repair, or cleaning; install specially fabricated removable insulation sections. Covers shall have mechanical fasteners and be reusable.

H. Install 26 gauge galvanized sheet metal corner protection angles where insulation extends to the floor. Minimum 2" coverage of insulation.

I. Insulate all equipment surfaces that are not factory insulated and are intended to operate below 60°F and/or above 100°F. Verify insulation type and thickness with equipment manufacturer and Architect/Engineer.

J. Insulate all supports on equipment operating below ambient temperature.

3.2 INSULATION

A. Type E:

1. Apply with edges tightly butted and joints staggered. Install multiple layers if required thickness is greater than 1" thick.

2. Do not wrap sheet insulation around square corners, but cut and overlap insulation at corners to provide full insulation thickness on all sides. Seal all overlapping insulation surfaces with manufacturer approved adhesive.

3. Secure with manufacturer approved adhesive in accordance with installation instructions. Where applied to underside surfaces or on surfaces with temperatures 140°F and above, cover all surfaces with full application of adhesive. Seal all joints and seams with manufacturer approved adhesive.

3.3 SCHEDULE

Equipment		Insulation Type	Insulation Thickness	Insulation Finish
A.	Geothermal Water Air Separator/Coalescing Filter	E	1"	None
B.	Geothermal Water Pumps	E	1"	None

END OF SECTION

SECTION 23 07 19
HVAC PIPING INSULATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Piping Insulation.
B. Insulation Jackets.

1.2 QUALITY ASSURANCE

A. Applicator: Company specializing in piping insulation application with five years minimum experience.

B. Materials: Flame spread/smoke developed rating of 25/50 in accordance with ASTM E84, NFPA 255, or UL 723 (where required).

C. In accordance with LEED EQc4.1, Low-Emitting Materials - Adhesives and Sealants, all adhesives and sealants used on the interior of the building must comply with the following requirements:

1. Adhesives, sealants and sealant primers must comply with South Coast Air Quality Management District (SCAQMD) Rule #1168.

2. Aerosol adhesives must comply with Green Seal Standard for Commercial Adhesives GS-36 requirements in effect on October 19, 2000.

PART 2 - PRODUCTS

2.1 INSULATION

A. Type A: Glass fiber; ANSI/ASTM C547; 0.24 maximum 'K' value at 75ºF; non-combustible. All purpose, white kraft jacket bonded to aluminum foil and reinforced with fiberglass yarn, 25/50 flame spread/smoke developed rating when tested in accordance with ASTM E84 (UL 723).

B. Type B: Elastomeric cellular foam; ANSI/ASTM C534; flexible plastic; 0.27 maximum 'K' value at 75ºF, 25/50 flame spread/smoke developed rating when tested in accordance with ASTM E84 (UL 723). Maximum 1" thick per layer where multiple layers are specified.

C. Type C: Molded rigid cellular glass; ANSI/ASTM C-552; 0.35 maximum 'K' value at 75ºF; moisture resistant, non-combustible; suitable for -100ºF to +900ºF. For below grade installations use asphaltic mastic paper vapor barrier jacket. Use self-seal all-purpose white kraft jacket for above grade installations.

2.2 VAPOR BARRIER JACKETS

A. Kraft reinforced foil vapor barrier with self-sealing adhesive joints. Beach puncture resistance ratio of at least 50 units. Tensile strength: 35 psi minimum. Single, self-seal acrylic adhesive on longitudinal jacket laps and butt strips.

B. Polyvinylidene Chloride (PVDC or Saran) film and tape: Durable and highly moisture and moisture vapor resistant. Please refer to manufacturer's recommended installation guidelines.

2.3 REMOVABLE INSULATION JACKETS

A. Removable insulation jackets shall consist of outer covering, interstitial insulation material, and inner covering.

B. Inner and outer covering shall be constructed from a minimum 16.5 oz/yd^2 PTFE fiberglass composite and suitable for insulating surface temperatures up to 550ºF.

C. Interstitial insulation blanket shall be minimum 1-1/2" thick and shall consist of either:

1. Silica and glass-fiber insulation felts and blankets – minimum 6 lb/ft^3 density.
2. E-type glass-fiber felts and blankets – minimum 6 lb/ft^3 density.

D. Construction: Inner and outer covering with interstitial insulation material shall be joined into a single assembly using a double sewn lock stitch with 4-6 stitches/inch. The thread used shall be able to withstand minimum 550ºF surface temperatures without degradation. The use of hog rings, staples, and wires for closure of assembly are not acceptable. The interstitial insulation shall be sewn as an integral part of the inner and outer coverings to prevent shifting of the insulation. Insulation pins are not an allowable method of preventing the insulation from shifting and shall not be used.

E. No raw cut jacket edges shall be exposed.

F. Jackets shall be fastened to equipment and piping components using hook and loop (Velcro) straps and minimum 1" slide buckles.

G. Jacket coverings shall have an inner covering edge with a continuous strip of hook & loop closure (Velcro) that is parallel to the seam and overlaps the outer covering by a minimum of 2 inches.

H. Acceptable Manufacturers: Firwin Corp, Lewco Specialty Products, ThermaXX Jackets LLC or approved equivalent.

2.4 REFRIGERANT PIPE COUPLING

A. Insulation Coupling: Molded thermoplastic ASTM D1525, -65ºF to 275ºF, sizes up to 4-1/8" O.D., and receive insulation thickness up to 1". Suitable for use indoors or outdoors with UV stabilizers.

B. Acceptable Manufacturers: Klo-Shure or equal.

PART 3 - EXECUTION

3.1 PREPARATION

A. Install insulation after piping has been tested. Pipe shall be clean, dry and free of rust before applying insulation.

3.2 INSTALLATION

A. General Installation Requirements:

1. Install materials per manufacturer's instructions, building codes and industry standards.

2. Continue insulation with vapor barrier through penetrations. This applies to all insulated piping. Maintain fire rating of all penetrations.

3. On all insulated piping, provide at each support an insert of same thickness and contour as adjoining insulation, between the pipe and insulation jacket, to prevent insulation from sagging and crushing. The insert shall be suitable for planned temperatures, be suitable for use with specific pipe material, and shall be a 180° cylindrical segment the same length as metal shields. Inserts shall be a cellular glass (for all temperature ranges) or molded hydrous calcium silicate (for pipe with operating temperatures above 70°F, with a minimum compressive strength of 50 psi. Factory fabricated inserts may be used. Rectangular blocks, plugs, or wood material are not acceptable. Temporary wood blocking may be used by the Piping Contractor for proper height; however, these must be removed and replaced with proper inserts by the Insulation Contractor.

4. Neatly finish insulation at supports, protrusions, and interruptions.

5. Install metal shields between all hangers or supports and the pipe insulation. Shields shall be galvanized sheet metal, half-round with flared edges. Adhere shields to insulation. On cold piping, seal the shields vapor-tight to the insulation as required to maintain the vapor barrier, or add separate vapor barrier jacket.

6. Shields shall be at least the following lengths and gauges:

	Pipe Size	Shield Size
a.	1/2" to 3”	12" long x 18 gauge
b.	4"	12" long x 16 gauge
c.	5” to 6"	18" long x 16 gauge
d.	8” to 14"	24" long x 14 gauge
e.	16” to 24"	24" long x 12 gauge

7. All piping and insulation that does not meet 25/50 that is located in an air plenum shall have written approval from the Authority Having Jurisdiction and the local fire department for authorization and materials approval. If approval has been allowed, the non-rated material shall be wrapped with a product that has passed ASTM E84 and/or NFPA 255 testing with a rating of 25/50 or below.

B. Insulated Piping Operating Below 60°F:

1. Insulate fittings, valves, unions, flanges, strainers, flexible connections, flexible hoses, and expansion joints. Seal all penetrations of vapor barrier.

2. On piping operating below 60ºF in locations that are not mechanically cooled (e.g., penthouses, mechanical rooms, tunnels, chases at exterior walls, etc.), Type B insulation shall be used.

3. All balance valves with fluid operating below 60°F shall be insulated with a removable plug wrapped with vapor barrier tape to allow reading and adjusting of the valve.

C. Insulated Piping Operating Between 60°F and 140°F:

1. Do not insulate flanges and unions, but bevel and seal ends of insulation at such locations. Insulate all fittings, valves and strainers.

D. Insulated Piping Operating Above 140°F:

1. Insulate fittings, valves, flanges, float & thermostatic steam traps, and strainers. On gate valves, the insulation shall be extended to cover the entire valve bonnet, leaving only the portion of the stem that is above the bonnet and valve operator exposed.

2. All balance valves with fluid operating above 140°F shall be insulated and an opening shall be left in the insulation to allow for reading and adjusting the valve.

3. The use of removable insulation jackets is acceptable for insulating large and non-cylindrical shaped piping components (e.g., check valves, pressure regulating valves, calibrated balance valves, gate valve bonnets, F&T traps, strainers, line sets, and the like).

E. Exposed Piping:

1. Locate and cover seams in least visible locations.

2. Where exposed insulated piping extends above the floor, provide a sheet metal guard around the insulation extending 12" above the floor. Guard shall be 0.016" cylindrical smooth or stucco aluminum and shall fit tightly to the insulation.

3.3 INSULATION

A. Type A Insulation:

1. All Service Jackets: Seal all longitudinal joints with self-seal laps using a single pressure sensitive adhesive system. Do not staple.

2. Insulation without self-seal lap may be used if installed with Benjamin Foster 85-20 or equivalent Chicago Mastic, 3M or Childers lap adhesive.

3. Apply insulation with laps on top of pipe.

4. Fittings, Valve Bodies and Flanges: For 4" and smaller pipes, insulate with 1 lb. density insulation wrapped under compression to a thickness equal to the adjacent pipe insulation. For pipes over 4", use mitered segments of pipe insulation. Finish with preformed plastic fitting covers. Secure fitting covers with pressure sensitive tape at each end. Overlap tape at least 2" on itself. For pipes operating below 60ºF, seal fitting covers with vapor retarder mastic in addition to tape.

B. Type B Insulation:

1. Elastomeric Cellular Foam: Where possible, slip insulation over the open end of pipe without slitting. Seal all butt ends, longitudinal seams, and fittings with adhesive. At elbows and tees, use mitered connections. Do not compress or crush insulation at cemented joints. Joints shall be sealed completely and not pucker or wrinkle. Paint the outside of outdoor insulation with two coats of latex enamel paint recommended by the manufacturer.

2. Self-seal insulation may be used on pipes operating below 170ºF.

3.4 JACKET COVER INSTALLATION

A. Plastic Covering:

1. Provide vapor barrier as specified for insulation type. Cover with plastic jacket covering. Position seams to shed water.

2. Solvent weld all joints with manufacturer recommended cement.

3. Overlap all laps and butt joints 1-1/2" minimum. Repair any loose ends that do not seal securely. Solvent weld all fitting covers in the same manner. Final installation shall be watertight.

4. Use plastic insulation covering on all exposed pipes including, but not limited to:

   a. All exposed piping in areas noted on drawings.
   b. All piping in mechanical rooms that is subject to damage from normal operations. (Example: Piping that must be stepped over routinely.)

3.5 SCHEDULE

	Piping System	Insulation Type/Thickness
A.	Geothermal Water Supply & Return	
	All Sizes	B / 1” (2 layers 1/2”)
B.	Heating Water Supply & Return	
	Under 1-1/2"	A / 1-1/2”
	1-1/2" and above	A / 2"
C.	Insulation Inserts at hangers	C - Match pipe insulation thickness

END OF SECTION

SECTION 23 09 00
CONTROLS

TABLE OF CONTENTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Complete System of Automatic Controls.
B. Control Devices, Components, Wiring and Material.
C. Instructions for Owners.

1.2 QUALITY ASSURANCE

A. Manufacturer: Company specializing in manufacturing the products specified in this Section with minimum five years' experience.

B. TCC: Company specializing in the work of this section with minimum five years temperature control experience.

C. Technician: Minimum five years' experience installing commercial temperature control systems.

D. TCCs are limited to firms regularly employing a minimum of five full-time temperature control technicians within 50 miles of the job site.

1.3 SUBMITTALS

A. Equipment Coordination:

1. The Controls Contractor shall obtain approved equipment submittals from other contractors to determine equipment wiring connections, to choose appropriate controllers, and to provide programming.

2. Control valve selections shall be based on flow rates shown in approved shop drawings.

3. Coordinate the control interface of all equipment with the equipment manufacturers prior to submittal submission.

B. Shop Drawings:

1. Submit shop drawings per Section 23 05 00. In addition, submit an electronic copy of the shop drawings in Adobe Acrobat (.pdf) format to the Owner for review.

2. Cross-reference **all** control components and point names in a single table located at the beginning of the submittal with the **identical** nomenclature used in this section.

3. Submittal shall also include a trunk cable schematic diagram depicting operator workstations, control panel locations and a description of the communication type, media and protocol.

4. System Architecture: Provide riser diagrams of wiring between central control unit and all control panels. This shall include specific protocols associated with each level within the architecture. Identify all interface equipment between CPU and control panels. The architecture shall include interface requirements with other systems including, but not limited to, security systems, lighting control, fire alarm, elevator status, and power monitoring system.

5. Diagrams shall include:

a. Wiring diagrams and layouts for each control panel showing all termination numbers.

b. Schematic diagrams for all control, communication, and power wiring. Provide a schematic drawing of the central system installation. Label all cables and ports with computer manufacturers' model numbers and functions. Show all interface wiring to the control system.

c. Identification of all control components connected to emergency power.

d. Schematic diagrams for all field sensors and controllers.

e. A schematic diagram of each controlled system. The schematics shall have all control points labeled. The schematics shall graphically show the location of all control elements in the system.

f. A schematic wiring diagram for each controlled system. Each schematic shall have all elements labeled. Where a control element is the same as that shown on the control system schematic, label it with the same name. Label all terminals.

g. A tabular instrumentation list for each controlled system. The table shall show element name, type of device, manufacturer, model number and product data sheet number.

h. All installation details and any other details required to demonstrate that the system will function properly.

i. All interface requirements with other systems.

6. The network infrastructure shall conform to the published guidelines for wire type, length, number of nodes per channel, termination, and other relevant wiring and infrastructure criteria as published. The number of nodes per channel shall be no more than 80% of the defined segment (logical or physical) limit in order to provide future system enhancement with minimal infrastructure modifications.

7. Sequences: Submit a complete description of the operation of the control system, including sequences of operation. The description shall include and reference a schematic diagram of the controlled system. **The wording of the control sequences in the submittal shall match verbatim that included in the construction documents to ensure there are no sequence deviations from that intended by the Architect/Engineer. Clearly highlight any deviations from the specified sequences on the submittals.**

8. Points List Schedule: Submit a complete points list of all points to be connected to the TCS and FMCS. The points list for each system controller shall include both inputs and outputs (I/O), point number, the controlled device associated with the I/O point, the location of the I/O device, and reference drawings. Where a control point is the same as that shown on the control system schematic, label it with the same name. Points list shall specifically identify alarms, trends, event history, archive, totalization, graphic points, and all mapped points from other systems (security systems, lighting control, fire alarm, etc.). Provide points lists, point naming convention, and factory support information for systems provided and integrated into the FMCS.

9. Damper Schedule: Schedule shall include a separate line for each damper and a column for each of the damper attributes:

a. Damper Identification Tag.
b. Location.
c. Damper Type.
d. Damper Size.
e. Duct Size.
f. Arrangement.
g. Blade Type.
h. Velocity.

i. Pressure Drop.
j. Fail Position.
k. Actuator Identification Tag.
l. Actuator Type.
m. Mounting.

10. Valve Schedule: Valve manufacturer shall size valves and create a valve schedule. Schedule shall include a separate line for each valve and a column for each of the valve attributes:

a. Valve Identification Tag.
b. Location.
c. Valve Type.
d. Valve Size.
e. Pipe Size.
f. Configuration.
g. Flow Characteristics.
h. Capacity.
i. Valve C_V.
j. Design Pressure Drop.
k. Pressure Drop at Design Flow.
l. Fail Position.
m. Close-off Pressure.
n. Valve and Actuator Model Number and Type.

11. Airflow Measuring Station Schedule:

a. The manufacturer's authorized representative shall prepare the airflow measuring station submittal, or review and approve in writing the submittal prepared by the TCC prior to submission to the Architect/Engineer and prior to installation. The representative shall review air handling equipment submittals and duct fabrication drawings to ensure that all AFMS locations meet the appropriate parameters to achieve proper installation and the specified accuracy. Comply with all manufacturer's installation requirements including straight up and downstream duct lengths. Install airflow straighteners if required by the manufacturer based on installation constraints. The Architect/Engineer shall be notified for approval of any deviations.

b. Submit product data sheets for airflow measuring devices indicating minimum placement requirements, sensor density, sensor distribution, and installed accuracy to the host control system.

c. Submit installation, operation, and maintenance documentation.

12. Product Data Sheets: Required for each component that includes: unique identification tag that is consistent throughout the submittal, manufacturer's description, technical data, performance curves, installation/maintenance instructions, and other relevant items. When manufacturer's literature applies to a product series rather than a specific product, the data specifically applicable to the project shall be highlighted or clearly indicated by other means. Each submitted piece of literature and drawings shall clearly reference the specification and/or drawing that the submittal is to cover. General catalogs shall not be accepted as cutsheets to fulfill submittal requirements.

13. Provide PICS files indicating the BACnet® functionality and configuration of each device.

14. Provide documentation of submitted products that have been tested and listed by the BACnet Testing Laboratory (BTL), or provide a letter on the manufacturer's company letterhead indicating the anticipated date by which testing is expected to be completed. If, for any reason, BTL testing and listing has not been completed, a written commitment to upgrade installed controls to a version that meets BTL testing and listing requirements in the event that problems are found during BTL testing is required.

15. Graphic Display: Include a sample graphic of each system and component identified in the points list with a flowchart (site map) indicating how the graphics are to be linked to each other for system navigation.

16. Software: A list of operating system software, operator interface software, color graphic software, and third-party software.

17. Control System Demonstration and Acceptance: Provide a description of the proposed process, along with all reports and checklists to be used.

18. Clearly identify work by others in the submittal.

19. Quantities of items submitted may be reviewed but are the responsibility of the Contractor to verify.

C. Operation and Maintenance Manual:

1. In addition to the requirements of Section 23 05 00, submit an electronic copy of the O&M manuals in PDF format.

2. Provide three complete sets of manuals.

3. Each O&M manual shall include:

a. Table of contents with indexed tabs dividing information as outlined below.

b. Definitions: List of all abbreviations and technical terms with definitions.

c. Warranty Contacts: Names, addresses, and 24-hour telephone numbers of contractors installing equipment and controls and service representatives of each.

d. Licenses, Guarantees, and Warranties: Provide documentation for all equipment and systems.

e. System Components: Alphabetical list of all system components, with the name, address, and telephone number of the vendor.

f. Operating Procedures: Include procedures for operating the control systems; logging on/off; enabling, assigning, and reporting alarms; generating reports; collection, displaying, and archiving of trended data; overriding computer control; event scheduling; backing up software and data files; and changing setpoints and other variables.

g. Programming: Description of the programming language (including syntax), statement descriptions (including algorithms and calculations used), point database creation and modification, program creation and modification, and use of the editor.

h. Engineering, Installation, and Maintenance: Explain how to design and install new points, panels, and other hardware; recommended preventive maintenance procedures for all system components, including a schedule of tasks (inspection, cleaning, calibration, etc.), time between tasks, and task descriptions; how to debug hardware problems; and how to repair or replace hardware. A list of recommended spare parts.

i. Original Software: Complete original issue CDs for all software provided, including operating systems, programming language, operator workstation software, and graphics software.

j. Software: One set of CDs containing an executable copy of all custom software created using the programming language, including the setpoints, tuning parameters, and object database.

k. Graphics: A glossary or icon symbol library detailing the function of each graphic icon and graphics creation and modification. One set of CDs containing files of all color graphic screens created for the project.

D. Training Manual:

1. Provide a course outline and training manuals for each training class.

E. Record Documents:

1. Submit record documentation per Section 23 05 00.

2. Provide a complete set of "as-built" drawings and application software on CDs. Provide drawings as AutoCAD™ or Visio™ compatible files. Provide two copies of the "as-built" drawings with revisions clearly indicated in addition to the documents on compact disk. All as-built drawings shall also be installed on the FMCS server in a dedicated directory. Provide all product data sheets in PDF format.

3. Submit two hard copies and one electronic copy of as-built versions of the shop drawings, including product data and record drawings with revisions clearly indicated. Provide floor plans showing actual locations of control components including panels, thermostats, sensors, and hardware.

4. Provide all completed testing and commissioning reports and checklists, along with all trend logs for each system identified in the points lists.

5. Submit printouts of all graphic screens with current values (temperatures, pressures, etc.) to the A/E verifying completion and proper operation of all points.

1.4 DELIVERY, STORAGE AND HANDLING

A. Provide factory-shipping cartons for each piece of equipment and control device. Maintain cartons through shipping, storage, and handling as required to prevent equipment damage. Store equipment and materials inside and protected from weather.

B. Factory-Mounted Components: Where control devices specified in this section are indicated to be factory mounted on equipment, arrange for shipping control devices to unit manufacturer.

1.5 PRODUCTS FURNISHED BUT NOT INSTALLED UNDER THIS SECTION

A. Control Valves.
B. Flow Switches.
C. Temperature Sensor Sockets.
D. Gauge Taps.
E. Automatic Dampers.
F. Flow Meters.

1.6 AGENCY AND CODE APPROVALS

A. All products shall have the following agency approvals. Provide verification that the approvals exist for all submitted products with the submittal package.

1. UL-916; Energy Management Systems.
2. C-UL listed to Canadian Standards Association C22.2 No. 205-M1983 "Signal Equipment."

3. EMC Directive 89/336/EEC (European CE Mark).
4. FCC, Part 15, Subpart J, Class A Computing Devices.

1.7 ACRONYMS

A. Acronyms used in this specification are as follows:

1.	B-AAC	BACnet Advanced Application Controller
2.	B-ASC	BACnet Application Specific Controller
3.	BTL	BACnet Testing Laboratories
4.	DDC	Direct Digital Controls
5.	FMCS	Facility Management and Control System
6.	GUI	Graphic User Interface
7.	IBC	Interoperable BACnet Controller
8.	IDC	Interoperable Digital Controller
9.	LAN	Local Area Network
10.	NAC	Network Area Controller
11.	ODBC	Open DataBase Connectivity
12.	OOT	Object Oriented Technology
13.	OPC	Open Connectivity via Open Standards
14.	PICS	Product Interoperability Compliance Statement
15.	PMI	Power Measurement Interface
16.	POT	Portable Operator's Terminal
17.	TCC	Temperature Control Contractor
18.	TCS	Temperature Control System
19.	WAN	Wide Area Network
20.	WBI	Web Browser Interface

1.8 SUMMARY

A. Provide new standalone FMCS for this project with connection to city server system..

B. TCC shall furnish all labor, materials, equipment, and service necessary for a complete and operating Temperature Control System (TCS) and Facility Management and Control System (FMCS) using Direct Digital Controls as shown on the drawings and as described herein.

C. All labor, material, equipment and software not specifically referred to herein or on the plans that is required to meet the intent of this specification shall be provided without additional cost to the Owner.

D. The Owner shall be the named license holder of all software associated with any and all incremental work on the project.

1.9 LEED REQUIREMENTS

A. This project shall meet the requirements of the U.S. GREEN BUILDING COUNCIL LEADERSHIP IN ENERGY AND ENVIRONMENTAL DESIGN (LEED) program.

B. This project will attempt to achieve the U.S. Green Building Council's LEED Version 3.0 certification Level: Silver.

C. This Contractor shall carefully examine the LEED portion of this specification for full compliance with the following LEED points:

1. "Energy & Atmosphere": Prerequisite 1, "Fundamental Building Systems Commissioning," Prerequisite 2 - "Minimum Energy Performance," Credit 3 - "Additional Commissioning," and Credit 5 - "Measurement and Verification," as described by LEED.

2. "Indoor Environmental Quality": Prerequisite 1 - "Minimum IAQ Performance," Credit 1 - "Outdoor Air Delivery Monitoring," Credit 2 - "Increased Ventilation," Credit 6 - "Controllability of Systems," Credit 6.1 - "Lighting Control," and Credit 6.2 - "Thermal Comfort."

3. All labor and materials required for these and any other LEED initiatives shall be provided without additional cost to the Owner.

1.10 SYSTEM DESCRIPTION

A. The entire TCS shall be comprised of a network of interoperable, standalone digital controllers communicating via the following protocol to an NAC. Temperature Control System products shall be as specified below.

B. The FMCS shall include Network Area Controller or Controllers (NAC) within each facility. The NAC shall connect to the Owner's local or wide area network, depending on configuration. Provide access to the system, either locally in each building or remotely from a central site or sites, through standard Web browsers, via the Internet, and/or via local area network.

C. Provide materials and labor necessary to connect factory supplied control components.

D. Provide central and remote hardware, software, and interconnecting wire and conduit.

E. The FMCS shall include automated alarming software capable of calling e-mail compatible cellular telephones and pagers. The e-mail alarm paging system shall be able to segregate users, time schedules, and equipment and be capable of being programmed by the Owner.

F. For the dedicated configuration tool provided, it is preferable that it be launched from within the applicable Network Management Software. If not, include any software required for controller configuration as a leave-behind tool with enough license capability to support the installation.

1.11 SOFTWARE LICENSE AGREEMENT

A. The Owner shall be the named license holder of all software associated with any and all incremental work on the project(s). In addition, the Owner shall receive ownership of all job-specific configuration documentation, data files, configuration tools, and application-level software developed for the project. This shall include, but is not limited to, all custom, job-specific software code and documentation for all configuration and programming that is generated for a given project and/or configured for use with the NAC, FMCS Server(s), and any related LAN/WAN/intranet and/or Internet connected routers and devices. Provide the Owner with all required IDs and passwords for access to any component or software program. The Owner shall determine which organizations shall be named in the SI organization ID (**"orgid"**) of all software licenses. Owner shall be free to direct the modification of the **"orgid"** in any software license, regardless of supplier.

1.12 JOB CONDITIONS

A. Cooperation with Other Trades: Coordinate the Work of this section with that of other sections to ensure that the Work will be carried out in an orderly fashion. It is this Contractor's responsibility to check the Contract Documents for possible conflicts between the Work of this section and that of other crafts in equipment location; pipe, duct and conduit runs; electrical outlets and fixtures; air diffusers; and structural and architectural features.

1.13 WARRANTY

A. Refer to Section 23 05 00 for warranty requirements.

B. Within the warranty period, any defects in the work provided under this section due to faulty materials, methods of installation or workmanship shall be promptly (within 48 hours after receipt of notice) repaired or replaced by this Contractor at no expense to the Owner.

C. Warranty requirements include furnishing and installing all FMCS software upgrades issued by the manufacturer during the one-year warranty period.

D. Update all software and back-ups during warranty period and all user documentation on the Owner's archived software disks.

1.14 WARRANTY ACCESS

A. The Owner shall grant to this Contractor reasonable access to the TCS and FMCS during the warranty period.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

Acceptable Manufacturers	BACnet Protocol
Honeywell WEBs-AX	●

2.2 SYSTEM ARCHITECTURE

A. General:

1. The Temperature Control System (TCS) and Facility Management Control System (FMCS) shall consist of a network of interoperable, standalone digital controllers, a computer system, graphic user interface software, printers, network devices, valves, dampers, sensors, and other devices as specified herein.

2. The installed system shall provide secure password access to all features, functions and data contained in the overall FMCS.

3. The FMCS shall be based on Tridium's Niagara Framework and adhere to the open NICS licensing. The FMCS shall be comprised of Java Application Control Engine or Controllers (JACE) within each facility. The system shall support JACE Version 3.8. The JACE shall connect to the local area network, depending on configuration. Access to the system, either locally in each building, or remotely from a central site or sites, shall be accomplished through standard Web browsers, via the Internet and/or local area network. Each JACE is capable communicate to LonMark/LonTalk (ILC) and/or BACnet (IBC) controllers and other open and legacy protocol systems/devices.

4. The FMCS shall be based on the NiagaraAX Framework (or "NiagaraAX"), a Java-based framework developed by Tridium. NiagaraAX provides an open automation infrastructure that integrates diverse systems and devices (regardless of manufacturer, communication standard or software) into a unified platform that can be easily managed in real time over the Internet using a standard Web browser. Systems not developed on the NiagaraAX Framework platform are unacceptable.

5. The entire Temperature Control System (TCS) shall be comprised of a network of interoperable, stand-alone digital controllers communicating via LonMark/LonTalk and/or BACnet communication protocols to Java Application Control Engines (JACE) which communicate BACnet TCP/ IP or OBIX TCP/IP to the Niagara AX Server. Niagara AX Supervisor Software to be installed on owner provided server.

6. The Owner shall be the named license holder of all software associated with any and all incremental work on the project(s). All Niagara AX software licenses shall have the "accept.station.in=*" and "accept.station.out=*"and "accept.wb.in=*" and "accept.wb.out=*" section of the software licenses. The intent is to insure that the installed Niagara AX products may be completely open for integrations. Owner shall be free to direct the modification of any software license, regardless of supplier. In addition, the owner shall receive ownership of all job specific software configuration documentation, data files, and application-level software developed for the project. This shall include all custom, job specific software code and documentation for all configuration and

programming that is generated for a given project and/or configured for use with Niagara Framework (Niagara AX) based controllers and/or servers and any related LAN / WAN / Intranet and Internet connected routers and devices. Any and all required I.D.'s and passwords for access to any component or software program shall be provided to the owner. Provide all software necessary for developing software algorithms in all supervisory, programmable and application specific direct digital controllers which is licensed to the Owner.

B. Open, Interoperable, Integrated Architectures:

1. All components and controllers supplied under this Division shall be true "peer-to-peer" communicating devices. Components or controllers requiring "polling" by a host to pass data are not acceptable.

2. The supplied system must be able to access all data using standard Web browsers without requiring proprietary operator interface and configuration programs. An Open DataBase Connectivity (ODBC) or Structured Query Language (SQL) compliant server database is required for all system database parameter storage. This data shall reside on a supplier-installed server for all database access. Systems requiring proprietary database and user interface programs are not acceptable.

3. Hierarchical or "flat" topologies are required to have system response times as indicated below and to manage the flow and sharing of data without unduly burdening the customer's internal intranet network.

a. Maximum acceptable response time from any alarm occurrence (at the point of origin) to the point of annunciation shall not exceed 5 seconds for network connected user interfaces.

b. Maximum acceptable response time from any alarm occurrence (at the point of origin) to the point of annunciation shall not exceed 60 seconds for remote or dial-up connected user interfaces.

2.3 NETWORKS

A. The Local Area Network (LAN) shall be a 100 megabits/sec Ethernet network supporting BACnet, Java, XML, HTTP, and SOAP. Provide support for multiple Network Area Controllers (NACs), user workstations and, if specified, a local server.

B. Local area network minimum physical and media access requirements:

1. Ethernet; IEEE Standard 802.3.
2. Cable; 100 Base-T, UTP-8 wire, Category 6.
3. Minimum throughput; 100 Mbps.

C. Communication conduits shall not be installed closer than six feet from 110VAC or higher transformers or run parallel within six feet of electrical high power cables. Route the cable as far from interference generating devices as possible. Where communication wire must cross 110VAC or higher wire, it must do so at right angles.

D. Ground all shields (earth ground) at one point only to eliminate ground loops. Provide all shield grounding at the controller location, with the shield at the sensor/device end of the applicable wire being left long and "safed" off in an appropriate manner.

E. There shall be no power wiring in excess of 30 VAC rms run in conduit with communications wiring. In cases where signal wiring is run in conduit with communication wiring, run all communication wiring and signal wiring using separate twisted pairs (24awg) in accordance with the manufacturer's wiring practices.

2.4 REMOTE NETWORK ACCESS

A. For Local Area Network installations, provide access to the LAN from a remote location via the Internet. The Owner shall provide a connection to the Internet to enable this access via high speed cable modem, asynchronous digital subscriber line (ADSL) modem, ISDN line, T1 Line or via the customer's intranet to a corporate server providing access to an Internet Service Provider (ISP). Customer agrees to pay monthly access charges for connection and ISP.

2.5 NETWORK AREA CONTROLLER (NAC)

A. The TCC shall supply one or more Network Area Controllers (NAC) as part of this contract. Number of NACs required depends on the type and quantity of devices provided under Divisions 23 and 26. The TCC shall determine the quantity and type of devices.

B. Each NAC shall provide the interface between the LAN or WAN and the field control devices and shall provide global supervisory control functions over the control devices connected to the NAC. It shall execute application control programs to provide:

1. Calendar functions.
2. Scheduling.
3. Trending.
4. Alarm monitoring and routing.
5. Time synchronization.
6. Integration of all controller data.
7. Network Management functions.

C. The Network Area Controller shall provide the following hardware features as a minimum:

1. One Ethernet Port – 10/100 Mbps.
2. One RS-232 port.
3. One LonWorks Interface Port – 78KB FTT-10A (for LonWorks systems only).
4. One RS-485 port.
5. Battery backup.
6. Flash memory for long-term data backup. (If battery backup or flash memory is not supplied, the controller shall contain a hard disk with at least 1 gigabyte storage capacity.)
7. The NAC must be capable of operation over a temperature range of 32°F to 122°F.
8. The NAC must be capable of withstanding storage temperatures of between 0°F and 158°F.
9. The NAC must be capable of operation over a humidity range of 5% RH to 95% RH, non-condensing.

D. The NAC shall provide multiple user access to the system and support for ODBC or SQL. Databases resident on the NAC shall be ODBC-compliant or must provide an ODBC data access mechanism to read and write data stored within it.

E. The NAC shall support standard Web browser access via the Internet or an intranet and a minimum of five (5) simultaneous users.

F. Event Alarm Notification and Actions:

1. The NAC shall provide alarm recognition, storage; routing, management, and analysis to supplement distributed capabilities of equipment or application specific controllers.

2. The NAC shall be able to route any alarm condition to any defined user location whether connected to a LAN, remote via dial-up telephone connection, or WAN.

3. Alarm generation shall be selectable for annunciation type and acknowledgement requirements including, but not limited to:

a. Alarm

b. Normal

4. Provide for the creation of a minimum of eight alarm classes with different routing and acknowledgement properties, e.g. security, HVAC, Fire, etc.

5. Provide timed (scheduled) routing of alarms by class, object, group, or node.

6. Provide alarm generation from binary object "runtime" and/or event counts for equipment maintenance. The user shall be able to reset runtime or event count values with appropriate password control.

G. Treat control equipment and network failures as alarms and annunciated.

H. Annunciate alarms in any of the following manners as defined by the user:

1. Screen message text.

2. E-mail of the complete alarm message to multiple recipients. Provide the ability to route and e-mail alarms based on:

a. Day of week.
b. Time of day.
c. Recipient.

3. Pagers via paging services that initiate a page on receipt of e-mail message.

4. Graphic with flashing alarm object(s).

5. Printed message, routed directly to a dedicated alarm printer.

I. The FMCS shall record the following for each alarm:

1. Time and date.
2. Location (building, floor, zone, office number, etc.).
3. Equipment tag.
4. Acknowledge time, date, and user who issued acknowledgement.
5. Number of occurrences since last acknowledgement.

J. Give defined users proper access to acknowledge any alarm.

K. A log of all alarms shall be maintained by the NAC and/or a server (if configured in the system) and shall be available for review by the user.

L. Provide a "query" feature to allow review of specific alarms by user-defined parameters.

M. A separate log for system alerts (controller failures, network failures, etc.) shall be provided and available for review by the user.

N. An error log to record invalid property changes or commands shall be provided and available for review by the user.

2.6 BACNET FMCS

A. The intent of this specification is to provide a peer-to-peer networked, standalone, distributed control system with the capability to integrate ANSI/ASHRAE Standard 135-2001 BACnet, MODBUS, OPC, and other open and proprietary communication protocols in one open, interoperable system.

B. The supplied computer software shall employ object-oriented technology (OOT) for representation of all data and control devices in the system. Adherence to industry standards including the latest ANSI/ASHRAE Standard 135 (BACnet) to assure interoperability between all system components is required. For each BACnet device, the device supplier must provide a PICS document showing the installed device's compliance level. Minimum compliance is Level 3; with the ability to support data read and write functionality. Physical connection of BACnet devices shall be via Ethernet (BACnet Ethernet/IP) and/or RS-485 (BACnet MSTP).

C. Interoperable BACnet Controller (IBC):

1. Controls shall be microprocessor based Interoperable BACnet Controllers (IBC) in accordance with the latest ANSI/ASHRAE Standard 135. Provide IBCs for unit ventilators, fan coils, heat pumps, terminal air boxes (TAB) and other applications. The application control program shall reside in the same enclosure as the input/output circuitry that translates the sensor signals. Provide a PICS document showing the installed system's compliance level to ANSI/ASHRAE Standard 135. Minimum compliance is Level 3.

2. The IBCs shall be listed by the BACnet Testing Laboratory (BTL) as follows:

    a. BACnet Building Controller(s) (B-BC).
    b. BACnet Advanced Application Controller(s) (B-ACC).
    c. BACnet Application Specific Controller(s) (B-ASC).

3. The IBCs shall communicate with the NAC via an Ethernet connection at a baud rate of not less than 10 Mbps.

4. Each IBC sensor shall connect directly to the IBC and shall not use any of the I/O points of the controller. The IBC Sensor shall provide a two-wire connection to the controller that is polarity and wire type insensitive. The IBC sensor shall provide a communications jack for connection to the BACnet communication trunk to which the IBC controller is connected. The IBC sensor, the connected controller, and all other devices on the BACnet bus shall be accessible by the POT.

5. All IBCs shall be fully application programmable and shall at all times maintain their BACnet Level 3 compliance. Controllers offering application selection only (non-programmable) require a 10% spare point capacity to be provided for all applications. Store all control sequences within or programmed into the IBC in non-volatile memory that does not depend on a battery to be retained.

6. The Contractor supplying the IBCs shall provide documentation for each device, with the following information at a minimum:

    a. BACnet Device; MAC address, name, type and instance number.
    b. BACnet Objects; name, type and instance number.

7. It is the responsibility of the Contractor to ensure that the proper BACnet objects are provided in each IBC.

D. Object Libraries

1. A standard library of objects shall be included for development and setup of application logic, user interface displays, system services, and communication networks.

2. The objects in this library shall be capable of being copied and pasted into the user's database and shall be organized according to their function. In addition, the user shall have the capability to group objects created in their application and store the new instances of these objects in a user-defined library.

3. In addition to the standard libraries specified here, the system supplier shall maintain an on-line accessible (over the Internet) library, available to all registered users, to provide new or updated objects and applications as they are developed.

4. All control objects shall conform to the control objects specified in the BACnet specification.

5. The library shall include applications or objects for the following functions, at a minimum:

   a. Scheduling Object: The schedule must conform to the schedule object as defined in the BACnet specification, providing seven-day plus holiday and temporary scheduling features and a minimum of 10 on/off events per day. Data entry to be by graphic sliders to speed creation and selection of on-off events.

   b. Calendar Object: The calendar must conform to the calendar object as defined in the BACnet specification, providing 12-month calendar features to allow for holiday or special event data entry. Data entry to be by graphic "point-and-click" selection. This object must be "linkable" to any or all scheduling objects for effective event control.

   c. Override Object: Provide override object that is capable of restarting equipment turned off by other energy saving programs to maintain occupant comfort or for equipment protection.

   d. Start-Stop Time Optimization Object: Provide a start-stop time optimization object to start equipment just early enough to bring space conditions to desired conditions by the scheduled occupancy time. Also, allow equipment to be stopped before the scheduled unoccupied time just far enough ahead to take advantage of the building's "flywheel" effect for energy savings. Provide automatic tuning of all start-stop time object properties based on historical performance.

   e. Demand Limiting Object: Provide a demand-limiting object that is capable of controlling demand for any selected energy utility (electric, oil, gas, etc.). The object shall be able to monitor a demand value and predict (using a sliding window prediction algorithm) the demand at the end of the user-defined interval period (1 to 60 minutes). This object shall also accommodate a utility meter time sync pulse for fixed interval demand control. Upon a prediction that will exceed the user-defined demand limit (supply a minimum of 6 per day), the demand limiting object shall issue shed commands to either turn off user specified loads or modify equipment setpoints to provide the desired energy reduction. If the list of sheddable equipment is not enough to reduce the demand to below the setpoint, display a message on the user's screen (as an alarm) instructing the user to take manual actions to maintain the desired demand. The shed lists are specified by the user and shall be selectable to be shed in either a fixed or rotating order to control which equipment is shed the most often. Upon suitable reductions in demand, the demand-limiting object shall restore the equipment that was shed in the reverse order in which it was shed. Each sheddable object shall have a minimum and maximum shed time property to provide both equipment protection and occupant comfort.

6. The library shall include control objects for the following functions:

   a. Analog Input Object: Minimum requirement is to comply with the BACnet standard for data sharing. Allow high, low and failure limits to be assigned for alarming. Also, provide a time delay filter property to prevent nuisance alarms caused by temporary excursions above or below the user defined alarm limits.

   b. Analog Output Object: Minimum requirement is to comply with the BACnet standard for data sharing.

   c. Binary Input Object: Minimum requirement is to comply with the BACnet standard for data sharing. The user must be able to specify either input condition for alarming. This object must also include the capability to record equipment runtime by counting the amount of time the hardware input is in an "on" condition. The user must be able to specify either input condition as the "on" condition.

d. Binary Output Object: Minimum requirement is to comply with the BACnet standard for data sharing. Properties to enable minimum on and off times for equipment protection as well as start-to-start delay must be provided. Incorporate the BACnet Command Prioritization priority scheme to allow multiple control applications to execute commands on this object with the highest priority command being invoked. Provide 16 levels of priority as a minimum. Systems not employing the BACnet method of contention resolution are not acceptable.

e. PID Control Loop Object: Minimum requirement is to comply with the BACnet standard for data sharing. Each individual property must be adjustable to allow proportional control only, or proportional with integral control, or proportional, integral and derivative control.

f. Comparison Object: Allow a minimum of two analog objects to be compared to select either the highest, lowest, or equality between the two linked inputs. Also, allow limits to be applied to the output value for alarm generation.

g. Math Object: Allow a minimum of four analog objects to be tested for the minimum or maximum, or the sum, difference, or average of linked objects. Also, allow limits to be applied to the output value for alarm generation.

h. Custom Programming Objects: Provide a blank object template for the creation of new custom objects to meet specific user application requirements. This object must provide a simple BASIC-like programming language that is used to define object behavior. Provide a library of functions including, but not limited to, math and logic functions and string manipulation. Also, provide a comprehensive on-line debug tool to allow complete testing of the new object. Allow new objects to be stored in the library for reuse.

i. Interlock Object: Provide an interlock object that provides a means of coordination of objects within a piece of equipment, such as an air handler or other similar types of equipment. An example is to link the return fan to the supply fan such that, when the supply fan is started, the return fan object is also started automatically without the user having to issue separate commands or to link each object to a schedule object. In addition, the control loops, damper objects, and alarm monitoring (such as return air, supply air, and mixed air temperature objects) will be inhibited from alarming during a user-defined period after startup to allow for stabilization. When the air handler is stopped, the interlocked return fan is also stopped, the outside air damper is closed, and other related objects within the air handler unit are inhibited from alarming, thereby eliminating nuisance alarms during the off period.

j. Temperature Override Object: Provide an object whose purpose is to override a binary output to an “on” state in the event a user-specified high or low limit value is exceeded. Link this object to the desired binary output object as well as to an analog object for temperature monitoring to cause the override to be enabled. This object will execute a start command at the Temperature Override level of start/stop command priority, unless changed by the user.

k. Composite Object: Provide a container object that allows a collection of objects representing an application to be encapsulated to protect the application from tampering or to more easily represent large applications. This object must have the ability to allow the user to select the appropriate parameters of the “contained” application that are represented on the graphic shell of this container.

7. The object library shall include objects to support the integration of devices connected to the Network Area Controller (NAC). Provide the following as part of the standard library included with the programming software:

a. LonMark/LonWorks Devices: These devices shall include, but not be limited to, devices for control of HVAC, lighting, access, and metering. Provide LonMark manufacturer-specific objects to facilitate simple integration of these devices. Support all network variables defined in the LonMark profile. The device manufacturer shall provide information (type and function) regarding network variables not defined in the LonMark profile.

b. For devices not conforming to the LonMark standard, provide a dynamic object that can be assigned to the device based on network variable information provided by the device manufacturer. Device manufacturer shall provide an XIF file, resource file, and documentation for the device to facilitate device integration.

c. For BACnet devices, provide the following objects:

1) Analog In.
2) Analog Out.
3) Analog Value.
4) Binary.
5) Binary In.
6) Binary Out.
7) Binary Value.
8) Multi-State In.
9) Multi-State Out.
10) Multi-State Value.
11) Schedule Export.
12) Calendar Export.
13) Trend Export.
14) Device.

d. For each BACnet object, provide the ability to assign the object a BACnet device and object instance number.

e. For BACnet devices, provide the following support at a minimum:

1) Segmentation.
2) Segmented Request.
3) Segmented Response.
4) Application Services.
5) Read Property.
6) Read Property Multiple.
7) Write Property.
8) Write Property Multiple.
9) Confirmed Event Notification.
10) Unconfirmed Event Notification.
11) Acknowledge Alarm.
12) Get Alarm Summary.
13) Who-has.
14) I-have.
15) Who-is.
16) I-am.
17) Subscribe COV.
18) Confirmed COV notification.
19) Unconfirmed COV notification.
20) Media Types.
21) Ethernet.
22) BACnet IP Annex J.
23) MSTP.

24) BACnet Broadcast Management Device (BBMD) function.
25) Routing.

2.7 TERMINAL AIR BOX (TAB) CONTROLLERS

A. FMCS Volume Controller: Electronic, furnished and installed by TCC. Boxes shall have pressure independent control to maintain constant air volume regardless of duct pressure changes up to 6 inches w.c. Provide velocity and static sensor at box inlet for use by unit controller. Set boxes for maximum and minimum settings shown on the drawings. Refer to Section 23 36 00 for additional information.

B. The controller shall support various digital and analog inputs and outputs as needed for damper control, control valves, electric coils, airflow sensors, remote heating, occupancy sensors, etc. and shall be capable of independent occupancy scheduling.

C. Controller shall provide continuous zone temperature histories internal to device for up to 24 hours and perform its own limit and status monitoring and alarms to limit unnecessary communications.

D. Operator interface to any ASC point data or programs shall be through network resident programs or portable operator's terminal connected to the specific controller.

E. Store all system setpoints, proportional bands, control algorithms, and other programmable parameters such that a power failure of any duration does not necessitate reprogramming of the controller.

F. BACnet TAB controllers shall either be B-AAC devices or B-ASC devices as required to meet the performance and BTL listing.

2.8 DATA COLLECTION AND STORAGE (TRENDING REQUIREMENTS)

A. The NAC shall be able to collect data for any property of any object and store resident in the NAC that shall have, at a minimum, the following configurable properties:

1. Designating the log as interval or deviation.

2. For interval logs, configure the object for time of day, day of week and the sample collection interval.

3. For deviation logs, configure the object for the deviation of a variable to a fixed value. This value, when reached, will initiate logging of the object.

4. For all logs, provide the ability to set the maximum number of data stores for the log and to set whether the log will stop collecting when full or rollover the data on a first-in, first-out basis.

5. Each log shall have the ability to have its data cleared on a time-based event or by a user-defined event or action.

B. Store all log data in a relational database in the NAC that is accessible from a server (if the system is so configured) or a standard Web browser.

C. All log data, when accessed from a server, shall be capable of being manipulated using standard SQL statements.

D. All log data shall be available to the user in ALL the following data formats:

1. HTML.
2. XML.
3. Plain text.
4. Comma or tab separated values.

E. The NAC shall archive its log data either locally (to itself) or remotely to a server or other NAC on the network. Provide the ability to configure the following archiving properties:

1. Archive on time of day.
2. Archive on user-defined number of data stores in the log (buffer size).
3. Archive when log has reached its user-defined capacity of data stores.
4. Provide ability to clear logs once archived.

2.9 AUDIT LOG

A. Provide and maintain an audit log that tracks all activities performed on the NAC. Provide the ability to specify a buffer size for the log and the ability to archive log based on time or when the log has reached its user-defined buffer size. Provide the ability to archive the log locally (to the NAC), to another NAC on the network, or to a server. For each log entry, provide the following data:

1. Time and date.
2. User ID.
3. Change or activity: i.e., change setpoint, add or delete objects, commands, etc.

2.10 DATABASE BACKUP AND STORAGE

A. The NAC shall automatically backup its database on a user-defined time interval.

B. Store copies of the current database and, at the most, the recently saved database in the NAC. The age of the most recently saved database shall depend on the user-defined database save interval.

C. Store the NAC database in XML format to allow viewing and editing. Other formats are acceptable as long as XML format is supported.

2.11 GRAPHIC USER INTERFACE SOFTWARE

A. Operating System:

1. Provide computer with the most current Microsoft-based operating system with which the GUI has proven compatibility.

B. The GUI shall employ browser-like functionality for ease of navigation. It shall include a tree view (similar to Windows Explorer) for quick viewing of, and access to, the hierarchical structure of the database. In addition, menu pulldowns and toolbars shall employ buttons, commands and navigation to permit the operator to perform tasks with basic computing skills. These shall include, but are not limited to, forward/backward buttons, home button, and a context sensitive locator line (similar to a URL line) that displays the location and the selected object identification.

C. Point Organization: Organize points by equipment categories, location, or other means acceptable to Owner.

D. Real-Time Displays: The GUI shall support the following graphic features and functions:

1. Graphic screens shall be developed using any drawing package capable of generating a GIF, BMP, or JPG file. Use of proprietary graphic file formats is not acceptable. In addition to, or in lieu of, a graphic background, the GUI shall support the use of scanned pictures.

2. Graphic screens shall be able to contain objects for text, real-time values, animation, color spectrum objects, logs, graphs, HTML or XML document links, schedule objects, hyperlinks to other URLs, and links to other graphic screens.

3. Graphics shall support layering, and each graphic object shall be configurable for assignment to a layer. A minimum of six layers shall be supported.

4. Modifying common application objects, such as schedules, calendars, and setpoints, shall be accomplished graphically.

   a. Schedule times shall be adjusted using a graphic slider without requiring any keyboard entry from the operator.

   b. Holidays shall be set by using a graphic calendar without requiring any keyboard entry from the operator.

5. Commands to start and stop binary objects shall be made by selecting the object and the appropriate command from a pop-up menu. No text entry shall be required.

6. Adjustments to analog objects, such as setpoints, shall be made by selecting the object and using a graphic slider to adjust the value. No text entry shall be required.

E. System Configuration: At a minimum, the GUI shall include the necessary software and components to enable the operator to perform the following tasks with proper password access:

1. Create, delete or modify control strategies.
2. Add/delete objects.
3. Tune control loops by adjusting control loop parameters.
4. Enable or disable control strategies.
5. Generate hard copy records or control strategies on a printer.
6. Select alarm points and define the alarm state.
7. Select points to be trended and initiate the recording of values automatically.
8. View any trend as a graph.

F. On-Line Help: Provide a context sensitive, on-line help system to assist the operator in operation and editing of the system. On-line help shall be available for all applications and shall provide the relevant data for that particular screen. Additional help information shall be available through the use of hypertext. All system documentation and help files shall be in HTML format.

G. Security: Each operator shall be required to log on to that system with a user name and password in order to view, edit, add, or delete data. System security shall be selectable for each operator. The system administrator shall be able to set passwords and security levels for all other operators. Each operator password shall be able to restrict the operator's access for viewing and/or changing each system application, full screen editor, and object. Each operator shall be automatically logged off the system if no keyboard or mouse activity is detected. This auto log-off time shall be set per operator password. Store all system security data in an encrypted format.

H. System Diagnostics: The system shall automatically monitor the operation of all workstations, printers, modems, network connections, building management panels, and controllers. Annunciate the failure of any device to the operator.

I. Alarm Console:

1. The system shall have a dedicated alarm window or console. This window will notify the operator of an alarm condition, and allow the operator to view details of the alarm and to acknowledge the alarm.

2. When the alarm console is enabled, a separate alarm notification window will supersede all other windows on the desktop and shall not be capable of being minimized or closed by the operator. This window will notify the operator of new alarms and un-acknowledged alarms. Alarm notification windows or banners that can be minimized or closed by the operator are not acceptable. The use of the alarm console can be enabled or disabled by the system administrator.

2.12 WEB BROWSER CLIENTS

A. The system shall be capable of supporting an unlimited number of clients using a standard Web browser such as Internet Explorer™, Firefox™, or Chrome. Systems requiring additional software to enable a standard Web browser to reside on the client machine, or manufacturer-specific browsers, are not acceptable.

B. The Web browser shall provide the same view of the system, in terms of graphics, schedules, calendars, logs, etc., and provide the same interface methodology as is provided by the Graphic User Interface. Systems that require different views or that require different means of interacting with objects, such as schedules or logs, are not permitted.

C. The Web browser client shall provide:

1. User log-on identification and password shall be required. If an unauthorized user attempts access, display a blank web page. Implement security using Java authentication and encryption techniques to prevent unauthorized access.

2. Graphic screens developed for the GUI shall be the same screens used for the Web browser client. The web browser interface shall support all animated graphic objects supported by the GUI.

3. HTML programming shall not be required to display system graphics or data on a Web page. HTML editing of the Web page shall be allowed if the user desires a specific look or format.

4. Store all graphic screens in the Network Area Controller (NAC) without requiring any graphics storage on the client machine.

5. Real-time values displayed on a Web page shall update automatically without requiring a manual "refresh" of the Web page.

6. Users shall have administrator-defined access privileges. Depending on the access privileges assigned, the user shall be able to perform the following:

   a. Modify common application objects, such as schedules, calendars, and setpoints, graphically.

      1) Schedule times shall be adjustable using a graphic slider, without requiring any keyboard entry from the operator.

      2) Holidays shall be set using a graphic calendar, without requiring any keyboard entry from the operator.

   b. Commands to start and stop binary objects shall be made by right-clicking the selected object and selecting the appropriate command from a pop-up menu. No text entry shall be required.

   c. View logs and charts.

   d. View and acknowledge alarms.

   e. Setup and execute SQL queries on log and archive information

7. The system shall be able to specify a user's (as determined by the log-on user identification) home page. Provide the ability to limit a specific user to just his/her defined home page. From the home page, links to other views or pages in the system shall be possible, if allowed by the system administrator.

8. Graphic screens on the Web Browser client shall support hypertext links to other locations on the Internet or on intranet sites by specifying the Uniform Resource Locator (URL) for the desired link.

2.13 UNINTERRUPTIBLE POWER SUPPLY (UPS)

A. A UPS shall be provided for each of the following:

1. FMCS workstations and servers.
2. Network area controllers.
3. Chiller plant manager.
4. Boiler plant manager.

B. Provide a 120 volt 60 Hz line-interactive uninterruptible power supply with backup battery capacity for 5 minutes at 100% load. UPS shall have hot swappable batteries, automatic battery self-test and start-on-battery capabilities. Batteries shall be valve regulated, sealed lead acid type. UPS shall have sine wave shape output waveform. UPS shall be UL 1778 list and comply with FCC Part 15, Class A.

C. Acceptable Manufacturers: Sola/Hevi-Duty, Eaton Powerware, APC.

2.14 SYSTEM PROGRAMMING

A. The GUI software shall perform system programming and graphic display engineering. Access to the GUI software shall be through password access as assigned by the system administrator.

B. Provide a library of control, application, and graphic objects to enable creation of all applications and user interface screens. Applications shall be created by selecting the control objects from the library, dragging or pasting them on the screen, and linking them together using a built-in graphic connection tool. Completed applications may be stored in the library for future use. GUI screens shall be created in the same fashion. Data for the user displays shall be obtained by graphically linking the user display objects to the application objects to provide “real-time” data updates. Any real-time data value or object property may be connected to display its current value on a user display. Provide all software tools or processes to create applications and user interface displays.

C. Programming Methods

1. Provide the capability to copy objects from the supplied libraries or from a user-defined library to the user’s application. Link objects with a graphic linking scheme by dragging a link from one object to another. Object links will support one-to-one, many-to-one, or one-to-many relationships. Linked objects shall maintain their connections to other objects regardless of where they are positioned on the page and shall show link identification for links to objects on other pages for easy identification. Links will vary in color depending on the type of link; e.g., internal, external, hardware, etc.

2. Configuration of each object shall be done through the object’s property sheet using fill-in-the-blank fields, list boxes, and selection buttons. Use of custom programming, scripting language, or a manufacturer-specific procedural language for configuration is not acceptable.

3. The software shall provide the ability to view the logic in a monitor mode. When on-line, the monitor mode shall provide the ability to view the logic in real time for easy diagnosis of the logic execution. When off-line (debug), the monitor mode shall allow the user to set values to inputs and monitor the logic for diagnosing execution before it is applied to the system.

4. All programming shall be done in real time. Systems requiring the uploading, editing, and downloading of database objects are not allowed.

5. The system shall support object duplication in a customer’s database. An application, once configured, can be copied and pasted for easy reuse and duplication. All links, other than to the hardware, shall be maintained during duplication.

2.15 DDE DEVICE INTEGRATION

A. The NAC shall support the integration of device data via Dynamic Data Exchange (DDE) over the Ethernet network. The NAC shall act as a DDE client to another software application that functions as a DDE server.

B. Provide the required objects in the library included with the Graphic User Interface programming software to support the integration of these devices into the FMCS. Objects provided shall include, at a minimum:

1. DDE Generic AI Object.
2. DDE Generic AO Object.
3. DDE Generic BO Object.
4. DDE Generic BI Object.

2.16 MODBUS SYSTEM INTEGRATION

A. The NAC shall support integration of device data from Modbus RTU, ASCII, and TCP control system devices. Connect to the Modbus system via an RS-232, RS485, or Ethernet IP as required by the device.

B. Provide the required objects in the library included with the GUI programming software to support the integration of the Modbus system data into the FMCS. Objects provided shall include, at a minimum:

1. Read/Write Modbus AI Registers.
2. Read/Write Modbus AO Registers.
3. Read/Write Modbus BI Registers.
4. Read/Write Modbus BO Registers.

C. The NAC shall perform all scheduling, alarming, logging and global supervisory control functions of the Modbus system devices.

D. The FMCS supplier shall provide a Modbus system communications driver. The equipment system vendor that provided the equipment using Modbus shall provide documentation of the system's Modbus interface and shall provide factory support at no charge during system commissioning.

2.17 SOFTWARE

A. IDC/IBCs shall operate totally standalone and independent of a central computer for all specified control applications.

B. Software shall include a complete operating system (OS), communications handler, point processing, energy management application packages as specified herein, standard control algorithms and specific control sequences (IDC/IBC) and an Owner/user custom control calculation package complete with interpreter.

C. OS software shall be PROM resident, operate in real time, provide prioritized task scheduling, control time programs, monitor and manage communications, and scan inputs and outputs.

D. Each IDC/IBC panel shall include the following energy management routines:

1. Time of day scheduling.
2. Optimum start/stop.
3. Peak demand limiting.
4. Economizer control.
5. PID control.
6. Supply air reset.
7. Outdoor air reset.

E. Input/output point processing software shall include:

1. Update of all connected input and output points at least once per second.

2. Analog to digital conversion, scaling and offset, correction of sensor non-linearity, sensing no response or failed sensors, and conversion of values to 32-bit floating point format. Retain both the maximum and minimum values sensed for each analog input in memory. It shall be possible to input subsets of standard sensor ranges to the A/D converter and assign gains to match the full-scale 32-bit conversion to achieve high accuracy readout.

3. A reasonability check on all analog inputs against previous values and discarding of values falling outside preprogrammed reasonability limits.

4. Assignment of proper engineering units and status conditions to all inputs and outputs.

5. Analog input alarm comparison with the ability to assign two individual sets of high and low limits (warning and alarm) to an input or to assign a set of floating limits (alarm a reset schedule or FMCS control point) to the input. Assign each alarm a unique differential to prevent a point from oscillating in and out of alarm. Make alarm comparisons of each scan cycle.

6. Adjustment of timing from two seconds to two minutes in one-second increments to eliminate nuisance alarms on startup.

F. Command Control software shall manage the receipt of commands from the server and from control programs.

1. Provide command delay to prevent simultaneous energizing of loads. Delay must be programmable from 0 to 30 seconds.

2. Assign each command a command and residual priority to manage conflicts created by multiple programs having access to the same command point. Allow only outputs with a higher command priority to execute. Whenever a command is allowed to execute, its assigned residual priority shall replace the existing residual priority.

3. A "fixed mode" option (override) shall allow inputs to and outputs from control programs to set to a fixed state or value. When in the "fixed mode", assign inputs and outputs high residual command priority to prevent override by application programs.

G. Alarm lockout software shall prevent nuisance alarms. On initial start-up of mechanical equipment, assign a "timed lockout" period to analog points to allow them to reach a stable condition before activating alarm comparison logic. Lockout period shall be programmable for each point from 0 to 90 minutes in one-minute increments.

H. A "hard lockout" shall also be provided to positively lock out alarms when equipment is turned off or when a true alarm depends on the condition of an associated point. Hard lockout points and lockout initiators shall be operator programmable.

I. Runtime shall be accumulated based on the status of a digital input point. It shall be possible to totalize either on time or off time up to 10,000 hours with one-minute resolution. Runtime counts shall reside in non-volatile memory and have DCP resident runtime limits assignable through the operator's terminal.

J. A transition counter shall count the number of times a device is cycled on or off. Counter shall be non-volatile and capable of counting 600,000 cycles. Limits shall be assignable to counts to provide maintenance alarm printouts.

K. Custom IDC/IBC programs shall meet the control strategies called for in the sequence of operation of these specifications. Each IDC/IBC shall have resident in its memory and available to the programs a full library of IDC/IBC algorithms, intrinsic control operators, arithmetic, logic, and relational operators. Provide the following features:

1. Proportional Control, Proportional plus Integral (PI), Proportional plus Integral plus Derivative (PID), and Adaptive Control (self-learning). Use Adaptive Control where the controlled flow rate is

variable (such as TAB units and variable flow pumping loops). The adaptive control algorithm shall monitor the loop response to output corrections and adjust the loop response characteristics in accordance with the time constant changes imposed by variable flow rates. The algorithm shall operate in a continuous self-learning manner and shall retain in memory a stored record of the system dynamics so that, on system shutdown and restart, the learning process starts from where it left off. Standard PID algorithms are not acceptable substitutes for variable flow applications since they will provide satisfactory control at only one flow rate and will require continued manual fine tuning.

2. All IDC/IBC setpoints, gains and time constants associated with IDC/IBC programs shall be available to the operator for display and modification via the operator workstation.

3. The execution interval of each IDC/IBC loop shall be adjustable from 2 to 120 seconds in one-second increments.

4. IDC/IBC control programs shall assign initialization values to all outputs so controlled devices assume a failsafe position on start-up.

L. Provide time and event programming (TEP) capability to initiate a controlled sequence of events for execution at a specific time or upon the occurrence of an event. Minimum program features required are:

1. Analog points commandable to a specific value.

2. Digital points commandable to a specific state; e.g. on or off; fast, slow or off.

3. Initiator to be a specific day and time or a specific event; e.g. an alarm.

4. Manual initiation via operator's command.

5. Commands must honor command delays (to prevent current surges), and assigned minimum ON and OFF times.

6. Commands must honor command and residual priority structures allowing higher priority commands (like smoke control) to override lower priority commands (like time of day scheduling) and residual priority.

7. Ability to chain TEPs.

8. Ability to enable and disable TEPs individually.

9. Ability to enable/disable TEP initiators.

M. Store Energy Management application programs and associated data files in non-volatile or 72-hour battery backed RAM memory. Individual programs shall be accessible from the operator workstation for enabling/disabling and program parameter modification and shall include:

1. Time Programs:

a. Provide an independent start and stop program time for each system identified in the points list.

b. It shall be possible to assign two independent start and stop times/days to any equipment connected to a controller.

2. Exception Day Scheduling:

a. Provide an Exception Day program for holiday and other planned exceptions to time programs. Exception schedules shall be DSC resident and operator programmable up to one year in advance.

b. The program shall allow definition of up to 32 exception time spans. Define each span by calendar start day and calendar stop day.

3. An IDC/IBC resident temporary scheduler shall allow operators to modify present time program control of equipment. Minimum feature set required is:

a. Ability to alter time schedules as much as six days in advance.

b. Ability to alter either start time, stop time or both for each day.

c. Temporary schedule shall be in effect for all days specified.

d. Automatically delete the temporary schedule and restore program to normal schedule after execution.

e. Ability to assign schedule changes as permanent as well as temporary.

N. The IDC/IBC shall have built-in, non-descriptive, self-test procedure for checking the indication lights, digital display, and memory. It shall display advisories for maintenance, performance, and/or software problems.

O. All electronics shall be:

1. Standard locally stocked modular boards.
2. Plug-in type.
3. Furnish all ROM programs unlocked.

2.18 CONTROL DAMPERS

A. Rectangular Control Dampers - Standard Construction:

1. Shall be licensed to bear the AMCA Certified Rating Seal.

2. Test leakage and pressure drop per AMCA 500.

3. Frame: Hat-shaped channel, minimum 12 gauge extruded aluminum, and minimum 4" deep. Caulk or weld seams to prevent leakage.

4. Blades: Minimum 12 gauge extruded aluminum airfoil design, minimum 6" wide, and overlapping blades and blade seals (overlapping blade seals only is unacceptable).

5. Shaft: Non-cylindrical, solid aluminum shaft with opening in blade to match profile of shaft. Shaft shall be securely fastened to the blade and of sufficient length to mount direct-coupled actuator. Damper manufacturer shall provide drive pin extensions and outboard bearing support brackets as required.

6. Bearings: Acetal (Delrin/Celcon) inner bearing fixed to an aluminum shaft, rotating within a polycarbonate outer bearing inserted in the frame. Provide thrust bearings for vertical damper applications.

7. Blade Seals: Extruded silicone gaskets secured in an integral slot within the blade.

8. Side Seals: Stainless steel compression type or extruded silicone gasket secured in an integral slot within the frame.

9. Linkage: Shall be concealed in the frame, constructed of aluminum or corrosion-resistant zinc plated steel, and securely fastened to shaft. Blades linked for opposed operation, unless noted otherwise on the drawings. Blades shall close evenly. Use one direct-coupled actuator per damper section. Jack-shafting is not acceptable.

10. Size Limits: 48" maximum horizontal blade length, 24 square foot maximum area per damper. Total cross-sectional area of dampers in ducts shall be at least as large as the duct without the use of blank-off sections.

11. Damper shall be maintenance free Leakage Class 1A.

12. Maximum Pressure Drop for Opposed Blade Damper: 0.15" for 8,000 cfm through a 24"x24" damper (2000 fpm).

13. Maximum Pressure Drop for Parallel Blade Damper: 0.08" for 8,000 cfm through a 24"x24" damper (2000 fpm).

B. Thermally Insulated Control Damper:

1. Shall be licensed to bear the AMCA Certified Rating Seal.

2. Test leakage and pressure drop per AMCA 500.

3. Frame: Extruded aluminum, minimum 4” deep, 0.080” minimum thickness. Frame shall be insulated with Styrofoam on three sides if installed in duct and four sides if flanged to duct.

4. Blades: Minimum 12 gauge extruded aluminum airfoil design, minimum 6” wide, internally insulated with expanded polyurethane foam and thermally broken, with overlapping blades and blade seals (overlapping blade seals only is unacceptable).

5. Shaft: Non-cylindrical, solid aluminum shaft with opening in blade to match profile of shaft. Shaft shall be securely fastened to the blade and of sufficient length to mount direct-coupled actuator. Damper manufacturer shall provide drive pin extensions and outboard bearing support brackets as required.

6. Bearings: Acetal (Delrin/Celcon) inner bearing fixed to an aluminum shaft, rotating within a polycarbonate outer bearing inserted in the frame. Provide thrust bearings for vertical damper applications.

7. Side Seals: Stainless steel compression type or extruded silicone gasket secured in an integral slot within the frame.

8. Linkage: Shall be concealed in the frame, constructed of aluminum or corrosion-resistant zinc plated steel, and securely fastened to shaft. Blades linked for opposed operation, unless noted otherwise on the drawings. Blades shall close evenly. Use one direct-coupled actuator per damper section. Jack-shafting is not acceptable.

9. Size Limits: 48" maximum horizontal blade length, 24 square foot maximum area per damper. Total cross-sectional area of dampers in ducts shall be at least as large as the duct without the use of blank-off sections.

10. Damper shall be rated for conditions of -40°F.

11. Maximum Leakage: Damper shall be maintenance free Leakage Class 1A.

12. Maximum Pressure Drop: 0.21" for 8,000 cfm through a 24"x24" damper (2000 fpm).

2.19 DAMPER ACTUATORS

A. Damper Actuators - Electronic - Spring Return:

1. Damper actuators shall be UL listed, electronic direct coupled with spring return to normal position for modulating or two-position control as noted in the sequence of control. Actuator shall be 24 VAC with proportional control, electronic overload protection to prevent actuator damage due to over-rotation and "V" bolt clamp with matching "V" toothed cradle (single bolt or setscrew fasteners not acceptable).

2. Following power interruption, spring return mechanism shall close the damper. Mechanical spring shall be rated for a minimum of 60,000 full cycles. Provide breathable membrane in actuator housing to compensate for pressure differential and allow for 95% non-condensing relative humidity in the airstream.

3. Mount actuators with motor outside of airstream whenever possible. Unit casings shall have housing with proper weather, corrosive, or explosion-proof construction as required by application.

4. Actuators shall be rated for 60,000 full cycles at rated torque with 2-year unconditional warranty. Size actuators per damper manufacturer's recommendations.

5. Provide end switches as required for the sequence of operation.

6. Provide analog feedback signal for positive position indication. Refer to FMCS points list.

7. Acceptable manufacturer: Honeywell or Belimo

2.20 HYDRONIC CONTROL VALVES

A. General:

1. All control valves shall be pressure independent type control valves.

2. Two-position valves shall be a minimum of line size with a maximum allowable pressure drop of 2 psi.

3. Size two-way and three-way modulating valves to provide a pressure drop at full flow of 1 to 4 psi, except boiler three-way and cooling tower bypass valves shall not have a pressure drop over 2 psi.

4. Two-way valves shall be 100% tight-closing. Three-way valves shall be 100% tight-closing in both extreme positions.

5. Modulating two-way valves shall have equal percentage flow characteristics.

6. Modulating three-way valves shall have linear flow characteristics.

7. Piping geometry correction factors for C_v ratings shall be used and stated for ball valves or non-characterized valves.

B. Two-position:

1. Ball 2" and under:

a. Design Pressure: 400 psi

Design Temperature: 212ºF
Design Flow Differential Pressure Rating: 150 psi

b. Bronze or brass body, stainless steel stem, chrome plated brass or stainless steel full port ball, PTFE or RTFE seats and seals, screwed ends (solder ends are acceptable only if rated for soldering in line with 470ºF melting point of 95-5 solder).

2. Ball 3" to 6":

a. Design Pressure: 200 psi

Design Temperature: 212ºF
Design Flow Differential Pressure Rating: 35 psi

b. Cast iron body, stainless steel stem, stainless steel full port ball, PTFE or RTFE seats and seals, flanged ends.

C. Modulating:

1. Ball 2" and under:

a. Design Pressure: 400 psi

Design Temperature: 212ºF
Design Flow Differential Pressure Rating: 35 psi

b. Bronze or brass body, nickel plated brass or stainless steel stem, chrome plated brass or stainless steel ball, PTFE or RTFE seats and seals, screwed ends (solder ends are acceptable only if rated for soldering in line with 470ºF melting point of 95-5 solder).

2. Ball 3" to 6":

a. Design Pressure: 200 psi

Design Temperature: 212ºF
Design Flow Differential Pressure Rating: 35 psi

b. Cast iron body, stainless steel stem, stainless steel full port ball, PTFE or RTFE seats and seals, flanged ends.

2.21 VALVE ACTUATORS

A. General:

1. Actuators shall be sized to operate the valve through its full range of motion and shall close against pump shutoff pressure without producing audible noise at any valve position.

2. Provide visual position indication.

3. Mount actuator directly on valve or provide linear motion assembly as required for valve type.

B. Valve Actuators - Electronic:

1. Actuator shall be UL listed and provided with NEMA housing for applicable environment, electronic overload protection to prevent actuator damage due to over-rotation, and "V" bolt clamp with matching "V" toothed cradle (single bolt or setscrew fasteners not acceptable).

2. Actuators shall be rated for 60,000 full stroke cycles at rated torque. Stall motor not acceptable.

3. Tri-state/floating actuators shall have auto-zeroing function for realigning valve position.

4. Proportional actuator position shall be proportional to analog or pulse width modulating signal from electronic control system.

5. Spring return actuators shall have an internal spring return mechanism. Non-mechanical forms of fail-safe operation are not acceptable.

6. Provide analog feedback signal for positive position indication as required by control diagrams.

7. Acceptable Manufacturer: Honeywell or Belimo.

2.22 CONTROL INSTRUMENTATION

A. Temperature Measuring Devices:

1. Electric Thermostats:

a. Single Temperature - Line Voltage Electric: Integral manual ON/OFF/AUTO selector switch, minimum dead band of 5ºF, concealed temperature adjustment, locking cover, rated for load, single or double pole as required.

b. Single Temperature - Low Voltage Electric: Integral manual ON/OFF/AUTO selector switch, minimum dead band of 5ºF, anticipator circuits, concealed temperature adjustment, locking cover, 24 V control transformer (if not included with unit under control), single or double pole as required.

2. Low Limit Switch:

a. Provide one foot of sensing element for each one square foot of coil area, maximum element length 25 feet, of the vapor tension type, so that any point along the entire length of measuring element is capable of triggering the switch.

b. Provide 3" minimum radius capillary support clips at each turn.

c. Furnish each thermostat with one single pole, single throw normally-opened switch and one single pole, single throw normally-closed auxiliary switch.

d. Setpoint range shall be 15ºF to 55ºF with a permanent stop at 35ºF.

e. Differential shall be fixed at approximately 5ºF and supplied with manual reset.

B. Temperature Sensors:

1. Room Temperature Sensor:

a. Sensor Only: Honeywell TR23, Two-piece construction, ventilated plastic enclosure, off-white color, thermistor sensing element or resistance temperature device (RTD), 45°F to 90°F operating range, ± 0.50°F accuracy, no setpoint adjustment or override button.

b. Sensor with Setpoint Adjustment: Honeywell TR 71, Two-piece construction, ventilated plastic enclosure, off-white color, thermistor sensing element or resistance temperature device (RTD), 45°F to 90°F operating range, ± 0.50°F accuracy, with exposed single setpoint adjustment (no numeric temperature scale – provide with a single warmer/cooler or red/blue visual scale), no override button.

c. Sensor with Override: Honeywell TR 71, Two-piece construction, ventilated plastic enclosure, off-white color, thermistor sensing element or resistance temperature device (RTD), 45°F to 90°F operating range, ± 0.50°F accuracy, occupied/unoccupied override button with LED, no setpoint adjustment.

d. Sensor with Setpoint Adjustment and Override: Honeywell TR 71, Two-piece construction, ventilated plastic enclosure, off-white color, thermistor sensing element or resistance temperature device (RTD), 45°F to 90°F operating range, ± 0.50°F accuracy, with exposed single setpoint adjustment (no numeric temperature scale – provide with a warmer/cooler or red/blue visual scale), occupied/unoccupied override button with LED.

2. Duct Temperature Sensor:

a. Thermistor or RTD type with 20K ohm rating. Pneumatic transmitters with transducers are not acceptable.

3. Water Temperature Sensor:

a. Install in immersion wells. Separate thermometers as specified elsewhere, also of the immersion well type, shall be installed within 2 feet of each temperature sensor.

4. In-slab Temperature Sensor

a. Slab sensor designed to measure temperature in concrete. Unit shall have high density polyethylene sleeve for use in conduits. Unit shall be supplied with 20 feet of 2 conductor cable. Operating range is -60°F to 140°F. Unit shall be 10K thermistor and be water resistant.

b. Acceptable Manufacturer: Tekmar 072

C. Humidity Measuring Devices:

1. Humidity Sensors:

a. Humidity Sensors: Fully electronic with no moving parts or parts requiring periodic service. Accuracy shall be ± 2% of reading.

D. Pressure Measuring Devices

1. Differential Pressure Switches:

a. Standard Pressure Switches:

1) Diaphragm-activated gauge with 4-3/4" dial, cast aluminum case, sealed interior, designed to resist shock and vibration, and rated for 15 psig.

2) Accuracy shall be ± 3% of full scale maximum throughout entire range at 70ºF.

3) Provide mounting brackets, probes, and shutoff valves required for proper installation.

4) The range and service shall be as required for application or as noted on the drawings.

5) Provide two (2) photo-transistor-activated circuits and two (2) DPDT relays for both high or low limit alarms or controls.

6) Provide latching relays that require manual reset once activated.

7) Acceptable Manufacturer: Dwyer Photohelic Series 3000.

b. High Pressure Switches (Manual Reset):

1) Differential pressure switch with single pole, double-throw snap switch and enclosure.

2) Rated for pressure specified in sequence of control.

3) Electrical rating shall be 15 amps at 120-480 volts.

4) Setpoint adjustment shall be screw type located inside enclosure.

5) Provide optional manual reset for overpressure protection with all tubing, brackets, and adapters.

6) Repeatability: ± 3%.

2. Pressure Transmitters/Transducer:

a. Select device suitable for intended application; water or air, static or differential.

b. Select for appropriate range, including negative if applicable.

c. 100% solid state device, temperature compensated, suitable for pressures of 200% rated range with averaging to stabilize output, accuracy of ± 1% full scale, and a 4-20 mA output.

d. Provide a NEMA 4 enclosure unless panel mounted.

e. Air service shall have a minimum of three field selectable ranges.

f. When used for room pressure control, the transducer shall be bidirectional with a range of ± 0.1" W.C.

g. Provide pressure line outlet cover on both sides of the wall when used for room pressure control.

h. Furnish with integral LED's to indicate Zero Pressure, Pressure In Range, and Pressure Out Of Range as a diagnostic aid.

E. Flow Measuring Devices:

1. Flow Switches:

a. Suitable for the intended application (water or air system).

b. Vane Operated Flow Switch: Vane motion shall activate a single pole, double throw snap switch.

2. Insertion Type Electromagnetic Flow Meter:

a. General:

1) Each flow meter shall be of the magnetic insertion type.

b. Service:

1) Heating Water: Rated for minimum of 240°F service.

c. Insertion Type Electromagnetic Flow Meter:

1) Each meter shall be rated for system pressure and shall have adequate structural integrity for a flow rate equal to 150% of the scheduled maximum initial or future flow rate, whichever is greater.

2) Each insertion type electromagnetic flow meter shall be complete with all hardware necessary to enable insertion and removal of the meter without system shutdown. The flow meter shall be hand insertable up to 400 PSI.

3) Construction:

a) Wetted Components: 316 stainless steel
b) Sensor Head: Polypropylene
c) Electronics enclosure shall be NEMA 4 and aluminum.

4) Each meter shall be wet calibrated against a primary volumetric standard that is accurate to within 0.1% and traceable to NIST.

d. Output:

1) Output signals shall be completely isolated and shall consist of the following:

a) High resolution frequency output for use with peripheral devices such as display module or BTU meter.

b) Analog output; 4-20mA, 0-10V, or 0-5V jumper selectable.

c) Scalable dry contact output for totalization.

2) The output shall be connected with display unit.

3) The meter shall include 25 feet of cable to connect with a remotely mounted display unit.

4) Unless indicated otherwise, the initial span adjustment of each transmitter shall be 0-120% of the scheduled maximum flow rate.

e. Accuracy:

1) The accuracy of each meter/transmitter assembly shall be ± 1.0% of flow rate reading over a range of 3-15 feet/second fluid velocity, with a repeatability of 0.1%. Accuracy at 1 foot/second shall be ± 2.0%.

f. Display Unit:

1) Pair with Display Unit described below.

g. BTU Meter:

1) Pair with BTU Meter described below.

h. Calibration:

1) Each meter shall be calibrated on a NIST traceable flow stand at 1, 8, and 15 FPS. Provide written documentation of calibration.

i. Installation Hardware

1) The flow meter shall be supplied with standard installation hardware, which shall include, but not be limited to, full port bronze ball valve, brass close nipple and weld-on carbon steel branch outlet.

j. Warranty:

1) Provide performance warranty of at least two years from the date of installation and startup. Warranty shall cover parts and labor for repair or replacement of the meter assembly. Performance during the warranty period shall satisfy the above-stated requirements for accuracy and repeatability.

k. Approved Manufacturers:

1) ABB, Onicon, Magmeter.

3. Display Unit:

a. General:

1) The display shall compatible with virtually any flow meter.

2) The display module shall provide a local indication of liquid flow rate and net totalized flow, along with associated engineering units (e.g., GPM/second and gallons).

3) House in a steel wall-mounted enclosure with a built-in user interface/display.

4) Display unit shall accept 4-20 mA pulse or contact closure flow signals. It shall also function as a network interface for two (2) additional analog rate inputs and one (1) additional totalizing pulse input.

5) It shall support BACnet communication protocols.

6) The display shall have two-line alphanumeric LCD displays of flow rate and flow total.

7) The display shall have non-volatile EEPROM memory that retains all program parameters and totalized values in the event of power loss.

8) Electrical Power Supply: 24VAC. 60Hz, 500mA max.

b. Approved Manufacturers:

1) Onicon, Yokogawa.

4. Airflow Measuring Stations:

a. In accordance with the requirements of LEED EQc1: Outdoor Air Delivery Monitoring, any AFMS used to measure outside air CFM shall have an accuracy of ±15% of the design minimum outdoor air flow rate (or better). The AFMS accuracy shall also comply with requirements outlined in the following paragraphs of this specification.

b. Duct Mounted Airflow Measuring Stations (AFMS) - Thermal Dispersion

1) Provide airflow/temperature measurement devices where indicated on the plans.

2) Each AFMS shall consist of one or more sensor probes and a single, remotely mounted, microprocessor-based transmitter capable of independently processing up to 16 independently wired sensor assemblies.

a) Each sensor assembly shall contain two individually wired, hermetically sealed bead-in-glass thermistors.

b) Thermistors shall be mounted in the sensor assembly using a marine-grade, waterproof epoxy. Thermistor leads shall be protected and not exposed to the environment.

c) Devices using chip-in-glass or diode-case chip thermistors are not acceptable.

d) Devices using less than two thermistors in each sensor assembly are not acceptable.

e) Devices using platinum wire RTDs are not acceptable.

f) Devices having electronic circuitry mounted in or at the sensor probe are not acceptable.

g) Pitot tubes and arrays are not acceptable.

h) Vortex shedding devices are not acceptable.

3) All Sensor Probes

a) Each sensor assembly shall independently determine the velocity and temperature at its measurement point.

b) Each sensor assembly shall be calibrated at a minimum of 16 airflow rates and 3 temperatures to standards that are traceable to the National Institute of Standards and Technology (NIST).

c) Airflow measuring station assembly accuracy shall be +/-2% of Reading over the entire operating airflow range. Temperature accuracy shall be +/-0.15° F between -20° F and 160° F.

d) The operating humidity range for each sensor probe shall be 0-99% RH (non-condensing).

e) Each sensor probe shall have an integral, UL listed, plenum rated cable and terminal plug for connection to the remotely mounted transmitter. A single manufacturer shall provide both the airflow/temperature measuring probe(s) and transmitter for each measurement location.

f) The number of probes shall be as recommended by the manufacturer to achieve the specified accuracy.

4) Duct and Plenum Probes

a) Probes shall be constructed of extruded, gold anodized, 6063 aluminum tube. All wires within the aluminum tube shall be Kynar coated.

b) Probe assembly mounting brackets shall be constructed of 304 stainless steel.

c) The operating airflow range shall be 0 to 5,000 FPM unless otherwise indicated on the plans.

5) Sensor Density

Area (sq.ft.)	Total # of Sensors Required
< 2	4
2 to < 4	6
4 to < 8	8
8 to < 16	12
≥ 16	16

6) Transmitters

a) The transmitter shall have an integral 16 character alphanumeric LCD display capable of simultaneously displaying individual airflow and temperature.

b) The transmitter shall be capable of field configuration and diagnostics using an on-board interface and LCD display.

c) The operating temperature range for the transmitter shall be -20° F to 120° F.

d) The transmitter shall be capable of communicating with other devices using one of the following interface options:

(1) Linear analog output signals for airflow and temperature: Field selectable, fuse protected and isolated, 0-10VDC/4-20mA (4-wire)

(2) RS-485: Field selectable BACnet-ARCNET, BACnet-MS/TP, Modbus-RTU or Johnson Controls N2-Bus. BACnet devices shall provide analog variables for airflow and temperature containing individual sensor airflow rate and temperature data.

(3) 10 Base-T Ethernet: Field selectable BACnet Ethernet, BACnet-IP, Modbus-TCP and TCP/IP. Provide dynamic link libraries and VBA functions to interface Ethernet devices to Microsoft Excel for remote monitoring of airflow and temperature using a Windows 2000 or Windows XP based PC.

(4) LonWorks Free Topology

c. Fan Inlet Airflow Measuring Stations - Differential Pressure:

1) Fan Inlet Measuring Station Pressure Sensors, Transmitters and Transducers:

a) Select for appropriate pressure range, fan type, inlet velocity, and airflow volume.

b) Transmitter features and minimum performance requirements shall be as follows:

(1) Combined Accuracy: ± 0.50%.
(2) Terminal Point Nonlinearity: ± 0.40%.
(3) Hysteresis: ± 0.02%.
(4) Non-repeatability: ± 0.05%.
(5) Compensation Range:

(a) Zero Shift: ±0.025% FS/°F.
(b) Span Shift: 0.025% FS/°F.

(6) Differential Overpressure: 5 psi proof and 25 psi burst pressure.
(7) Output signal: 0 to 10 VDC.

c) Each transducer shall be provided with an integral manual zeroing valve to allow for field calibration of the zero reference value without the need for shutting the operating system down.

d) System airflow (measured in CFM) shall be continuously displayed on an LCD display meter (0.5 inches high by 3.5 digits) located on the face of the air volume/velocity transducer control enclosure.

d. Mounting of fan inlet static pressure sensing elements shall be in accordance with manufacturer's published installation instructions to ensure accuracy of readings.

F. Current Measuring Devices:

1. Current Switches for Constant Speed Motors:

a. Digital device rated for amperage load of motor or device with split core design, adjustable high and low trip points, 600 VAC rms isolation, induced power from the monitored load, LED indicator lamps for output status and sensor power. The device shall sense overloading, belt-loss, and power failure with a single signal.

2. Current Switches for Motors Controlled by VFD:

a. Digital device rated for amperage load of motor or device with split core design, factory programmed to detect motor undercurrent conditions on variable or constant volume loads, self-calibrating, positive status indication, LED indicator lamps, 600 VAC rms isolation, induced power from the monitored load with NO output. The current sensor shall store the motor current operating parameters in non-volatile memory and have a pushbutton reset to clear the memory if the operating parameters change or the sensor is moved to another load. The device shall sense overloading, belt-loss, and power failure with a single signal. The sensor shall be mounted on the load side of variable frequency drives.

G. Occupancy Sensors:

1. Ceiling mounted, passive infrared, 360° coverage pattern, zero crossing circuitry, adjustable sensitivity and time delay (initial setting: Time delay - 5 minutes), integral isolated relay with normally open and normally closed outputs, LED indicator, five-year warranty, UL listed. TCC shall submit manufacturer supplied sensor layout drawing for shop drawing review. Provide full room coverage as recommended by manufacturer.

H. Combination Carbon Monoxide/Nitrogen Dioxide Sensors:

1. Solid-state gas sensor/transmitter for each gas, NEMA 1 gasketed enclosure, normal operating temperature 0-120°F, normal relative humidity operation 5-95%, ± 5% accuracy, and detection range of 0-200 ppm. Unit shall be have a replaceable sensor element.

2. Provide separate 4-20 mA output from the sensor to the FMCS system for each gas.

3. Install with spacing per manufacturer and OSHA requirements.

4. Unit shall be factory calibrated and shall be re-calibrated after installation per manufacturer's recommendations.

I. Carbon Dioxide Sensors:

1. Microprocessor based non-dispersive infrared sensor with range of 0 to 2,000 ppm CO2 with ± 100 ppm accuracy, maximum drift (compensated) of ± 5% full scale in five years, VOC software and hardware sensing, duct mounting where applicable, 0-10V dc or 4-20 mA output directly proportional to ppm, adjustable alarm limit, membrane filter, and terminal block. The diffusion gas chamber in the sensor shall incorporate a reflective light pipe or wave guide surrounded by a gas permeable membrane that prevents particulate contamination of the sensor. Unit shall have selectable IAQ mode with output signal and sum of CO2 and VOC levels.

J. Miscellaneous Devices:

1. Control Relays:

a. Form "C" contacts rated for the application with "push-to-test" contact transfer feature and an integral LED to indicate coil energization.

b. Mount all relays and power supplies in a NEMA 1 enclosure beside the FMCS panel or controlled device and clearly label their functions.

2. Thermostat and Sensor Enclosures:

a. Clear plastic guard with lock. Wire guard with tamperproof screws. Setpoint shall be adjustable with cover in place. Fasten to wall separately from thermostat. Provide guards in all corridors, gymnasiums, locker rooms, toilet rooms, assembly halls and as noted on the drawings.

3. Twist Timers:

a. Wall-mounted heavy duty, with rotary dial and face graduated in minutes or hours as noted. Unit shall fit behind standard "decorator" wall plate. Color of timer and face plate shall match remainder of project. Verify with Electrical Contractor. Provide wall plate and engraved plastic label indicating service.

b. Switch shall be rated for 20 amps at 125 volts (10 amps at 277 volts) and fit standard 2-1/2" deep electrical box.

c. Provide time cycle noted on the drawings or in the specifications; up to 12 hours.

d. Acceptable Manufacturers: Paragon SWD Series, Tork A500 Series, Intermatic FD Series, or Marktime Series 93.

2.23 CONDUIT

A. Conduit and Fittings: Refer to Electrical Section 26 05 33 for materials and sizing.

2.24 WIRE AND CABLE

A. Wire and Cable Materials: Refer to Electrical Section 26 05 13 for wire and cable materials.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION

A. Verify that systems are ready to receive work. Beginning of installation means installer accepts existing conditions.

B. Install system and materials in accordance with manufacturer's instructions.

C. Drawings of the TCS and FMCS network are diagrammatic only. Any apparatus not shown but required to meet the intent of the project documents shall be furnished and installed without additional cost.

D. Install all operators, sensors, and control devices where accessible for service, adjustment, calibration, and repair. Do not install devices where blocked by piping or ductwork. Devices with manual reset or limit adjustments shall be installed below 6'-0" if practical to allow inspection without using a ladder.

E. Verify locations of wall-mounted devices (such as thermostats, temperature and humidity sensors, and other exposed sensors) with drawings and room details before installation. Coordinate mounting heights to be consistent with other wall-mounted devices. Maximum height above finished floor shall not exceed 48”. In accordance with the requirements of LEED EQc1: Outdoor Air Delivery Monitoring, install all wall-mounted CO2 sensors between 3 feet and 6 feet above the floor.

F. Provide valves over 3/4" size with position indicators and pilot positioners where sequenced with other controls.

G. Mount control panels adjacent to associated equipment on vibration-free walls or freestanding angle iron supports. One cabinet may accommodate more than one system in same equipment room.

H. After completion of installation, test and adjust control equipment.

I. Check calibration of instruments. Recalibrate or replace.

J. Furnish and install conduit, wire, and cable per the National Electric Code, unless noted otherwise in this section.

K. All controls associated with the proper operation of air handling units, pumps, or other mechanical equipment served by emergency power shall be connected to the emergency power system. Control components shall not be powered from the life safety branch of the emergency power system. Coordinate emergency power source connections with the Architect/Engineer.

L. All hardware, software, equipment, accessories, wiring (power and sensor), piping, relays, sensors, power supplies, transformers, and instrumentation required for a complete and operational FMCS system, but not shown on the electrical drawings, are the responsibility of the TCC.

M. Labels For Control Devices:

1. Provide labels indicating service of all control devices in panels and other locations.

2. Labels may be made with permanent marking pen in the control panels if clearly legible.

3. Use engraved labels for items outside panel such as outside air thermostats.

4. Labels are not required for room thermostats, damper actuators and other items where their function is obvious.

N. VFDs:

1. This project includes several variable frequency drives to control the flow of fans and/or pumps based on a control variable.

2. Verify output signal required, 4-20 mA or 0-10V dc, with the EC.

3. If VFD has a bypass feature, auxiliary contacts on the drive may not be used for motor status. A separate relay must be used to indicate motor rotation in either hand or auto positions.

4. If a separate current transmitter or switch is indicated for status, install this device between the VFD and the motor. In this case, the drive status may be connected to the auxiliary contacts in the VFD.

5. Some devices, such as low limits and fire alarm shutdown relays, must be hardwired to the fan motor. Make connections such that fan will shut down whether in hand or auto position if the unit has a bypass feature.

O. Airflow Stations:

1. The transmitter shall be installed at a location that is protected from weather, water, and vibration.

2. Mount transmitter where they can easily be read (36" to 66" above floor). Do not fasten transmitters directly to ductwork or compromise duct insulation.

3. The manufacturer's authorized representative shall visit the project site during construction prior to station installations to confirm all submitted sizes, mounting requirements and locations. Size adjustments shall be made at no additional cost. The representative shall meet on site with the TCC to support and train them on proper installation procedures and calibration.

4. Install labels at each sensor and transmitter identifying its service.

3.2 GRAPHIC DISPLAY

A. Create a customized graphic for each piece of equipment indicated on the itemized points list.

B. Components shall be arranged on graphic as installed in the field.

C. Include each graphic point listed in the itemized points list using real time data.

D. Provide a graphic representation of the following:

1. Where there are multiple buildings, color code the campus map by the systems serving that building. The building graphic shall be linked to the graphic for that building's systems.

2. Where there are multiple floors, provide color codes/designations for the areas served by each AHU and TAB by floor.

3. Where multiple AHUs serve one floor, color code the areas served by each AHU. The area shall be linked to the graphic for that area's AHU.

4. Provide an overall floor plan of each floor of the building color coded by zone linked to the TAB for that zone. The zone shall be linked to the graphic for that zone's TAB graphic.

5. Show the location of each thermostat on the floor plan.

6. Provide separate graphics showing the chilled and heating water system flow diagram. Show temperatures and flows on the flow diagram. Each piece of equipment shown on the flow diagram shall be linked to the graphic for that piece of equipment.

7. Provide a graphic showing the steam system flow diagram. Show pressures and flows on the flow diagram. Each piece of equipment shown on the flow diagram shall be linked to the graphic for that piece of equipment.

E. The FMCS shall include full graphic operator interface to display the following graphics as a minimum:

1. Home page to include a minimum of six critical points: Outside Air Temperature, Outside Air Relative Humidity, Enthalpy, KWH, KW, etc.

2. Graphic floor plans accurately depicting rooms, walls, hallways, and showing accurate locations of space sensors and major mechanical equipment.

3. Detailed graphics for each mechanical system including AHUs, ERUs, EFs, chillers, and boilers, as a minimum.

4. Access corresponding system drawings, technical literature, and sequences of operations directly from each system graphic.

F. The FMCS shall include individual graphical buttons to access the following data stored in PDF format:

1. Project control as-built documentation including all TCS drawings, diagrams and sequences of operation.

2. TCS Bill of Material for each system, e.g. AHU, RTU, FCU, boiler, etc.

3. Technical literature specification data sheets for all components listed in the TCS Bill of Material.

3.3 CONDUIT INSTALLATION

A. Conduit Sizing and Installation: Refer to Electrical Section 26 05 33 for execution and installation.

1. Thermostats/temperature sensors shall be installed in junction boxes, flush with the wall, and shall be coordinated for orientation with Architect/Engineer.

3.4 WIRE AND CABLE INSTALLATION

A. Wire and Cable Materials Installation: Refer to Electrical Section 26 05 13 for execution and installation.

B. Field Quality Control:

1. Inspect wire and cable for physical damage and proper connection.

2. Torque test conductor connections and terminations to manufacturer's recommended values.

3. Perform continuity test on all conductors.

4. Protection of cable from foreign materials:

a. It is the Contractor's responsibility to provide adequate physical protection to prevent foreign material application or contact with any cable type. Foreign material is defined as any material that would negatively impact the validity of the manufacturer's performance warranty. This includes, but is not limited, to overspray of paint (accidental or otherwise), drywall compound, or any other surface chemical, liquid or compound that could come in contact with the cable, cable jacket or cable termination components.

b. Overspray of paint on any cable, cable jacket or cable termination component will not be accepted. It shall be the Contractor's responsibility to replace any component containing overspray, in its entirety, at no additional cost to the project. Cleaning of the cables with harsh chemicals is not allowed. This requirement is regardless of the PASS/FAIL test results of the cable containing overspray. Should the manufacturer and warrantor of the structured cabling system desire to physically inspect the installed condition and certify the validity of the structured cabling system (via a signed and dated statement by an authorized representative of the structured cabling manufacturer), the Owner may, at their sole discretion, agree to accept said warranty in lieu of having the affected cables replaced. In the case of plenum cabling, in addition to the statement from the manufacturer, the Contractor shall also present to the Owner a letter from the local Authority Having Jurisdiction stating that they consider the plenum rating of the cable to be intact and acceptable.

C. Installation Schedule:

1. Conduit terminations to all devices installed in applications with rotating equipment, expansion/contraction or vibration shall be made with flexible metallic conduit, unless noted otherwise. Final terminations to exterior devices installed in damp or wet locations shall be made with liquidtight flexible metallic conduit. Terminations in hazardous areas, as defined in the National Electrical Code, shall be connected using flexible conduit rated for the environment.

3.5 FMCS INSTALLATION

A. Coordinate voltage and ampacity of all contacts, relays, and terminal connections of equipment being monitored or controlled. Voltage and ampacity shall be compatible with equipment voltage and be rated for full ampacity of wiring or overcurrent protection of circuit controlled.

B. Naming Conventions: Coordinate all point naming conventions with Owner standards. In the absence of Owner standards, naming conventions shall use equipment designations shown on plans.

3.6 COMMISSIONING

A. Upon completion of the installation, this Contractor shall load all system software and start up the system. This Contractor shall perform all necessary calibration, testing and de-bugging and perform all required operational checks to ensure that the system is functioning in full accordance with these specifications.

B. This Contractor shall perform tests to verify proper performance of components, routines, and points. Repeat tests until proper performance results. This testing shall include a point-by-point log to validate 100% of the input and output points of the FMCS system operation.

C. This Contractor shall prove that the controls network is functioning correctly and within acceptable bandwidth criteria and shall test the system with an approved protocol analysis tool. Provide a log and statistics summary showing that each channel is within acceptable parameters. Each channel shall be shown to have at least 25% spare capacity for future expansion.

D. Upon completion of the performance tests described above, repeat these tests, point by point, as described in the validation log above in the presence of Owner's Representative, as required. Properly schedule these tests so testing is complete at a time directed by the Owner's Representative. Do not delay tests so as to prevent delay of occupancy permits or building occupancy.

E. System Acceptance: Satisfactory completion is when this Contractor has performed successfully all the required testing to show performance compliance with the requirements of the Contract Documents to the satisfaction of the Owner's Representative. System acceptance shall be contingent upon completion and review of all corrected deficiencies.

3.7 PREPARATION FOR BALANCING

A. Verify that all dampers are in the position indicated by the controller (e.g., open, closed or modulating).

B. Check the calibration and setpoints of all controllers.

C. Check the locations of all thermostats and humidistats for potential erratic operation from outside influences such as sunlight, drafts, or cold walls.

D. Check that all sequences operate as specified. Verify that no simultaneous heating and cooling occurs, unless specified. Observe that heating cannot begin at TAB reheat terminals until the unit is at the minimum cfm.

E. Verify the operation of all interlock systems.

3.8 TEST AND BALANCE COORDINATION

A. The Contractor shall furnish a single set of all tools necessary to interface to the control system for test and balance purposes.

B. The Contractor shall provide a minimum of four (4) hours training for the Balancing Contractor in the use of these tools.

C. In addition, the Contractor shall provide a qualified technician to assist in the test and balance process until the first 20 terminal units are balanced.

D. The tools used during the test and balance process shall be returned at the completion of the testing and balancing.

3.9 DEMONSTRATION AND ACCEPTANCE

A. At completion of installation, provide two days minimum instruction for operators. Demonstrate operation of all controls and systems. Describe the normal operation of all equipment.

3.10 TRAINING

A. On-Site:

1. After completion of commissioning, the manufacturer shall provide 8 hours of training on consecutive days for 4 Owner's representatives. The training course shall enable the Owner's representatives to perform Day-to-Day Operations as defined herein. A factory-trained instructor with experience in presenting the training material and the system programmer for this project shall perform the training.

B. Day-to-Day Operations - Training Description:

1. Proficiently operate the system.
2. Understand control system architecture and configuration.
3. Understand FMCS systems components.
4. Understand system operation, including FMCS system control and optimizing routines (algorithms).
5. Operate the workstation and peripherals.
6. Log-on and off the system.
7. Access graphics, point reports, and logs.
8. Adjust and change system setpoints, time schedules, and holiday schedules.
9. Recognize malfunctions of the system by observation of the printed copy and graphic visual signals.

10. Understand system drawings and Operation and Maintenance manual.
11. Understand the job layout and location of control components.
12. Access data from FMCS controllers and ASCs.
13. Operate portable operator's terminals.

C. Advanced Operations - Training Description:

1. Make and change graphics on the workstation.
2. Create, delete, and modify alarms, including annunciation and routing of these.
3. Create, delete and modify point trend logs and graph or print these both on and ad-hoc basis and at user-definable time intervals.
4. Create, delete, and modify reports.
5. Add, remove, and modify system's physical points.
6. Create, modify and delete programming.
7. Add panels when required.
8. Add operator interface stations.
9. Create, delete, and modify system displays, both graphic and others.
10. Perform FMCS system field checkout procedures.
11. Perform FMCS controller unit operation and maintenance procedures.
12. Perform workstation and peripheral operation and maintenance procedures.
13. Perform FMCS system diagnostic procedures.
14. Configure hardware including PC boards, switches, communication, and I/O points.
15. Maintain, calibrate, troubleshoot, diagnose, and repair hardware.
16. Adjust, calibrate, and replace system components.

D. System Management - Training Description:

1. Maintain software and prepare backups.
2. Interface with job-specific, third-party operator software.
3. Add new users and understand password security procedures.

E. Provide course outline and materials in accordance with the "SUBMITTALS" article in Part 1 of this section. The instructor(s) shall provide one copy of training material per student.

3.11 INSTALLATION OF SENSORS

A. Install sensors in accordance with the manufacturer's recommendations.

B. Mount sensors rigidly and adequately for the environment within which the sensor operates.

C. Room temperature sensors shall be installed on concealed junction boxes properly supported by the wall framing.

D. All wires attached to sensors shall be air sealed in their raceways or in the wall to stop air transmitted from other areas affecting sensor readings.

E. Averaging sensors and low limits shall be installed at the top of the assembly with the element on a slight downward incline away from the sensor making a serpentine pattern over the cross-sectional area with elements spaced not over 12" apart and within 6" of the top and bottom of the area.

F. All pipe-mounted temperature sensors shall be installed in immersion wells. Install all liquid temperature sensors with heat-conducting fluid in thermal wells.

G. Install outdoor air temperature sensors on exterior of north wall, complete with sun shield at designated location approved by Architect/Engineer. TCC shall prime and paint the device enclosure. Color selection by Architect.

H. Install all wall-mounted CO2 sensors between 3 feet and 6 feet above the floor.

3.12 INSTALLATION OF FLOW METERS

A. Provide manufacturer's recommended lengths of straight piping upstream and downstream of the flow meter. Up to 30 diameters upstream of the flow meter may be required depending on the piping arrangement and flow meter type.

B. Maintain adequate pull/service space.

END OF SECTION

SECTION 23 09 13
INSTRUMENTATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Pressure Gauge.
B. Pressure Gauge Accessories.
C. Thermometers.
D. Test Plugs.
E. Static and Differential Airflow Pressure Gauges.

1.2 SUBMITTALS

A. Submit shop drawings per Section 23 05 00. Include list that indicates use, operating range, total range and location for manufactured components.

PART 2 - PRODUCTS

2.1 PRESSURE GAUGES

A. Gauges shall be 4-1/2" diameter with aluminum or stainless steel case with phosphor bronze bourdon tube, brass socket for air, steam, water or oil application, 1/4" or 1/2" bottom connection. Gauges shall be 1% full scale accurate with bronze brushed brass movement and adjustable pointer. Standard ranges to be either pressure or pressure and vacuum as required of application.

B. Acceptable Manufacturers: Ashcroft, Marsh, Marshalltown, Miljoco, Trerice, U.S. Gauge Figure 1901, Weiss, Weksler, Wika.

2.2 PRESSURE GAUGE ACCESSORIES

A. All pressure gauges shall have valves and pressure snubbers. All pressure gauges on steam shall have pigtail syphon.

B. Shutoff Valve: 1/4" ball valve as specified for each piping system.

C. Pressure snubber, brass with 1/4" connections, porous metal type.

2.3 THERMOMETERS

A. Dial Type:

1. 4-1/2" diameter, hermetically sealed case. Stainless steel case and stem. Accuracy of 1% full scale with external recalibrator.

2. Select thermometers for appropriate temperature range. Adjustable elbow joint with locking device to allow rotation of thermometer to any angle.

3. Stem lengths as required for application with minimum insertion of 2-1/2".

4. Thermometers for water, steam, or oil shall have brass or steel separable socket. Socket shall extend through insulation. Thermometers for air shall have an aluminum or brass duct flange.

5. Acceptable Manufacturer: Ashcroft, Marsh, Marshalltown, Miljoco, Tel-Tru, Trerice, U.S. Gauge, Weiss, Weksler, Wika.

B. Select scales to cover expected range of temperatures.

2.4 TEST PLUGS

A. Test Plug: 1/4" or 1/2" brass fitting and cap, with Nordel core for temperatures up to 275°F, for receiving 1/8" outside diameter pressure or temperature probe. Plugs shall be rated for zero leakage from vacuum to 500 psi.

B. Provide extended units for all plugs installed in insulated piping.

C. Test Kit: Carrying case, internally padded and fitted containing one 3-1/2" diameter pressure gauge with 0-100 psi range, one gauge adapter with 1/8" probes, two 1-1/2" dial thermometers with 0° to 220°F and -25°F to 125°F ranges and 5" stems.

D. Acceptable Manufacturers: Sisco, Flow Design, or Peterson Equipment.

2.5 STATIC AND DIFFERENTIAL AIRFLOW PRESSURE GAUGES

A. Diaphragm-activated gauge with 4-3/4" dial, cast aluminum case, sealed interior, designed to resist shock and vibration, and rated for 15 psig.

B. Accuracy shall be ± 3% of full scale maximum throughout entire range at 70°F.

C. Provide mounting brackets, probes, and shutoff valves required for proper installation.

D. The range and service shall be as required for application or as noted on the drawings.

E. Acceptable Manufacturers: Dwyer Magnehelic Series 2000, Marshalltown Instrument Series 85C.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General Installation Requirements:

1. Install per manufacturer's instructions.

2. Coil and conceal excess capillary on remote element instruments.

3. Install gauges and thermometers in locations where they are easily read from normal operating level.

4. Do not install instrumentation when areas are under construction, except for required rough-in, taps, supports and test plugs.

B. Pressure Gauges:

1. Connect pressure gauges to suction and discharge side of all pumps.

2. Provide snubber for each pressure gauge.

3. Provide coil syphon for each pressure gauge connected to steam piping.

C. Thermometers:

1. Install thermometers in piping systems in sockets in short couplings. Enlarge pipes smaller than 2-1/2" for installation of thermometer sockets.

2. Install thermometer sockets adjacent to control system thermostat, transmitter and sensor sockets.

3. Locate duct thermometers minimum 10 feet downstream of mixing dampers, coils, or other devices causing air turbulence.

END OF SECTION

SECTION 23 21 00
HYDRONIC PIPING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Pipe and Pipe Fittings.
B. Valves.
C. Heating Water Piping System.
D. Geothermal Water Piping System.

1.2 QUALITY ASSURANCE

A. Valves: Manufacturer's name and pressure rating marked on valve body. Remanufactured valves are not acceptable.

B. Welding Materials, Procedures, and Operators: Conform to ASME Section 9, ANSI/AWS D1.1, and applicable state labor regulations.

1.3 SUBMITTALS

A. Submit product data under provisions of Section 23 05 00. Include data on pipe materials, fittings, valves, and accessories.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Store and protect piping to prevent entrance of foreign matter into pipe and to prevent exterior corrosion.

B. Deliver and store valves in shipping containers with labeling in place.

1.5 COORDINATION DRAWINGS

A. Reference Coordination Drawings article in Section 23 05 00 for required hydronic systems electronic CAD drawings to be provided to Coordinating Contractor for inclusion into composite coordination drawings.

PART 2 - PRODUCTS

2.1 HEATING WATER
GEOTHERMAL WATER INTERIOR TO BUILDING

A. Design Pressure: 125 psig.
Maximum Design Temperature: 225ºF. (230ºF for mechanical couplings)

B. Piping - 2" and Under:

1. Tubing: Type L drawn temper seamless copper tube, ASTM B88.

2. Joints: Solder with Type 95-5 solder. 50-50 solder is not acceptable.

3. Fittings: Wrought copper solder joint, ASME B16.22.

C. Piping - 2-1/2" and Over:

1. Pipe: Standard weight black steel, beveled ends, ASTM A53, Type E or S, Grade B.

2. Joints: Butt-welded or flanged.

3. Fittings: Standard weight wrought steel, butt-welding type, ASTM A234, ASME B16.9.

4. Flanges: Class 150 forged steel, welding neck or slip-on, ASTM A181 or A105, Class 60, ASME B16.5 up to 24" and B16.47 above 24". ASME B16.1 for flanges mating with flat face equipment flanges.

D. Shutoff Valves:

1. Ball Valves:

a. BA-1: 3" and under, 150 psi saturated steam, 600 psi WOG, full port, screwed or solder ends (acceptable only if rated for soldering in line with 470°F melting point of lead-free solder), bronze body of a copper alloy containing less than 15% zinc, stainless steel ball and stem, Teflon seats and seals. Apollo #77C-140, Stockham #S-206 BR1-R, Milwaukee #BA-400, Watts, Nibco #585-70-66, National Utilities Co., RUB.

NOTES:

1) Provide extended shaft with operating handle of non-thermal conductive material and protective sleeve that allows operation of valve, adjustment of the packing, and adjustment of the memory stop without breaking the vapor seal or disturbing the insulation for all valves in insulated piping.

b. BA-1A: 2-1/2" and over: 150 psi saturated steam, 275 psi WOG ANSI Class, 150 psi standard port, ductile iron body, FPA fused stainless steel ball and trim, Teflon seats and seals. American Valve 4000D

NOTES:

1) Provide extended shaft for all valves in insulated piping.

E. Throttling Valves:

1. Globe Valves:

a. GL-1: 2" and under, 125 psi saturated steam, 300 psi WOG, screwed, bronze. Crane #7TF, Stockham #B22T, Walworth #95, Milwaukee #590, Hammond #IB413T, Watts #B-4010-T, NIBCO #T-235.

b. GL-2: 2-1/2" thru 10", 125 psi S @ 353ºF, 200 psi WOG @ 150ºF, flanged, iron body, bronze mounted. Crane #351, Hammond #IR116, Stockham #G-512, Walworth #906F, Milwaukee #F2981, Watts #F-501, NIBCO #F-718-B.

c. GL-5: 2" and under, 300 psi WOG, solder, bronze. Hammond #IB423, Stockham #B24T, Milwaukee #1590, Watts #B-4011-T, NIBCO #S-235.

2. Butterfly Valves:

a. BF-4:

1) 2-1/2" thru 6", 175 psi WOG, elastomers rated for 20ºF to 250ºF at 125 psig, fully lugged or grooved end, ductile or cast iron body (not in contact with fluid); bronze, aluminum-bronze or EPDM coated ductile iron disc; EPDM seat, stainless steel stem, extended neck, 175 psi bubble-tight, bi-directional dead-end shutoff without backing flange or nuts and with cap screws extending to centerline of valve body (for pipe extension without draining system), infinite position locking operator with memory stop up to 6" size. Cv of at least 1580 in

6" size. Victaulic #300, Center Line Series 200, Keystone #222, Watts #DBF-03-121-1P, NIBCO N200 Series or LD2000 Series, Milwaukee CL series, Hammond 5200 series.

F. Check Valves:

1. CK-1: 2" and under, 125 psi S @ 353ºF, 200 psi WOG @ 150ºF, screwed, bronze, horizontal swing. Crane #37, Hammond #IB904, Stockham #B319, Walworth #406, Milwaukee #509, Watts #B-5000, or NIBCO #T-413.

2. CK-4: 2" and under, 200 psi WOG @ 150ºF, solder, bronze, horizontal swing. Crane #1342, Hammond #IB912, Stockham #B309, Walworth #406SJ, Milwaukee #1509, Watts #B-5001, or NIBCO #S-413.

3. CK-13: 2-1/2" thru 12", 200# WOG, double disc wafer type, iron body, bronze or aluminum-bronze discs, 316SS shaft and spring, Viton, EPDM or BUNA-N, Cv of at least 700 in 6" size. Mueller Steam Specialty Co. #71-AHB-6-H, Stockham #WG-961, NIBCO W-920-W, Crane, Victaulic #716/716H.

G. Strainers:

1. ST-1: Bronze body, screwed ends, screwed cover, 150 psi S @ 350°F, 200 psi WOG @ 150°F. Armstrong #F4SC, Metraflex #TS, Mueller Steam Specialty Co. #351, Sarco #BT, Watts #777, NIBCO T-122.

2. ST-2: Cast iron body, 125 lb. flanged ends, bolted cover, 125 psi S @ 350°F, 175 psi WOG @ 150°F. Armstrong #A1FL, Metraflex #TF, Mueller Steam Specialty Co.#758, Sarco #CI-125, Watts #77F-D, Victaulic #732 or #W732, NIBCO F-721-A.

2.2 EQUIPMENT DRAINS AND OVERFLOWS

A. Steel Pipe: ASTM A53, Schedule 40 galvanized.

1. Fittings: Galvanized cast iron screwed drainage type, ASME B16.12.

2. Joints: Screwed.

3. Service: Not allowed on boiler drains and overflow.

B. Steel Pipe: ASTM A53. [for boiler drains only]

1. Pipe: Standard weight black steel, threaded and coupled, ASTM A53.

2. Joints: Screwed.

3. Fittings: Class 125 cast iron, ASTM A126, ASME B16.4.

C. Copper Tubing: DWV drawn temper seamless copper drainage tube, ASTM B306.

1. Fittings: ASME B16.23 cast brass, or ASME B16.29 solder wrought copper.

2. Joints: Solder with Type 95-5 solder. 50-50 solder is not acceptable.

D. Piping Under 1-1/4” Size:

1. In sizes where drainage type fittings are not available, tees with threaded caps to permit rodding are acceptable.

E. Shutoff Valves:

1. Ball Valves:

a. BA-1: 3" and under, 125 psi saturated steam, 600 psi WOG, full port, screwed or solder ends (acceptable only if rated for soldering in line with 470°F melting point of lead-free solder), bronze body of a copper alloy containing less than 15% zinc, stainless steel ball and trim, Teflon seats and seals. Apollo #77C-140, Stockham #S-206 BR1-R, Milwaukee #BA-400, Watts, Nibco #585-70-66, National Utilities Co., RUB.

NOTES:

1) Provide extended shaft for all valves in insulated piping.

2) Provide lock out trim for all valves opening to atmosphere installed in domestic water piping over 120°F, heating water piping over 120°F, steam, condensate, boiler feed water piping, compressed air piping and gasoline/kerosene piping, and as indicated on the drawings. Solid extended shaft is not required on valves with lock out trim.

b. BA-1A: 2-1/2" and 3", 150 psi saturated steam, 275 psi WOG ANSI Class, 150 psi standard port, carbon steel body stainless steel ball and trim, Teflon seats and seals. Apollo #88A-100, Nibco #F510-CS/66, Milwaukee #F90.

NOTES:

1) Provide extended shaft for all valves in insulated piping.

2) Provide lock out trim for all valves opening to atmosphere installed in domestic water piping over 120°F, heating water piping over 120°F, steam, condensate, boiler feed water piping, compressed air piping and gasoline/kerosene piping, and as indicated on the drawings. Solid extended shaft is not required on valves with lock out trim.

2.3 AIR VENTS

A. At end of main and other points where large volume of air may be trapped - Use 1/4" globe valve, angle type, 125 psi, Crane #89, attached to coupling in top of main, 1/4" discharge pipe turned down with cap.

B. On branch lines and small heating units - Use coin-operated air vent equal to B&G #4V, attached to 1/8" coupling in top of pipe. Install air vents on all coils and terminal heating units.

2.4 AUTOMATIC AIR VENTS

A. Low capacity automatic air vent (for bladder tank anti-thermosyphon loops). Maximum operating pressure and temperature of at least 240°F and 125 psi, 1/2" or 3/4" inlet. B&G #87, Armstrong, Spirotherm, or Watts.

B. High/low capacity automatic air vent (for air separator connection). Maximum operating pressure and temperature of at least 240°F and 125 psi, 3/4" inlet, 3/8" minimum outlet. B&G #107, Armstrong, Spirotherm, Taco, or Watts.

2.5 STRAINERS

A. Unless otherwise indicated, strainers shall be Y-pattern and have stainless steel screens with perforations as follows:

Pipe Size	
Water and Glycol/Water	20# mesh

B. Furnish pipe nipple with ball valve, threaded hose connection, and cap to blow down all strainer screens.

C. Use bronze body strainers in copper piping and iron body strainers in ferrous piping.

2.6 MAKE-UP WATER ACCESSORIES

A. Pressure Reducing Valve:

1. For water fill lines to hydronic systems.

2. Pressure reducing valve. Removable strainer, field adjustable discharge pressure, brass body, disc and seat, union with 1/2" or 3/4" NPT sweat connection, 125 psig maximum working pressure, 225°F maximum temperature.

3. Acceptable Manufacturers: Armstrong, Bell & Gossett, Conbraco, Thrush, Watts.

B. Relief Valve:

1. For water fill lines to hydronic systems.

2. Cast iron or bronze body, 1/2" or 3/4" screwed connections, 125 psig working pressure, 225°F maximum temperature. Minimum 500,000 Btuh capacity at 30 psig. Manual test lever.

3. Acceptable Manufacturers: Armstrong, Bell & Gossett, Conbraco, Watts.

C. Backflow Preventer:

1. Reduced pressure type as scheduled on the drawings.

2. Provide an air gap fitting and piping to drain.

3. If not indicated on the drawings, unit shall be same size as pipe.

4. Field test and tag units per manufacturer's instructions by a certified tester before initial operation.

2.7 SAFETY RELIEF VALVES

A. SRV-1 (Hydronic Heating Systems): Spring-loaded disc type with cast iron or bronze body, bronze or stainless steel disc, side outlet and lifting lever for maximum service of 125 psig at 250ºF. For relieving water during pressure fluctuations and in case of control failure. Capacities shall be ASME Section IV certified and labeled. Acceptable Manufacturers: Kunkle # 537, B&G, Conbraco, McDonnell & Miller, or Watts.

2.8 SUCTION DIFFUSER

A. Furnish and install on base mounted pumps with inlet size same as pipe size shown on the drawing.

B. In no case shall pressure drop exceed 3.0 psi.

C. Suction diffuser shall consist of angle body with inlet vanes and combination diffuser-strainer-orifice cylinder with 3/16" diameter openings for pump protection, gauge tappings, and blowdown connection. Orifice cylinder, with bronze or stainless steel strainer with free area at least 5 times cross section area of pump suction opening. Furnish adjustable foot to support weight of suction piping. Connect drain valve to blowdown connection. Provide 16 mesh bronze startup strainer. The startup strainer shall be removed after the system has been started, cleaned, and is operating under normal conditions, but before the system is turned over to the Owner. Hang the startup strainer on the piping near the pump after it is removed.

D. Acceptable Manufacturers: Amtrol, Armstrong, Bell & Gossett, Patterson, Taco, Wheatley, Victaulic.

2.9 BALANCING VALVE

A. Rated for 125 psi working pressure and 250ºF operating temperature, taps for determining flow with a portable meter, positive shutoff valves for each meter connection, memory feature, tight shutoff, and a permanent pressure drop between 1' and 2' water column at full flow with valve 100% open. Furnish with molded, removable insulation covers.

B. Provide a nomograph to determine flow from meter reading (and valve position on units which sense pressure across a valve). Graph shall extend below the specified minimum flow.

C. Furnish one meter kit equivalent to Bell & Gossett Model RO-5 meeting the following requirements:

1. Carrying case with handle.

2. Pressure gauge with 0-25 feet of head scale with 3.0% full scale accuracy.

3. High and low side hoses with 5 feet length and 250 psig pressure rating, equipped with shutoff valves, vent valves, and probes for insertion into pressure and temperature plugs.

D. Valves in copper piping shall be brass or bronze. Acceptable Manufacturers: Flow Design “Accusetter”, Presso “B+”, Armstrong "CVB", Bell & Gossett "Circuit Setter Plus", Griswold “Quickset”, Gerand “BALVALVE Venturi”, HCI “Terminator B”, NIBCO 1710 (S1710L), Tour&Anderson (STAD), Nexus Valve “UltraXB Orturi”, Victaulic 785.

E. Valves in ferrous piping 2" or smaller shall have threaded ends and steel, brass or bronze construction. Acceptable Manufacturers: Flow Design “Accusetter”, Presso “B+”, TA Hydronics “786-789”, Armstrong "CVB", Bell & Gossett "Circuit Setter Plus", Autoflow “AB”, Gerand “BALVALVE Venturi”, HCI “Terminator B”, NIBCO 1710 (T1710L), Nexus Valve “UltraXB Orturi”, Victaulic 787, or flow sensors specified in Section 23 09 00 with a specified throttling valve.

F. Balancing valves in ferrous piping over 2" size shall consist of flow sensors as specified in Section 23 09 00 combined with specified throttling valves.

G. Manufacturer shall size balancing valves for the scheduled flow rate. Flow rate shall be measurable on manufacturer's standard meters.

2.10 EXPANSION TANK

A. Bladder Type:

1. Tank shall be welded steel, ASME construction and stamped.

2. Tank shall be complete with heavy-duty replaceable butyl bladder, site glass, charging valve, lifting ring, drain tapping, and system connection.

3. 125 psig working pressure and 240ºF maximum operating temperature.

4. Acceptable Manufacturers: Thrush, Bell & Gossett, Armstrong, Watts, Wessels, Wheatley, Amtrol, Patterson.

2.11 BYPASS/SIDE STREAM FILTER

A. Cartridge filtration system rated for up to 50 gpm.

B. Filter vessel shall be 304 stainless steel and suitable for use up to 150 psi maximum operating pressure.

C. Vessel shall be equipped with an automatic air vent, manual air vent, and pressure gauge.

D. Filter shall be capable of removing 90% of all particles 5 microns and larger with each pass through the media.

E. Filter cartridge shall have a PVC core to prevent cartridge from collapse.

F. Filtration system shall be suitable for use up to 200°F.

G. System shall be provided with close coupled centrifugal pump with strainer capable of providing flow as scheduled on drawings.

H. Filtration system components shall be pre-piped and skid mounted as a single unit.

I. Mechanical Contractor shall provide and install shutoff valves on both up and downstream sides of filtration system, a check valve on suction side of pump between shutoff valve and pump, and drain piping to nearest trench drain.

J. Acceptable Manufacturers: PEP, Lenntech Filters, Parker Hannifin, United Filtration Systems, Lakos.

2.12 COALESCING TYPE COMBINATION AIR ELIMINATOR AND DIRT SEPARATOR

A. Coalescing type air eliminator and dirt separator shall be fabricated from steel and ASME constructed and certified for 125 psi working pressure and 270ºF operating temperature. Units 2-1/2 inches and smaller shall have threaded connections. Units 3 inches and larger shall have flanged connections.

B. Air elimination and dirt separation shall be by coalescing action by either:

1. Stainless steel PALL rings.

2. Copper tubes with continuous wound, permanently attached copper wire and followed by a separate continuous wound permanently affixed copper wire.

C. Provide unit with factory mounted air vent at the top of the air elimination chamber.

D. Provide brass flushing cock on the separator side to facilitate system fast-fill and to blow down impurities from the water surface within the separator.

E. Provide factory mounted blow-down valve on the unit bottom to allow for draining and cleaning.

F. Coalescing separators shall be as sized on the construction drawings, but in no case shall it have less than line size connections nor shall pressure drop exceed 1 psi at design flow. Include on submittal the pressure drop of each unit at its design flow rate.

G. Coalescing separators shall be equipped with removable cover to allow for removal, inspection and cleaning of the internal coalescing media.

H. Acceptable Manufacturers: Spirotherm VDN Series, Wessels WVA.

2.13 DRAIN VALVES AND BLOWDOWN VALVES

A. Drain valve and blowdown valve shall mean a shutoff valve as specified for the intended service with added 3/4" male hose thread outlet, cap, and retaining chain.

2.14 PROPYLENE GLYCOL - FOOD GRADE

A. Fill systems with a 25% solution by weight of water and industrially inhibited propylene glycol low temperature industrial heat transfer fluid with an expected life of at least 12 years in normal use. Water shall meet the glycol manufacturer's recommendations (generally < 25ppm chloride, sulfite, and hardness). Distilled, deionized, or reverse osmosis water is acceptable, as are pre-diluted solutions from the manufacturer.

B. Glycol shall be approved by Wisconsin DNR for geothermal applications.

C. All ingredients shall be FDA recognized as safe food additives. Fluid suitable for use from -28ºF to 250ºF.

D. Glycol shall pass ASTM D1384 (less than 0.5 mils annual penetration of all system metals). Glycol supplier shall provide a certificate of assurance.

E. For performance purposes a 50% solution by weight shall depress the freezing point to at least -34ºF. At 40ºF the solution shall have viscosity of not over 14 centipoises, thermal conductivity of at least 0.199 Btu/hr*ft*ºF, specific heat of at least 0.839 Btu/lbm*ºF, and specific gravity of at least 1.06. However, as described above the project requires a 25% solution by weight of propylene glycol.

F. Manufacturer shall offer a testing service to determine if inhibitor addition is needed.

G. Acceptable Manufacturer: Dow Chemical "Dowfrost", Interstate Chemical "P-323", Houghton Chemical "Safe-T-Therm

2.15 GLYCOL FEED SYSTEM

A. Package system complete with storage tank, pump(s) and controls with audio and visual alarm, designed to add glycol solution to a closed loop water system. System shall automatically maintain pressure in the piping system.

B. Provide cut-off and alarm to stop pump in case of low level or high pressure. Provide dry contact for alarm point to the DDC.

C. Complete with polyethylene storage tank and lid. Mount on floor above pumping assembly in a steel frame with legs. Lid shall be removable for filling and provide means for system relief valve outlet to be piped back to tank without removal of piping from relief valve or automatic air vent

D. Pumping system shall consist of a pump, starter, pressure tank with pressure control, pressure reducing valve, shutoff valve and pressure gauge. Refer to schedule for pump requirements.

E. Acceptable Manufacturer: Wessels GMP, Advantage Controls AGF, B&G GMU, Patterson.

2.16 LOCK OUT TRIM

A. Provide lock out trim for all quarter turn valves opening to atmosphere installed in heating water piping over 120°F and as indicated on the drawings.

PART 3 - EXECUTION

3.1 PREPARATION

A. Ream pipe and tube ends, remove burrs, bevel plain end ferrous pipe.

B. Remove scale and dirt on inside and outside before assembly.

C. Connect to all equipment with flanges or unions.

D. After completion, fill, clean, and treat systems. Refer to Section 23 25 00 for treatment.

3.2 TESTING PIPING

A. Heating Water:
Geothermal Water (inside building):

1. Test pipes underground or in chases and walls before piping is concealed.

2. Complete testing before insulation is applied. If insulation is applied before pipe is tested and a leak ruins the insulation, replace all damaged insulation.

3. Test the pipe with 100 psig water pressure. Hold pressure for at least two hours.

4. Test to be witnessed by the Architect/Engineer or their representative, if requested by the Architect/Engineer.

3.3 CLEANING PIPING

A. Assembly:

1. Prior to assembly of pipe and piping components, remove all loose dirt, scale, oil and other foreign matter on internal or external surfaces by means consistent with good piping practice subject to approval of the Architect/Engineer. Blow chips and burrs out of pipe before assembly. Wipe cutting oil from internal and external surfaces.

2. During fabrication and assembly, remove slag and weld spatter from both internal and external joints by peening, chipping and wire brushing to the degree consistent with good piping practices.

3. Notify the Architect/Engineer prior to starting any post erection cleaning operation in time to allow witnessing the operation. Properly dispose of cleaning and flushing fluids.

4. Prior to blowing or flushing erected piping systems, disconnect all instrumentation and equipment, open wide all valves, control valves, and balance valves, and verify all strainer screens are in place.

B. Chemical Cleaning:

1. Flush pipe and components with clean water until all discharge from system is clean. Maintain minimum velocities at all points of 5 feet/second for 30 minutes. Flow shall be in same direction as when system is in normal operation. Discharge shall be from low points of pipes, ends of headers and as otherwise needed to flush entire system. After flushing, all residual water shall be drained and/or blown out.

2. Add 2 pounds of trisodium phosphate per 100 gallons of system capacity. Use an alternate chemical if discharge of trisodium phosphate is not permitted. Maintain 150°F in the system if possible. If heat is not available, use 3 pounds per 100 gallons.

3. Drain the system after circulating the chemical cleaner for six hours at 150°F, or 12 hours at a lower temperature. Refill. Test a water sample. Drain and fill again if excessive cleaning chemicals remain and until water appears clear.

4. After circulating the chemical cleaner for six hours at 150ºF, or 12 hours at less than 90ºF, connect fresh water to the system and discharge to a drain. Run circulating pumps and flush until discharge is clear water.

5. When system water is clear, remove, clean and replace all strainers.

6. Add chemical treatment as specified in Section 23 25 00.

7. Water samples may be taken by the Architect/Engineer to verify a clean system. If system is not clean, the entire process, including chemical treatment specified in Section 23 25 00, shall be repeated at the Contractor's expense.

8. Chemical cleaning applies to the following systems:

   a. Heating Water
   b. Geothermal Water

3.4 INSTALLATION

A. General Installation Requirements:

1. Route piping in orderly manner, straight, plumb, with consistent pitch, parallel to building structure, with minimum use of offsets and couplings. Provide only offsets required for needed headroom or clearance and needed flexibility in pipe system.

2. Install piping to conserve building space, and not interfere with other work.

3. Group piping whenever practical at common elevations.

4. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

5. Reducers are generally not shown. Where pipe sizes change at tee, the tee shall be the size of the largest pipe shown connecting to it. Where pipe sizes are not shown, the larger size in either direction shall continue through the fitting nearest to the indication of a smaller pipe size.

6. Install bell and spigot pipe with bells upstream.

7. Seal pipes passing through exterior walls with a wall seal per Section 23 05 29. Provide Schedule 40 galvanized sleeve at least 2 pipe sizes larger than the pipe.

8. Branch takeoffs shall be from the top side (if branch is two sizes smaller than main), or any angle from the horizontal plane to the top of piping.

B. Installation Requirements in Electrical Rooms:

1. Do not install piping or other equipment above electrical switchboards or panelboards. This includes a dedicated space extending 25 feet from the floor to the structural ceiling with width and depth equal to the equipment plus its required clearance space.

C. Buried Piping:

1. Install thrust blocking and restraints on all buried piping at elbows and other changes in pipe direction.

D. Valves/Fittings and Accessories:

1. Provide chain operators for all valves over 2" size that are over 10'-0" above finished floor. Extend to 7'-0" above finished floor.

2. Provide valve position indicator on all valves 10’-0” or greater above finish floor and not located above ceiling.

3. Provide clearance for installation of insulation, and access to valves and fittings.

4. Provide access doors where valves are not exposed.

5. Where a manual balance valve is shown to be installed in series with a service (isolation) valve, separate balance and service (isolation) valves shall be installed.

6. Install balancing valves with the manufacturers recommended straight upstream and downstream diameters of pipe.

7. Prepare pipe, fittings, supports, and accessories for finish painting.

8. Install valves with stems upright or horizontal, not inverted, except install manual quarter turn valves in radiation cabinets and all butterfly valves with stems horizontal.

9. Provide shutoff valves and flanges or unions at all connections to equipment, traps, and items that require servicing.

10. Provide flanges or unions at all final connections to equipment, traps and valves.

11. Arrange piping and piping connections so equipment may be serviced or totally removed without disturbing piping beyond final connections and associated shutoff valves.

E. Underground Piping:

1. Lay all underground piping in trenches. Provide and operate pumping equipment to keep trenches free of water.

2. For all underground piping, provide a foundation 6" bedding layer of sand below the all pipe. Provide recessed areas for pipe bells and joints. After joints are made, any misalignment in elevation shall be corrected by tamping sand around the pipe. Backfill with sand in uniform layers not over 6" deep to the spring line of all underground pipes, and carefully compact each layer to 90 percent Proctor density. Backfill with sand up to 6" above pipe. Remaining backfill may be soil, unless under paving or buildings, in which case it shall be sand and compacted to 90 percent Proctor density.

3.5 PIPE ERECTION AND LAYING

A. Carefully inspect all pipe, fittings, valves, equipment and accessories prior to installation. Immediately reject and remove from the job any items which are unsuitable, cracked or otherwise defective.

B. All pipe, fittings, valves, equipment and accessories shall have factory-applied markings, stampings, or nameplates sufficient to determine their conformance with specified requirements.

C. Exercise care at every stage of storage, handling, laying and erecting to prevent entry of foreign matter into piping, fittings, valves, equipment and accessories. Do not erect or install any unclean item.

D. During construction, until system is fully operational, keep all openings in piping and equipment closed at all times except when actual work is being performed on that item. Closures shall be plugs, caps, blind flanges or other items designed for this purpose.

E. Change direction of pipes only with fittings or pipe bends. Change size only with fittings. Do not use miter fittings, face or flush bushings, or street elbows. **2-1/2" and larger fittings shall be long radius type**, unless otherwise shown on the drawings or specified. Construct welded elbows of angles not available as standard fittings by cutting and welding standard elbows to form smooth, long radius fittings.

F. Use full and double lengths of pipe wherever possible.

G. Unless otherwise indicated, install all inlet and outlet piping, including shutoff valves and strainers, to coils, pumps and other equipment at line size with reduction in size being made only at control valve or pump.

H. Cut all pipe to exact measurement and install without springing or forcing except in the case of expansion loops where cold springing is indicated on the drawings.

I. Do not create, even temporarily, undue loads, forces or strains on valves, equipment or building elements.

3.6 DRAINING AND VENTING

A. Unless otherwise indicated on the drawings, all horizontal pipes, including branches, shall pitch 1" in 40 feet to low points for complete drainage, removal of condensate, and venting.

B. Provide drain valves at all low points of water piping systems or where indicated on drawings for complete or sectionalized draining. Drain valves are defined above.

C. Use eccentric reducing fittings on horizontal runs when changing size for proper drainage and venting. Install all liquid lines with top of pipe and eccentric reducers in a continuous line.

D. Provide air vents at all high points and wherever else required for elimination of air in all water piping systems. Do not use automatic air vents in glycol systems unless they are piped to the fill tank.

E. Air vents shall be in accessible locations. If needed to trap and vent air in a remote location, a 1/8" pipe shall connect the tapping location to a venting device in an accessible location.

F. All vent and drain piping shall be of same materials and construction as the service involved.

3.7 BRANCH CONNECTIONS

A. Make branch connections with standard tee or cross fittings of the type required for the service unless otherwise specified herein or detailed on the drawings.

B. At the option of the Contractor, branch connections from headers and mains may be cut into black steel pipe using forged weld-on fittings.

C. Use of forged weld-on fittings is also limited as follows:

1. Must have at least same pressure rating as the main.
2. Header or main must be 2-1/2" or over.
3. Branch line is at least two pipe sizes under header or main size.

3.8 JOINING OF PIPE

A. Threaded Joints:

1. Ream pipe ends and remove all burrs and chips.
2. Protect plated pipe and valve bodies from wrench marks when making up joints.
3. Apply Teflon tape to male threads.

B. Flanged Joints:

1. Bronze flanges shall conform to B16.24 and ductile iron flanges to B16.42. Steel flanges shall be raised face except when bolted to flat face cast iron flange.

2. Bolting shall be ASTM A307 Grade B with bolts and heavy hexagonal nuts conforming to ASME B18.2.1 and B18.2.2.

3. Torque bolts in at least three passes, tightening to 1/3, 2/3, and final torque in a cross pattern with an indicating torque wrench for equal tension in all bolts.

4. Gaskets for flat face flanges shall be full-face type. Gaskets for raised faced flanges shall conform to requirements for "Group I gaskets" in ASME B16.5. All gaskets shall conform to ASME B16.21. Unless otherwise specified, gaskets shall meet the following requirements:

   a. Gasket material and thickness approved by manufacturer for intended service, chemical compatibility, pipe system test pressure, and operating temperature range.

   b. Maximum pressure rating of at least 250 psig.

   c. Minimum temperature rating: -10°F.

   d. Maximum temperature rating of at least 170°F for water and glycol solution systems operating 140°F and less.

   e. Maximum temperature rating of at least 250°F for water and glycol solution systems operating above 140°F and up to 180°F.

C. Solder Joints:

1. Make up joints with 95% tin and 5% antimony (95-5) solder conforming to ASTM B32 Grade 95TA. Cut copper tubing ends perfectly square and remove all burrs inside and outside. Thoroughly clean sockets of fittings and ends of tubing to remove all oxide, dirt and grease just prior to soldering. Apply flux evenly, but sparingly, to all surfaces to be joined. Heat joints uniformly to proper soldering temperature so solder flows to all mated surfaces. Wipe excess solder, leaving a uniform fillet around cup of fitting.

2. Flux shall be non-acid type conforming to ASTM B813.

3. Solder end valves may be installed directly in the piping system if the entire valve is suitable for use with 470ºF melting point solder. Remove composition discs and all seals during soldering if not suitable for 470ºF.

D. Welded Joints:

1. Welding of all pipe joints, both as to procedures and qualification of welders, shall be in accordance with Section IX, ASME "Boiler & Pressure Vessel Code" unless local codes take precedence.

2. Furnish certificates qualifying each welder to the Owner's Representative prior to start of work.

3. The Owner's Representative reserves the right to require qualifying demonstration, at the Contractor's expense, of any welders assigned to the job.

4. Ends of pipe and fittings to be joined by butt-welding shall be beveled, cleaned to bare metal and internal diameters aligned before tack welding.

5. Single-welded butt joints may be employed with or without the use of backing rings in all sizes. Where backing rings are not used on pumped pressurized systems, the root side of the weld shall either be chipped or ground flush with the piping wall. For services such as vents, overflows, and gravity drains, the backing ring may be eliminated, and the root of the weld need not be chipped or ground. Backing rings shall be of the material being welded.

END OF SECTION

SECTION 23 21 23
HVAC PUMPS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. All pumps except where integral with a manufactured piece of equipment.
B. Pump controls where self-contained.

1.2 SUBMITTALS

A. Submit shop drawings under provisions of Section 23 05 00.

B. Submit certified pump performance curves with pump and system operating point plotted. Include NPSH curve when applicable.

C. Pumps with motors operating above the RPM the pump curves are based on shall have impellers trimmed to deliver GPM and head scheduled.

D. Submit motor data indicating compliance with Section 23 05 13.

PART 2 - PRODUCTS

2.1 PUMPS - GENERAL

A. Statically and dynamically balance rotating parts.

B. Construction shall permit complete servicing without breaking piping or motor connections.

C. Pumps shall operate at 1750 rpm unless specified otherwise.

D. Pump connections shall be flanged, whenever available.

E. Heating pumps shall be suitable for 225ºF water.

F. Motors shall comply with Section 23 05 13.

G. Pump impellers shall not have smaller diameters than those scheduled. The inlet and discharge pipe sizes shall also meet or exceed the scheduled pump.

2.2 IN-LINE PUMP

A. Type: Centrifugal, single stage, close coupled in-line, back pullout design, suitable for horizontal or vertical operation.

B. Casing: Cast iron, rated for greater of 125 psior 1.5 times actual working discharge pressure, flanged suction and discharge with gauge ports.

C. Impeller: Bronze or stainless steel, fully enclosed, dynamically balanced, keyed to shaft and secured with locknut.

D. Shaft: Steel or stainless steel.

E. Seals: Carbon rotating against a stationary ceramic seat.

F. Acceptable Manufacturers: Bell & Gossett, Grundfos/Peerless/PACO.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General Installation Requirements:

1. Install all products per manufacturer's recommendations.

2. Support piping adjacent to pumps so that no weight is carried by pump casings. Provide supports under elbows on 4" and larger pump suction and discharge pipes. Allow a minimum of 18" clearance for removal of suction diffuser.

3. Ensure pumps operate at specified fluid temperatures without vapor binding or cavitation, are non-overloading in parallel or individual operation, and operate within 25% of midpoint of published maximum efficiency curve.

4. For pumps not powered by a VFD, trim or order new impeller to meet maximum operating conditions. Coordinate final trimmed diameter with Testing, Adjusting, and Balancing Contractor.

5. Install on vibration isolators as scheduled on drawings.

B. In-Line Pumps:

1. Support in-line pumps individually so there is no strain on the piping. Install with a minimum of five diameters of straight pipe on pump suction and discharge.

END OF SECTION

SECTION 23 25 00
CHEMICAL (WATER) TREATMENT

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Treatment for Closed Systems (Water).
B. Treatment for Closed Systems (Glycol).
C. Chemical Feed Equipment.

1.2 SUBMITTALS

A. Submit shop drawings under provisions of Section 23 05 00.

B. Include system schematics, equipment locations, and controls schematics.

C. Submit product data indicating chemicals and equipment.

D. Submit manufacturer's installation instructions.

E. Submit reports indicating start-up of treatment systems is completed and operating properly. Include reports indicating analysis of system water after cleaning and after treatment.

1.3 EXTRA STOCK

A. Provide clean cartridges or bags in all bypass (pot) feeders with filters.

B. Provide two complete sets of replacement cartridges or filters for each bypass (pot) feeder with filters and sidestream filter installed. Deliver to Owner at job site.

1.4 OPERATION AND MAINTENANCE DATA

A. Submit operation and maintenance data.

B. Include data on pumps and other equipment including spare parts lists, procedures, and treatment programs.

C. Include step-by-step instructions on test procedures including target concentrations and test frequencies.

D. Include list of treatment chemicals and the MSDS for all chemicals.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the products specified in this section with minimum five years documented experience. Company shall have local representatives with water analysis laboratories and full time service personnel.

1.6 REGULATORY REQUIREMENTS

A. Conform to all applicable codes and regulations for addition of non-potable chemicals to building mechanical systems, and for discharge to public sewage systems.

B. Provide only chemicals approved for use and disposal by local authorities. Contact the Architect/Engineer if any specified chemicals are prohibited.

1.7 MAINTENANCE SERVICE

A. Provide the following services to assist the owner in setting up and maintaining chemical treatment systems for one year from Date of Substantial Completion:

1. Provide technical service visits to perform field inspections and make water analysis on site. Visits shall be twice annually for closed systems and monthly for steam and cooling tower systems. For cooling tower systems, monthly testing shall have dipslide culture counts, and quarterly water samples shall be sent to a CDC Elite lab for culturing to establish baseline total organism and Legionella counts. Detail findings in writing on proper practices, chemical treating requirements, and corrective actions needed. Submit copies of the field service report after each visit to the Owner and to the Mechanical Contractor. Any problems related to the operation of the chemical treatment program shall be reported to the Architect/Engineer.

2. Provide laboratory and technical assistance services for warranty period.

3. Include one (1) hour training course for operating personnel, instructing them on installation, care, maintenance, testing, and operation of water treatment systems. Arrange course at start-up of systems.

4. Provide on-site inspections of equipment during scheduled or emergency shutdown to properly evaluate success of water treatment program, and make recommendations in writing based upon these inspections.

5. Provide sufficient chemicals for treatment and testing during warranty period.

B. The Chemical Treatment Subcontractor shall be responsible for assisting the Mechanical Contractor by adding the chemical solutions required for cleaning each piping system. During the remainder of the warranty period, the Chemical Treatment Subcontractor will be responsible for adding chemicals and doing other work related to the operation of system such as boiler blowdown. The Chemical Treatment Contractor shall make periodic tests of the chemical treatment program as called for above and recommend changes to Owner when needed.

1.8 WATER ANALYSIS

A. Sample feedwater to determine appropriate chemical treatment. Contact the Architect/Engineer if test indicates treatment required is different than that specified.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Nalco.
B. Betz.
C. America's Best Water Treaters.
D. H-O-H Chemicals, Inc.
E. Industrial Water Management.
F. Garratt-Callahan Company.
G. Lakeland Chemical Specialties, Inc.
H. Iowa Water Management Corp.
I. Butler Chemical Company.
J. Eldon Water.
K. ChemTreat.
L. Watertech of America
M. Earthwise Environmental, Inc.
N. Rhomar Water Management, Inc.

2.2 MATERIALS

A. Closed System Treatment (Water):

1. Provide one bypass feeder on each system. Install inlet, outlet and drain valves, and necessary piping.

2. Provide a 3/4" water meter in the domestic cold water line that provides makeup water to steam systems.

3. Provide coupon rack around main system pumps for all systems.

4. Proprietary blend containing the following items:

a. Corrosion Inhibitors for Water Systems Operating Above 145°F: Sodium nitrite-borax or molybdate with added inhibitors such as mercaptobenzothiazole, sodium tolytriazole, or phenyltriazole to protect copper and brass and minimize dielectric pitting of steel. Maintain 1,000 ppm nitrite or 100 ppm molybdate. Adjust borax content to keep correct pH for type of system (mainly steel or mainly copper).

b. Corrosion Inhibitors for Chilled Water Systems and Heating Systems operating at ≤145°F: Sodium molybdate with added inhibitors such as mercaptobenzothiazole, sodium tolytriazole, or phenyltriazole to protect copper and brass and minimize dielectric pitting of steel. Maintain 50 ppm molybdate. Adjust borax content to keep correct pH for type of system (mainly steel or mainly copper).

c. Scale Inhibitor: Organic phosphonates such as aminomethylene-phosphonate; phosphonates such as hydroxyethylidenediphosphonate or polyamino-substituted phosphonates; or synthetic polymers such as low-molecular-weight polyacrylates, poly-methacrylates and polyacrylanides. Inorganic phosphates are not acceptable. Maintain residual concentration as recommended by the manufacturer.

B. Closed System Treatment (Glycol):

1. The specified glycols contain initial charge of corrosion inhibitors, however, the pH after installation must be checked and adjusted to maintain between 8.0 and 10.0 using inhibitors recommended by the manufacturer (normally dipotassium phosphate).

2.3 EQUIPMENT

A. Bypass (Pot) Feeder: 5.0 gal; quick-opening cap with 3-1/2” minimum diameter opening and opening wrench, legs to raise fill cap to 30” to 36”, ASME rated, drain valve, air cock, working pressure of 200 psig at 200°F, 20 to 25 micron cartridge or bag filter. Acceptable Manufacturers: Griswold, Vector Industries, J.L. Wingert, or Neptune.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install bypass (pot) feeder with top approximately 36” above the floor.

C. Coordinate with Contractor to provide temporary metering capabilities during system fill to determine overall system volume.

D. For systems containing glycol, carefully review the glycol manufacturer's water requirements and coordinate to provide system cleaning, flushing, and initial fill with the proper quality of water conforming to the manufacturer's and these specifications.

3.2 CLOSED-LOOP HYDRONIC SYSTEM WATER QUALITY STANDARDS

A. Review equipment manufacturer's water quality standard to ensure water quality is sufficient to meet their warranty requirements as well as to ensure peak heat transfer efficiency. Contractor shall maintain hydronic systems within the more stringent of either the equipment manufacturer's requirements or those listed below:

Measured Value	Multi-Metal Systems with Aluminum	Multi-Metal Systems with Stainless Steel	Multi-Metal Systems with Copper
pH Range	6.5 – 8.5	6.5 – 8.5	9.0 – 10.0
Alkalinity as $CaCO_3$	100 – 500 mg/l	100 – 500 mg/l	100 – 500 mg/l
Hardness as $CaCO_3$*	100 – 500 mg/l	100 – 500 mg/l	100 – 500 mg/l
Suspended Solids	< 10 mg/l	< 10 mg/l	< 10 mg/l
Dissolved Solids	< 1,000 mg/l	< 1,000 mg/l	< 1,000 mg/l
Chlorides	< 150 mg/l	< 150 mg/l	< 150 mg/l
Iron	< 5.0 mg/l	< 5.0 mg/l	< 5.0 mg/l
Manganese	< 0.4 mg/l	< 0.4 mg/l	< 0.4 mg/l
Nitrate	< 100 mg/l	< 100 mg/l	< 100 mg/l
Sulfate	< 200 mg/l	< 200 mg/l	< 200 mg/l
Ammonia	< 5.0 mg/l	< 5.0 mg/l	< 5.0 mg/l
Free Copper	< 0.10 mg/l	< 0.10 mg/l	< 0.10 mg/l
Free Aluminum	< 3.0 mg/l		

* Minimum hardness only applies to softened water. If water from rivers or lakes is below 100 mg/l, remineralizing is not required.

B. Submit an independent third-party test report for each chemically treated closed-loop system showing compliance with all measured values shown in the above table as part of project closeout documentation.

END OF SECTION

SECTION 23 31 00
DUCTWORK

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Galvanized Ductwork
B. Ductwork Reinforcement
C. Ductwork Sealants
D. Rectangular Ductwork - Single Wall
E. Round and Flat Oval Ductwork - Single Wall
F. Exposed Ductwork (Rectangular, Round, or Oval)
G. Flexible Duct
H. Grease Exhaust Duct
I. Leakage Testing
J. Ductwork Penetrations
K. Duct Cleaning
L. Painting

1.2 SUBMITTALS

A. Submit shop drawings per Section 23 05 00.

B. Submit duct fabrication standards in compliance with SMACNA and these specifications. Clearly indicate metal gauges, reinforcement, and joining methods intended for use for each pressure classification. Furnish details of all common duct fittings and joint connections to be used on this project.

C. The Architect/Engineer may require field verification of sheet metal gauges and reinforcing to verify compliance with these specifications. At the request of the Architect/Engineer, the contractor shall remove a sample of the duct for verification. The contractor shall repair as needed.

1.3 DEFINITIONS

A. Duct Sizes shown on drawings are inside clear dimensions. Maintain clear dimensions inside any lining.

B. Transitions are generally not shown in single-line ductwork. Where sizes change at a divided flow fitting, the larger size shall continue through the fitting.

1.4 COORDINATION DRAWINGS

A. Reference Coordination Drawings article in Section 23 05 00 for required duct systems electronic CAD drawings to be provided to Coordinating Contractor for inclusion into composite coordination drawings.

B. Duct drawings shall be at 1/4" minimum scale complete with the following information:

1. Actual duct routing, ductwork fittings, actual sheet metal dimensions including insulation liner and wrap, duct hanger and support types, ductwork accessories, etc. with lengths and weights noted.

2. Differentiate ducts that are lined or wrapped. Include insulation thickness, type of insulation, and acoustical lagging.

3. Location and size of all duct access doors.

4. Room names and numbers, ceiling types, and ceiling heights.

5. Indicate location of all beams, bar joists, etc. along with bottom of steel elevations for each member.

C. IMEG will provide electronic file copies of ventilation drawings for contractor's use if the contractor signs and returns an "Electronic File Transfer" waiver provided by IMEG. IMEG will not consider blatant reproductions of original file copies an acceptable alternative for coordination drawings. Architectural plans will need to be obtained from the Architect.

PART 2 - PRODUCTS

2.1 GALVANIZED DUCTWORK

A. General Requirements:

1. Duct and reinforcement materials shall conform to ASTM A653 and A924.

2. Interior Ductwork and reinforcements: G60 galvanized (0.60 ounces per square foot total zinc coating for two sides per ASTM A90) unless noted otherwise.

3. Exterior Ductwork: G90 galvanized (0.90 ounces per square foot total zinc coating for two sides per ASTM A90) unless noted otherwise. G60 is not acceptable for exterior use.

4. Ductwork reinforcement shall be of galvanized steel.

5. Ductwork supports shall be of galvanized or painted steel. Slip cable hangers are acceptable. Acceptable manufacturers are Gripple, Ductmate, Duro Dyne, or Architect/Engineer approved.

6. All fasteners shall be galvanized or cadmium plated.

2.2 DUCTWORK REINFORCEMENT

A. General Requirements:

1. All reinforcement shall be external to the duct except that tie rods may be used with the following limitations.

a. Ducts must be over 18" wide.

b. Duct dimensions must be increased 2" in one dimension (h or w) for each row of tie rods installed.

c. Tie rods must not exceed 1/2" diameter.

d. Manufacturer of tie rod system must certify pressure classifications of various arrangements, and this must be in the shop drawings.

2.3 DUCTWORK SEALANTS

A. One part joint sealers shall be water-based mastic systems that meet the following requirements: maximum 48-hour cure time, service temperature of -20°F to +175°F, resistant to mold, mildew and water, flame spread rating below 25 and smoke-developed rating below 50 when tested in accordance with ASTM E84, suitable for all SMACNA seal classes and pressure classes. Mastic used to seal flexible ductwork shall be marked UL 181B-M.

B. Two-part joint sealers shall consist of a minimum 3" wide mineral-gypsum compound impregnated fiber tape and a liquid sealant. Sealant system shall meet the following requirements: maximum 48-hour cure time, service temperature of 0°F to 200°F, resistant to mold, mildew, and water, flame spread rating below 25 and smoke developed rating below 50 when tested in accordance with ASTM E84, suitable for all SMACNA seal classes and pressure classes.

C. Pressure sensitive tape used for sealing ductwork shall be minimum 2.5-inch wide, listed and marked UL 181A-P, having minimum 60 oz/inch peel adhesion to steel, and service temperature range from -20°F to +250°F.

D. Joint sealers shall meet the volatile organic compound (VOC) limits of U.S. Green Building Council LEED credit EQ 4.1, Low-Emitting Materials - Adhesives & Sealants (follow the latest edition at the time of bidding or as referenced in these specifications).

E. Where pressure sensitive tape is called for on drawings and specifications for sealing flexible ductwork, tape shall be minimum 2.5-inch wide, UL 181 B-FX listed, and marked tape having minimum 60 oz/inch peel adhesion to steel and service temperature range from -20°F to +250°F. Acceptable manufacturers include: Venture Tape 1581A, Compac #340, Scotch Foil Tape 3326, Polyken 339.

2.4 RECTANGULAR DUCT - SINGLE WALL

A. General Requirements:

1. All ductwork gauges and reinforcements shall be as listed in SMACNA Duct Construction Standards Chapter 2. Where necessary to fit in confined spaces, furnish heaviest duct gauge and least space consuming reinforcement.

2. Transitions shall not exceed the angles in Figure 4-7.

B. Exceptions and modifications to the 2005 HVAC Duct Construction Standards are:

1. All ducts shall be cross-broken or beaded.

2. Turning vanes shall be used in all 90° mitered elbows, unless clearly noted otherwise on the drawings. Vanes shall be as follows:

a. Type 1:

1) **Description**: Single wall type with 22-gauge (0.029") or heavier vanes, 3-1/4" blade spacing, and 4" to 4-1/2" radius. Vanes hemmed if recommended by runner manufacturer. Runners shall have extra long locking tabs. C-value independently tested at below 0.26. EZ Rail II by Sheet Metal Connectors or equal.

2) **Usage**: Limited to 3,000 fpm and vane lengths 36" and under.

b. Type 2:

1) **Description**: Double wall type with 3-1/4" blade spacing, 4-1/2" radius, 24-gauge minimum, and SMACNA Type 1 runners. C-value below 0.27.

2) **Usage**: No limits other than imposed by the manufacturer. Provide intermediate support for vanes over 48" long.

c. Turning vanes shall operate quietly. Repair or replace vanes that rattle or flutter.

d. Runners must be installed at a 45° angle. Elbows with different size inlet and outlet must be radius type.

e. Omitting every other vane is prohibited.

3. Where smooth radius rectangular elbows are shown, they shall be constructed per SMACNA Figure 4-2. Type RE1 shall be constructed with a centerline duct radius R/W of 1.0. Where shown on drawings, Type RE3 elbows with 3 vanes shall be used with centerline duct radius R/W of 0.6 (SMACNA r/W=0.1). RE1 or RE3 elbows may be used where mitered elbows are shown if space permits. **Mitered elbows (with or without turning vanes) may not be substituted for radius elbows.** Do not make branch takeoffs within 4 duct diameters on the side of the duct downstream from the inside radius of radius elbows.

4. Rectangular branch and tee connections in ducts over 1" pressure class shall be 45° entry type per Figs. 4-5 and 4-6. Rectangular straight taps are not acceptable above 1" pressure class.

5. Bellmouth fittings shown on return duct inlets shall expand at a 60-degree total angle horizontally and vertically (space permitting) and have length of at least 25% of the smallest duct dimension.

6. Round taps off rectangular unlined ducts shall be flanged conical or bellmouth type (equal to Buckley Bellmouth or Sheet Metal Connectors E-Z Tap), or 45° rectangular with transition to round (equal to Sheet Metal Connectors Inc. High Efficiency Takeoff). Straight taps are acceptable if pressure class is 1" or less, round duct is 12" diameter or less, and the tap is not located between fans and TAB devices.

7. Duct offsets shall be constructed as shown on drawings. Additional offsets required in the field shall be formed of mitered elbows without turning vanes for offsets up to 30° maximum angle in accordance with SMACNA offset Type 2. Offsets of greater than 30° angle shall be formed of radius elbows with centerline radius R/W=1.0 or greater. SMACNA Type 1 offsets are not permitted.

8. All lined duct shall utilize dovetail joints where round or conical taps occur. The dovetail joints shall extend past the liner before being folded over.

9. Cushion heads are acceptable only downstream of TAB devices in ducts up to ± 2" pressure class, and must be less than 6" in length.

10. Slide-on flanged transverse joint systems are acceptable provided they are a manufactured product that has been tested for conformance with Chapter 2 of the SMACNA HVAC Duct Construction Standards for sheet and joint deflection at the specified pressure class.

a. Apply sealant to all inside corners. Holes at corners are not acceptable.

b. Acceptable Manufacturers: Ductmate Industries - 25/35/45, Nexus, Mez, or WDCI. Other manufacturers must submit test data and fabrication standards and receive Architect/Engineer's approval before any fabrication begins.

11. Formed-on flanged transverse joint systems are acceptable provided they are a manufactured product that has been tested for conformance with Chapter 2 of the SMACNA HVAC Duct Construction Standards for sheet and joint deflection at the specified pressure class.

a. Apply sealant to all inside corners. Holes at corners are not acceptable.

b. Flanges shall be 24-gauge minimum (not 26 gauge).

c. Acceptable Manufacturers: Lockformer TDC, TDF, United McGill, or Sheet Metal Connectors. Other manufacturers must submit test data and fabrication standards and receive Architect/Engineer's approval before any fabrication begins.

2.5 ROUND AND FLAT OVAL DUCTWORK - SINGLE WALL

A. Conform to applicable portions of Rectangular Duct Section. Round or flat oval ductwork may be substituted for rectangular ductwork where approved by the Architect/Engineer. The spiral seam ductwork shall meet the standards set forth in this specification. The ductwork shall meet or exceed the specified cross-sectional area and insulation requirements. The substitution shall be coordinated with all other trades prior to installation.

B. Snap lock seams are not permitted.

C. Flat oval duct in negative pressure applications shall have flat sides reinforced as required for rectangular ducts of the same gauge with dimensions equal to the flat span of the oval duct.

D. 90° elbows shall be smooth radius or have a minimum of five sections with mitered joints and R/D of at least 1.5.

E. Duct and fittings shall meet the required minimum gauges listed in chapter 3 of the SMACNA requirements for the specified pressure class. Ribbed and lightweight duct are not permitted.

F. Ductwork shall be suitable for velocities up to 5,000 fpm.

G. Divided flow fittings may be made as separate fittings or factory installed taps with sound, airtight, continuous welds at intersection of fitting body and tap.

H. Spot weld and bond all fitting seams in the pressure shell. Coat galvanizing damaged by welding with corrosion resistant paint to match galvanized duct color.

I. Ducts with minor axis less than 22" shall be spiral seam type. Larger ducts may be rolled, longitudinal welded seam type. SMACNA seams RL-2 and RL-3 are not permitted.

J. Reinforce flat oval ducts with external angles. Internal tie rods are permitted only as indicated for rectangular ductwork.

K. Transverse Joint Connections:

1. Crimped joints are not permitted.

2. Ducts and fittings 36" in diameter and smaller shall have slip joint connections. Size fitting ends to slip inside mating duct sections with minimum 2-inch insertion length and a stop bead. Use inside slip couplings for duct-to-duct joints, and outside slip couplings for fitting-to-fitting joints.

3. Ducts and fittings larger than 36" shall have flanged connections.

4. Secure all joints with at least 3 sheet metal screws before sealing.

5. Slide-on flanges as manufactured by Ductmate Industries, Accuflange, or Sheet Metal Connectors are acceptable. Self-sealing duct systems are also acceptable (Lindab, Ward “Keating Coupling”).

2.6 EXPOSED DUCTWORK (RECTANGULAR, ROUND, AND FLAT OVAL)

A. The following applies to all ductwork exposed in finished areas including the apparatus bay in addition to requirements noted above:

1. Provide extra shipping protection. Use Cardboard or other protective means to prevent dents and deformed ends.

2. Provide cardboard or other means of protection during field fabrication. Protect from scratches. Provide stiffeners to retain shape during fabrication.

3. Remove all identification stickers and thoroughly clean exterior of all ducts.

4. Locate fitting seams on least visible side of duct.

5. Provide exterior finish suitable for field painting without further oil removal.

6. Provide ramp-type internal joint couplings. Provide bead of sealant around the inside of the duct about 1/2" from the end of the duct. Slide-on flanges as manufactured by Ductmate Industries, Accuflange or Sheet Metal Connectors are acceptable. Self-sealing duct system is also acceptable (Lindab, Ward "Keating Koupling").

7. The system shall be free of visible dents and scratches when viewed from normal occupancy.

8. All insulation shall be internal, except at reheat coils.

B. Alternate manufacturers, including shop fabricated duct, must be reviewed before installation. The following information is required:

1. Metal gauge of duct and fittings.
2. Fitting type and construction.
3. Type and size of reinforcement.

2.7 FLEXIBLE DUCT

A. Flexible duct shall be listed and labeled as UL 181 Class 1 Air Duct Material, and shall comply with NFPA 90A and 90B, and meet GSA, FHA and other U.S. Government agency standards. Flexible duct shall bear the ADC Seal of Certification.

B. Flame Spread/Smoke Developed: Not over 25/50.

C. Flexible duct shall have corrosion-resistant wire helix, bonded to an inner liner that prevents air from contacting the insulation, covered with minimum 1-1/2", 3/4 lb/cf density fiberglass insulation blanket, sheathed in a vapor barrier of metalized polyester film laminated to glass mesh.

D. Inner liner shall be airtight and suitable for 6" WC static pressure through 10" diameter and shall be airtight and suitable for 4" WC static pressure 12" through 16" diameter. Outer jacket shall act as a vapor barrier only with permeance not over 0.1 perm per ASTM E96, Procedure A. "R" value shall not be less than 4.0 ft^2*ºF*hr/Btuh. Temperature range of at least 0-180ºF. Maximum velocity of 4,000 fpm.

E. Usage:

1. Take-offs from supply ducts to inlets of terminal air boxes. Do not exceed 36" in length.

2. Connections to air inlets and outlets. Do not exceed 3'-0" in length.

F. Stretch all flexible duct to prevent sags and reduce air friction. Shorten and reinstall all sagging or loose flexible duct. Avoid sharp elbows. Elbows shall maintain 1.5 diameter centerline turning radius.

G. Install per the SMACNA Flexible Duct Manual. Secure inner layer with draw band. Wrap with pressure sensitive tape for protection prior to installing draw band. Pressure sensitive tape alone is not acceptable.

2.8 GREASE EXHAUST DUCT

A. Exposed ductwork shall be 16 gauge minimum, Type 304L stainless steel. Concealed ductwork may be 16 gauge black steel.

B. All joints and fittings shall be continuously welded and liquid-tight.

C. Exposed ductwork shall have a #3 finish. Concealed ductwork may have a mill finish.

D. Do not penetrate fire rated partitions, unless protected as required by applicable codes.

E. Provide pre-fabricated access doors and labels required by NFPA 96 on sides of duct at least 1.5" from bottom. Provide access at each change in direction and at maximum 20-foot intervals in horizontal ducts. Provide access at every floor for vertical ducts.

F. Where grease ducts are 20" x 20" or larger, install access for personnel to enter duct. Duct supports must be sized to support the duct weight and an additional 800 lbs per NFPA 96.

G. Install ducts with proper clearance to combustible and limited-combustible materials.

H. Grease ducts installed with volume dampers shall conform to the damper specified in ductwork accessories.

I. Refer to Section 23 07 13 for duct insulation material and insulated access door when required to provide proper enclosure of ductwork.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Provide openings in ducts for thermometers and controllers.

B. Locate ducts with space around equipment for normal operation and maintenance.

C. Do not install ducts or other equipment above electrical switchboards or panelboards. This includes a dedicated space extending 25 feet from the floor to the structural ceiling with width and depth equal to the electrical equipment. Unless intended to serve these rooms, do not install any ductwork or equipment in electrical rooms, transformer rooms, electrical closets, telephone rooms or elevator machine rooms

D. During construction provide temporary closures of metal or taped polyethylene on open ducts to prevent dust from entering ductwork. Supply ductwork shall be free of construction debris, and shall comply with level "B" of the SMACNA Duct Cleanliness for New Construction Guidelines.

E. Repair all duct insulation and liner tears.

F. Install manual volume dampers in branch supply ducts so all outlets can be adjusted. Do not install dampers at air terminal device or in outlets, unless specifically shown.

G. Insulate terminal air box reheat coils. Seal insulation tight to form a tight vapor barrier.

H. Install flexible duct in accordance with the ADC Flexible Duct Performance and Installation Standards.

I. Flexible duct shall NOT be joined to flat-oval connections. Provide sheet metal oval-to-round transitions where required, to include, but not limited to, all connections to air inlets, air outlets, and terminal air boxes.

J. Install all exterior ductwork per SMACNA Fig. 6-3. Where drawings do not indicate otherwise, ductwork seams and joints shall be sealed watertight and pitched to shed water.

K. Support all duct systems in accordance with the SMACNA HVAC Duct Construction Standards: Metal and Flexible and the SMACNA Seismic Restraint Manual: Guidelines for Mechanical Systems, where applicable. Refer to Section 23 05 50 for seismic requirements.

L. Adhesives, sealants, tapes, vapor retarders, films, and other supplementary materials added to ducts, plenums, housing panels, silencers, etc. shall have flame spread/smoke developed ratings of under 25/50 per ASTM E84, NFPA 255, or UL 723.

3.2 DUCTWORK APPLICATION SCHEDULE

USAGE	MATERIAL	PRESSURE CLASS	SEAL CLASS†	INSULATION (Refer to Section 23 07 13 for insulation types)
Supply Duct from Fan to Terminal Air Boxes – Single Wall	Galvanized Sheet Metal - Rectangular	+3"	A	1-1/2" thick Type A
Supply Duct from Fan to Terminal Air Boxes – Single Wall	Galvanized Sheet Metal - Round	+3"	A	1-1/2" thick Type A
Supply Duct from Fan to Terminal Air Boxes	Galvanized Sheet Metal w/Slide-On Flange System or Formed-on Flanges	+3"	A	1-1/2" thick Type A
Supply Duct from Terminal Air Boxes to Outlets	Galvanized Sheet Metal - Rectangular	+2″	A	1-1/2″ thick Type A.
Supply Duct from Terminal Air Boxes to Outlets	Galvanized Sheet Metal - Round	+2″	A	1-1/2″ thick Type A.
Return Duct	Galvanized Sheet Metal	-2"	A	None
Exhaust Duct from Fan to Terminal Air Boxes	Galvanized Sheet Metal	-3″	A	None
Exhaust Duct from Terminal Air Boxes to Outlets	Galvanized Sheet Metal - Rectangular	-2″	A	None
Exhaust Duct from Terminal Air Boxes to Outlets	Galvanized Sheet Metal - Round	-2″	A	None
Outside Air Intake from Louver to ERU/AHU	Galvanized Sheet Metal	-2"	A	2" thick Type B
Mixed/Make-up Air Duct	Galvanized Sheet Metal	-2"	A	2" thick Type B
	Galvanized Sheet Metal	+2"	A	2" thick Type B
Relief Air Louver to Relief Damper	Galvanized Sheet Metal	+2"	A	2" thick Type B
Transfer Ducts	Galvanized Sheet Metal	-1/2"	---	1" thick Type C
Ductwork Accessories (Fabric Flex Connectors, Equipment Flanges, etc.)	---	---	---	1-1/2″ thick Type A
All Terminal Air Box/ Reheat Coil Headers and Duct Mounted Coil Headers	--	--	---	1-1/2″ thick Type A
† Seal Class is per SMACNA HVAC Air Duct Leakage Test Manual				

3.3 DUCTWORK SEALING

A. General Requirements:

1. Openings, such as rotating shafts, shall be sealed with bushings or similar.

2. Pressure sensitive tape shall not be used as the primary sealant unless it has been certified to comply with UL-181A or UL-181B by an independent testing laboratory and the tape is used in accordance with that certification.

3. All connections shall be sealed including, but not limited to, taps, other branch connections, access doors, access panels, and duct connections to equipment. Sealing that would void product listings is not required. Spiral lock seams need not be sealed.

4. Mastic-based duct sealants shall be applied to joints and seams in minimum 3 inch wide by 20 mil thick bands using brush, putty knife, trowel, or spray, unless manufacturer's data sheet specifies other application methods or requirements.

B. For Seal Class A ducts, all transverse joints, longitudinal seams, and duct wall penetrations shall be sealed. Joints are inclusive of, but not limited to, girth joints, branch and sub-branch intersections, duct collar tap-ins, fitting subsections, louver and air terminal connections to ducts, access door and access panel frames and jambs, duct, plenum, and casing abutments to building structures.

3.4 TESTING

A. Duct - 2" WG or Less (positive or negative):

1. Systems shall not leak more than shown in Table 4-1 of SMACNA HVAC Air Duct Leakage Test Manual for Seal Class A.

2. Leak testing of these systems is not normally required for interior ductwork. However, leak tests will be required if, in the opinion of the Architect/Engineer, the leakage appears excessive. All exterior ductwork shall be tested. If duct has outside wrap, testing shall be done before it is applied.

3. Leak test shall be at the Contractor's expense and shall require capping and sealing all openings.

4. Seal ducts to bring the air leakage into compliance.

5. Contractor shall notify the Architect/Engineer five business days prior to pressurizing ductwork for testing.

B. Duct - 3" WG and Above (positive or negative):

1. Duct system shall be completely pressure tested. If duct has outside wrap, testing shall be done before it is applied.

2. Leak test shall be at the Contractor's expense and shall require capping and sealing all openings.

3. Seal ducts to bring the air leakage into compliance.

4. Contractor shall notify the Architect/Engineer five business days prior to pressurizing ductwork for testing.

C. Test procedure shall be as listed in the latest edition of the SMACNA HVAC Duct Leakage Manual, with the following additional requirements:

1. Test pressure shall be the specified duct pressure class. Testing at reduced pressures and converting the results mathematically is not acceptable. This is required to test the structural integrity of the duct system.

2. If any leak causes discernible noise at a distance of 3 feet, that leak shall be eliminated, regardless of whether that section of duct passed the leakage test.

3. All joints shall be felt by hand, and all discernible leaks shall be sealed.

4. Totaling leakage from several tested sections and comparing them to the allowable leakage for the entire system is not acceptable. Each section must pass the test individually.

5. Contractor shall notify the Architect/Engineer five business days prior to pressurizing ductwork for testing. Failure to notify the Architect/Engineer of pressure testing may require the contractor to repeat the duct pressure test after proper notification.

6. Upon completion of the pressure test, the contractor shall submit an air duct leakage test summary report as outlined in the SMACNA HVAC Duct Leakage Test Manual.

7. All access doors, taps to terminal air boxes, and other accessories and penetrations must be installed prior to testing. Including terminal air boxes in the test is not required.

8. The required leakage class for Seal Class A, both round and rectangular ducts, shall be 4.

9. Positive pressure leakage testing is acceptable for negative pressure ductwork.

D. Grease Exhaust Duct:

1. A light test shall be performed by passing a lamp having a power rating of not less than 100 watts through the entire section of ductwork to be tested. The lamp shall be open to emit light equally in all four directions.

2. Testing of the entire exhaust duct system including the hood-to-duct connection shall be performed. Ductwork shall be permitted to be tested in sections provided every joint is tested.

3. Leakage testing shall occur prior to use or concealment of the duct system. Ducts shall be considered concealed where installed in shafts or covered by insulation or wrap that prevents ductwork from being visibly inspected on all sides. The test shall be performed in the presence of the code official.

3.5 DUCTWORK PENETRATIONS

A. All duct penetrations of firewalls shall have fire or fire/smoke dampers where required by code.

B. Dampers shall be compatible with fire rating of wall assembly. Verify actual rating of any wall being penetrated with Architect/Engineer.

C. Seal all duct penetrations of walls that are not fire rated by caulking or packing with fiberglass. Install galvanized steel (unless otherwise indicated) trim strip to cover vacant space and raw construction edges of all rectangular openings in finished rooms.

END OF SECTION

SECTION 23 33 00
DUCTWORK ACCESSORIES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Manual Volume Dampers.
B. Fabric Connectors.
C. Duct Access Doors.
D. Duct Test Holes.

1.2 SUBMITTALS

A. Submit shop drawings under provisions of Section 23 05 00.

B. Submit manufacturer's installation instructions.

PART 2 - PRODUCTS

2.1 MANUAL VOLUME DAMPERS

A. Fabricate in accordance with SMACNA Duct Construction Standards, and as indicated.

B. Fabricate single blade dampers for duct sizes to 9-1/2 x 30 inches.

C. Fabricate multi-blade damper of opposed blade pattern with maximum blade sizes 12" x 72". Assemble center and edge crimped blades in prime coated or galvanized channel frame with suitable hardware.

D. Except in round ductwork 12 inches and smaller, provide end bearings. On multiple blade dampers, provide molded synthetic or oil-impregnated nylon or sintered bronze bearings.

E. Provide locking quadrant regulators on single and multi-blade dampers.

F. On insulated ducts, mount quadrant regulators on stand-off mounting brackets, bases, or adapters.

G. If blades are in open position and extend into the main duct, mount damper so blades are parallel to airflow.

2.2 FABRIC CONNECTORS

A. Fabric connectors shall be installed between all fans or fan units and metal ducts or casings to prevent transfer of fan or motor vibration.

B. The fabric connectors shall be completely flexible material which shall be in folds and not drawn tight.

C. Fabric connectors shall be of glass fabric double coated with neoprene, with UL approval. Weight = 30 oz. per square yard minimum. Fabric shall not be affected by mildew and shall be absolutely waterproof, airtight and resistant to acids, alkalies, grease and gasoline, and shall be noncombustible.

D. Fabric connections shall not exceed 6" in length on ductwork that has a positive pressure. On ductwork that has a negative pressure, the length shall not exceed 2" in length.

E. All corners shall be folded, sealed with mastic and stapled on 1" centers.

F. Fabric connectors shall not be painted.

G. Unless otherwise shown on the drawings, the fabric connection at the inlet to centrifugal fans shall be at least one duct diameter from the fan to prevent inlet turbulence.

H. Acceptable Materials: Durodyne MFN-4-100, Vent Fabrics, Inc. "Ventglas", or Proflex PFC3NGA.

I. Fabric connectors exposed to sunlight and weather shall be as described above, except the coating shall be hypalon in lieu of neoprene.

J. Acceptable Materials: Durodyne "Duralon MFD-4-100", Vent Fabrics, Inc. "Ventlon", or Proflex PFC3HGA.

2.3 DUCT ACCESS DOORS

A. Fabricate per Fig. 7-2 and 7-3 of the SMACNA HVAC Duct Construction Standards and as indicated.

B. Review locations prior to fabrication. Install access doors at fire dampers, smoke dampers, motorized dampers, fan bearings, filters, automatic controls, humidifiers, louvers, duct coils and other equipment requiring service inside the duct.

C. Construction shall be suitable for the pressure class of the duct. Fabricate rigid, airtight, and close-fitting doors of materials identical to adjacent ductwork with sealing gaskets butt or piano hinges, and quick fastening locking devices. For insulated ductwork, install minimum one inch thick insulation with sheet metal cover.

D. Access doors with sheet metal screw fasteners are not acceptable.

E. Minimum size for access doors shall be 24" x16" or full duct size, whichever is less.

F. Provide quantity of access doors such that two hands can fit inside ductwork to manually reset fire dampers. This will typically require one access door on the bottom and one access door on an accessible side of the duct for sizes 12x12 and smaller.

2.4 GREASE DUCT ACCESS DOORS

A. Provide pre-fabricated and pre-insulated duct access doors by the same manufacturer as the fire resistive duct wrap.

2.5 DUCT TEST HOLES

A. Cut or drill temporary test holes in ducts as required. Cap with neat patches, neoprene plugs, threaded plugs, or threaded or twist-on metal caps.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General Installation Requirements:

1. Install accessories in accordance with manufacturer's instructions.

2. Where duct access doors are located above inaccessible ceilings, provide ceiling access doors. Coordinate location with the Architect/Engineer.

3. Coordinate and install access doors provided by others.

4. Provide access doors for all equipment requiring maintenance or adjustment above an inaccessible ceiling. Minimum size shall be 24” x 24”.

5. Grease duct access doors shall be installed per approvals from manufacturer's ICC-ES Evaluation Report.

6. Provide duct test holes where indicated and as required for testing and balancing purposes.

B. Manual Volume Damper:

1. Provide manual volume dampers at points on low pressure supply, return, and exhaust systems where branches are taken from larger ducts where indicated on drawings and as required for air balancing. Use splitter dampers only where indicated.

2. Provide ceiling access doors for manual volume dampers. When manual volume dampers are located above an inaccessible ceiling and an access door cannot be installed, provide a remote controlled volume control device for operation of the damper. Coordinate location with the Architect/Engineer.

3. Grease duct volume dampers shall be continuously welded to duct and/or hoods so that system is liquidtight.

END OF SECTION

SECTION 23 34 23
POWER VENTILATORS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Cabinet Fans
B. Roof Exhaust Fans.
C. Rooftop Fan Curbs.
D. Wall Exhausters.
E. Propeller Fans.
F. Ceiling Fans.

1.2 QUALITY ASSURANCE

A. Performance Ratings: Conform to AMCA 210 and bear AMCA Certified Rating Seal.

B. Sound Ratings: AMCA 301, tested to AMCA 300.

C. Fabrication: Conform to AMCA 99.

1.3 SUBMITTALS

A. Submit shop drawings per Section 23 05 00. Include product data on wall and roof exhausters, and ceiling and cabinet fans.

B. Provide multi-rpm fan curves with specified operating point clearly plotted.

C. Submit manufacturer's installation instructions.

PART 2 - PRODUCTS

2.1 CABINET FANS

A. Housing:

1. Heavy gauge steel reinforced and braced with steel angle framework.
2. Cleaned, phosphatized and painted with enamel or constructed entirely of galvanized steel.
3. Removable access panels for fan removal.
4. Insulate fan section interior with 1" thick, 3/4 lb. density fiberglass.
5. Insulated, corrosion-resistant drain pan under fan sections.
6. Minimum 12" x 18" hinged access doors on both sides of fan housing.

B. Fan:

1. Double width, double inlet, forward curved centrifugal, statically and dynamically balanced.
2. Grease lubricated ball bearings, rated for 200,000 hours L-50 life at design operating conditions.
3. Extend lubrication lines for all bearings to an easily accessible location.

C. Motors and Drives:

1. Motor shall have slide rails, adjusting screws, anchor bolts and bedplates.

2. Open drip-proof motors with grease lubricated bearings, minimum 1/3 HP.

3. Furnish factory mounted and wired disconnect switch, non-fusible type with thermal overload protection.

D. Acceptable Manufacturer: Greenheck, Cook, Aerovent.

2.2 ROOFTOP EXHAUST FAN - VERTICAL DISCHARGE - DIRECT DRIVEN

A. Fan Wheel: Centrifugal type, aluminum hub and wheel with backwards inclined blades, statically and dynamically balanced.

B. Housing: Removable, spun aluminum dome or rectangular top, with square, one piece, aluminum base and curb cap with Venturi inlet cone.

C. Fan Shaft: Turned, ground and polished steel; keyed to wheel hub.

D. Motor mounted outside of air stream and ventilated with outside air. Motor not less than 1/3 HP.

E. Furnish permanently lubricated sealed ball type motor and drive shaft bearings sized for 200,000 hours life at specified operating conditions. Drives sized for 150% of rated motor horsepower. Drive assembly and wheel supported by vibration isolators. Motor shall be ECM type per 23 05 13.

F. Include ventilated curb cap and hinged base with restraining means.

G. All fans serving range hoods shall have extended shrouds to discharge at least 40" above roof and built-in grease trough with drain.

H. Mill aluminum finish.

I. Acceptable Manufacturers: ACME, Greenheck, Penn, Twin City.

2.3 ROOFTOP FAN CURBS

A. Furnish and install prefabricated roof curbs for all rooftop fans.

B. Size curb to match the curb cap of fan.

C. Top of all curbs shall be at least 12" above the top of the roof. Increase curb height to allow for roof insulation.

D. Unitized construction, continuous arc welded corner seams. Insulated with 1-1/2" thick, 3 lb. density rigid fiberglass board. Damper support angle. Pressure treated wood nailer.

E. If called for in the drawings, curbs shall be of the sound attenuation type. Sound attenuation curbs shall reduce the fan sone rating by at least 40% and not decrease fan cfm more than 8% (which is accounted for in the scheduled fan cfm). Baffles shall be removable for access to the dampers.

F. 14-gauge aluminum construction.

G. Curb without cant.

H. Acceptable Manufacturers: Same manufacturer as the fan, Pate, RPS or Thy.

2.4 PROPELLER FANS

A. Direct-driven as scheduled propeller fans consisting of fan blades, hub, housing, orifice ring, motor, drive assembly, and accessories. Motor shall be ECM type per 23 05 13.

B. Galvanized steel sheet, all welded, and integral Venturi orifice ring with baked-enamel finish coat applied after assembly.

C. Formed-steel blades riveted to heavy-gage steel spider bolted to cast-iron hub.

D. Extruded-aluminum blades fastened to cast-aluminum hub; factory set pitch angle of blades.

E. Provide galvanized steel motor-side back guard complying with OSHA specifications, removable for maintenance.

F. Fan Shaft: Turned, ground, and polished steel; keyed to wheel hub.

G. Shaft Bearings: Permanently lubricated, L_{10} of 100,000 hours, permanently sealed, self-aligning ball bearings.

H. Provide with the following accessories:

1. Variable-Speed Controller: Integral Variable frequency drive control to reduce speed from 100 percent to less than 50 percent.

2. Disconnect Switch: Non-fusible type, with thermal-overload protection mounted inside fan housing, factory wired through an internal aluminum conduit.

I. Acceptable Manufacturers: Aerovent, Cook, Greenheck, ACME, Penn, Carnes.

2.5 CEILING FANS

A. The fan shall be designed to move an effective amount of air for cooling and destratification in large industrial applications over an extended life. The fan and components shall be designed specifically for high volume, low speed fans to ensure lower noise operation. The sound levels from the fan operating at maximum speed shall not exceed 55 dBA (measured 20' or 6.1 m below the blades and 20' or 6.1 m horizontally from the center of the fan).

B. The fan shall be direct drive.

C. The fan shall be equipped with a mounting post that provides a structural connection between the fan assembly and upper mounting system. As an option, mounting post may be colored as specified by the architect or owner.

D. The fan mounting system shall be designed for quick and secure installation from a structural support beam. All components in the mounting system shall be of welded construction using low carbon steel no less than 3/16" (0.5 cm) thick and be powder coated for appearance and resistance to corrosion. All mounting bolts shall be SAE Grade 8 or equivalent. As an option, mounting components may be colored as specified by the architect or owner.

E. The fan controller shall be constructed using a Variable Speed Drive (VSD) that is factory programmed to minimize the starting and braking torques, for smooth and efficient operation. Provide wall wiring between VSD and fan as required for installation.

F. The fan shall be equipped with remote wall control. The wall control shall be equipped with touchpad controls and an LED display for controlling the fan's direction, operation and speed. Communication with the fan drive and controller shall be by a standard commercially available CAT-5 (or higher) Ethernet cable that is field installed and provided by the mechanical contractor. Wall controller shall be able to control 4 fans simultaneously.

G. Fan shall include an input from fire alarm dry contacts to shut down fan during a fire alarm event. Input shall be located at the fan.

H. Fan shall also include relay contacts to shut down the fan from the DDC control system. Fan shall return to last speed operation after shutdown from DDC system. Input shall be located at the fan.

I. The manufacturer shall replace any products or components defective in material or workmanship, free of charge to the customer (including transportation charges within the USA), pursuant to the complete terms and conditions of the manufacturer's warranty in accordance to the following schedule:

1. Blades Lifetime (Parts)

2. Hub Lifetime (Parts)

3. Motor 3 years (Parts)

J. Acceptable Manufacturer: MacroAir or BigAss.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Secure roof exhausters with cadmium plated lag screws to roof curb.

C. If manufacturer has no recommendations, secure roof exhaust fans to curbs with 1/4" lag bolts on 8" maximum centers.

D. MC shall install and wire factory provided damper to open when the fan runs if the manufacturer does not provide an option to pre-wire the damper.

END OF SECTION

SECTION 23 36 00
AIR TERMINAL UNITS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Single Duct Variable Air Volume Terminal Box.

1.2 REFERENCES

A. NFPA 70 - National Electric Code.
B. NFPA 90A - Installation of Air-Conditioning and Ventilation Systems.
C. UL 181 - Factory-Made Air Ducts and Connectors.

1.3 SUBMITTALS

A. Submit shop drawings under provisions of Section 23 05 00.

B. Submit shop drawings indicating configuration, general assembly, and materials used in fabrication.

C. Submit product data indicating configuration, general assembly, and materials used in fabrication. Include catalog performance ratings which indicate airflow, static pressure, and NC designation.

D. Include schedules listing discharge and radiated sound power level for each of second through sixth octave bands at inlet static pressures of one to 4 inch WG.

E. Submit manufacturer's installation instructions.

1.4 OPERATION AND MAINTENANCE DATA

A. Submit operation and maintenance data.

B. Include manufacturer's descriptive literature, operating instructions, maintenance and repair data, and parts lists.

C. Include directions for resetting constant volume regulators.

PART 2 - PRODUCTS

2.1 ACOUSTICAL CONSIDERATIONS (THIS APPLIES TO ALL UNITS)

A. All units shall have noise data certified in accordance with AHRI Standard 885-98 with 5/8” 20-lb. density mineral fiber ceiling tile and shall not produce space noise values over NC-35 due to radiated and airborne noise combined.

2.2 SINGLE DUCT VARIABLE AIR VOLUME TERMINAL BOX

A. 18 gauge aluminum housing with internal components of aluminum and stainless steel.

B. Teflon bearings at moving parts and Neoprene seals.

C. Valve configuration for smooth variations in airflow.

D. Pressure independent operation without means of external monitoring devices. Box shall maintain constant volume at all flow rates regardless of changes in upstream or downstream static pressure.

E. Box shall be fully wrapped with elastomeric insulation.

F. Box shall be capable of controlling within 5% accuracy.

G. Unit shall have Belimo actuator.

H. Unit shall fail in last position.

I. Refer to control diagrams and notes on control drawings for complete sequence of control.

J. Acceptable Manufacturers: Accutrol.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Maintain minimum working clear space for all electrical connections in accordance with NFPA 70, National Electrical Code.

C. Provide ceiling access doors or locate units above easily removable ceiling components.

D. Support units individually from structure. Do not support from adjacent ductwork.

E. Where boxes are located adjacent to a wall or joist, the damper motors and control valves shall be located on the side of the box away from the wall or joist to permit easy access.

3.2 ADJUSTING

A. All boxes shall be set to the cfm shown on the drawings. TCC shall be responsible to field recalibrate all boxes that are not set correctly.

END OF SECTION

SECTION 23 37 00
AIR INLETS AND OUTLETS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Commercial Exhaust Range Type 1 Hood
B. Variable Volume Type 1 Exhaust Hood Controller
C. Grilles And Registers.
D. Architectural Square Panel Diffusers.
E. Louvers.
F. Roof Curbs.

1.2 QUALITY ASSURANCE

A. Test and rate performance of air inlets and outlets per ASHRAE 70.

B. Test and rate performance of louvers per AMCA 500L-99.

C. All air handling and distribution equipment mounted outdoors shall be designed to prevent rain intrusion into the airstream when tested at design airflow and with no airflow, using the rain test apparatus described in Section 58 of UL 1995.

1.3 SUBMITTALS

A. Submit product data under provisions of Section 23 05 00.

B. Submit schedule of inlets and outlets indicating type, size, location, application, and noise level.

C. Review requirements of inlets and outlets as to size, finish, and type of mounting prior to submitting product data and schedules of inlets and outlets.

D. Submit manufacturer's installation instructions.

1.4 REGULATORY REQUIREMENTS

A. Conform to ANSI/NFPA 90A.

B. Conform to ASHRAE 90.1.

PART 2 - PRODUCTS

2.1 COMMERCIAL EXHAUST RANGE TYPE 1 HOOD

A. Hood shall be 18 gauge Type 304 stainless steel construction with #3 polished finish. All exterior seams shall be continuously welded, ground, and polished to match hood finish.

B. System should include stainless steel backsplash, sidesplashes, and end panels along with insulation on rear of unit.

C. Hood shall be furnished with UL classified baffle type stainless steel grease filters.

D. Provide UL listed 100 watt incandescent or LED equiavlent vapor-proof lights, pre-wired to junction box mounted on top of hood. Fixture shall have plastic coated glass.

E. Unit shall have NSF label and UL label in accordance with NFPA-96 for Type 1 hood applications.

F. Provide full NFPA wet chemical fire suppression system including storage tank control panel, piping, detectors, nozzles, manual pull station and mechanical gas shutoff valve. Cabinet shall be integrated into the top of the exhaust hood with top access from the front of the hood. Size system to meet the hood dimensions. System controls shall be integrated with controls for fans and lights. Acceptable Manufacturer: Ansul R-102 System.

G. Provide variable exhaust system controller as specified below.

H. Hood manufacturer shall work with mechanical contractor shall submit plans to Department of Safety & Professional Services - State of Wisconsin for Commercial Kitchen Hood review. Hood manufacturer shall provide Professional Engineer stamp with submission.

I. Acceptable Manufacturers: Captive Aire, Halton, Avtec, Gaylord, Incorporated, Econovent.

2.2 VARIABLE VOLUME TYPE 1 EXHAUST HOOD CONTROLLER

A. Operator shall automatically control speed of exhaust fan, and make-up air if applicable, to ensure optimal hood performance.

B. Control system shall include I/O processor, keypad, temperature sensors, optic sensors, cables, and analog output for control of ECM exhaust fan.

C. Keypad shall control exhaust fans and lights associated with hood.

D. Install I/O processor, keypad and electronic motor starters in a cabinet.

E. Install one temperature sensor in each exhaust collar.

F. Install optic sensors to monitor smoke inside the ends of each Type 1 hood with air purge units mounted on top.

G. Factory install controller in hood.

H. Controller shall be warranted for three years from time of purchase.

I. Controller shall be UL and CSA listed.

J. Acceptable Manufacturers: Melink Intelli-Hood Control System or CaptiveAire

2.3 GRILLES AND REGISTERS

A. Reference to a grille means an air supply, exhaust or transfer device without a damper.

B. Reference to a register means an air supply, exhaust or transfer device with a damper.

C. The type of unit, margin, material, finish, etc., shall be as shown on the drawing schedule and suitable for the intended use.

D. All margins shall be compatible with ceiling types specified (including 'Thin-Line' T-bar lay-in grid system). Any discrepancies in contract documents shall be brought to the attention of the Architect/Engineer, in writing, prior to Bid Date. Submission of Bid indicates ceiling and air inlet and outlet types have been coordinated.

E. The capacity and size of the unit shall be as shown on the drawings.

F. All units shall handle the indicated cfm as shown on the drawings while not exceeding an NC level of 25, referenced to 10^{-12} watts with a 10 dB room effect.

G. Refer to the drawings for construction material, color and finish, margin style, deflection, and sizes of grilles and registers.

H. Provide with 3/4" blade spacing. Blades shall have steel friction pivots to allow for blade adjustment, plastic pivots are not acceptable.

I. Corners of steel grilles and registers shall be welded and ground smooth before painting. Aluminum grilles and registers shall have staked corners.

J. Where specified to serve registers, provide opposed blade volume dampers operable from the face of the register.

K. Screw holes for surface fasteners shall be countersunk for a neat appearance. Provide concealed fasteners for installation in lay-in ceilings and as specified on the drawings.

L. Acceptable Manufacturers: Tuttle & Bailey, Titus, Price, Nailor, Carnes, Metalaire, Krueger.

2.4 ARCHITECTURAL SQUARE PANEL DIFFUSERS

A. Reference to a diffuser means an air supply device, ceiling mounted, that shall diffuse air uniformly throughout the conditioned space.

B. The type of unit, margin, material, finish, etc., shall be as shown on the drawing schedule. Flat-oval inlets are not acceptable for connection to flexible ducts.

C. All margins shall be compatible with ceiling types specified (including 'Thin-Line' T-bar lay-in grid system). Any discrepancies in contract documents should be brought to the attention of the Architect/Engineer, in writing, prior to Bid Date. Submission of Bid indicates ceiling and air inlet and outlet types have been coordinated.

D. The capacity and size of the unit shall be as shown on the drawings.

E. All units shall handle the indicated cfm as shown on the drawings while not exceeding an NC level of 25, referenced to 10^{-12} watts with a 10 dB room effect.

F. Diffusers shall be architectural solid square panel and flush with ceiling.

G. The exposed surface shall be smooth, flat and free of visible fasteners. The face panel shall be 22 gauge steel with a rolled edge or shall be 18 gauge with a smooth ground, uniform edge.

H. The back pan shall be one piece 22 gauge stamped and shall include an integral inlet. (Welded inlets and corner joints are not acceptable).

I. Diffusers with a 24x24 back pan shall have a minimum 18x18 face panel size. Diffusers with a 12x12 back pan shall have a minimum 9x9 face panel size.

J. The face panel shall be mechanically fastened to the back panel with steel components. (Plastic fasteners are not acceptable.)

K. Acceptable Manufacturers: Tuttle & Bailey, Titus, Price, Nailor, Carnes, Metalaire, Krueger.

2.5 LOUVERS - FIXED - ALUMINUM

A. Louvers shall be minimum 4" deep and constructed of extruded aluminum. Blade, jamb and sill thickness shall be minimum 0.081". Blades shall be spaced at a maximum of 5.1" apart.

B. Louvers shall be of the drainable blade design with water collected on the leading edge of the blade and diverted to the jamb.

C. Louvers shall be furnished with aluminum bird screen mounted on the outside surface.

D. Size, cfm, finish and pressure drop for louvers shall be as scheduled on the drawings.

E. AMCA Certified performance for 48" x 48" samples with intake airflow of 8,000 cfm shall not exhibit more than 0.19" pressure drop. Maximum water penetration shall be 0.01 ounces per square foot at the scheduled intake velocity based on 15 minute test duration when subjected to a water flow rate of 0.25 gal/min as described under the Water Penetration Test in AMCA 500-L-07.

F. Contractor shall provide the General Contractor with the correct sizes and locations of all louvers required in masonry walls.

G. Louvers shall be sealed around perimeter to avoid moisture penetration between the louver frame and wall.

H. Louvers shall be suitable for duct connection.

I. Acceptable Manufacturers: Air Flow - “EA-403”, Arrow - “EA-415-D", American Warming & Ventilating - “LE-21", Construction Specialties - “A4097", Dowco - “DBE-4", Louvers & Dampers, Inc. - “IL-23", Ruskin - “ELF375DX”, Vent Products - “2760", Greenheck - “ESD-403", Pottorff - “EFD”.

2.6 ROOF CURBS

A. Furnish and install, where shown on the drawings, prefabricated roof curbs for all rooftop hood openings.

B. Curbs shall be sized to match curb cap of the hood. The top of all curbs shall be 12" above the top of the roof.

C. Curbs shall be unitized construction, 14 gauge aluminum, with continuous arc welded corner seams, insulated with 1-1/2" thick, 3 lb. density rigid fiberglass board and damper support angle.

D. Curb without cant – suitable for use with membrane type roof.

E. Acceptable Manufacturers: Same manufacturer as the equipment it serves or Pate, RPS, or Thy.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General Installation Requirements:

1. Install items in accordance with manufacturers' instructions.

2. Install seismic restraints according to SMACNA’s “Kitchen Equipment Fabrication Guidelines, Appendix 1, “Guidelines for Seismic Restraints for Kitchen Equipment".

3. Check location of inlets and outlets and make necessary adjustments in position to conform to architectural features, symmetry, and lighting arrangement.

4. Install diffusers to ductwork with air tight connections.

5. Flexible ducts shall NOT be joined to flat-oval connections. Provide sheet metal oval-to-round transitions where required.

B. Volume Damper:

1. Provide manual volume dampers on duct take-off to diffusers when there are multiple connections to a common duct. Locate volume dampers as far as possible from the air inlet or outlet.

C. Roof Hood and Louvered Penthouse:

1. If manufacturer has no recommendations, secure roof hoods and louvered penthouses to curbs with 1/4" lag bolts on 8" maximum centers.

2. Provide 20 gauge sheet metal duct blank-off behind louvers at unused portions of louver openings in exterior walls. Back with 2" rigid 3# density fiberglass board insulation with foil scrim facing the room. Seal watertight.

END OF SECTION

SECTION 23 40 00
AIR CLEANING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Filters and Filter Media.
B. Activated Carbon Filters.
C. Filter Frames.
D. Filter Gauges.

1.2 QUALITY ASSURANCE

A. Filter media shall be tested under ANSI/UL 900 and labeled.

B. Provide all filters and filter banks by one manufacturer.

1.3 SUBMITTALS

A. Submit shop drawings per Section 23 05 00. Include data on media, performance, assembly and frames.

1.4 EXTRA STOCK

A. Provide clean filters in all units at time of installation.

B. Provide clean filters in all units at project final completion after all interior finishes are complete and as needed for the TAB Contractor to perform their work..

C. Provide one additional set of replacement filters for all units. Deliver to Owner at job site.

PART 2 - PRODUCTS

2.1 MEDIUM EFFICIENCY - DISPOSABLE

A. Non-woven cotton fabric, pleated media, disposable type with welded wire grid support bonded to the filter media.

B. Heavy duty, paper board frame with diagonal support members bonded to inlet and exit sides of each pleat. Bond frame to media periphery to eliminate air bypass.

C. 4" thick media. Maximum initial resistance of 0.26" WG at 500 fpm face velocity.

D. 25-30% efficiency and 90-92% arrestance per ASHRAE 52.1 or MERV 8 per ASHRAE 52.2.

2.2 80% EFFICIENCY - DISPOSABLE

A. Non-woven cotton fabric, pleated media, disposable type with welded wire grid support bonded to the filter media.

B. Heavy duty, paper board frame with diagonal support members bonded to inlet and exit sides of each pleat. Bond frame to media periphery to eliminate air bypass.

C. 4" thick media. Maximum initial resistance of 0.20" WG at 500 fpm face velocity.

D. 80% efficiency and 98% arrestance per ASHRAE 52.1 or MERV 13 per ASHRAE 52.2.

2.3 FILTER GAUGES

A. Differential Pressure Gauge: Diaphragm actuated, nominal 3" round dial, glass filled nylon housing, polycarbonate lens, zero adjustment, 0-2" W.G. range, 5% of full scale accuracy.

B. Accessories: Static pressure tips with integral compression fittings and 1/8" NPT plastic tubing.

C. Acceptable Manufacturers: Dwyer "Minihelic II" 2-5000, Marshalltown Instrument “Series 85C”.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install all products per manufacturers' instructions.

B. Seal filter media to prevent passage of unfiltered air around filters with felt, rubber, or neoprene gaskets.

C. Do not operate fan systems without filters.

D. Install static pressure tips upstream and downstream of filters. Mount filter gauges on outside of filter housing or filter plenum, in accessible position. Adjust and calibrate. Every filter bank, including packaged units, shall have a filter gauge.

E. Install four (4) high efficiency filter test holes. Two upstream and two downstream, at all high efficiency filter banks in air handling units and ductwork (85% efficiency and higher). Coordinate location of test holes with Owner.

END OF SECTION

SECTION 23 52 16
CONDENSING BOILERS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Boilers.
B. Controls and Boiler Trim.
C. Hot Water Connections.
D. Fuel Burning System and Connection.
E. Vent Connection.
F. Boiler Vent Flue.

1.2 QUALITY ASSURANCE

A. Manufacturer: Company specializing in manufacturing the products specified in this Section with at least three years documented experience.

B. Provide factory authorized start-up service by manufacturer's agent.

C. Conform to ANSI/ASME SEC 4 and ANSI/AGA Z21.13 for construction of boilers.

D. Boiler Units: AGA certified, UL listed and ASME certified.

E. Installation shall meet the requirements of ASME CSD-1, including remote emergency shutdown switches for boilers, applicable gas train, individual venting of gas regulators, and repackable shutoff valves at all boilers.

F. Conform to ASHRAE 90.1.

1.3 SUBMITTALS

A. Submit product data under provisions of Section 23 05 00.

B. Submit product data indicating general assembly, components, controls, safety controls, and wiring diagrams, and service connections.

C. Submit manufacturer's installation instructions.

D. Submit reports indicating condition and operation at start-up.

E. Submit reports indicating specified performance and efficiency is met or exceeded.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Protect boilers from damage by leaving factory inspection openings and shipping packaging in place until final installation.

1.5 OPERATION AND MAINTENANCE DATA

A. Submit operation and maintenance data. Include manufacturer's descriptive literature, operating instructions, cleaning procedures, replacement parts list, and maintenance and repair data.

PART 2 - PRODUCTS

2.1 BOILERS

A. Provide factory assembled, factory fire-tested, self-contained unit ready for automatic operation except for connection of water, fuel, electrical, and vent services.

B. Unit: Hot water, condensing type boiler with integral forced draft burner, burner controls, boiler trim, insulation and jacket.

C. ASME allowable working pressure of 125 psig water.

D. Provide two lifting eyes on top of boiler.

E. Unit casing shall be a minimum of 16 gauge steel. Factory paint boiler, base, and other components with hard finish enamel.

F. Porcelain enameled or stainless steel exhaust manifold with gravity drain and reservoir for condensate elimination.

G. Boiler shall be intended for variable flow system.

H. Acceptable Manufacturer: Lochinvar (FTXL) or pre-approved equal.

2.2 HEAT EXCHANGER

A. Condensing, fire tube design surrounded by water that is suitable for return water temperatures as low as 80ºF. Heat exchanger shall be constructed of fully welded 316L stainless steel.

B. Ten-year non-prorated warranty against leakage due to thermal shock or corrosion.

2.3 BOILER FLUE

A. The boiler manufacturer shall furnish all vent flue and intake piping, fittings, dampers, and accessories as required to properly vent the equipment. Vent piping shall be UL listed for use IV appliances with operating temperatures of up to 480°F and shall be stainless steel materials.

2.4 HOT WATER BOILER TRIM

A. Provide ASME safety relief valve set at 50 psi maximum.

B. Provide low water cut-off with manual reset to automatically prevent burner operation whenever boiler water falls below safe level.

C. Provide operating temperature controller to control burner operation to maintain boiler water temperature, as determined by a remote 4-20 mA signal from building DDC system or boiler controller.

D. Limit temperature controller to control burner to prevent boiler water temperature from exceeding safe system water temperature.

E. Provide all trim required to meet ASME CSD-1. This includes, but is not limited to, gas train and all terminals and necessary relays for connection to remote shutdown switch(es) to disconnect all power to the burner controls.

2.5 FUEL BURNING SYSTEM

A. General: Forced draft automatic burner integral with boiler designed to burn natural gas at 8.5" to 14” W.C. inlet pressure. Maintain fuel-air ratios automatically.

B. Gas Burner: Forced draft, power burner with interrupted spark ignition and flame sensor.

C. Include on unit complete gas train including gas safety shutoff valve conforming to CSD-1 requirements. Vent all gas valves to outdoors separately.

D. Burner to be modulating with a minimum turndown ratio of 10:1.

2.6 CONTROL PANEL

A. The boiler system control panel shall include contacts for a trouble alarm to the DDC system. System shall include analog input from DDC system for boiler temperature setpoint control and digital input for boiler enable/disable.

B. The boiler system control panel shall include gateway device for BACnet Communications. Coordinate final connections with temperature control contractor.

C. The boiler control system shall modulate burner as required to maintain heating water temperature setpoint.

D. The boiler manufacturer shall supply boiler isolation valve for each boiler. Boiler control panel shall open isolation valve when boiler is operating. At no time shall all isolation valves on the boilers be closed.

E. Program relay to control ignition, starting and stopping of burner and provide both pre-combustion purge and post combustion purge. Burner to shut down in event of ignition, or main flame failure. Interlock to shut down burner upon combustion air pressure drop.

F. Manual-automatic selector switch to permit automatic firing in accordance with load demand, or manual control of firing rate at fixed temperature.

G. Panel to include indicating lights to show fault conditions of low water level, flame failure, fuel pressure, exhaust temperature, water temperature, or combustion air pressure. Mount indicating lights and switches in hinged drop-panel for access to wiring.

H. The boiler system control panel shall include contacts for a manual CSD-1 emergency shutdown switch. The switch shall be furnished, installed, and wired by the Electrical Contractor. Switch shall be located at each exit just outside the boiler room door or as shown on plans. If boiler room door is on exterior of building, the switch shall be located just inside the door or as shown on plans. Verify final location with Architect/Engineer. The switch shall disable all boilers and shall be wired to the boiler burner safety control circuit to interrupt burner operation. If electrical plans and specifications do not show switch and wiring, the Mechanical Contractor shall furnish, install, and wire.

I. Mechanical Contractor shall provide shutdown switch and associated wiring. The boiler shutdown switch shall be an emergency stop, mushroom head with N.C. contact, turn to release switch with engraved nameplate to read “BOILER EMERGENCY SHUTOFF”. Square D XAL K174 or as approved by Architect/Engineer.

2.7 PERFORMANCE

A. Minimum efficiency, verified by factory tests, shall be 91% at 100% output with 110°F return water and 96% at 25% output with 90°F return water.

B. Rated for return temperatures as low as 40°F and supply temperatures as high as 190°F.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General Requirements:

1. Install in accordance with manufacturer's instructions.
2. Provide for connection to electrical service.
3. Provide connection of gas service in accordance with ANSI/AGA Z223.1.
4. Pipe safety relief valve and condensate trap to nearest floor drain. Route condensate pipe to acid resistant floor drain.
5. Install circulation pump as recommended by the manufacturer.

B. Combustion Inlet and Venting:

1. Provide complete sealed combustion inlet and venting system.
2. Slope all horizontal runs of exhaust vent towards the boilers at a slope of 1" per 4'.

C. Service Clearance:

1. Install the boilers with a minimum of three feet clear space behind them for installation of piping and services. Verify exact maintenance clearances required by the manufacturer prior to installation.

3.2 MANUFACTURER'S FIELD SERVICES

A. Prepare and start systems under factory authorized supervision.

B. Provide field representative for starting unit and training operator.

C. Provide combustion test and submit report. Test shall include boiler firing rate, overfire draft, gas flow rate, heat input, burner manifold gas pressure, percent carbon monoxide (CO), percent oxygen (O_2), percent excess air, flue gas temperature at outlet, ambient temperature, net stack temperature, percent combustion efficiency, and heat output.

END OF SECTION

SECTION 23 57 33
GEOTHERMAL HEAT EXCHANGERS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Vertical Bore Type Ground Loop Geothermal Heat Exchanger.

1.2 QUALITY ASSURANCE

A. The Contractor must have on this project a certified IGSHPA installer. The Contractor performing this work must have a minimum of three years experience in performing underground closed circuit, earth coupled, vertical heat exchanger, including systems of 100 tons or larger.

B. Geothermal Heat Exchanger Fabricators must be heat fusion certified by an authorized high density polyethylene (HDPE) pipe manufacturer's representative of the brand of pipe used. Certification must include successful completion of a written heat fusion exam, as well as demonstrating proper heat fusion techniques under the direct supervision of the authorized HDPE pipe manufacturer's representative.

C. Certified technicians must attend a retraining school annually. A single failure of a fusion joint will void the certification, and the technician must be retested to demonstrate satisfactory performance.

D. Local, State, and Federal laws and ordinances, as they pertain to buried pipe systems, shall be strictly followed or a variance obtained. Installation shall follow the recommendations of the National Ground Water Association.

E. Procure and pay for all applicable permits and licenses.

F. Verify that survey benchmark and intended elevation of grade at well field prior to beginning work.

G. Grouting compound shall be certified and listed by NSF (National Sanitation Foundation International) to ANSI/NSF Standard 60, "*Drinking Water Treatment Chemicals - Health Effects*".

H. Drilling contractor shall be a licensed water well driller in the State of Wisconsin.

1.3 REFERENCES

A. ASTM D2610 – Solid Wall HDPE Conduit Based On Controlled Outside Diameter.

B. ASTM D2683 – Socket Fusion Fittings.

C. ASTM D3261 – Butt/Saddle Fusion Fittings.

D. ASTM D3350-93 – Polyethylene Plastic Pipe and Fittings.

E. International Ground Source Heat Pump Association (IGSHPA).

1.4 SHOP DRAWINGS

A. Submit shop drawings per Section 23 05 00.

B. Before geothermal heat exchanger construction begins, the Contractor must submit shop drawings to the Design Architect/Engineer. The shop drawings shall include all applicable manufacturer's material specifications, warranties, installer qualifications, material safety data sheets for all materials used in the geothermal installation, all polyethylene piping and fitting materials, U-bend assemblies, and testing and flushing procedure.

C. Submit detailed 1"=20' scale CAD drawing showing bore field layout, including site utilities and obstructions. Drawing shall include all horizontal pipe routing.

D. Submit all underground piping pressure test results.

1.5 DESCRIPTION OF WORK

A. This design has been prepared in accordance with the materials standards and accepted installation practices of the International Ground Source Heat Pump Association (IGSHPA). The Geothermal Contractor shall comply with these standards and practices along with all state and local regulations pertaining to the installation.

B. The Geothermal Contractor is responsible for all aspects involved with the complete geothermal loop field installation. All materials, drilling, excavation, hauling of backfill, pumping, soil compaction, utilities (including but not limited to water, electricity and fuel), and labor required shall be included in the bid price.

C. The Geothermal Contractor shall verify exact locations of utilities in the loop field. Some areas may require hand digging to locate utilities. The Geothermal Contractor must include in the bid price the repair of any sewer, domestic water, electrical, communication or any service line that may be damaged during the construction of this project. Any offsets required to route over or under existing lines shall also be included in the bid price of the project.

D. Refer to drawings for description of test bore drilling log results.

1.6 WARRANTY

A. Provide five (5) year warranty covering the entire installation for materials and workmanship. Warranty shall cover leaks and settlement due to improper backfilling or compaction.

1.7 UNIT PRICE

A. Contractor shall submit as part of his/her bid a unit price per well for additional wells (up to 10%) authorized by the Owner.

B. Contractor's Base Bid shall be based on the number and depth of wells described on the drawings.

1.8 DESIGN

A. A test bore and thermal conductivity test was performed at this site in Month/Year. A copy of the test report is available by request from the Owner.

1.9 PROTECTION

A. Protect trees, shrubs, lawns, rock outcropping, and other features remaining as a portion of final landscaping. Place excavated material from trench on hard surface area, heavy mil sheet plastic or sheet vinyl to minimize damage to grassed areas.

B. Protect benchmarks, existing structures, fences, sidewalks, paving, and curbs from equipment and vehicular traffic.

C. Protect above and below grade utilities that are to remain.

D. Protect excavations by shoring, bracing, sheet piling, underpinning, or other methods required to prevent cave-in or loose soil from falling into excavation.

E. Notify Architect/Engineer of unexpected subsurface conditions.

F. Protect bottom of excavations and soil adjacent to and beneath foundations from freezing.

G. Refer to Section 23 05 00 for other requirements.

PART 2 - PRODUCTS

2.1 PIPE

A. The pipe shall be PE4710 HDPE with a minimum cell classification of 345464C per ASTM D3350-93 and a DR11 (200 psig) rating for u-bends and header pipe two inches and smaller and a minimum of DR15.5 (139 psig) for header pipe greater than two inch in diameter. This pipe will carry a warranty of no less than 50 years. Submit written warranty on piping.

B. Each pipe shall be durably marked with the manufacturer's name, nominal size, pressure rating, relevant ASTM standards, cell classification number and date of manufacture.

C. All piping used for the U-bend heat exchanger (pipe located in borehole) will have factory hot-stamped lengths impressed on the side of the piping indicating the length of the heat exchanger at that point. The length stamp shall read zero on one end and the actual heat exchanger total length on the other end.

D. The vertical heat exchanger will have a factory fused one-piece U-bend with pipe lengths long enough to reach grade from the bottom of the bore. U-bends fabricated from two elbows are not permitted.

E. Approved pipe manufacturers are Chevron Phillips Driscoplex 5300, Vanguard, Plexco, Centennial Plastics.

2.2 FITTINGS

A. Pipe fittings shall meet the requirements of ASTM D2683 (for socket fusion fittings) or ASTM D3261 (for butt/saddle fusion fittings). Each fitting shall be identified with the manufacturer's name, nominal size, pressure rating, relevant ASTM standards, and date of manufacturer.

2.3 BENTONITE GROUT (THERMALLY ENHANCED)

A. Material: Thermally enhanced bentonite grout shall be used to seal and backfill each vertical u-bend well bore of the closed-loop ground heat exchanger to ensure proper thermal contact with the earth and to ensure the environmental integrity of each vertical bore column. The grouting material shall remain in a plastic state (moldable) throughout the life of the system and shall not generate heat during the hydration process. No other backfill material shall be accepted.

B. Thermal Conductivity: The thermal conductivity of the grouting compound must be 1.0 Btu/hr-ft-°F or greater.

C. Permeability: The grout mixture shall also have a maximum permeability rate of less than 6.9 x 10-8 cm/s as determined by using the "Falling-Head Method" (defined in the United States Army Corp of Engineers' Civil Engineering Manual No. EM 1110-2-1906, *"Laboratory Soils Testing"*) as recommended by the U.S. Environmental Protection Agency to ensure proper sealing. Permeability shall be verified by an independent lab, with a copy of the report being supplied upon request from the Architect/Engineer.

D. Packaging: Grouting materials shall be pre-manufactured and packaged prior to delivery to the site. If the grouting material supplier does not supply sand additive, Contractor shall obtain pre-approval from the Architect/Engineer prior to site use as a thermal enhancement additive.

E. Product: Grouting material shall be Black Hills Bentonite's Thermal Grout Select as supplied by GeoPro, Inc., Barotherm Gold by Baroid Industrial Drilling Products, or Cetco High TC Geothermal Grout.

2.4 WARNING TAPE

A. Provide warning tape above underground piping per the requirements of Section 23 05 53.

2.5 LOCATING WIRE

A. Provide locating wire around perimeter of borefield and supply and return piping to building.

2.6 FIELD LOCATION

A. Bore locations shall be confined to the area designated on the accompanying drawings. Bore locations to be individually surveyed after drilling is complete, but before horizontal trenching is done.

B. Permanent corner markers shall be provided at the four corners of the bore field. Place 18-inch square concrete paving stone flush with grade at each corner.

C. Provide detailed GPS coordinates of each corner.

D. Final bore locations are to be surveyed and GPS located.

PART 3 - EXECUTION

3.1 PREPARATION

A. Identify required lines, levels, contours, and datum.

B. Identify known underground, above ground, and aerial utilities. Stake and flag locations.

C. Notify the Owner and coordinate the removal and relocation of utilities. At the Owner's direction, the Contractor shall notify utility company to remove and relocate utilities.

3.2 DRILLING

A. The vertical boreholes will be drilled to a depth allowing complete insertion of the vertical heat exchanger to its specified depth. The maximum borehole diameter will be six inches. If a larger diameter is required, prior approval must be granted by the Design Architect/Engineer.

B. Refer to drilling log or obtain subsurface conditions from another source.

3.3 U-BEND HEAT EXCHANGER ASSEMBLY

A. The U-bend heat exchanger pipe shall be air fill pressurized to 100 psig to check for leaks before insertion. If necessary, an iron (sinker) bar can be attached at the base of each vertical heat exchanger u-bend to overcome buoyancy. This iron bar will have all sharp edges adequately taped to avoid scarring and/or cutting of the HDPE pipe. No driving rod that is pulled out after U-bend insertion will be allowed. The entire assembly shall be inserted to the specified depth in the borehole.

3.4 GROUTING PROCEDURES

A. The U-bend heat exchanger shall be pressure grouted from the bottom up to the ground surface in a continuous fashion using a one inch HDPE tremie pipe. The tremie pipe will be pulled out during the grouting procedure, maintaining the pipe's end just below grout level within the borehole. All state regulations will be met for borehole grouting of a vertical heat exchanger.

B. Slurry mixture and grouting process shall conform to "Grouting Procedures: As published by IGSHPA 1991."

C. All bore holes shall be grouted immediately after loop pipe installation. Bore hole grouting shall be monitored, and all grout quantities consumed shall be documented. Drill cuttings/chips shall not be used as grout or bore hole fill material. All voids, fractures, or highly permeable formations shall be noted on the well log, along with means used to stop grout loss/subsidence.

3.5 HEAT FUSION PIPE JOINING

A. All underground pipe joining shall be heat fused by socket, butt, or saddle (sidewall) fusion in accordance to ASTM D2610, ASTM D2683, and the manufacturer's heat fusion specifications. The operator shall be heat fusion certified and experienced in executing quality fusion joints.

3.6 EXCAVATION AND BACKFILLING FOR PIPING

A. General Requirements:

1. The Contractor shall do all excavating, backfilling, shoring, bailing, and pumping for the installation of their work and will perform necessary grading to prevent surface water from flowing into trenches or other excavations. Sewer lines shall not be used for draining trenches, and the end of all pipe and conduit shall be kept sealed and lines left clean and unobstructed during construction. Only material suitable for backfilling shall be piled a sufficient distance from banks of trenches to avoid overloading. Unsuitable backfill material shall be removed as directed by the Design Architect/Engineer.

2. Sheathing and shoring shall be done as necessary for protection of work and personnel safety. Unless otherwise indicated, excavation shall be open cut except for short sections. The Contractor shall install geothermal marking (warning) tape 18 inches above all horizontal/header piping.

3. Prior to drilling or trenching, the Contractor shall be responsible for reviewing the location of underground utilities with the Owner’s representative. Contractor shall arrange for utility marking. Existing utility lines uncovered during excavation shall be protected from damage during excavation and backfilling.

4. Stockpile and protect excavated material in area designated on site. Remove clean excess material not being reused to location on site designated by Owner. Remove from site excess excavated material not determined to be clean. Legally dispose of excess excavated material.

B. Excavation Requirements:

1. Underpin adjacent structures that will be damaged by excavation work, including utilities and pipe chases.

2. Excavate subsoil required to accommodate site structures, construction operations, and other work.

3. Machine slope banks to angle of repose or less, until shored.

4. Excavation cut not to interfere with normal 45 degree bearing splay of foundation, except where excavation support system is used.

5. Grade top perimeter of excavation to prevent surface water from draining into excavation.

6. Hand trim excavation. Remove loose matter.

7. Compaction should be 85% or higher.

8. Notify Architect/Engineer immediately of unexpected subsurface conditions.

3.7 PIPE INSTALLATION

A. The U-bend ends shall be sealed with fusion caps prior to insertion into the borehole. Reasonable care shall be taken to ensure the geothermal loop field pipe is not crushed, kinked, or cut. Should any pipe be damaged, the damaged section shall be cut out and the pipe reconnected by heat fusion.

B. The U-bend heat exchanger must be connected as indicated on the plans. The header design accounts for balanced flow, as well as flushing and purging flow rates. No variations can be made in the circuit hookup or the pipe sizes indicated. The minimum bend radius for each pipe size shall be 25 times the nominal pipe diameter or the pipe manufacturer's recommendations, whichever is greater. The depth of all headers and supply and return piping is indicated on the plans or must be maintained below the frost line.

C. Circuits shall be pressure tested before any backfilling of the header trenches is executed. The individual circuits shall be pressure tested with water at 100 psig; however, not to exceed 150% of SDR 11 pipe working pressure at bottom of vertical U-bend heat exchanger.

3.8 TESTING AND CLEANING

A. General Requirements:

1. During installation, all trash, soil, small animals, and other organic material shall be kept out of the pipe. Ends of the HDPE pipe shall be sealed until the pipe is joined to the circuits.

2. The Contractor shall be responsible for correcting any problems and/or paying for any damage caused by any debris left in the lines, after the flushing procedure has been completed, that enter the building and plug strainers or otherwise negatively impact the performance of the building systems.

B. Flushing and Purging:

1. Before backfilling the trenches, all systems shall be flushed and purged of air and flow tested to ensure all portions of the closed-loop ground heat exchanger are properly flowing. A portable temporary purging unit shall be used.

2. Each supply and return circuit shall be flushed and purged with a minimum water velocity of four feet per second. Flush until clean, including removal of all cuttings, shavings, mud, sand, and debris. The lines shall be left filled with clean water and then pressure tested. If connection to the manifold is not immediate, piping must be capped.

3. Utilizing the purging unit, conduct a pressure and flow test on the ground heat exchanger to ensure the system is free of blockage. If the flow test indicates blockage, locate blockage using manufacturer’s recommendation, remove blockage, then re-purge and conduct the pressure and flow test again until all portions of the system are flowing properly.

C. Hydrostatic Testing:

1. Fill and pressure test each piping circuit to 100 psig for four hours prior to the backfilling of the trenches.

2. Each joint shall be visually and physically inspected, using industry standards, for cold joints. Any joints failing the test shall be completely removed from the system and a new joint or fitting installed, with the test being repeated.

3. Correction of any piping leaks will be the responsibility of the Contractor who installed the piping. A second leak test will be required.

4. Before final connection of the plastic piping lines to the building system main supply and return loops, each circuit shall be flushed thoroughly and left filled with clean water.

D. Grout Testing:

1. The contractor, when directed by the owner or engineer, will take up to three (3) grout samples. Sampling will be spread apart (approximately first bore, sometime during first 1/3 and sometime during middle 1/3)). Contractor will pay for sampling costs, including shipping.

2. Grout samples will be mailed within 24 hours of being taken.

3. Results from grout samples will be provided within 24 hours of being received.

E. During piping installation, the Architect/Engineer has the option to test the depth of two holes at random. If the length is as specified, the piping may be tested and covered. If shorter than the length specified, the heat exchanger field or the individual heat exchanger must be increased as specified. In addition, all heat exchanger holes must be uncovered and have their lengths verified and vertical and horizontal tolerances verified. At the Owner Representative's option, the heat exchanger field will be required to be increased to the specified lengths or replaced.

END OF SECTION

SECTION 23 73 13
MODULAR AIR HANDLING UNITS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Modular Indoor Air Handling Units.

1.2 QUALITY ASSURANCE

A. AHU Unit: Manufacturer specializing in design and manufacturing of the products specified in this section with a minimum of five years' experience.

B. Fabrication: Conform to AMCA 99 and AHRI 430.

C. Fan Performance Ratings: Conform to AMCA 210 and bear AMCA Certified Rating Seal.

D. Sound Ratings: Tested to AMCA 300.

E. Air Coils: Certify capacities, pressure drops, and selection procedures per AHRI 410.

F. Electrical control wiring shall be in accordance with NEC codes and ETL requirements.

G. Unit shall contain only UL listed components.

H. Conform to ASHRAE 90.1.

I. All air handling and distribution equipment mounted outdoors shall be designed to prevent rain intrusion into the airstream when tested at design airflow and with no airflow, using the rain test apparatus described in Section 58 of UL 1995.

1.3 SUBMITTALS

A. Submit shop drawings per Section 23 05 00. Indicate ratings, fan performance, motor electrical characteristics, gauges, material finishes, assembly, unit dimensions, weight loading, required clearances, construction details, and field connection details.

1. Product Data

a. Provide fan curves with specified operating point clearly plotted. Select fans using external static pressure noted in the schedule. Manufacturer responsible for calculation of internal static pressure. Manufacturer shall include an allowance for clean filters in the internal static pressure. An allowance for the difference between dirty filters and clean filters is included in the external static. Submit static pressure calculations showing total pressure drops, including tabulated internal pressure drops and specified external static pressure drops

b. Submit sound power level data for both fan outlet and casing radiation at rated capacity.

c. Submit shop drawings indicating coil and frame configurations, dimensions, materials, rows, connections, and rough-in dimensions

d. Submit manufacturer's data showing that coil capacities, pressure drops, and selection procedures meet or exceed specified requirements.

e. Provide a copy of data of filter media, filter performance data, filter assembly, and filter frames with unit submittal for reference only.

B. Submit manufacturer's installation instructions.

C. All base bid pricing shall be based on the drawings, schedules and this specification

1. If a manufacturer requests to deviate from the requirements described herein, the Manufacturer and/or Contractor may list voluntary add or deduct prices on the bid form. These voluntary prices will not be used in determining the low bidder.

2. All voluntary adds or deducts shall be discussed and agreed to by the Owner and Architect/Engineer prior to the award of the air handling unit bid and before the submittal process begins.

D. Any exceptions to the specifications must be clearly noted to the Architect/Engineer prior to acceptance. Contractor is responsible for all expenses due to exceptions.

E. Submit operation and maintenance data. Include instructions for lubrication, filter replacement, motor and drive replacement, and spare parts lists.

1.4 EXTRA STOCK

A. Provide clean filters in all units at time of installation.

B. Provide clean filters in all units at project final completion after all interior finishes are complete.

C. Provide one additional set of replacement filters for all units. Deliver to Owner at job site.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site with protective coverings in-place. Loose shipped items must be in factory-provided protective coverings, with factory-installed shipping skids and lifting lugs.

B. Store unit in clean dry place and protect from weather and construction traffic. Handle carefully to avoid damage to components, enclosures, and finish.

1.6 WARRANTY

A. Provide a manufacturer’s 1-year parts and labor warranty against defects in material and workmanship.

1.7 GENERAL DESCRIPTION

A. Unit Location:

1. The unit will be set on a concrete housekeeping pad by the Contractor.

B. Unit Description:

1. The unit shall contain all the components described in these specifications and shown on the drawings and schedules.

2. Refer to air handling unit drawings and schedules for additional information

PART 2 - PRODUCTS

2.1 MODULAR INDOOR AIR HANDLING UNITS

A. Acceptable Manufacturers

1. Daikin
2. Carrier
3. Johnson Controls
4. Ventrol – ITF Indoor Unit

B. Housing:

1. WALL/ROOF CONSTRUCTION

a. Construct walls and roof from 2" thick double wall panel assemblies. Panels shall be injected with polyurethane foam insulation and shall have a minimum thermal conductivity (R) of at least 12.5. The outer shell shall be constructed of solid G90 galvanized steel with baked enamel or mill galvanized finish or G40 galvanized steel with gardobond finish. The inner liner shall be constructed of solid G90 galvanized steel or G40 galvanized steel with gardobond finish. Panels shall be gasketed with permanently applied bulb-type gaskets and able to be removed without affecting the integrity of casing structure.

b. Under 55°F supply air temperature and design conditions on the exterior of the unit of 91°F dry bulb and 74°F wet bulb, condensation shall not form on the casing exterior. The AHU manufacturer shall provide tested casing thermal performance for the scheduled supply air temperature plotted on a psychrometric chart. The design condition on the exterior of the unit shall also be plotted on the chart. If tested casing thermal data is not available, AHU manufacturer shall provide, in writing, a guarantee against condensation forming on the unit exterior at the stated design conditions above. The guarantee shall note that the AHU manufacturer will cover all expenses associated with modifying or replacing units should external condensate form on them.

c. Wall/Roof panel deflection shall not exceed L/240 ratio at a maximum +/- 5 inches of static pressure. Deflection shall be measured at the midpoint of the panel.

2. FLOOR CONSTRUCTION

a. Construct floors from 2" thick double wall panel assemblies. Panels shall be injected with polyurethane foam insulation and shall have a minimum thermal conductivity (R) of at least 12.5. The outer shell shall be constructed of solid G90 galvanized steel with baked enamel or mill galvanized finish or G40 galvanized steel with gardobond finish. The inner liner shall be constructed of solid G90 galvanized steel or G40 galvanized steel with gardobond finish. Panels shall be gasketed with permanently applied bulb-type gaskets.

b. Under 55°F supply air temperature and design conditions on the exterior of the unit of 91°F dry bulb and 74°F wet bulb, condensation shall not form on the casing exterior. The AHU manufacturer shall provide tested casing thermal performance for the scheduled supply air temperature plotted on a psychrometric chart. The design condition on the exterior of the unit shall also be plotted on the chart. If tested casing thermal data is not available, AHU manufacturer shall provide, in writing, a guarantee against condensation forming on the unit exterior at the stated design conditions above. The guarantee shall note that the AHU manufacturer will cover all expenses associated with modifying or replacing units should external condensate form on them.

c. Floor panel deflection shall not exceed L/240 ratio based upon a 300 lb concentrated load at the mid-span of the panel.

3. A full perimeter base rail shall be installed at each air handling unit. The base rail shall be constructed from a minimum of 16 gauge G90 galvanized steel and shall be at least 6" high. Panels shall be able to be removed without affecting the integrity of casing structure.

4. Install a stainless steel drain pan under each cooling coil meeting requirements as outlined in ASHRAE 62.1. Extend drain pans the entire width of each coil, including piping and header if in the air stream, and from the upstream face of each coil to a distance 1/2 of the vertical coil height downstream from the downstream face. Pitch drain pans in two directions towards the outlet, with a slope of at least 1/8" per foot.

5. Provide internal wiring for the installation of the lights and power for the lights and receptacles should be provided to a single point inlet power connection.

C. Doors:

1. Unit doors shall be double wall and insulated with the same materials used in the surrounding unit walls.

2. Doors shall contain a continuous neoprene bulb type gasket.

3. Each door shall contain a double pane tempered, reinforced or safety glass window.

4. Each door shall have a minimum of two (2) high compression type latches, operable from both sides.

5. Provide minimum 12" x 18" hinged access doors on both sides of the fan housing.

D. Access Sections:

1. Provide access sections as shown on the drawings between unit sections. Provide access doors as shown on plans.

E. Fan:

1. Double width, double inlet, airfoil centrifugal.

2. Fan RPM shall not exceed 110% of scheduled value with the scheduled wheel type. Substitution of BI or BIA fans for FC is acceptable if efficiency is not lower.

3. Statically and dynamically balanced.

4. Grease lubricated ball bearings, selected for 200,000 hours L-50 life at the design operating conditions.

5. Provide extended lubrication lines for all bearings to an easily accessible location.

6. Factory balanced fans will be used with variable speed controls to operate at all speeds up to the design speed.

7. Fan(s) shall have internal spring isolators.

F. Motors and Drives:

1. Motors shall have slide rails, adjusting screws, anchor bolts and bedplates.

2. Motor mounting bracket shall be adjustable to allow tightening of belts.

3. Motors shall be TEFC type with grease lubricated bearings.

4. Motors shall be "variable frequency drive rated" when controlled by VFDs. Refer to Section 23 05 13.

5. No equipment shall be selected or operate above 90% of its motor nameplate rating.

G. Enthalpy Wheel:

1. Refer to specification section 23 72 00 for requirements.

H. Coils

1. Glycol Water Coils:

a. Extended surface type with seamless copper tubes and continuous plate type aluminum fins.

b. Suitable for continuous operation at 200 psi. Maximum air velocity of 1000 fpm.

c. Galvanized steel casing. Coil headers and U-bends shall not be exposed.

d. AHRI rated with 0.0005 fouling factor.

e. Size coils sized based on EWT, EAT, gpmand cfm as scheduled. LAT shall be at least as high as scheduled. APD and WPD shall not exceed scheduled values.

f. Maximum 144 fins per foot.

g. Coils shall have drain and vent connections at supply and return headers with valves. Extend valving outside of the unit casing.

h. Install coils level to allow drainage.

i. Minimum 0.024" tube wall thickness.

j. Acceptable Manufacturers: Trane, York, Carrier, Marlo, Daikin/McQuay, Heatcraft, or American Air Filter.

2. Direct Expansion Coils:

a. Extended surface type with seamless copper tubes and continuous plate type aluminum fins.

b. Galvanized steel casing.

c. Suitable for 250 psig. Maximum air velocity of 500 fpm.

d. AHRI rated for direct expansion use with R-22.

e. Size coils based on saturated suction temperature, EAT and cfm scheduled. The leaving DB and APD shall not exceed the scheduled values.

f. Maximum 144 fins per foot. No water carryover shall occur at design airflow and no anti-carryover coating shall be used.

g. All coils shall be split row or intertwined configuration.

h. Minimum 0.016" tube wall thickness.

i. Acceptable Manufacturers: Trane, York, Heatcraft, or Daikin/McQuay.

I. Mixing and Filter Section

1. Provide an angle filter section for 4" thick filters. Maximum filter velocity shall not exceed specified value. Provide full size hinged access doors.

2. Reference Section 23 40 00 for filter requirements.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General Installation Requirements

1. Install per manufacturer's instructions.

2. During construction provide temporary closures of metal or taped polyethylene over openings into housing ducts to prevent dust from entering ductwork.

3. Seal all contractor installed penetrations airtight. Seal all openings prior to cleaning. Seal holes with proper SMACNA closures conforming to pressure class of the housing.

4. Do not operate units for any purpose, temporary or permanent, until ductwork is clean, filters are in place, bearings lubricated, and fan has been test run under observation.

B. Coil Requirements:

1. Comb all coils to repair bent fins.

2. Extend coil drain and vent connections to outside unit housing. Provide normally closed valve on drain and vent connection outside of unit housing.

END OF SECTION

SECTION 23 74 23.13
GAS FIRED MAKE-UP AIR UNITS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Direct Fired Make-Up Air Unit.

1.2 QUALITY ASSURANCE

A. Comply with applicable regulations and have local Gas Company approval.

B. Factory test to check construction, controls, and operation of unit and provide certification.

C. Test operation after installation.

D. Provide with complete one (1) year warranty. Warranty period begins at date of initial startup.

E. Conform to ASHRAE 90.1.

F. All air handling and distribution equipment mounted outdoors shall be designed to prevent rain intrusion into the airstream when tested at design airflow and with no airflow, using the rain test apparatus described in Section 58 of UL 1995.

1.3 SUBMITTALS

A. Submit shop drawings per Section 23 05 00 showing dimensions, connections, arrangement, accessories, electrical service and duct connections, and controls.

B. Submit manufacturer's installation instructions.

C. Submit operation and maintenance data including manufacturer's descriptive literature, maintenance and repair data, and parts listing.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Protect units from physical damage by storing off-site until ready for installation.

PART 2 - PRODUCTS

2.1 DIRECT FIRED MAKE-UP AIR UNIT

A. Acceptable Manufacturers:

1. Greenheck.
2. Modine

B. Manufactured Units:

1. Self-contained direct-fired make-up air unit with burner, inlet damper, gas controls, unit controls, and all accessories noted or required for complete installation.

2. Units shall bear a UL, ETL or AGA label indicating that the units have been tested and comply with Standard ANSI Z83.4.

3. Suspended mounted inside building.

4. Unit to consist of direct-fired gas burner, unit cabinet and frame, direct drive supply fan, and all unit and burner safety and control devices.

5. Controls shall include terminal connections for setpoint adjustment and system enable/disable.

6. Furnish non-fused disconnect switch, short circuit protection of all internal electrical components, and all necessary motor starters, contactors, and over-current protection.

C. Fabrication:

1. Construct heater casing and components of 18 gauge steel panels, reinforced with angles and channels for rigidity. Provide access panels to burner and blower motor assemblies.

2. Locate port on burner section for observing main and pilot flames.

3. Insulate indoor units up to burner section with 1" thick neoprene faced glass fiber insulation.

4. Finish casing and components with heat resistant baked enamel.

D. Filters:

1. Provide filter section complete with removable 4" thick MERV 13 pleated filter. Refer to 23 40 00 for requirements.

E. Burner:

1. Provide natural gas burner with modulating turndown ratio of 30:1. Adjustable profile plate, stainless steel baffles, cast aluminum burner tube.

2. Gas Burner: Forced draft type burner with adjustable combustion air supply, pressure regulator, gas valves, manual shutoff, intermittent spark, flame sensing device, and automatic 100 percent shutoff pilot.

3. Gas Burner Safety Controls: Energize ignition, limit time for establishment of flame, prevent opening of gas valve until pilot flame is proven, stop gas flow on ignition failure, energize blower motor, and after airflow proven and slight delay, allow gas valve to open.

4. High Limit Control: Temperature sensor with fixed stop at maximum permissible setting, de-energize burner on excessive bonnet temperature and energize burner when temperature drops to lower safe value.

F. Fan:

1. Provide statically and dynamically balanced direct drive centrifugal fan. Extend any grease lines to access doors.

G. Unit Controls:

1. Pre-wire unit so connection of power supply and field wiring to unit's terminal strip makes unit operative. Wiring and control enclosures shall meet NEC and local codes. Provide pre-wired, numbered terminal strips for field wiring connections to Building Automation System.

2. Provide the following safety controls: air flow switch, electronic flame safety relay, high temperature limit switch, starter interlock, high gas pressure switch, low gas pressure switch, low discharge temperature control with bypass timer.

H. Gas Manifold:

1. Pilot line shall include: gas shutoff valve, gas regulator, pilot gas valve.

2. Main gas line shall include: gas shutoff valve, gas regulator, main gas valve (2 required), modulating gas valve, leakage test valve, low pressure gas switch, high pressure gas switch, vent valve between the two main gas valves and all required test valves.

3. Gas train shall meet FIA/IRI, local utility, and Owner's insurance company requirements.

4. Provide piping from vent valve to outside the building.

5. Provide additional regulator if the incoming gas pressure exceeds 2 psig.

6. Locate all valves and components in a unit mounted enclosure.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that area is ready to receive work and opening dimensions are as indicated on the shop drawings and illustrated by the manufacturer.

B. Verify that proper power supply is available.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. All field wiring shall be per the National Electrical Code.

3.3 MANUFACTURER'S FIELD SERVICES

A. Provide initial start-up and shutdown during first year of operation, including routine servicing and check-out.

END OF SECTION

SECTION 23 81 46
PACKAGED WATER SOURCE HEAT PUMPS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Water – to - Water.

1.2 QUALITY ASSURANCE

A. Fan Performance Ratings: Conform to AMCA 210 and bear the AMCA Certified Rating Seal.

B. Fabrication: Conform to AMCA 99, ARI 320 and /or ARI 340.

C. Air Coils: Certify capacities, pressure drops, and selection procedures in accordance with ARI 410.

D. Water Source Heat Pumps: Product of manufacturer regularly engaged in production of components who issue complete catalog data on total product.

E. Conform to ASHRAE 90.1.

1.3 SUBMITTALS

A. Submit shop drawings and product data under provisions of Section 23 05 00.

B. Shop drawings shall indicate assembly, unit dimensions, weight loading, required clearances, construction details, and field connection details.

C. Product and data shall indicate capacities, ratings, fan performance, motor electrical characteristics, and gauges and finishes of materials.

D. Provide fan curves with specified operating point clearly plotted.

E. Submit manufacturer's installation instructions.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site in factory fabricated protective containers with factory installed shipping skids and lifting lugs.

B. Store in clean dry place and protect from weather and construction traffic. Handle carefully to avoid damage to components, enclosures, and finish.

1.5 OPERATION AND MAINTENANCE DATA

A. Submit operation and maintenance data.

B. Include instructions for lubrication, filter replacement, motor and drive replacement, and spare parts list.

1.6 ENVIRONMENTAL REQUIREMENTS

A. Do not operate units for any purpose, temporary or permanent, until filters are in place, bearings lubricated, and fan has been test run under observation.

1.7 WARRANTY

A. Provide one (1) year manufacturer's warranty on all components of heat pump.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Multistack (Heatstack)
B. Climacool
C. Aaon

2.2 WATER – TO - WATER

A. General:

1. Equipment shall be completely factory assembled and tested, piped, internally wired, and fully charged with R-410A. Field interface terminal strip and all safety controls shall be furnished and factory installed.

2. Capacities shall be rated in accordance with ARI 320. Equipment shall be UL or ETL approved.

3. All water source heat pumps shall be high efficiency type.

4. All units shall be factory run and tested for proper operation.

5. Unit shall include flow switches and two way head pressure control.

B. Housing:

1. 18-gauge steel construction with baked on enamel finish. 1/2", 1-1/2 lb. density interior insulation.

2. Access panels for compressor and control compartments.

3. Knockouts for entrance of line voltage and control wiring, all wiring connections shall be made internal to the unit.

4. Supply and return water connections shall be FPT fittings and shall protrude through the cabinet for connection to flexible hose.

5. Metal bracket, Isolators, and fasteners to suspend unit from building structure.

6. Unit size and capacity shall be as scheduled on the drawings.

C. Refrigerant Circuit:

1. Unit shall be ARI rated and ETL and CSA listed. Each unit shall be fully run tested at the factory with a copy of the run test report furnished with operation and maintenance manuals.

2. Each unit shall have a sealed refrigerant circuit including digital scroll type hermetic compressors, capillary expansion tubes, water to refrigerant coaxial heat exchanger and safety controls to include low suction temperature, high and low pressure switches. Safety controls shall be resettable from the main disconnect only.

3. Compressor shall be digital scroll type hermetic type, spring isolated for maximum sound and vibration isolation, and have thermal overload protection.

4. UL listed coaxial heat exchanger constructed of copper inner tube and galvanized steel outer tube.

5. Unit shall accept time delay fuses or HACR circuit breaker for branch over-current protection.

6. The use of chlorofluorocarbon (CFC)-based refrigerants is prohibited.

D. Electrical:

1. Disconnect provided by Electrical Contractor.

2. Unit electrical characteristics shall be as scheduled on the drawings. Provide transformers as required for control power.

E. Controls

1. Unit shall have a low-voltage terminal strip for hardwire connection to the DDC system. Unit shall include internal safety controls for compressor short cycle protection, brown out protection, and compressor time delay. The DDC system will control the unit operation as detailed on the mechanical drawings.

2.3 WATER – TO - REFRIGERANT

A. General:

1. Equipment shall be completely factory assembled and tested, piped, internally wired, and fully charged with R-410A. Field interface terminal strip and all safety controls shall be furnished and factory installed.

2. Capacities shall be rated in accordance with ARI 320. Equipment shall be UL or ETL approved.

3. All water source heat pumps shall be high efficiency type.

4. All units shall be factory run and tested for proper operation.

5. Unit shall include balancing valves, water flow switch, and two way head pressure control.

B. Housing:

1. 18-gauge steel construction with baked on enamel finish. 1/2", 1-1/2 lb. density interior insulation.

2. Access panels for compressor and control compartments.

3. Knockouts for entrance of line voltage and control wiring, all wiring connections shall be made internal to the unit.

4. Supply and return water connections shall be FPT fittings and shall protrude through the cabinet for connection to flexible hose.

5. Metal bracket, Isolators, and fasteners to suspend unit from building structure.

6. Unit size and capacity shall be as scheduled on the drawings.

C. Refrigerant Circuit:

1. Unit shall be ARI rated and ETL and CSA listed. Each unit shall be fully run tested at the factory with a copy of the run test report furnished with operation and maintenance manuals.

2. Each unit shall have a sealed refrigerant circuit including digital scroll type hermetic compressors, capillary expansion tubes, water to refrigerant coaxial heat exchanger and safety controls to include low suction temperature, high and low pressure switches. Safety controls shall be resettable from the main disconnect only.

3. Compressor shall be digital scroll type hermetic type, spring isolated for maximum sound and vibration isolation, and have thermal overload protection.

4. UL listed coaxial heat exchanger constructed of copper inner tube and galvanized steel outer tube.

5. Unit shall accept time delay fuses or HACR circuit breaker for branch over-current protection.

6. The use of chlorofluorocarbon (CFC)-based refrigerants is prohibited.

D. Electrical:

3. Disconnect provided by Electrical Contractor.

4. Unit electrical characteristics shall be as scheduled on the drawings. Provide transformers as required for control power.

E. Controls

1. Unit shall have a low-voltage terminal strip for hardwire connection to the DDC system. Unit shall include internal safety controls for compressor short cycle protection, brown out protection, and compressor time delay. The DDC system will control the unit operation as detailed on the mechanical drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Protect units with protective cover during construction.

3.2 CLEANING

A. After construction is completed, including painting, clean exposed surfaces of units. Clean coils and inside of units by vacuuming.

END OF SECTION

SECTION 23 82 00
TERMINAL HEAT TRANSFER UNITS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Panel Radiation.
B. Unit Heaters.
C. Cabinet Heaters.

1.2 QUALITY ASSURANCE

A. Factory wired equipment shall conform to ANSI/NFPA 70.

1.3 REFERENCES

A. ANSI/ASHRAE 62.1 - Ventilation for Acceptable Indoor Air Quality.

B. ANSI/ASHRAE/IES Standard 90.1 (latest published edition) - Energy Standard for Buildings Except Low-Rise Residential Buildings.

C. ANSI/NFPA 70 - National Electrical Code.

1.4 SUBMITTALS

A. Submit shop drawings per Section 23 05 00.

B. Submit catalog data including arrangements, cross sections of cabinets, grilles, bracing, typical elevations.

C. Submit schedules of equipment and enclosures indicating length, number of pieces of element and enclosure, corner pieces, end caps, cap strips, access doors, and comparison of specified to actual heat output.

D. Indicate mechanical and electrical service locations and requirements. Show deviations from scheduled products.

E. Submit manufacturers' installation instructions.

1.5 DELIVERY, STORAGE AND HANDLING

A. Protect units from physical damage by storing in protected areas and leaving factory covers in place.

1.6 REGULATORY REQUIREMENTS

A. Conform to ASHRAE 90.1.

1.7 OPERATION AND MAINTENANCE DATA

A. Submit manufacturer's operation and maintenance data. Include operating, installation, maintenance and repair data, and parts listings.

PART 2 - PRODUCTS

2.1 PANEL RADIATION - WALL HUNG

A. All components shall be steel.

B. With corrugated fins welded to flat horizontal tubes to connect to vertical headers at each end.

C. Headers with inlet, outlet, vent and drain connections, and baffles for even heat distribution.

D. Provide integral all-welded perforated top grille.

E. Rated for 85 psi working and 110 psi test pressure.

F. Rated per ISO 1503147-3150.

G. Units to have gloss powder-coated finish. Color selection by the Architect. Furnish color charts with shop drawings.

H. Install mounting hardware per manufacturer's recommendations. Conceal all mounting hardware.

I. Acceptable Manufacturer: Runtal, Rittling, Vulcan, Sterling.

2.2 UNIT HEATERS

A. Casings shall be heavy gauge steel with a baked finish.

B. Coils shall have copper heads and tubes, and aluminum fins.

C. Units shall have threaded pipe connections for hanger rods.

D. Fans shall be direct drive propeller type, factory balanced, with fan guards and totally enclosed motors with integral thermal overload protection.

E. Horizontal units shall have adjustable outlet air louvers.

F. Provide unit mounted and wired disconnects. Contractor shall be responsible for providing and wiring disconnect when using a manufacturer who does not provide factory mounted option.

G. Acceptable Products: Trane - S or P, Daikin/McQuay - UHH or UDH, Modine - HS or V, Vulcan - HV or VV, Sterling HS or VS, Rittling - H or V, Sigma H or V, Airtherm HA or VA.

2.3 HOT WATER CABINET HEATERS

A. Units shall include cabinet, fan, motor, coil, filter, inlet grille and discharge grille.

B. Cabinets: 16 gauge exposed surfaces and 18 gauge concealed surfaces. Plastic exposed parts are not acceptable.

C. Baked enamel finish. Color selected by Architect.

D. All motors shall be three-speed permanent split capacitor with integral thermal overload protection.

E. Coils shall have finned copper tubes.

F. Provide 1" thick disposable filters or 1/2” thick washable 65% aluminum filters ahead of all coils.

G. Provide a concealed unit mounted fan switch with "Off-High-Medium-Low" positions that doubles as disconnect.

H. Acceptable Manufacturers: Trane - 'Force-Flo', Sterling, Modine, Rittling, Sigma, Vulcan, Airtherm, Beacon Morris.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General Installation Requirements:

1. Install all products per manufacturers' instructions.
2. Coordinate recess sizes for recessed equipment.
3. Protect units with protective covers during construction.
4. Comb all coils to repair bent fins.

B. Panel Radiation:

1. Locate finned tube radiation as shown and run cover wall-to-wall, unless otherwise shown. Center elements under windows.

C. Unit Heater:

1. Hang unit heaters from building structure, not from piping. Mount as high as possible within manufacturer's recommended mounting height requirements. If unit heaters cannot be installed within manufacturer's recommended range, notify Architect/Engineer prior to mounting.

3.2 CLEANING

A. After construction is complete, including painting, clean exposed surfaces of units. Vacuum clean coils and inside of cabinets.

B. Touch-up marred or scratched surfaces of factory-finished cabinets, with materials furnished by manufacturer.

C. Install new filters.

END OF SECTION

SECTION 23 83 00
RADIANT FLOOR HEATING SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Description:

1. Furnish and install radiant floor heating system tubing, distribution manifolds, manifold support brackets, manifold to tubing fittings, manifold end caps and bushings, circuit isolation and balancing valves, controls, and installation specialties, supervision and field engineering required for complete and proper function of the system.

B. System Design:

1. Provide a system as zoned per equipment schedule.

1.2 REFERENCES

A. ASTM F876 - Standard Specification for Cross-Linked Polyethylene (PEX) Tubing.

B. ASTM F877 - Cross-Linked Polyethylene (PEX) Plastic Hot and Cold Water Distribution Systems.

C. CAN/CSA-B137.5 - Cross-Linked Polyethylene (PEX) Tubing Systems for Pressure Applications.

D. DIN 4726 - German Standard for Plastic Piping used in Warm Water Floor Heating Systems.

1.3 SUBMITTALS

A. Provide submittals and shop drawings in accordance with the General Requirements and as specified herein.

B. Submit shop drawings indicating detailed layout of system, including equipment, tubing locations, loop lengths, critical dimensions, tubing/slab penetration details, fittings, and details for protected exposed PEX tubing. Provide pressure drops at design flow rates for all equipment including loops, manifolds, isolation valves, and control valves. Provide detailed flow, pressure, and electrical power requirements of radiant system pump.

C. Submit manufacturer's technical instructions including specific installation instructions for system installation in the specific construction of the radiant panel or slab. Include details at slab construction joints and expansion joints.

D. Submit installer’s certifications of training for installation of PEX floor heating systems.

E. Submit data indicating tube sizing and panel performance at tube spacing and warm water temperatures selected.

F. Submit independent certification results for the tubing systems from a recognized testing laboratory.

G. Submit catalog data on all supports, tube guides, spacers, fittings, and associated items necessary for the installation of the tubing and manifolds.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store tubing and specialties in shipping containers with labeling in place. Do not expose to ultraviolet light for more than 90 days.

B. Protect tubing and specialties from entry of contaminating material by installing tape or plugs in all open tube ends until installation and/or maintain tubing in the original shipping boxes or packaging until usage.

C. Unprotected tubes shall not be dragged across the ground or concrete surfaces, and shall be stored on a flat surface with no sharp edges.

D. Tube shall be protected from oil, grease, direct sunlight, paint, and other elements as recommended by manufacturer.

1.5 REGULATORY REQUIREMENTS

A. Tubing shall conform to ASTM F876 and ASTM F877 (for Canada conform to CAN/CSA B137.5). Tubing oxygen permeation barrier shall conform to DIN 4726.

B. Installer's Qualification: Installer's shall be qualified, in writing, as either being certified or certifiable prior to the commencement of the installation.

1.6 WARRANTY

A. The radiant floor system component manufacturer shall warrant the tubing to be free from defects in material and workmanship for a period of twenty-five (25) years.

B. All manifolds, pumps, and controls shall be warranted for 18 months and/or two heating seasons.

PART 2 - PRODUCTS

2.1 SYSTEM COMPONENTS

A. Tube:

1. Tube shall be cross-linked polyethylene, aluminum core polyethylene, or multi-layer, elastomeric, industrial grade EPDM rubber hose with maximum working pressure/temperature of 160 psi @ 73.4ºF, 100 psi @ 180ºF, 80 psi @ 200ºF.

2. The tube shall be manufactured in accordance with ASTM standard specification F876. The tube shall be listed to ASTM by independent third party testing laboratory.

3. The tube shall be of cross-linked polyethylene with a minimum degree of cross-linking of 80% or multi-layer, elastomeric, industrial grade EPDM rubber hose. The tube shall have an oxygen diffusion barrier capable of limiting oxygen diffusion through the tube to no greater than 0.10g/m^3/day @ 104ºF water temperature.

4. The tube dimensions shall be: 5/8" nominal inside diameter or 3/4” nominal inside diameter in accordance with ASTM standard specification, as pertaining to paragraph 2.

5. The minimum bend radius for cold bending of the tube shall not be less than six (6) times the outside diameter. Bends with a radius less than stated shall require the use of a bend support as supplied by the tube manufacturer.

6. All Components: Components of the buried tubing system shall be provided by one manufacturer, including; tube, fittings, manifolds, controls, and other ancillary items required for a complete installation.

B. Manifolds:

1. Manifolds shall be of cast brass construction, manufactured of alloys to prevent dezincification, and shall have integral circuit balancing valves. Manifolds shall be able to vent air from the system, and shall be provided with support brackets and tube bend supports. Manifolds shall be isolated from supply and return tubing with valves that are suitable for isolation and balancing.

C. Fittings:

1. Fittings shall be manufactured of dezincification resistant brass. These fittings must be supplied by the tube manufacturer. The fittings shall consist of a compression fitting with insert, compression ring and a compression nut.

D. Supply And Return Piping To Manifolds:

1. Piping shall be metal pipe or cross-linked polyethylene tube with an integral oxygen diffusion barrier. Cross-linked polyethylene tube should only be used when specifically approved by the local building inspector for supply and return piping applications.

2. Fittings shall be compatible to the piping material used. Fittings used with the cross-linked polyethylene tube shall not permit excessive oxygen permeation.

E. Acceptable Manufacturers: Roth, Uponor, Rehau, Kitec, Zurn,

PART 3 - EXECUTION

3.1 INSTALLATION

A. Hydronic radiant heat tubing loops shall be installed in accordance with the manufacturer's recommendations and the details as shown on the contract drawings.

B. All fittings should be accessible for maintenance. Tubing loops shall be installed without splices, as a minimum, from the point at which the tubing enters the panel to the point at which it exits the panel. No splices shall occur underground.

C. Installation shall follow the shop drawings for tubing layout, tube spacing, manifold configuration, manifold location, and controls. All notes on the drawing shall be followed.

1. The tubing system shall be pressurized, with water or air, in accordance, with applicable codes, or to a pressure of 60 psig 24 hours prior to encasement in the radiant panel. The tubing system shall remain at this pressure during the panel installation, and for a minimum of 24 hours thereafter to ensure system integrity. The Contractor shall provide the water or air for the pressurization of the tubing system. The Contractor assumes all liabilities for suitable safety precautions and testing, including the use of compressed air, when applicable.

2. Contractor shall take detailed photographs of installation and provide to owner as part of record documents in digital format for future reference.

D. At start up time, the Contractor shall: follow the manufacturer's recommendations for system water and temperature balancing, record balance settings at each manifold location, and deliver to the Owner a complete record of these settings for inclusion in the operation and maintenance manuals.

E. Any deviations from shop drawing layout must be accurately dimensioned for Owner's records.

F. Provide warning labels in mechanical equipment spaces to alert future building remodelers of the presence of in-slab tubing.

END OF SECTION

SECTION 26 05 00
BASIC ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Requirements applicable to all Division 26 Sections. Also refer to Division 1 - General Requirements. This section is also applicable to Interior Communications Pathways Section 27 05 28. This section is also applicable to Fire Alarm and Detection Systems Section 28 31 00.

B. All materials and installation methods shall conform to the applicable standards, guidelines and codes referenced in each specification section.

1.2 REFERENCES

A. NFPA 70 - National Electrical Code (NEC)

1.3 SCOPE OF WORK

A. This Specification and the associated drawings govern furnishing, installing, testing and placing into satisfactory operation the Electrical Systems.

B. The Contractor shall furnish and install all new materials as indicated on the drawings, and/or in these specifications, and all items required to make his portion of the Electrical Work a finished and working system.

C. Description of Systems shall be as follows:

1. Electrical power system to and including light fixtures, equipment, motors, devices, etc.
2. Electrical power service system from the Utility Company to and including service entrance equipment, distribution and metering.
3. Grounding system.
4. Fire alarm system.
5. Public address and intercom system.
6. Clock and program system.
7. Security system.
8. Wiring system for temperature control system as shown on the drawings.
9. Wiring of equipment furnished by others.
10. Removal work and/or relocation and reuse of existing systems and equipment.
11. Technology Systems as described in Division 27/28 and on the T-series documents as described in the Suggested Matrix of Scope Responsibility.

D. Work Not Included:

1. Telecommunications cabling will be by others, in raceways and conduits furnished and installed as part of the Electrical work.

2. Temperature control wiring for plumbing and HVAC equipment (unless otherwise indicated) will be by other Contractors.

1.4 OWNER FURNISHED PRODUCTS

A. The Owner will supply manufacturer's installation data for new equipment purchased by him for this project.

B. This Contractor shall make all electrical system connections shown on the drawings **or** required for fully functional units.

C. This Contractor is responsible for all damage to Owner furnished equipment caused during installation.

1.5 DIVISION OF WORK BETWEEN MECHANICAL, ELECTRICAL, AND CONTROL CONTRACTORS

A. Division of work is the responsibility of the Prime Contractor. Any scope of work described at any location on the contract document shall be sufficient for including said requirement in the project. The Prime Contractor shall be solely responsible for determining the appropriate subcontractor for the described scope. In no case shall the project be assessed an additional cost for scope that is described on the contract documents on bid day. The following division of responsibility is a guideline based on typical industry practice.

B. Definitions:

1. "Mechanical Contractors" refers to the Contractors listed in Division 21/22/23 of this Specification.

2. “Technology Contractors” refers to the Contractors furnishing and installing systems listed in Division 27/28 of this Specification.

3. Motor Power Wiring: The single phase or 3 phase wiring extending from the power source (transformer, panelboard, feeder circuits, etc.) through disconnect switches and motor controllers to, and including the connections to the terminals of the motor.

4. Motor Control Wiring: The wiring associated with the remote operation of the magnetic coils of magnetic motor starters or relays, or the wiring that permits direct cycling of motors by means of devices in series with the motor power wiring. In the latter case, the devices are usually single phase, have "Manual-Off-Auto" provisions, and are usually connected into the motor power wiring through a manual motor starter.

5. Control devices such as start-stop push buttons, thermostats, pressure switches, flow switches, relays, etc., generally represent the types of equipment associated with motor control wiring.

6. Motor control wiring is single phase and usually 120 volts. In some instances, the voltage will be the same as the motor power wiring. When the motor power wiring exceeds 120 volts, a control transformer is usually used to give a control voltage of 120 volts.

7. Temperature Control Wiring: The wiring associated with the operation of a motorized damper, solenoid valve or motorized valve, etc., either modulating or two-position, as opposed to wiring that directly powers or controls a motor used to drive equipment such as fans, pumps, etc. This wiring will be from a 120 volt source and may continue as 120 volt, or be reduced in voltage (24 volt), in which case a control transformer shall be furnished as part of the temperature control wiring.

8. Control Motor: An electric device used to operate dampers, valves, etc. It may be two-position or modulating. Conventional characteristics of such a motor are 24 volts, 60 cycles, 1 phase, although other voltages may be encountered.

9. Low Voltage Technology Wiring: The wiring associated with the Technology Systems, used for analog or digital signals between equipment.

10. Telecommunications Rough-in: Relates specifically to the backboxes, necessary plaster rings and other miscellaneous hardware required for the installation or mounting of telecommunications information outlets.

C. General:

1. The purpose of these Specifications is to outline the Electrical and Mechanical Contractors' responsibilities related to electrical work required for items such as temperature controls, mechanical equipment, fans, chillers, compressors, etc. The exact wiring requirements for much of the equipment cannot be determined until the systems have been selected and submittals approved. Therefore, the electrical drawings show only known wiring related to such items. All wiring not shown on the electrical drawings, but required for mechanical systems, is the responsibility of the Mechanical Contractor.

2. Where the drawings require the Electrical Contractor to wire between equipment furnished by the Mechanical Contractor, such wiring shall terminate at terminals provided in the equipment. The Mechanical Contractor shall furnish complete wiring diagrams and supervision to the Electrical Contractor and designate the terminal numbers for correct wiring.

3. The Electrical Contractor shall establish electrical utility elevations prior to fabrication and installation. The Electrical Contractor shall coordinate utility elevations with other trades. When a conflict arises, priority shall be as follows:

   a. Lighting Fixtures
   b. Gravity flow piping, including steam and condensate.
   c. Electrical bus duct.
   d. Sheet metal.
   e. Cable trays, including access space.
   f. Other piping.
   g. Conduits and wireway.

D. Mechanical Contractor's Responsibility:

1. Assumes responsibility for internal wiring of all equipment furnished by the Mechanical Contractor.

2. Assumes all responsibility for miscellaneous items furnished by the Mechanical Contractor that require wiring but are not shown on the electrical drawings or specified in the Electrical Specification. If items such as relays, flow switches, or interlocks are required to make the mechanical system function correctly or are required by the manufacturer, they are the responsibility of the Mechanical Contractor.

3. Assumes all responsibility for Temperature Control wiring, if the Temperature Control Contractor is a Subcontractor to the Mechanical Contractor.

4. This Contractor is responsible for coordination of utilities with all other Contractors. If any field coordination conflicts are found, the Contractor shall coordinate with other Contractors to determine a viable layout.

E. Temperature Control Contractor's or Subcontractor's Responsibility:

1. Wiring of all devices needed to make the Temperature Control System functional.

2. Verifying any control wiring on the electrical drawings as being by the Electrical Contractor. All wiring required for the Control System, but not shown on the electrical drawings, is the responsibility of the Temperature Control Contractor or Subcontractor.

3. Coordinating equipment locations (such as PE's, EP's, relays, transformers, etc.) with the Electrical Contractor, where wiring of the equipment is by the Electrical Contractor.

F. Electrical Contractor's Responsibility:

1. Furnishes and installs all combination starters, manual starters and disconnect devices shown on the Electrical Drawings or indicated to be by the Electrical Contractor in the Mechanical Drawings or Specifications.

2. Installs and wires all remote control devices furnished by the Mechanical Contractor or Temperature Control Contractor when so noted on the Electrical Drawings.

3. Furnishes and installs motor control and temperature control wiring, when noted on the drawings.

4. Furnishes, installs, and connects all relays, etc., for automatic shutdown of certain mechanical equipment (supply fans, exhaust fans, etc.) upon actuation of the Fire Alarm System.

5. This Contractor is responsible for coordination of utilities with all other Contractors. If any field coordination conflicts are found, the Contractor shall coordinate with other Contractors to determine a viable layout.

G. General (Electrical/Technology):

1. "Electrical Contractor" as referred to herein shall be responsible for scope listed in Division 27/28 of this specification when the "Suggested Matrix of Scope Responsibility" indicated work shall be furnished and installed by the EC. Refer to the Contract Documents for this "Suggested Matrix of Scope Responsibility".

2. The purpose of these Specifications is to outline the Electrical and Technology Contractor's work responsibilities as related to Telecommunications Rough-in, conduit, cable tray, power wiring and Low Voltage Technology Wiring.

3. The exact wiring requirements for much of the equipment cannot be determined until the systems have been purchased and submittals approved. Therefore, only known wiring, conduits, raceways and electrical power related to such items is shown on the Technology drawings. Other wiring, conduits, raceways, junction boxes and electrical power not shown on the Technology Drawings but required for operation of the systems is the responsibility of the Technology Contractor and included in said Contractor's bid.

4. Where the Electrical Contractor is required to install conduit, conduit sleeves and/or power connections in support of Technology systems, the final installation shall not be until a coordination meeting between the Electrical Contractor and the Technology Contractor has convened to determine the exact location and requirements of the installation.

5. Where the Electrical Contractor is required to install cable tray that will contain Low Voltage Technology Wiring, installation shall not begin prior to a coordination review of the cable tray shop drawings by the Technology Contractor.

H. Technology Contractor's Responsibility:

1. Assumes all responsibility for the Low Voltage Technology Wiring of all systems, including cable support where open cable is specified.

2. Assumes all responsibility for all required backboxes, conduit and power connections not specifically shown as being furnished and installed by the Electrical Contractor on the "Suggested Matrix of Scope Responsibility".

3. Assumes all responsibility for providing and installing all ladder rack and other cable management hardware (as defined herein).

4. Responsible for providing the Electrical Contractor with the required grounding lugs or other hardware for each piece of Technology equipment which is required to be bonded to the telecommunications ground bar.

5. This Contractor is responsible for coordination of utilities with all other Contractors. If any field coordination conflicts are found, the Contractor shall coordinate with other Contractors to determine a viable layout.

1.6 COORDINATION DRAWINGS

A. Definitions:

1. Coordination Drawings: A compilation of the pertinent layout and system drawings that show the sizes and locations, including elevations, of system components and required access areas to ensure that no two objects will occupy the same space.

a. Mechanical trades shall include, but are not limited to, mechanical equipment, ductwork, fire protection systems, plumbing piping, medical gas systems, hydronic piping, steam and steam condensate piping, and any item that may impact coordination with other disciplines.

b. Electrical trades shall include, but are not limited to, electrical equipment, conduit 1.5" and larger, conduit racks, cable trays, pull boxes, transformers, raceway, busway, lighting, ceiling-mounted devices, and any item that may impact coordination with other disciplines.

c. Technology trades shall include, but are not limited to, technology equipment, racks, conduit 1.5" and larger, conduit racks, cable trays, ladder rack, pull boxes, raceway, ceiling-mounted devices, and any item that may impact coordination with other disciplines.

d. Maintenance clearances and code-required dedicated space shall be included.

e. The coordination drawings shall include all underground, underfloor, in-floor, in chase, and vertical trade items.

2. The contractors shall use the coordination process to identify the proper sequence of installation of all utilities above ceilings and in other congested areas, to ensure an orderly and coordinated end result, and to provide adequate access for service and maintenance.

B. Participation:

1. The contractors and subcontractors responsible for work defined above shall participate in the coordination drawing process.

2. One contractor shall be designated as the Coordinating Contractor for purposes of preparing a complete set of composite electronic CAD coordination drawings that include all applicable trades, and for coordinating the activities related to this process. The Coordinating Contractor for this project shall be the Mechanical Contractor.

a. The Coordinating Contractor shall utilize personnel familiar with requirements of this project and skilled as draftspersons/CAD operators, competent to prepare the required coordination drawings.

3. Electronic CAD drawings shall be submitted to the Coordinating Contractor for addition of work by other trades. IMEG will provide electronic file copies of ventilation drawings for contractor's use if the contractor signs and returns an "Electronic File Transfer" waiver provided by IMEG. IMEG will not consider blatant reproductions of original file copies an acceptable alternative for coordination drawings.

C. Drawing Requirements:

1. The file format and file naming convention shall be coordinated with and agreed to by all contractors participating in the coordination process and the Owner.

a. Scale of drawings:

1) General plans: 1/4 Inch = 1 '-0" (minimum).

2) Mechanical, electrical, communication rooms, and including the surrounding areas within 10 feet: 1/2 Inch = 1'-0" (minimum).

3) Shafts and risers: 1/2 Inch = 1'-0" (minimum).

4) Sections of shafts and mechanical and electrical equipment rooms: 1/4 Inch = 1 '-0" (minimum).

5) Sections of congested areas: 1/2 Inch = 1'-0" (minimum).

2. Ductwork layout drawings shall be the baseline system for other components. Ductwork layout drawings shall be modified to accommodate other components as the coordination process progresses.

3. There may be more drawings required for risers, top and bottom levels of mechanical rooms, and shafts.

4. The minimum quantity of drawings will be established at the first coordination meeting and sent to the A/E for review. Additional drawings may be required if other areas of congestion are discovered during the coordination process.

D. General:

1. Coordination drawing files shall be made available to the A/E and Owner's Representative. The A/E will only review identified conflicts and give an opinion, but will not perform as a coordinator.

2. A plotted set of coordination drawings shall be available at the project site.

3. Coordination drawings are not shop drawings and shall not be submitted as such.

4. The contract drawings are schematic in nature and do not show every fitting and appurtenance for each utility. Each contractor is expected to have included in his/her bid sufficient fittings, material, and labor to allow for adjustments in routing of utilities made necessary by the coordination process and to provide a complete and functional system.

5. The contractors will not be allowed additional costs or time extensions due to participation in the coordination process.

6. The contractors will not be allowed additional costs or time extensions for additional fittings, reroutings or changes of duct size, that are essentially equivalent sizes to those shown on the drawings and determined necessary through the coordination process.

7. The A/E reserves the right to determine space priority of equipment in the event of spatial conflicts or interference between equipment, piping, conduit, ducts, and equipment provided by the trades.

8. Changes to the contract documents that are necessary for systems installation and coordination shall be brought to the attention of the A/E.

9. Access panels shall preferably occur only in gypsum board walls or plaster ceilings where indicated on the drawings.

   a. Access to mechanical, electrical, technology, and other items located above the ceiling shall be through accessible lay-in ceiling tile areas.

   b. Potential layout changes shall be made to avoid additional access panels.

   c. Additional access panels shall not be allowed without written approval from the A/E at the coordination drawing stage.

   d. Providing additional access panels shall be considered after other alternatives are reviewed and discarded by the A/E and the Owner's Representative.

   e. When additional access panels are required, they shall be provided without additional cost to the Owner.

10. Complete the coordination drawing process and obtain sign off of the drawings by all contractors prior to installing any of the components.

11. Conflicts that result after the coordination drawings are signed off shall be the responsibility of the contractor or subcontractor who did not properly identify their work requirements, or installed their work without proper coordination.

12. Updated coordination drawings that reflect as-built conditions may be used as record documents.

1.7 QUALITY ASSURANCE

A. Contractor’s Responsibility Prior to Submitting Pricing/Bid Data:

1. The Contractor is responsible for constructing complete and operating systems. The Contractor acknowledges and understands that the Contract Documents are a two-dimensional representation of a three-dimensional object, subject to human interpretation. This representation may include imperfect data, interpreted codes, utility guides, three-dimensional conflicts, and required field coordination items. Such deficiencies can be corrected when identified prior to ordering material and starting installation. The Contractor agrees to carefully study and compare the individual Contract Documents and report at once in writing to the Architect/Engineer any deficiencies the Contractor may discover. The Contractor further agrees to require each subcontractor to likewise study the documents and report at once any deficiencies discovered.

2. The Contractor shall resolve all reported deficiencies with the Architect/Engineer prior to awarding any subcontracts, ordering material, or starting any work with the Contractor’s own employees. Any work performed prior to receipt of instructions from the Architect/Engineer will be done at the Contractor’s risk.

B. Qualifications:

1. Only products of reputable manufacturers as determined by the Architect/Engineer are acceptable.

2. All Contractors and subcontractors shall employ only workmen who are skilled in their trades. At all times, the number of apprentices at the job site shall be less than or equal to the number of journeymen at the job site.

C. Compliance with Codes, Laws, Ordinances:

1. Conform to all requirements of the City of Madison, Wisconsin Codes, Laws, Ordinances and other regulations having jurisdiction over this installation.

2. If there is a discrepancy between the codes and regulations and these specifications, the Architect/Engineer shall determine the method or equipment used.

3. If the Contractor notes, at the time of bidding, any parts of the drawings or specifications that do not comply with the codes or regulations, he shall inform the Architect/Engineer in writing, requesting a clarification. If there is insufficient time for this procedure, he shall submit with his proposal a separate price to make the system comply with the codes and regulations.

4. All changes to the system made after the letting of the contract to comply with codes or the requirements of the Inspector, shall be made by the Contractor without cost to the Owner.

5. If there is a discrepancy between manufacturer's recommendations and these specifications, the manufacturer's recommendations shall govern.

6. If there are no local codes having jurisdiction, the current issue of the NEC shall be followed.

D. Permits, Fees, Taxes, Inspections:

1. Procure all applicable permits and licenses.

2. Abide by all laws, regulations, ordinances, and other rules of the State or Political Subdivision where the work is done, or as required by any duly constituted public authority.

3. Pay all charges for permits or licenses.

4. Pay all fees and taxes imposed by State, Municipal, and other regulatory bodies.

5. Pay all charges arising out of required inspections by an authorized body.

6. Pay all charges arising out of required contract document reviews associated with the project and as initiated by the Owner or authorized agency/consultant.

7. Where applicable, all fixtures, equipment and materials shall be listed by Underwriter's Laboratories, Inc. or a nationally recognized testing organization.

8. Pay all telephone company charges related to the service or change in service.

E. Utility Company Requirements:

1. Secure from the private or public utility company all applicable requirements.

2. Comply with all utility company requirements.

3. The Owner shall make application for and pay for new electrical service equipment and installation. The Contractor shall coordinate schedule and requirements with the Owner and Utility Company.

4. Furnish the meter socket and C.T. cabinet. Verify approved manufacturers and equipment with the Utility Company.

5. The Owner shall apply and pay for any changes for removal of existing electrical service by the utility company. The Contractor shall verify approved manufacturers and equipment with the Utility Company.

F. Examination of Drawings:

1. The drawings for the electrical work are completely diagrammatic, intended to convey the scope of the work and to indicate the general arrangements and locations of equipment, outlets, etc., and the approximate sizes of equipment.

2. Contractor shall determine the exact locations of equipment and rough-ins, and the exact routing of raceways so as to best fit the layout of the job. Conduit entry points for electrical equipment including, but not limited to, panelboards, switchboards, switchgear and unit substations, shall be determined by the Contractor unless noted in the contract documents.

3. Scaling of the drawings will not be sufficient or accurate for determining these locations.

4. Where job conditions require reasonable changes in arrangements and locations, such changes shall be made by the Contractor at no additional cost to the Owner.

5. Because of the scale of the drawings, certain basic items, such as junction boxes, pull boxes, conduit fittings, etc., may not be shown, but where required by other sections of the specifications or required for proper installation of the work, such items shall be furnished and installed.

6. If an item is either shown on the drawings or called for in the specifications, it shall be included in this contract.

7. The Contractor shall determine quantities and quality of material and equipment required from the documents. Where discrepancies arise between drawings, schedules and/or specifications, the greater and better quality number shall govern.

8. Where used in electrical documents the word “furnish” shall mean supply for use, the word “install” shall mean connect up complete and ready for operation, and the word “provide” shall mean to supply for use and connect up complete and ready for operation.

9. Any item listed as furnished shall also be installed unless otherwise noted.

10. Any item listed as installed shall also be furnished unless otherwise noted.

G. Electronic Media/Files:

1. Construction drawings for this project have been prepared utilizing Revit.

2. Contractors and Subcontractors may request electronic media files of the contract drawings and/or copies of the specifications. Specifications will be provided in PDF format.

3. Upon request for electronic media, the Contractor shall complete and return a signed “Electronic File Transmittal” form provided by IMEG.

4. If the information requested includes floor plans prepared by others, the Contractor will be responsible for obtaining approval from the appropriate Design Professional for use of that part of the document.

5. The electronic contract documents can be used for preparation of shop drawings and as-built drawings only. The information may not be used in whole or in part for any other project.

6. The drawings prepared by IMEG for bidding purposes may not be used directly for ductwork layout drawings or coordination drawings.

7. The use of these CAD documents by the Contractor does not relieve them from their responsibility for coordination of work with other trades and verification of space available for the installation.

8. The information is provided to expedite the project and assist the Contractor with no guarantee by IMEG as to the accuracy or correctness of the information provided. IMEG accepts no responsibility or liability for the Contractor’s use of these documents.

H. Field Measurements:

1. Verify all pertinent dimensions at the job site before ordering any conduit, conductors, wireways, bus duct, fittings, etc.

1.8 SUBMITTALS

A. Submittals shall be required for the following items, and for additional items where required elsewhere in the specifications or on the drawings.

1. Submittals list:

Referenced Specification Section	Submittal Item
26 05 26	Grounding and Bonding
26 05 35	Surface Raceways
26 05 73	Power System Study
26 09 33	Lighting Control System
26 20 00	Service Entrance
26 24 16	Panelboards
26 24 19	Motor Control
26 27 26	Wiring Devices
26 28 13	Fuses
26 28 16	Disconnect Switches
26 28 21	Contactors
28 31 00	Fire Alarm and Detection Systems

B. General Submittal Procedures: In addition to the provisions of Division 1, the following are required:

1. Transmittal: Each transmittal shall include the following:

a. Date
b. Project title and number
c. Contractor's name and address
d. Division of work (e.g., electrical, plumbing, heating, ventilating, etc.)
e. Description of items submitted and relevant specification number
f. Notations of deviations from the contract documents
g. Other pertinent data

2. Submittal Cover Sheet: Each submittal shall include a cover sheet containing:

a. Date
b. Project title and number
c. Architect/Engineer
d. Contractor and subcontractors' names and addresses
e. Supplier and manufacturer's names and addresses
f. Division of work (e.g., electrical, plumbing, heating, ventilating, etc.)
g. Description of item submitted (using project nomenclature) and relevant specification number
h. Notations of deviations from the contract documents
i. Other pertinent data
j. Provide space for Contractor's review stamps

3. Composition:

a. Submittals shall be submitted using specification sections and the project nomenclature for each item.

b. Individual submittal packages shall be prepared for items in each specification section. All items within a single specification section shall be packaged together where possible. An individual submittal may contain items from multiple specifications sections if the items are intimately linked (e.g., pumps and motors).

c. All sets shall contain an index of the items enclosed with a general topic description on the cover.

4. Content: Submittals shall include all fabrication, erection, layout, and setting drawings; manufacturers' standard drawings; schedules; descriptive literature, catalogs and brochures; performance and test data; wiring and control diagrams; dimensions; shipping and operating weights; shipping splits; service clearances; and all other drawings and descriptive data of materials of construction as may be required to show that the materials, equipment or systems and the location thereof conform to the requirements of the contract documents.

5. Contractor's Approval Stamp:

a. The Contractor shall thoroughly review and approve all shop drawings before submitting them to the Architect/Engineer. The Contractor shall stamp, date and sign each submittal certifying it has been reviewed.

b. Unstamped submittals will be rejected.

c. The Contractor's review shall include, but not be limited to, verification of the following:

1) Only approved manufacturers are used.
2) Addenda items have been incorporated.
3) Catalog numbers and options match those specified.
4) Performance data matches that specified.
5) Electrical characteristics and loads match those specified.
6) Equipment connection locations, sizes, capacities, etc. have been coordinated with other affected trades.
7) Dimensions and service clearances are suitable for the intended location.
8) Equipment dimensions are coordinated with support steel, housekeeping pads, openings, etc.
9) Constructability issues are resolved (e.g., weights and dimensions are suitable for getting the item into the building and into place, sinks fit into countertops, etc.).

d. The Contractor shall review, stamp and approve all subcontractors' submittals as described above.

e. **The Contractor's approval stamp is required on all submittals. Approval will indicate the Contractor's review of all material and a complete understanding of exactly what is to be furnished. Contractor shall clearly mark all deviations from the contract documents on all submittals. If deviations are not marked by the Contractor, then the item shall be required to meet all drawing and specification requirements.**

6. Submittal Identification and Markings:

a. The Contractor shall clearly mark each item with the same nomenclature applied on the drawings or in the specifications.

b. The Contractor shall clearly indicate the size, finish, material, etc.

c. Where more than one model is shown on a manufacturer's sheet, the Contractor shall clearly indicate exactly which item and which data is intended.

d. All marks and identifications on the submittals shall be unambiguous.

7. Schedule submittals to expedite the project. Coordinate submission of related items.

8. Identify variations from the contract documents and product or system limitations that may be detrimental to the successful performance of the completed work.

9. Reproduction of contract documents alone is not acceptable for submittals.

10. Incomplete submittals will be rejected without review. Partial submittals will only be reviewed with prior approval from the Architect/Engineer.

11. Submittals not required by the contract documents may be returned without review.

12. The Architect/Engineer's responsibility shall be to review one set of shop drawing submittals for each product. If the first submittal is incomplete or does not comply with the drawings and/or specifications, the Contractor shall be responsible to bear the cost for the Architect/Engineer to recheck and handle the additional shop drawing submittals.

13. Submittals shall be reviewed and approved by the Architect/Engineer **before** releasing any equipment for manufacture or shipment.

14. Contractor's responsibility for errors, omissions or deviation from the contract documents in submittals is not relieved by the Architect/Engineer's approval.

C. Electronic Submittal Procedures:

1. Distribution: Email submittals as attachments to all parties designated by the Architect/Engineer, unless a web-based submittal program is used.

2. Transmittals: Each submittal shall include an individual electronic letter of transmittal.

3. Format: Electronic submittals shall be in PDF format only. Scanned copies, in PDF format, of paper originals are acceptable. Submittals that are not legible will be rejected. Do not set any permission restrictions on files; protected, locked, or secured documents will be rejected.

4. File Names: Electronic submittal file names shall include the relevant specification section number followed by a description of the item submitted, as follows. Where possible, include the transmittal as the first page of the PDF instead of using multiple electronic files.

   a. Submittal file name: 26 XX XX.description.YYYYMMDD
   b. Transmittal file name: 26 XX XX.description.YYYYMMDD

5. File Size: Electronic file size shall be limited to a maximum of 4MB. Larger files shall be transmitted via a pre-approved method.

1.9 SCHEDULE OF VALUES

A. The requirements herein are in addition to the provisions of Division 1.

B. Format:

1. Use AIA Document Continuation Sheets G703 or another similar form approved by the Owner and Architect/Engineer.
2. Submit in Excel format.
3. Support values given with substantiating data.

C. Preparation:

1. Itemize work required by each specification section and list all providers. All work provided by subcontractors and major suppliers shall be listed on the Schedule of Values. List each subcontractor and supplier by company name.

2. Break down all costs into:

a. Material: Delivered cost of product with taxes paid.
b. Labor: Labor cost, excluding overhead and profit.

D. Update Schedule of Values when:

1. Indicated by Architect/Engineer.
2. Change of subcontractor or supplier occurs.
3. Change of product or equipment occurs.

1.10 CHANGE ORDERS

A. A detailed material and labor takeoff shall be prepared for each change order, along with labor rates and markup percentages. Change orders with inadequate breakdown will be rejected.

B. Change order work shall not proceed until authorized.

1.11 PRODUCT DELIVERY, STORAGE, HANDLING AND MAINTENANCE

A. Exercise care in transporting and handling to avoid damage to materials. Store materials on the site to prevent damage.

B. Keep all materials clean, dry and free from damaging environments.

C. Coordinate the installation of heavy and large equipment with the General Contractor and/or Owner. If the Electrical Contractor does not have prior documented experience in rigging and lifting similar equipment, he/she shall contract with a qualified lifting and rigging service that has similar documented experience. Follow all equipment lifting and support guidelines for handling and moving.

D. Contractor is responsible for moving equipment into the building and/or site. Contractor shall review site prior to bid for path locations and any required building modifications to allow movement of equipment. Contractor shall coordinate his/her work with other trades.

1.12 NETWORK / INTERNET CONNECTED EQUIPMENT

A. These specifications may require certain equipment or systems to have network, Internet and/or remote access capability ("Network Capability"). Any requirement for Network Capability shall be interpreted only as a functional capability and is not to be construed as authority to connect or enable any Network Capability. Network Capability may only be connected or enabled with the express written consent of the Owner.

1.13 WARRANTY

A. Refer to Division 01 specification for requirements.

1.14 INSURANCE

A. This Contractor shall maintain insurance coverage as set forth in Division 1 of these specifications.

1.15 MATERIAL SUBSTITUTION

A. Refer to Division 01 specification for requirements.

1.16 LEED REQUIREMENTS

A. This project is pursuing a LEED certification in accordance with USGBC LEED Rating System for New Construction v3. The Contractor shall provide all services and documentation necessary to achieve this rating. Refer to architectural specifications.

1.17 PROJECT COMMISSIONING

A. The Contractor shall work with the Commissioning Agent (CxA) as described in Section and provide all services necessary for compliance with LEED Prerequisite EAp1, Fundamental Commissioning, and EAc3 Enhanced Commissioning.

PART 2 - PRODUCTS

2.1 GENERAL

A. All items of material having a similar function (e.g., safety switches, panelboards, switchboards, contactors, motor starters, dry type transformers) shall be of the same manufacturer unless specifically stated otherwise on drawings or elsewhere in specifications.

PART 3 - EXECUTION

3.1 JOBSITE SAFETY

A. Neither the professional activities of the Architect/Engineer, nor the presence of the Architect/Engineer or his or her employees and subconsultants at a construction site, shall relieve the Contractor and any other entity of their obligations, duties and responsibilities including, but not limited to, construction means, methods, sequence, techniques or procedures necessary for performing, superintending or coordinating all portions of the work of construction in accordance with the contract documents and any health or safety precautions required by any regulatory agencies. The Architect/Engineer and his or her personnel have no authority to exercise any control over any construction contractor or other entity or their employees in connection with their work or any health or safety precautions. The Contractor is solely responsible for jobsite safety. The Architect/Engineer and the Architect/Engineer's consultants shall be indemnified and shall be made additional insureds under the Contractor's general liability insurance policy.

3.2 EXCAVATION, FILL, BACKFILL, COMPACTION

A. General:

1. Prior to the commencement of any excavation or digging, the Contractor shall verify all underground utilities with the regional utility locator. Provide prior notice to the locator before excavations. Contact information for most regional utility locaters can be found by calling 811.

2. The Contractor shall do all excavating, filling, backfilling, compacting, and restoration in connection with his work.

B. Excavation:

1. Make all excavations to accurate, solid, undisturbed earth, and to proper dimensions.

2. If excavations are carried in error below indicated levels, concrete of same strength as specified for the foundations or thoroughly compacted sand-gravel fill, as determined by the Architect/Engineer shall be placed in such excess excavations under the foundation. Place thoroughly compacted, clean, stable fill in excess excavations under slabs on grade, at the Contractor's expense.

3. Trim bottom and sides of excavations to grades required for foundations.

4. Protect excavations against frost and freezing.

5. Take care in excavating not to damage surrounding structures, equipment or buried pipe. Do not undermine footing or foundation.

6. Perform all trenching in a manner to prevent cave-ins and risk to workmen.

7. Where original surface is pavement or concrete, the surface shall be saw cut to provide clean edges and assist in the surface restoration.

8. If satisfactory bearing soil is not found at the indicated levels, immediately notify the Architect/Engineer or their representative, and do no further work until the Architect/Engineer or their representative gives further instructions.

9. Excavation shall be performed in all ground conditions, including rock, if encountered. Bidders shall visit the premises and determine the soil conditions by actual observations, borings, or other means. The cost of all such inspections, borings, etc., shall be borne by the bidder.

10. If a trench is excavated in rock, a compacted bed with a depth of 3" (minimum) of sand and gravel shall be used to support the conduit unless masonry cradles or encasements are used.

11. Mechanical excavation of the trench to line and grade of the conduit or to the bottom level of masonry cradles or encasements is permitted, unless otherwise indicated on the electrical drawings.

12. Mechanical excavation of the trench to line and grade where direct burial cables are to be installed is permitted provided the excavation is made to a depth to permit installation of the cable on a fine sand bed at least 3 inches deep.

C. Dewatering:

1. Furnish, install, operate and remove all dewatering pumps and pipes needed to keep trenches and pits free of water.

D. Underground Obstructions:

1. Known underground piping, conduit, feeders, foundations, and other obstructions in the vicinity of construction are shown on the drawings. Review all Bid Documents for all trades on the project to determine obstructions indicated. Take great care in making installations near underground obstructions.

2. If objects not shown on the drawings are encountered, remove, relocate, or perform extra work as directed by the Architect/Engineer.

E. Fill and Backfilling:

1. No rubbish or waste material is permitted for fill or backfill.

2. Furnish all necessary sand for backfilling.

3. Dispose of the excess excavated earth as directed.

4. Backfill materials shall be suitable for required compaction, clean and free of perishable materials, frozen earth, debris, earth with a high void content, and stones greater than 4 inches in diameter. Water is not permitted to rise in unbackfilled trenches.

5. Backfill all trenches and excavations immediately after installing of conduit, or removing forms, unless other protection is directed.

6. Around piers and isolated foundations and structures, backfill and fill shall be placed and consolidated simultaneously on all sides to prevent wedge action and displacement. Spread fill and backfill materials in 6” uniform horizontal layers with each layer compacted separately to required density.

7. For conduits that are not concrete encased, lay all conduits on a compacted bed of sand at least 3" deep. Backfill around conduits with sand, in 6" layers and compact each layer.

8. Conduits that are concrete encased or in a ductbank, conduit spacers, and cradles shall be installed on a bed of compacted CA-6 gravel. Refer to conduit section for backfilling and ductbank requirements.

9. Backfill with sand up to grade for all conduits under slabs or paved areas. All other conduits shall have sand backfill to 6" above the top of the conduit.

10. Place all backfill above the sand in uniform layers not exceeding 6” deep. Place then carefully and uniformly tamp each layer to eliminate lateral or vertical displacement.

11. Where the fill and backfill will ultimately be under a building, floor or paving, each layer of fill shall be compacted to 95% of the maximum density as determined by AASHTO Designation T-99 or ASTM Designation D-698. Moisture content of soil at time of compaction shall not exceed plus or minus 2% of optimum moisture content as determined by AASHTO T-99 or ASTM D-698 test.

12. After backfilling of trenches, no superficial loads shall be placed on the exposed surface of the backfill until a period of 48 hours has elapsed.

F. Surface Restoration:

1. Where trenches are cut through graded, planted or landscaped areas, the areas shall be restored to the original condition. Replace all planting and landscaping features removed or damaged to its original condition. At least 6” of topsoil shall be applied where disturbed areas are to be seeded or sodded. All lawn areas shall be sodded unless seeding is called out in the drawings or specifications.

2. Concrete or asphalt type pavement, seal coat, rock, gravel or earth surfaces removed or damaged shall be replaced with comparable materials and restored to original condition. Broken edges shall be saw cut and repaired as directed by Architect/Engineer.

3.3 ARCHITECT/ENGINEER OBSERVATION OF WORK

A. The contractor shall provide seven (7) calendar days’ notice to the Architect/Engineer prior to:

1. Placing fill over underground and underslab utilities.

2. Covering exterior walls, interior partitions and chases.

3. Installing hard or suspended ceilings and soffits.

B. The Architect/Engineer will review the installation and provide a written report noting deficiencies requiring correction. The contractor’s schedule shall account for these reviews and show them as line items in the approved schedule.

C. Above-Ceiling Final Observation:

1. All work above the ceilings must be complete prior to the Architect/Engineer’s review. This includes, but is not limited to:

a. All junction boxes are closed and identified in accordance with Section 26 05 53 Electrical Identification.

b. Light fixtures, including ceiling-mounted exit and emergency lights, are installed and operational.

c. Light fixture whips are suspended above the ceiling.

d. Conduit identification is installed in accordance with Section 26 05 53 Electrical Identification.

e. Light fixtures are suspended independently of the ceiling system when required by these contract documents.

f. All wall penetrations have been sealed.

2. In order to prevent the Above-Ceiling Final Observation from occurring too early, the Contractor shall review the status of the work and certify, in writing, that the work is ready for the Above-Ceiling Final Observation.

3. It is understood that if the Architect/Engineer finds the ceilings have been installed prior to this review and prior to seven days elapsing, the Architect/Engineer may not recommend further payments to the contractor until such time as full access has been provided.

3.4 PROJECT CLOSEOUT

A. The following paragraphs supplement the requirements of Division 1.

B. Final Jobsite Observation:

1. In order to prevent the Final Jobsite Observation from occurring too early, the Contractor shall review the completion status of the project and certify that the job is ready for the final jobsite observation.

2. Attached to the end of this section is a typical list of items that represent the degree of job completeness expected prior to requesting a review. The Contractor shall sign the attached certification and return it to the Architect/Engineer so that the final observation can be scheduled.

3. It is understood that if the Architect/Engineer finds the job not ready for the final observation and additional trips and observations are required to bring the project to completion, the cost of the additional time and expenses incurred by the Architect/Engineer will be deducted from the Contractor’s final payment.

4. Contractor shall notify Architect/Engineer 48 hours prior to installation of ceilings or lay-in ceiling tiles.

C. The following must be submitted before Architect/Engineer recommends final payment:

1. Operation and maintenance manuals with copies of approved shop drawings.

2. Record documents including reproducible drawings and specifications.

3. A report documenting the instructions given to the Owner's representatives complete with the number of hours spent in the instruction. The report shall bear the signature of an authorized agent of this Contractor and shall be signed by the Owner's representatives.

4. Provide spare parts, maintenance, and extra materials in quantities specified in individual specification sections. Deliver to project site and place in location as directed and submit receipt to Architect/Engineer.

5. Inspection and testing report by the fire alarm system manufacturer.

6. Start-up reports on all equipment requiring a factory installation or start-up.

3.5 OPERATION AND MAINTENANCE MANUALS

A. Refer to Division 01 specification for requirements.

3.6 INSTRUCTING THE OWNER'S REPRESENTATIVE

A. Adequately instruct the Owner's designated representatives in the maintenance, care, and operation of the complete systems installed under this contract as set forth in Division 1 specifications.

B. Provide verbal and written instructions to the Owner's representatives by FACTORY PERSONNEL in the care, maintenance, and operation of the equipment and systems.

C. The Owner has the option to make a video recording of all instructions. Coordinate schedule of instructions to facilitate this recording.

D. The instructions shall include:

1. Maintenance of equipment.
2. Start-up procedures for all major equipment.
3. Description of emergency system operation.

E. Notify the Architect/Engineer of the time and place for the verbal instructions to the Owner's representative so his representative can be present if desired.

F. Minimum hours of instruction time for each item and/or system shall be as indicated in each individual specification section.

G. Operating Instructions:

1. Contractor is responsible for all instructions to the Owner’s representatives for the electrical and specialized systems.

2. If the Contractor does not have staff that can adequately provide the required instructions, he shall include in his bid an adequate amount to reimburse the Owner for the Architect/Engineer to perform these services.

3.7 RECORD DOCUMENTS

A. The following paragraphs supplement the requirements of Division 1.

B. Maintain at the job site a separate and complete set of electrical drawings and specifications with all changes made to the systems clearly and permanently marked in complete detail.

C. Mark drawings and specifications to indicate approved substitutions; Change Orders, and actual equipment and materials used. All Change Orders, RFI responses, Clarifications and other supplemental instructions shall be marked on the documents. Record documents that merely reference the existence of the above items are not acceptable. Should this Contractor fail to complete Record Documents as required by this contract, this Contractor shall reimburse Architect/Engineer for all costs to develop record documents that comply with this requirement. Reimbursement shall be made at the Architect/Engineer’s hourly rates in effect at the time of work.

D. Record changes daily and keep the marked drawings available for the Architect/Engineer's examination at any normal work time.

E. Upon completing the job, and before final payment is made, give the marked-up drawings to the Architect/Engineer.

3.8 PAINTING

A. Paint all equipment that is marred or damaged prior to the Owner's acceptance. Paint and color shall match original equipment paint and shall be obtained from the equipment supplier if available. All equipment shall have a finished coat of paint applied unless specifically allowed to be provided with a prime coat only.

B. Equipment in finished areas that will be painted to match the room decor will be painted by others. Should this Contractor install equipment in a finished area after the area has been painted, he shall have the equipment and all its supports, hangers, etc., painted to match the room decor. Painting shall be performed as described in project specifications.

C. Equipment cabinets, casings, covers, metal jackets, etc., located in equipment rooms or concealed spaces, shall be furnished in standard finish, free from scratches, abrasions, chippings, etc.

D. Equipment in occupied spaces, or if standard to the unit, shall have a baked primer with baked enamel finish coat free from scratches, abrasions, chipping, etc. If color option is specified or is standard to the unit, verify with the Architect his color preference before ordering.

E. Paint all equipment in unfinished areas such as boiler room, mechanical spaces, and storage rooms. Equipment furnished with a suitable factory finish need not be painted; provided the factory applied finish is not marred or spattered. If so, equipment shall be refinished with the same paint as was factory applied.

F. All electrical conduit and equipment, fittings, hangers, structural supports, etc., in unfinished areas, such as equipment and storage room area, shall be painted two (2) coats of oil paint of colors selected by the Architect.

G. Do NOT paint electric conduits in crawl spaces, tunnels, or spaces above suspended ceilings except that where conduit is in a damp location give exposed threads at joints two coats of sealer after joint is made up.

H. After surfaces have been thoroughly cleaned and are free of oil, dirt or other foreign matter, paint all raceway and equipment with the following:

1. Bare Metal Surfaces - Apply one coat of metal primer suitable for the metal being painted. Finish with two coats of Alkyd base enamel paint.

2. Plastic Surfaces - Paint plastic surfaces with two coats of semi-gloss acrylic latex paint.

I. In accordance with LEED EQc4.2: Low-Emitting Materials - Paints and Coatings, all paints and coatings used on the interior of the building must comply with the following criteria:

1. Architectural paints and coatings applied to interior walls and ceilings must not exceed the volatile organic compound (VOC) content limits established in Green Seal Standard GS-11, Paints, 1st Edition, May 20, 1993.

2. Anti-corrosive and anti-rust paints applied to interior ferrous metal substrates must not exceed the VOC content limit of 250 g/L (2 lb./gal) established in Green Seal Standard GC-03, Anti-Corrosive Paints, 2nd Edition, January 7, 1997.

3.9 ADJUST AND CLEAN

A. Thoroughly clean all equipment and systems prior to the Owner's final acceptance of the project.

B. Clean all foreign paint, grease, oil, dirt, labels, stickers, etc. from all equipment.

C. Remove all rubbish, debris, etc., accumulated during construction from the premises.

3.10 SPECIAL REQUIREMENTS

A. Coordinate the installation of all equipment, controls, devices, etc., with other trades to maintain clear access area for servicing.

B. Install all equipment to maximize access to parts needing service or maintenance. Review the final location, placement, and orientation of equipment with the Owner's representative prior to setting equipment.

C. Installation of equipment or devices without regard to coordination of access requirements and confirmation with the Owner's representative will result in removal and reinstallation of the equipment at the Contractor's expense.

D. In accordance with LEED EQc4.1, Low-Emitting Materials - Adhesives and Sealants, all adhesives and sealants used on the interior of the building must comply with the following requirements:

1. Adhesives, sealants and sealant primers must comply with South Coast Air Quality Management District (SCAQMD) Rule #1168.

2. Aerosol adhesives must comply with Green Seal Standard for Commercial Adhesives GS-36 requirements in effect on October 19, 2000.

3.11 INDOOR AIR QUALITY (IAQ) MAINTENANCE FOR OCCUPIED FACILITIES UNDER CONSTRUCTION

A. Within the limits of Construction:

1. The Electrical Contractor shall coordinate all work with the contractor responsible for IAQ.

2. The means, methods and materials used by the Electrical Contractor shall be coordinated with the contractor responsible for IAQ and shall comply with the IAQ requirements set forth in Division 1 and Division 21/22/23 of these specifications.

B. Outside the limits of Construction:

1. IAQ shall be the responsibility of the electrical contractor for work that is required outside the limits of construction.

2. The Electrical Contractor is responsible for the IAQ set forth in Division 1 and Division 21/22/23 of these specifications.

3. The Electrical Contractor shall review and coordinate all IAQ plans and procedures with the owner's IAQ representative.

3.12 SYSTEM STARTING AND ADJUSTING

A. The electrical systems shall be complete and operating. System startup, testing, adjusting, and balancing to obtain satisfactory system performance is the responsibility of the Contractor. This includes all calibration and adjustment of electrical controls, balancing of loads, troubleshooting and verification of software, and final adjustments that may be needed.

B. Complete all manufacturer-recommended startup procedures and checklists to verify proper equipment operation and does not pose a danger to personnel or property.

C. All operating conditions and control sequences shall be tested during the start-up period. Testing all interlocks, safety shut-downs, controls, and alarms.

D. The Contractor, subcontractors, and equipment suppliers shall have skilled technicians to ensure that all systems perform properly. If the Architect/Engineer is requested to visit the job site for trouble shooting, assisting in start-up, obtaining satisfactory equipment operation, resolving installation and/or workmanship

problems, equipment substitution issues or unsatisfactory system performance, including call backs during the warranty period, through no fault of the design; the Contractor shall reimburse the Owner on a time and materials basis for services rendered at the Architect/Engineer's standard hourly rates in effect when the services are requested. The Contractor shall pay the Owner for services required that are product, installation or workmanship related. Payment is due within 30 days after services are rendered.

3.13 FIELD QUALITY CONTROL

A. General:

1. Conduct all tests required during and after construction. Submit test results in NETA format, or equivalent form, that shows the test equipment used, calibration date, tester's name, ambient test conditions, humidity, conductor length, and results corrected to 40°C.

2. Supply necessary instruments, meters, etc., for the tests. Supply competent technicians with training in the proper testing techniques.

3. All cables and wires shall be tested for shorts and grounds following installation and connection to devices. Replace shorted or grounded wires and cables.

4. Any wiring device, electrical apparatus or lighting fixture, if grounded or shorted on any integral "live" part, shall have all defective parts or materials replaced.

5. Test cable insulation of service and panel feeder conductors for proper insulation values. Tests shall include the cable, all splices, and all terminations. Each conductor shall be tested and shall test free of short circuits and grounds and have an insulation value not less than NEC Standards. Take readings between conductors, and between conductors and ground.

6. If the results obtained in the tests are not satisfactory make adjustments, replacements, and changes as needed. Then repeat the tests, and make additional tests, as the Architect/Engineer or authority having jurisdiction deems necessary.

B. Ground Resistance:

1. Conduct service ground resistance tests using an approved manufactured ground resistance meter. Submit to the Architect/Engineer a proposed test procedure including type of equipment to be used. (The conventional ohmmeter is not an acceptable device.)

2. Make ground resistance measurements during normal dry weather and not less than 48 hours after a rain.

3. If the ground resistance value obtained is more than the value set forth in Section 26 05 26, the following shall be done to obtain the value given:

   a. Verify that all connections in the service ground system are secure.

   b. Increase the depth to which ground rods are driven by adding section lengths to the rods and retest. If the resistance is still excessive increase the depth by adding an additional rod section and retest.

   c. If the resistance is still excessive, furnish and install additional ground rods, spaced not less than 20 feet from other ground rods unless otherwise noted on plans, and connect into the ground electrode system. Retest.

   d. Review results with the Architect/Engineer.

4. Before final payment is made to the Contractor submit a written report to the Architect/Engineer including the following:

a. Date of test.

b. Number of hours since the last rain.

c. Soil condition at the time of the test in the ground electrode location. That is: dry, wet, moist, sand, clay, etc.

d. Diagram of the test set-up showing distances between test equipment, ground electrode, auxiliary electrodes, etc.

e. Make, model, and calibration date of test equipment.

f. Tabulation of measurements taken and calculations made.

C. Other Equipment:

1. Give other equipment furnished and installed by the Contractor all standard tests normally made to assure that the equipment is electrically sound, all connections properly made, phase rotation correct, fuses and thermal elements suitable for protection against overloads, voltage complies with equipment nameplate rating, and full load amperes are within equipment rating.

D. If any test results are not satisfactory, make adjustments, replacements and changes as needed and repeat the tests and make additional tests as the Architect/Engineer or authority having jurisdiction deem necessary.

E. Upon completion of the project, the Contractor shall provide amperage readings for all panelboards and switchboards and turn the results over to the Owner for “benchmark” amperages.

3.14 CONSTRUCTION WASTE MANAGEMENT

A. This Contractor shall comply with all construction and demolition waste disposal and recycling requirements outlined in LEED MRc2: Construction Waste Management (follow latest edition at the time of bidding or as referenced in these specifications).

1. This Contractor shall coordinate with the General Contractor to develop and implement a construction waste management plan that, at a minimum, identifies the materials to be diverted from disposal and whether the materials will be sorted on-site or co-mingled.

2. The Contractor shall track waste disposal and recycling efforts throughout the construction process for all materials associated with this Contractor’s scope of work. The Contractor shall provide this information to the General Contractor so that it can be incorporated with similar information from all other contractors for the project.

a. Calculations for waste and recycled material can be done by weight or volume, but they must be consistent throughout the project. The Contractor shall coordinate with the General Contractor to establish the preferred calculation method and report the results accordingly.

b. Excavated soil and land-clearing debris do not count towards the waste disposal or recycled material.

END OF SECTION

READINESS CERTIFICATION PRIOR TO FINAL JOBSITE OBSERVATION

In order to prevent the final job observation from occurring too early, we require that the Contractor review the completion status of the project and, by copy of this document, certify that the job is indeed ready for the final job observation. The following is a typical list of items that represent the degree of job completeness expected prior to your requesting a final job observation.

1. Penetrations of fire-rated construction fire sealed in accordance with specifications.
2. Electrical panels have typed circuit identification.
3. Smoke and fire/smoke dampers are wired and have been tested.
4. Per Section 26 05 00, cable insulation test results have been submitted.
5. Per Section 26 05 00, medium voltage testing report has been submitted.
6. Per Section 26 05 00, ground resistance test results have been submitted.
7. Operation and Maintenance manuals have been submitted as per Section 26 05 00.
8. Bound copies of approved shop drawings have been submitted as per Section 26 05 00.
9. Report of instruction of Owner's representative has been submitted as per Section 26 05 00.
10. Fire alarm inspection and testing report has been submitted as per Sections 26 05 00 and 28 31 00.
11. Start-up reports from factory representative have been submitted as per Section 26 05 00.

Accepted by:

Prime Contractor _____

By _____ Date _____

Upon Contractor certification that the project is complete and ready for a final job observation, we require the Contractor to sign this agreement and return it to the Architect/Engineer so that the final observation can be scheduled.

It is understood that if the Architect/Engineer finds the job not ready for the final observation and that additional trips and observations are required to bring the project to completion, the costs incurred by the Architect/Engineers for additional time and expenses will be deducted from the Contractor's contract retainage prior to final payment at the completion of the job.

* * * * * *

SECTION 26 05 03
THROUGH PENETRATION FIRESTOPPING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Through-Penetration Firestopping.

1.2 QUALITY ASSURANCE

A. Manufacturer: Company specializing in manufacturing products specified in this Section.

B. Installer: Individuals performing work shall be certified by the manufacturer of the system selected for installation.

1.3 REFERENCES

A. UL 723 - Surface Burning Characteristics of Building Materials
B. ANSI/UL 1479 - Fire Tests of Through Penetration Firestops
C. UL Fire Resistance Directory Through Penetration Firestop Systems (XHEZ)
D. Intertek / Warnock Hersey - Directory of Listed Products
E. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials
F. ASTM E814 - Standard Test Method for Fire Tests of Through-Penetration Firestops
G. The Building Officials and Code Administrators National Building Code
H. Uniform Building Code
I. Wisconsin Administrative Code
J. International Building Code
K. NFPA 5000 – Building Construction Safety Code

1.4 DELIVERY, STORAGE, AND HANDLING

A. Store, protect and handle products on site. Accept material on site in factory containers and packing. Inspect for damage. Protect from deterioration or damage due to moisture, temperature changes, contaminants, or other causes. Follow manufacturer's instructions for storage.

B. Install material prior to expiration of product shelf life.

1.5 PERFORMANCE REQUIREMENTS

A. General: For penetrations through the following fire-resistance-rated constructions, including both empty openings and openings containing penetrating items, provide through-penetration firestop systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated.

1. Fire-resistance-rated walls including fire partitions, fire barriers, and smoke barriers.
2. Fire-resistance-rated horizontal assemblies including floors, floor/ceiling assemblies, and ceiling membranes of roof/ceiling assemblies.

B. Rated Systems: Provide through-penetration firestop systems with the following ratings determined per UL 1479:

1. F-Rated Systems: Provide through-penetration firestop systems with F-ratings indicated, but not less than that equaling or exceeding fire-resistance rating of constructions penetrated.
2. T-Rated Systems: For the following conditions, provide through-penetration firestop systems with T-ratings indicated, as well as F-ratings**:**

a. Floor penetrations located outside wall cavities.
b. Floor penetrations located outside fire-resistance-rated shaft enclosures.

3. L-Rated Systems: Provide through-penetration firestop systems with L-ratings of not more than 5.0 cfm/sq.ft. (0.0254 cu. m/s x sq. m) at both ambient temperature and 400°F (204°C) for smoke barriers.

C. For through-penetration firestop systems exposed to light, traffic, moisture, or physical damage, provide products that, after curing, do not deteriorate when exposed to these conditions both during and after construction.

D. For through-penetration firestop systems exposed to view, provide products with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.

E. For through-penetration firestop systems in air plenums, provide products with flame-spread and smoke-developed indexes of less than 25 and 50, respectively, as determined per ASTM E 84.

F. In accordance with LEED EQc4.1, Low-Emitting Materials - Adhesives and Sealants, all adhesives and sealants used on the interior of the building must comply with the following requirements:

1. Adhesives, sealants and sealant primers must comply with South Coast Air Quality Management District (SCAQMD) Rule #1168.

2. Aerosol adhesives must comply with Green Seal Standard for Commercial Adhesives GS-36 requirements in effect on October 19, 2000.

1.6 MEETINGS

A. Pre-installation meeting: A pre-installation meeting shall be scheduled and shall include the Construction Manager, General Contractor, all Subcontractors associated with the installation of systems penetrating fire barriers, Firestopping Manufacturer's Representative, and the Owner.

1. Review foreseeable methods related to firestopping work.

2. Tour representative areas where firestopping is to be installed; inspect and discuss each type of condition and each type of substrate that will be encountered, and preparation to be performed by other trades.

1.7 WARRANTY

A. Provide one year warranty on parts and labor.

B. Warranty shall cover repair or replacement of firestop systems which fail in joint adhesion, cohesion, abrasion resistance, weather resistance, extrusion resistance, migration resistance, stain resistance, general durability, or appear to deteriorate in any manner not clearly specified by the manufacturer as an inherent quality of the material.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Products: Subject to compliance with requirements, provide one of the through-penetration firestop systems indicated for each application that are produced by one of the following manufacturers. All firestopping systems installed shall be provided by a single manufacturer.

1. 3M; Fire Protection Produces Division.
2. Hilti, Inc.

3. RectorSeal Corporation, Metacaulk.
4. Tremco; Sealant/Weatherproofing Division.
5. Johns-Manville.
6. Specified Technologies Inc. (S.T.I.)
7. Spec Seal Firestop Products
8. AD Firebarrier Protection Systems
9. Wiremold/legrand: FlameStopper

2.2 THROUGH PENETRATION FIRESTOP SYSTEMS

A. Provide materials and systems classified by or listed by Intertek / Warnock Hersey to provide firestopping equal to time rating of construction being penetrated.

B. All firestopping materials shall be free of asbestos, lead, PCB's, and other materials that would require hazardous waste removal.

C. Firestopping shall be flexible to allow for normal penetrating item movement due to expansion and contraction.

D. Provide firestopping systems capable of supporting floor loads where systems are exposed to possible floor loading or traffic.

E. Provide firestopping systems allowing continuous insulation for all insulated pipes.

F. Provide firestopping systems classified by UL or listed by Intertek / Warnock Hersey for penetrations through all fire rated construction. Firestopping systems shall be selected from the UL or listed by Intertek / Warnock Hersey Fire Resistance Directory Category XHEZ based on substrate construction and penetrating item size and material and shall fall within the range of numbers listed:

1. Combustible Framed Floors and Chase Walls - 1 or 2 Hour Rated
   F Rating = Floor/Wall Rating
   T Rating = Floor/Wall Rating
   L Rating = Penetrations in Smoke Barriers

Penetrating Item	UL System No.
No Penetrating Item	FC 0000-0999*
Metallic Pipe or Conduit	FC 1000-1999
Non-Metallic Pipe or Conduit	FC 2000-2999
Electrical Cables	FC 3000-3999
Cable Trays	FC 4000-4999
Insulated Pipes	FC 5000-5999
Bus Duct and Misc. Electrical	FC 6000-6999
Duct without Damper and Misc. Mechanical	FC 7000-7999
Multiple Penetrations	FC 8000-8999

2. Non-Combustible Framed Walls - 1 or 2 Hour Rated
   F Rating = Wall Rating
   T Rating = 0
   L Rating = Penetrations in Smoke Barriers

Penetrating Item	UL System No.
No Penetrating Item	WL 0000-0999*
Metallic Pipe or Conduit	WL 1000-1999
Non-Metallic Pipe or Conduit	WL 2000-2999

Penetrating Item	UL System No.
Electrical Cables	WL 3000-3999
Cable Trays	WL 4000-4999
Insulated Pipes	WL 5000-5999
Bus Duct and Misc. Electrical	WL 6000-6999
Duct without Damper and Misc. Mechanical	WL 7000-7999
Multiple Penetrations	WL 8000-8999

3. Concrete or Masonry Floors and Walls - 1 or 2 Hour Rated
F Rating = Wall/Floor Rating
T Rating (Floors) = Floor Rating
L Rating = Penetrations in Smoke Barriers

Penetrating Item	UL System No.
No Penetrating Item	CAJ 0000-0999*
Metallic Pipe or Conduit	CAJ 1000-1999
Non-Metallic Pipe or Conduit	CAJ 2000-2999
Electrical Cables	CAJ 3000-3999
Cable Trays	CAJ 4000-4999
Insulated Pipes	CAJ 5000-5999
Bus Duct and Misc. Electrical	CAJ 6000-6999
Duct without Damper and Misc. Mechanical	CAJ 7000-7999
Multiple Penetrations	CAJ 8000-8999

*Alternate method of firestopping is patching opening to match original rated construction.

G. Any opening in walls or floors not covered by the listed series of numbers shall be coordinated with the firestopping manufacturer.

H. Any openings in floors or walls not described in the UL or listed by Intertek / Warnock Hersey Fire Resistance Directory, or outlined in manufacturer's information shall be sealed in a manner agreed upon by the Firestopping Manufacturer, Owner, and the Authority Having Jurisdiction.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Ensure all surfaces that contact seal materials are free of dirt, dust, grease, oil, rust, or loose materials. Clean and repair surfaces as required. Remove laitance and form-release agents from concrete.

B. Ensure substrate and penetrating items have been permanently installed prior to installing firestopping systems. Ensure penetrating items have been properly spaced and have proper clearance prior to installing firestopping systems.

C. Surfaces to which sealing materials are to be installed must meet the selected UL or Intertek / Warnock Hersey system substrate criteria.

D. Prime substrates where recommended in writing by through-penetration firestop system manufacturer. Confine primer to area of bond.

3.2 INSTALLATION

A. In existing construction, provide firestopping of openings prior to and after installation of penetrating items. Remove any existing coatings on surfaces prior to firestopping installation. Temporary firestopping shall consist of packing openings with fire resistant mineral wool for the full thickness of substrate, or an alternate method approved by the Authority Having Jurisdiction. All openings shall be temporarily firestopped immediately upon their installation and shall remain so until the permanent UL or listed by Intertek / Warnock Hersey listed firestopping system is installed.

B. Install penetration seal materials in accordance with printed instructions of the UL or Intertek / Warnock Hersey Fire Resistance Directory and with the manufacturer's printed application instructions.

C. Install dams as required to properly contain firestopping materials within openings and as required to achieve required fire resistance rating. Remove combustible damming after appropriate curing.

3.3 CLEANING AND PROTECTING

A. Clean excess fill materials adjacent to openings as Work progresses by methods and with cleaning materials that are approved in writing by through-penetration firestop system manufacturers and that do not cause damage.

B. Provide final protection and maintain conditions during and after installation that ensure that through-penetration firestop systems are without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, remove damaged or deteriorated through-penetration firestop systems immediately and install new materials to produce systems complying with specified requirements.

3.4 INSPECTION

A. All penetrations shall be inspected by the manufacturer's representative to ensure proper installation.

B. Access to firestop systems shall be maintained for examination by the Authority Having Jurisdiction at their request.

C. Proceed with enclosing through-penetration firestop system with other construction only after inspection reports are issued and firestop installations comply with requirements.

D. The contractor shall allow for visual destructive review of 5% of installed firestop systems (minimum of one) to prove compliance with specifications and manufacturer's instructions and details. Destructive system removal shall be performed by the contractor and witnessed by the Architect/Engineer and manufacturer's factory representative. The Architect/Engineer shall have sole discretion of which firestop system installations will be reviewed. The contractor is responsible for all costs associated with this requirement including labor and material for removing and replacing the installed firestop system. If any firestop system is found to not be installed per manufacturer's specific instructions and details, all firestop systems are subject to destructive review and replacement at the Architect/Engineer's discretion and the contractor's expense.

END OF SECTION

SECTION 26 05 13
WIRE AND CABLE

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Building wire
B. Remote control and signal cable
C. Fire rated cable

1.2 REFERENCES

A. NEMA WC 70 - Power Cables Rated 2,000V or Less for the Distribution of Electrical Energy

B. NFPA 70 - National Electrical Code (NEC)

C. UL 44 – Thermoset-Insulated Wires and Cables

D. UL 83 – Thermoplastic-Insulated Wires and Cables

E. UL 854 – Service-Entrance Cables

F. UL 1581 – Standard for Electrical Wires, Cables, and Flexible Cords

PART 2 - PRODUCTS

2.1 BUILDING WIRE

A. Feeders and Branch Circuits Larger Than 6 AWG: Copper, stranded conductor, 600 volt insulation, XHHW-2.

B. Feeders and Branch Circuits Larger than 6 AWG in Underground Conduit: Copper, stranded conductor, 600 volt insulation, XHHW-2.

C. Feeders and Branch Circuits 6 AWG and Smaller: Copper conductor, 600 volt insulation, THHN/THWN. 6 and 8 AWG, stranded conductor; smaller than 8 AWG, solid or stranded conductor, unless otherwise noted on the drawings.

D. Three conductor stranded coverall helical copper tape shield. Shield shall be terminated at both ends of cable with an approved termination.

E. Control Circuits: Copper, stranded conductor 600 volt insulation, THHN/THWN.

F. Each 120 and 277 volt branch circuit shall have a dedicated neutral conductor. Neutral conductors shall be considered current-carrying conductors for wire derating.

2.2 REMOTE CONTROL AND SIGNAL CABLE

A. Control Cable for Class 1 Remote Control and Signal Circuits: Copper conductor, 600 volt insulation, rated 60°C, individual conductors twisted together, shielded, and covered with a PVC jacket.

B. Control Cable for Class 2 or Class 3 Remote Control and Signal Circuits: Copper conductor, 300 volt insulation, rated 60ºC, individual conductors twisted together, shielded, and covered with a PVC jacket; UL listed.

C. Plenum Cable for Class 2 or Class 3 Remote Control and Signal Circuits: Copper conductor, 300 volt insulation, rated 60°C, individual conductors twisted together, shielded, and covered with a nonmetallic jacket; UL listed for use in air handling ducts, hollow spaces used as ducts, and plenums.

2.3 FIRE-RATED CABLE

A. Two-hour Fire Rated Mineral Insulated Cables: Copper conductor, 600 volt insulation, rated 90ºC, Type MI.

PART 3 - EXECUTION

3.1 WIRE AND CABLE INSTALLATION SCHEDULE

A. Above Accessible Ceilings:

1. Building wire shall be installed in raceways.

B. All Other Locations: Building wire in raceway.

C. Above Grade: All conductors installed above grade shall be type “THHN”.

D. Underground or In Slab: All conductors shall be type “THWN”.

E. Low Voltage Cable (less than 100 volts): Low voltage cable shall be installed in raceway.

3.2 WIRE FOR SPECIALIZED SYSTEMS

A. Wire for the following specialized systems shall be as designated on the drawings, or elsewhere in these specifications. If not designated on the drawings or specifications, the system manufacturer's recommendations shall be followed:

1. Fire alarm
2. Low voltage switching
3. Sound
4. Electronic control
5. Security
6. TV
7. Telephone
8. Data
9. Clock

3.3 CONTRACTOR CHANGES

A. The basis of design is copper conductors installed in raceway based on ambient temperature of 30°C, NEC Table 310.16. Service entrance and fire pump feeder conductors are based on copper conductor installed in underground electrical ducts, NEC Table B.310.15(B)(2)(7).

B. The Contractor shall be responsible for derating and sizing conductors and conduits to equal or exceed the ampacity of the basis of design circuits, if he/she chooses to use methods or materials other than the basis of design.

C. Underground electrical duct ampacity rating shall be in accordance with NEC Table B.310.15(B)(2)(7) or calculated in accordance with Annex B Application Information for Ampacity Calculation. The calculations and a sketch of the proposed installation shall be submitted prior to any conduit being installed.

D. Record drawing shall include the calculations and sketches.

3.4 GENERAL WIRING METHODS

A. Use no wire smaller than 12 AWG for power and lighting circuits, and no smaller than 14 AWG for control wiring.

B. Use no wire smaller than 18 AWG for low voltage control wiring (<100 volts).

C. Use 10 AWG conductor for 20 ampere, 120 volt branch circuit home runs longer than 75 feet, and for 20 ampere, 277 volt branch circuit home runs longer than 200 feet.

D. Use no wire smaller than 8 AWG for outdoor lighting circuits.

E. The ampacity of multiple conductors in one conduit shall be derated per NEC 310. In no case shall more than 4 conductors be installed in one conduit to such loads as motors larger than 1/4 HP, panelboards, motor control centers, etc.

F. Where installing parallel feeders, place an equal number of conductors for each phase of a circuit in same raceway or cable.

G. Splice only in junction or outlet boxes.

H. Neatly train and lace wiring inside boxes, equipment, and panelboards.

I. Make conductor lengths for parallel circuits equal.

J. All conductors shall be continuous in conduit from last outlet to their termination.

K. Terminate all spare conductors on terminal blocks, and label the spare conductors.

L. Cables or wires shall not be laid out on the ground before pulling.

M. Cables or wires shall not be dragged over earth or paving.

N. Care shall be taken so as not to subject the cable or wire to high mechanical stresses that would cause damage to the wire and cable.

O. At least six (6)-inch loops or ends shall be left at each outlet for installation connection of luminaires or other devices.

P. All wires in outlet boxes not connected to fixtures or other devices shall be rolled up, spliced if continuity of circuit is required, and insulated.

3.5 WIRING INSTALLATION IN RACEWAYS

A. Pull all conductors into a raceway at the same time. Use UL listed wire pulling lubricant for pulling 4 AWG and larger wires.

B. Install wire in raceway after interior of building has been physically protected from the weather and all mechanical work likely to injure conductors has been completed.

C. Pulling shall be continuous without unnecessary stops and starts with wire or cable only partially thru raceway.

D. Where reels of cable or wire are used, they shall be set up on jacks close to the point where the wire or cable enters the conduit or duct so that the cable or wire may be unreeled and run into the conduit or duct with a minimum of change in the direction of the bend.

E. Conductors shall not be pulled through conduits until plastering or masonry work is completed and conduits are free from moisture. Care shall be taken so that long pulls of wire or pulls around several bends are not made where the wire may be permanently stretched and the insulation damaged.

F. Only nylon rope shall be permitted to pull cables into conduit and ducts.

G. Completely and thoroughly swab raceway system before installing conductors.

H. Conductor Supports in Vertical Raceways:

1. Support conductors in vertical raceways in accordance with NEC 300.19 and Table 300.19(A) Spacing of Conductors Supports.

2. Supports shall be of insulated wedge type (OZ Gedney Type S, or equal) and installed in a tapered insulated bushing fitting or a metal woven mesh with a support ring that fits inside conduit fitting installed in an accessible junction box (Hubbell Kellems support grip or equal).

3.6 CABLE INSTALLATION

A. Provide protection for exposed cables where subject to damage.

B. Use suitable cable fittings and connectors.

C. Run all open cable parallel or perpendicular to walls, ceilings, and exposed structural members. Follow the routing as illustrated on the drawings as closely as possible. Cable routing on drawings scaled 1/4”=1’-0” or less shall be considered diagrammatical, unless noted otherwise. The correct routing, when shown diagrammatically, shall be chosen by the Contractor based on information in the contract documents; in accordance with the manufacturer’s written instructions, applicable codes, the NECA’s “Standard of Installation”, recognized industry standards; and coordinated with other contractors.

D. Open cable shall be supported by the appropriate size J-hooks or other means if called for on the drawings. Wire and cable from different systems shall not be installed in the same J-hook. J-hooks shall be sized with 20% spare capacity. J-hooks shall provide proper bend radius support for data cable and fiber cables. J-hooks shall be Caddy CAT or Mono Systems H-433 series.

E. Open cable installed above suspended ceilings shall not rest on the suspended ceiling construction, nor utilize the ceiling support system for wire and cable support.

F. J-hook supports shall be installed at a maximum of five-foot (5') intervals. All J-hooks shall be installed where completely accessible and not blocked by piping, ductwork, inaccessible ceilings, etc. J-hooks shall be independently rigidly attached to a structural element. J-hooks shall be installed to provide 2” horizontal separation and 6” vertical separation between systems.

G. Open cable shall only be installed where specifically shown on the drawings, or permitted in these specifications.

3.7 FIRE-RATED CABLE INSTRUCTIONS

A. Terminations of the fire-rated cable must be outside of the fire zone.

B. Fire-rated cable shall be installed according to the manufacturer’s recommendations.

3.8 WIRING CONNECTIONS AND TERMINATIONS

A. Splice and tap only in accessible junction boxes.

B. Use solderless, tin-plated copper, compression terminals (lugs) applied with circumferential crimp for copper conductor terminations, 8 AWG and larger.

C. Use solderless, tin-plated, compression terminals (lugs) applied with indenter crimp for copper conductor terminations, 10 AWG and smaller.

D. Use solderless pressure connectors with insulating covers for copper wire splices and taps, 8 AWG and smaller. For 10 AWG and smaller, use insulated spring wire connectors with plastic caps.

E. Use copper, compression connectors applied with circumferential crimp for copper wire splices and taps, 6 AWG and larger. Tape uninsulated conductors and connectors with electrical tape to 150 percent of the insulation value of conductor.

F. Thoroughly clean wires before installing lugs and connectors.

G. Make splices, taps and terminations to carry full ampacity of conductors without perceptible temperature rise.

H. Phase Sequence: All apparatus shall be connected to operate in the phase sequence A-B-C representing the time sequence in which the phase conductors so identified reach positive maximum voltage.

I. As a general rule, applicable to switches, circuit breakers, starters, panelboards, switchgear and the like, the connections to phase conductors are intended thus:

1. Facing the front and operating side of the equipment, the phase identification shall be:

a. Left to Right - A-B-C
b. Top to Bottom - A-B-C

J. Connection revisions as required to achieve correct rotation of motors shall be made at the load terminals of the starters or disconnect switches.

3.9 FIELD QUALITY CONTROL

A. Field inspection and testing will be performed under provisions of Division 1.

B. Building Wire and Power Cable Testing: Perform an insulation-resistance test on each conductor with respect to ground and adjacent conductors. Test shall be made by means of a low-resistance ohmmeter, such as a "Megger". The applied potential shall be 500 volts dc for 300 volt rated cable and 1000 volts dc for 600 volt rated cable. The test duration shall be one minute. Insulation resistance must be greater than 100 mega-ohm for 600 volt and 25 mega-ohm for 300 volt rated cables per NETA Acceptance Testing Standard. Verify uniform resistance of parallel conductors.

C. Inspect wire and cable for physical damage and proper connection.

D. Torque test conductor connections and terminations to manufacturer's recommended values.

E. Perform continuity test on all power and equipment branch circuit conductors. Verify proper phasing connections.

F. Protection of wire and cable from foreign materials:

1. It is the Contractor's responsibility to provide adequate physical protection to prevent foreign material application or contact with any wire or cable type. Foreign material is defined as any material that would negatively impact the validity of the manufacturer's performance warranty. This includes, but is not limited to, overspray of paint (accidental or otherwise), drywall compound, or any other surface chemical, liquid, or compound that could come in contact with the cable, cable jacket, or cable termination components.

G. Overspray of paint on any wire or cable will not be accepted. It shall be the Contractor's responsibility to replace any component containing overspray, in its entirety, at no additional cost to the project. Cleaning of the cables with harsh chemicals is not allowed.

END OF SECTION

SECTION 26 05 26
GROUNDING AND BONDING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Equipment grounding system
B. Bonding system
C. Grounding electrode system

1.2 QUALITY ASSURANCE

A. Testing Agency Qualifications: Testing agency as defined by OSHA in 29 CFR 1910.7 or a member company of the International Electrical Testing Association and that is acceptable to authorities having jurisdiction.

B. Testing Agency's Field Supervisor: Person currently certified by the International Electrical Testing Association to supervise on-site testing specified in Part 3.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

D. Comply with UL 467 Grounding and Bonding Equipment.

E. Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system.

F. Comply with NFPA 70; for overhead-line construction and medium-voltage underground construction, comply with IEEE/ANSI C2 National Electrical Safety Code (NESC).

1.3 SUBMITTALS

A. Submit shop drawings under provisions of Section 26 05 00.

B. Product Data: For the following:

1. Ground rods.
2. Chemical electrodes.

C. Field Test Reports: Submit written test reports to include the following:

1. Test procedures used.
2. Test results that comply with requirements.
3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

D. Indicate layout of ground field, location of system grounding electrode connections, and routing of grounding electrode conductor and ground ring.

1.4 SUMMARY

A. This section includes grounding of electrical systems and equipment. Grounding requirements specified in this Section may be supplemented by special requirements of systems described in other Sections.

PART 2 - PRODUCTS

2.1 GROUNDING CONDUCTORS

A. For insulated conductors, comply with Division 26 Section 26 05 13 "Wire and Cable".

B. Material: Copper.

C. Equipment Grounding Conductors: Insulated with green-colored insulation.

D. Grounding Electrode Conductors: Stranded cable.

E. Underground Conductors: Bare, tinned, stranded, unless otherwise indicated.

F. Sizes and types below are typical. Adjust to suit Project conditions and requirements.

G. Copper Bonding Conductors: As follows:

1. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG copper conductor, 1/4 inch in diameter.

2. Bonding Conductor: No. 4 or No. 6 AWG, stranded copper conductor.

3. Bonding Jumper: Bare copper tape, braided bare copper conductors, terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.

4. Tinned Bonding Jumper: Tinned-copper tape, braided copper conductors, terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.

H. **[GB]:** Grounding Bus:

1. Bare, annealed copper bars of rectangular cross section, with insulators. 1/4” x 2” x 24”.

I. **[IBT]:** Intersystem Bonding Termination:

1. Copper bar, 1/4” x 2” x 24”. Provide with wall mounting brackets, insulators and pre-tapped holes.

2. Approved Manufacturers: Harger GBI Series, Erico B544 Series.

2.2 CONNECTOR PRODUCTS

A. Comply with UL 467; listed for use for specific types, sizes, and combinations of conductors and connected items.

B. Connectors: Hydraulic compression type or exothermic-welded type, in kit form, and selected per manufacturer’s written instructions.

C. Bolted Connectors: Bolted-pressure-type connectors.

2.3 GROUNDING ELECTRODES

A. Ground Rods: Copper-clad steel.

B. Concrete-Encased Grounding Electrode (Ufer): Fabricate according to NFPA 70, Paragraph 52-(3), using a minimum of 20 feet of bare copper conductor not smaller than No. 4 AWG or 20 feet (6.0 m) of 1/2” (13mm) steel reinforcing bar.

PART 3 - EXECUTION

3.1 CONNECTIONS

A. General: Make connections so galvanic action or electrolysis possibility is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible.

1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer to order of galvanic series.

2. Make connections with clean, bare metal at points of contact.

3. Make aluminum-to-steel connections with stainless-steel separators and mechanical clamps.

4. Make aluminum-to-galvanized steel connections with tin-plated copper jumpers and mechanical clamps.

5. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.

B. Exothermic-Welded Connections: Comply with manufacturer's written instructions. Welds that are puffed up or that show convex surfaces indicating improper cleaning are not acceptable.

C. Compression-Type Connections: Use hydraulic compression tools to provide correct circumferential pressure for compression connectors. Use tools and dies recommended by connector manufacturer. Provide embossing die code or other standard method to make a visible indication that a connector has been adequately compressed on grounding conductor.

D. Equipment Grounding Conductor Terminations: For No. 8 AWG and larger, use pressure-type grounding lugs. No. 10 AWG and smaller grounding conductors may be terminated with winged pressure-type connectors.

E. Noncontact Metal Raceway Terminations: If metallic raceways terminate at metal housings without mechanical and electrical connection to housing, terminate each conduit with a grounding bushing. Connect grounding bushings with a bare grounding conductor to grounding bus or terminal in housing. Bond electrically non-continuous conduits at entrances and exits with grounding bushings and bare grounding conductors, unless otherwise indicated.

F. Structural Steel Connection: Exothermic-welded connections to structural steel. Coordinate with structure to provide physical protection.

G. Exothermic-welded connections or hydraulic compression connection. Use for underground connections, except those at test wells.

H. Connections at Test Wells: Use compression-type connectors on conductors and make two bolted- and clamped-type connections between conductors and ground rods.

I. Tighten screws and bolts for grounding and bonding connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

J. Moisture Protection: If insulated grounding conductors are connected to ground rods or grounding buses, insulate entire area of connection and seal against moisture penetration of insulation and cable.

3.2 INSTALLATION

A. Use only copper conductors for both insulated and bare grounding conductors in direct contact with earth, concrete, masonry, crushed stone, and similar materials.

B. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage. Each grounding conductor that passes through a below grade wall must be provided with a waterstop.

C. Grounding electrode conductor (GEC) shall be protected from physical damage by rigid polyvinyl chloride conduit (PVC) in exposed locations.

D. Bonding Straps and Jumpers: Install so vibration by equipment mounted on vibration isolation hangers and supports is not transmitted to rigidly mounted equipment. Use exothermic-welded connectors for outdoor locations, unless a disconnect-type connection is required; then use a bolted clamp. Bond straps directly to the basic structure, taking care not to penetrate any adjacent parts. Install straps only in locations accessible for maintenance.

E. In raceways, use insulated equipment grounding conductors.

F. Underground Grounding Conductors: Use copper conductor, No. 2/0 AWG minimum. Bury at least 24 inches below grade or bury 12 inches above duct bank when installed as part of the duct bank.

G. Grounding Bus: Install in electrical and telephone equipment rooms, in rooms housing service equipment, below access floors, and elsewhere as indicated, with bolted connections to form a continuous ground path.

3.3 EQUIPMENT GROUNDING SYSTEM

A. Comply with NFPA 70, Article 250, for types, sizes, and quantities of equipment grounding conductors, unless specific types, larger sizes, or more conductors than required by NFPA 70 are indicated.

B. Install equipment grounding conductors in all feeders and circuits. Terminate each end on a grounding lug or bus.

3.4 BONDING SYSTEM

A. At building expansion joints, provide flexible bonding jumpers to connect to columns or beams on each side of the expansion joint.

B. Isolated Equipment Enclosure: For designated equipment supplied by a branch circuit or feeder, isolate equipment enclosure from supply raceway with a nonmetallic raceway fitting listed for the purpose. Install fitting where raceway enters enclosure, and install a separate equipment bonding conductor.

C. Exterior Metallic Pull and Junction Box Covers, Metallic Hand Rails: Bond to grounding system using flexible grounding conductors.

D. Bond metal ducts of dust collectors, particulate conveying, fume hoods, and other hazardous materials to the equipment grounding conductors of associated pumps, fans, or blowers. Use braided-type bonding straps. Provide braided bare copper bonding conductor in nonmetallic dust collector ductwork to each equipment inlet location, and bond to equipment.

E. Water Heater, Heat-Tracing, Metal Well Casing, and Heating Cables: Install a separate equipment grounding conductor to each electric water heater, heat-tracing, and anti-frost heating cable. Bond conductor to heater units, piping, well casing, connected equipment, and components.

F. Connect bonding conductors to metal water pipe using a suitable ground clamp. Make connections to flanged piping at street side of flange. Provide bonding jumper around water meter.

G. Signal and Communication Systems: For telephone, alarm, voice and data, and other communication systems, provide No. 6 AWG minimum insulated bonding conductor in raceway from grounding electrode system to each service location, terminal cabinet, wiring closet, and central equipment location. Leave 10 feet of slack conductor at terminal board.

H. Telecom Service and Central Equipment Locations and Wiring Closets: Terminate grounding conductor on a 1/4-by-2-by-12-inch grounding bar.

I. Terminal Cabinets: Terminate bonding conductor on cabinet grounding terminal.

J. Remote control, signaling, and fire alarm circuits shall be bonded in accordance with the most recent version of the National Electric Code.

K. Metal Poles Supporting Outdoor Lighting Fixtures > 15 feet: Provide a grounding electrode in addition to installing a separate equipment grounding conductor with supply branch-circuit conductors.

3.5 GROUNDING ELECTRODE SYSTEM

A. Ground Ring (Counterpoise):

1. Ground the steel framework of the building with a driven ground rod at the base of every corner column and at intermediate exterior columns at average distances not more than 60 feet (18 m) apart. Provide a grounding conductor, electrically connected to each ground rod and to each steel column, extending around the perimeter of the building. Use tinned-copper conductor not less than No. 2 AWG for ground ring and for tap to building steel. Bury conductor not less than 30 inches (760 mm) below grade, 24 inches (600 mm) from building foundation, and 18 inches (459 mm) outside of roof drip line.

B. Supplementary Grounding Electrode: Use driven ground rod on exterior of building.

C. Provide bonding at Utility Company's metering equipment and pad mounted transformer.

D. Ground Rods: Install at least two rods spaced at least 20 feet from each other and located at least the same distance from other grounding electrodes.

1. Drive ground rods until tops are 12 inches below finished floor or final grade, unless otherwise indicated.

2. Interconnect ground rods with grounding electrode conductors. Use exothermic welds, except at test wells and as otherwise indicated. Make connections without exposing steel or damaging copper coating.

E. Metal Water Service Pipe: Provide insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes by grounding clamp connectors. Where a dielectric main water fitting is installed, connect grounding conductor to street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.

F. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with grounding clamp connectors.

G. Bond each aboveground portion of natural gas metallic piping system at equipment locations. The equipment grounding conductor may serve as the bonding means.

H. Concrete-Encased Grounding Electrode (Ufer): Install concrete-encased grounding electrode encased in at least 2 inches (50mm) of concrete horizontally within the foundation that is in contact with the earth. If concrete foundation is less than 20 feet long, coil excess conductor within the base of the foundation. Bond grounding conductor to reinforcing steel in at least four locations and to anchor bolts. Extend grounding conductor below grade and connect to building grounding grid or to a grounding electrode external to concrete.

3.6 CONCRETE BUILDING GROUNDING SYSTEM

A. Provide a copper common grounding electrode conductor for the attachment of multiple separately derived systems in accordance with NEC 250.30(A)(4)(a) through 250.30(A)(4)(c). Individual grounding conductor taps from the separately derived systems to the common grounding electrode shall be sized in accordance with NEC 250.66. All tap connections shall be made in an accessible location in such a manner that common grounding electrode conductor remains without a splice or joint.

3.7 EQUIPOTENTIAL (MULTI-POINT) GROUNDING SYSTEM

A. Provide an equipotential grounding system in the following locations:

1. Class I Div 1 and Div 2 locations as required in NEC 501.30.
2. Critical patient care and special care areas as indicated on drawings.

B. The non-current-carrying metal parts of equipment, raceways and other enclosures shall be bonded to the grounding system.

3.8 FIELD QUALITY CONTROL

A. Inspect grounding and bonding system conductors and connections for tightness and proper installation.

1. Measure ground resistance from system neutral connection at service entrance to convenient ground reference points using suitable ground testing equipment. Resistance shall not exceed 5 ohms.

2. Testing: Engage a qualified testing agency to perform the following field quality-control testing:

a. After installing grounding system but before permanent electrical circuitry has been energized, test for compliance with requirements.

b. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, and at ground test wells. Measure ground resistance not less than two full days after the last trace of precipitation, and without the soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance. Perform tests, by the fall-of-potential method according to IEEE 81.

c. Provide drawings locating each ground rod and ground rod assembly and other grounding electrodes, identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.

1) Equipment Rated 500 kVA and Less: 10 ohms.
2) Equipment Rated 500 to 1000 kVA: 5 ohms.
3) Equipment Rated More Than 1000 kVA: 3 ohms.
4) Substations and Pad-Mounted Switching Equipment: 5 ohms.
5) Manhole Grounds: 10 ohms.

d. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect/Engineer promptly and include recommendations to reduce ground resistance.

END OF SECTION

SECTION 26 05 27
SUPPORTING DEVICES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Conduit and equipment supports
B. Fastening hardware
C. Concrete housekeeping pads

1.2 QUALITY ASSURANCE

A. Support systems shall be adequate for weight of equipment and conduit, including wiring, which they carry.

1.3 COORDINATION

A. Coordinate size, shape and location of concrete pads with Section on Cast-in-Place Concrete or Concrete Topping.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Allied Support Systems
B. Cooper B-Line
C. Erico, Inc.
D. Hilti
E. Power Fasteners

2.2 MATERIAL

A. Support Channel: Stainless steel for wet/damp locations; painted steel for interior/dry locations. All field cut ends shall be touched up with matching finish to inhibit rusting.

B. Hardware: Corrosion resistant.

C. Anchorage and Structural Attachment Components:

1. Strength: Defined in reports by ICBO Evaluation Service or another agency acceptable to Authorities Having Jurisdiction.

a. Structural Safety Factor: Strength in tension and shear of components used shall be at least two times the maximum seismic forces to which they will be subjected.

2. Through Bolts: Structural type, hex head, high strength. Comply with ASTM A 325.

3. Welding Lugs: Comply with MSS-SP-69, Type 57.

4. Beam clamps for Steel Beams and Joists: Double sided. Single-sided type is not acceptable.

5. Bushings for Floor-Mounted Equipment Anchors: Neoprene units designed for seismically rated rigid equipment mountings, and matched to the type and size of anchor bolts and studs used.

6. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for seismically rated rigid equipment mountings, and matched to the type and size of attachment devices used.

7. Concrete Anchors: Fasten to concrete using cast-in or post-installed anchors designed per the requirements of Appendix D of ACI 318-08. Post-installed anchors shall be qualified for use in cracked concrete by ACI-355.2.

8. Masonry Anchors: Fasten to concrete masonry units with expansion anchors or self-tapping masonry screws. For expansion anchors into hollow concrete block, use sleeve-type anchors designed for the specific application. Do not fasten in masonry joints. Do not use powder actuated fasteners, wooden plugs, or plastic inserts.

D. Conduit Sleeves and Lintels:

1. Each Contractor shall provide, to the General Contractor for installation, lintels for all openings required for the Contractor's work in masonry walls and conduit sleeves for floors, unless specifically shown as being by others.

2. Refer to Structural General Notes for lintel requirements in masonry construction.

3. Fabricate all lintels from structural steel shapes or as indicated on the drawings. All lintels and grouped wall openings shall be approved by the Architect or Structural Engineer.

4. Fabricate all sleeves from standard weight black steel pipe. Provide continuous sleeve. Cut or split sleeves are not acceptable. Sleeves through concrete walls may be high density polyethylene pipe penetration sleeve with a water stop collar, suitable for use with Link-Seal mechanical seals. Century-Line Model CS.

5. Sleeves through the floors on exposed risers shall be flush with the ceiling, with planed squared ends extending 1" above the floor in unfinished areas, and flush with the floor in finished areas, to accept spring closing floor plates.

6. Sleeves shall not penetrate structural members without approval from the Structural Engineer.

7. Openings through unexcavated floors and/or foundation walls below the floor shall have a smooth finish with sufficient annular space around material passing through opening so slight settling will not place stress on the material or building structure.

8. Install all sleeves concentric with conduits. Secure sleeves in concrete to wood forms. This Contractor is responsible for sleeves dislodged or moved when pouring concrete.

9. Where conduits rise through concrete floors that are on earthen grade, provide 3/4" resilient expansion joint material (asphalt and cork) wrapped around the pipe, the full depth of concrete, at the point of penetration. Secure to prevent shifting during concrete placement and finishing.

10. Size sleeves large enough to allow expansion and contraction movement.

E. Concrete Housekeeping Pads:

1. Concrete bases for all floor mounted equipment and wall mounted equipment which is surface mounted and extends to within 6" of the finished floor, unless shown otherwise on the drawings, shall be 3-1/2" thick concrete.

2. Bases shall extend 3" on all sides of the equipment (6" larger than factory base).

3. Where the base is less than 12" from a wall, the base shall be carried to the wall to prevent a "dirt-trap".

4. Concrete materials and workmanship required for the Contractor's work shall be provided by him. Materials and workmanship shall conform to the applicable standards of the Portland Cement Association. Reinforce with 6" x 6", W1.4-W1.4 welded wire fabric. Concrete shall withstand 3,000 pounds compression per square inch at twenty-eight days.

F. Rooftop Support System:

1. Provide pre-fabricated roof supports for all conduit and equipment installed above the roof. Support all conduit and equipment a minimum of 4" above roof.

2. Support system shall be compatible with single ply, bituminous, metal, and spray foam roof systems. The base shall be rounded to prevent damage to the roof, and drainage holes shall prevent ponding of water in the support.

3. All metal components shall be hot dipped galvanized. Mounting hardware shall be stainless steel or hot dipped galvanized. Support shall be UV, corrosion, and freeze/thaw resistant. Support shall include orange paint, reflective safety orange accents, or similar markings for increased visibility.

4. Acceptable Products: Anvil International HBS-Base Series, Cooper B-Line Dura-Blok, Erico Caddy Pyramid 50, 150, 300, or 600 (to match load).

PART 3 - EXECUTION

3.1 INSTALLATION

A. Fasten hanger rods, conduit clamps, and outlet and junction boxes to building structure using expansion anchors in concrete and beam clamps on structural steel.

B. Use toggle bolts or hollow wall fasteners in hollow masonry, plaster, or gypsum board partitions and walls; expansion anchors or preset inserts in solid masonry walls; self-drilling anchors or expansion anchor on concrete surfaces; sheet metal screws in sheet metal studs; and wood screws in wood construction.

C. Do not fasten supports to ceiling systems, piping, ductwork, mechanical equipment, or conduit, unless otherwise noted.

D. Do not use powder-actuated anchors without specific permission.

E. Do not drill structural steel members.

F. Fabricate supports from structural steel or steel channel, rigidly welded or bolted to present a neat appearance. Use hexagon head bolts with spring lock washers under all nuts.

G. In wet locations and on all building floors below exterior earth grade install free-standing electrical equipment on concrete pads.

H. Install cabinets and panelboards with minimum of four anchors. Provide horizontal backing/support framing in stud walls for rigid mounting.

I. Bridge studs top and bottom with channels to support flush-mounted cabinets and panelboards in stud walls.

J. Do not exceed 25 lbs. per hanger and a minimum spacing of 2'-0" on center when attaching to metal roof decking (excludes concrete on metal deck). This 25 lbs. load and 2'-0" spacing include adjacent electrical and mechanical items hanging from deck. If the hanger restrictions cannot be achieved, supplemental framing off steel framing will need to be added.

K. Refer to Section 26 05 33 for special conduit supporting requirements.

3.2 FINISH

A. Prime coat exposed steel hangers and supports. Hangers and supports in crawl spaces, pipe shafts, and above suspended ceiling spaces are not considered exposed.

B. Trim all ends of exposed field fabricated steel hangers, slotted channel and threaded rod to within 1" of support or fastener to eliminate potential injury to personnel unless shown otherwise on the drawings. Smooth ends and install elastomeric insulation with two coats of latex paint if exposed steel is within 6'-6" of finish floor and presents potential injury to personnel.

END OF SECTION

SECTION 26 05 33
CONDUIT AND BOXES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Rigid metallic conduit and fittings
B. Intermediate metallic conduit and fittings
C. Electrical metallic tubing and fittings
D. Flexible metallic conduit and fittings
E. Liquidtight flexible metallic conduit and fittings
F. Rigid polyvinyl chloride conduit and fittings
G. High density polyethylene conduit and fittings
H. Wall and ceiling outlet boxes
I. Electrical connection
J. Pull and junction boxes
K. Rough-ins
L. Handholes
M. Accessories

1.2 REFERENCES

A. American National Standards Institute (ANSI):

1. ANSI C80.1 - Rigid Steel Conduit, Zinc-Coated
2. ANSI C80.3 - Electrical Metallic Tubing, Zinc-Coated and Fittings
3. ANSI C80.4 - Fittings for Rigid Metal Conduit and Electrical Metallic Tubing
4. ANSI C80.6 – Intermediate Metal Conduit, Zinc Coated
5. ANSI/NEMA OS 1 - Sheet-Steel Outlet Boxes, Device Boxes, Covers and Box Supports
6. ANSI/NEMA OS 2 - Nonmetallic Outlet Boxes, Device Boxes, Covers and Box Supports

B. Federal Specifications (FS):

1. A–A–50553A – Fittings for Conduit, Metal, Rigid, (Thick-Wall and Thin-Wall (EMT) Type
2. A–A–55810 – Specification for Flexible Metal Conduit

C. NECA “Standards of Installation”

D. National Electrical Manufacturers Association (NEMA):

1. ANSI/NEMA FB 1 – Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing and Cable
2. RN 1 – Polyvinyl chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit
3. TC 2 – Electrical Polyvinyl Chloride (PVC) Conduit
4. TC 9 – Fittings for PVC Plastic Utilities Duct for Underground Installation

E. NFPA 70 – National Electrical Code (NEC)

F. Underwriters Laboratories (UL): Applicable Listings

1. UL 1 – Flexible Metal Conduit
2. UL 6 – Rigid Metal Conduit
3. UL 360 – Liquid Tight Flexible Steel Conduit
4. UL514-B – Conduit Tubing and Cable Fittings
5. UL651-A – Type EB and a PVC Conduit and HDPE Conduit

6. UL651-B – Continuous Length HDPE Conduit
7. UL746A – Standard for Polymeric Materials – Short Term Property Evaluations
8. UL797 – Electrical Metal Tubing
9. UL1242 – Intermediate Metal Conduit

G. American Standard of Testing and Materials (ASTM):

1. ASTM D 570 - Standard Test Method for Water Absorption of Plastics
2. ASTM D 638 - Standard Test Method for Tensile Properties of Plastics
3. ASTM D 648 - Standard Test Method for Deflection Temperature of Plastics under Flexural Load in the Edge Wise Position
4. ASTM D 2412 - Standard Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading
5. ASTM D 2447 - Standard Specification for Polyethylene (PE) Plastic Pipe, Schedules 40 and 80, Based on Outside Diameter
6. ASTM D 3350 - Standard Specification for Polyethylene Plastic Pipe and Fittings Material

H. Definitions:

1. Fittings: Conduit connection or coupling.

2. Body: Enlarged fittings with opening allowing access to the conductors for pulling purposes only.

3. Mechanical Spaces: Enclosed areas, usually kept separated from the general public, where the primary use is to house service equipment and to route services. These spaces generally have exposed structures, bare concrete and non-architecturally emphasized finishes.

4. Finished Spaces: Enclosed areas where the primary use is to house personnel and the general public. These spaces generally have architecturally emphasized finishes, ceilings and/or floors.

5. Concealed: Not visible by the general public. Often indicates a location either above the ceiling, in the walls, in or beneath the floor slab, in column coverings, or in the ceiling construction.

6. Above Grade: Not directly in contact with the earth. For example, an interior wall located at an elevation below the finished grade shall be considered above grade but a wall retaining earth shall be considered below grade.

7. Slab: Horizontal pour of concrete used for the purpose of a floor or sub-floor.

1.3 SUBMITTALS

A. Include fittings and conduits 1.5" and larger in coordination files. Include all in--floor and underfloor conduit in coordination files. Refer to Section 26 05 00 for coordination drawing requirements.

PART 2 - PRODUCTS

2.1 RIGID METALLIC CONDUIT (RMC) AND FITTINGS

A. Acceptable Manufacturers:

1. Acceptable Manufacturers: Allied, LTV, Steelduct, Wheatland Tube Co, O-Z Gedney, or approved equal.

2. Acceptable Manufacturers of RMC Conduit Fittings: Appleton Electric, O-Z/Gedney Co., Electroline, Raco, Bridgeport, Midwest, Regal, Thomas & Betts, Crouse-Hinds, Killark, or approved equal.

B. Minimum Size Galvanized Steel: 3/4 inch (19mm), unless otherwise noted.

C. Fittings and Conduit Bodies:

1. End Bell Fittings: Malleable iron, hot dip galvanized, threaded flare type with provisions for mounting to form.

2. Expansion Joints: Malleable iron and hot dip galvanized providing a minimum of 4 inches of movement. Fitting shall be watertight with an insulating bushing and a bonding jumper.

3. Expansion Joint for Concrete Encased Conduit: Neoprene sleeve with bronze end coupling, stainless steel bands and tinned copper braid bonding jumper. Fittings shall be watertight and concrete-tight.

4. Conduit End Bushings: Malleable iron type with molded-on high impact phenolic thermosetting insulation. Where required elsewhere in the contract documents, bushing shall be complete with ground conductor saddle and clamp. **High impact phenolic threaded type bushings are not acceptable.**

5. All other fittings and conduit bodies shall be of malleable iron construction and hot dip galvanized.

D. PVC Externally Coated Conduit: Compliant with UL 6, ANSI C80.1 and NEMA RN 1; rigid galvanized steel conduit with external 40 mil PVC coating and internal 2 mil urethane coating surface. All fittings and conduit bodies shall be complete with coating. Threads shall be hot galvanized and coated with a clear coat of urethane. The PVC coated system shall include necessary PVC coated fittings, boxes and covers to form a complete encapsulated system. Acceptable Manufacturers: Robroy, T&B Ocal or approved equal.

2.2 INTERMEDIATE METALLIC CONDUIT (IMC) AND FITTINGS

A. Minimum Size Galvanized Steel: 3/4 inch, unless otherwise noted.

B. Acceptable Manufacturers: Allied, LTV, Steelduct, Wheatland Tube Co, O-Z Gedney, or approved equal.

C. Fittings and Conduit Bodies:

1. End Bell Fittings: Malleable iron, hot dip galvanized, threaded flare type with provisions for mounting to form.

2. Expansion Joints: Malleable iron and hot dip galvanized providing a minimum of 4 inches of movement. Fitting shall be watertight with an insulating bushing and a bonding jumper.

3. Expansion Joint for Concrete Encased Conduit: Neoprene sleeve with bronze end coupling, stainless steel bands and tinned copper braid bonding jumper. Fittings shall be watertight and concrete-tight.

4. Conduit End Bushings: Malleable iron type with molded-on high impact phenolic thermosetting insulation. Where required elsewhere in the contract documents, bushing shall be complete with ground conductor saddle and clamp. **High impact phenolic threaded type bushings are not acceptable.**

5. All other fittings and conduit bodies shall be of malleable iron construction and hot dip galvanized.

2.3 ELECTRICAL METALLIC TUBING (EMT) AND FITTINGS

A. Minimum Size Electrical Metallic Tubing: 3/4 inch, unless otherwise noted.

B. Acceptable Manufacturers of EMT Conduit: Allied, LTV, Steelduct, Wheatland Tube Co, or approved equal.

C. Fittings and Conduit Bodies:

1. 2" Diameter or Smaller: Compression type of steel designed for their specific application.

2. Larger than 2": Compression type of steel designed for their specific application.

3. Acceptable Manufacturers of EMT Conduit Fittings: Appleton Electric, O-Z/Gedney Co., Electroline, Raco, Bridgeport, Midwest, Regal, Thomas & Betts, or approved equal.

2.4 FLEXIBLE METALLIC CONDUIT (FMC) AND FITTINGS

A. Minimum Size Galvanized Steel: 3/4 inch, unless otherwise noted. Lighting branch circuit wiring to an individual luminaire may be a manufactured, UL listed 3/8" flexible metal conduit and fittings with #14 AWG THHN conductors and an insulated ground wire. Maximum length of 3/8" FMC shall be six (6) feet.

B. Acceptable Manufacturers: American Flex, Alflex, Electri-Flex Co, or approved equal.

C. Construction: Flexible steel, approved for conduit ground, zinc coated, threadless type formed from a continuous length of spirally wound, interlocked zinc coated strip steel. Provide a separate equipment grounding conductor when used for equipment where flexibility is required.

D. Fittings and Conduit Bodies:

1. Threadless hinged clamp type, galvanized zinc coated cadmium plated malleable cast iron or screw-in type, die-cast zinc.

2. Fittings and conduit bodies shall include plastic or cast metal inserts supplied by the manufacturer to protect conductors from sharp edges.

3. Acceptable Manufacturers: O-Z/Gedney Co., Thomas & Betts, Appleton Electric, Electroline, Bridgeport, Midwest, Regal, or approved equal.

2.5 LIQUIDTIGHT FLEXIBLE METALLIC CONDUIT (LFMC) AND FITTINGS

A. Acceptable Manufacturers: Anaconda Type UA, Electri-Flex Type LA, Alflex, Carlon (Lamson & Sessions), or approved equal.

B. Construction: Flexible steel, approved for conduit ground, zinc coated, threadless type formed from a continuous length of spirally wound, interlocked zinc coated strip steel and an extruded PVC cover.

C. Fittings and Conduit Bodies:

1. Watertight, compression type, galvanized zinc coated cadmium plated malleable cast iron, UL listed.

2. Fittings and conduit bodies shall include plastic or cast metal inserts supplied by the manufacturer to protect conductors from sharp edges.

3. Acceptable Manufacturers: Appleton Electric, O-Z/Gedney Co., Electroline, Bridgeport, Thomas & Betts, Midwest, Regal, Carlon (Lamson & Sessions), or approved equal.

2.6 RIGID NON-METALLIC CONDUIT (PVC) AND FITTINGS

A. Minimum Size Rigid Smooth-Wall Nonmetallic Conduit: 3/4 inch, unless otherwise noted.

B. Acceptable Manufacturers: Carlon (Lamson & Sessions) Type 40, Cantex, J.M. Mfg., or approved equal.

C. Construction: Schedule 40 and Schedule 80 rigid polyvinyl chloride (PVC), UL labeled for 90°C.

D. Fittings and Conduit Bodies: NEMA TC 3; sleeve type suitable for and manufactured especially for use with the conduit by the conduit manufacturer.

E. Plastic cement for joining conduit and fittings shall be provided as recommended by the manufacturer.

2.7 HIGH DENSITY POLYETHYLENE

A. Minimum Size: 2 inch, unless noted otherwise.

B. Acceptable Manufacturers: Carlon, Chevron Phillips Chemical Company, or approved equal.

C. Materials used for the manufacture of polyethylene pipe and fittings shall be extra high molecular weight, high-density polyethylene resin. The material shall be listed by PPI (Plastic Pipe Institute) and shall meet the following resin properties:

ASTM Test	Description	Values HDPE
D-1505	Density g/CM 3	< .941
D-1238	Melt Index, g/10 min Condition E	> .55 grams/10 min.
D-638	Tensile Strength at yield (psi)	3000 min.
D-1693	Environmental Stress Crack Resistance Condition B, F 20	96 hrs.
D-790	Flexural Modulus, MPa (psi)	< 80,000
D-746	Brittleness Temperature	-75°C Max

D. The pipe shall contain no recycled compound except that generated in the manufacturer's own plant from resin of the same raw material, including both the base resin and coextruded resin. The pipe shall be homogeneous throughout and free of visible cracks, holes, voids, foreign inclusions, or other defects that may affect the wall integrity.

E. Fitting and Conduit Bodies:

1. Directional Bore and Plow Type Installation: Electrofusion or Universal Aluminum threaded couplings. Tensile strength of coupled pipe must be greater than 2,000 lbs.

2. For all other type of installation: Coupler must provide a water tight connection. The tensile strength of coupled pipe must be greater than 1,000 lbs.

3. E-loc type couplings are not acceptable in any situations.

4. Acceptable Manufacturers: ARCON, Carlon, or approved equal.

2.8 OUTLET BOXES

A. Sheet Metal Outlet Boxes: ANSI/NEMA OS 1; galvanized steel, minimum of 14 gauge, with 1/2 inch male fixture studs where required.

B. Nonmetallic Outlet Boxes: ANSI/NEMA OS 2.

C. Cast Boxes: NEMA FB1, Type FD, Aluminum or cast feralloy, deep type, gasketed cover, threaded hubs.

D. Outlet boxes for luminaires to be not less than 1-1/2" deep, deeper if required by the number of wires or construction. The box shall be coordinated with surface luminaires to conceal the box from view or provide a finished trim plate.

E. Switch outlet boxes for local light control switches, dimmers and occupancy sensors shall be 4 inches square by 2-1/8 inches deep, with raised cover to fit flush with finish wall line. Multiple gang switch outlets shall consist of the required number of gang boxes appropriate to the quantity of switches comprising the gang. Where walls are plastered, provide a plaster raised cover. Where switch outlet boxes occur in exposed concrete block walls, boxes shall be installed in the block cavity with a raised square edge tile cover of sufficient depth to extend out to face of block or masonry boxes.

F. Outlet boxes for telephone substations in walls and columns shall be 4 inches square and 2-1/8 inches deep with single gang raised cover to fit flush with finished wall line equipped with flush telephone plate.

G. Wall or column receptacle outlet boxes shall be 4 inches square with raised cover to fit flush with finished wall line. Boxes in concrete block walls shall be installed the same as for switch boxes in block walls.

2.9 [ECONN]: ELECTRICAL CONNECTION

A. Electrical connection to equipment and motors, sized per NEC. Coordinate requirements with contractor furnishing equipment or motor. Refer to specifications and general installation notes for terminations to motors.

2.10 [JB]: PULL AND JUNCTION BOXES

A. Sheet Metal Boxes: ANSI/NEMA OS 1; galvanized steel.

B. Sheet metal boxes larger than 12 inches in any dimension that contain terminations or components: Continuous hinged enclosure with 1/4 turn latch and white back panel for mounting terminal blocks and electrical components.

C. Cast Metal Boxes for Outdoor and Wet Location Installations: NEMA 250; Type 4 and Type 6, flat-flanged, surface-mounted junction box, UL listed as raintight. Galvanized cast iron box and cover with ground flange, neoprene gasket, and stainless steel cover screws.

D. Cast Metal Boxes for Underground Installations: NEMA 250; Type 4, inside flanged, recessed cover box for flush mounting, UL listed as raintight. Galvanized cast iron box and plain cover with neoprene gasket and stainless steel cover screws.

E. Flanged type boxes shall be used where installed flush in wall.

2.11 HANDHOLES

A. **[HH-1]**: Handhole, composite polymer concrete body and cover. Stainless steel hardware. Bolted non-skid cover rated for 20,000 pounds. Design load occasional non-deliberate vehicular traffic. Stack units to achieve depth shown on plans. Units in landscaped areas shall be green in color. 11”W, 18”L, 18”D or dimensions as shown on plans.

1. Approved Manufacturers:

a. Hubbell/Quazite PG####BB18, PG####HA00
b. Carson Industries H Series
c. Armorcast
d. Highline Products
e. Synertech

B. **[HH-2]**: Handhole, cast iron, hot dipped galvanized with checkered cover sidewalk weatherproof box, flat neoprene cover gasket. Stainless steel screw hardware. Mounted flush in concrete. 17”W, 18”L, 12”D or dimensions as shown on plans.

1. Approved Manufacturers:

a. Appleton Electric WYT Series, WYT 181212
b. OZ Gedney YT Series
c. Crouse Hinds WJBF Series

C. **[HH-3]**: Handhole, concrete traffic box and galvanized steel checkered cover. Stainless steel hardware. Bolted cover and box rated for H/20 vehicular traffic. Reinforced concrete slab for bottom. 17”W, 18”L, 24”D or dimensions as shown on plans.

1. Approved Manufacturer: Oldcastle Precast B1017 Box

2.12 ACCESSORIES

A. Fire Rated Moldable Pads: UL #9700, moldable sheet putty at required thickness on all five sides of back boxes. Kinetics Noise Control – IsoBacker Pad, SpecSeal – SSP Putty and Pads, 3M #MPP-4S or equal.

B. Sound Barrier Insulation Pads: Mastic, non-hardening, sheet material, minimum 1/8" thickness applied to all five sides of back boxes. Kinetics Noise Control – SealTight Backer Pad, L.H. DOTTIE Co., #68 or equal.

PART 3 - EXECUTION

3.1 INSTALLATION TRAINING

A. PVC coated rigid metal conduit and reinforced thermosetting resin conduit (RTRC) manufacturers shall provide Contractor installation training for field cutting, joint preparation, joint assembly, field bending, and field cut sealing.

3.2 CONDUIT SIZING

A. Size conduit as shown on the drawings and specifications. Where not indicated in the contract documents, conduit size shall be according to NEC. Conduit and conductor sizing shall be coordinated to limit conductor fill to less than 40%, maintain conductor ampere capacity as required by the NEC (to include enlarged conductors due to temperature and quantity derating values) and to prevent excessive voltage drop and pulling tension due to long conduit/conductor lengths.

B. Minimum Conduit Size (Unless Noted Otherwise):

1. Above Grade: 3/4 inch. (The use of 1/2 inch would be allowed for installation conduit to individual light switches, individual receptacles and individual fixture whips from junction box.)
2. Below Grade 5' or less from Building Foundation: 1 inch.
3. Below Grade More than 5' from Building Foundation: 1 inch.
4. Telecommunication Conduit: 1 inch.
5. Low Voltage Systems Conduit: 3/4" inch.
6. Controls Conduit: 1/2 inch.

C. Conduit sizes shall change only at the entrance or exit to a junction box, unless specifically noted on the drawings.

3.3 CONDUIT ARRANGEMENT

A. In general, conduit shall be installed concealed in walls, in finished spaces and where possible or practical, or as noted otherwise. Conduit shall be installed parallel or perpendicular to walls, ceilings, and exposed structural members. In unfinished spaces, mechanical and utility areas, conduit may run either concealed or exposed as conditions dictate and as practical unless noted otherwise on drawings. Installation shall maintain headroom in exposed vicinities of pedestrian or vehicular traffic.

B. Exposed conduit on exterior walls or above roof will not be allowed without prior written approval of Architect/Engineer. A drawing of the proposed routing and a photo of the location shall be submitted 14 days prior to start of conduit rough-in. Routing shall be shown on coordination drawings.

C. Conduit shall not share the same cell as structural reinforcement in masonry walls.

D. Contractor shall adapt his work to the job conditions and make such changes as required and permitted by the Architect/Engineer, such as moving to clear beams and joists, adjusting at columns, avoiding interference with windows, etc., to permit the proper installation of other mechanical and/or electrical equipment.

E. Contractor shall cooperate with all Contractors on the project. He shall obtain details of other Contractor's work in order to ensure fit and avoid conflict. Any expense due to the failure of This Contractor to do so shall be paid for in full by him. The other trades involved as directed by the Architect/Engineer shall perform the repair of work damaged as a result of neglect or error by This Contractor. The resultant costs shall be borne by This Contractor.

3.4 CONDUIT SUPPORT

A. Conduit runs installed above a suspended ceiling shall be properly supported. In no case shall conduit rest on the suspended ceiling construction, nor utilize ceiling support system for conduit support.

B. Conduit shall not be supported from ductwork, water, sprinkler piping, or other non-structural members, unless approved by the Architect/Engineer. All supports shall be from structural slabs, walls, structural members, and bar joists, and coordinated with all other applicable contractors, unless noted otherwise.

C. Conduit shall be held in place by the correct size of galvanized one-hole conduit clamps, two-hole conduit straps, patented support devices, clamp back conduit hangers, or by other means if called for on the drawings.

D. Support individual horizontal raceways with separate, malleable-iron pipe hangers or clamps.

E. Spring-steel conduit clips specifically designed for supporting single conduits or tubing may be used in lieu of malleable-iron hangers for 1" and smaller raceways serving lighting and receptacle branch circuits above accessible ceilings and for securing raceways to slotted channel and angle supports.

F. Group conduits in parallel runs where practical and use conduit racks or trapeze hangers constructed of steel channel, suspended with threaded solid rods or wall mounted from metal channels with conduit straps or clamps. Provide space in each rack or trapeze for 25% additional conduits.

G. Do not exceed 25 lbs. per hanger and a minimum spacing of 2’-0” on center when attaching to metal roof decking (excludes concrete on metal deck). This 25 lbs. load and 2’-0” spacing include adjacent electrical and mechanical items hanging from deck. If the hanger restrictions cannot be achieved, supplemental framing off steel framing will need to be added.

H. Arrange supports in vertical runs so the weight of raceways and enclosed conductors is carried entirely by raceway supports, with no weight load on raceway terminals.

I. Supports for metallic conduit shall be no greater than 10 feet. A smaller interval may be used if necessitated by building construction, but in no event shall support spans exceed the NEC requirements. Conduit shall be securely fastened within 3 feet of each outlet box, junction box, device box, cabinet, or fitting.

J. Supports of flexible conduit shall be within 12 inches of each outlet box, junction box, device box, cabinet, or fitting and at intervals not to exceed 4.5 feet.

K. Supports for non-metallic conduit shall be at sufficiently close intervals to eliminate any sag in the conduit. The manufacturer's recommendations shall be followed, but in no event shall support spans exceed the NEC requirements.

L. Where conduit is to be installed in poured concrete floors or walls, provide concrete-tight conduit inserts securely fastened to forms to prevent conduit misplacement.

M. Finish:

1. Prime coat exposed steel hangers and supports. Hangers and supports in crawl spaces, pipe shafts, and above suspended ceiling spaces are not considered exposed.

2. Trim all ends of exposed field fabricated steel hangers, slotted channel and threaded rod to within 1" of support or fastener to eliminate potential injury to personnel unless shown otherwise on the drawings. Smooth ends and install elastomeric insulation with two coats of latex paint if exposed steel is within 6'-6" of finish floor and presents potential injury to personnel.

3.5 CONDUIT INSTALLATION

A. Conduit Connections:

1. Shorter than standard conduit lengths shall be cut square using industry standards. The ends of all conduits cut shall be reamed or otherwise finished to remove all rough edges.

2. Metallic conduit connections in slab on grade installation shall be sealed and one coat of rust inhibitor primer applied after the connection is made.

3. Where conduits with tapered threads cannot be coupled with standard couplings, then approved split or Erickson couplings shall be used. Running threads will not be permitted.

4. Install expansion/deflection joints where conduit crosses structure expansion/seismic joints.

B. Conduit terminations for all low voltage wiring shall have nylon bushings installed on each end of every conduit run.

C. Conduit Bends:

1. Use a hydraulic one-shot conduit bender or factory elbows for bends in conduit 2" in size or larger. All steel conduit bending shall be done cold; no heating of steel conduit shall be permitted.

2. All bends of rigid polyvinyl chloride conduit (PVC) shall be made with the manufacturer's approved bending equipment. The use of spot heating devices will not be permitted (i.e. blow torches).

3. A run of conduit shall not contain more than the equivalent of four (4) quarter bends (360°), including those bends located immediately at the outlet or body.

4. Telecommunications conduits shall have no more than two (2) 90 degree bends between pull points and contain no continuous sections longer than 100 feet. Insert pull points or pull boxes for conduits exceeding 100 feet in length.

   a. A third bend is acceptable if:

      1) The total run is not longer than (33) feet.
      2) The conduit size is increased to the next trade size.

5. Telecommunications pull boxes shall not be used in lieu of a bend. Align conduits that enter into the pull box from opposite ends with each other. Pull box size shall be twelve (12) times the diameter of the largest conduit. Slip sleeves or gutters can be used in place of a pull box.

6. Telecommunications conduit bend radius shall be six (6) times the diameter for conduits under 2" and ten (10) times the diameter for conduits over 2".

7. Rigid polyvinyl chloride conduit (PVC) runs longer than 100 feet or runs which have more than two 90° equivalent bends (regardless of length) shall use rigid metal or RTRC factory elbows for bends.

8. Use conduit bodies to make sharp changes in direction (i.e. around beams).

D. Conduit Placement:

1. Conduit shall be mechanically continuous from source of current to all outlets. Conduit shall be electrically continuous from source of current to all outlets, unless a properly sized grounding conductor is routed within the conduit. All metallic conduits shall be bonded per the NEC.

2. Route exposed conduit and conduit above suspended ceilings (accessible or not) parallel/perpendicular to the building structural lines, and as close to building structure as possible. Wherever possible, route horizontal conduit runs above water and steam piping.

3. Route conduit through roof openings provided for piping and ductwork where possible. If not provided or routing through provided openings is not possible, route through roof jack with pitch pocket. Coordinate roof penetrations with other trades.

4. Conduits, raceway, and boxes shall not be installed in concealed locations in metal deck roofing or less than 1.5” below bottom of roof decking.

5. Avoid moisture traps where possible. Where unavoidable, provide a junction box with drain fitting at conduit low point.

6. All conduits through walls shall be grouted or sealed into openings. Where conduit penetrates firewalls and floors, seal with a UL listed sealant. Seal penetrations with intumescent caulk, putty, or sheet installed per manufacturer's recommendations. All materials used to seal penetrations of firewalls and floors shall be tested and certified as a system per ASTM E814 Standard for fire tests or through-penetration fire stops as manufactured by 3M or approved equal.

7. CONTRACTOR SHALL BE RESPONSIBLE FOR ALL OPENINGS REQUIRED IN MASONRY OR EXTERIOR WALLS UNDER THIS DIVISION. A QUALIFIED MASON AT THE EXPENSE OF THIS CONTRACTOR SHALL REPAIR ALL OPENINGS TO MATCH EXISTING CONDITIONS.

8. Seal interior of conduit at exterior entries, air handling units, coolers/freezers, etc., and where the temperature differential can potentially be greater than 20°F, to prevent moisture penetration. Seal shall be placed where conduit enters warm space. Conduit seal fitting shall be a drain/seal, with sealing compound, equal to O-Z/Gedney type EYD.

9. Horizontal conduit routing through slabs above grade:

   a. No conduits are allowed in concrete on metal deck unless expressly approved in writing by the Structural Engineer.

   b. No conduits are allowed to be routed horizontally through slabs above grade.

10. Do not route conduits across each other in slabs on grade.

11. Rigid polyvinyl chloride conduit (PVC) shall be installed when material surface temperatures and ambient temperature are greater than 40°F.

12. Where rigid polyvinyl chloride conduit (PVC) is used below grade, in a slab, below a slab, etc., a transition to rigid galvanized steel or PVC-coated steel conduit shall be installed before conduit exits earth. The metallic conduit shall extend a minimum of 6" into the surface concealing the non-metallic conduit.

13. Contractor shall provide suitable mechanical protection around all conduits stubbed out from floors, walls or ceilings during construction to prevent bending or damaging of stubs due to carelessness with construction equipment.

14. Contractor shall provide a polypropylene pull cord with 2000 lbs. tensile strength in each empty conduit (indoor and outdoor), except in sleeves and nipples.

15. Telecommunications conduits that protrude through the structural floor shall be installed 1 to 3" above finished floor (AFF).

16. Telecommunications conduits that enter into Telecommunications rooms below the finished ceiling shall terminate a minimum of 4" below ceiling and as close to the wall as possible.

17. Telecommunications conduits that are below grade and enter into a building shall terminate a minimum of 4" above finished floor (AFF) and as close to the wall as possible.

3.6 CONDUIT TERMINATIONS

A. Where conduit bonding is indicated or required in the contract documents, the bushings shall be a grounding type sized for the conduit and ground bonding conductor as manufactured by O-Z/Gedney, Appleton, Thomas & Betts, Burndy, Regal, or approved equal.

B. Conduits with termination fittings shall be threaded for one (1) lock nut on the outside and one (1) lock nut and bushing on the inside of each box.

C. Where conduits terminate in boxes with knockouts, they shall be secured to the boxes with lock nuts and provided with approved screw type tinned iron bushings or fittings with plastic inserts.

D. Where conduits terminate in boxes, fittings, or bodies with threaded openings, they shall be tightly screwed against the shoulder portion of the threaded openings.

E. Conduit terminations to all motors shall be made with flexible metallic conduit (FMC), unless noted otherwise. Final connections to roof exhaust fans, or other exterior motors and motors in damp or wet locations shall be made with liquidtight flexible metallic conduit (LFMC). Motors in hazardous areas, as defined in the NEC, shall be connected using flexible conduit rated for the environment. Flexible conduit shall not exceed 6' in length. Route equipment ground conductors from circuit ground to motor ground terminal through flexible conduit.

F. Rigid polyvinyl chloride conduit (PVC) shall be terminated using fittings and bodies produced by the manufacturer of the conduit, unless noted otherwise. Prepare conduit as per manufacturer's recommendations before joining. All joints shall be solvent welded by applying full even coat of plastic cement to the entire areas that will be joined. Turn the conduit at least a quarter to one half turn in the fitting and let the joint cure for 1-hour minimum or as per the manufacturer's recommendations.

G. All conduit ends shall be sealed with plastic immediately after installation to prevent the entrance of any foreign matter during construction. The seals shall be removed and the conduits blown clear of any and all foreign matter prior to any wires or pull cords being installed.

3.7 UNDERGROUND CONDUIT INSTALLATION

A. Conduit Connections:

1. Conduit joints in a multiple conduit run shall be staggered at least one foot apart.

B. Conduit Bends (Lateral):

1. Conduits shall have long sweep radius elbows instead of standard elbows wherever special bends are indicated and noted on the drawings, or as required by the manufacturer of the equipment or system being served.

2. Telecommunications conduit bend radius shall be six times the diameter for conduits under 2" and ten times the diameter for conduits over 2". Where long cable runs are involved, sidewall pressures may require larger radius bends. Coordinate with Architect/Engineer prior to conduit installation to determine bend radius.

C. Conduit Elbows (vertical):

1. Minimum metal or RTRC elbow radiuses shall be 30 inches for primary conduits (>600V) and 18 inches for secondary conduits (<600V). Increase radius, as required, based on pulling tension calculation requirements.

D. Conduit Placement:

1. Conduit runs shall be pitched a minimum of 4" per 100 feet to drain toward the terminations. Duct runs shall be installed deeper than the minimum wherever required to avoid any conflicts with existing or new piping, tunnels, etc.

2. For parallel runs, use suitable separators and chairs installed not greater than 4' on centers. Band conduit together with suitable banding devices. Securely anchor conduit to prevent movement during concrete placement or backfilling.

3. Where concrete is required, the materials for concreting shall be thoroughly mixed to a minimum f'c = 2500 and immediately placed in the trench around the conduits. No concrete that has been allowed to partially set shall be used.

4. Before the Contractor pulls any cables into the conduit he shall have a mandrel 1/4" smaller than the conduit inside diameter pulled through each conduit and if any concrete or obstructions are found, the Contractor shall remove them and clear the conduit. Spare conduit shall also be cleared of all obstructions.

5. Conduit terminations in manholes, masonry pull boxes, or masonry walls shall be with malleable iron end bell fittings.

6. All spare conduits not terminated in a covered enclosure shall have its terminations plugged as described above.

7. Ductbanks and conduit shall be installed a minimum of 24" below finished grade, unless otherwise noted on the drawings or elsewhere in these specifications.

8. All non-metallic conduit installed underground outside of a slab shall be rigid.

E. Horizontal Directional Drilling:

1. Entire drill path shall be accurately surveyed, with entry and exit stakes placed and coordinated with other contractors. If using a magnetic guidance system, entire drill path shall be surveyed for any surface geo-magnetic variations or anomalies.

2. Any utility locates within 20 feet of the bore path shall have the exact location physically verified by hand digging or vacuum excavation. Restore inspection holes to original condition after verification.

F. Raceway Seal:

1. Where a raceway enters a building or structure, it shall be sealed with a sealing bushing or duct seal to prevent the entry of liquids or gases. Seal must be compatible with conductors and raceway system. Spare or unused raceway shall also be sealed.

2. All telecommunications conduits and innerducts, including those containing cables, shall be plugged at the building and vault with “JackMoon” or equivalent duct seal, capable of withstanding a 10 foot head of water (5 PSI).

3.8 CONDUIT INSTALLATION SCHEDULE

A. In the event the location of conduit installation represents conflicting installation requirements as specified in the following schedule, a clarification shall be obtained from the Architect/Engineer. If This Contractor is unable to obtain a clarification as outlined above, concealed rigid galvanized steel conduit installed per these specifications and the NEC shall be required.

B. The following schedule shall be adhered to unless they constitute a violation of applicable codes or are noted otherwise on the drawings. The installation of RMC conduit will be permitted in place of any and all conduit specified in this schedule.

1. Exposed:
    a. Switchboards, panel feeders, etc.: IMC.
    b. Branch Circuits (lighting, receptacles, controls, etc.): EMT.
    c. Mechanical Equipment Feeders (pumps, AHU's, chillers, etc.): EMT.
    d. Floor Mounted Pump Feeders: EMT with no more than 6’ of PVC coated flexible metal conduit to pump.
    e. Controls: EMT painted blue or dyed blue.
2. Finished Spaces/Concealed: EMT.
3. Wet or Damp Locations: RMC conduit, boxes and fittings, installed and equipped so as to prevent water from entering the conduit system.
4. Corrosive Locations: PVC Coated Rigid Metal conduit, boxes and fittings installed and equipped so as to prevent water from entering the conduit system.
5. Under Slabs on Grade:
    a. Within 5’ from the perimeter of the building: RMC
    b. Within 5’ from the perimeter of the building when passing through the perimeter of the building foundation: RMC.
6. Site Conduits:
    a. Within 5' from the Perimeter of a Building Foundation: RMC.
    b. 5' or Greater from the Perimeter of a Building Foundation: PVC.
    c. Under Roads, Drives, and Vehicle Traveled Ways: Concrete encased PVC with a minimum of 3” concrete cover on all sides of conduit.
7. Hazardous Locations as Defined by the NEC: RMC conduit complete with screwed fittings and conduit seals.

3.9 BOX INSTALLATION SCHEDULE

A. Galvanized steel boxes may be used in:

1. Concealed interior locations above ceilings and in hollow studded partitions.
2. Exposed interior locations in mechanical rooms and in rooms without ceilings; higher than 8’ above the highest platform level.

3. Direct contact with concrete except slab on grade.
4. Recessed in stud wall of kitchens and laundries.

B. Cast boxes shall be used in:

1. Exterior locations.
2. Hazardous locations.
3. Exposed interior locations within 8' of the highest platform level.
4. Direct contact with earth.
5. Direct contact with concrete in slab on grade.
6. Wet locations.
7. Kitchens and laundries when exposed on wall surface.

3.10 COORDINATION OF BOX LOCATIONS

A. Provide electrical boxes as shown on the drawings, and as required for splices, taps, wire pulling, equipment connections, and code compliance.

B. Electrical box locations shown on the Contract Drawings are approximate, unless dimensioned. Verify location of floor boxes and outlets in offices and work areas prior to rough-in.

C. Locate and install boxes to allow access. Avoid interferences with ductwork, piping, structure, equipment, etc. Where installation is inaccessible, provide access doors. Coordinate locations and sizes of required access doors with the Architect/Engineer and General Contractor.

D. Locate and install to maintain headroom and to present a neat appearance.

E. Coordinate locations with Heating Contractor to avoid baseboard radiation cabinets.

3.11 OUTLET BOX INSTALLATION

A. Do not install boxes back-to-back in walls.

1. Provide a minimum horizontal separation of 6 inches between boxes installed on opposite sides of non-rated stud walls. When the minimum separation cannot be maintained, install sound insulation pads on all five sides of the back box in accordance with the manufacturer's instructions.

2. Provide a minimum horizontal separation of 24 inches between boxes installed on opposite sides of fire-rated walls. When the minimum separation cannot be maintained, the box is greater than 16 square inches or the total box area (all trades) per 100 square feet is greater than or equal to 100 square inches, install fire-rated moldable pads to all five sides of the back box to maintain the fire rating of the wall. Install moldable pads in accordance with UL listing for the specific product. Sound insulation pads are not acceptable for use in fire-rated wall applications unless the product carries the necessary fire rating.

B. Install sound insulation pads on all five sides of the back of all boxes in sound-rated wall assemblies. Sound-rated wall assemblies are defined as partition types carrying a Sound Transmission Class (STC) rating.

C. The Contractor shall anchor switch and outlet box to wall construction so that it is flush with the finished masonry, paneling, drywall, plaster, etc. The Contractor shall check the boxes as the finish wall surface is being installed to assure that the box is flush. (Provide plaster rings as necessary.)

D. Mount at heights shown or noted on the drawings or as generally accepted if not specifically noted.

E. Locate boxes in masonry walls to require cutting of masonry unit corner only. Coordinate masonry cutting to achieve neat openings for boxes.

F. Provide knockout closures for unused openings.

G. Support boxes independently of conduit.

H. Use multiple-gang boxes where more than one device are mounted together; do not use sectional boxes. Provide barriers to separate wiring of different voltage systems.

I. Install boxes in walls without damaging wall insulation.

J. Coordinate mounting heights and locations of outlets mounted above counters, benches, backsplashes, and below baseboard radiation.

K. Position outlets to locate luminaires as shown on reflected ceiling drawings.

L. In inaccessible ceiling areas, position outlets and junction boxes within 6 inches of recessed luminaire, to be accessible through luminaire ceiling opening.

M. Provide recessed outlet boxes in finished areas; secure boxes to interior wall and partition studs, accurately positioned to allow for surface finish thickness. Use stamped steel stud bridges for flush outlets in hollow stud wall, and adjustable steel channel fasteners for flush ceiling outlet boxes.

N. Align wall-mounted outlet boxes for switches, thermostats, and similar devices.

O. Provide cast outlet boxes in exterior locations and wet locations, and where exposed rigid or intermediate conduit is used.

3.12 PULL AND JUNCTION BOX INSTALLATION

A. Locate pull boxes and junction boxes above accessible ceilings or in unfinished areas.

B. Support pull and junction boxes independent of conduit.

C. Do not install boxes back-to-back in walls.

1. Provide a minimum horizontal separation of 6 inches between boxes installed on opposite sides of non-rated stud walls. When the minimum separation cannot be maintained, install sound insulation pads on all five sides of the back box in accordance with the manufacturer's instructions.

2. Provide a minimum horizontal separation of 24 inches between boxes installed on opposite sides of fire-rated walls. When the minimum separation cannot be maintained, the box is greater than 16 square inches or the total box area (all trades) per 100 square feet is greater than or equal to 100 square inches, install fire-rated moldable pads to all five sides of the back box to maintain the fire rating of the wall. Install moldable pads in accordance with UL listing for the specific product. Sound insulation pads are not acceptable for use in fire-rated wall applications unless the product carries the necessary fire rating.

D. Install sound insulation pads on all five sides of the back of all boxes in sound-rated wall assemblies. Sound-rated wall assemblies are defined as partition types carrying a Sound Transmission Class (STC) rating.

3.13 EXPOSED BOX INSTALLATION

A. Boxes shall be secured to the building structure with proper size screws, bolts, hanger rods, or structural steel elements.

B. On brick, block and concrete walls or ceilings, exposed boxes shall be supported with no less than two (2) Ackerman-Johnson, Paine, Phillips, or approved equal screw anchors or expansion shields and round head machine screws. Cast boxes shall not be drilled.

C. On steel structures, exposed boxes shall be supported to the steel member by drilling and tapping the member and fastening the boxes by means of round head machine screws.

D. Boxes may be supported on steel members by APPROVED beam clamps if conduit is supported by beam clamps.

E. Boxes shall be fastened to wood structures by means of a minimum of two (2) wood screws adequately large and long to properly support. (Quantity depends on size of box.)

F. Wood, plastic, or fiber plugs shall not be used for fastenings.

G. Explosive devices shall not be used unless specifically allowed.

END OF SECTION

SECTION 26 05 35
SURFACE RACEWAYS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Surface metal raceways
B. Surface non-metallic raceways

1.2 REFERENCES

A. FS W-C-582 - Conduit, Raceway, Metal, and Fitting; Surface

PART 2 - PRODUCTS

2.1 SURFACE METAL RACEWAY

A. Surface Metal Raceway: FS W-C-582; sheet metal channel with fitted cover, suitable for use as a continuous surface metal raceway.

B. Finish: Coordinate paint color with Architect.

C. Fittings: Couplings, elbows, and connectors designed for use with raceway system.

D. Boxes and Extension Rings: Designed for use with raceway systems.

E. Coverplates shall be stainless steel.

F. Normal power receptacles shall be same color as raceway. Coordinate color with Architect.

G. Receptacles and outlets shown on raceway on drawings shall be mounted with overlapping faceplates in the raceway and shall not be mounted in boxes unless specifically noted otherwise.

H. **[WW-1]:** Surface metal raceway, metallic cover, minimum 2” opening, minimum 3 square inch capacity.

1. Approved Manufacturers: Wiremold G3000, Mono-Systems SMS3200, Hubbell HBL3000 Series.

I. **[WW-2]:** Surface metal raceway, metallic cover, minimum 4” opening, power / communication divider, minimum 7.5 square inch capacity.

1. Approved Manufacturers: Wiremold G4000/G4048, Mono-Systems SMS4200, Hubbell HBL4750 Series.

J. **[WW-3]**: Surface metal raceway, metallic cover, minimum 4” opening, power / communication divider, minimum 16.6 square inch capacity.

1. Approved Manufacturers: Wiremold G6000/G4048, Mono-Systems SMS4400, Hubbell HBL6750 Series.

2.2 SURFACE NON-METALLIC RACEWAY

A. Surface Non-Metallic Raceway: Polyvinyl chloride channel with fitted cover; UL listed for power conductors.

B. Length: As shown on the drawings.

C. Finish: Field paint with latex paint; color selected by Architect.

D. Fittings and Accessories: Couplings, elbows, outlet and device boxes, and connectors designed for use with the raceway system.

E. Coverplates shall be same material and finish as raceway.

F. Normal power receptacles shall be same color as raceway. Coordinate color with Architect.

G. Acceptable Manufacturers: Wiremold PN20A Series, Hubbell PW2 Series.

PART 3 - EXECUTION

3.1 INSTALLATION - SURFACE METAL RACEWAY

A. Only install in locations pre-approved by Architect/Engineer.

B. Use flat-head screws to fasten channel to surfaces. Mount plumb and level.

C. Use suitable insulating bushings and inserts at connections to outlets and corner fittings.

D. Maintain grounding continuity between raceway components to provide a continuous grounding path.

E. Fastener: Use clips and straps suitable for the purpose.

F. Field cuts to be clean and straight and use the proper tools as recommended by the system manufacturer to prohibit damage to factory finish or raceway. Joints to be matched so there are no gaps or spaces in the cover. Furnish and install manufacturer's raceway accessories as needed.

G. Provide conduits to technology raceway per drawings or provide a minimum of one (1) 1-1/4" conduit per six feet of assembly (minimum 2) to above ceiling for technology requirements if assembly has technology raceway (Contractor shall provide quantities of conduits that provide maximum capacity to assembly). Provide conduits equally spaced within entire length of assembly.

H. Provide one (1) 3/4" empty conduit per six feet of assembly (minimum 1) to above ceiling for future power needs. Provide conduits equally spaced within entire length of assembly.

3.2 INSTALLATION - SURFACE NON-METALLIC RACEWAY

A. Only install in locations pre-approved by Architect/Engineer.

B. Use flat-head screws to fasten channel to surfaces. Mount plumb and level.

C. Do not locate raceway near heating elements, open flames or surfaces with a probable temperature greater than 150°F.

D. Do not locate raceway where there is a probability of contact with oils, chemicals or moisture.

E. Contractor shall install a bonded ground conductor the entire length of the raceway.

F. Field cuts to be clean and straight and use the proper tools as recommended by the system manufacturer to prohibit damage to factory finish or raceway. Joints to be matched so there are no gaps or spaces in the cover. Furnish and install manufacturer's raceway accessories as needed.

G. Provide conduits to technology raceway per drawings or provide a minimum of one (1) 1-1/4" conduit per six feet of assembly (minimum 2) to above ceiling for technology requirements if assembly has technology raceway (Contractor shall provide quantities of conduits that provide maximum capacity to assembly). Provide conduits equally spaced within entire length of assembly.

H. Provide one (1) 3/4" empty conduit per six feet of assembly (minimum 1) to above ceiling for future power needs. Provide conduits equally spaced within entire length of assembly.

END OF SECTION

SECTION 26 05 36
CABLE TRAYS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Cable trays
B. Cable tray accessories

1.2 QUALITY ASSURANCE

A. NEC Compliance: Comply with NEC as applicable to construction and installation of cable tray and cable channel systems (Article 392, NEC).

B. NFPA Compliance: Comply with NFPA 70B, "Recommended Practice for Electrical Equipment Maintenance" pertaining to installation of cable tray systems.

1.3 REFERENCES

A. ANSI/NFPA 70 – National Electrical Code

B. ASTM A123 – Specification for Zinc (Hot Galvanized) Coatings on Iron and Steel

C. ASTM A510 – Specification for General Requirements for Wire Rods and Coarse Round Wire, Carbon Steel

D. ASTM B633 – Specification for Electrodeposited Coatings of Zinc on Iron and Steel

E. NEMA VE 1 – Metallic Cable Tray Systems

F. NEMA VE 2 – Cable Tray Installation

1.4 SUBMITTALS

A. Submit shop drawings and product data under provisions of Section 26 05 00.

B. Indicate tray type, dimensions, support points, clamps, hangers, connectors, fittings, expansion joint assemblies, accessories and finishes.

C. Submit manufacturer's installation instructions under provisions of Section 26 05 00.

D. Include cable tray in composite electronic coordination files. Refer to Section 26 05 00 for coordination drawing requirements.

1.5 DELIVERY, STORAGE AND HANDLING

A. Deliver materials to site in manufacturer's original, unopened containers and packaging.

B. Store materials in a dry area indoors, protecting from damage and in accordance with manufacturer's instructions.

1.6 TESTING AND COMMISSIONING

A. Visually inspect each cable tray ground connection for mechanical continuity.

B. Visually inspect each structural suspension point for specified loading and spacing.

C. Submit notification of testing and results under provisions of Section 26 05 00.

1.7 OPERATION AND MAINTENANCE DATA

A. Submit operation and maintenance data under provisions of Section 26 05 00.

B. Include cleaning and bolt-tightening procedures.

C. Note grounding point on as-built drawings.

1.8 COORDINATION

A. Coordinate layout and installation of cable trays and suspension system with other construction, including structural members, light fixtures, HVAC equipment, fire suppression systems, and partition assemblies.

PART 2 - PRODUCTS

2.1 GENERAL

A. Provide all cable tray with all fittings and mounting hardware. Install according to NEMA class with 1.5 safety factor.

B. Accessories and Fittings: Manufacturer's standard clamps, hangers, brackets, splice plates, reducer plates, blind ends, barrier strips, connectors, and grounding straps.

C. Refer to manufacturers installation instructions and specific product data below for additional information.

1. Approved Manufacturers: Cooper B-Line Series 35, Cope, Thomas & Betts, Cablofil

2. Manufacturers: Cooper B-Line Channel CC Series, Cope, Thomas & Betts, Cablofil

2.2 WELDED WIRE MESH CABLE TRAYS

A. [CT-#]: Wire mesh type cable tray, 4” loading depth, width indicated on plans. Provide trapeze support with plastic retainer.

1. Approved Manufacturers: B-Line, Mono-Systems, Cope, Cablofil Inc., Hubbell HBT.

B. Tray: Continuous, rigid, welded steel wire mesh cable tray with continuous top wire safe edge with T-weld.

C. Wire mesh shall be welded at all intersections.

D. Material: Carbon steel wire, 0.197” minimum wire diameter, ASTM A510, Grade 1008. Wire shall be welded, formed and surface treated.

E. Finish: Finish shall be applied after welding and bending of mesh. Finish shall be electro-plated zinc galvanizing: ASTM B633, Type I, SC-1.

F. Provide grounding clip for continuous grounding of tray.

G. Accessories: Provide all supporting, hanging, tee, cross, level change, reducing, drop outs, and miscellaneous hardware as required for a complete and functioning installation to manufacturer’s recommendations.

H. Load Span Criteria: Install and support cable management system in accordance with span load criteria of L/240.

2.3 WARNING SIGNS

A. Provide manufacturer's standard, permanent, legible warning label indicating the following:

WARNING! DO NOT USE AS A WALKWAY, LADDER, OR SUPPORT FOR PERSONNEL. TO BE USED ONLY AS MECHANICAL SUPPORT FOR CABLES AND TUBING!

B. Label shall also indicate cable tray NEMA load class. Label shall be a maximum of 10' on center.

C. Cable trays containing conductors rated over 600 volts shall have a label with the wording "DANGER-HIGH VOLTAGE-KEEP AWAY".

D. Cable trays containing service entrance conductors shall be labeled with "CABLE TRAY CONTAINS SERVICE-ENTRANCE CONDUCTORS".

PART 3 - EXECUTION

3.1 INSTALLATION

A. Installation: In conformance with NEMA VE 2 requirements and in accordance with manufacturer's instructions.

B. Support cable tray at each connection point, at the end of each run, and at other points to maintain spacing between supports of 8 ft. maximum.

C. Use expansion connectors where indicated in NEMA VE 1.

D. Cut standard straight sections to length in field.

E. Tray shall be electrically continuous from source to termination and shall not change elevation, direction or otherwise expose cables to travel without support.

F. Tray shall be field cut using the manufacturer's approved cutting device and methods. Cutting device shall be an offset blade bolt cutter. The use of standard bolt cutters is strictly prohibited.

G. Bends in tray shall be accomplished by utilizing manufacturer's cutting guides.

H. All splices of tray shall be provided with splice washers, bars or springs as recommended by the manufacturer.

I. Provide bonding continuity between cable tray sections, fittings and conduit terminations in accordance with manufacturer's instructions.

J. Tighten electrical connectors and terminals per manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

K. Remove burrs and sharp edges from cable trays.

L. Seal penetrations through fire and smoke barriers.

M. Install capped sleeves for future cables through firestop sealed cable tray penetrations of fire and smoke barriers as shown on drawings.

N. Install cable trays with sufficient space to permit access for installing cables. Install tray bottom within 18" of access ceiling paneling for ease of access. Adjust mounting height only momentarily for field coordination with other trades and systems as required.

O. Provide separation of cables of different systems, such as power, telecommunications, fire alarm system, security systems and audio or visual systems. Install barriers between power and low voltage cables.

END OF SECTION

SECTION 26 05 53
ELECTRICAL IDENTIFICATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Nameplates and tape labels
B. Wire and cable markers
C. Conduit labeling
D. Conduit color coding
E. Conductor color coding
F. Electrical gear labeling
G. Power distribution equipment labeling
H. Transformer equipment labeling
I. Series rating identification
J. Pole identification

1.2 REFERENCES

A. ANSI C2 – National Electrical Safety Code

B. NFPA 70 – National Electrical Code

C. ANSI A13.1 – Standard for Pipe Identification

D. ANSI Z535.4 – Standard for Product Safety Signs and Labels

PART 2 - PRODUCTS

2.1 ELECTRICAL IDENTIFICATION PRODUCTS

A. Adhesive Marking Labels for Raceway: Pre-printed, flexible, self-adhesive vinyl labels with legend indicating voltage and service (Emergency, Lighting, Power, HVAC, Communications, Control, Fire).

1. Label Size as follows:

a. Raceways: Kroy or Brother labels 1-inch high by 12-inches long. (Minimum)

2. Color: As specified for various systems.

B. Colored Adhesive Marking Tape for banding Raceways, Wires, and Cables: Self-adhesive vinyl tape not less than 3 mils thick by 1 inch to 2 inches in width.

C. Pretensioned Flexible Wraparound Colored Plastic Sleeves for Cable Identification: flexible acrylic bands sized to suit the cable diameter and arranged to stay in place by pre-tensioned gripping action when coiled around the cable.

D. Wire/Cable Designation Tape Markers: Vinyl or vinyl-cloth, self-adhesive, wraparound, cable/conductor markers with preprinted numbers and letter.

E. Cable Ties: Fungus-inert, self-extinguishing, one-piece, self-locking nylon cable ties, 0.18-inch minimum width, 50-lb minimum tensile strength, and suitable for a temperature range from minus 50°F to 350°F. Provide ties in specified colors when used for color coding.

F. Underground Plastic Markers: Bright colored continuously printed plastic ribbon tape of not less than 6 inches wide by 4 mil thick, printed legend indicating type of underground line, manufactured for direct burial service. Tape shall contain a continuous metallic wire to allow location with a metal detector.

G. Aluminum, Wraparound Marker Bands: 1" in width, .014 inch thick aluminum bands with stamped or embossed legend, and fitted with slots or ears for permanently securing around wire or cable jacket or around groups of conductors.

H. Brass or aluminum Tags: 2" by 2" by .05-inch metal tags with stamped legend, punched for fastener.

I. Indoor/Outdoor Number and Letters: Outdoor grade vinyl label, minimum of 3/4" high x 9/16" wide, with acrylic adhesive designed for permanent application in severe indoor and outdoor environments.

2.2 NAMEPLATES AND SIGNS

A. Engraved, Plastic-Laminated Labels, Signs and Instruction Plates: Engraving stock melamine plastic laminate, 1/16-inch minimum thick for signs up to 20 square inches, or 8 inches in length; 1/8 inch thick for larger sizes. Labels shall be punched for mechanical fasteners. Engraving legend shall be as follows:

1. Black letters on white face for normal power.
2. White letters on red face for emergency power.
3. White letters on green face for grounding.
4. Black letter on yellow face for Caution or UPS.

B. Baked–Enamel Signs for interior Use: Preprinted aluminum signs, punched, or drilled for fasteners, with colors, legend, and size required for application. Mounting ¼" grommets in corners.

C. Exterior, Metal-Backed, Butyrate Signs: Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs with .0396 inch galvanized-steel backing: and with colors, legend, and size required for application. Mounting ¼" grommets in corners.

D. Safety Signs: Comply with 29 CFR, Chapter XVII, Part 1910.145.

E. Fasteners for Plastic-Laminated Signs; Self-tapping stainless steel screws or number 10/32 stainless steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Lettering and Graphics: Coordinate names, abbreviations, colors, and other designations used in electrical identification work with corresponding designations specified or indicated. Install numbers, lettering, and colors as required by code.

B. Install identification devices in accordance with manufacturer's written instruction and requirements of NEC.

C. Sequence of Work: Where identification is to be applied to surfaces that require finish, install identification after completion of finish work. All mounting surfaces shall be cleaned and degreased prior to identification installation.

D. Identify Junction, Pull and Connection Boxes: Labeling shall be 3/8-inch Kroy tape or permanent magic marker (color coded), neatly hand printed. In rooms that are painted out, provide labeling on inside of cover.

E. Circuit Identification: Tag or label conductors as follows:

1. Multiple Power or Lighting Circuits in Same Enclosure: Where multiple branch circuits are terminated or spliced in a box or enclosure, label each conductor with source and circuit number.

2. Multiple Control Wiring and Communication/Signal Circuits in Same Enclosure: For control and communications/signal wiring, use wire/cable marking tape at terminations in wiring boxes, troughs, and control cabinets. Use consistent letter/number conductor designations throughout on wire/cable marking tape.

3. Match identification markings with designations used in panelboards shop drawings, Contract Documents, and similar previously established identification schemes for the facility's electrical installations.

F. Apply warning, caution and instruction signs as follows:

1. Install warning, caution or instruction signs where required by NEC, where indicated, or where reasonably required to assure safe operation and maintenance of electrical systems and of the items to which they connect. Install engraved plastic-laminated instruction signs with approved legend where instructions or explanations are needed for system or equipment operation. Install metal-backed butyrate signs for outdoor items.

2. Emergency Operating Signs: Install, where required by NEC, where indicated, or where reasonably required to assure safe operation and maintenance of electrical systems and of the items to which they connect, engraved laminate signs with white legend on red background with minimum 3/8-inch high lettering for emergency instructions on power transfer, load shedding, or other emergency operations.

G. Apply circuit/control/item designation labels of engraved plastic laminate for pushbuttons, pilot lights, alarm/signal components, and similar items, except where labeling is specified elsewhere.

H. Install labels parallel to equipment lines at locations as required and at locations for best convenience of viewing without interference with operation and maintenance of equipment.

I. Install ARC FLASH WARNING signs on all switchboards, panelboards, industrial control panels, and motor control centers. Sign at a minimum shall contain:

J. Underground Electrical Lines: For exterior underground power, control, signal, and communication lines, install continuous underground plastic line marker located directly above line at 6 to 8 inches below grade. Where width of multiple lines installed in a common trench or concrete envelope does not exceed 16 inches overall, use a single marker. Install line marker for underground wiring, both direct-buried cables and cables in raceway.

3.2 SWITCH AND RECEPTACLE COVER PLATES

A. Provide identification on all switch and receptacle cover plates. Identification shall indicate source and circuit number serving the device (i.e. "C1A #24").

B. Identification material to be a clear, 3/8-inch Kroy tape or Brother self-laminating vinyl label with black letters in normal size “Swiss 721 Bold” font. Letter and number size to 3/16-inch high. Embossed Dymo-Tape labels are not acceptable. Permanently affix identification label to cover plates, centered above the receptacle openings.

3.3 CONDUIT AND EXPOSED CABLE LABELING

A. Conduit Identification: Pre-printed, flexible, self-adhesive vinyl labels with legend at 20 foot intervals to identify all conduits run exposed or located above accessible ceilings. Conduits located above non-accessible ceiling or in floors and walls shall be labeled within 3 feet of becoming accessible. Labels for multiple conduits shall be aligned. Use the following colors

1. 600 Volts and Below Normal: White letters on black background indicating feeder identification and voltage.
2. 600 Volt and Below Emergency: White or black letters on red background indicating feeder identification and voltage.
3. Fire Alarm: Red letter on white background indicating “FIRE ALARM”.
4. Temperature Control: White or black letters on blue background.
5. Grounding: White letters on green background indicating “GROUND” and equipment and designation.
6. Security System: Blue letters on yellow background indicating "Security".
7. Telephone System: Green letters on yellow background indicating "Telephone".

B. Blank conduit ends or outlet boxes for future extension of system shall have permanent identification marker indicating purpose of conduit or box and where the raceway originated.

3.4 BOX LABELING

A. All junction, pull, and connection boxes shall be identified as follows:

1. For power and lighting circuits, indicate system voltage and identity of contained circuits (“120V, 1LA1-3,5,7”).
2. For other wiring, indicate system type and description of wiring (“FIRE ALARM NAC #1”).

B. Box covers shall be painted to correspond with system type as follows:

1. Box color to match conduit color indicated below.

3.5 CONDUIT COLOR CODING SCHEDULE

A. Provide color coded conduit as indicated below. Conduit shall be colored by the manufacturer:

1. Fire Alarm System: Red.
2. Normal Power Distribution System 277V/480V: Silver. Labeled as “277/480Y”
3. Normal Power Distribution System 120V/208V: Silver. Labeled as “120/208Y”
4. Emergency Power Distribution System: Green, Labeled per Voltage used.
5. Optional Standby: Blue, Labeled per Voltage used.
6. DC Voltage (Solar etc.): Orange, labeled as “600VDC” or per system rating.
7. Temperature Controls, Motor Control and Other Control or Building Automation Systems: White. Labeled as “BAS”

8. Communication (CAT6, Fiber, Access System, Radio, etc.): Purple. Labeled “COM”, “FIBER”, or as directed by owner.
9. Security System: Yellow.
10. Ground: Green.

B. Blank conduit ends or outlet boxes for future extension of system shall have permanent identification marker indicating purpose of conduit or box and where the raceway originated.

C. This Contractor shall furnish and install framed 8" x 10" charts of the color coded identification scheme used for the electrical system in all electrical rooms and next to the main fire alarm panel.

3.6 CONDUIT COLOR CODING SCHEDULE

A. Identify Raceways with Color Banding: Band exposed or accessible raceways, cables, and bare conductors of the following systems for identification. Bands shall be pretensioned, snap-around colored plastic sleeves, colored adhesive marking tape, or a combination of the two. Make each color band 2 inches wide, completely encircling conduit, and place adjacent bands of two-color markings in contact, side by side. Install bands at changes in direction, at penetrations of walls and floors, at each junction box and at 20-foot maximum intervals in straight runs. Apply the following colors:

B. System Conduit Color:

1. Primary Distribution System: Silver.
2. Normal 480Y/277 Volt Distribution System: Orange.
3. Normal 208Y/120 Volt, Distribution System: White.
4. Fire Alarm System: Red.
5. Motor and Other Control Systems: Black.
6. Telephone System: Green/Yellow banding.
7. Clock, Sound & Intercom: Blue.
8. Emergency 480Y/277 Volt Distribution System: Orange/Yellow band.
9. Emergency 208Y/120 Volt Distribution System: White/Yellow band.
10. Nurse Call: Green.
11. Security System: Blue/Yellow band.
12. Ground: Green.

C. Where conduit leaves a switchboard or panelboard, identification shall be installed on each conduit indicating load served.

D. Where conduit is above an accessible ceiling, each electrical system shall be color coded and identified.

E. Identification of emergency conduit shall be by means of spray painted bands on maximum of 10'-0" centers.

F. Blank conduit ends or outlet boxes for future extension of system shall have permanent identification marker indicating purpose of conduit or box and where the raceway originated.

G. This Contractor shall furnish and install framed 8" x 10" charts of the color coded identification scheme used for the electrical system in all electrical rooms and next to the main fire alarm panel.

3.7 CONDUCTOR COLOR CODING

A. Color coding shall be applied at all panels, switches, junction boxes, pull boxes, vaults, manholes etc., where the wires and cables are visible and terminations are made. The same color coding shall be used throughout the entire electrical system, therefore maintaining proper phasing throughout the entire project.

B. Where more than one nominal voltage system exists in a building or facility, the identification of color coding used in the panelboard or equipment shall be permanently posted on the interior of the door or cover.

C. All wires and cables, 6 AWG or larger, used in motor circuits, main feeders, sub-main feeders and branch circuits, shall be coded by the application of plastic tape. The tape shall be 3-M, Plymouth or Permacel, in colors specified below. The tape shall be applied at each conductor termination with two 1-inch tape bands at 6-inch centers. Contractor option to use colored cabling in lieu of the tape at each end for conductor 6 AWG to 500 KCM.

D. Wire and cables smaller than 6 AWG shall be color coded by the manufacturer.

E. Colored cable ties shall be applied in groups of three ties of specified color to each conductor at each terminal or splice point starting 3 inches from the termination and spaced at 3- inches centers. Tighten to a snug fit, and cut off excess length.

F. Where more than one nominal voltage system exists in a building or facility, each ungrounded conductor of a multi-wire branch circuit, where accessible, shall be identified by phase and system.

G. Conductors shall be color coded as follows:

1. 120/240 Volt, 3-Wire:

   a. A-Phase – Black
   b. B-Phase – Red
   c. Neutral – White
   d. Ground Bond – Green

2. 208Y/120 Volt, 4-Wire:

   a. A-Phase – Black
   b. B-Phase – Red
   c. C-Phase – Blue
   d. Neutral – White
   e. Ground Bond – Green

3. 480Y/277 Volt, 4-Wire:

   a. A-Phase – Brown
   b. B-Phase – Orange
   c. C-Phase – Yellow
   d. Neutral – Gray
   e. Ground Bond – Green

3.8 ELECTRICAL GEAR LABELING

A. Exterior electrical gear shall be identified with vinyl label names and numbers to be visible on the exterior of the gear. The labels shall correspond to the 1-line nomenclature and identify each cubicle of multi-section gear.

B. Arc Energy Reduction Label:

1. Provide an engraved plastic laminate label centered at the top of each vertical section of the electrical gear indicating the following when applicable.

   a. Label: “This equipment is designed with a [system listed below]”.

   b. Applicable Systems:

      1) Zone-selective interlocking system for selective coordination and arc energy reduction

2) Differential relaying system for selective coordination and arc energy reduction

3) Arc energy reducing maintenance switch

4) Energy reducing active arc flash mitigation system

3.9 CONTROL EQUIPMENT IDENTIFICATION

A. Provide identification on the front of all control equipment, such as disconnect switches, starters, VFDs, contactors, motor control centers, etc. Nameplate text shall be a minimum of 1/4" high.

B. Labeling shall include:

1. Equipment type and contract documents designation of equipment being served.
2. Location of equipment being served if it is not located within sight.
3. Voltage and phase of circuit(s).
4. Panel and circuit number(s) serving the equipment.
5. Method of automatic control, if included ("AUTO CONTROL BY FCMS").

EXHAUST FAN EF-1 ("LOCATED ON ROOF")
480V, 3-PHASE
FED FROM "1HA1-1"

3.10 POWER DISTRIBUTION EQUIPMENT IDENTIFICATION

A. Provide identification on the front of all power distribution equipment, such as panelboards, switchboards, etc. The identification material shall be engraved plastic-laminated labels. Text shall be a minimum of 1/4" high, Swiss 721 Bold.

B. Labeling shall include:

1. Equipment type and contract documents designation of equipment.
2. Voltage of the equipment.
3. Name of the upstream equipment and location of the upstream equipment if it is not located within sight.
4. Rating and type of the overcurrent protection device serving the equipment if it is not located within sight ("FED BY 400A/3P BREAKER").

DISTRIBUTION PANEL DP-H1
480Y/277V
FED FROM SWITCHBOARD "SB-1" (LOCATED IN MAIN ELECTRIC ROOM)

C. A separate nameplate for the service entrance equipment shall be labeled with the MAXIMUM AVAILABLE FAULT CURRENT and DATE of calculation given on the one-line diagram.

D. Distribution panelboards and switchboards shall have each overcurrent protection device identified with name and location of the load being served ("AHU-1 LOCATED IN PENTHOUSE 1").

E. Branch panelboards shall be provided with typed panel schedules upon completion of the project. Existing panelboards shall have their existing panel schedules typed, with all circuit changes, additions or deletions also typed on the panel schedules. A copy of all panel schedules for the project shall be turned over as part of the O&M Manuals. Refer to Section 26 05 00 for other requirements.

3.11 POLE IDENTIFICATION

A. Lighting poles shall be individually identified with a unique number, for maintenance purposes. Apply the vinyl label number above the hand hole cover or 24" above grade.

END OF SECTION

SECTION 26 05 73
POWER SYSTEM STUDY

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Low voltage distribution system power study.
B. Short-circuit analysis and report.
C. Selective coordination analysis and report.
D. Arc-flash hazard analysis and report.

1.2 SUBMITTALS

A. Analyses shall be performed by an agent authorized by the manufacturer of equipment specified in the related specification sections and shall bear the seal/signature of the licensed Professional Engineer who performed the analysis.

B. The input for the power system study shall be based on the contract documents, with estimated conductor lengths provided by the Electrical Contractor. IMEG will provide a preliminary Power Tools for Windows project file for information, if requested.

C. Documentation of the analyses shall be submitted in a bound booklet format and shall accompany the shop drawing submittals for equipment provided under the related work specification sections. These shop drawings will not be reviewed without this documentation. Submit a sample arc-flash hazard label for Owner review and approval prior to printing.

D. Power system study project model shall be submitted on electronic media for review and the Owner's operating and maintenance records.

1.3 SCOPE

A. Provide a power system study of the electrical system shown on the plans. The study shall include arc-fault analysis, selective coordination analysis and arc flash hazard analysis.

B. Contractor is required to provide a fully coordinated system for the essential electrical system and the associated normal side of each transfer switch and all other locations indicated on the one line diagram. Contractor shall provide overcurrent protective devices with the appropriate models, frame sizes, trip units, etc. as required to provide a selectively coordinated system.

PART 2 - PRODUCTS

2.1 Power systems study shall be completed in Power Tools for Windows **(PTW) 7.0** or later version or pre-approved equivalent program**.**

PART 3 - EXECUTION

3.1 SHORT-CIRCUIT ANALYSIS

A. Provide a complete short-circuit analysis from the utility service to and including the entire building distribution as shown on the drawings.

B. Analysis shall include the entire distribution system from the point of connection to the utility power source to the distribution panels and branch circuit panelboards.

C. Documentation shall be made in one-line diagram form showing the magnitude and location of each calculated fault. Fault current calculations shall be made at the main bus of each switchboard, distribution panel, and branch circuit panel. A summary of the fault currents available shall also be submitted.

3.2 SELECTIVE COORDINATION ANALYSIS

A. Provide a complete selective coordination analysis, comparing time/current curves of the protective devices to be installed to assure complete selectivity between main and downstream devices for code-required branches and branches identified on one-line drawings. Overcurrent protective devices serving the essential electrical system shall selectively coordinate for the period of time that a fault's duration extends beyond 0.01 second.

B. The analysis shall include primary protective device, secondary main switchboard device(s), switchboard branch feeder devices, generator breaker, distribution panel, panelboard main devices, and branch feeder devices.

C. The coordination plots provided shall indicate graphically the coordination proposed for the system on full-size log forms and shall define the types of protective devices selected, together with proposed time dial and pickup settings required. The plots shall include titles, representative one-line diagrams, legend, complete parameters for transformer(s), and complete operating bands for circuit breaker trip devices, fuses, etc.

1. The long-time region of the coordination plots shall designate the pickups required for the circuit breakers.

2. The short-time region shall indicate the magnetizing in-rush and ASA-withstand-transformer parameter, the circuit breaker, short-time and instantaneous trip devices, fuse-manufacturing tolerance bands, significant symmetrical fault currents, etc.

3. Include zone selective interlocking, differential relaying, and other selective coordination technology in the study when required by other specification sections.

4. The protective device characteristics or operating bands shall be suitably indicated to reflect the actual symmetrical fault currents sensed by the device.

5. The drawings and specifications indicate the general requirements for motors, motor-starting equipment, and medium-voltage and low-voltage equipment, but additional specific requirements of equipment furnished shall be determined in accordance with the results of the coordination study.

    a. The study shall include verification of equipment ratings and settings. The Contractor shall keep the study up-to-date with any project changes which affect the study and submit the revised study for review. A final electronic copy shall be submitted with the record drawings.

D. Provide summary table of adjustable overcurrent protective devices settings for the operating and maintenance manual.

3.3 ARC FLASH HAZARD ANALYSIS

A. The arc flash hazard analysis shall be performed according to the IEEE 1584 equations that are presented in NFPA70E-2004, Annex D.

B. The flash protection boundary and the incident energy shall be calculated at all significant locations in the electrical distribution system (switchboards, switchgear, unit substations, motor-control centers, panelboards, busway, and splitters) where work could be performed on energized parts.

C. Safe working distances shall be based on the calculated arc flash boundary considering an incident energy of 1.2 cal/cm^2.

D. When appropriate, the short circuit calculations and the clearing times of the phase overcurrent devices will be retrieved from the short-circuit analysis and coordination study models. Ground overcurrent relays should not be taken into consideration when determining the clearing time when performing incident energy calculations

E. The short-circuit calculations and the corresponding incident energy calculations for multiple system scenarios must be compared, and the greatest incident energy must be uniquely reported for each equipment location. Calculations must be performed to represent the maximum and minimum contributions of fault current magnitude for all normal and emergency operating conditions. The minimum calculation will assume that the utility contribution is at a minimum and will assume a minimum motor contribution (all motors off). Conversely, the maximum calculation will assume a maximum contribution from the utility and will assume the maximum amount of motors to be operating. Calculations shall take into consideration the parallel operation of synchronous generators with the electric utility, where applicable.

F. The incident energy calculations must consider the accumulation of energy over time when performing arc flash calculations on buses with multiple sources. Iterative calculations must take into account the changing current contributions, as the sources are interrupted or decremented with time. Fault contribution from motors and generators should be decremented as follows:

1. Fault contribution from induction motors should not be considered beyond 3 to 5 cycles.

2. Fault contribution from synchronous motors and generators should be decayed to match the actual decrement of each as closely as possible (e.g., contributions from permanent magnet generators will typically decay from 10 per unit to 3 per unit after 10 cycles).

G. For each equipment location with a separately enclosed main device (where there is adequate separation between the line side terminals of the main protective device and the work location), calculations for incident energy and flash protection boundary shall include both the line and load side of the main breaker.

H. Include Arc Energy Reduction (AER) analysis in the study when required by other specification sections.

I. When performing incident energy calculations on the line side of a main breaker (as required per the above), the line side and load side contributions must be included in the fault calculation.

J. Mis-coordination should be checked among all devices within the branch containing the immediate protective device upstream of the calculation location, and the calculation should utilize the fastest device to compute the incident energy for the corresponding location.

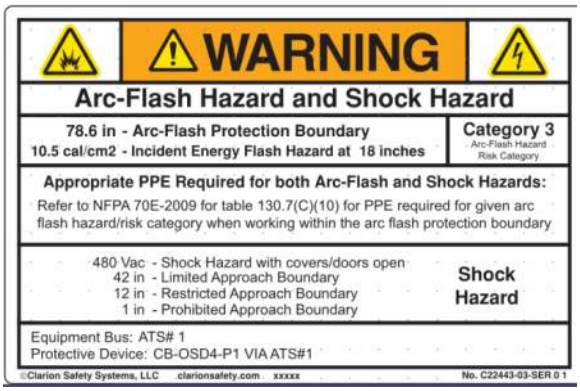
K. Arc flash calculations shall be based on actual overcurrent protective device clearing time. Maximum clearing time will be capped at 2 seconds based on IEEE 1584-2002 section.

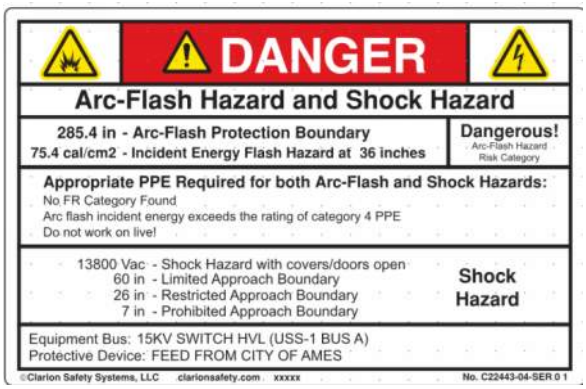
L. Where it is not physically possible to move outside the flash protection boundary in less than 2 seconds during an arc flash event, a maximum clearing time based on the specific location shall be utilized.

M. Create and install NFPA 70E compliant labels describing the arc flash hazard level at all switchboards, panelboards, and other locations in the electrical distribution system where work could be performed on energized parts.

N. The label shall include the incident energy calculated in the analysis and the hazard category or appropriate personal protective equipment (PPE) required to perform maintenance on the system when energized. Labels shall be vinyl or laminated, with a self-adhesive backing.

O. Examples showing the minimum required information follow:





P. A list of all hazard categories and the corresponding PPE requirements shall be posted in the main electric room, engineering office, or other location. The list shall be plastic laminate or typewritten and housed in a plastic frame.

3.4 ADJUSTMENTS

A. Manufacturer's authorized representative or Contractor shall set all adjustable protective devices to values indicated in the approved coordination study.

B. Wherever the arc flash incident energy exceeds Arc Flash Category 2 (i.e. > 8 cal/cm^2), provide options for adjusting breaker trip times, if possible, to reduce energies to Category 2 or below.

3.5 TRAINING

A. Provide four hours of Owner training to explain the implications of arc-flash requirements and work permit procedure.

END OF SECTION

SECTION 26 09 33
LIGHTING CONTROL SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Line voltage standalone lighting controls
B. Emergency transfer devices
C. Time switches

1.2 RELATED WORK

A. Section 01 91 00 - Commissioning
B. Section 23 09 00 - Facility Management Control System (FMCS)
C. Section 26 51 00 - Lighting

1.3 QUALITY ASSURANCE

A. Manufacturers shall be regularly engaged in the manufacture of lighting control equipment and ancillary equipment, of types and capacities required, whose products have been in satisfactory use in similar service for not less than five (5) years.

B. All components and assemblies are to be factory pre-tested prior to delivery and installation.

C. Comply with NEC as applicable to electrical wiring work.

D. Comply with applicable portions of NEMA standards pertaining to types of electrical equipment and enclosures.

E. Panels and accessory devices are to be UL listed under UL 916 Energy Management Equipment. Panels and accessories used for control of life safety and critical branch circuits shall be listed under UL 924 Emergency Lighting and Power Equipment.

F. All assemblies are to be in compliance with FCC emissions standards specified in Part 15 Subpart J for Class A applications.

1.4 REFERENCES

A. FCC Rules and Regulations, Part 15, Subpart J - Radio Frequency Interference
B. FS W S 896 Switch, Toggle
C. International Energy Conservation Code (IECC)
D. NEMA WD 1 - General Color Requirements for Wiring Devices
E. NEMA WD 7 - Occupancy Motion Sensors
F. NFPA 70 - National Electrical Code (NEC)
G. UL Standard 916 Energy Management Equipment
H. UL 924 - Emergency Lighting and Power Equipment
I. UL 1472 – Solid-State Dimming Controls

1.5 SUBMITTALS

A. Submit product data under provisions of Section 26 05 00.

B. Submit a comprehensive package including devices, hardware, software, product specification, finishes, dimensions, installation instructions, warranty, system software requirements.

C. Provide floor plan showing location, orientation, and coverage area of each control device, sensor, and controller/interface. For areas requiring multiple sensor devices for appropriate coverage, submit specific manufacturer-approved sensor layout as an overlay directly on the project drawings, either in print or approved electronic form.

D. Submit project specific control wiring diagrams showing all equipment, line voltage, and control wiring requirements for all components including, but not limited to, dimmers, relays, low voltage switches, and occupancy sensors.

1.6 EXTRA STOCK

A. Provide extra stock under provisions of Section 26 05 00.

B. Sensors, Controls, Power Supplies, and Relays: Five (5) percent of quantity installed. Minimum of two (2) of each configuration and type.

1.7 PROJECT RECORD DOCUMENTS

A. Submit project record documents under provisions of Section 26 05 00.

B. Accurately record location of all controls and devices. Include description of switching sequences and circuiting arrangements.

1.8 OPERATION AND MAINTENANCE DATA

A. Submit emergency, operation, and maintenance data under provisions of Section 26 05 00. Data shall also include the following:

1. Schedule for routine maintenance, inspection, and calibration of all lighting control devices and system components. Recommended schedule for inspection and recalibration of sensors.

2. Replacement part numbers for all system components.

B. Identify installed location and labeling for each luminaire controlled by automated lighting controls.

1.9 SYSTEM DESCRIPTION

A. Performance Statement: This specification section and the accompanying lighting design documents describe the minimum material quality, required features, and operational requirements of the lighting control system (LCS). These documents do not convey every wire that must be installed and every equipment connection that must be made. Based on the performance required of the system, as presented in these documents, the Contractor and system manufacturer/vendor are solely responsible for determining all equipment, wiring, and programming required for a complete and operational system.

B. The following control types and features are acceptable. Acceptable control locations are shown on the drawings.

1. Line Voltage Control: Control equipment consists of traditional line voltage wiring devices and equipment such as switches, dimmers and combination occupancy/vacancy sensor switches, etc.

1.10 COMMISSIONING

A. Commissioning of a system or systems specified in this section is part of the construction process. Documentation and testing of these systems, as well as training of the Owner's operation and maintenance personnel, is required in cooperation with the Owner's Representative and the Commissioning Agent. Project closeout is dependent on successful completion of all commissioning procedures, documentation, and issue closure. Refer to Division 1 for detailed commissioning requirements.

B. The Contractor shall notify the Commissioning Agent, Architect/Engineer and Owner's Representative ten (10) working days prior to scheduled commissioning date.

C. The commissioning process requires meeting attendance. Refer to Division 1 for meeting requirements.

D. The system shall be functionally tested by a factory-authorized engineer and comply with the Sequence of Operation. All loads shall be tested live for continuity and freedom from defects, and all control wiring shall be tested for continuity and connections prior to energizing the system.

1.11 WARRANTY

A. Manufacturer shall warrant products under normal use and service to be free from defects in materials and workmanship for a period of two (2) years from date of commissioning.

B. Occupancy, vacancy, daylight sensors and controls shall have a five (5) year warranty from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 LIGHTING CONTROLS

A. All items of material having a similar function (e.g., switches, dimmers, sensors, contactors, relays, etc.) shall be of the same manufacturer, unless specifically stated otherwise on drawings or elsewhere in the specifications.

B. Color of lighting controls and sensors shall match the receptacle wiring devices specified in the space.

C. The functions described in the lighting sequence of operation shall dictate the actual lighting control device required to accomplish the functions described for the space.

2.2 DEVICE COLOR

A. All switch, lighting controls, and coverplate colors shall be the same as wiring devices, unless indicated otherwise.

2.3 COVERPLATES

A. All switches and lighting controls shall be complete with coverplates that match material and color of the wiring device coverplates in the space.

B. Where several devices are ganged together, the coverplate shall be of the ganged style for the number of devices used.

C. Install nameplate identification as indicated in Section 26 05 53.

D. Plate-securing screws shall be metal with head color matching the wall plate finish.

2.4 WALL SWITCHES

A. Refer to Electrical Symbols List for device type.

B. **[SW-1P]**: Single Pole Switch:

1. Single throw, 120/277 volt, 20 amp maintained contact. Toggle handle, side and back wired.

2. Approved Manufacturers: Hubbell HBL1221, Leviton 1221-2, Pass & Seymour PS20AC1, Cooper AH1221.

C. **[SW-1P-ADJ]**: Local Timer Switch:

1. User adjustable timeout, 120/277 volt, 800/1200 watt rating. No minimum load requirement. Flashes lights one minute before timeout.

2. Approved Manufacturers: Watt Stopper TS-400, Hubbell Automation TD200.

D. **[SW-1P-K]**: Key Lock Single Pole Switch:

1. Single throw, 120/277 volt, 20 amp maintained contact. Side and back wired. Provide key to Owner.

2. Approved Manufacturers: Hubbell HBL1221L, Leviton 1221-2L, Pass & Seymour PS20AC1-L.

E. **[SW-1P-M]**: Momentary Contact Single Pole Switch:

1. 120/277 volt, 20 amp. Three position, two circuit. Center off toggle spring return handle.

2. Approved Manufacturers: Hubbell HBL1557, Leviton 1257, Pass & Seymour 1251, Cooper 1995.

F. **[SW-1P-PL]**: Red Pilot Light Single Pole Switch:

1. 120 volt maintained contact. Toggle handle. Pilot light on when contact closed (switch on). Side and back wired.

2. Approved Manufacturers: Hubbell HBL1221PL, Leviton 1221-PLR, Pass & Seymour PS20AC1-RPL, Cooper AH1221PL.

G. **[SW-1P-WP]**: Weatherproof Single Pole Switch:

1. Single throw, 120/277 volt, 20 amp maintained contact. Toggle handle, side and back wired. Provide with weatherproof coverplate.

2. Approved Manufacturers: Hubbell1221/HBL1795, Leviton 1221-2, Taymac MM180, Pass & Seymour PS20AC1/CA1-GL, Cooper 2221.

H. **[SW-2P]**: Two Pole Switch:

1. Single throw, 120/277 volt, 20 amp maintained contact. Toggle handle, side and back wired.

2. Approved Manufacturers: Hubbell HBL 1222, Leviton 1222-2, Pass & Seymour PS20AC2, Cooper 2222.

I. **[SW-2P-K]**: Key Lock Two Pole Switch:

1. Single throw, 120/277 volt, 20 amp maintained contact. Side and back wired. Provide key to Owner.

2. Approved Manufacturers: Hubbell HBL1222L, Leviton 1222-2L, Pass & Seymour PS20AC2-L.

J. **[SW-3W]**: Three-way Switch:

1. 120/277 volt, 20 amp. Toggle handle, side and back wired.

2. Approved Manufacturers: Hubbell 1223, Leviton 1223-2, Pass & Seymour PS20AC3, Cooper AH1223.

K. **[SW-3W-K]**: Key Lock Three Way Switch:

1. Single throw, 120/277 volt, 20 amp maintained contact. Side and back wired. Provide key to Owner.

2. Approved Manufacturers: Hubbell HBL1223L, Leviton 1223-2L, Pass & Seymour PS20AC3-L.

L. **[SW-4W]**: Four-way Switch:

1. 120/277 volt, 20 amp. Toggle handle, side and back wired.

2. Approved Manufacturers: Hubbell 1224, Leviton 1224-2, Pass & Seymour PS20AC4, Cooper AH1224.

M. **[SW-4W-K]**: Key Lock Four Way Switch:

1. Single throw, 120/277 volt, 20 amp maintained contact. Side and back wired. Provide key to Owner.

2. Approved Manufacturers: Hubbell HBL1224L, Leviton 1224-2L, Pass & Seymour PS20AC4-L, Cooper AH11224L.

N. **[SW-A-TPCO]**: Three Position-Center Off Switch:

1. 120/277 volt, 20 amp, 2 pole maintained contact. Toggle handle, side and back wired.

2. Approved Manufacturers: Hubbell HBL1386, Leviton 1286, Pass & Seymour 1226, Cooper 2226.

2.5 WALL DIMMERS

A. UL listed with integral air-gap switch for on/off control.

B. Integral EMI/RFI suppression.

C. Non-viewable heat sink.

D. Dimmer compatibility and wiring with the load being controlled shall be verified by Contractor prior to purchase and installation.

E. Dimmer to match device color.

F. **[SW-D-IN]**: Incandescent Style Dimmer:

1. 120 volt, linear slider operator with positive off. 16 amp maximum capacity.

2. Approved Manufacturers: Lutron, Lightolier.

G. **[SW-D-LED]**: LED Electronic Driver Dimmer:

1. 120 volt, decora style linear slider operator with positive off. Color to match adjacent devices. Luminaire manufacturer shall list compatible dimmer manufacturers and models. 0-10V dimmers shall comply with IEC 60629 Annex E.

2. Approved Manufacturers: Compatible with provided LED driver.

H. **[SW-D3-LED]**: LED Electronic Driver Three-Way Dimmer:

1. 120 volt, decora style linear slider operator with positive off. Color to match adjacent devices. Luminaire manufacturer shall list compatible dimmer manufacturers and models. 0-10V dimmers shall comply with IEC 60929 Annex E.

2. Approved Manufacturers: Compatible with provided LED driver.

I. [**SW-OD]**: Wall 0-10V Dimmer / Occupancy sensor:

1. Wall switch with manual on/auto off. 120VAC load rating of 0-800 W for electronic ballast, LED. 277VAC load rating of 0-1,800 W for electronic ballast, LED. adjustable OFF delay. 0-10V dimming with up to 30ma sink. Automatic ON/OFF, manual ON/automatic OFF, or occupancy on to predetermined dimming level go to last dimming setting upon occupancy.

2. Approved Manufacturers: Sensor Switch WSX D Series

J. **[SW-D-LED-M]**: LED Electronic Driver Dimmer with Momentary Contact Switch:

1. 120 volt, decora style linear slider operator with positive off. Color to match adjacent devices. Luminaire manufacturer shall list compatible dimmer manufacturers and models. 0-10V dimmers shall comply with IEC 60629 Annex E. Momentary toggle button or center off toggle spring return handle.

K. **[SW-D-IN-M]**: Incandescent Style Dimmer with Momentary Contact Switch:

1. 120 volt, linear slider operator with positive off. 16 amp maximum capacity. Momentary toggle button or center off toggle spring return handle.

2. Approved Manufacturers: Lutron, Lightolier.

L.

2.6 LOCAL DAYLIGHTING CONTROLS

A. Standalone Interior Photo Sensors:

1. **[SW-LS]**: Daylight Level Sensor - On/Off Control - One Zone:

a. On/Off control. Range of 10-200 FC. Adjustable deadband prevents cycling. Adjustable time delay.

b. Approved Manufacturers: Watt Stopper LS-102, Sensor Switch CM-PC, Hubbell Automation DLCPC Series, Greengate PPS-4.

2. **[SW-LS-3Z]**: Daylight Level Sensor and Controller - On/Off Control - Three Zones:

a. On/off control of up to three 10-amp zones. Range of 10 to 200 FC. Adjustable deadband prevents cycling. Adjustable time delay.

b. Approved Manufacturers: Watt Stopper LCO-203/LS-290C, Hubbell Automation LUXSTATOCM/LUXSTATLS, LC&D Micro GR/2404 iDH/Pcell, Sensor Switch N-CMPC.

3. Sensor shall detect changes in ambient light level and provide triggering of lighting groups in area based on sequence of operation.

4. Sensor shall be configurable via DIP switches at device or via handheld wireless remote programming unit. Settings shall include:

   a. Ambient sensitivity range between 1 and 1,000 foot-candles.
   b. Time delay of 5 to 300 seconds.
   c. Trigger setpoints with deadband adjustment.

5. Sensor shall provide on/off setpoints in quantity as specified on drawings and as shown in the sequence of operation.

6. Sensor shall be ceiling- or wall-mounted for range and viewing angle meeting application requirements as outlined in the sequence of operation.

7. Output signal from sensor shall be linear with light level.

B. **[SW-LS-PC]**: Standalone Exterior Photo Sensors:

1. Sensor shall be within a weatherproof enclosure, with design operation in temperatures of -30°F to +130°F. Sensor shall have threaded stem for box mounting, with knuckle to permit aiming of receptor after installation. Sensor shall be mounted facing north.

2. Sensor shall contain an integral switching contactor rated for 277-volt operation, with loads of up to 1,800 VA. Contacts shall be configured for zero-crossing closure to provide 100,000 cycle minimum operation.

3. Sensor shall detect changes in daylight levels to provide triggering of exterior lighting equipment based on the sequence of operation.

4. Sensor shall be field configurable at the device or via handheld wireless remote controller. Configurable settings shall include:

   a. Ambient sensitivity range of 5 to 1,500 foot-candles.
   b. Adjustable setpoint.
   c. Deadband adjustment by percentage of setpoint.
   d. Time delay of up to five minutes.

5. Sensor shall be equipped with a lens cover that can be applied for system testing during daylight conditions.

6. Approved Manufacturers: Paragon, Tork, Intermatic.

2.7 INDOOR OCCUPANCY AND VACANCY SENSORS

A. General Description: Wall- or ceiling-mounting, solid-state units with a separate power supply/relay unit.

1. Operation: Unless otherwise indicated, turn lights on when covered area is occupied and off when unoccupied, with a time delay for turning lights off, adjustable over a minimum range of 1 to 30 minutes. Vacancy sensors require a manual switch operation to turn lights on and off, with a time delay for turning lights off when unoccupied.

2. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor shall be powered from the relay unit.

3. Relay Unit: Dry contacts rated for 20 A ballast load at 120 and 277 VAC, for 13 amp tungsten at 120 VAC, and for 1 hp at 120 VAC. Power supply to sensor shall be 24 V dc, 150-mA, Class 2 power source as defined by NFPA 70.

4. Mounting:

a. Sensor: Suitable for mounting in any position on a standard outlet box.

b. Relay: Externally mounted through a 1/2-inch knockout in a standard electrical enclosure. Mount relay above accessible ceiling near entry door to room or area.

c. Time Delay and Sensitivity Adjustments: Recessed and concealed.

5. Indicator: LED to show when motion is being detected during testing and normal operation of the sensor.

6. Bypass Switch: Override the on function in case of sensor failure.

7. Power Supply and Slave Packs: Provide as required for sensor quantity and switching scheme. Mount to standard 1/2" knockout on electrical box above accessible ceiling near entry door to room or area. Sensor power shall be from emergency circuit if emergency lighting is in the area.

8. Detection Coverage (Room): Detect occupancy anywhere in an area based on hand motion.

9. Detection Coverage (Corridor): Detect occupancy based on a half-step motion.

10. Warranty: Five (5) year warranty.

B. Dual-Technology Type: Detect occupancy by using a combination of PIR and ultrasonic detection methods in area of coverage. Particular technology or combination of technologies that controls on and off functions shall be selectable in the field by operating controls on unit.

1. **[SW-VS-D] or [SW-OC-D]**: 360 Degree Coverage Pattern:

a. Frequency greater than 40 KHz. Dual sensing verifications (requires both technologies to activate), either technology maintains on status. Integrated ambient light level sensor (2 to 200 FC range), adjustable sensitivity and time delay, integrated isolated relay contact. Sensor shall control all circuits in area, unless noted otherwise. Initial settings: ambient sensor 40 FC.

b. Approved Manufacturers: Watt Stopper DT 300 Series, Hubbell OMNI-DT2000 or ATD2000C, Greengate OAC-DT, Leviton OSC##-MOW.

2. **[SW-VS-D-W] or [SW-OC-D-W]**: Wall Mounted on Adjustable Swivel Mount:

a. Wall or ceiling sensor with adjustable settings to allow manual on/auto off or auto on/auto off. Integrated ambient light level sensor (2 to 100 FC range).

b. Approved Manufacturers: Watt Stopper DT-200 Series, Hubbell LODTRP, Leviton OSM12--M series.

3. **[SW-O]**: Wall Switch:

a. Wall switch with manual on/auto off. 120/277 VAC load rating of 0-800 W for ballast, LED or tungsten. 5-, 15-, 30-minute adjustable OFF delay. Coverage of minor motion in 12' x 15' pattern.

b. Approved Manufacturers: Watt Stopper DW-100 Series, Hubbell LHMTS, Leviton OSSMT series.

4. **[SW-O2]**: Wall Switch:

a. Multi-relay wall switch with manual on/auto off for two separate loads. 120/277 VAC load relay rating of 0-800 W for ballast, LED or tungsten. 5-, 15-, 30-minute adjustable OFF delay. Coverage of minor motion in 12' x 15' pattern.

b. Approved Manufacturers: Watt Stopper DW-200 Series, Hubbell LHMTD, Leviton OSSMD series.

5. Sensitivity Adjustment: Separate for each sensing technology.

6. Detection Coverage:

a. Task Areas: Detect occupancy anywhere in an area based on hand motion.

b. Circulation Areas: Detect occupancy anywhere in an area based upon half-step walking motion.

C. Mask sensors where necessary to prevent nuisance switching from adjacent areas.

D. PIR Type: Detect occupancy by sensing a combination of heat and movement in area of coverage.

1. **[SW-OC-P-HA]**: High Bay - Aisle Coverage Pattern:

a. 20' to 40' mounting height. Minimum 1.3:1 walking motion coverage pattern to height ratio. Adjustable sensitivity and time delay, integral isolated relay contact. Sensor shall control all luminaires in area. Initial settings: Time delay 10 minutes.

b. Approved Manufacturers: Watt Stopper HB-300 Series, Hubbell FHB 140 or HMHB series, Leviton OSFHU, Greengate OEF-P.

2. **[SW-OC-P-HB]:** High Bay - 360 Degree Coverage Pattern:

a. 20' to 40' mounting height. Minimum 1.3:1 walking motion coverage pattern to height ratio. Adjustable sensitivity and time delay, integral isolated relay contact. Sensor shall control all luminaires in area.

b. Approved Manufacturers: Watt Stopper HB-300 Series, Hubbell FHB 140 or HMHB series, Leviton OSFHU, Greengate OEF-P.

3. **[SW-O]**: Wall Switch Occupancy Sensor:

a. Passive infrared, zero crossing circuitry, integrated ambient light sensor (10 to 150 FC range), adjustable sensitivity and time delay, no minimum load requirements, manual or auto on operation, Initial settings: 10 minutes, ambient sensor 40 FC. Manual ON for vacancy sensing.

b. Approved Manufacturers: Watt Stopper PW-100 Series, Sensor Switch WSX, Hubbell LHIRS1 or AP1277, Leviton ODS15, Greengate OSW-P-0451.

4. **[SW-O2]**: Dual Wall Switch Occupancy Sensor:

a. Passive infrared, zero crossing circuitry. Switches control two separate circuits or relays. Integrated ambient light sensor (10 to 150 FC range), adjustable sensitivity and time delay, no minimum load requirements, manual or auto on operation, Initial settings: 10 minutes, ambient sensor 40 FC. Manual ON for vacancy sensing.

b. Approved Manufacturers: Watt Stopper PW-200 Series, Sensor Switch WSD-2, Hubbell LHIRD2 or AP127712, Leviton ODS, Greengate OSW-P-0451.

5. **[SW-OC-P-P]**: Ceiling Mounted - 360 Degree Coverage Pattern:

a. Passive infrared, zero crossing circuitry, integrated ambient light sensor (4 to 190 FC Range), adjustable sensitivity and time delay, integral isolated relay contact. Sensor shall control all circuits in the area unless noted otherwise. Initial settings: ambient sensor 40 FC.

b. Approved Manufacturers: Watt Stopper CI Series, Sensor Switch CM-9, Hubbell Automation Omni-IR, Leviton OSC Series, Greengate OMR-P Series.

6. **[SW-OC-P-P2]:** Ceiling Mounted - 100 Degree Coverage Pattern:

a. Passive infrared, zero crossing circuitry, integrated ambient light sensor (4 to 190 FC Range), adjustable sensitivity and time delay, integral isolated relay contact. Sensor shall control all circuits in the area unless noted otherwise. Initial settings: ambient sensor 40 FC.

b. Approved Manufacturers: Watt Stopper WPIR Series, Sensor Switch CM-9, Hubbell LOIRWV or ATD1600W.

7. **[SW-OC-P-W]:** Wall Mounted - 100 Degree Coverage Pattern:

a. Passive infrared, zero crossing circuitry, integrated ambient light sensor (4 to 190 FC range), adjustable sensitivity and time delay, integral isolated relay contact. Sensor shall control all circuits in the area unless noted otherwise. Initial settings: Ambient sensor 40 FC.

b. Approved Manufacturers: Watt Stopper WPIR Series, Sensor Switch CM-9, Hubbell LOIRWV or ATD1600W.

8. With daylight filter and lens to afford coverage applicable to space to be controlled.

E. Ultrasonic Type: Ceiling mounting. Detect occupancy by sensing a change in pattern of reflected ultrasonic energy in area of coverage.

1. **[SW-OC-U]**: 360 Degree 20’ x 20’ Hand Motion Coverage Pattern:

a. Frequency greater than 32 KHz solid state, adjustable sensitivity and time delay, integral isolated 1 amp relay contact, temperature and humidity resistant receivers. Sensor shall control all circuits in area, unless noted otherwise.

b. Approved Manufacturers: Watt Stopper WT-1100 series, Hubbell OMNI-US or ATU series, Leviton OSC series, Greengate ODC-U series.

2. **[SW-OC-U2]**: 35’ x 30’ Hand Motion Coverage Pattern:

a. Frequency greater than 32 KHz solid state, adjustable sensitivity and time delay, integral isolated relay contact, temperature and humidity resistant receivers. Sensor shall control all circuits in area, unless noted otherwise.

b. Approved Manufacturers: Watt Stopper WT-2200 series, Hubbell OMNI-US or ATU series, Leviton OSC series, Greengate ODC-U series.

3. **[SW-OC-U-A]**: 360 Degree Two Sided Corridor Coverage Pattern:

a. Frequency greater than 32 KHz solid state, adjustable sensitivity and time delay, integral isolated relay contact, temperature and humidity resistant receivers. Sensor shall control all circuits in area, unless noted otherwise.

b. Approved Manufacturers: Watt Stopper WT-2250 Series, Hubbell OMNI-US or ATU series, Greengate ODC-U Series.

4. **[SW-OC-U-W]**: Wall Mounted:

a. Wall switch with adjustable settings to allow manual on/auto off or auto on/auto off.

b. Approved Manufacturers: Watt Stopper UW-100 Series, Hubbell AU1277I,

5. Crystal controlled with circuitry that causes no detection interference between adjacent sensors.

2.8 EMERGENCY TRANSFER DEVICES

A. Loss of power on normal circuit shall switch load to emergency power source.

B. Provide suitable NEMA 1 enclosure and mounting per manufacturer specification.

C. **[ETD]**: Emergency Lighting Control Override - Single Luminaire:

1. Rated 2 amps at 120 volt incandescent and 10 amps at 277 volt fluorescent.

2. Approved Manufacturers: Bodine GTD, Iota ETS, Watt Stopper ELCU-100.

D. **[ETD-2]**: Emergency Lighting Control Override - Branch Loads:

1. Rated 1000 watts at 120 volt incandescent and 20 amp at 277 volt fluorescent.

2. Approved Manufacturers: Bodine GTD20, Chloride Lightstar, Dual-Lite ATSD, Nine24 ELCR, Highlites HEPC.

E. **[ETD-D]:** Emergency Lighting Dimming Control Override:

1. Loss of power on normal circuit shall switch luminaires on at 100% rated light output.

2. Approved Manufacturers: Nine24 BLTCv3, nLight nPP16D (ER)

2.9 TIME SWITCH

A. **[TC-30]**: Time switch, 7 day, electronic, 30 setpoints available, LCD display, 12 or 24 hour format, minimum 200 hours battery backup, one SPDT 15 amp contact, UL listed.

1. Approved Manufacturers: Paragon EC71/30S, Tork EW101S, Intermatic ET70115C.

B. **[TC-7]**: Time switch, 7 day, 2 channel, electronic, two SPDT 15 amp contacts, two separate programs with 16 setpoints available, LCD display, 12 or 24 hour format, minimum 100 hours carry-over, UL listed.

1. Approved Manufacturers: Paragon EC72, Tork DTS 200A, Intermatic ET70215C.

C. **[TC-1]**: Astronomical time switch, 7 day, 1 channel, electronic, one SPDT 5 amp contact, LCD display, 12 or 24 hour format, minimum 100 hours carryover, UL listed.

1. Approved Manufacturers: Paragon EC71ST, Tork DWZ100A, Intermatic ET70115C.

D. **[TC-S]**: Timer, 24 hour, 20 amp continuous contacts, 1 N.O. and 1 N.C. contacts, spring wound backup, 120 volt, override switch, UL listed.

1. Approved Manufacturers: Paragon 4213-OS, Tork 7200L, Intermatic T173CR.

2.10 CONDUCTORS AND CABLES

A. Control Wiring:

1. Where installed with the line-voltage wiring, control wiring shall be copper conductors not smaller than No. 16 AWG with insulation voltage rating and temperature rating equal to that of the line-voltage wiring, complying with Division 26 Section 26 05 13 "Wire and Cable."

2. Tap conductors to switches or relays: Stranded copper conductors of 16 AWG or solid 16 or 18 AWG with insulation rating equal to that of the line-voltage wiring.

3. Tap conductors to dimming ballasts: Solid copper conductors of 18 AWG with insulation voltage rating equal to that of the line-voltage wiring and insulation temperature rating not less than 90°C.

4. Network cabling as required by manufacturer.

B. Splices and Taps:

1. Tapping or wire trap connectors shall be used to splice all Class 1 and Class 2 control wiring. Twist-on, wire-nut type connectors are not allowed.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that surfaces are ready to receive work.

B. Verify field dimensions and coordinate physical size of all equipment with the architectural requirements of the spaces into which they are to be installed. Allow space for adequate ventilation and circulation of air.

C. Verify that required utilities are available, in proper location, and ready for use.

D. Beginning of installation means installer accepts existing conditions.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions and approved shop drawings.

B. All wiring shall be installed in conduit.

C. All branch load circuits shall be live tested before connecting the loads to the lighting control panel.

3.3 SUPPORT SERVICES

A. Testing:

1. Programming of initial zones, schedules, lighting levels, control station groups, and sensor settings shall be performed. The following procedures shall be performed at a minimum:

   a. Confirm occupancy sensor placement, sensitivity, and time delay settings to meet specified performance criteria.

   b. Confirm daylight sensor placement, sensitivity, deadband, and delay settings to meet specified performance criteria.

   c. Confirm that schedules and time controls are configured to meet specified performance criteria and Owner's operating requirements.

2. Verify occupancy/vacancy and daylight sensor operation is correct after furniture and equipment is installed in each area. Make adjustments to sensor settings and time delays to allow proper operation.

3. Verify occupancy/vacancy sensors are located to provide complete coverage for the area served with no nuisance switching.

   a. Relocate sensors or provide additional sensors as necessary to provide adequate coverage.

   b. Mask occupancy sensors where necessary to prevent nuisance switching from adjacent areas.

END OF SECTION

SECTION 26 20 00
SERVICE ENTRANCE

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Arrangement with Utility Company for permanent electric service
B. Underground service entrance

1.2 RELATED SECTIONS AND WORK

A. Refer to the One-Line Diagram for additional information.

1.3 QUALITY ASSURANCE

A. Utility Company: Madison Gas and Electric.

B. Install service entrance in accordance with Utility Company's rules and regulations.

1.4 SUBMITTALS

A. Submit shop drawings and product data under provisions of Section 26 05 00.

B. Submit Utility Company prepared drawings (if applicable).

1.5 SYSTEM DESCRIPTION

A. System Voltage: 208Y/120 volts, three phase, four-wire, 60 Hertz.

PART 2 - PRODUCTS

2.1 METERING EQUIPMENT

A. Meter: Furnished by the Utility Company.

B. Meter Base: Furnished by the Contractor, as approved by the Utility Company. (Manufacturers: Milbank, Superior, Duncan, or Anchor).

C. **[MC-#]:** Exterior Mounted Metering Cabinets: Stainless Steel enclosure. Furnished and installed by the Contractor to Utility Company's specifications. Conduit and conductors between metering cabinets and instrumentation shall be by the Contractor. Connections as required by the Utility Company.

2.2 IDENTIFICATION

A. Provide a permanent plaque or sign denoting all services, feeders, and branch circuits supplying the building or structure and the area served by each. Install plaque or sign at each service disconnecting means.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Make arrangements with Utility Company to obtain permanent electric service to the Project.

B. Primary distribution equipment and pad-mounted transformers shall be furnished and installed by the Utility Company.

C. Primary conductors shall be furnished, installed, and terminated by the Utility Company. Primary conduit shall be furnished and installed by the Contractor, as shown on the drawings, to the Utility Company's requirements.

D. Underground: Install service entrance conduits in concrete envelope from Utility Company's pad mounted transformer to meter cabinet and building service entrance equipment. Utility Company will connect service conductors to transformer secondary lugs.

E. Concrete Pad for Transformer: Furnished and installed by the Contractor to Utility Company's specifications.

END OF SECTION

SECTION 26 24 16
PANELBOARDS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Service and distribution panelboards**: [DP-#], [DP-#]**
B. Lighting and appliance branch circuit panelboards**: [Panel '###']**
C. Fusible branch circuit panelboards**: [Panel '###']**

1.2 RELATED SECTIONS AND WORK

A. Refer to the One-Line Diagram and Panel Schedules for size, rating, and configuration.

1.3 REFERENCES

A. NEMA AB 1 - Molded Case Circuit Breakers

B. NEMA FU 1 – Low voltage cartridge fuses

C. NEMA KS 1 - Enclosed Switches

D. NEMA PB 1 - Panelboards

E. NEMA PB 1.1 - Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less

F. NEMA PB 1.2 - Application Guide for Ground-fault Protective Devices for Equipment

G. UL 248 – Low-Voltage Fuses

H. UL 67 - Panelboards

1.4 SUBMITTALS

A. Submit shop drawings for equipment and component devices under provisions of Section 26 05 00.

B. Include outline and support point dimensions, voltage, main bus ampacity, integrated short circuit ampere rating, circuit breaker and fusible switch arrangement and sizes.

C. Selective coordination study to prove that all essential electrical systems, emergency systems and legally required standby system panelboards are selectively coordinated with all supply side overcurrent protective devices.

1.5 SPARE PARTS

A. Keys: Furnish four (4) each to the Owner.

B. Fuses: Furnish 10% or a minimum of three (3) spare fuses of each type and rating installed to the Owner.

C. Fuse Pullers: Furnish one (1) fuse puller to the Owner.

PART 2 - PRODUCTS

2.1 RATINGS

A. Definitions:

1. Series rated equipment shall be defined as equipment that can achieve a required UL AIC rating with an upstream device such as a main breaker or a combination of devices to meet or exceed a required UL AIC rating. All series rated equipment shall have a permanently attached nameplate indicating that device rating must be maintained. See Section 26 05 53 for additional requirements.

2. Fully rated equipment shall be defined as equipment where all devices in that equipment shall carry a minimum of the AIC rating that is specified.

B. The panelboards for this project shall be fully rated unless otherwise specifically noted in the Drawings or Specifications.

2.2 MAIN AND DISTRIBUTION PANELBOARDS

A. General

1. Approved Manufacturers:

a. Square D QMB, I-Line
b. General Electric Spectra ADS
c. Siemens F2, P4

B. Panelboards: NEMA PB 1; type as shown on the drawings.

C. Enclosure: NEMA PB 1; Type 1.

D. Provide cabinet front with concealed trim clamps and hinged trim on door to allow access to wiring gutters without removal of trim and flush lock. Finish in manufacturer's standard gray enamel.

E. Provide panelboards with copper bus, ratings as scheduled on the drawings. Provide copper ground bus in all panelboards.

F. All spaces shown on the one-line diagram shall be fully prepared spaces for future breakers.

G. Minimum Integrated Short Circuit Rating: 100,000 amperes rms symmetrical for 240 volt panelboards; 50,000 amperes rms symmetrical for 480 volt panelboards, or as shown on the drawings.

H. Fusible Switch Assemblies: NEMA KS 1; quick-make, quick-break, load interrupter enclosed knife switch with externally operable handle. Provide interlock to prevent opening front cover with switch in ON position. Handle lockable in OFF position.

I. Fuse Clips (Switches 600 Amperes and Smaller): Provide with Class 'R' rejection clips. Fuse Clips (601 Amperes and Larger): Designed to accommodate Class 'L' fuses.

J. Molded Case Circuit Breakers: Provide circuit breakers with integral thermal and instantaneous magnetic trip in each pole.

K. Solid State Molded Case Circuit Breakers: **(All breakers identified on plans as solid-state with 1,200 ampere frame sizes and below.)** Provide molded case switch with electronic sensing, timing, and tripping circuits for fully adjustable time current characteristic settings including ground fault trip, instantaneous trip, long time trip, long time delay, short time trip, and short time delay. Trip setting shall be field programmable with a sealable clear cover.

L. Arc Energy Reduction:

1. Provide an arc energy reduction system to reduce the clearing time of an arc flash event. The arc energy reduction system shall be provided for overcurrent protection devices rated 1,000 amps or larger.

2. Energy-Reducing Maintenance Switch: Provide an energy-reducing maintenance switch visual status indication when engaged. Install the maintenance switch at the entrance to the electrical room.

M. Suitable for use as service entrance equipment.

N. **[DPM]:** Digital AC Power Monitor. Capable of measuring, calculating and directly displaying; Volts (L-L, L-N), Amps, KW, KWH. Monitor shall be true RMS measurement with programmable set-up parameters. All set-up parameters data shall be stored in non-volatile memory to protect from power outages.

2.3 BRANCH CIRCUIT PANELBOARDS

A. General

1. Approved Manufacturers:

a. Square D NQ, NF
b. General Electric AQ, AE
c. Siemens P1

B. Lighting and Appliance Branch Circuit Panelboards: NEMA PB 1; circuit breaker type.

C. Enclosure: NEMA PB 1; Type 1.

D. Provide cabinet front with door-in-door construction, concealed hinge, and flush lock all keyed alike. Finish in manufacturer's standard gray enamel.

E. Provide panelboards with copper bus, ratings as scheduled on the drawings. Provide copper ground bus in all panelboards.

F. All unlabeled circuits shown on the panelboard schedule shall be fully prepared spaces for future breakers.

G. All multiple-section panelboards shall have the same dimensional back box and cabinet front size.

H. Minimum Integrated Short Circuit Rating: As shown on the drawings.

I. Provide handle lock-on devices for all breakers serving exit sign and lighting circuits with emergency battery units. Provide handle lock-on devices and red handles for breakers serving fire alarm panels.

J. Molded Case Circuit Breakers: Bolt-on type thermal magnetic trip circuit breakers, with common trip handle for all poles. Provide circuit breakers UL listed as Type SWD for lighting circuits. Provide UL Class A ground fault interrupter circuit breakers where scheduled on the drawings. Do not use tandem circuit breakers.

K. Current Limiting Molded Case Circuit Breakers: Provide circuit breakers with integral thermal and instantaneous magnetic trip in each pole, coordinated with automatically resetting current limiting elements in each pole. Interrupting rating 100,000 symmetrical amperes, let-through current and energy level less than permitted for same size Class RK-5 fuse.

2.4 FUSIBLE BRANCH CIRCUIT PANELBOARDS

A. General

1. Approved Manufacturers:

a. Bussmann
b. Littelfuse
c. Mersen MFCP

B. Provide cabinet front with concealed hinge and flush lock all keyed alike. Finish in manufacturer's standard gray enamel.

C. Provide panelboards with copper bus, ratings as scheduled on the drawings. Provide copper ground bus in all panelboards.

D. Overcurrent protective devices shall be UL listed, with voltage, amperage, number of poles, and short-circuit current rating as shown on the panelboard schedule. Multi-pole branch circuit protection devices shall trip on an overcurrent of any pole to prevent single-phasing of the load.

E. Fuse holder shall be finger-safe with trim installed. Fuses shall only be removable when terminals are not energized.

F. All unlabeled circuits shown on the panelboard schedule shall be fully prepared spaces for future fuse units.

G. All multiple-section panelboards shall have the same dimensional backbox and cabinet front size.

H. Minimum Integrated Short Circuit Rating: As shown on the drawings.

I. Branch fuse disconnect shall have visible ON/OFF indication, blown fuse indicating lights, and permanently installed lockout means.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install panelboards plumb as indicated on the drawings in conformance with NEMA PB 1.1.

B. Height: 6 feet to handle of highest device.

C. Provide filler plates for unused spaces in panelboards.

D. Provide typed circuit directory for each branch circuit panelboard. Label each circuit with the type of load and the name and number of the area served. Revise directory to reflect circuit changes required to balance phase loads.

E. Stub five (5) empty one inch conduits to accessible location above ceiling out of each recessed panelboard.

F. Install fuses in fusible switch assemblies.

3.2 FIELD QUALITY CONTROL

A. Measure steady state load currents at each panelboard feeder. Should the difference at any panelboard between phases exceed 20 percent, rearrange circuits in the panelboard to balance the phase loads within 20 percent. Take care to maintain proper phasing for multi-wire branch circuits.

B. Visual and Mechanical Inspection: Inspect for physical damage, proper alignment, anchorage, and grounding. Check proper installation and tightness of connections for circuit breakers, fusible switches, and fuses.

END OF SECTION

SECTION 26 24 19
MOTOR CONTROL

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Manual motor starters
B. Magnetic motor starters
C. Combination magnetic motor starters

1.2 RELATED SECTIONS AND WORK

A. Refer to the Disconnect and Starter Schedule and One-Line Diagram for rating and configuration.

1.3 REFERENCES

A. ANSI/UL Standard 508. Standard for Industrial Control Equipment

B. FCC Rules and Regulations, Part 15, Subpart J- Radio Frequency Interference

C. FS W-C-375 - Circuit Breakers, Molded Case; Branch Circuit and Service

D. FS W-F-870 - Fuseholders (For Plug and Enclosed Cartridge Fuses)

E. FS W-P-115 - Power Distribution Panel

F. FS W-S-865 - Switch, Box, (Enclosed), Surface-Mounted

G. IEEE Standard 519-1981 - Guide for Harmonic Control and Reactive Compensation of Static Power Converters

H. NEMA AB 1 - Molded Case Circuit Breakers

I. NEMA ICS 2 - Industrial Control Devices, Controllers, and Assemblies

J. NEMA ICS 6 - Enclosures for Industrial Controls and Systems

K. NEMA KS 1 - Enclosed Switches

L. NEMA PB 1 - Panelboards

M. NEMA PB 1.1 - Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600 Volts or less

1.4 SUBMITTALS

A. Submit shop drawings and product data under provisions of Section 26 05 00.

B. Indicate on shop drawings, front and side views of motor control center enclosures with overall dimensions. Include conduit entrance locations and requirements; wiring diagrams that differentiate between manufacturer-installed and field-installed wiring; nameplate legends; size and number of bus bars per phase, neutral, and ground; electrical characteristics including voltage, frame size and trip ratings, withstand ratings, and time-current curves of all equipment and components.

C. Provide product data on motor starters and combination motor starters, relays, pilot devices, and switching and over-current protective devices.

D. Submit manufacturer's instructions under provisions of Section 26 05 00.

1.5 SPARE PARTS

A. Keys: Furnish four (4) each to the Owner.

B. Fuses: Furnish three (3) spare fuses of each type and rating installed to the Owner.

C. Fuse Pullers: Furnish one (1) fuse puller to the Owner.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site under provisions of Section 26 05 00.

B. Deliver in 60 inch maximum width shipping splits, individually wrapped for protection, and mounted on shipping skids.

C. Store and protect products under provisions of Section 26 05 00.

D. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from fumes, dirt, water, construction debris, traffic, and physical damage.

E. Handle in accordance with manufacturer's written instructions. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to motor control center components, enclosure, and finish.

1.7 OPERATION AND MAINTENANCE DATA

A. Submit operation and maintenance data under provisions of Section 26 05 00.

B. Include spare parts data listing; source and current prices of replacement parts and supplies; and recommended maintenance procedures and intervals.

PART 2 - PRODUCTS

2.1 MANUAL MOTOR STARTERS

A. Manual Motor Starter: NEMA ICS 2; AC general-purpose Class A manually operated non-reversing full-voltage controller for induction motors rated in horsepower, with overload relay, and toggle operator.

B. Fractional Horsepower Manual Starter: NEMA ICS 2; AC general-purpose Class A manually operated, full-voltage controller for fractional horsepower induction motors, with thermal overload unit, and toggle operator.

C. Motor Starting Switch: NEMA ICS 2; AC general-purpose Class A manually operated, full-voltage controller for fractional horsepower induction motors, without thermal overload unit, and toggle operator.

D. Enclosure: NEMA ICS 6; Type 1.

2.2 MAGNETIC MOTOR STARTERS

A. Magnetic Motor Starters: NEMA ICS 2; AC general-purpose Class A magnetic controller for induction motors rated in horsepower.

B. Full Voltage Starting: Non-reversing type, unless otherwise indicated.

C. Coil Operating Voltage: 120 volts, 60 Hertz, obtained from integral control power transformer of sufficient capacity to operate connected pilot, indicating, and control devices, plus 100% spare capacity.

D. Size: NEMA ICS 2; size as shown on the drawings.

E. Overload Relay:

1. Overload Relay: Ambient-compensated type with inverse-time-current characteristic and NEMA ICS 2, Class 20 tripping characteristic. Provide with heaters or sensors in each phase matched to nameplate full-load current of specific motor to which they connect and with appropriate adjustment for duty cycle.

F. Enclosure: NEMA ICS 6; Type 1.

G. Combination Motor Starters: Combine motor starters with disconnect switch in common enclosure. Provide with disconnecting means as indicated on drawings.

H. Auxiliary Contacts: NEMA ICS 2; two normally open, field convertible contacts in addition to seal-in contact.

I. Pushbuttons: NEMA ICS 2; START/STOP in front cover.

J. Indicating Lights: NEMA ICS 2; RUN: red in front cover.

K. Selector Switches: NEMA ICS 2; HAND/OFF/AUTO, in front cover.

L. Relays: NEMA ICS 2.

M. Control Power Transformers: 120 volt fused secondary, fused primary, minimum VA as scheduled:

Size 1 - 100 VA
Size 2 - 100 VA
Size 3 - 150 VA
Size 4 - 300 VA
Size 5 - 300 VA
Size 6 - 300 VA

N. Provide phase loss protection relay with contacts to de-energize the starter for each starter serving motors 5 HP or greater.

2.3 CONTROLLER OVER-CURRENT PROTECTION AND DISCONNECTING MEANS

A. Molded Case Thermal-Magnetic Circuit Breakers: Circuit breakers with integral thermal and instantaneous magnetic trip in each pole. NEMA AB 1, motor-circuit protector with field-adjustable, short-circuit trip coordinated with motor locked-rotor amperes.

B. Non-fusible Switch Assemblies: Quick-make, quick-break, load interrupter enclosed knife switch with externally operable handle. Provide interlock to prevent opening front cover with switch in ON position. Handle lockable in OFF position.

C. Fusible Switch Assemblies: NEMA KS 1, quick-make, quick-break, load interrupter enclosed knife switch with externally operable handle. Provide interlock to prevent opening front cover with switch in ON position. Handle lockable in OFF position. Fuse Clips: Provide with Class' R' rejection clips. Select and size fuses to provide Type 2 protection according to IEC 947-4-1, as certified by a nationally recognized testing laboratory.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install motor control equipment in accordance with manufacturer's instructions on concrete bases.

B. Install fuses in fusible switches.

C. Select and install heater elements in motor starters to match installed motor characteristics.

D. Set field-adjustable switches and circuit-breaker trip ranges.

E. Motor Data: Provide neatly typed label inside each motor starter enclosure door identifying motor served, nameplate horsepower, full load amperes, code letter, service factor, and voltage/phase rating.

END OF SECTION

SECTION 26 27 26
WIRING DEVICES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Device plates and box covers
B. Receptacles
C. Floor boxes
D. Service fitting
E. Pendant cord/connector devices
F. Cord and plug sets
G. Cord reel

1.2 QUALITY ASSURANCE

A. Provide similar devices from a single manufacturer.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in the NEC Article 100, by a testing agency to Authorities Having Jurisdiction and marked for intended use.

C. Comply with the NEC.

1.3 REFERENCES

A. DSCC W-C-896F – General Specification for Electrical Power Connector
B. FS W-C-596 - Electrical Power Connector, Plug, Receptacle, and Cable Outlet
C. NEMA WD 1 – General Color Requirements for Wiring Devices
D. NEMA WD 6 – Wiring Devices – Dimensional Requirements
E. NFPA 70 - National Electrical Code (NEC)
F. UL 498 – Standard for Attachment Plugs and Receptacles
G. UL 943 – Standard for Ground Fault Circuit Interrupters

1.4 SUBMITTALS

A. Submit product data under provisions of Section 26 05 00.

B. Provide product data showing configurations, finishes, dimensions, and manufacturer's instructions.

C. Submit manufacturer occupancy sensor coverage patterns applicable to this project. For areas requiring multiple sensor devices for appropriate coverage, submit specific manufacturer approved sensor layout as an overlay directly on the project drawings, either in print or approved electronic form.

1.5 COORDINATION

A. Receptacles for Owner Furnished Equipment: Match plug configurations.

B. Cord and Plug Sets: Match equipment requirements.

PART 2 - PRODUCTS

2.1 DEVICE COLOR

A. All switch, receptacle, outlet, and coverplate colors shall be verified with Architect, unless indicated otherwise.

2.2 COVERPLATES

A. All switches, receptacles, and outlets shall be complete with the following:

1. Unbreakable thermoplastic/thermoset plastic coverplates in finished spaces where walls are finished.

2. #302 stainless steel coverplates in unfinished spaces for flush boxes.

3. Galvanized steel coverplates in unfinished spaces for surface mounted boxes.

B. Where several devices are ganged together, the coverplate shall be of the ganged style for the number of devices used.

C. Install nameplate identification as indicated in Section 26 05 53.

D. Plate securing screws shall be metal with head color matching the wall plate finish.

2.3 RECEPTACLES

A. Refer to Electrical Symbols List for device type.

B. Devices that are shaded on the drawings shall be red.

C. **[REC-DUP]**: NEMA 5-20R Duplex Receptacle:

1. 125 volt, 20 amp, 3-wire grounding type heavy duty industrial grade with impact resistant thermoplastic face and one-piece brass back strap with integral ground contacts.

2. Approved Manufacturers: Hubbell 5362, Leviton 5362, Pass & Seymour 5362A, Cooper AH5362.

D. **[REC-DUP-GFI]**: NEMA 5-20R Ground Fault Duplex Receptacle:

1. 125 volt, 20 amp, 3-wire grounding type with test and reset buttons in impact resistant thermoplastic face.

2. Device shall perform self-test of GFCI circuitry in accordance with UL 943.

3. Approved Manufacturers: Hubbell GF20L, Leviton GFNT2, Pass & Seymour 2097, Cooper SGF20.

E. **[REC-DUP-GFI-R]**: Remote Ground Fault Device:

1. Ground fault device for remote downstream receptacles. 125 volt, 20 amp. Test and reset buttons in impact resistance thermoplastic face.

2. Approved Manufacturers: Hubbell GFBF20, Leviton 6895, Pass & Seymour 2085, Cooper VGFD20.

F. **[REC-DUP-WP]**: NEMA 5-20R Weatherproof Ground Fault Duplex Receptacle:

1. 125 volt, 20 amp, 3-wire grounding type with test and reset buttons in impact resistant thermoplastic face. Provide NEMA 3R rated while-in-use cast aluminum cover.

2. Device shall perform self-test of GFCI circuitry in accordance with UL 943.

3. Approved Manufacturers: Hubbell GFTR20/(RW57300) WP826, Leviton GFWT2/(5977-CL) M5979, Pass & Seymour 2097TRWR/(WIUC10-C) WIUCAST1, Cooper WRSGF20/(WIU-1) WIUMV-1.

G. **[REC-USB]**: NEMA 5-20R Receptacle with USB Charger:

1. 125 volt, 20 amp, tamper resistant, 3-wire grounding type with impact resistant thermoplastic face. Type A USB charging rated at 5VDC 2.1A. Mounted in double gang backbox.

2. Approved Manufacturers: Hubbell USB20X2, Pass & Seymour TR5362USB, Cooper TR7766.

H. **[REC-ARC]**: NEMA 5-20R Receptacle with Arc Fault Circuit Interrupts

1. 125 volt, 20 amp, 3-wire grounding type hospital grade, arc fault circuit interrupter receptacle with test and reset buttons in impact resistant thermoplastic face.

2. Approved Manufacturers: Leviton AFTR2.

I. **[REC-SIM-520R]**: NEMA 5-20R Simplex Receptacle:

1. 125 volt, 20 amp, 3-wire grounding type with impact resistant thermoplastic face.

2. Approved Manufacturers: Hubbell HBL5361, Leviton, 5361, Pass & Seymour 5361, Cooper 5361.

J. **[REC-SIM-530R]**: NEMA 5-30R Simplex Receptacle:

1. 125 volt, 30 amp, 3-wire grounding type, phenolic face.

2. Approved Manufacturers: Hubbell HBL9308, Leviton 5371, Pass & Seymour 3802, Cooper 5716N.

K. **[REC-SIM-550R]**: NEMA 5-50R Simplex Receptacle:

1. 125 volt, 50 amp, 3-wire grounding type, phenolic face.

2. Approved Manufacturers: Hubbell HBL9360, Cooper 1253.

L. **[REC-SIM-620R]**: NEMA 6-20R Simplex Receptacle:

1. 250 volt, 20 amp, 2-pole, 3-wire grounding type with thermoplastic face.

2. Approved Manufacturers: Hubbell HBL5461, Leviton 5461, Pass & Seymour 5871, Cooper 5461.

M. **[REC-SIM-630R]**: NEMA 6-30R Simplex Receptacle:

1. 250 volt, 30 amp, 2-pole, 3-wire grounding type with thermoplastic face.

2. Approved Manufacturers: Hubbell HBL9330, Leviton 5372, Pass & Seymour 3801, Cooper 5700N.

N. **[REC-SIM-650R]**: NEMA 6-50R Simplex Receptacle:

1. 250 volt, 50 amp, 2-pole, 3-wire grounding type with thermoplastic face.

2. Approved Manufacturers: Hubbell HBL9367, Leviton 5374, Pass & Seymour 3804, Cooper 5709N.

O. **[REC-SIM-720R]**: NEMA 7-20R Simplex Receptacle:

1. 277 volt, 20 amp, 2-pole, 3-wire grounding type with thermoplastic face.

2. Approved Manufacturers: Hubbell, Leviton, Pass & Seymour 7621.

P. **[REC-SIM-730R]**: NEMA 7-30R Simplex Receptacle:

1. 277 volt, 30 amp, 2-pole, 3-wire grounding type with thermoplastic face.

2. Approved Manufacturers: Hubbell HBL9315, Leviton 9730-A, Pass & Seymour, Cooper 5795N.

Q. **[REC-SIM-750R]**: NEMA 7-50R Simplex Receptacle:

1. 277 volt, 50 amp, 2-pole, 3-wire grounding type with thermoplastic face.

2. Approved Manufacturers: Hubbell HBL9365, Leviton 9750-A, Pass & Seymour, Cooper.

R. **[REC-SIM-1420R]**: NEMA 14-20R Simplex Receptacle:

1. 125/250 volt, 20 amp, 3-pole, 4-wire grounding type with thermoplastic face.

2. Approved Manufacturers: Hubbell HBL8410, Pass & Seymour 3820, Cooper 5759.

S. **[REC-SIM-1430R]**: NEMA 14-30R Simplex Receptacle:

1. 125/250 volt, 30 amp, 3-pole, 4-wire grounding type with thermoplastic face. Flush mounted at +24 AFF.

2. Approved Manufacturers: Hubbell HBL9430A, Leviton 278, Pass & Seymour 3864, Cooper 5744N.

T. **[REC-SIM-1450R]**: NEMA 14-50R Simplex Receptacle:

1. 125/250 volt, 50 amp, 3-pole, 4-wire grounding type with thermoplastic face. Flush mounted at +4" AFF.

2. Approved Manufacturers: Hubbell HBL9450A, Leviton 279, Pass & Seymour 3894, Cooper 5754N.

U. **[REC-SIM-1460R]**: NEMA 14-60R Simplex Receptacle:

1. 125/250 volt, 60 amp, 3-pole, 4-wire grounding type with thermoplastic face.

2. Approved Manufacturers: Hubbell HBL9460A, Leviton 9460, Pass & Seymour, Cooper 9460N.

V. **[REC-SIM-1520R]**: NEMA 15-20R Simplex Receptacle:

1. 250 volt, 20 amp, 3-phase, 3-pole, 4-wire grounding type with thermoplastic face.

2. Approved Manufacturers: Hubbell HBL8420, Leviton, Pass & Seymour, Cooper.

W. **[REC-SIM-1530R]**: NEMA 15-30R Simplex Receptacle:

1. 250 volt, 30 amp, 3-phase, 3-pole, 4-wire grounding type with thermoplastic face.

2. Approved Manufacturers: Hubbell HBL8430A, Leviton 8430, Pass & Seymour 5740, Cooper 8430N.

X. **[REC-SIM-1550R]**: NEMA 15-50R Simplex Receptacle:

1. 250 volt, 50 amp, 3-phase, 3-pole, 4-wire grounding type with thermoplastic face.
2. Approved Manufacturers: Hubbell HBL8450A, Leviton 8450, Pass & Seymour 5750, Cooper 8450N.

Y. **[REC-SIM-1560R]**: NEMA 15-60R Simplex Receptacle:

1. 250 volt, 60 amp, 3-phase, 3-pole, 4-wire grounding type with thermoplastic face.
2. Approved Manufacturers: Hubbell HBL9460A, Pass & Seymour 5760, Cooper 8460N.

Z. **[REC-SIM-L520R]**: NEMA L5-20R Simplex Receptacle, Locking Type:

1. 125 volt, 20 amp, 2-pole, 3-wire grounding type with impact resistant thermoplastic face.
2. Approved Manufacturers: Hubbell, Leviton, Pass & Seymour L520, Cooper CWL520R.

AA. **[REC-SIM-L530R]**: NEMA L5-30R Simplex Receptacle Locking Type:

1. 125 volt, 30 amp, 2-pole, 3-wire grounding type with impact resistant thermoplastic face.
2. Approved Manufacturers: Hubbell, Leviton, Pass & Seymour L530, Cooper CWL530R.

BB. **[REC-SIM-L620R]**: NEMA L6-20R Locking Type Simplex Receptacle:

1. 250 volt, 20 amp, 2-pole, 3-wire grounding type with thermoplastic face.
2. Approved Manufacturers: Hubbell HBL2320, Leviton 2320, Pass & Seymour L620R, Cooper CWL620R.

CC. **[REC-SIM-L630R]**: NEMA L6-30R Locking Type Simplex Receptacle:

1. 250 volt, 30 amp, 2-pole, 3-wire grounding type with thermoplastic face.
2. Approved Manufacturers: Hubbell HBL2620, Leviton 2620, Pass & Seymour L630R, Cooper CWL630R.

DD. **[REC-SIM-L720R]**: NEMA L7-20R Locking Type Simplex Receptacle:

1. 277 volt, 20 amp, 2-pole, 3-wire grounding type with thermoplastic face.
2. Approved Manufacturers: Hubbell HBL2330, Leviton 2330, Pass & Seymour L720R, Cooper CWL720R.

EE. **[REC-SIM-L730R]**: NEMA L7-30R Locking Type Simplex Receptacle:

1. 277 volt, 30 amp, 2-pole, 3-wire grounding type with thermoplastic face.
2. Approved Manufacturers: Hubbell HBL2630, Leviton 2630, Pass & Seymour L730R, Cooper CWL730R.

FF. **[REC-SIM-L1420R]**: NEMA L14-20R Locking Type Simplex Receptacle:

1. 125/250 volt, 20 amp, 3-pole, 4-wire grounding type with thermoplastic face.
2. Approved Manufacturers: Hubbell HBL 2410, Pass & Seymour L1420, Cooper CWL1420R.

GG. **[REC-SIM-L1430R]**: NEMA L14-30R Locking Type Simplex Receptacle:

1. 125/250 volt, 30 amp, 3-pole, 4-wire grounding type with thermoplastic face.

2. Approved Manufacturers: Hubbell HBL 2710, Leviton 2710, Pass & Seymour L1430R, Cooper CWL1430R.

HH. **[REC-SIM-L1520R]**: NEMA L15-20R Locking Type Simplex Receptacle:

1. 250 volt, 20 amp, 3-phase, 3-pole, 4-wire grounding type with thermoplastic face.

2. Approved Manufacturers: Hubbell HBL2420, Leviton 2420, Pass & Seymour L1520R, Cooper CWL1520R.

II. **[REC-SIM-L1530R]**: NEMA L15-30R Locking Type Simplex Receptacle:

1. 250 volt, 30 amp, 3-phase, 3-pole, 4-wire grounding type with thermoplastic face.

2. Approved Manufacturers: Hubbell HBL2720, Leviton 2720, Pass & Seymour L1530R, Cooper CWL1530R.

JJ. **[REC-SIM-L2120R]**: NEMA L21-20R Locking Type Simplex Receptacle:

1. 120/208Y 3 phase 20 amp 5 wire grounding type.

2. Approved Manufacturers: Hubbell HBL2510, Cooper CWL2120R, Pass & Seymour L2120R.

KK. **[REC-SIM-L2130R]**: NEMA L21-30R Locking Type Simplex Receptacle:

1. 120/208Y 3 phase 30 amp 5 wire grounding type.

2. Approved Manufacturers: Hubbell HBL2750, Cooper CWL2130R, Pass & Seymour L2130R.

LL. **[REC-TAMP]**: NEMA 5-20R Tamper Resistant Duplex Receptacle:

1. 125 volt, 20 amp, 3-wire grounding type with impact resistant thermoplastic face.

2. Approved Manufacturers: Hubbell BR20TR, Leviton TBR20, Pass & Seymour TR5362, Cooper TRBR20.

3. Provide decorative style duplex tamper resistant receptacles in public spaces where walls are finished.

4. Approved Manufacturers: (Decorative), Hubbell DR20TR, Leviton TDR20, Pass & Seymour TR2635.

MM. **[REC-TAMP-GFI]**: NEMA 5-20R GFI Tamper Resistant Receptacle:

1. 125 volt, 20 amp, 3-wire grounding type tamper-resistant with test and reset buttons in impact resistant thermoplastic face.

2. Device shall perform self-test of GFCI circuitry in accordance with UL 943.

3. Approved Manufacturers: Hubbell GFTR20, Cooper TRSGF20, Pass & Seymour 2097TR, Leviton GFTR2.

NN. **[REC-TAMP-QUAD]**: NEMA 5-20R Double Duplex Tamper Resistant Receptacle:

1. Consists of two duplex tamper resistant receptacles, double gang box, plaster ring and faceplate.

2. Approved Manufacturers: Refer to Tamper Resistant Receptacle above.

OO. **[REC-DUP-O]**: NEMA 5-20R Plug Load Controlled Duplex Receptacle:

1. 125 volt, 20 amp, 3-wire grounding type with impact resistant thermoplastic face and steel back strap. Bottom half of duplex shall be split circuit wired and controlled by remote relay. Controlled receptacle shall have permanent NEMA approved and NEC 2014 compliant marking on face of device.

2. Approved Manufacturers: Pass & Seymour 5362H, Leviton 5362-1P, Hubbell, Cooper.

PP. **[REC-QUAD-O]**: NEMA 5-20R Plug Load Controlled Duplex Receptacle:

1. Consists of two duplex tamper resistant receptacles, double gang box, plaster ring and faceplate.

2. Approved Manufacturers: Refer to Plug Load Controlled Duplex Receptacles above.

QQ. **[REC-QUAD]:** NEMA 5-20R Double Duplex Receptacle:

1. Consists of two duplex receptacles, double gang box, plaster ring and faceplate.

2. Approved manufacturers: Refer to Duplex Receptacle above.

RR. **[REC-QUAD-GFI]**: NEMA 5-20R Double Duplex GFI Receptacle:

1. Consists of two duplex GFI receptacles, double gang box, plaster ring and faceplate.

2. Approved Manufacturers: Refer to Duplex GFI Receptacle above.

SS. **[REC-QUAD-USB]**: NEMA 5-20R Double Duplex USB Receptacle:

1. Consists of two duplex USB receptacles, double gang box, plaster ring and faceplate.

2. Approved Manufacturers: Refer to USB Receptacle above.

TT. **[REC-QUAD-WP]**: NEMA 5-20R Weatherproof Ground Fault Quad Receptacle:

1. Consists of two duplex, GFI receptacles. Double gang box. Provide NEMA 3R rated while-in-use cast aluminum cover.

2. Approved Manufacturers:

   a. Receptacle: Refer to GFCI Receptacle above.

   b. Cover: Intermatic WP1030MXD, Pass & Seymour WIUCAST2, Thomas & Betts Red Dot 2CKU.

UU. Back wired devices shall be complete with eight holes that are screw activated with metal clamps for connection to #12 or #10 copper conductors.

VV. Side wired devices shall have four binding screws that are undercut for positive wire retention.

WW. Ground fault circuit interrupter (GFCI) receptacles shall comply with UL 943 requiring increased surge immunity, improved corrosion resistance, improved resistance to false tripping and diagnostic indication for miswiring if the line and load conductors are reversed during installation.

XX. Integral surge suppression receptacles with integral surge suppression shall comply with the following:

1. Category A3 listed.

2. Line to ground, line to neutral, and neutral to ground modes.

3. Metal-oxide varistors with a nominal clamp level rating of 500 volts and minimum single transient pulse energy dissipation of 210 joules per mode.

4. Status indication: Light visible in the face of the device and audible alarm to indicate device is no longer active or in service.

5. Distinctive symbol on device face to denote SPD-type device.

6. Device shall be blue.

7. NEMA 5-20R duplex receptacle, 125 volt, 20 amp, 3-wire grounding type heavy duty industrial grade with impact resistant thermoplastic face and one-piece brass back strap.

a. Approved Manufacturers: Hubbell HBL5362SA, Leviton, Pass & Seymour, Cooper.

YY. Hazardous (Classified) location receptacles shall comply with NEMA FB 11.

2.4 FLOOR BOXES

A. Color: Verify with Architect.

B. Coordinate with Technology drawings for voice/data outlet requirements.

C. Floor Boxes for Installation in Cast-In-Place Concrete Floors: Fully adjustable, cast iron.

D. **[FB-1]**: Cast iron floor box, dual compartment, flush mount, brass carpet flange. One compartment with one (1) **[REC-DUP]** and brass duplex flap cover. One compartment with brass 2-1/8" x 3/4" combination cover and one (1) 3/4" and one (1) 1" conduit stubbed to above the lay-in ceiling.

1. Approved Manufacturers:

a. Hubbell

E. **[FB-2]**: Cast iron floor box, dual compartment, flush mount, brass carpet flange. One compartment with one (1) **[REC-DUP]** and brass duplex flap cover. One compartment with brass 2-1/8" x 3/4" combination cover and one (1) 3/4" and one (1) 1" conduit stubbed to above the lay-in ceiling.

1. Approved Manufacturers:

a. Hubbell

2.5 PENDANT CORD/CONNECTOR DEVICES

A. Description: Matching, locking type plug and receptacle body connector, NEMA WD 6, Configurations L5-20P and L5-20R, heavy-duty grade or refer to Details as shown on drawings.

1. Body: Nylon with screw-open cable gripping jaws and provisions for attaching external cable grip.

B. External Cable Grip: Woven wire mesh type made of high strength galvanized steel wire stand, matched to cable diameter, and with attachment provision designed for corresponding connector.

2.6 CORD AND PLUG SETS

A. Description: Match voltage and current ratings and number of conductors to requirements of equipment being connected.

1. Cord: Rubber-insulated, stranded copper conductors, with Type SOW-A jacket; with green insulated grounding conductor and equipment rating ampacity plus a minimum of 30 percent.

2. Plug: Nylon body and integral cable-clamping jaws. Match cord and receptacle type for connection, FS/UL listed.

2.7 CORD REELS

A. **[CR-1]**: 50' 3#12 AWG type 'SOW-A' cord with adjustable ball stop. 120 volt, NEMA 5-20R, simplex receptacle connector, rated 16 amps continuous.

1. Approved Manufacturers:

a. Daniel Woodhead w/ Hubbell
b. Appleton
c. Hubbell HBL

B. **[CR-2]**: 50' 3#10 AWG type 'SOW-A' cord with adjustable ball stop. 120 volt, NEMA 5-30R, simplex receptacle connector, rated 20 amps continuous.

1. Approved Manufacturers:

a. Daniel Woodhead w/ Hubbell
b. Appleton
c. Hubbell HBL

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install light switches, dimmers, and convenience receptacles at elevations indicated in the General Installation Notes on the contract drawings.

B. Install specific-use receptacles at heights shown on the contract drawings. Install devices level, plumb, and square with building lines. Coordinate installation of adjacent devices of separate systems with common mounting heights, including lighting, power, systems, technology, and temperature control device rough-ins.

C. Drill opening for poke-through fitting installation in accordance with manufacturer's instructions. This Contractor is responsible for taking any measures required to ensure no conduits or other services are damaged. This may include X-ray or similar non-destructive means.

D. Install receptacles vertically with ground slot up or where indicated on the drawings, horizontally with ground slot to the left.

E. Install decorative plates on switch, receptacle, and blank outlets in finished areas, using jumbo size plates for outlets installed in masonry walls.

F. Install galvanized steel plates on outlet boxes and junction boxes in unfinished areas, above accessible ceilings, and on surface-mounted outlets.

G. Install devices and wall plates flush and level.

H. Contractor to verify that wall dimmer ratings are achieved where a ganged installation is used.

I. Install nameplate identification to receptacle cover plates indicated. Identification shall identify panel name and circuit number. Refer to Specification Section 26 05 53 - Electrical Identification.

J. Identify locations of power packs, control units, and relays above ceiling on record drawing.

K. Test receptacles for proper polarity, ground continuity and compliance with requirements.

L. Healthcare devices shall be tested in accordance with NFPA 99 6.3.3 for grounding, voltage, and impedance measurements.

M. Floor Box Installation:

1. Set boxes level and flush with finish flooring material.

2. Use cast iron floor boxes for installations in slab on grade. Trim shall match floor covering to be used.

3. Provide a minimum horizontal offset of 24 inches between boxes.

4. Provide saw-cutting and patching of existing concrete floors as necessary for floor box installations within existing floors.

END OF SECTION

SECTION 26 28 13
FUSES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Fuses
B. Spare Fuse Cabinet

1.2 REFERENCES

A. UL 198C - High-Interrupting Capacity Fuses; Current Limiting Types

B. UL 198E - Class R Fuses

C. FS W-F-870 - Fuseholders (For Plug and Enclosed Cartridge Fuses)

D. NEMA FU 1 - Low Voltage Cartridge Fuses

E. NFPA 70 – National Electrical Code

1.3 SUBMITTALS

A. Submit product data under provisions of Section 26 05 00.

1.4 EXTRA MATERIALS

A. Provide two fuse pullers.

B. Provide three of each size and type of fuse installed.

1.5 PROJECT CONDITIONS

A. Where ambient temperature to which fuses are directly exposed is less than 40°F (5°C) or more than 100°F (38°C), apply manufacturer's ambient temperature adjustment factors to fuse ratings.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS – FUSES

A. Cooper Bussman
B. Eagle Electric Mfg. Co.; Cooper Industries
C. Mersen
D. Tracor; Littelfuse Subsidiary

2.2 FUSES

A. Dimensions and Performance: NEMA FU 1, Class as specified or indicated.

B. Voltage: Provide fuses with voltage rating suitable for circuit phase-to-phase voltage.

C. Fuses with ratings larger than 600 amperes: Class L (time delay), unless otherwise noted on the drawings.

D. Fuses with ratings larger than 200 amperes but equal to or less than 600 amperes: Class RK-1 (time delay), unless otherwise noted on the drawings.

E. Fuses with ratings less than or equal to 200 amperes (not including control transformer fuses): Class RK-5, unless otherwise noted on the drawings.

F. Control transformer fuses: Class CC (time delay).

G. Fuses for packaged equipment: Size and type as recommended by equipment manufacturer.

2.3 **SPARE FUSE CABINET**

A. Cabinet: Wall-mounted, 0.05-inch- (1.27-mm-) thick steel unit with full-length, recessed piano-hinged door and key-coded cam lock and pull.

1. Size: Adequate for storage of spare fuses specified with 15 percent spare capacity minimum.
2. Finish: Gray, baked enamel.
3. Identification: "SPARE FUSES" in 1-1/2-inch- (38-mm-) high letters on exterior of door.
4. Fuse Pullers: For each size of fuse.

PART 3 - EXECUTION

3.1 **INSTALLATION**

A. Install fuses where indicated on the drawings and specifications.

B. Install fuses in accordance with manufacturer's instruction.

C. Install fuses in packaged equipment as required by equipment manufacturer.

D. Install fuse with label oriented such that manufacturer, type, and size are easily read.

E. Install spare fuse cabinet in the Main Electrical Room.

END OF SECTION

SECTION 26 28 16
DISCONNECT SWITCHES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Fusible switches
B. Non-fusible switches
C. Molded case circuit switches
D. Molded case switches
E. Motor disconnect switch
F. Enclosures

1.2 RELATED SECTIONS AND WORK

A. Refer to the Disconnect and Starter Schedule for rating and configuration.

1.3 REFERENCES

A. NEMA KS 1 - Enclosed Switches

1.4 SUBMITTALS

A. Submit product data under provisions of Section 26 05 00.

B. Product Data: For each type of enclosed switch, circuit breaker, accessory and component indicated, include dimensions, weights, and manufacturer's technical data on features, performance, and ratings.

C. Electrical Characteristics: For each type of enclosed switch, enclosure types, current and voltage ratings, short-circuit current ratings, UL listing for series rating of installed devices, features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.

1.5 COORDINATION

A. Coordinate layout and installation of switches, circuit breakers, and components with other construction, including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

PART 2 - PRODUCTS

2.1 FUSIBLE AND NON-FUSIBLE SWITCHES

A. **[FDS-#]:** Fusible Switch Assemblies: NEMA KS 1; Type heavy duty, quick-make, quick-break, load interrupter enclosed knife switch with externally operable handle interlocked to prevent opening front cover with switch in ON position. Handle lockable in OFF position. Fuse Clips: Class 'R' fuse clips only, unless indicated otherwise on the drawings.

B. **[DS-#]:** Non-fusible Switch Assemblies: NEMA KS 1; Type heavy duty, quick-make, quick-break, load interrupter enclosed knife switch with externally operable handle interlocked to prevent opening front cover with switch in ON position. Handle lockable in OFF position.

C. Enclosures: Type as indicated on the disconnect schedule.

D. Accessories: As indicated on the disconnect schedule.

2.2 MOLDED CASE CIRCUIT BREAKERS AND SWITCHES

A. **[CB-#]:** Molded Case Circuit Breaker: NEMA AB 1, with interrupting capacity to meet available fault currents.

1. Thermal Magnetic Circuit Breakers: Inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.

2. Adjustable Instantaneous Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip settings.

3. Electronic Trip Unit Circuit Breakers: RMS sensing; field-replaceable rating plug; with the following field-adjustable settings:

   a. Instantaneous trip.
   b. Long- and short-time pickup levels.
   c. Long- and short-time adjustments.
   d. Ground-fault pickup level, time delay, and I^2t responses.

4. Current Limiting Circuit Breakers: Frame sizes 400 A and smaller and let-through ratings less than NEMA FU 1, RK-5.

B. **[CB-#]:** Molded Case Switches: Molded case circuit breaker with fixed, high-set instantaneous trip only, and short-circuit withstand rating equal to equivalent breaker frame size interrupting rating.

C. Accessories: As indicated on the disconnect schedule.

2.3 MOTOR DISCONNECT SWITCH

A. **[DS-#]:** Rotary Switch Assemblies: Rated for making and breaking loads, rotary type enclosed switch with externally operable handle interlocked to prevent opening front cover with switch in ON position. Handle lockable in OFF position.

B. Enclosures: Type as indicated on the Disconnect Schedule.

C. Ground lug connection provided in enclosure.

D. Accessories: As indicated on the Disconnect Schedule.

E. Listed UL 508 suitable for motor control.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install disconnect switches where indicated on the drawings.

B. Install fuses in fusible disconnect switches.

C. Provide adhesive label on inside door of each switch indicating UL fuse class and size for replacement.

1 **3.2 ADJUSTING**

2 A. Set field-adjustable circuit breaker trip ranges.

3 **END OF SECTION**

SECTION 26 28 21
CONTACTORS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. General-purpose contactors
B. Lighting contactors
C. Enclosures

1.2 RELATED SECTIONS AND WORK

A. Refer to Lighting Contactor Schedule.

1.3 REFERENCES

A. ANSI/NEMA ICS 6 - Enclosures for Industrial Controls and Systems

B. NEMA ICS 2 - Industrial Control Devices, Controllers, and Assemblies

C. UL 508 - Industrial Control Equipment

1.4 SUBMITTALS

A. Submit shop drawings under provisions of Section 26 05 00.

B. Include outline drawings with dimensions, and equipment ratings for voltage, capacity, and poles.

C. Submit manufacturer's instructions under provisions of Section 26 05 00.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Schneider Electric
B. G.E.
C. ASCO

2.2 [C-1]: GENERAL-PURPOSE CONTACTORS

A. Contactors: NEMA ICS 2 and UL 508; electrically held, 2-wire control.

B. Coil Operating Voltage: 120 volts, 60 Hertz.

C. Size: NEMA ICS 2; size as indicated on the drawings.

D. Contacts: 600 volts, 60 Hertz.

E. Enclosure: ANSI/NEMA ICS 6; Type 1.

F. Provide solderless pressure wire terminals.

2.3 [LC-1]: LIGHTING CONTACTORS

A. Contactors: NEMA ICS 2 and UL 508; electrically held, 2-wire control.

B. Coil Operating Voltage: 120 volts, 60 Hertz.

C. Contacts: As indicated on the drawings.

D. Enclosure: ANSI/NEMA ICS 6; Type 1.

E. Provide solderless pressure wire terminals.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.

C. Size conductors according to lighting control device manufacturer's written instructions, unless otherwise indicated.

D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction boxes: and equipment enclosures.

E. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

END OF SECTION

SECTION 26 31 00
PHOTOVOLTAIC SYSTEM PERFORMANCE REQUIREMENTS

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section includes general performance requirements that apply to installing a roof mounted solar electric (PV) system for this project

B. Contractor is the Designer of Record for this system. Contractor is required to provide a Structural PE (Professional Engineer) Stamp for the structural design and an Electrical PE Stamp for the overall system design.

C. Both the structural and electrical stamps are to be provided from experienced PV designers with at least 5 similar completed projects.

D. Contractor is required to have experience with at least 5 similar completed PV projects.

E. Product specifications included in this section are the Basis for Design. Design substitutions shall meet the minimum performance requirements defined in this section. Contractor shall select number of inverters and perform string sizing.

F. Related Work and Requirements:

1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

G. Incentive Paperwork:

1. Contractor to provide support with Owner's application for Focus on Energy incentives.

1.2 DEFINITIONS

A. MPPT: Maximum power point tracking.

B. STC: Standard test conditions, 1000 W/m2, 1.5 air mass, and 25°C cell temperature.

C. NABCEP: North American Board of Certified Energy Practitioners

D. PTC: PV USA Test Conditions, 1000 W/m2, 1.5 air mass, 20°C air temperature, and 1 meter/sec. wind speed.

E. Voc: Open circuit voltage

F. Isc: Short circuit current.

1.3 SUBMITTALS

A. Experience: Submit resumes for individuals involved with the design and construction of the PV System. Submit references and summaries of five similar projects that these individuals have completed.

B. Product Data: For each type of component indicated below. Include rated capacities, operating characteristics, and furnished specialties and accessories. All product data submittals shall be submitted for review by Owner prior to purchasing any materials or equipment.
   1. Solar panels
   2. Combiner boxes and fuses
   3. Grid tied inverters, including efficiency data.
   4. Solar panel structural system, including rail, clamps, and brackets.
   5. Manufacturer's installation instructions.

C. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection. All shop drawings shall be submitted for review by Owner prior to purchasing any materials or equipment.
   1. Dimensioned AutoCAD plan drawings of equipment including solar panel array, inverters, disconnects, combiner boxes, metering, and electrical routing.
   2. Provide AutoCAD drafted three-line wiring diagram of solar PV system indicating ratings of all panels and inverters, wire and conduit types and sizes, and disconnects.
   3. Wiring Diagrams: Power, signal, and control wiring.

D. Design Calculations
   1. The following design calculations shall be performed by Contractor and submitted for review by Owner prior to purchasing any materials or equipment.
      a. Electrical calculations, including string sizing, inverter selection, and voltage losses.
      b. Structural calculations, including rail spans, wind and snow loading, required ballast weights, and roof strength calculations.

E. Permitting and Agreements
   1. The following permits and agreements shall be prepared by Contractor on behalf of the Owner. All approved permits and agreements shall be submitted for review by Owner prior to purchasing any materials or equipment.
      a. Utility interconnection agreement
      b. Building permit
      c. Electrical permit

F. As built drawings:
   1. Dimensioned AutoCAD plan drawings of equipment including solar panel array, inverters, disconnects, combiner boxes, metering, and electrical routing.
   2. Provide AutoCAD drafted three-line diagram of solar PV system indicating ratings of all panels and inverters, wire and conduit types and sizes, and disconnects.

G. Field quality-control test reports.
   1. Include voltages and power output for each string. Measure and record solar intensity during testing. Include time, date, and weather conditions of test.

H. Operation and Maintenance Data: For panels, inverter, metering, and monitoring. In addition to items specified in Division 01 include the following:
   1. Instructions for operating equipment.
   2. Identification of operating limits which may result in hazardous or unsafe conditions.
   3. Document ratings of equipment and each major component.
   4. Technical Data Sheets.
   5. Wiring Diagrams.
   6. Parts list.

I. Warranty: Copies of all manufacturer's and installer's warranties.

1.4 QUALITY ASSURANCE

A. Installer Qualifications:
   1. Maintenance Proximity: Not more than four hours' normal travel time from Installer's place of business to Project site.
   2. Installer must have PV Installer certification through NABCEP.

B. Source Limitations: Obtain panels from a single manufacturer, of a single type and rating. Obtain inverters from a single manufacturer, of a single type and a single rating.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

D. Comply with NFPA 70 and all applicable state and local codes

1.5 COORDINATION

A. Coordinate metering and interconnection agreement with electric utility. Contractor shall pay all interconnection fees including the application review fee, engineering review fee, and distribution system study fee. Contractor shall submit all required forms to utility.

1.6 WARRANTY

A. Installer must provide a two year installation warranty covering any defects of the installation.

B. Panel Warranty Period:

1. 5 years workmanship warranty.
2. 10 year 90% linear power output warranty.
3. 25 year 80% linear power output warranty.

C. Inverter Warranty Period: 15 year warranty.

PART 2 - PRODUCTS

2.1 SOLAR PANELS

A. Available Manufacturers: Subject to compliance with performance requirements, manufacturers offering products that may be incorporated into the Work include:

1. Heliene
2. Solarworld
3. LG
4. Hanwha Q-cells
5. Canadian Solar

B. If an alternate product is proposed, bid is to document how the proposed solution is more cost effective to the owner. Follow substitution request procedure per 01 25 13.

C. Capacities and Characteristics:

1. All panels shall be of a single type from a single manufacturer.
2. Power Output Ratings: STC rated power of between 270 and 300 watts.
3. DC Array size of 50.05 to 50.40 kW
4. AC Energy Produced between 59,646 and 60,065 kWh/yr based on the following assumptions:
   a. http://pvwatts.nrel.gov/pvwatts.php (PV Watts version 1)
   b. Module Type: Standard
   c. Array Type: Fixed (roof mount)
   d. System Losses: 14%
   e. Tilt: 5 degrees
   f. Azimuth: 180 degrees
   g. DC to AC Size Ratio: 1.1
   h. Inverter Efficiency: 96%
   i. Ground Coverage Ratio: 0.4
5. Power tolerance of less than 5% variation (maximum minus minimum). Minimum tolerance of -0%.
6. Manufactured in the U.S., Mexico or Canada
7. Nameplates: To identify electrical characteristics, manufacturer's name and address, and model and serial number of component.
8. Module efficiency: minimum 17.00%

D. Materials and construction

1. Monocrystalline or Polycrystalline
2. Junction box with bypass diodes.
3. Output Connections: Factory wired separate positive and negative leads sized per division 26 wire requirements with locking quick disconnects, rated for use in direct sunlight. Shall meet all requirements of NEC article 690.33.
4. Anodized aluminum frame with drainage holes and grounding holes.
5. Operating temperature range of -40°C to +85°C.
6. Withstand 1" diameter hail at 50 mph without damage.
7. Load rated at 5400 Pa (113 psf) when used with two rail system.

2.2 INVERTERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include:
   1. SMA
   2. Fronius
   3. Solar Edge with P600 Optimizers (1 Optimizer per 2 panels) -Basis of Design

B. If an alternate product is proposed, bid is to document how the proposed solution is more cost effective to the owner. Follow substitution request procedure per 01 25 13.

C. Standards
   1. IEEE 1547
   2. UL 1741 – anti-islanding.

D. Electrical characteristics
   1. AC kW rating: Minimum DC-to-AC ratio of 1.2
      a. Provide up to four (4) inverters rated for a total of 50 kW nominal DC input.
      b. The basis of design is three (3) inverters. Systems with an additional inverter shall include providing an additional circuit breaker, disconnect, and feeder from main service panel to inverter to match other inverters.
   2. Output voltage: 208VAC (-12%, +10%), 3 phase.
   3. Frequency: 60 Hz sine wave
   4. Input voltage: Coordinated with solar array.
   5. Max Voc: Coordinated with solar array.
   6. Max DC current: Coordinated with solar array.
   7. Startup voltage: Coordinated with solar array.
   8. Output power factor: Unity
   9. DC to AC conversion efficiency:
      a. 97.5% CEC rated efficiency
   10. A/C and D/C rapid shutdown compliant with NEC 2017

E. Features
   1. Transformerless design.
   2. Forward facing DC disconnect
   3. DC side ground fault protection.
   4. Inverter must limit power output to nameplate value. If connected to an array capable of producing more than the inverter's capacity, the inverter must limit the power without damage.
   5. Maximum power point tracking over the range of voltages of the array, at the ambient temperatures of the site.
   6. User navigable display.
   7. LED status lights on enclosure.
   8. Communication port for diagnostics and communication port for communication with multiple inverters and internet interface device.
   9. NEMA 3R enclosure

2.3 PV WIRING

A. Type PV-WIRE, #10AWG, from array to combiner box, and where used as a jumper for connection between panels.

B. UV-Stabilized Cable Ties:
   1. Fungus inert, designed for continuous exposure to exterior sunlight, self extinguishing, one piece, self locking, Type 6/6 nylon.
   2. Minimum Width: 3/16 inch (5 mm).
   3. Tensile Strength at 73 °F (23 °C), According to ASTM D 638: 12,000 psi (82.7 MPa).
   4. Temperature Range: -40 to +185 °F (-40 to +85 °C).
   5. Color: Black.

C. Ampacity of PV source circuits shall be a minimum of 156% of the sum of parallel strings short circuit currents.
   1. Shall be sized to limit voltage drop to 0.5% from array to inverter during full production at MPPT voltage at maximum ambient temperature.
   2. Shall be in metallic conduit from combiner box, if installed, to inverter.

2.4 COMBINER BOX

A. If needed, Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include:
   1. Blue Oak
   2. SMA
   3. MidNite solar

B. If an alternate product is proposed, bid is to document how the proposed solution is more cost effective to the owner. Follow substitution request procedure per 01 25 13.

C. Capacities and Characteristics:
   1. DC current and voltage ratings coordinated with array.
   2. Positive and negative combiner blocks.
      a. Number of poles coordinated with array.
   3. DC voltage fuses in fingersafe fuse holder.

D. Materials and construction
   1. Powder coated steel, NEMA 3R enclosure.
   2. Knockouts
   3. Stainless steel hardware.

2.5 RACKING & ROOF ATTACHMENT & ROOF PENETRATIONS

A. Tilt Angle of Panels: 5 degrees from horizontal (flat to roof)

B. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include:
   1. Products for systems on low slope standing seam metal roofs and canopy superstructre :
      a. Schletter
      b. IronRidge

2.6 METERING

A. Refer to Division 26 specifications.

2.7 INTERNET BASED MONITORING

A. Provide standard package from inverter manufacturer and connect to the City Network. Coordinate with Owner. Contractor is required to test monitoring to confirm it is functioning.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine roughing-in of electrical connections. Verify actual locations of connections before panel installation.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 ARRAY REQUIREMENTS

A. Install panels on racking designed for solar (PV) panels.

B. Coordinate installation with roof shop drawings.

C. Structural Performance: Installation shall withstand all local wind and snow loads, and all local building department requirements.

D. If applicable, slip sheet is to be used between ballasted racking and roof membrane

E. All fastening hardware must be stainless steel.

F. All materials must be metallurgically compatible where different materials are in contact with each other.

G. Roof penetrations shall be made watertight using methods that are standard to the roofing industry, are approved by the roofing manufacturer, and that protect the warranty of the roof.

H. The panels shall be connected in arrays with the following characteristics:
   1. Total DC peak STC rated power of all panels in the array shall be minimum 50.05 kW. The panels shall be divided into even arrays between the inverters.
   2. The panels shall be installed only in the area outlined on the architectural roof drawing.
   3. If an alternate layout is proposed, bid is to document how the proposed solution is more cost effective to the owner. Follow substitution request procedure per 01 25 13.
   4. If needed, each array shall be provided with a combiner box.
   5. The panels shall be installed with long axis as shown on architectural roof drawing.

6. PV panel cables may be installed exposed where routed directly behind panels, but all cables shall be installed in a section of conduit where crossing part of the roof not under a panel. Conduit running across roof shall be supported on roof using Cooper B-Line Dura-Blok or equivalent.
7. All PV panel cables shall be installed in a neat and workmanship like manner. Excess wire shall be coiled and bundled neatly and supported securely in an area where they are not subject to environmental degradation, such as from wind, sun, and animals. Attach PV panel cables to racking with zip-ties listed for use in direct sunlight.
8. Panels shall be connected in series and parallel to match voltage and current ratings of inverter, across all ambient temperatures common to site (-25°C to 40°C).
    a. Open circuit voltage of array on coldest day of year in full sunlight shall not exceed maximum operating voltage rating of inverter, panels, or any other equipment.
    b. Open circuit voltage on warmest day of year in morning sunlight conditions (200W/m2 irradiance) shall exceed inverter startup voltage. Voltage under operating MPPT conditions, minus any voltage drop over conductors, shall exceed minimum inverter input voltage.
    c. Available short circuit current multiplied by 1.25 shall not exceed ratings for the inverter or any panels.
    d. All series strings of panels shall have same performance characteristics.

3.3 ELECTRICAL INSTALLATION

A. Ground equipment according to Division 26
    1. Size grounding conductors per NEC articles 250 and 690.
    2. All conductive equipment enclosures must be grounded.
    3. All panel frames must be grounded.
        a. The removal of any panel shall not interrupt a grounded conductor to another photovoltaic source circuit.

B. Install wiring, combiner boxes, conduit, disconnects, inverter, web based monitoring hardware, sensors and other equipment according to Division 26.

C. Connect wiring according to Division 26.

3.4 IDENTIFICATION

A. Identify and label system components according to Division 26.
    1. Provide a unique label for each inverter, PV output circuit, combiner box, PV Source circuit, and panel. Labeling shall match labeling shown on as-built diagram and plan provided by contractor.

B. Provide all labeling required by NEC article 690, including, but not limited to:
    1. Label disconnects capable of being energized from both directions as such.
    2. Provide plaque at utility service disconnect per article 690.56B. Field verify exact location.
    3. Label each photovoltaic disconnecting means per NEC article 690.53.

3.5 FIELD QUALITY CONTROL

A. Perform tests and inspections as indicated below and prepare test reports. Correct any deficiencies.
    1. Visually inspect all connections.
    2. Visually inspect all supports.
    3. Measure Voc of each individual string of panels under full sunlight.
        a. Verify Voc of all strings are balanced.
        b. Verify measured Voc against calculated Voc for the ambient temperature. Extrapolate Voc to temperatures expected at site, and verify they are within inverters ratings.
    4. Measure Isc of each string of panels.
    5. Verify correct operation of inverter.
    6. Verify correct operation of complete system.
    7. Replace any defective panels. Panels shall be replaced at contractor's expense.

3.6 DEMONSTRATION

A. Simulate power outage by interrupting normal source, and demonstrate that system disconnects from utility.

B. Provide owner's maintenance personnel with minimum two hour training session and in compliance with Div 1 Training Requirements.
    1. Provide training on function of each piece of equipment.

2. Provide training on maintaining the system.
3. Explain means of disconnecting the system, and principals of operation and safety.

END OF SECTION

SECTION 26 43 00
SURGE PROTECTION DEVICES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. This section describes materials and installation requirements for low voltage surge protection devices (SPD) for the protection of all AC electrical circuits. SPD equipment to be installed at designated service entrance equipment, distribution panels, electronic equipment, and receptacle devices.

1.2 QUALITY ASSURANCE

A. The specified unit shall be designed, manufactured, tested and installed in compliance with the above references. The unit shall be "Listed by Underwriters Laboratories" to UL 1449.

B. Each unit shall be designed and manufactured by a qualified manufacturer of power conditioning equipment. The qualified manufacturer must have been engaged in the design and manufacturer of such products for a minimum of five years.

1.3 REFERENCES

A. ANSI/IEEE C62.33 – IEEE Guide on Testing of MOV components

B. ANSI/IEEE C62.35 – IEEE Guide on Testing of SAD components

C. ANSI/IEEE C62.41 - IEEE Recommended Practice on Surge Voltage in Low Voltage AC Power Circuits

D. ANSI/IEEE C62.45 - IEEE Guide on Surge Testing for Equipment Connected to Low Voltage AC Power Circuits

E. ANSI/UL 1449 Third Edition (Version 3.0) - UL Standard for Safety for Surge Protective Devices

F. CBEMA – Computer Business Equipment Manufacturers Association

G. IEC 664 – International Engineering Consortium, Standard for Clamping Voltage

H. National Electrical Code 285 - Surge Protection Devices

I. NFPA 70 - National Electrical Code

J. UL 67 – Listed for Internal Panelboard Transient Voltage Surge Suppressors

K. UL 96A – Devices listed as approved for secondary surge arrestors (VZCA)

L. UL 248-1 - Fusing

M. UL 1283 – Electromagnetic Interference Filters, Fifth Edition

1.4 SUBMITTALS

A. Shop Drawings: Should include device dimensions, mounting requirements including wire size and over-current protection device rating, nameplate nomenclature, electrical ratings, short circuit current rating, and test results as indicated below under "Testing, Warranty and Life Expectancy" as provided by an independent test lab or a UL certified test lab for the category(ies) of suppression device(s) specified using the appropriate IEEE test wave. Product data sheets with installation instructions for each size and type of device are required. Shop drawings submitted without the testing data as required by section this section will be rejected.

B. Fuse information: Provide fuse information if required for operation. Include size, manufacturer, time-current chart responses to UL 1449 testing requirements, maximum surge protection capability per mode and phase as limited by the fuse, and verification of repetitive surge protection device operation without system degeneration greater than 10%.

1.5 SPARE PARTS

A. Fuses: Furnish to the Owner 3 spare fuses of each type and rating installed.

1.6 TESTING, WARRANTY AND LIFE EXPECTANCY

A. Manufacturer must provide independent testing on repetitive capability and maximum surge current rating of service entrance suppressor units. This shall be performed at a nationally recognized lab not affiliated with the manufacturer.

1. Single pulse surge current capacity: Single pulse surge current tested in a mode at rated surge currents.

2. Single pulse surge current capacity test: An initial UL 1449 defined 1.2 x 50µs, 6000V open circuit voltage waveform and an 8 x 20µs, 500A and 3kA short circuit current waveform shall be applied to benchmark the unit's suppression voltage (VPR).

3. A single 8 x 20µs waveform pulse of maximum rated surge current per mode shall then be applied. To complete the test, another UL 1449 surge shall be applied to verify the unit's survival. Survival is achieved if the suppression voltage measured from the two UL1449 surges does not vary by more than 10%.

B. Minimum Repetitive Surge Current Capacity:

1. Service entrance suppressor units should be tested repetitively at an independent lab to verify repetitive capacity.

2. Minimum Repetitive Surge Current Capacity Test:

a. An initial UL 1449 surge defined as 1.2 x 50µs, 6000V open circuit voltage waveform and an 8 x 20µs, 500A and 3kA short circuit current waveform shall be applied to benchmark the unit's suppression voltage.

b. A repetitive number of ANSI/IEEE C62.41.2-2002 (Category C3) surges, defined as a 1.2 x 50µs 10kV or 20kV open circuit voltage waveform and an 8 x 20µs 10,000A short circuit current waveform, shall then be applied at one-minute intervals.

c. To complete the test, another UL 1449 surge shall be applied to verify the unit's survival.

3. Survival is achieved if the suppression voltage (VPR) does not vary by more than 10%.

4. Proof of such testing shall be the test log generated by the surge generator.

C. Provide UL 1449 classification white sheet pages indicating the VPR (voltage protection rating) for each SPD unit submitted for this product using the 6kV/3kA combination wave surge.

D. Warranty: Ten (10) years. Includes workmanship, installation and programming.

PART 2 - PRODUCTS

2.1 DESCRIPTION

A. General: The unit shall provide transient voltage suppression, surge current diversion and high-frequency noise attenuation, when connected in parallel to the facilities distribution system. The unit MCOV shall not be less than 115% of the nominal system voltage. Operating frequency shall be for a 60 Hz system. The unit shall provide protection in all normal modes for "wye" and "delta" systems. The short circuit current rating shall be the larger of the listed value on the drawings or as required by the equipment protected.

2.2 RATINGS

A. **[SPD-1]:** Service Entrance Suppressors:

1. For 120/208 volt, 3 phase, 4 wire, type 2, category C3 unit.

    a. Surge current capacity: 100,000/200,000 amps per protection mode/phase
    b. Nominal Discharge Current: 20 kA.
    c. Mounting: Refer to the drawings.
    d. Voltage Protection Rating: Refer to requirements below.
    e. Components: Minimum component size of 20mm metal oxide varistors (MOV).
    f. Disconnect: Surge-rated disconnect with 200,000 SCCR.

2. Approved Manufacturers:

    a. Square D Surelogic EMA Series
    b. Siemens TPS3 Series
    c. Cutler Hammer SPD Series
    d. Current Technology Current Guard Plus
    e. Emerson Network Power 560 Series
    f. LEA International LSS Series

B. **[SPD-2]:** Secondary Distribution Suppressors:

1. For 120/208 volt, 3 phase, 4 wire, type 2, category B3/C1 unit.

    a. Surge current capacity: 60,000/120,000 amps per protection mode/phase
    b. Nominal Discharge Current (I_N): 20 kA.
    c. Mounting: Refer to the drawings.
    d. Voltage Protection Rating: Refer to requirements below.
    e. Components: Minimum component size of 20mm metal oxide varistors (MOV).

2. Approved Manufacturers:

    a. Square D Surgelogic EMA Series
    b. Siemens/APT TPS3 Series
    c. Cutler Hammer SPD Series
    d. Current Technology Current Guard Plus
    e. Emerson Network Power 510 Series
    f. LEA International CFS Series

C. Voltage Protection Rating:

1. Protection modes and UL 1449 voltage protection rating for surge suppression units per each mode (L-N, L-L, L-G, and N-G as appropriate).

    a. 120/208 Volt, 3 phase, 4 wire. 700 Volt L-N, N-G, 800 Volt L-G and 1200 Volt L-L

D. Critical Load Protection – Fixed Equipment:

1. For 120 volt, 1 phase, 3 wire, type 3, category A3 unit.

a. Surge current capacity (I_N): 15,000/30,000 amps per protection mode/phase

b. Mounting: External, NEMA 12 enclosure

c. Components: Nonmodular units composed of 20mm Metal Oxide Varistors (MOV). Series inductors, SAD, or selenium cells may be used in addition to MOVs.

d. Protection modes and UL 1449 clamping voltage: 475 Volt L-N, L-G, and N-G.

E. Receptacles:

1. For 120 volt, 1 phase, 3 wire, type 3, category A3 unit.

a. Surge current capacity (I_N): 12,000 amps per protection mode.

b. Components: 20mm MOV

c. Maximum Continuous Operating Voltage: 150 Volts

2. Refer to Specification Section 26 27 26 for additional receptacle construction information.

F. EMI/RFI Noise Rejection or Filtering:

1. Each unit shall include a UL1283 first order, high-frequency filter for noise filtering between 10 KHz and 100 MHz.

G. Indication:

1. Each unit shall include solid-state indicators with externally mounted LED visual status indicators that indicate on-line status of each protection mode of the unit.

2. Provide each service entrance secondary distribution type unit(s) with a transient counter.

3. Each unit shall contain form “C” contacts for remote indication of an alarm status.

H. Fuses:

1. Use fuses recommended by the manufacturer to satisfy repetitive UL 1449 operation of the surge suppression unit.

2. Fuses shall be rated 200, 000 AIC minimum interrupting capacity.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine equipment for size and type of surge protection device to be used to ensure physical compatibility.

B. Inspect surge protection device for any signs of physical damage due to shipping or handling before installing surge protection device.

3.2 INSTALLATION

A. Mounting Location:

1. The unit shall be installed as close as practical to the panel secondary lugs in accordance with applicable national/Local Electrical Codes and the manufacturer's recommended installation instructions. Connect the unit to the panel using a conduit nipple. Flush mount the unit in the front of the switchboard. Mount unit directly across from the breaker or disconnect serving it.

2. If internal surge protection device is specified, device shall be installed in a barrier compartment isolated from other components.

B. Connections:

1. Contractor shall provide wire and circuit breakers sized per the approved manufacturer's requirements. Maximum lead length from protected bus to surge protection device shall be per manufacturer's requirements, but no greater than 5'-0".

2. The surge protection unit shall be isolatable from the electrical distribution system via 3 pole circuit breaker mounted in the switchboard/panelboard. Single phase 120 volt units shall be hardwired without a disconnecting means.

3. Neutral and ground shall not be bonded together at secondary panelboard locations.

C. Additional Locations: Critical Load Protection – Fixed Equipment (120 Vac):

1. Install an A3 hard-wired surge protection device between each of the following equipment items and its power supply conductors.

   a. Fire alarm master panel
   b. Phone switch
   c. Intercom master
   d. Building management system master
   e. Security system master
   f. Telephone switch
   g. TV head

D. General:

1. Check unit for proper operation of protection and indication under start-up.

2. Check unit to ensure all MOVs for each mode of protection are operational. Verify integral fuse links are operational and have not melted.

3. Surge suppression devices shall not be installed ahead of the main service disconnect(s).

4. Install fuses in all fuse holders and fused disconnects internal to the surge protection unit. Use fuses recommended by the manufacturer to satisfy repetitive UL 1449 operation of the surge suppression unit. External fusing of the surge protection device is not allowed.

5. Coordinate location of surge protection device to allow adequate clearances for maintenance.

END OF SECTION

SECTION 26 51 00
LIGHTING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Interior luminaires and accessories
B. Exterior luminaires and accessories
C. Lamps
D. Ballasts
E. Poles

1.2 REFERENCES

A. ANSI C78.377-2008 – Specifications for the Chromaticity of Solid State Lighting Products

B. ANSI C82.77-2002 – Standard for Harmonic Emission Limits and Related Power Quality Requirements for Lighting Equipment

C. IEEE C2 - National Electrical Safety Code

D. Project site classification as defined in IESNA RP-33 LZ2

1.3 SUBMITTALS

A. Submit product data under provisions of Section 26 05 00.

B. Submit product data sheets for luminaires, lamps, drivers and poles. Include complete product model number with all options as specified. Submittal shall be arranged with fixtures listed in ascending order, and with each luminaire's associated lamp, ballast, driver, or pole information following luminaire's product data. Failure to organize submittal in this manner will result in the submittal being rejected.

C. Submit lens product data, dimensions and weights if not included in product data sheet submittal.

D. Include outline drawings, support points, weights, and accessory information for each luminaire type.

E. Submit utility rebate forms, where offered at project location, with rebate items completed.

F. LED luminaire submittals shall include photometric report per IESNA LM-79-08 for the latest generation system being furnished, including independent testing laboratory name, report number, date, luminaire model number, input wattage, luminaire, and light source specifications. Manufacturer origin of LED chipset and driver shall be submitted.

G. For all LED luminaires specified as dimmer controlled, submit dimmer device data that is approved by manufacturer of submitted luminaire and that Contractor proposes to furnish and install. Contractor is responsible for verifying that installed dimming controls are compatible with and approved by the luminaire manufacturer.

H. LEED Requirements:

1. Light Pollution Reduction:

a. Exterior Luminaires: Submit manufacturer data showing percentage of light lumens emitted at or above 90° from nadir for each luminaire type.

1.4 EXTRA STOCK

A. Provide extra stock under provisions of Section 26 05 00.

B. Fixtures: One (1) fixture of each type listed in the Luminaire Schedule.

C. LED Light Engines or Modules: Three (3) percent of quantity installed, minimum of one (1) of each size and type.

D. Lenses: Three (3) percent of quantity installed, minimum of one (1) of each size and type.

E. LED replacement lamps: Three (3) percent of quantity installed, minimum of one (5) of each size and type.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site. Store and protect under provisions of Section 26 05 00.

B. Protect luminaire finishes, lenses, and trims from damage during storage and installation. Do not remove protective films until construction cleanup within each area is complete.

C. Handle site lighting poles carefully to prevent breakage and damage to finish.

1.6 WARRANTY

A. Light emitting diode (LED) light engines and drivers shall have a ten-year warranty from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 INTERIOR LUMINAIRES AND ACCESSORIES - GENERAL

A. Lensed Troffers: Provide hinged frames with latches and 0.125 inch thick virgin acrylic lenses. Prismatic lenses shall have depth of no less than 0.080", KSH12 or equal. Other lenses as scheduled.

B. Recessed Luminaires: Confirm ceiling and wall type and furnish trim and accessories necessary to permit proper installation in each system. Where fire-rated ceiling or wall assemblies are specified, furnish and install listed enclosures around luminaires that maintain the system rating.

C. Suspended Luminaires: Coordinate power feed and suspension canopies with ceiling type and architectural RCP for proper fit and location. Ensure finished installations are plumb and level at elevations specified.

D. Exit Signs: Stencil face, 6 inch high letters, directional arrows as indicated, universal mounting type as indicated on the drawings.

E. Self-Powered Emergency Lighting Units: One-piece, self-contained unit with sealed, maintenance-free nickel cadmium battery, automatic charger and electronic circuitry. Relay automatically energizes lamp from battery when circuit voltage drops to 80 percent of nominal voltage or below. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.

F. Painted reflector surfaces shall have a minimum reflectance of 90%.

G. All painted components shall be painted after fabrication.

2.2 EXTERIOR LUMINAIRES AND ACCESSORIES - GENERAL

A. Listed for wet or damp location as scheduled. Fountain and pool luminaires shall be listed for submersible location to meet depth specified.

B. Provide low temperature ballasts or LED drivers, with reliable starting to -20°F.

C. In-grade luminaires shall have lamp/optic separation to prevent surface temperature from exceeding 115°F. Compartment separation of wire entry and control gear/lamp chamber.

2.3 LIGHT EMITTING DIODE (LED) LUMINAIRE SYSTEMS

A. Light emitting diodes used in interior applications shall have a minimum color rendering index (CRI) of 80. Light emitting diodes used in exterior applications shall have a minimum color rendering index (CRI) of 70. Color temperature of the luminaires shall be as noted on the luminaire schedule.

B. LED chip arrays specified as color changing shall have chip colors as noted on the luminaire schedule.

C. LED chips shall be wired so that failure of one chip does not prohibit operation of the remainder of the chip array.

D. LED Driver:

1. Solid state driver with integral heat sink. Driver shall have overheat, short-circuit and overload protection, power factor 0.90 or above and maximum total harmonic distortion of 20%. Surge suppression device for all exterior luminaires.

2. Drivers shall have dimming capabilities as outlined in the luminaire schedule for each luminaire type.

3. Driver shall have a minimum of 50,000 hours rated life.

2.4 ACCEPTABLE MANUFACTURERS - POLES

A. Manufacturer of Luminaire.
B. Valmont Poles.
C. U. S. Pole Company.
D. KW Industries

2.5 LIGHTING POLES

A. Metal Poles: Size and type as noted on drawings.

B. Wind Load: 100 MPH velocity, with 1.3 gust factor with luminaires and brackets mounted.

C. Hand Hole: 2 x 4 inches with removable weatherproof cover installed at manufacturer's standard location. Provide matching gasketed cover plate.

D. Pole Top: Provide slipfitter.

E. Anchor Bolts: As recommended by pole manufacturer. Provide template, flat washers, lock washers, and hex nuts for each pole. Grout between anchor plate and concrete base with non-shrink grout after pole is plumbed.

F. Vibration Damper: Canister or snake type second mode vibration damper internal to the pole as recommended by pole manufacturer. Provide additional pole top damper for first mode vibration on single-head poles where recommended by manufacturer.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Securely fasten luminaires to the listed and labeled ceiling framing member by mechanical means such as bolts, screws, rivets or listed clips identified for use with the type of ceiling framing members. If ceiling framing is not listed for luminaire size or weight, support luminaires independent of ceiling grid with a minimum of two (2) #12 gauge wires located on diagonal corners.

B. Install recessed flanged luminaires to permit removal from below. Use manufacturer-supplied plaster frames and swing gate supports. Support luminaires independent of ceiling with a minimum of two (2) #12 gauge wires located on diagonal corners.

C. Support surface-mounted luminaires directly from building structure. Install luminaires larger than eight square feet (8 ft^2) or weighing more than 30 pounds independent of ceiling framing.

D. Support suspended or pendant mounted luminaires independent of ceiling grid with a minimum of two #12 gauge wires. Suspension assembly and anchors shall be capable of supporting 300 pounds dead load at each suspension point.

E. Install lamps in lamp holders of luminaires.

F. Adjust aimable luminaires to obtain lighting levels on objects and areas as directed to obtain desired lighting levels.

G. Parabolic louvers and other optical accessories shall remain in protective wraps or films until construction in area is complete and area has been cleaned.

H. Industrial Pendant Luminaires: Use hangers rated 500 pounds minimum or provide safety chain between ballast and structure. Provide safety chain between reflector and ballast.

I. Luminaire Pole Bases: Sized and constructed as indicated on the drawings. Project anchor bolts 2 inches minimum above base. Install poles plumb with double nuts for adjustment. Grout around pole anchor base.

J. Use belt slings or non-chafing ropes to raise and set pre-finished luminaire poles.

3.2 RELAMPING

A. Replace failed lamps at completion of work.

3.3 ADJUSTING AND CLEANING

A. Align luminaires and clean lenses and diffusers at completion of work. Clean paint splatters, dirt, and debris from installed luminaires.

B. Touch up luminaire and pole finish at completion of work.

3.4 LUMINAIRE SCHEDULE

A. As shown on the drawings.

END OF SECTION

SECTION 26 52 00
EMERGENCY LIGHTING EQUIPMENT

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Emergency lighting units with self-test capability
B. Emergency exit signs with self-test capability
C. Emergency fluorescent lamp power supplies
D. Emergency inverters for LED
E. Emergency transfer devices

1.2 REFERENCES

A. FS W-L-305 - Light Set, General Illumination (Emergency or Auxiliary)

B. NFPA 101 - Code for Safety to Life from Fire in Buildings and Structures

C. UL 924 – Emergency Lighting and Power Equipment

1.3 SUBMITTALS

A. Submit shop drawings under provisions of Section 26 05 00.

B. Provide product data on emergency lighting units, exit signs, emergency inverters, and emergency fluorescent lamp power supply units.

1.4 REGULATORY REQUIREMENTS

A. Conform to NFPA 101 for installation requirements.

PART 2 - PRODUCTS

2.1 INCANDESCENT EMERGENCY LIGHTING UNITS

A. Emergency Lighting Unit: Self-contained unit with rechargeable storage batteries, charger, and lamps.

B. Battery: Maintenance free lead calcium type, with 1.5 hour capacity to supply the connected lamp load.

C. Charger: Dual-rate solid state charger, capable of maintaining the battery in a full-charge state during normal conditions, and capable of recharging discharged battery to full charged within 168 hours. Low voltage disconnect to prevent deep discharge of battery.

D. Lamps: As scheduled on luminaire schedule.

E. Remote Lamps: Match lamps on unit.

F. Indicators: Provide lamps to indicate AC ON and RECHARGING.

G. Provide test switch to transfer unit from normal supply to battery supply.

H. Electrical Connection: Knockout for conduit connection.

I. Unit Voltage: 120 volts, AC.

J. Unit shall be self-diagnostic with continuous monitoring of charger performance and battery voltage. Any malfunction of battery, charger, transfer circuit or emergency lamps shall be detected and visually indicated.

K. Unit shall be programmed to exercise the battery and test emergency operation by performing a five minute discharge/diagnostic cycle every 6 months. A manual test switch shall allow a five minute discharge/diagnostic test at any time.

L. Warranty: Emergency lighting unit shall have a full three (3) year, non-prorated warranty.

2.2 SELF-CONTAINED EMERGENCY POWER EXIT SIGNS

A. Type: Exit signs with integral battery-operated emergency power supply, including power failure relay, test switch, AC ON pilot light, battery, and fully-automatic two-rate charger.

B. Battery: Sealed lead acid or lead calcium cell, requiring no maintenance or replacement for 10 years under normal conditions.

C. Directional Indicators: The directional indicator for exit signage shall be of a chevron type meeting all requirements of NFPA 101.

D. Unit shall be self-diagnostic with continuous monitoring of charger performance and battery voltage. Any malfunction of battery, charger, transfer circuit or emergency lamps shall be detected and visually indicated.

E. Unit shall be programmed to exercise the battery and test emergency operation by performing a five minute discharge/diagnostic cycle every 6 months. A manual test switch shall allow a five minute discharge/diagnostic test at any time.

2.3 ACCEPTABLE MANUFACTURERS - EMERGENCY BALLASTS AND INVERTERS

A. Philips/Bodine.
B. Dual-Lite.
C. Iota.

2.4 EMERGENCY INVERTER – LED LAMPS UP TO 20 WATTS

A. Unit: Self-contained, with automatic transfer to battery supply on loss of normal power, UL 924 listed for factory or field installation in indoor and damp locations.

B. Battery: Sealed, high temperature, maintenance free, nickel cadmium battery with capacity to provide 90 minutes of emergency operation, with 24-hour recharge time, seven (7) year minimum battery life expectancy.

C. Features: Integral battery charger with LED charging indicator light, test switch, electronic circuitry for use with ballasts, and LED drivers. Output of inverter shall be sinusoidal with solid-state low voltage disconnect circuit.

D. Inverter to be mounted remote and adjacent to luminaire shown on drawings. Inverter to be accessible from below ceiling through luminaire opening.

E. Charging indicator LED and test switch to be mounted in remote test/monitor plate provided with inverter.

F. Inverter capable of operating a switched, dimmed or unswitched luminaire up to 20 watts with full lumen output.

G. Warranty: Emergency inverter shall have a full five (5) year, non-prorated warranty.

2.5 EMERGENCY LED DRIVER

A. Unit: Self-contained, with automatic transfer to battery supply on loss of normal power, UL 924 listed for factory or field installation in indoor and damp locations.

B. Battery: Sealed, high temperature, maintenance free, nickel cadmium battery with capacity to provide 90 minutes of emergency operation, with 24-hour recharge time, seven (7) year minimum battery life expectancy.

C. Features: Integral battery charger with LED charging indicator light, test switch, and electronic circuitry for use with LED drivers.

D. Inverter to be mounted remote and adjacent to luminaire shown on drawings. Inverter to be accessible from below ceiling through luminaire opening.

E. Charging indicator LED and test switch to be mounted in remote test/monitor plate.

F. Inverter capable of operating a switched, dimmed, or unswitched luminaire up to 7 watts at a rated current of 270mA.

G. Warranty: Emergency inverter shall have a full five (5) year, non-prorated warranty.

2.6 EMERGENCY TRANSFER DEVICES

A. Loss of power on normal circuit shall switch load to emergency power source.

B. Provide suitable NEMA 1 enclosure and mounting per manufacturer specification.

C. **[ETD]**: Emergency Lighting Control Override - Single Luminaire:

1. Rated 2 amps at 120 volt incandescent and 10 amps at 277 volt fluorescent.

2. Approved Manufacturers: Bodine GTD, Iota ETS, Watt Stopper ELCU-100.

D. **[ETD-2]**: Emergency Lighting Control Override - Branch Loads:

1. Rated 1000 watts at 120 volt incandescent and 20 amp at 277 volt fluorescent.

2. Approved Manufacturers: Bodine GTD20, Chloride Lightstar, Dual-Lite ATSD, Nine24 BLTC, Highlites HEPC.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install units plumb and level.

B. Aim directional lampheads as directed.

C. Test emergency lighting equipment for 60 minutes to determine proper operation, prior to substantial completion. Provide typewritten periodic test log form to Owner's representative. Explain and instruct Owner's representative of requirements for testing and maintenance.

END OF SECTION

SECTION 26 52 15
EMERGENCY POWER SUPPLY

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Emergency power supply **[LIV-1]**

1.2 QUALITY ASSURANCE

A. Manufacturer: Company specializing in battery-inverter power supplies with three (3) years documented experience.

1.3 SUBMITTALS

A. Submit product data under provisions of Section 26 05 00.

B. Indicate unit ratings, dimensions, and finishes. Include performance data for batteries.

C. Submit manufacturer's installation instructions under provisions of Section 26 05 00.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site under provisions of Section 26 05 00.

B. Store and protect products under provisions of Section 26 05 00.

1.5 REGULATORY REQUIREMENTS

A. Listed to UL 924.Emergency Lighting and Power Equipment.

B. Compliance with NFPA 101 Life Safety Code.

1.6 SYSTEM DESCRIPTION

A. System Configuration: Emergency power supply consisting of rectifier/charger unit, storage battery, and solid state inverter in one or several enclosures.

B. Operating Sequence: When utility power is available, it supplies load through transfer switch, and battery charger maintains battery charge. If utility fails, load is transferred to battery-powered inverter. When utility is restored, load is retransferred and battery charger restores battery charge.

1.7 OPERATION AND MAINTENANCE DATA

A. Submit data under provisions of Section 26 05 00.

B. Include battery maintenance and unit testing procedures.

1.8 WARRANTY

A. Warranty: The manufacturer shall warrant the inverter for a period of 12 months after Substantial Completion. Provide 10 year pro-rated warranty on battery under provisions of Section 26 05 00, pro-rated after first year on straight line basis.

B. Include coverage of travel, labor, parts and service.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Dual-Lite - Hubbell Lighting Inc.
B. Philips Chloride.
C. Lithonia Lighting EAC Series.
D. Perfect Power Systems.

2.2 EMERGENCY LIGHTING INVERTER [LIV-1]

A. Inverter: Uninterruptible double-conversion IGBT type. Unit suitable for operating HID lamps or LED drivers without extinguishing lamp on transfer.

B. Input Voltage: 208 volts, 60 Hertz, three phase +/-10%.

C. Output Power: 4800 VA at 0.8 power factor.

D. Output Voltage: 120/208 volts ± 2 percent, three phase 4 wire.

E. Inverter Output Frequency: 60 Hertz ± 1 percent.

F. Maximum Recharge Time: 12 hours following 1.5 hour discharge.

G. Total Harmonic Distortion: Less than 5 percent at full linear load.

H. Battery Operating Time: 1.5 hours at full load and within output voltage limits.

I. Battery: Lead calcium, sealed maintenance-free type. Low voltage battery disconnect protects the battery from “deep discharge” during prolonged power outages.

J. Charger: Dual rate, designed to maintain battery in full-charge condition during normal conditions.

K. Self-test/Self-diagnostics: Automatically perform and log monthly1 minute test and annual 60 minute test.

L. Accessories: Provisions for remote monitoring via RS232 interface.

2.3 REMOTE STATUS MONITORING

A. Indicators: Common derangement lamp and audible tone. Include silence switch arranged for ring back feature.

B. Enclosure: Surface mounted with factory finish.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install units plumb and level with required clearances.

B. Provide interconnection between cabinets.

1 **3.2 MANUFACTURER'S FIELD SERVICES**

2 A. Provide manufacturer's field services under provisions of Section 26 05 00.

3 B. Include services of technician to supervise adjustments, final connections, and system start-up.

4 **END OF SECTION**

SECTION 27 05 00
BASIC COMMUNICATIONS SYSTEMS REQUIREMENTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Basic Communications Systems Requirements specifically applicable to Division 27 sections, in addition to Division 1 - General Requirements.

1.2 SCOPE OF WORK

A. This Specification and the accompanying drawings govern the work involved in furnishing, installing, testing and placing into satisfactory operation the Communications Systems as shown on the drawings and specified herein.

B. Each Contractor shall provide all new materials as indicated in the schedules on the drawings, and/or in these specifications, and all items required to make their portion of the Communications Systems a finished and working system.

C. Description of Systems include but are not limited to the following:

1. Complete Structured Cabling System including, but not limited to:

    a. Voice and data horizontal cabling and terminations.
    b. Information outlets (IO's) including faceplates, jacks and labeling.
    c. Equipment racks, cabinets, cable management and equipment.
    d. Telecommunication Room equipment including patch panels, and termination blocks.
    e. Cabling pathways.
    f. Grounding and Bonding
    g. Testing

2. Low Voltage Communications Wiring (less than +120VAC) as specified and required for proper system control and communications.

3. All associated electrical backboxes, conduit, miscellaneous cabling, and power supplies required for proper system installation and operation as defined in the "Suggested Matrix of Scope Responsibility".

1.3 OWNER FURNISHED PRODUCTS

A. Network electronics (software and hardware devices), wireless access points and cross connects.

1.4 DIVISION OF WORK BETWEEN ELECTRICAL AND COMMUNICATIONS CONTRACTORS

A. Division of work is the responsibility of the Prime Contractor. Any scope of work described in the contract document shall be sufficient for including said requirement in the project. The Prime Contractor shall be solely responsible for determining the appropriate subcontractor for the described scope. In no case, shall the project be assessed an additional cost for scope that is described in the contract documents. The following division of responsibility is a guideline based on typical industry practice.

B. Definitions:

1. "Electrical Contractor" as referred to herein refer to the Contractors listed in Division 26 of this Specification.

2. "Electrical Contractor" shall also refer to the Contractor listed in Division 27 of this specification when the "Suggested Matrix of Scope Responsibility" indicates the work shall be provided by the EC. Refer to the Contract Documents for the "Suggested Matrix of Scope Responsibility".

3. "Communications Contractor" as referred to herein refer to the Contractors listed in Division 27 of this Specification.

4. Low Voltage Communications Wiring: The wiring (less than 120VAC) associated with the Communications Systems, used for analog and/or digital signals between equipment.

5. Telecommunications Rough-in: Relates specifically to the backboxes, necessary plaster rings and other miscellaneous hardware required for the installation and mounting of the telecommunications information outlet. Rough-in shall include conduit from the information outlet backbox to above the lay-in ceiling. Where surface mounted backboxes are required, conduit shall be routed to above the lay-in ceiling the bottom of the exposed structural joists the nearest cable tray.

C. General:

1. The purpose of these Specifications is to outline typical Electrical and Communications Contractor's work responsibilities as related to Communications Systems including Telecommunications rough-in, conduit, cable tray, power wiring and Low Voltage Communications Wiring. The prime contractor is responsible for all divisions of work.

2. The exact wiring requirements for much of the equipment cannot be determined until the systems have been purchased and submittals are approved. Therefore, only known wiring, conduits, raceways, and electrical power as related to such items, is shown on the Communications Drawings. Other wiring, conduits, raceways, junction boxes, and electrical power not shown on the Communications Drawings but required for the successful operation of the systems shall be the responsibility of the Communications Contractor and included in the Contractor's bid.

3. Where the Electrical Contractor is required to install conduit, conduit sleeves and/or power connections in support of Communications systems, the final installation shall not begin until a coordination meeting between the Electrical Contractor and the Communications Contractor has convened to determine the exact location and requirements of the installation.

4. Where the Electrical Contractor is required to install cable tray that will contain Low Voltage Communications Wiring, the installation shall not begin until the Communications Contractor has completed a coordination review of the cable tray shop drawing.

5. This Contractor shall establish Electrical and Communications utility elevations prior to fabrication and installation. The Communications Contractor shall cooperate with the Electrical Contractor and the determined elevations in accordance with the guidelines below. This Contractor shall coordinate utility elevations with other trades. When a conflict arises, priority shall be as follows:

    a. Lighting Fixtures
    b. Gravity Flow Piping, including Steam and Condensate
    c. Sheet Metal
    d. Electrical Busduct
    e. Cable Trays, including 12" access space
    f. Sprinkler Piping and other Piping
    g. Conduit and Wireway
    h. Open Cabling

D. Electrical Contractor's Responsibility:

1. Assumes all responsibility for all required conduit and power connections when shown on the "Suggested Matrix of Scope Responsibility" to be provided by the Electrical Contractor.

2. Assumes all responsibility for providing and installing cable tray.

3. Responsible for Communications Systems grounding and bonding.

4. This Contractor is responsible for coordination of utilities with all other Contractors. If any field coordination conflicts are found, the Contractor shall coordinate with other Contractors to determine a viable layout.

E. Communications Contractor's Responsibility:

1. Assumes all responsibility for the Low Voltage Communications Wiring of all systems, including cable support where open cable is specified.

2. Assumes all responsibility for all required backboxes, conduit and power connections not specifically shown as being provided by the Electrical Contractor on the "Suggested Matrix of Scope Responsibility."

3. Assumes all responsibility for providing and installing all ladder rack and other cable management hardware (as defined in here-in).

4. Responsible for providing the Electrical Contractor with the required grounding lugs or other hardware for each piece of Communications equipment which is required to be bonded to the Communications ground system.

5. This Contractor is responsible for coordination of utilities with all other Contractors. If any field coordination conflicts are found, the Contractor shall coordinate with other Contractors to determine a viable layout.

1.5 COORDINATION DRAWINGS

A. Definitions:

1. Coordination Drawings: A compilation of the pertinent layout and system drawings that show the sizes and locations, including elevations, of system components and required access areas to ensure that no two objects will occupy the same space.

a. Mechanical trades shall include, but are not limited to, mechanical equipment, ductwork, fire protection systems, plumbing piping, medical gas systems, hydronic piping, steam and steam condensate piping, and any item that may impact coordination with other disciplines.

b. Electrical trades shall include, but are not limited to, electrical equipment, conduit 1.5" and larger, conduit racks, cable trays, pull boxes, transformers, raceway, busway, lighting, ceiling-mounted devices, and any item that may impact coordination with other disciplines.

c. Technology trades shall include, but are not limited to, technology equipment, racks, conduit 1.5" and larger, conduit racks, cable trays, ladder rack, pull boxes, raceway, ceiling-mounted devices, and any item that may impact coordination with other disciplines.

d. Maintenance clearances and code-required dedicated space shall be included.

e. The coordination drawings shall include all underground, underfloor, in-floor, in chase, and vertical trade items.

2. The contractors shall use the coordination process to identify the proper sequence of installation of all utilities above ceilings and in other congested areas, to ensure an orderly and coordinated end result, and to provide adequate access for service and maintenance.

B. Participation:

1. The contractors and subcontractors responsible for work defined above shall participate in the coordination drawing process.

2. One contractor shall be designated as the Coordinating Contractor for purposes of preparing a complete set of composite electronic CAD coordination drawings that include all applicable trades, and for coordinating the activities related to this process. The Coordinating Contractor for this project shall be the Mechanical Contractor.

   a. The Coordinating Contractor shall utilize personnel familiar with requirements of this project and skilled as draftspersons/CAD operators, competent to prepare the required coordination drawings.

3. Electronic CAD drawings shall be submitted to the Coordinating Contractor for addition of work by other trades. IMEG Corporation will provide electronic file copies of ventilation drawings for contractor's use if the contractor signs and returns an "Electronic File Transfer" waiver provided by IMEG Corporation. IMEG Corporation will not consider blatant reproductions of original file copies an acceptable alternative for coordination drawings.

C. Drawing Requirements:

1. The file format and file naming convention shall be coordinated with and agreed to by all contractors participating in the coordination process and the Owner.

   a. Scale of drawings:

      1) General plans: 1/4 Inch = 1 '-0" (minimum).

      2) Mechanical, electrical, communication rooms, and including the surrounding areas within 10 feet: 1/2 Inch = 1'-0" (minimum).

      3) Shafts and risers: 1/2 Inch = 1'-0" (minimum).

      4) Sections of shafts and mechanical and electrical equipment rooms: 1/4 Inch = 1 '-0" (minimum).

      5) Sections of congested areas: 1/2 Inch = 1'-0" (minimum).

2. Ductwork layout drawings shall be the baseline system for other components. Ductwork layout drawings shall be modified to accommodate other components as the coordination process progresses.

3. There may be more drawings required for risers, top and bottom levels of mechanical rooms, and shafts.

4. The minimum quantity of drawings will be established at the first coordination meeting and sent to the A/E for review. Additional drawings may be required if other areas of congestion are discovered during the coordination process.

D. General:

1. Coordination drawing files shall be made available to the A/E and Owner's Representative. The A/E will only review identified conflicts and give an opinion, but will not perform as a coordinator.

2. A plotted set of coordination drawings shall be available at the project site.

3. Coordination drawings are not shop drawings and shall not be submitted as such.

4. The contract drawings are schematic in nature and do not show every fitting and appurtenance for each utility. Each contractor is expected to have included in his/her bid sufficient fittings, material, and labor to allow for adjustments in routing of utilities made necessary by the coordination process and to provide a complete and functional system.

5. The contractors will not be allowed additional costs or time extensions due to participation in the coordination process.

6. The contractors will not be allowed additional costs or time extensions for additional fittings, reroutings or changes of duct size, that are essentially equivalent sizes to those shown on the drawings and determined necessary through the coordination process.

7. The A/E reserves the right to determine space priority of equipment in the event of spatial conflicts or interference between equipment, piping, conduit, ducts, and equipment provided by the trades.

8. Changes to the contract documents that are necessary for systems installation and coordination shall be brought to the attention of the A/E.

9. Access panels shall preferably occur only in gypsum board walls or plaster ceilings where indicated on the drawings.

   a. Access to mechanical, electrical, technology, and other items located above the ceiling shall be through accessible lay-in ceiling tile areas.

   b. Potential layout changes shall be made to avoid additional access panels.

   c. Additional access panels shall not be allowed without written approval from the A/E at the coordination drawing stage.

   d. Providing additional access panels shall be considered after other alternatives are reviewed and discarded by the A/E and the Owner's Representative.

   e. When additional access panels are required, they shall be provided without additional cost to the Owner.

10. Complete the coordination drawing process and obtain sign off of the drawings by all contractors prior to installing any of the components.

11. Conflicts that result after the coordination drawings are signed off shall be the responsibility of the contractor or subcontractor who did not properly identify their work requirements, or installed their work without proper coordination.

12. Updated coordination drawings that reflect as-built conditions may be used as record documents.

1.6 QUALITY ASSURANCE

A. Telecommunications Structured Cabling System Standards:

1. All work and equipment shall conform to the most current ratified version of the following published standards unless otherwise indicated that draft standards are to be followed:

   a. TIA/EIA 569-A – Commercial Building Standard for Telecommunications Pathways and Spaces.

b. TIA/EIA 606 – Administration Standards for the Telecommunications Infrastructure of Commercial Buildings.

c. TIA/EIA 607 – Commercial Building Grounding and Bonding Requirements for Telecommunications.

d. ANSI/NECA 568 – Standard for Installing Commercial Building Telecommunications Cabling.

e. TIA/EIA 568-B – Commercial Building Telecommunications Cabling Standard

1) B.1 – Part 1: General Requirements

2) B.1-1 – Addendum 1: Minimum 4-Pair UTP and 4-Pair ScTP Patch Cable Bend Radius.

3) B.2 – Part 2: Balanced Twisted Pair Cabling Components.

4) B.2-1-2002– Addendum 1: Transmission Performance Specifications for 4-Pair 100 Ohm Category 6 Cabling.

f. UL 444 – Standard for Safety for Communications Cable.

g. NFPA 70 (NEC) – National Electrical Code.

h. NFPA 1221 – Standard for Installation, Maintenance and Use of Emergency Communications Systems

B. Refer to individual sections for additional Quality Assurance requirements.

C. Qualifications:

1. Only products of reputable manufacturers as determined by the Engineer will be acceptable.

2. The installing Contractor shall be certified by the manufacturer of the structured cabling system. Certification of Contractor shall have been in place for a minimum of one (1) year prior to bidding this project. Documentation of certification is required at the time of bid. Shop drawings will not be approved until proof of certification is submitted. Refer to the end of this specification section for certification documentation requirements.

3. Each Contractor and their subcontractors shall employ only workers who are skilled in their respective trades and fully trained. All workers involved in the termination of cabling shall be individually certified by the manufacturer.

4. The Contractor shall be experienced in all aspects of this work and shall be required to demonstrate direct experience on recent systems of similar type and size.

5. The Contractor shall own and maintain tools and equipment necessary for successful installation and testing of optical and copper structured cabling systems and have personnel adequately trained in the use of such tools and equipment.

6. The Contractor shall obtain the services of a RCDD (Registered Communications Distribution Designer) for the project. The RCDD shall perform the following tasks on the project:

a. Review contractor's submittals and stamp the submittals with a current RCDD stamp stating the submittals compliance with the contract documents.

7.

8. The Contractor shall have certified BICSI installation technicians on staff to perform the following tasks on the project:

   a. Act as the field superintendent or job foreman with the responsibility of monitoring the daily work of each technician.

   b. Oversee all testing and termination of cabling.

9. A resume of qualification shall be submitted with the Contractor's bid indicating the following:

   a. Documentation of certification of This Contractor by the proposed structured cabling system manufacturer as required at the end of this specification section.

   b. A list of recently completed projects of similar type and size with contact names and telephone numbers for each.

   c. A list of test equipment proposed for use in verifying the installed integrity of copper and fiber optic systems on the project.

   d. A technical resume of experience for the Contractor's project manager and on-site installation supervisor assigned to this project.

   e. Resume and certification of the BICSI installation technician for the project.

D. Compliance with Codes, Laws, Ordinances:

1. This Contractor shall conform to all requirements of the City of Madison, Wisconsin Codes, Laws, Ordinances and other regulations having jurisdiction over this installation.

2. In the event, there are no local codes having jurisdiction over this job, the current issue of the National Electrical Code shall be followed.

3. If there is a discrepancy between the codes and regulations having jurisdiction over this installation, and these specifications, the codes and regulations shall determine the method or equipment used.

4. If the Contractor notes, at the time of bidding, any parts of the drawings and specifications which are not in accordance with the applicable codes or regulations, he shall inform the Architect/Engineer in writing, requesting a clarification. If there is insufficient time to follow this procedure, he shall submit with the proposal, a separate price required to make the system shown on the drawings comply with the codes and regulations.

5. All changes to the system made after the letting of the contract, in order to comply with the applicable codes or the requirements of the Inspector, shall be made by the Contractor without cost to the Owner.

E. Permits, Fees, Taxes, Inspections:

1. Procure all applicable permits and licenses.

2. Abide by all applicable laws, regulations, ordinances, and other rules of the State or Political Subdivision wherein the work is done, or as required by any duly constituted public authority.

3. Pay all applicable charges for such permits or licenses that may be required.

4. Pay all applicable fees and taxes imposed by the State, Municipal and/or other regulatory bodies.

5. Pay all charges arising out of required inspections due to codes, permits, licenses or as otherwise may be required by an authorized body.

6. Pay all charges arising out of required contract document reviews associated with the project and as initiated by the Owner or authorized independent agency/consultant.

7. Pay any charges by the service provider related to the service or change in service to the project.

8. All equipment and materials shall be as approved or listed by the following (unless approval or listing is not applicable to an item by all acceptable manufacturers):

   a. Factory Mutual
   b. Underwriters' Laboratories, Inc.

F. Examination of Drawings:

1. The drawings for the Communications Systems work are diagrammatic, intended to convey the scope of the work and to indicate the general arrangements and locations of equipment etc., and the approximate sizes of equipment.

2. Contractor shall determine the exact locations of equipment and the exact routing of cabling so as to best fit the layout of the job. Scaling of the drawings will not be sufficient or accurate for determining this layout. Where a specific route is required, such route will be indicated on the drawings.

3. Where job conditions require reasonable changes in indicated arrangements and locations, such changes shall be made by the Contractor at no additional cost to the Owner.

4. If an item is either shown on the drawings, called for in the specifications or required for proper operation of the system, it shall be considered sufficient for including same in this contract.

5. The determination of quantities of material and equipment required shall be made by the Contractor from the drawings. Schedules on the drawings and in the specifications, are completed as an aid to the Contractor but where discrepancies arise, the greater number shall govern.

6. Where words "provide", "install", or "furnish" are used on the drawings or in the specifications, it shall be taken to mean, to furnish, install and terminate completely ready for operation, the items mentioned.

G. Electronic Media/Files:

1. Construction drawings for this project have been prepared utilizing Revit MEP.

2. Contractors and Subcontractors may request electronic media files of the contract drawings and/or copies of the specifications. Specifications will be provided in PDF format.

3. Upon request for electronic media, the Contractor shall complete and return a signed “Electronic File Transmittal” form provided by IMEG Corporation.

4. If the information requested includes floor plans prepared by others, the Contractor will be responsible for obtaining approval from the appropriate Design Professional for use of that part of the document.

5. The electronic contract documents can be used for preparation of shop drawings and as-built drawings only. The information may not be used in whole or in part for any other project.

6. The drawings prepared by IMEG Corporation for bidding purposes may not be used directly for ductwork layout drawings or coordination drawings.

7. The use of these CAD documents by the Contractor does not relieve them from their responsibility for coordination of work with other trades and verification of space available for the installation.

8. The information is provided to expedite the project and assist the Contractor with no guarantee by IMEG Corporation as to the accuracy or correctness of the information provided. IMEG Corporation accepts no responsibility or liability for the Contractor's use of these documents.

H. Field Measurements:

1. Before ordering any materials, this Contractor shall verify all pertinent dimensions at the job site and be responsible for their accuracy.

2. Field conditions that will result in telecommunications drops that exceed the length limitations identified in the contract documents shall be brought to the attention of the Engineer prior to installation. The cost of reworking cabling that is too long, that was not brought to the written attention of the Engineer will be borne entirely by the Contractor.

3. This Contractor shall provide the Engineer with written documentation of any cabling drops that will not be able to use the cable tray (where cable tray is available) due to the resulting cabling lengths. This documentation shall be submitted prior to installation and installation shall not commence until approved by the Engineer.

1.7 SUBMITTALS

A. Submittals shall be required for the following items, and for additional items where required elsewhere in the specifications or on the drawings.

1. Submittals list:

Referenced Specification Section	Submittal Item
27 05 26	Communications Bonding
27 05 28	Interior Communications Pathways
27 05 43	Exterior Communications Pathways
27 05 53	Identification and Administration
27 11 00	Communication Equipment Rooms
27 15 00	Horizontal Cabling Requirements
27 17 10	Testing

B. In addition to the provisions of Division 1, the following is required:

1. Submittals shall include all layout drawings; manufacturers' standard drawings; schedules; descriptive literature, catalogs and brochures; performance and test data; wiring diagrams; and all other drawings and descriptive data of materials of construction as may be required to show that the materials, equipment or systems and the location thereof conform to the requirements of the contract documents.

2. The Contractor shall submit an electronic copy of each shop drawing for review by the Architect/Engineer BEFORE releasing any equipment for manufacture or shipment.

3. Shop drawings which are larger than 11" x 17" or are plan size layout drawings such as wiring diagrams and cable tray drawings, shall be submitted on reproducible media. Submit one reproducible and one print of each drawing or plan. All Contractor approval stamps shall be made on the reproducible. The Architect/Engineer will return the reproducible copy of the shop drawings, complete with comments. This Contractor shall copy and distribute these reviewed shop drawings as required. All costs for copying and distribution of reproducible shop drawings shall be included by This Contractor in their bid.

4. The Contractor shall thoroughly review and approve all shop drawings before submitting them to the Architect/Engineer. CONTRACTOR'S APPROVAL STAMP IS REQUIRED ON ALL SUBMITTALS. APPROVAL WILL INDICATE THE CONTRACTOR'S REVIEW of all material and a COMPLETE UNDERSTANDING OF EXACTLY WHAT IS TO BE FURNISHED. Contractor shall clearly mark all deviations from the contract documents on all submittals. IF DEVIATIONS ARE NOT MARKED BY THE CONTRACTOR, THEN THE ITEM SHALL BE REQUIRED TO MEET ALL DRAWING AND SPECIFICATION REQUIREMENTS.

5. The Contractor shall provide RCDD stamp on the submittal.

6. The Contractor shall clearly mark each item with the same nomenclature applied on the drawings or in the specifications.

7. The Contractor shall clearly indicate the size, finish, material, etc.

8. All submittals shall be assembled in sets by system.

9. Each set shall be bound in a manufacturer's folder or inside of a manila file folder.

10. Each set shall contain an index of the items enclosed with a general topic description on the cover.

11. Where more than one model is shown on a manufacturer's sheet, the Contractor shall clearly indicate exactly which item and which data is relevant to the work.

12. Failure to comply with the above shall be reason to resubmit all shop drawing submittals.

13. The Engineer's responsibility shall be to review one set of shop drawing submittals for each product. If the first submittal is incomplete or does not comply with the drawings and/or specifications, the Contractor shall be responsible to bear the cost for the Engineer to recheck and handle the additional shop drawing submittals.

14. Provide documentation of all warranties required by the contract documents.

15. Submit copy of the Contractor certification form contained at the end of specification section.

C. Provide Schedule of Values for Technology Work:

1. Application forms: Use AIA Document Continuation Sheets G703 (or similar) as the form for application.

2. Provide line items on the Schedule of Values including:

   a. Structured Cabling
   b. Audio/Video Systems

3. Change orders shall have schedule of values broken out as listed above submitted with each change order.

4. Coordinate with the Project Engineer the items included in the Schedule of Values. The intent is to not create schedules in addition to those the Technology Contractor normally submits to the General Contractor for payment.

1.8 EQUIPMENT SUPPLIERS' INSPECTION

A. The following equipment shall not be placed in operation until a representative of the manufacturer has inspected the installation and certified that the equipment is properly installed and that the equipment is ready for operation:

1. Firestopping, including mechanical firestop systems.

1.9 PRODUCT DELIVERY, STORAGE, HANDLING & MAINTENANCE

A. Exercise care in transporting and handling to prevent damage to fixtures, equipment and materials.
B. Store materials on the site so as to prevent damage.
C. Keep fixtures, equipment and materials clean, dry and free from deleterious conditions.

1.10 WARRANTY

A. In addition to the provisions of Division 1, the following is required:

B. At a minimum, provide a one (1) year warranty for all equipment, materials, and workmanship. Individual specifications sections within Division 27 may require additional warranty requirements for specific equipment or systems.

C. Provide a structured cabling System Assurance Warranty as described herein.

D. The warranty period for the entire installation described in this Division of the specifications shall commence on the date of substantial completion unless a whole or partial system or any separate piece of equipment or component is put into use for the benefit of any party other than the installing contractor with prior written authorization. In this instance, the warranty period shall commence on the date when such whole system, partial system or separate piece of equipment or component is placed in operation and accepted in writing by the Owner or their representative.

E. Warranty requirements shall extend to correction, without cost to the final user, of all work and/or equipment found to be defective or nonconforming to the contract documents. The Contractor shall bear the cost of correcting all damage resulting from such defects or nonconformance with contract documents exclusive of repairs required as a result of improper maintenance or operation, or of normal wear as determined by the Architect/Engineer.

1.11 INSURANCE

A. This Contractor shall maintain insurance coverage as set forth in Division 1 of these specifications.

1.12 MATERIAL

A. Where several manufacturers' names are given, the first named manufacturer constitutes the basis for job design and establishes the equipment quality required to be used in this contract.

PRODUCTS

1.13 REFER TO INDIVIDUAL SECTIONS

PART 2 - EXECUTION

2.1 JOBSITE SAFETY

A. Neither the professional activities of the Engineer, nor the presence of the Engineer or his or her employees and sub-consultants at a construction site, shall relieve the Contractor and any other entity of their obligations, duties and responsibilities including, but not limited to, construction means, methods, sequence, techniques or procedures necessary for performing, superintending or coordinating all portions of the work of construction in accordance with the contract documents and any health or safety precautions required by any regulatory agencies. The Engineer and his or her personnel have no authority to exercise any control over any construction contractor or other entity or their employees in connection with their work or any health or safety precautions. The Contractor is solely responsible for jobsite safety. The Engineer and the Engineer's consultants shall be indemnified and shall be made additional insureds under the Contractor's general liability insurance policy.

2.2 GENERAL INSTALLATION REQUIREMENTS

A. Installation of all conduit and cabling shall comply with Sections 26 05 33 and 26 05 13. Additional conduit requirements described within this Division shall be supplemental to the requirement described in Section 26 05 33. Should conflicts exist between the two Divisions the more stringent (more expensive material and labor) condition shall prevail until bidding addendum or construction clarification or RFI can be submitted and responded to. In no case shall the Contractor carry the least stringent condition in the pricing.

B. It is the Contractor's responsibility to survey the site and include all necessary costs to perform the installation as specified.

C. All cables and devices installed in damp or wet locations, including any underground or underslab location, shall be listed as suitable for use in such environments. Follow manufacturer's recommended installation practices for installing cables and devices in damp or wet locations. Any cable or device that fails as a result of being installed in a damp or wet location shall be replaced at the Contractor's expense.

2.3 FIELD QUALITY CONTROL

A. General:

1. Refer to specific Division 27 sections for further requirements.

2. The Contractor shall conduct all tests required and applicable to the work both during and after construction of the work.

3. The necessary instruments and materials required to conduct or make the tests shall be supplied by the Contractor who shall also supply competent personnel for making the tests who has been schooled in the proper testing techniques.

4. In the event the results obtained in the tests are not satisfactory, This Contractor shall make such adjustments, replacements and changes as are necessary and shall then repeat the test or tests which disclose faulty or defective work or equipment, and shall make such additional tests as the Architect/Engineer or code enforcing agency deems necessary.

5. All telecommunications tests that fail, including those due to excessive cabling lengths, shall be remedied by the Contractor without cost to the project.

B. Protection of cable from foreign materials:

1. It is the Contractor's responsibility to provide adequate physical protection to prevent foreign material application or contact with any cable type. Foreign material is defined as any material that would negatively impact the validity of the manufacturer's performance warranty. This includes, but is not limited, to overspray of paint (accidental or otherwise), drywall compound, or any other surface chemical, liquid or compound that could come in contact with the cable, cable jacket or cable termination components.

2. Overspray of paint on any cable, cable jacket or cable termination component will not be accepted. It shall be the Contractor's responsibility to replace any component containing overspray, in its entirety, at no additional cost to the project. Cleaning of the cables with harsh chemicals is not allowed. This requirement is regardless of the PASS/FAIL test results of the cable containing overspray. Should the manufacturer and warrantor of the structured cabling system desire to physically inspect the installed condition and certify the validity of the structured cabling system (via a signed and dated statement by an authorized representative of the structured cabling manufacturer), the Owner may, at their sole discretion, agree to accept said warranty in lieu of having the affected cables replaced. In the case of plenum cabling, in addition to the statement from the manufacturer, the Contractor shall also present to the Owner a letter from the local Authority Having Jurisdiction stating that they consider the plenum rating of the cable to be intact and acceptable.

2.4 PROJECT CLOSEOUT

A. Refer to the Division 1 Section: PROJECT CLOSEOUT for requirements. The following paragraphs supplement the requirements of Division 1.

B. Final Jobsite Observation:

1. The Engineer will not perform a final jobsite observation until the project is ready. This is not dictated by schedule, but rather by completeness of the project.

2. Refer to the end of this specification section for a "STATEMENT INDICATING READINESS FOR FINAL JOBSITE OBSERVATION."

3. The Contractor shall sign this form and return it to the Engineer so that the final observation can commence.

C. Before final payment will be authorized, this Contractor must have completed the following:

1. Submitted operation and maintenance manuals to the Architect/Engineer for review.

2. Submitted bound copies of approved shop drawings.

3. Record documents including edited drawings and specifications accurately reflecting field conditions, **inclusive** of all project revisions, change orders, and modifications.

4. Submitted a report stating the instructions given to the Owner's representative complete with the number of hours spent in the instruction. The report shall bear the signature of an authorized agent of This Contractor and shall be signed by the Owner's representative as having received the instructions.

5. Submitted testing reports for all systems requiring final testing as described herein.

6. Submitted start-up reports on all equipment requiring a factory installation inspection and/or start.

7. Provide spare parts, maintenance, and extra materials in quantities specified in individual specification sections. Deliver to project site; submit receipt to Architect/Engineer prior to final payment being approved.

8. Provide System Assurance Warranty certificate for the telecommunications system.

2.5 OPERATION AND MAINTENANCE INSTRUCTIONS

A. In addition to the provisions of Division 1, the following is required:

B. Submit three (3) properly indexed and bound copies, in "D" ring style notebooks, of the Operations and Maintenance Instructions to the Architect/Engineer for approval. Make all corrections or additions required.

C. Operation and Maintenance Instructions shall include:

1. Notebooks shall be heavy duty locking three ring binders and incorporate clear vinyl sheet sleeves on the front cover and spine for slip-in labeling. "Peel and stick" labels are **not** acceptable. Sheet lifters shall be supplied at the front of each notebook. Provide "Wilson-Jones" or equal, color black. Size notebooks a minimum of 1/2" thicker than material for future inserts. Label the spine and front cover of each notebook. If more than one notebook is required, label in consecutive order. For example; 1 of 2, 2 of 2. No other forms of binding will be acceptable.

2. Prepare binder covers (front and spine) with printed title "Operation and Maintenance Instructions", title of project, and subject matter of binder when multiple binders are required.

3. Title page with project title, Architect, Engineer, Contractor, and Subcontractor with addresses, telephone numbers, and contacts.

4. Table of Contents describing all index tabs.

5. Listing of all Subcontractors and major equipment suppliers with addresses, telephone numbers, and contacts.

6. Index tabs dividing information by specification section, major equipment, or systems. All tab titles shall be clearly printed under reinforced plastic tags.

7. Copies of warranties.

8. Copies of all final approved shop drawings and submittals.

9. Copies of all factory inspection and/or equipment start-up reports.

10. Schematic wiring diagrams of the equipment which have been updated for field conditions. Field wiring shall have label numbers to match drawings.

11. Dimensional drawings of equipment.

12. Detailed parts list with list of suppliers.

13. Operating procedures for each system.

14. Maintenance schedule and procedures. Include maintenance chart that lists routine maintenance requirements and frequency over one-year time period.

15. Repair procedures for major components.

16. Replacement parts and service material requirements for each system and the frequency of service required.

17. Instruction books, cards, and manuals furnished with the equipment.

2.6 INSTRUCTING THE OWNER'S REPRESENTATIVE

A. In addition to the provisions of Division 1, the following is required:

B. Adequately instruct the Owner's designated representative or representatives in the maintenance, care, and operation of the complete systems installed under this contract.

C. Provide verbal and written instructions to the Owner's representative or representatives by FACTORY PERSONNEL in the care, maintenance, and operation of the equipment and systems.

D. The Owner has the option to make a video recording of all instructions.

E. The Architect/Engineer shall be notified of the time and place for the verbal instructions to be given to the Owner's representative so that their representative can be present if desirable.

F. Refer to the individual specification sections for minimum hours of instruction time for each system.

G. Operating Instructions:

1. The Contractor is responsible for all instructions to the Owner and/or Owner’s operating staff on the Communications Systems.

2. If the Contractor does not have Engineers and/or Technicians on staff that can adequately provide the required instructions on system operation, performance, troubleshooting, care and maintenance, they shall include in the bid an adequate amount to reimburse the Owner for the Engineer to perform these services.

2.7 SYSTEM COMMISSIONING

A. The Communications Systems included in the construction documents are to be complete and operating systems. The Architect/Engineer will make periodic job site observations during the construction period. The system start-up, testing, configuration, and satisfactory system performance is the responsibility of the Contractor. This shall include all calibration and adjustments of electrical equipment controls, equipment settings, software configuration, troubleshooting and verification of software, and final adjustments that may be required.

B. All operating conditions and control sequences shall be simulated and tested during the start-up period.

C. The Contractor, subcontractors, and equipment suppliers are expected to have skilled technicians to insure that the system performs as designed. If the Architect/Engineer is requested to visit the job site for the purpose of trouble shooting, assisting in the satisfactory start-up, obtaining satisfactory equipment operation, resolving installation and/or workmanship problems, equipment substitution issues or unsatisfactory system performance, including call backs during the warranty period through no fault of the design; the Contractor shall reimburse the Owner on a time and material basis for services rendered at the Architect/Engineer's standard hourly rates in effect at the time the services are requested. The Contractor shall be responsible for making payment to the Owner for services required that are product, installation or workmanship related. Payment is due within 30 days after services are rendered.

2.8 RECORD DOCUMENTS

A. Refer to the Division 1 Section: PROJECT CLOSEOUT for requirements. The following paragraphs supplement the requirements of Division 1.

B. Mark specifications to indicate approved substitutions, change orders, and actual equipment and materials used.

C. This Contractor shall maintain at the job site, a separate and complete set of Communications Drawings which shall be clearly and permanently marked and noted in complete detail any changes made to the location and arrangement of equipment or made to the Communications Systems and wiring as a result of building construction conditions or as a result of instructions from the Architect or Engineer. All Change Orders, RFI responses, Clarifications and other supplemental instructions shall be marked on the documents. Record documents that merely reference the existence of the above items are not acceptable. Should This Contractor fail to complete Record Documents as required by this contract, This Contractor shall reimburse Architect/Engineer for all costs to develop record documents that comply with this requirement. Reimbursement shall be made at the Architect/Engineer’s hourly rates in effect at the time of work.

D. The above record of changes shall be made available for the Architect and Engineer's examination during any regular work time.

E. Upon completion of the job, and before final payment is made, This Contractor shall give the marked-up drawings to the Architect/Engineer.

2.9 ADJUST AND CLEAN

A. Contractor shall thoroughly clean all equipment and systems prior to the Owner's final acceptance of the project.

B. Contractor shall clean all foreign paint, grease, oil, dirt, labels, stickers, and other foreign material from equipment.

C. Contractor shall remove all rubbish, debris, etc., accumulated during the Contractor's operations from the premises.

END OF SECTION

STATEMENT INDICATING READINESS FOR FINAL JOBSITE OBSERVATION

In order to assist the contractor in a timely close-out of the project, it is crucial that the final jobsite observation is not conducted prior to the project being ready. The contractor is required to review the completion status of the project at the time the observation is scheduled. This review, and the subsequent submittal of this form to the Engineer, shall indicate the contractor's agreement that the area of the project being requested for final observation is ready as defined below. The following list represents the degree of completeness required prior to requesting a final observation:

1. All cabling pathways (cable tray, ladder rack, conduit sleeves, etc) are installed and all cabling has been pulled through them.
2. All mechanical firestop products are installed and all other penetrations have been sealed.
3. All telecommunications jacks are installed in the faceplates.
4. All telecommunications cabling is pulled and at least 75% of all jacks have been terminated at the jack and at the telecom room.
5. Telecommunications testing is in progress and at least 25% of testing has been completed.
6. Telecommunications labeling has been provided on at least 25% of each type of component requiring a label.
7. All telecommunications related grounding is complete.
8. All CCTV camera rough-ins are installed.
9. All access control system rough-ins are installed.

The project will be ready for final jobsite observation prior to the requested date of the observation, according to the above list of requirements.

Prime Contractor: _____By: _____

Requested Observation Date _____Today's Date: _____

Contractor shall sign this readiness statement and transmit to Engineer at least 10 days prior to the requested date of observation.

It is understood that if the Engineer finds that the project is not complete as defined above and that the final jobsite observation cannot be completed on the requested date, the Engineer will return to the site at a later date. All additional visits to the site for the purposes of completing the final observation will be billed T&M to the Contractor at our standard hourly rates, including travel expenses or the contractor's retainage may be deducted for the same amount.

Telecommunications – Proof of Certification

There are specific Contractor qualification requirements for this project as defined in specification section 27 05 00, which may include Manufacturer Certification. This Proof of Certification document and the supporting documentation require herein, is required to be submitted at the time of bid to show compliance with the requirements of 27 05 00.

Statement of Compliance:

The named Contractor's base bid is a structured cabling solution from the connectivity manufacturer _____. Named Contractor is trained and certified, under the named manufacturer's formal certification program to provide and install all materials and work required by this project. Further, said Contractor is authorized, by the named manufacturer, to offer all product, labor and system assurance warranties required for this project by these contract documents.

The certification of this named manufacturer is valid, current and in effect as of the bid day of this project, the _____ day of _____, 20____.

The named Contractor is not employing any other sub-contractor on the telecommunications portion of this project that does not also meet this certification requirement.

Contractor Company Name: _____

Authorized Representative: (print) _____

Date: _____ Manufacturer Certification Number (if any): _____

Submit the following with the bid:

- This form.
- Proof of Manufacturer Certification indicated above.

SECTION 27 05 26
COMMUNICATIONS BONDING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Bonding Conductors
B. Bonding Connectors
C. Grounding Busbar (TMGB)
D. Rack-mount Telecommunications Grounding Busbar

1.2 RELATED WORK

A. Section 26 05 33 – Conduit
B. Section 26 05 36 – Cable Trays
C. Section 26 05 13 – Wire and Cable
D. Section 26 05 26 – Grounding and Bonding
E. Section 27 05 00 – Basic Communications Systems Requirements
F. Section 27 11 00 – Communication Equipment Rooms
G. Section 27 05 28 – Interior Communication Pathways
H. Section 27 05 53 – Identification and Administration

1.3 QUALITY ASSURANCE

A. Refer to Section 27 05 00 for relevant standards.

B. Communications bonding system component, device, equipment, and material manufacturer(s) shall have a minimum of five (5) years documented experience in the manufacture of communications bonding products.

C. The entire installation shall comply with all applicable electrical codes, safety codes, and standards. All applicable components, devices, equipment, and material shall be listed by Underwriters' Laboratories, Inc.

1.4 REFERENCES

A. ANSI/IEEE 1100 – Recommended Practice for Power and Grounding Sensitive Electronic Equipment in Industrial and Commercial Power Systems

B. ANSI/TIA/EIA 568-C – Commercial Building Telecommunications Cabling Standard

C. ANSI/TIA/EIA 569-A – Commercial Building Standard for Telecommunications Pathways and Spaces

D. ANSI/TIA/EIA 606 – Administration Standard for the Telecommunications Infrastructure of Commercial Buildings

E. ANSI/TIA/EIA 758 – Customer Owned Outside Plant

F. ANSI-J-STD-607-A – Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications

G. IEEE 81 – IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System Part 1: Normal Measurements

H. IEEE 837 – IEEE Standard for Qualifying Permanent Connections Used in Substation Grounding

I. NFPA 70 – National Electrical Code

J. NFPA 780 – Standard for the Installation of Lightning Protection Systems

K. UL 96 – Lightning Protection Components

L. UL 96A – Installation Requirements for Lightning Protection Systems

M. UL 467 – Grounding and Bonding Equipment

1.5 SUBMITTALS

A. Submit product data and shop drawings under provisions of Section 27 05 00 and Division 1.

B. Provide manufacturer's technical product specification sheet for each individual component type. Submitted data shall show the following:

1. Compliance with each requirement of these documents. The submittal shall acknowledge each requirement of this section, item-by-item, including construction, materials, ratings, and all other parameters identified in Part 2 - Products.

2. Manufacturer's installation instructions indicating application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of product.

C. Provide CAD-generated, project-specific system shop drawings as follows:

1. Provide a system block diagram indicating system configuration, system components, interconnection between components, and conductor routing. The diagram shall clearly indicate all wiring and connections required in the system. When multiple devices or pieces of equipment are required in the exact same configuration (e.g., multiple identical equipment racks or sections of ladder tray), the diagram may show one device and refer to the others as "typical" of the device shown. The diagram shall list room numbers where system equipment will be located.

2. Installation details for all system components.

D. Provide system checkout test procedure to be performed at acceptance.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to the site under the provisions of Section 27 05 00.

B. Store and protect products under the provisions of Section 27 05 00.

C. Contractor shall exercise care to prevent corrosion of any products prior to installation. Corroded products shall not be acceptable for use on this project.

1.7 SYSTEM DESCRIPTION

A. This section describes the requirements for the furnishing, installation, adjusting, and testing of a complete turnkey communications bonding system, including connection to the electrical ground grid.

B. Performance Statement: This specification section and the accompanying drawings are performance based, describing the minimum material quality, required features, operational requirements, and performance of the system. These documents do not convey every wire that must be installed, every equipment connection that must be made, or every feature and function that must be configured. Based on the equipment constraints described and the performance required of the system as presented in these documents, the Contractor is solely responsible for determining all components, devices, equipment, wiring, connections, and terminations required for a complete and operational system that provides the required performance.

C. This document describes the major components of the system. All additional hardware, subassemblies, supporting equipment, and other miscellaneous equipment required for complete, proper system installation and operation shall be provided by the Contractor.

D. Basic System Requirements:

1. A complete communications bonding infrastructure is required for this project. Refer to the drawings and the requirements of ANSI-J-STD-607-A and NFPA 70 for complete information.

2. The bonding system shall include, but not be limited to, the following major components:

a. Bonding Conductor for Telecommunications (BCT)
b. Telecommunications Main Grounding Busbar (TMGB)
c. Telecommunications Bonding Backbone (TBB)
d. Rack mount Telecommunications Grounding Busbar(s)
e. Bonding Conductor(s) (BC)
f. Bonding Connectors
g. Bonding system labeling and administration as defined in Section 27 05 53.

1.8 PROJECT RECORD DOCUMENTS

A. Submit documents under the provisions of Section 27 05 00.

B. Provide final system block diagram showing any deviations from approved shop drawing submittal.

C. Provide floor plans that document the following:

1. Actual locations of system components, devices, and equipment.
2. Actual conductor routing.
3. Actual system component, device, equipment, and conductor labels.

D. Provide statement that system checkout test, as outlined in the approved shop drawing submittal, is complete and test results were satisfactory.

E. Complete all operation and maintenance manuals as described below.

1.9 OPERATION AND MAINTENANCE DATA

A. Submit under provisions of Section 27 05 00.

B. Submitted data shall include:

1. Approved shop drawings.

2. Descriptions of recommended system maintenance procedures, including:

a. Inspection
b. Periodic preventive maintenance
c. Fault diagnosis
d. Repair or replacement of defective components

PART 2 - PRODUCTS

2.1 BONDING CONDUCTORS

A. Bare Copper:

1. Annealed uncoated stranded conductor.
2. Minimum size 6 AWG.

B. Insulated Copper:

1. Annealed uncoated stranded conductor.
2. Insulation:
   a. PVC insulation with nylon outer jacket.
   b. Rated ≥ 600 volts.
   c. Green.
3. Minimum size 6 AWG.

C. All bonding conductors shall be listed and recognized by a nationally recognized testing laboratory as being suitable for the intended purpose and for installation in the space in which they are installed.

D. Bonding Conductor Sizing

1. All Communications bonding system conductors shall be sized by length as follows:

Length Linear ft (m)	Size (AWG)
Less than 13 (4)	6
14 - 20 (4 - 6)	4
21 - 26 (6 - 8)	3
27 - 33 (8 - 10)	2
34 - 41 (10 - 13)	1
42 - 52 (13 - 16)	1/0
53 - 66 (16 - 20)	2/0
Greater than 66 (20)	3/0

2. The BCT shall be the same size as the TBB or larger.

2.2 BONDING CONNECTORS

A. Acceptable Types:

1. Two-hole compression lug
2. Exothermic weld
3. Irreversible compression

B. Connectors shall be provided in kit form and selected per manufacturer's written instructions.

C. Connectors shall comply with IEEE 837 and UL 467 and be listed for use for specific types, sizes, and combinations of conductors and connected items.

2.3 GROUNDING BUSBAR (TMGB)

A. Features:

1. Wall-mount configuration.
2. Listed and recognized by a nationally recognized testing laboratory as being suitable for intended purpose.
3. Hole patterns compliant with BICSI recommendations and ANSI-J-STD-607-A standards.
4. Predrilled holes.
5. Integral insulators.
6. Stainless steel offset mounting brackets.

B. Specifications:

1. Material: Electrolytic tough pitch copper bar with tin plating.

2. Minimum Dimensions: 1/4" thick x 4" high x 12" long.

   a. Increase dimensions and/or quantity furnished and installed as required to accommodate all terminations required by the project, plus 20% spare capacity.

3. Hole pattern shall include:

   a. A minimum of 15 sets of 5/16" holes, 5/8" on center, to accommodate "A" spaced 2-hole compression lugs.

   b. A minimum of three (3) sets of 7/16" holes, 1" on center, to accommodate "C" spaced 2-hole compression lugs.

2.4 RACK-MOUNT TELECOMMUNICATIONS GROUNDING BUSBAR

A. Features:

1. Listed and recognized by a nationally recognized testing laboratory as being suitable for intended purpose.

2. Predrilled holes.

3. Mounts in a standard 19" equipment rack.

B. Specifications:

1. Material: Electrolytic tough pitch copper bar with tin plating.

2. Minimum Dimensions: 3/16" thick x 3/4" high x 19" long.

   a. Increase dimensions and/or quantity furnished and installed as required to accommodate all terminations required by the project, plus 20% spare capacity.

3. Hole pattern shall include:

   a. A minimum of eight (8) 6-32 tapped lug mounting holes on 1" centers.

   b. A minimum of two (2) pairs of 5/16" diameter holes spaced 3/4" apart.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General Bonding Requirements:

1. The communications bonding system shall be a complete system. Contractor shall furnish and install all necessary miscellaneous components, devices, equipment, material, and hardware, including, but not limited to, lock washers, paint-piercing washers, hex nuts, compression lugs, insulators, mounting screws, lugs, etc., to provide a complete system.

2. A licensed electrician shall perform all bonding.

3. Comply with the manufacturer's instructions and recommendations for installation of all products.

B. Main Cross Connect and Service Entrance Room Bonding Requirements:

1. Locate the TMGB in the service entrance room unless otherwise noted on the drawings.

2. The location of the TMGB shall be the shortest practical distance from the telecommunications primary lightning protection devices.

3. Bond the telecommunications primary protectors to the TMGB. Maintain a minimum 1 foot (300 mm) separation of the bonding conductor from all DC power cables, switchboard cable, and high frequency cable.

C. Telecommunications Main Ground Bar (TMGB) Requirements:

1. Install TMGB such that it is insulated from its support with a minimum 2" standoff.

2. Bond the TMGB to the electrical service ground via the BCT.

   a. A minimum of 1 foot (300 mm) separation shall be maintained between the BCT and any DC power cables, switchboard cable, or high frequency cables.

3. Where backbone or horizontal cabling contains a shield, the shield(s) shall be bonded to the TMGB.

4. TMGB shall be bonded to all electrical panels located in the same room or space as the TMGB or in an immediately adjacent space within 20 linear feet of the TMGB. TMGB shall be bonded to all electrical panels providing electrical power to communications equipment located in the same room or space as the TMGB.

5. TMGB shall be bonded to accessible metallic building structure located within the same room or space as the TMGB.

6. All metallic continuous cable pathways, including, but not limited to, cable trays, basket trays, ladder racks, raceways, conduits, conduit sleeves, and fire-rated cable pathway devices, located within the same room or space as the TMGB, shall be bonded to the TMGB.

7. All metallic communications equipment, including, but not limited to, cable pair protectors, surge suppressors, cross-connect frames, patch panels, equipment cabinets, etc., located within the same room or space as the TMGB, shall be bonded to the TMGB.

D. Rack-mount Telecommunications Ground Bar Requirements (RTGB):

1. Provide a rack-mount telecommunications ground bar in each equipment rack.

2. Install RTGB such that it is electrically bonded to the rack. Where necessary, remove paint and/or use paint-piercing washers to provide proper electrical bond between RTGB and equipment rack.

3. Bond each RTGB to the TGB via a BC.

4. If more than one (1) RTGB is provided within the same room or space, they shall all be bonded together via a BC.

5. All contractor-furnished and/or contractor-installed metallic communications equipment, including, but not limited to patch panels, fiber optic distribution enclosures, splice enclosures, active electronics, uninterruptible power supplies, etc., mounted within the same equipment rack as the RTGB, shall be bonded to the RTGB. Where necessary, remove paint and/or use paint-piercing washers to provide proper electrical bond between equipment rack and installed metallic communications equipment. Active electronics and uninterruptible power supplies shall be bonded to the RTGB via a dedicated BC for each device.

E. Metallic Interior Communication Pathway Bonding Requirements:

1. All metallic interior continuous communication cable pathways, including, but not limited to, conduit, conduit sleeves, fire-rated cable pathway devices, cable tray, basket tray, and ladder rack, shall be bonded to the communications bonding system.

F. Bonding Conductor Requirements:

1. Bonding conductors shall be green or marked with a distinctive green color.

2. Bonding conductors shall be routed parallel and perpendicular to building structure along shortest and straightest paths possible. Number of bends and changes in direction should be minimized. Install and secure conductors in a manner that protects the conductors from impact and from physical or mechanical strain or damage.

3. Bonding conductors shall not be installed in metallic conduit.

4. All conductors, including, but not limited, to the BCT, TBB, GE(s), and BC(s), shall be installed splice-free. If the Contractor believes that site conditions do not allow a splice-free installation, the Contractor may request permission from the Architect/Engineer to splice a specific communications bonding system conductor.

   a. Where documented permission to splice a conductor is granted:

      1) The number of splices shall be limited to as few as possible.

      2) Splices shall be made using exothermic welding or irreversible compression-type connections only. Splice hardware shall be listed for grounding and bonding. Solder is not an acceptable means of splicing conductors.

      3) Splices shall be made in telecommunications spaces in accessible locations to facilitate future inspection and maintenance.

      4) Splices shall be adequately supported and protected from impact and from physical or mechanical strain or damage.

5. All bonding conductors shall be labeled in accordance with the requirements of Section 27 05 53. In addition to the requirements of Section 27 05 53:

   a. Labels shall be nonmetallic.

   b. Labels shall be printer-generated.

c. Labels shall be located on conductors as close as is practical to their point of termination in a readable position.

d. Additionally, conductors shall be labeled as follows:

1) "IF THIS CONNECTOR OR CABLE IS LOOSE OR MUST BE REMOVED, PLEASE CALL THE BUILDING TELECOMMUNICATIONS MANAGER."

6. Interior water piping is not acceptable for use as a communications bonding system bonding conductor.

7. Metallic cable shields are not acceptable for use as communications bonding system bonding conductors.

G. Bonding Connection Requirements:

1. Make all connections in accessible locations to facilitate future inspection and maintenance.

2. Communications bonding system connections shall be made using exothermic welding, two-hole compression lugs, or other irreversible compression-type connections. The use of 1-hole lugs is prohibited, except for connections to a rack-mount telecommunications ground bar. Connection hardware shall be listed for grounding and bonding. Sheet metal screws shall not be used to make communications bonding system connections.

3. Thoroughly clean conductors before installing lugs and connectors.

4. Install and tighten all connectors in accordance with manufacturer's instructions, using the appropriate purpose-designed tool(s) recommended by the manufacturer for that purpose. Exercise care not to tighten connectors beyond manufacturer's recommendations.

5. Where necessary, remove paint and/or use paint-piercing washers to provide proper electrical bond at all connections.

6. All bonding connections shall be coated in anti-oxidant joint compound that is purpose-designed and purpose-manufactured for that use. Anti-oxidant joint compound shall be applied in accordance with manufacturer's recommendations and instructions.

7. All installed connectors on conductors installed in damp locations shall be sealed with dielectric grease and then covered with heat shrink tubing to protect against moisture ingress. Applied heat shrink tubing shall overlap conductor's outer jacket a minimum of four (4) inches past connector and be installed in accordance with manufacturer's recommendations and instructions.

3.2 FIELD QUALITY CONTROL

A. Field testing shall be performed under provisions of Section 27 05 00.

B. Where these specifications require a product or assembly without the use of a brand or trade name, provide a product from a reputable manufacturer that meets the requirements of the specifications.

C. Periodic observations will be performed during construction to verify compliance with the requirements of the specifications. These services do not relieve the Contractor of responsibility for compliance with the contract documents.

3.3 ADJUSTING

A. Adjust work under provisions of Section 27 05 00.

B. Contractor shall make any and all adjustments to the communications bonding system necessary to ensure that the installed system meets all requirements listed herein. Modifications necessary to comply with listed requirements or to provide specified performance shall be completed by the Contractor at no additional cost to the Owner.

3.4 TESTING

A. Test installed system under provisions of Section 27 17 10.

B. Measure and document resistance to ground at TMGB, each TGB, each RTGB, and each electrical distribution panel bonded to the TMGB or a TGB.

1. Measurements shall be made not less than two full days after the last trace of precipitation, and without the soil being moistened by any means other than natural drainage or seepage, and without chemical treatment or other artificial means of reducing natural ground resistance. Perform tests by the fall-of-potential method according to IEEE 81.

2. Measured resistance to ground at TMGB, each TGB, and each RTGB must not exceed 5 ohms.

3. Under no circumstances shall any point in the communications bonding system have a lower resistance to ground than that of nearby electrical distribution system components that it is bonded to.

C. Include measurement documentation in test data submitted at completion of project under provisions of Section 27 17 10.

3.5 SYSTEM TRAINING

A. All labor and materials required for on-site system training shall be provided. Training shall be conducted at the project site using the project equipment.

1. Provide two week's advanced notice of training to the Owner and Architect/Engineer.

2. The Architect/Engineer shall be presented with the option to attend the training.

3. Provide a training outline agenda describing the subject matter and the recommended audience for each topic.

B. At a minimum, the following training shall be conducted:

1. A course detailing the system functions and operations that a technical user will encounter. Provide training on all aspects of using the system, including making new bonding connections to the TMGB, TGB, or RTGB. Provide training on all recommended inspection, maintenance, and repair procedures for the system.

C. Minimum on-site training times shall be:

1. Technical user: Four hours.

END OF SECTION

SECTION 27 05 28
INTERIOR COMMUNICATION PATHWAYS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. The work covered under this section consists of the furnishing of all necessary labor, supervision, materials, equipment, tests and services to install complete wire mesh support systems, conduits, sleeves, innerduct, etc. for an interior cabling plant as shown on the drawings.

B. Wire mesh support systems are defined to include, but are not limited to straight sections of continuous wire mesh, field formed horizontal and vertical bends, tees, drop outs, supports and accessories.

1.2 RELATED WORK

A. Section 26 05 33 - Conduit
B. Section 27 05 00 - Basic Communications Systems Requirements
C. Section 27 05 26 - Communications Bonding

1.3 QUALITY ASSURANCE

A. Refer to Section 27 05 00 for requirements.

1.4 REFERENCES

A. ANSI/NFPA 70 - National Electrical Code

B. NEMA VE 2-2000 - Cable Tray Installation Guidelines

1.5 SUBMITTALS

A. Under the provisions of Section 27 05 00 and Division 1, prior to the start of work the Contractor shall submit:

1. Manufacturer's data covering all products proposed, including construction, materials, ratings and all other parameters identified in Part 2 - Products, below.

2. Manufacturer's installation instructions.

B. Coordination Drawings:

1. Include cable tray and conduit sleeve layout in composite electronic coordination files. Refer to Section 27 05 00 for coordination drawing requirements.

1.6 DRAWINGS

A. The drawings, which constitute a part of these specifications, indicate the general route of the wire mesh support systems, conduit, sleeves, etc. Data presented on these drawings is as accurate as preliminary surveys and planning can determine until final equipment selection is made. Accuracy is not guaranteed and field verification of all dimensions, routing, etc., is required.

PART 2 - PRODUCTS

2.1 CONDUIT

A. Refer to Section 26 05 33 for conduit requirements for this project.

2.2 WIRE MESH CABLE TRAY – OVERHEAD

A. Acceptable Manufacturers:

1. Cooper B-Line "Flextray"
2. Cablofil, Inc.
3. Wiremold "Fieldmate"

B. General: Provide wire mesh of types and sizes indicated on drawings; with connector assemblies, clamp assemblies, connector plates, splice plates and splice bars. Provide drop-out fittings where cable tray is installed over equipment racks. Two drop-out fittings shall be installed over each rack so that a controlled radius is maintained into each side of every equipment rack that cable tray passes over. Construct units with rounded edges and smooth surfaces; in compliance with applicable standards; and with the following additional construction features.

C. Wire mesh shall be made of high strength steel wires and formed into a standard 2 inch by 4-inch wire mesh pattern with intersecting wires welded together. All wire ends along wire mesh sides (flanges) shall be rounded during manufacturing for safety of cables and installers.

D. Materials and Finishes: Material and finish specifications for each wire mesh type are as follows:

1. Electro-Galvanized Zinc: Straight sections shall be made from steel meeting the minimum mechanical properties of ASTM A510 and shall be electro-plated zinc in accordance with ASTM B633 SC2. Additionally, straight sections shall be painted Flat Black.

2. Accessories:

   a. Electro-Galvanized Zinc: Support accessories and miscellaneous hardware shall be coated in accordance with ASTM B633 SC3. All threaded components shall be coated in accordance with ASTM B633 SC1.

E. Type of Overhead Wire Mesh Support System:

1. All straight section longitudinal wires shall be straight (with no bends).

2. Wire mesh supports shall be trapeze hangers or wall brackets. Center hung supports will not be allowed.

3. Trapeze hangers are to be supported by 1/4 inch or 3/8-inch diameter rods.

4. Provide manufacturer approved grounding clips as necessary for continuous grounding of tray.

2.3 CABLE HANGERS AND SUPPORTS

A. Provide a non-continuous cable support system suitable for use with open cable.

B. Cable Hooks:

1. Construction: Flat bottom design with a minimum cable bearing surface of 1-5/8". Hooks shall have 90-degree radius edges.

2. All cable hook mounting hardware shall be recessed to prevent damage to cable during installation. Installed cabling shall be secured using a cable latch retainer that shall be removable and reusable.

3. Finish: Pre-galvanized steel, ASTM A653 suitable for general duty use.

C. Cable Hangers:

1. Adjustable, non-continuous cable support slings for use with low voltage cabling.

2. Steel and woven laminate construction, rated for indoor non-corrosive use. Laminate material shall be suitable for use in plenum environments.

3. Sling length shall be adjustable to a capacity of 425 4-pair UTP cables.

4. Cabling hanger load limit shall be 100 lbs per foot.

5. Manufacturer: Erico Caddy, CableCat CAT425, Arlington Fittings Tl Series or approved equal.

PART 3 - EXECUTION

3.1 CABLE HOOK SUPPORT SYSTEM

A. In areas where cabling is not supported by cable tray, ladder rack, enclosed wireway or installed in conduit, such cabling shall be supported by an approved cable hook support system.

B. Refer to manufacturer's requirements for allowable fill capacity for selected cable hook. In no case, shall a 40% fill capacity be exceeded.

C. Cable hooks shall be securely mounted per manufacturer's instructions. In no case, shall the side-to-side travel of any cable hook exceed 6".

D. Cable hooks shall be selected based on the contractor's cable routing. Hooks shall be capable of supporting a minimum of 30 pounds with a safety factor of 3.

E. Support spans shall be based on the manufacturer's load ratings. In no case, shall a 5-foot span be exceeded.

F. The resting and supporting of cabling on structural members shall not meet the requirements for cabling support specified herein.

G. The use of tie-wraps or hook and loop type fasteners is specifically prohibited as a substitute for cable hooks specified herein.

3.2 CONDUIT AND CABLE ROUTING

A. Refer to specification section 26 05 03 for additional requirements.

B. All conduits shall be reamed and shall be installed with a nylon bushing.

C. Maintain appropriate conduit bend radius at all times. For conduits with an internal diameter of 2" or less, maintain a bend radius of at least 6 times the internal diameter. For conduits with an internal diameter greater than 2", maintain a bend radius of at least 10 times the internal diameter.

D. No conduit or sleeve containing more than two (2) cables shall exceed 40% fill ratio, regardless of length.

E. Any conduit exceeding 90' in length or containing more than two (2) 90-degree bends shall contain a pull box sized per ANSI/TIA/EIA 569 requirements.

1. A separate pull box is required for each 90' (or greater) length section.

2. A separate pull box is required after any two (2) consecutive 90-degree bends.

3. Pull box shall be located in an area that maintains accessibility of box, including the ability to remove box lid without removal or relocation of any other materials.

F. Any conduit with bends totaling 90 degrees or more shall have the fill capacity derated by 15% for each 90 degrees of cumulative bend.

G. Cables installed in any conduits that do not meet the above requirements shall be replaced at the Contractor's expense, after the conduit condition has been remedied.

3.3 WIRE MESH TRAY INSTALLATION

A. The wire mesh cable tray system shall be only for telecommunications.

B. Install wire mesh as indicated; in accordance with recognized industry practices (NEMA VE-2 2000), to ensure that the cable tray equipment complies with requirements of NEC, and applicable portions of NFPA 70B and NECA's "Standards of Installation" pertaining to general electrical installation practices.

C. Cable tray sections shall be grounded in accordance with manufacturer's recommendations using manufacturer approved hardware. Painted sections shall have paint removed at each grounding attachment point.

D. Test wire mesh support systems to ensure electrical continuity of bonding and grounding connections, and to demonstrate compliance with specified maximum grounding resistance. Refer to NFPA 70B, Chapter 18, for testing and test methods.

E. Provide sufficient space encompassing wire mesh to permit access for installing and maintaining cables.

F. Tray shall be continuous from source to termination and shall not change elevation, direction or otherwise expose cables to travel without 2" x 4" mesh support.

G. Overhead and Underfloor Tray shall be field cut using only manufacturer approved cutting device and methods. Cutting device shall be an offset blade bolt cutter; standard bolt cutters are specifically not permitted. Drop-in tray sections shall not be field cut or field modified in any way.

H. Bends in overhead and underfloor tray shall be accomplished by utilizing manufacturer's cutting guides.

I. All splices of tray shall be provided with splice washers, bars or springs as recommended by the manufacturer.

3.4 ATTACHMENT TO METAL DECKING

A. Where supports for cable trays and cable hook systems attach to metal roof decking, excluding concrete on metal decking, do not exceed 25 lbs. per hangar and a minimum spacing of 2'-0" on center. This 25-lb. load and 2'-0" spacing include adjacent electrical and mechanical items hanging from deck. If the hanger restrictions cannot be achieved, supplemental framing off steel framing will need to be added.

END OF SECTION

SECTION 27 05 43
EXTERIOR COMMUNICATION PATHWAYS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. This section describes the products and execution requirements relating to furnishing and installing exterior racks, ladders, conduits, sleeves, etc. for an exterior cabling plant.

1.2 QUALITY ASSURANCE

A. Refer to Section 27 05 00 for relevant standards.

B. Precast Manufacturer (if applicable): Company specializing in precast concrete structures with three (3) years documented experience.

1.3 REFERENCES

A. Section 27 05 00 – Basic Communications Systems Requirements.

B. ANSI/ASTM A153 - Zinc Coating (Hot-Dip) on Iron and Steel Hardware.

C. ANSI/ASTM A569 - Steel, Sheet and Strip, Carbon (0.15 Maximum Percent), Hot-Rolled, Commercial Quality.

D. ASTM A48 - Gray Iron Castings.

E. ASTM A123 - Zinc (Hot-Galvanized) Coatings on Products Fabricated from Rolled, Pressed, and Forged Steel Shapes, Plates, Bars, and Strips.

1.4 SUBMITTALS

A. Under the provisions of Section 27 05 00 and Division 1, prior to the start of work the Contractor shall submit:

1. Manufacturer’s data covering all products proposed, including construction, materials, ratings and all other parameters identified in Part 2 - Products, below.

2. Manufacturer’s installation instructions.

B. Submit shop drawings and product data under provisions of Section 27 05 00.

C. Submit manufacturer's installation instructions under provisions of Section 27 05 00.

D. Coordination Drawings:

1. Include hand holes, and conduits 1.5” and larger in coordination files. Include all in--floor and underfloor conduit in coordination files. Refer to Section 27 05 00 for coordination drawing requirements.

1.5 REGULATORY REQUIREMENTS

A. Equipment and material shall be UL (Underwriters Laboratory) listed and labeled.

PART 2 - PRODUCTS

2.1 OUTSIDE PLANT CONDUIT

A. High-Density Polyethylene (HDPE) Conduit:

1. Minimum Size: 4inches, unless noted otherwise.

2. Acceptable Manufacturers: Carlon, Chevron Phillips Chemical Company, or pre-approved equal.

3. Materials used for the manufacture of polyethylene pipe and fittings shall be extra high molecular weight, high-density polyethylene resin. The material shall be listed by PPI (Plastic Pipe Institute) and shall meet the following resin properties:

ASTM Test	Description	Values HDPE
D-1505	Density g/CM 3	< .941
D-1238	Melt Index, g/10 min Condition E	> .55 grams/10 min.
D-638	Tensile Strength at yield (psi)	3000 min.
D-1693	Environmental Stress Crack Resistance Condition B, F 20	96 hrs.
D-790	Flexural Modulus, MPa (psi)	< 80,000
D-746	Brittleness Temperature	-75°C Max

4. The pipe shall contain no recycled compound except that generated in the manufacturer's own plant from resin of the same raw material, including both the base resin and coextruded resin. The pipe shall be homogeneous throughout and free of visible cracks, holes, voids, foreign inclusions, or other defects that may affect the wall integrity.

5. Fitting and Conduit Bodies:

a. Directional Bore and Plow Type Installation: Electrofusion or universal aluminum threaded couplings. Tensile strength of coupled pipe must be greater than 2,000 lbs.

b. For All Other Types of Installation: Coupler must provide a watertight connection. The tensile strength of coupled pipe must be greater than 1,000 lbs.

c. E-loc type couplings are not acceptable in any situations.

d. Acceptable Manufacturers: ARCON, Carlon, or approved equal.

B. Fittings:

1. Sweeps: Factory manufactured RMC wrapped with 4 mil vinyl tape with a bend radius as follows:

a. Conduit internal diameter of 2" or less is 6 times the internal conduit diameter.

b. Conduit internal diameter of more than 2" is 10 times the internal conduit diameter.

2. End Caps (Plugs): Pre-manufactured and watertight. Tape is not an acceptable end cap or cover.

2.2 HAND-HOLES

A. Type:

1. Polymer concrete

B. Dimensions:

C. 17”x30”x24”Requirements:

1. Includes steel checker plate covers.

D. Acceptable Manufacturers

1. Quazite
2. Old Castle Precast Christy®
3. New Basis.

2.3 UNDERGROUND WARNING TAPE

A. Detectable three-layer laminate, consisting of a printed pigmented polyolefin film, a solid aluminum-foil core, and a clear protective film that allows inspection of the continuity of the conductive core, bright-colored, compounded for direct-burial service.

B. Overall Thickness: 5 mils (0.125 mm).

C. Foil Core Thickness: 0.35 mil (0.00889 mm).

D. Orange colored tape 3-wide with 1-inch high black letters permanently imprinted with “CAUTION – BURIED COMMUNICATIONS LINE BELOW”. Printing on tape shall be permanent and shall not be damaged by burial operations.

E. Tape material and ink shall be chemically inert, and not subject to degrading when exposed to acids, alkalis, and other destructive substances commonly found in soils.

F. Comply with ANSI Z535.1 through ANSI Z535.5.

PART 3 - EXECUTION

3.1 EXCAVATION, FILL, BACKFILL, COMPACTION

A. General:

1. The Contractor shall do all necessary excavating, securing, filling, backfilling, compacting, and restoration in connection with their work.

B. Excavation:

1. Excavations for trenches shall be excavated to proper dimensions to permit installation and inspection of work.

2. Where excavations are carried in error below indicated levels, thoroughly compacted sand-gravel fill, shall be placed in such excess excavations.

3. Excavations shall be protected against frost action and freezing.

4. Care shall be exercised in excavating so as to not damage surrounding structures, equipment, and buried utilities. In no case shall any major structural footing or foundation be undermined.

5. Excavation shall be performed in all ground characteristics, including rock, if encountered. Each bidder shall visit the premises and determine, by actual observations, borings, or other means, the nature of the soil conditions. The cost of all such inspections, borings, etc., shall be borne by the bidder.

6. In the case where the trench is excavated in rock, a compacted bed with a depth of 3" (minimum) of sand and gravel shall be used to support the conduit unless masonry cradles or encasements are used.

7. Where satisfactory bearing soil is not found at the indicated levels, the Architect/Engineer or their representative shall be notified immediately and no further work shall be done until further instructions are given.

8. Mechanical excavation of the trench to line and grade of the conduit, unless otherwise indicated on the drawings.

C. Dewatering:

1. The Contractor shall be responsible for the furnishing, installation, operation and removal of all dewatering pumps and lines necessary to keep the excavation free of water at all times.

D. Underground Obstructions:

1. Prior to the commencement of any excavation or digging, the Contractor shall verify all underground utilities with the regional utility locator. Provide prior notice to the locator before excavations. Contact information for most regional utility locaters can be found by calling 811. The Contractor is responsible for obtaining all utility locates for all trades on the project to determine obstructions indicated. The Contractor shall use great care in installing in the vicinity of underground obstruction.

E. Fill and Backfilling:

1. No rubbish or waste material shall be permitted in excavations for trench fill and backfill.

2. The Contractor shall provide the necessary sand for backfilling.

3. Dispose of the excess excavated earth as directed.

4. Soils for backfill shall be suitable for required stability and compaction, clean and free from perishable materials, frozen earth, debris or earth with an exceptionally high void content, and free from stones greater than 4 inches in diameter. Under no circumstances shall water be permitted to rise in unbackfilled trenches after installation has been placed.

5. All trenches shall be backfilled immediately after installation of conduit, unless other protection is directed.

6. All conduit shall be laid on a compacted bed of sand at least 3" deep. Backfill around the conduit with sand, spread in 6" layers, then compact each layer.

7. Use sand for backfill up to grade for all conduit located under building slabs or paved areas. All other conduit shall have sand backfill to 6" above the top of the conduit.

8. The backfilling above the sand shall be placed in uniform layers not exceeding 6" in depth. Each layer shall be placed, then carefully and uniformly tamped, so as to eliminate the possibility of lateral or vertical displacement.

9. Install a warning tape approximately 12 inches below finished grade over all underground duct banks. The identifying warning tape shall be as specified above.

10. Where the fill and backfilling will ultimately be under a building, floor or paving, each layer of fill shall be compacted to 95% of the maximum density as determined by AASHTO Designation T-99 or ASTM Designation D-698. Moisture content of soil at time of compaction shall not exceed plus or minus 2% of optimum moisture content as determined by AASHTO T-99 or ASTM D-698 test.

11. After backfilling of trenches, no superficial loads shall be placed on the exposed surface of the backfill until a period of 48 hours has elapsed.

3.2 RESTORATION REQUIREMENTS

A. Where soil and sod has been removed, it shall be replaced as soon as possible after backfilling is completed. All areas disturbed by work shall be restored to their original condition. The restoration shall include any necessary topsoiling, fertilizing, liming, seeding, or mulching,

END OF SECTION

SECTION 27 05 53
IDENTIFICATION AND ADMINISTRATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. This section describes the execution and administration requirements relating to the structured cabling system and its termination components and related subsystems.

B. Identification and labeling.

1.2 RELATED WORK

A. Section 27 05 00 – Basic Communications Systems Requirements

1.3 QUALITY ASSURANCE

A. Refer to section 27 05 00 for relevant standards.

1.4 SUBMITTALS

A. Under the provisions of Section 27 05 00 and Division 1, prior to the start of work the Contractor shall submit:

1. Documentation of labeling scheme.

PART 2 - PRODUCTS

2.1 LABELING

A. Adhesive labels shall meet the requirements of UL 969 (Ref D-16) for legibility, defacement and adhesion. Exposure requirements of UL 969 for indoor and outdoor (as applicable) use shall be met.

B. Insert labels shall meet the requirements of UL 969 for legibility, defacement and general exposure.

C. Labeling shall be consistent for all common elements in the project. This consistency shall include label size, color, typeface an attachment method.

D. Labels incorporating bar codes shall be either Code 39 conforming to USS-39 or Code 128 conforming to USS-128.

1. All Code 39 bar codes shall have a ratio between 2.5:1 and 3.0:1. Provide a minimum “quite zone” of 0.25” on each side of the bar code.

2. A descriptive label for reading by personnel shall be provided with any bar code. Bar codes by themselves are not acceptable.

E. Color Code: Observe the following requirements for color coding:

1. Labels on each end of a cable shall be the same color for each termination.

2. Labels for cross-connects shall be two different colors at each termination fields, representative of the color of that field.

3. Orange (Pantone 15C) shall be used for the demarcation point.

4. Green (Pantone 353C) shall be used for the termination point of network connection on the facility side of the demarc.

5. Purple (Pantone 264C) shall be used to identify the termination of cables from common equipment (PBX, computers, LANS, etc.)

6. White shall be used to identify the first-level backbone termination in the main cross-connect.

7. Gray (Pantone 422C) shall be used to identify the second-level backbone termination in the main cross-connect.

8. Blue (Pantone 291C) shall be used to identify the termination of station cabling at the telecommunications closet and/or equipment room end of the cable.

9. Brown (Pantone 465C) shall be used to identify the termination of the interbuilding backbone cable terminations.

10. Yellow (Pantone 101C) shall be used to identify the termination of auxiliary circuits, alarms, maintenance, security, etc.

11. Red (Pantone 184C) shall be used to identify the termination of key telephone systems.

12. In facilities that do not contain a main cross-connect, the color white may be used to identify second-level backbone terminations.

F. Tag all CAT 6 cables at both the Communications Equipment Room and the information outlets. Coordinate labeling scheme with the City of Madison staff during Pre-installation meeting.

2.2 DOCUMENTATION/AS-BUILTS/RECORDS

A. General:

1. Upon completion of the installation, the Contractor shall submit as-builts per the requirements of Section 27 05 00 and Division 1. Documentation shall include the items detailed in the subsections below.

2. All documentation, including hard copy and electronic forms shall become the property of the Owner.

B. Record Drawings:

1. The drawings are to include cable routes and outlet locations. Outlet locations shall be identified by their sequential number as defined elsewhere in this document. Numbering, icons and drawing conventions used shall be consistent throughout all documentation provided.

PART 3 - EXECUTION

3.1 IDENTIFICATION AND LABELING

A. Cable Labeling: Horizontal cables shall be labeled at each end.

1. Provide additional cable labeling at each pull box.

2. Cables that are routed through multiple pathway segments shall contain reference to all pathway segments in the pathway linkage field.

3. Cables that differ only by performance class shall have a suitable marking or label to indicate the higher performance class. For example, station cabling utilizing the blue color, may include blue with a white stripe to indicate the higher performance class station cabling.

B. Information Outlet Labeling: Tag all data jacks as defined herein.

C. Termination Hardware Labeling:

1. An identifier shall be provided at each termination hardware location or its label.

D. Grounding/Bonding Labeling:

1. The TMGB shall be labeled "TMGB." There shall be only one TMGB in the facility.

2. Label all TBB conductors connecting to the TMGB with a unique label, located at both ends of the TBB.

END OF SECTION

SECTION 27 11 00
COMMUNICATION EQUIPMENT ROOMS (CER)

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. This section describes the products and execution requirements related to furnishing and installing equipment for Communication Equipment Rooms. Communication Equipment Rooms include rooms for the Main Cross Connect (MC).

B. Definitions:

1. Main Cross Connect (MC): Allows single point administration of technology components for cross-connect of first level backbone cables, entrance cables and equipment cables.

C. Refer to Specification Section 27 05 28 for cable pathway and support requirements.

1.2 RELATED WORK

A. Section 27 05 00 - Basic Communications Systems Requirements
B. Section 27 05 26 - Communications Bonding
C. Section 27 05 28 - Interior Communication Pathways
D. Section 27 15 00 - Horizontal Cabling Requirements

1.3 QUALITY ASSURANCE

A. Refer to Section 27 05 00 for applicable standards.

1.4 SUBMITTALS

A. Under the provisions of Section 27 05 00 and Division 1, prior to the start of work the Contractor shall submit:

1. Manufacturer's data covering all products including construction, materials, ratings and all other parameters identified in Part 2 - Products, below.

2. Manufacturer's installation instructions.

B. Coordination Drawings:

1. Include ladder racking, equipment racks, cable tray and conduit sleeve layout in composite electronic coordination files. Refer to Section 27 05 00 for coordination drawing requirements.

PART 2 - PRODUCTS

2.1 EQUIPMENT GROUNDING

A. Refer to specification section 27 05 26 for grounding requirements.

B. All equipment required to be grounded shall be provided with a grounding lug suitable for termination of the specified size electrode conductor.

2.2 EQUIPMENT RACKS

A. Where identified on the drawings in Communication Equipment Rooms, equipment racks shall be furnished and installed by the Contractor to house cable termination components and network electronics.

B. The equipment rack shall conform to the following requirements:

1. Standard TIA/EIA 19" Floor Rack:

a. Equipment rack shall be 84" in height, self-supporting and provide a useable mounting height of 45 rack units (RU) (1 RU = 1 ¾").

b. Channel uprights shall be spaced to accommodate industry standard 19" mounting.

c. Equipment rack shall be double side drilled and tapped to accept 12-24 screws. Uprights shall also be drilled on back to accept cable brackets, clamps, power strip(s), etc. Hole pattern on rack front shall be per TIA/EIA specifications (5/8"-5/8"-1/2"). Hole pattern on the rear shall be at 3" intervals to accept cable brackets.

d. Equipment racks shall be provided with a supply of spare screws (minimum of 24).

e. Equipment racks shall be provided with a ground bar and #6 AWG ground lug.

f. Provide all mounting hardware and accessories as required for a complete installation.

2.3 CABLE MANAGEMENT – VERTICAL AND HORIZONTAL

A. Equipment Racks:

1. Equipment racks shall be equipped with vertical and horizontal cable management hardware in the form of rings and guides. Racks shall incorporate vertical and horizontal covers, to allow an orderly, hidden, routing of copper, optical fiber, and coax jumpers from the modular patch panels and/or 110-type termination blocks to the customer provided network electronics. Vertical and horizontal cable management hardware shall be as follows:

a. Horizontal cable management hardware shall be 16 gauge cold rolled steel construction with six (6) pass-thru holes and seven (7) front-mounted 3.5" steel rod D-rings. Provide with cover designed to conceal and protect cable.

b. At a minimum, horizontal cable management hardware shall be positioned above and below (a) each grouping of two rows of jacks on modular patch panels, and (b) above and below each optical fiber patch panel and (c) each grouping of two rows of F-type connectors on coax patch panels.

c. Vertical cable management hardware shall provide for cable routing on front and rear of each rack and be 14" deep x 6" wide (minimum). Where multiple equipment racks are to be installed, this hardware shall be mounted between the uprights of adjacent equipment racks. Equipment rack uprights and the spacers shall be secured together per manufacturer's recommendations. Provide with cover designed to conceal and protect cable.

2. Each equipment rack shall be supplied with a minimum of 12 releasable (e.g., "hook and loop") cable support ties.

3. Where cable termination hardware is wall-mounted, the Contractor shall be responsible for establishing a cable pathway for jumpers routed from the equipment rack(s) to the wall. This shall be in the form of slotted ducts or troughs. Routing of jumpers via the overhead cable tray or ladder rack system is NOT acceptable. The proposed method shall be included in the submittals required by this document and shall be approved by the Architect/Engineer prior to installation.

2.4 PATCH PANELS

A. Where identified on the drawings in Communication Equipment Rooms, modular patch panels shall be furnished and installed by the Contractor for termination of copper cable.

B. Copper cabling shall be terminated in Communication Equipment Rooms on modular patch panels consisting of a modular connector system incorporating modular jacks meeting the specifications for the jacks detailed in Section 27 15 00.

C. The largest single modular patch panel configuration shall not exceed 48-Ports. Modular patch panels shall be fully populated (all ports occupied by jacks) and be provided in increments of no less than 12 jacks. High-density modular patch panels will not be accepted.

D. The modular patch panel blocks shall have the ability to seat and cut eight (8) conductors (4 pairs) at a time and shall have the ability of terminating 22- through 26-gauge plastic insulated, solid and stranded copper conductors. Modular patch panel blocks shall be designed to maintain the cables' pair twists as closely as possible to the point of mechanical termination.

E. Modular patch panels shall incorporate cable support and/or strain relief mechanisms to secure the horizontal cables at the termination block and to ensure that all manufacturers minimum bend radius specifications are adhered to.

2.5 LADDER RACK

A. Provide complete ladder rack system including metallic ladder rack, splice connectors, fastening hardware and other miscellaneous materials as required for a complete installation per manufacturer's recommendations.

B. Steel C-Channel Stringer Style Ladder Rack:

1. Rolled steel siderail stringer, 2" stringer height, 9" spaced welded rungs.

2. Steel shall meet the requirements of ASTM A1011 SS Grade 33.

3. Loading limits shall be 292 lbs/ft for 4 ft spans.

C. Ladder rack finish shall be flat black powder coat standard ASTM B633 SC3 yellow zinc dichromate.

2.6 D-RINGS

A. Rounded edge D-rings for support of cabling in vertical and horizontal configurations.

B. EIA 310D compliant, manufactured from materials meeting UL94-V0 specifications.

C. Provide ¼" screw holes for wall mounting.

D. Provide power strips on all equipment racks, unless noted otherwise. These power strips shall have the following characteristics:

1. Standard Rack Mount:

a. TIA/EIA 19" equipment rack mountable.

b. Compliant with UL-1449 Third Edition and UL-497A.

c. Provide transient suppression to 12,000-A. Protection shall be in all three modes (line-neutral, line-ground and neutral-ground).

d. Shall meet or exceed ANSI C62 Category A3 requirements.

e. Provide high-frequency noise suppression as follows:

1) >20-dB @ 50 kHz
2) >40-dB @ 150 kHz
3) >80-dB @ 1 MHz
4) >30-dB @ 6 to 1000 MHz

f. Protection Modes and UL 1449 Clamping Voltage: 475 volt L-N, L-G, and N-G.

g. Components: Nonmodular units composed of 20mm metal oxide varistors (MOV). Series inductors, SAD, or selenium cells may be used in addition to MOVs.

h. Be equipped with a 10-foot power cord.

PART 3 - EXECUTION

3.1 EQUIPMENT RACKS

A. Equipment racks shall be furnished and installed as shown on the drawings.

B. The Contractor shall bolt the rack to the floor as recommended by the manufacturer. Multiple racks shall be joined and the ground made common on each. The rack shall be stabilized by extending a brace to the wall. Alternately, overhead ladder rack by which the cabling accesses the equipment rack(s) may provide this function.

C. A space between the rack upright and the wall (approximately 4") should be provided to allow for cabling in that area. The rear of the rack should be approximately 40" from the wall to allow for access by maintenance personnel. In all cases, a minimum of 40" workspace in front of the rack is also required. Locations where these guidelines cannot be followed should be brought to the attention of the Architect/Engineer for resolution prior to installation.

D. All hardware and equipment is to be mounted between 18" and 79" above floor level. This is to afford easy access and, in the case of the lower limit, prevent damage to the components. Positioning of hardware should be reviewed and approved by the Architect/Engineer and Site Coordinator(s) prior to installation.

E. Equipment racks shall be equipped with cable management hardware as to allow an orderly and secure routing of optical fiber and/or copper cabling to the optical fiber distribution cabinets and/or modular patch panels. At minimum, one such horizontal jumper management panel shall be placed below each optical fiber distribution cabinet installed by the Contractor. Additional Jumper Management panels may be required pending installation of other cable types on the equipment rack.

F. Each rack shall be grounded to the Telecommunications Ground Bar (GND) using a #6 AWG (or larger) insulated stranded copper conductor (GREEN jacket) directly or via an adjacent grounded equipment rack. Refer to grounding requirements below.

3.2 LADDER RACK

A. Provide support for ladder rack on 4 ft centers.

B. Maintain a 1.5 safety factor on all load limits specified herein.

C. Ladder rack support shall be by 5/8” diameter threaded rod when ceiling mounted. Ladder rack requiring wall mounting shall utilize accessories supplied by the ladder rack manufacturer specifically for the purpose of wall mounting ladder rack.

3.3 D-RINGS

A. Provide D-rings for cable routing and management in all areas where open cabling is routed along the wall in an Equipment Room.

B. Locate D-rings on 24" centers vertically and horizontally.

C. Securely attach D-rings to the wall as required by the manufacturer.

3.4 GROUNDING

A. Provide a complete grounding system in accordance with the requirements of Section 27 05 26.

3.5 CONDUITS AND CABLE ROUTING

A. Refer to Section 26 05 33 for additional requirements.

B. Where conduits enter a telecommunications room, conduits shall be terminated on the wall where shown on the contract documents. Conduits entering the room from the floor shall extend 3" above the floor slab.

C. Where cabling rises vertically in a telecommunications rooms, provide vertical cable management to support the cabling from floor to ceiling level.

D. All conduits shall be reamed and shall be installed with a nylon bushing.

E. Maintain appropriate conduit bend radius at all times. For conduits with an internal diameter of 2" or less, maintain a bend radius of at least 6 times the internal diameter. For conduits with an internal diameter greater than 2", maintain a bend radius of at least 10 times the internal diameter.

END OF SECTION

SECTION 27 15 00
HORIZONTAL CABLING REQUIREMENTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. This section describes the products and execution requirements relating to furnishing and installing horizontal communications cabling and termination components and related subsystems as part of a cabling plant. The cabling plant consists of copper cabling.

1.2 RELATED WORK

A. Section 27 05 00 - Basic Communications Systems Requirements

1.3 QUALITY ASSURANCE

A. Refer to Section 27 05 00 for relevant standards.

B. The channel shall be required to meet the performance requirements indicated herein. The manufacturer shall warranty the performance of their system to the required performance (and not just to the Standard, should the required performance exceed the Standard).

C. Specific components of the channel shall be required, at a minimum, to meet the Standard component requirements for that particular component.

D. The installing contractor must be certified by the manufacturer of the structured cabling system.

1.4 SUBMITTALS

A. Under the provisions of Section 27 05 00 and Division 1, prior to the start of work the Contractor shall submit:

1. Manufacturer's data covering all products proposed, including construction, materials, ratings and all other parameters identified in Part 2 - Products, below.

2. Manufacturer's installation instructions.

PART 2 - PRODUCTS

2.1 HORIZONTAL CABLE

A. CAT 6 Plenum Cable:

1. The horizontal cable requirements must be met, as well as the following channel requirements.

2. CAT 6 cable shall terminate on rack-mounted modular patch panels in their respective communication equipment room as indicated on the drawings.

3. Performance tests shall be conducted at a maximum discrete test frequency of 250 MHz for the channel. All numbers given are dB per 100 meters.

4. Channel Requirements:

Insertion Loss:	250 MHz	35.8 dB
NEXT:	250 MHz	33.1 dB
PS NEXT:	250 MHz	30.2 dB

Insertion Loss:	250 MHz	35.8 dB
ACR:	250 MHz	1.5 dB
PS ACR:	250 MHz	-5.7 dB
ELFEXT	250 MHz	18.8 dB
PS ELFEXT:	250 MHz	12.3 dB
Return Loss:	250 MHz	10.0 dB

5. The jacket color for CAT 6 cable shall be blue for data applications.

6. Basis of Design:

   a. Hubbell Nextspeed CMP

2.2 FACEPLATES/JACKS

A. CAT 6 Jacks:

1. CAT 6 horizontal cable shall each be terminated at their designated work area location on RJ-45 modular jacks. These modular jack assemblies shall snap into a modular mounting frame. The combined modular jack assembly is referred to as an information outlet.

2. The same orientation and positioning of modular jacks shall be utilized throughout the installation. Prior to installation, the Contractor shall submit the proposed configuration for each information outlet type for review by the Architect/Engineer.

3. Information outlet faceplates shall incorporate recessed designation strips at the top and bottom of the frame for identifying labels. Designation strips shall be fitted with clear plastic covers.

4. Where standalone CAT 6 only modular jacks are identified, the information outlet faceplate shall be configured as to allow for the addition of one (1) additional modular jack CAT 6 to be installed to supplement each such modular jack as defined by this project. The installation of these supplemental modular jacks is NOT part of this project.

5. Any unused modular jack positions on an information outlet faceplate shall be fitted with a removable blank inserted into the opening.

6. All modular jacks will be fitted with a dust cover. Modular jacks shall incorporate a dust cover that fits over and/or into the modular jack opening. The dust cover shall be designed to remain with the modular jack assembly when the modular jack is in use. No damage to the modular jack pinning shall result from insertion or removal of these covers. Dust covers that result in deformation of the modular jack pinning, will not be accepted.

7. The information outlet faceplate shall be constructed of high impact plastic (except where noted otherwise). The information outlet faceplate color shall (1) match the faceplate color used for other utilities in the building or (2) when installed in surface raceway (if applicable), match the color of that raceway.

8. Information outlets that incorporate optical fiber shall be compliant with the above requirements plus:

   a. Be a low-profile assembly.

   b. Incorporate a mechanism for storage of cable and fiber slack needed for termination.

9. All information outlets and the associated modular jacks shall be of the same manufacturer throughout the project.

10. The CAT 6 modular jacks shall be non-keyed 8-pin modular jacks.

11. The interface between the modular jack and the horizontal cable shall be a 110-type termination block or insulation displacement type contact. Termination components shall be designed to maintain the horizontal cable's pair twists as closely as possible to the point of mechanical termination.

12. CAT 6 modular jacks shall be pinned per TIA-568A.

13. CAT 6 termination hardware shall, as a minimum, meet all of the mechanical and electrical performance requirements of the following standards:

    a. ANSI/TIA/EIA-568-A-5
    b. ANSI/TIA/EIA-568A
    c. ISO/IEC 11801
    d. IEC 603-7
    e. FCC PART 68 SUBPART F

14. The color for CAT 6 jacks shall be ivory

PART 3 - EXECUTION

3.1 CABLE INSTALLATION REQUIREMENTS

A. Horizontal Cabling:

1. The maximum horizontal cable drop length for Data UTP shall not exceed 295 feet (90 meters) in order to meet data communications performance specifications. This length is measured from the termination panel in the wiring closet to the outlet and must include any slack required for the installation and termination. The Contractor is responsible for installing horizontal cabling in a fashion so as to avoid unnecessarily long runs. Any area that cannot be reached within the above constraints should be identified and reported to the Architect/Engineer prior to installation. Changes to the contract documents shall be approved by the Architect/Engineer.

2. All cable shall be free of tension at both ends. In cases where the cable must bear some stress, Kellum grips may be used to spread the strain over a longer length of cable.

3. Manufacturer's minimum bend radius specifications shall be observed in all instances.

4. Horizontal cabling installed as open cabling shall be supported at a maximum of 5' between supports. Refer to the specifications for required cable supports.

5. Horizontal cabling installed as open cable or in cable tray shall be bundled at not less than 10' intervals with hook-and-loop tie wraps. The use of plastic cable ties is strictly prohibited.

6. The maximum conduit fill for horizontal cabling shall not exceed 40% regardless of conduit length.

7. Cable sheaths shall be protected from damage from sharp edges. Where a cable passes over a sharp edge, a bushing or grommet shall be used to protect the cable.

8. A coil of 3 feet in each cable shall be placed in the ceiling at the last support (e.g., J-hook, bridle ring, etc.) before the cables enter a fishable wall, conduit, surface raceway or box. At any location where cables are installed into movable partition walls or modular furniture via a service pole, approximately 15-feet of slack shall be left in each horizontal cable under 250 feet in length to allow for change in the office layout without re-cabling. These "service loops" shall be secured at the last cable support before the cable leaves the ceiling and shall be coiled from 100% to 200% of the cable recommended minimum bend radius.

9. To reduce or eliminate EMI, the following minimum separation distances from 480V power lines shall be adhered to:

   a. Twelve (12) inches from power lines of <5-kVa.
   b. Eighteen (18) inches from high-voltage lighting (including fluorescent).
   c. Thirty-nine (39) inches from power lines of 5-kVa or greater.
   d. Thirty-nine (39) inches from transformers and motors.

10. Information outlets shown on floor plans with the subscript "W" are intended to be used for wall mounted telephones. Back boxes for wall mounted telephones shall not be located within 12" vertically, or horizontally, from any light switches, power receptacles, nurse call devices, thermostats, or any other architectural element that would otherwise prevent the installation of a wall mounted telephone on the mating lugs.

3.2 CABLE TERMINATION REQUIREMENTS

A. Cable Terminations - Data UTP:

1. Modular patch panels shall be designed and installed in a fashion as to allow future horizontal cabling to be terminated on the panel without disruption to existing connections.

2. If the "last" patch (per rack) is greater than 50% utilized, one additional patch panel shall be provided for future use. Modular patch panels shall be sized to accommodate a minimum of 12 additional drops.

3. At information outlets and modular patch panels, the Contractor shall ensure that the twists in each cable pair are preserved to within 0.5-inch of the termination for data cables. The cable jacket shall be removed only to the extent required to make the termination.

END OF SECTION

SECTION 27 17 10
TESTING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. This section describes the testing requirements relating to the structured cabling system and its termination components and related subsystems.

1.2 RELATED WORK

A. Section 27 05 00 – Basic Communications Systems Requirements

1.3 QUALITY ASSURANCE

A. Refer to Section 27 05 00 for relevant standards.

1.4 SUBMITTALS

A. Under the provisions of Section 27 05 00 and Division 1, prior to the start of work, the Contractor shall submit:

1. Complete information on testing procedure as described herein.

PART 2 - PRODUCTS

2.1 TESTING COPPER

A. General Requirements:

1. The Contractor is responsible to perform acceptance tests as indicated below for each sub-system (e.g., backbone, horizontal, etc.) as it is completed.

2. The Contractor is responsible for supplying all equipment and personnel necessary to conduct the acceptance tests. Prior to testing, the Contractor should provide a summary of the proposed test plan for each cable type including equipment to be used, setup, test frequencies or wavelengths, results format, etc. The method of testing shall be approved by the Architect/Engineer.

3. The Contractor shall visually inspect all cabling and termination points to ensure that they are complete and conform to the wiring pattern defined herein. The Contractor shall provide the Architect/Engineer with a written certification that this inspection has been made.

4. The Contractor shall conduct acceptance testing according to a schedule coordinated with the Owner/Architect/Engineer. Representatives of the Owner may be in attendance to witness the test procedures. The Contractor shall provide a minimum of one (1) week's advance notice to the Architect/Engineer to allow for such participation. The notification shall include a written description of the proposed conduct of the tests, including copies of blank test result sheets to be used.

5. Tests related to connected equipment of others shall only be done with the permission and presence of the Contractor involved. The Contractor shall ascertain that testing only is required to prove the wiring connections are correct.

6. The Contractor shall provide test results and describe the conduct of the tests including the date of the tests, the equipment used, and the procedures followed. At the request of the Architect/Engineer, the Contractor shall provide copies of the original test results.

7. All cabling shall be 100% fault-free unless noted otherwise. If any cable is found to be outside the specification defined herein, that cable and the associated termination(s) shall be replaced at the expense of the Contractor. The applicable tests shall then be repeated.

8. Should it be found by the Architect/Engineer that the materials or any portion thereof furnished and installed under this Contract fail to comply with the specifications and drawings with respect or regard to the quality, amount, or value of materials, appliances, or labor used in the work, it shall be rejected and replaced by the Contractor and all work disturbed by changes necessitated in consequence of said defects or imperfections shall be made good at the Contractor's expense.

1) Horizontal Cable:

a) Testing shall be from the modular jack at the information outlet in the work area to the 110-type termination block on which the cables are terminated at the Communication Equipment Room.

b) All horizontal cable shall be free of shorts within the pairs and be verified for continuity, pair validity and polarity, and conductor position on the modular jack (e.g., wire map). Any defective, split, or mis-positioned pairs must be identified and corrected.

b. CAT 6 Cable:

1) Testing shall be from the modular jack at the information outlet to the modular patch panel in the communication equipment room.

2) Horizontal cable shall be free of shorts within the pairs, and be verified for continuity, pair validity and polarity, and conductor position on the modular jack (e.g., wire map). Any defective, split, or mis-positioned pairs must be identified and corrected.

3) CAT 6 horizontal cable shall also be tested to 250 MHz as defined by TIA/EIA-568-C.2. Measurements shall be of the "Basic Link" including cabling and modular jacks at the information outlet and modular patch panel. Parameters to be tested must include:

a) Wire Map
b) Length
c) NEXT Loss (Pair-to-Pair)
d) NEXT (Power Sum)
e) ELFEXT (Pair-to-Pair)
f) ELFEXT (Power Sum)
g) Return Loss
h) Attenuation
i) Propagation Delay
j) Delay Skew

4) The maximum length of horizontal cable shall not exceed 295 feet (90m), which allows 33 feet (10 m) for technology equipment and modular patch cords.

5) To establish testing baselines, cable samples of known length and of the cable type and lot installed shall be tested. The cable may be terminated with an eight-position CAT 6 modular connector (8-pin) to facilitate testing. Nominal Velocity of Propagation (NVP) and nominal attenuation values shall be

calculated based on this test and be utilized during the testing of the installed cable plant. This requirement can be waived if NVP and nominal attenuation data is available from the cable manufacturer for the exact cable type under test.

6) CAT 6 horizontal cable testing shall be performed using a test instrument designed for testing to 250 MHz or higher. Test records shall verify, "PASS" on each cable and display the specified parameters, comparing test values with standards based "templates" integral to the unit. Test records that report a PASS*, FAIL*, or FAIL result for any of the parameters will not be accepted.

7) In the event results of the tests are not satisfactory, the Contractor shall make adjustments, replacements, and changes as necessary and shall then repeat the test or tests that disclosed faulty or defective material, equipment, or installation methods, and shall make additional tests as the Architect/Engineer deems necessary at no additional expense to the project or user agency.

2.2 DOCUMENTATION/AS-BUILTS/RECORDS

A. General:

1. Upon completion of the installation, the Contractor shall submit as-builts per the requirements of Section 27 05 00 and Division 1. Documentation shall include the items detailed in the subsections below.

2. All documentation, including hard copy and electronic forms, shall become the property of the Owner.

3. The Architect/Engineer may request that a 10% random field retest be conducted on the cable system at no additional cost to verify documented findings. Tests shall be a repeat of those defined above. If findings contradict the documentation submitted by the Contractor, additional testing can be requested to the extent determined necessary by the Architect/Engineer, including a 100% retest. This retest shall be at no additional cost to the Owner.

B. Copper Media Test Data:

1. Test results shall include a record of test frequencies, cable type, conductor pair and cable (or Outlet) I.D., measurement direction, test equipment type, model and serial number, date, reference setup, and crew member name(s).

2. Printouts generated for each cable by the wire test instrument shall be submitted as part of the documentation package. The Contractor shall furnish this information in electronic form (CD-ROM). The CD-ROM shall contain the electronic equivalent of the test results as defined by the bid specification and be of a format readable by Microsoft Word (Version 6.0 or newer). The Contractor shall provide a licensed copy of the software required to view and print the data that is provided in a proprietary format. The Contractor shall furnish one (1) copy of the Data and Display (if applicable) software.

PART 3 - EXECUTION

NOT APPLICABLE

END OF SECTION

SECTION 27 17 20
SUPPORT AND WARRANTY

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. This section describes support and warranty requirements relating to the structured cabling system and related subsystems.

1.2 RELATED WORK

A. Section 27 05 00 – Basic Technology Systems Requirements.

1.3 QUALITY ASSURANCE

A. Refer to Section 27 05 00 for relevant standards.

PART 2 - PRODUCTS

2.1 MANUFACTURER REQUIREMENTS

A. The Basis of Design for all structured cabling components is listed on the drawings within the General Technology Equipment Schedule.

2.2 WARRANTY

A. A twenty-five (25) year Product Installation Warranty and System Assurance Warranty shall be provided for the structured cabling system as described in the contract documents.

B. The Product Installation Warranty shall cover the replacement or repair of the defective product(s) and labor for the replacement or repair of such defective product(s).

C. The system assurance warranty shall cover the failure of the wiring system to support the application it was designed to support, as well as additional applications introduced in the future by recognized standards or user forums that use the TIA/EIA 568A component and link/channel specifications for cabling.

D. Upon successful completion of the installation and subsequent inspection, the Owner shall be provided with a numbered certificate from the manufacturing company registering the installation.

PART 3 - EXECUTION

NOT APPLICABLE

END OF SECTION

SECTION 27 20 00
FIRE STATION ALERTING
"FOR REFERENCE ONLY"

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. This section describes the products and execution requirements related to furnishing and installing equipment for the Fire Station Alerting System. System shall be a US Digital Designs "Phoenix G2" system or equal. It shall be capable of interfacing to, and receiving alerts from a data network, radio network and two-tone paging system.

B. The work under this section is for Owner provided and installed Fire Station Alerting devices and Owner provided backboxes. The contractors work include installation of the backboxes given to them by the owner and contractor provided conduits and all cabling. Refer to Specification Section 27 05 28 for cable pathway and support requirements.

1.2 RELATED WORK

A. Section 27 05 00 - Basic Communications Systems Requirements
B. Section 27 05 26 - Communications Bonding
C. Section 27 05 28 - Interior Communication Pathways
D. Section 27 15 00 - Horizontal Cabling Requirements

1.3 QUALITY ASSURANCE

A. Refer to Section 27 05 00 for applicable standards.

1.4 SUBMITTALS

A. Under the provisions of Section 27 05 00 and Division 1, prior to the start of work the Contractor shall submit:

1. Contractor licenses and qualifications are required as part of the complete Division 27 submittal package as indicated under Specification 27 00 05.

2. No submittals are required for the Owner provided USDD equipment.

3. Contractor to follow Manufacturer's installation instructions for backboxes, conduits and cabling requirements for a complete USDD Fire Station Alerting system

1.5 SUMMARY

1. The City of Madison IT department shall work with the manufacturer of the UDSS Fire Station Alerting System to provide all backboxes and all devices necessary for the complete system. The City of Madison IT department will also work with the manufacture to provide all product firmware and software necessary for a complete installation and upgrades for a period of the warranty. The contractor shall work with the City of Madison IT department to install the backboxes provided along with providing all conduits and cabling necessary for a complete system. Contractor is to work with the City of Madison IT Department for termination and testing of the cabling for each device the City of Madison IT Department installs. Contractor to follow all manufacturer recommendations and requirements for installation of all cabling.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. The products specified shall be new and of the standard manufacture of a single reputable manufacture. As a reference of standard and quality, functionality and operation, it is a request of the Owner that bids be based on equipment manufactured by US Digital Designs, Tempe, Arizona.

2.2 CABLING

A. Cabling shall be in strict accordance with local codes and to the cable specifications found in the manufacturer's installation manual.

B. All peripheral network cabling shall be ANSI/TIA-568-B Category 6 UTP plenum rated cable. Cable jacket shall be yellow in color. Certification documents shall be provided for all cabling runs. Refer to Cable specification 27 15 00 for Horizontal Cabling requirements

C. Message Remote message sign data cable shall be a minimum of 6 conductor cable with 6 conductor modular plugs attached at both ends. Wiring shall be straight through wiring (DO NOT turn over conductors). Message Sign to Message Remote cabling shall be no longer than 25 feet to observe proper serial operation.

D. All speaker cabling shall be 18 gauge, 2-conductor stranded jacketed cables for speakers only and 18 gauge, 4-conductor stranded jacketed cables for Jupiter speaker lights.

E. All wiring shall be free of shorts and faults. Wiring shall be UL listed, NEC and NFPA 70, Article 25 approved. Terminate all network cabling on approved patch panels. Label each jack panel with room number of each terminating jack and the end of corresponding cable with jack panel number and jack number. Terminate all 4 pairs of Category 6 cable on manufacturer approved connectors and test and certify all connection to 100 MHz. Provide all cabling test certifications after testing.

2.3 FIRE STATION CONTROLLER EQUIPMENT

A. All equipment is furnished and installed by Owner. Each unit shall have the following equipment factory installed and interconnected: Fire Station Controller, Audio Tone Unit – ATU, 24 port Ethernet Switch, 24-port Ethernet Audio Mixer. UPS, Cabling Patch Panels, Radio mounting bracket.

2.4 MESSAGE REMOTES

A. Owner furnished and installed as shown on plans. Capable of dual message sign control, independently controlled dual 15-watt audio amplifier, lighting control, flush or surface mountable., single cable connection.

2.5 ROOM REMOTES

A. Owner furnished and installed as shown on plans. Capable of integrated message display, 15-watt audio amplifier, lighting control, flush or surface mountable., single cable connection.

2.6 SPEAKER SYSTEMS

A. Speaker system shall be 70 volts. Speakers shall be grouped into "areas" of similar sound level and unit alerting requirements.

B. City of Madison IT Department will furnish speaker(s): Manufacturer recommended: Juniper, Bogen S86T725PG8W in corridors and rooms. US Digital Design Low voltage lighted LED Jupiter speakers for lighted applications and Bogen NEAR A2 speakers for weather resistant applications.

PART 3 - EXECUTION

3.1 SUPERVISION

A. Equipment racks shall be furnished and installed as shown on the drawings. Only Factory trained installers shall install, service and maintain the specified system.

3.2 ROUGH OPENINGS

A. The Phoenix G2 Station Alerting System Station Alerting system shall be mounted in the 19-inch equipment rack in the telecommunications room.

B. The Room Remote devices require a minimum of a 5.5" High x 13.5" Wide opening. Typical mounting height if wall mounted is 48" AFF, Contractor to provide back box appropriately sized for equipment being furnished, confirm all sizes of back boxes with manufacturer before installation.

C. Provide access panels in drywall ceilings where access is restricted to devices above ceilings.

3.3 WIRING

A. All peripheral network cables terminate in a patch panel located in the Station Controller Cabinet. Each peripheral requires a single telecommunications outlet. Jack to be a Panduit CJ Mini-Com type jack or equivalent for Category 6 cable installation. Contractor to test and certify all connections to 250 MHz. Provide all cabling test certifications after testing. Contractor is to provide the patch panel, jack and cabling described in the beginning of this note.

B. All speaker cables shall be as noted under products for the basis of design.

C. All wiring shall be free of shorts and faults. Wiring shall be UL Listed, NEC and NFPA 70, Article 25 approved.

D. 8 ohm speakers shall have cabling run to nearest speaker, Message Remote or Room Remote. 70-volt speaker shall have cabling run to nearest speaker, Message Remote with 70 volt transformer, or home run to Station Controller.

E. Label both ends of all network cabling and all speaker cabling. Label patch panel for Station Controller.

3.4 OUTLET BOXES

A. Provide pull string in all empty conduits installed for these devices. All conduits to have bushings at ends for protection of cabling that will be installed. No conduit shall be smaller than 3/4".

B. Message Remote – provide a 4" metal box with mud ring as indicated on drawings. Center box above doorway or as directed by architect. Orient mud ring opening horizontally. Provide a minimum of (1) ¾" conduit between Message Remote to nearest accessible ceiling, cable tray or other location. Any units mounted in hard ceilings shall be routed from j-box to nearest accessible ceiling.

C. Ceiling Speakers mounted suspended ceiling shall have Bogen RE84 ceiling speaker enclosures as required.

D. Ceiling Speakers mounted in hard ceiling shall have Bogen TB8 ceiling speaker enclosures as required.

E. Apparatus Bay, Exterior or weather resistant speakers shall be mounted in a 4" metal box with mud ring at each location. Provide a ¾" diameter hole centered in the j-box cover with a bushing to allow speaker cable to run to speaker. Typically the apparatus bay speakers are located at +13' AFF, typically outside speakers are located at +11' AFF.

F. Room Remote, provide ¾" empty conduit from rough opening to nearest accessible ceiling. Rough opening to be located at 48" AFF typical and no more than +64" AFF.

3.5 SPEAKERS

A. Ceiling speakers shall include tile bridges per manufacturer's recommendations. Connect Speakers to Room Remotes and Message Remotes. Provide 70 volt transformers as required

B. Apparatus Bay Speakers shall be in enclosures and connect to Room Remotes or Message Remotes.

3.6 EQUIPMENT MOUNTING

A. All equipment mounting to be to drywall shall use appropriate fasteners and anchors

3.7 ELECTRICAL POWER CONNECTIONS

A. It shall be the responsibility of all trades to provide the appropriate number of dedicated 120 volt, 20-amp duplex receptacles for equipment cabinet rough openings. Provide equipment labeling "Station Alerting" on all equipment for this system.

3.8 ENVIRONMENTAL PROTECTION

A. Make certain that all equipment is accessible for service.

3.9 CONNECTIONS TO OTHER EQUIPMENT

A. Lighting Controller. Connect low voltage dry contact lighting controls to Room Remote, Message Remote and other ATU outputs – if required by Owner. These controls are provided by a different specification section.

B. Local Area Network. Connect the Fire Station Controller to the LAN located at the Fire Station. This connection shall be connected back to the Communications Gateway to allow alerting commands to be sent from the Communications Gateway to the Fire Station Controller. In addition, the connections allow remote diagnostics and configuration. The LAN is provided by the City of Madison.

C. Radio System. Connect Audio input #1 to the dispatch voice radio system (provided by others) as necessary to provide dispatch audio. This connection shall provide a 600-ohm impedance 0 dBm level signal.

D. Telephone system Intercom. Connect Audio Input #3 to an intercom output from the building telephone system (provided by others). This line shall be provided via a jack box located directed adjacent to the Station Alerting system equipment.

E. Other Audio Source. Connect Audio Input #4 to an audio source (provided by others). This line shall be provided via a jack box located directly adjacent to the Station Alarming System equipment.

END OF SECTION

SECTION 27 21 33
WIRELESS ACCESS POINTS (WAP)

PART 1 – GENERAL

1.1. SCOPE

A. The work under this section is for the installation of OWNER PROVIDED, CONTRACTOR INSTALLED Wireless Access Points (WAP).

B. The WAPs shall be installed by the contractor providing and installing the Communications Cable and Equipment. All contractor qualifications and certifications for that section shall apply to this section.

1.2. RELATED SPECIFICATIONS

A. The Contractor shall be responsible for reviewing all other specifications for requirements associated with the complete installation of WAP's. This includes but is not limited to the following:

1. 01 31 23 Project Management Web Site
2. 01 33 23 Submittals
3. 27 00 05 Communications Cabling

1.3. SUBMITTALS

A. Contractor licenses and qualifications are required as part of the complete Division 27 submittal package as indicated under Specification 27 00 05.

B. No submittals are required for the owner provided WAP.

C. Submittals are required for installation/hanger equipment, connectors, and any other required equipment/material required for a complete WAP installation.

PART 2 - PRODUCTS

2.1. WIRELESS ACCESS POINT (WAP) DEVICES

A. The City of Madison Information Technology Department (CoM-IT) will be providing the WAP devices for this project.

B. The WAP device being used will be as manufactured by the Cisco, Model 3700E and shall be used for all types of ceiling mounted installations (suspended, gyp board, open truss, etc).

PART 3 - EXECUTION

3.1. OWNER RESPONSIBILITIES

A. The CoM-IT shall be responsible for ordering, making payment (including shipping fees), and configuring all WAP devices in a timely manner to comply with the Contractors schedule.

B. The CoM-IT shall configure and test each WAP to CoM-IT specifications prior to providing them to the contractor for installation.

C. The CoM-IT shall number each WAP and provide the contractor with a location map indicating where each WAP will be installed.

C. The CoM-IT shall test all WAP's after installation to verify configuration and signaling is correct prior to accepting the final installation of the WAP system.

3.2. CONTRACTORS RESPONSIBILITIES

A. The Contractor shall be solely responsible for coordinating with CoM-IT the scheduling and receipt of all WAP devices with his/her installation schedule.

B. The Contractor shall inspect all WAP devices upon receipt for damage. CoM-IT shall be notified immediately of any damage.

C. The Contractor shall provide all mounting hardware, blocking, and other items required for a complete installation to the manufacturers installation requirements.

D. The Contractor shall install all WAP devices per plans and specifications including cable connections.

E. The Contractor shall be responsible to pick up WAP devices from City IT and delivery to the jobsite.

3.3. FINAL TESTING

A. Contractor shall provide final testing of all WAP devices after installation is complete.

B. In the event any WAP device is not operating properly the contractor shall trouble shoot the installation and work with the CoM-IT to determine if re-configuration of the device will be required.

C. The CoM-IT shall be responsible for reconfiguring WAP's as needed after installation is complete. The contractor shall be responsible for verifying connections, cabling and connectivity of the installation is correct.

3.4. WARRANTY

A. The CoM-IT will be responsible for registering any warranty information associated with the purchase and ownership of all WAP devices.

B. The Contractor shall warrant the installation of the WAP device for one (1) year per the terms of this contract.

END OF SECTION

SECTION 27 41 23
AUDIO-VIDEO ACCESSORIES
"FOR REFERENCE ONLY"

PART 1 – GENERAL

1.1. SUMMARY

A. This specification shall identify equipment and accessories required for to complete Audio-Video (A/V) installations not previously identified in other Division 27 specifications. It does include materials such as cables, boxes, connectors, conduit, supports required to complete the installation.

B. This specification shall clearly identify responsibilities of various contractors and the Owner including project coordination, installation, and testing of installed components.

1.2. RELATED SPECIFICATIONS

A. 01 31 23 Project Management Web Site
B. 01 33 23 Submittals
C. 01 78 23 Operation and Maintenance Data
D. 01 78 36 Warranties
E. 01 78 39 As-Built drawings
F. All Division 27 specifications that may apply to this installation
G. Other division specifications that may apply to this work for coordination

1.3. AREAS OF RESPONSIBILITY

A. The General Contractor shall be responsible for ensuring all of the following:
   1. Coordinate with the Contractor and the Owner or Owners Representative the scheduling, purchasing, and receiving of all Owner provided products and equipment.
   2. Coordinate all Contractor related work with the construction schedule.
   3. Coordinate all required Work with the Contractor and other trades during pre-installation meetings and resolve installation issues as needed.

B. The Contractor shall be responsible for all of the following:
   1. Direct coordination with the Owner or Owners Representatives for all equipment being provided and/or configured by the Owner.
   2. Verification of Owner installation requirements prior to installing equipment and accessories.

C. The Owner or Owners Representatives shall be responsible for all of the following:
   1. Coordinating all purchases and deliveries of the Owner provided equipment to the project site with the GC and Contractor so as not to delay the installation or project schedule.
   2. Coordinate the pre-installation configuration of any A/V equipment so as not to delay the installation or project schedule.

1.4. SUBMITTALS

A. The Contractor shall not be required to provide submittals for equipment being provided by the Owner but shall provide submittals for ancillary equipment as needed under this specification or other Division 27 specifications.

B. The Contractor shall provide submittals of the following:

1. All applicable licenses of the Contractor and the Contractor's installation team. Applicable licenses shall be current from the start of the contract through the end of the warranty period.
2. One (1) submittal for all ancillary A/V and A/V Contractor provided equipment required for a complete A/V installation as follows:
   a. Product information sheets and shop drawings indicating each type/size/model of A/V accessory required for a complete A/V installation. Information sheets shall include the following information:
      i. Performance data for the item
      ii. Plan identification number(s) where applicable
      iii. Quantity required for each model

1.5. WARRANTY

A. The Contractor shall also provide all manufacturers warranties/guarantees associated with only contractor installed components of the installation.

PART 2 - PRODUCTS

2.1. PRODUCTS FURNISHED BY OWNER

A. The following products shall be furnished by the owner under this specification.
   1. IPTV cable boxes
   2. All monitor wall mounts
   3. Power Amplifiers
   4. Wall monitors as indicated in the plans and specifications (see section 2.3 below).

2.2 WALL MONITORS

A. New wall monitors furnished by the City of Madison (Owner).
   1. Sizes shall include 60" and 90" monitors.

2.3. WALL MOUNTS (MONITOR)

A. The City of Madison (Owner) shall provide wall mount brackets for all wall monitor installations noted in the construction documents.

B. Wall mount brackets shall be appropriately sized to support the monitor sizes described in the construction documents. Mount brackets are to be by the City of Madison (Owner).

2.4 POWER AMPLIFIER

A. The City of Madison (Owner) shall provide the Power Amplifier for the Sound System.

2.5. IP CABLE BOX

A. IP Cable Boxes shall be provided by the Owner and installed by the Contractor. This section is being provided as informational only. The Contractor shall be responsible for providing/installing the input to the cable box and the output to the monitor.
   1. Amino Communications, Aminet A140, cable box
      a. Input = Ethernet 10/100 BaseT via RJ-45 shielded connector
      b. Output = HDMI 1.3A with HDCP
      c. Power = 120V
      d. Decodes up to 720p and 1080i; displays up to 1080p
      e. HD graphics up to 1280x720

B. The Owner shall designate which model is required at each location.

2.6 PRODUCTS FURNISHED BY CONTRACTOR

A. The Contractor shall furnish all cabling, backboxes and conduits required for a complete A/V installation per the plans and specifications except where indicated as furnished by Owner.

B. All products, materials and equipment furnished by the contractor shall be new and meet all applicable codes.

C. The Contractor shall provide the following equipment as noted within this specification:

2.7 SPEAKERS

A. The contractor shall provide the following speakers or those of similar quality.
   1. Bogen Model: S810T725PG8WVR. 70 or 25 volt, 4 watt, ceiling mounted. Provide speaker and all mounting hardware to make for a complete installation.
   2. Bogen WBS810T725, 70 or 25 volt, 4 watt, wall mount. Provide speaker and all mounting hardware to make for a complete installation.

PART 3 - EXECUTION

3.1. CONTRACTOR COORDINATION

A. The Contractor shall coordinate with the General Contractor (GC) and all other trade contractors as needed for the installation of the A/V Accessories. Coordination shall include a pre-installation meeting during rough-in to ensure blocking, power outlets, and data outlets are properly located.

B. The Contractor shall review all plans and specifications indicating wall and position requirements for accessory A/V equipment and install all required equipment accordingly.
   1. The Contractor shall coordinate all connection and installation requirements with other trade contractors doing Division 27 Work.

3.2. GENERAL INSTALLATION REQUIREMENTS

A. Cables/cords shall be properly plugged in. Excess cable/cord shall be neatly looped and bundled using Velcro cable ties. Zip ties, wire ties, and other rigid, semi-permanent restraints will not be allowed.
   1. Excess cables/cords shall not be visible after the installation is complete.
      a. Example: Cables/cords behind wall monitors shall be neatly bundled behind the monitor and fastened to the monitor wall mount so as not to be visible from the front of the monitor.

B. Equipment mounts shall be properly sized for the equipment being supported. Fasteners shall be of sufficient strength to support the finished installation including required equipment.
   1. Fasteners shall be firmly attached to blocking where provided.
   2. Fasteners in solid materials such as concrete, brick, etc shall use appropriate sleeves and anchors for the material, weight being supported, and fastener being used.
   3. All drop ceiling mount locations shall have tile bridge supports.

C. Final testing of A/V components shall be performed only after all A/V equipment and components within Division 27 have been completely installed to ensure all components have been properly integrated with each other as needed.

3.3. EQUIPMENT INSTALLATION, TESTING, AND ACCEPTANCE

A. Any required system programming (by CoM-IT or Contractor) shall be completed prior to doing any installation testing and acceptance.

B. It is the sole responsibility of the Contractor to notify CoM-IT no less than two (2) weeks in advance of completing the installation to coordinate all final testing of the completed system.

C. Wall Mounts:
   1. Wall mounts shall be securely fastened to the wall and blocking per the manufacturer's supplied instructions and mounting hardware. Wall mounts shall be located horizontally and vertically on the designated wall as indicated in plans and details for each room receiving monitors.
   2. Monitors shall be securely installed on the wall mount.
   3. The mounting bracket shall be tested with the completed monitor and cable/cords properly installed. The completed installation and successful testing of the mounting bracket installation shall provide the following:
      a. All cords/cables are properly plugged in, excessive cable is bundled but not stretched tight, cords/cables are not pinched or impede the mounting brackets range of motion.
      b. Full range of motion in all directions as per the specifications above.

D. Monitor testing shall be part of the overall Division 27 installation of all A/V equipment and requirements. This shall include but not be limited to the following:
   1. Remote control is fully functional at each monitor location
      a. A single remote is used and properly programmed to control monitors, IPTV cable boxes and other devices as needed.
         i. Controls on/off/volume and other related functions as a TV with an IP Cable Box.
         ii. Controls various input modes as a monitor as described in other Division 27 specifications.
         iii. Works with other video/audio feeds as described in other Division 27 specifications.

2. Monitor (each location) functions in all modes and inputs as designated in the contract documents.
    a. Test with Polycom system
    b. Test with portable devices (laptop, etc)

E. The IP Cable Box shall be tested at each location installed. Troubleshoot and re-test as necessary. Contact Owners Representative if a bad unit is suspected for immediate replacement.

F A completed and accepted installation shall pass all of the above tests for each location where equipment will be installed.

G. The warranty period for the completed and accepted installation shall not begin until the date of the accepted general contract. The Contractor shall coordinate this date with the General Contractor.

END OF SECTION

SECTION 27 41 43
AUDIO-VIDEO CONFERENCING (POLYCOM)
"FOR REFERENCE ONLY"

PART 1 – GENERAL

1.1. SUMMARY

A. These specifications describe the materials, equipment, and installation requirements to install a fully integrated, audio-video conferencing system (Polycom) currently in use by the City of Madison (Owner).

B. The Contractor shall be responsible for verifying equipment cabling requirements, locations, and coordination with the General Contractor and all other necessary trades as needed for a complete installation.

1.2. RELATED SPECIFICATIONS AND REFERENCES

A. The Contractor shall be responsible for reviewing all other specifications for requirements associated with the complete installation of A/V Accessories associated with this specification. This includes but is not limited to the following:

1. 01 31 23 Project Management Web Site
2. 01 33 23 Submittals
3. 27 05 00 Basic Communication Systems Requirements
4. 27 41 23 Audio-Visual Accessories

B. The Contractor shall be familiar with all Polycom best practice guides for system design and component placement. The Contractor shall be responsible for reviewing all plans and providing written notification to the Architect and owner in the event the plan set is in error.

1.3. RELATED DRAWINGS

A. Refer to all Electrical drawings for locations of distribution panels and equipment as it relates to standard line voltage locations.

B. Refer to all Technical drawings for locations of Polycom and other related audio visual equipment.

C. Refer to Architectural floor plans and details for information relating to equipment shelves, wall location, and blocking requirements.

1.4. CONTRACTOR QUALIFICATIONS

A. The Contractor shall be a certified in all of the following aspects associated with the complete installation of the specified Polycom system:

1. Polycom Platinum Solution Advisor in the Polycom Certified/Specialized Partner Program.

1.5. AREAS OF RESPONSIBILITY

A. The Owner and City of Madison Information Technology Department (CoM-IT) shall be responsible for all the following:

1. Review the plans and Polycom Best Practice Requirements for each installation with the Contractor.
2. Order & purchase all major Polycom components in quantities per the comprehensive list generated by the Contractor. Provide estimated delivery dates to the Contractor with confirmation of orders. The Owner and CoM-IT shall be responsible for the following major Polycom components:

a. Codecs, by owner
b. Cameras, by owner
c. Microphones, by owner

3. The CoM-IT shall be responsible for programming the Polycom codecs.
4. The Owner shall not be responsible for ancillary equipment required to complete the installation.

B. The General Contractor (GC) shall be responsible for the following:
1. Coordinating progress scheduling with the Contractor for all A/V related equipment.
2. Coordinating scheduling with the Owner for the timely purchase of equipment.
3. Receiving all A/V equipment delivered to the construction site and notifying the Contractor and Owner of its arrival.
4. Providing dry and secure storage for all A/V equipment until installed.

C. The Contractor shall be responsible for the following:
1. The Contractor shall review with CoM-IT the plans and Polycom Best Practice Requirements for each installation. The Contractor shall provide a comprehensive list of major components and quantities to be ordered/purchased by the Owner.
2. Coordinating/reporting installation progress with the GC, Owner, and CoM-IT.
3. See other division 27 specifications for additional A/V installation requirements.
a. Connector cables, connector ends, and cable ties

D. The following equipment shall be provided by the contractor under the A/V specification and drawings as noted to complete the Polycom installation:
1. Speakers: Pre-assembled baffle with white perforated steel grille and speaker assembly. Equip with 8" loudspeaker with 10-ounce magnet, universal matching transformer for 25 or 70 volt system with a minim of five secondary transformer taps. Provide matching back box and tile bridge.

1.7. WARRANTY

A. The Contractor shall warrant for one year the complete installation of cabling to equipment and components associated with this contract and installation. Contractors warranty shall be in the form of a written letter on company letterhead referring to the contract information, dates of installation and acceptance, signed by an authorized representative of the Contractors Company.
1. The Contractors warranty shall include but not be limited to the following:
a. Transportation to and from the location as often as needed during the warranty period.
b. All labor and materials necessary to properly and thoroughly trouble shoot the system.

PART 2 - PRODUCTS

2.1. GENERAL

A. The Contractor shall be responsible for providing all cable, boxes, conduit required to complete the Polycom installations.

PART 3 - EXECUTION

3.1. CONTRACTOR COORDINATION

A. The Contractor shall coordinate with the General Contractor (GC) and all other trade contractors as needed for the installation of the cabling for the Polycom system. Coordination shall include a pre-installation meeting during rough-in to ensure blocking, power outlets, and data outlets are properly located.

B. The contractor shall coordinate with the GC, Owner, Architect, and CoM IT a pre-installation walk through to verify all equipment locations including but not limited wall mounting locations, ceiling mounting locations, and floor outlet connections where applicable.

3.2. EQUIPMENT MOUNTING

A. All other plans and specifications shall apply to equipment mounting. In general terms:
1. The Electrical Contractor shall be responsible for all line voltage outlets
2. The Data Cabling contractor shall be responsible for all data and A/V cable boxes and wiring in support of the Polycom system
3. The Polycom Contractor shall be responsible for the installation of all Polycom component cabling.

3.3. CONDUITS AND WIRING

A. General Conduit and wiring shall be provided as per 3.2.A.2. and 3.2.A.3. above.

B. All excess cabling shall be properly bundled using Velcro cable straps only.

3.4. INSTALLATION TESTING AND ACCEPTANCE

A. It is the sole responsibility of the Contractor to notify CoM IT no less than two (2) weeks in advance of completing the installation to coordinate all final testing of the completed system.

B. The Contractor and CoM IT shall test each Polycom installation to ensure the installed components work per the specifications.

1. All installed components shall be inspected as follows:
    a. Excess cabling has been neatly wrapped with Velcro wire wraps and are properly stored
2. Each Polycom installation at the project site shall be tested with an offsite Polycom installation to ensure that all the following performance measures have been achieved:
    a. All network connectivity is complete and installed properly.
    b. Video output (may be one or more monitors)
    c. Refer to Specification 27 41 23 Audio-Visual Accessories for additional testing procedures of Polycom systems (identified in item 2.2.E. above) with A/V integrated equipment.

C. A completed and accepted installation shall pass all the above tests for each installed Polycom location.

D. The warranty period for the completed and accepted installation shall not begin until the date of the accepted general contract. The Contractor shall coordinate this date with the General Contractor.

END OF SECTION

SECTION 28 05 00
BASIC ELECTRONIC SAFETY AND SECURITY SYSTEM REQUIREMENTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Basic Safety and Security System Requirements (herein referred to Security) specifically applicable to Division 28 sections, in addition to Division 1 - General Requirements.

1.2 SCOPE OF WORK

A. This Specification and the accompanying drawings govern the work involved in furnishing, installing, testing and placing into satisfactory operation the security systems as shown on the drawings and specified herein.

B. Each Contractor shall provide all new materials as indicated in the schedules on the drawings, and/or in these specifications, and all items required to make their portion of the security systems a finished and working system.

C. Description of systems include but are not limited to the following:

1. Electronic Access Control System
2. Video Surveillance
3. Fire Detection and Alarm
4. Low Voltage Security Wiring (less than +120VAC) as specified and required for proper system control and communications.
5. All associated electrical backboxes, conduit, miscellaneous cabling, and power supplies required for proper system installation and operation as defined in the “Suggested Matrix of Scope Responsibility”.
6. Firestopping of penetrations of fire-rated construction as described in Division 7.

1.3 WORK SEQUENCE

A. The successful Bidders shall be responsible for scheduling overtime hours for the following work:

B. Successful Bidders shall itemize all work and list associated hours and pay scale for each item.

1.4 DIVISION OF WORK BETWEEN ELECTRICAL AND SECURITY CONTRACTORS

A. Division of work is the responsibility of the Prime Contractor. Any scope of work described in the contract document shall be sufficient for including said requirement in the project. The Prime Contractor shall be solely responsible for determining the appropriate subcontractor for the described scope. In no case shall the project be assessed an additional cost for scope that is described in the contract documents. The following division of responsibility is a guideline based on typical industry practice.

B. Definitions:

1. "Electrical Contractor" as referred to herein refers to the Contractors listed in Division 26 of this Specification.

2. "Electrical Contractor" shall also refer to the Contractor listed in Division 28 of this specification when the "Suggested Matrix of Scope Responsibility" indicates the work shall be provided by the EC. Refer to the Contract Documents for the "Suggested Matrix of Scope Responsibility".

3. "Security Contractor" as referred to herein refers to the Contractors listed in Division 28 of this Specification.

4. Low Voltage Security Wiring: The wiring (less than 120VAC) associated with the Security Systems, used for analog and/or digital signals between equipment.

C. General:

1. The purpose of these Specifications is to outline typical Electrical and Security Contractor's work responsibilities as related to Security Systems including conduit, cable tray, power wiring and Low Voltage Security Wiring. The prime contractor is responsible for all divisions of work.

2. The exact wiring requirements for much of the equipment cannot be determined until the systems have been purchased and submittals are approved. Therefore, only known wiring, conduits, raceways, and electrical power as related to such items, is shown on the Security Drawings. Other wiring, conduits, raceways, junction boxes, and electrical power not shown on the Security Drawings but required for the successful operation of the systems shall be the responsibility of the Security Contractor and included in the Contractor's bid.

3. Where the Electrical Contractor is required to install conduit, conduit sleeves and/or power connections in support of Security systems, the final installation shall not begin until a coordination meeting between the Electrical Contractor and the Security Contractor has convened to determine the exact location and requirements of the installation.

4. Where the Electrical Contractor is required to install cable tray that will contain Low Voltage Security Wiring, the installation shall not begin until the Security Contractor has completed a coordination review of the cable tray shop drawing.

5. This Contractor shall establish Electrical and Security utility elevations prior to fabrication and installation. The Security Contractor shall cooperate with the Electrical Contractor and the determined elevations in accordance with the guidelines below. This Contractor shall coordinate utility elevations with other trades. When a conflict arises, priority shall be as follows:

   a. Lighting Fixtures
   b. Gravity Flow Piping, including Steam and Condensate
   c. Sheet Metal
   d. Electrical Busduct
   e. Cable Trays, including 12" access space
   f. Sprinkler Piping and other Piping
   g. Conduit and Wireway
   h. Open Cabling

D. Electrical Contractor's Responsibility:

1. Assumes all responsibility for all required conduit and power connections when shown on the "Suggested Matrix of Scope Responsibility" to be provided by the Electrical Contractor.

2. Assumes all responsibility for providing and installing cable tray.

3. Responsible for Security Systems grounding and bonding.

4. This Contractor is responsible for coordination of utilities with all other Contractors. If any field coordination conflicts are found, the Contractor shall coordinate with other Contractors to determine a viable layout.

E. Security Contractor's Responsibility:

1. Assumes all responsibility for the Low Voltage Security Wiring of all systems, including cable support where open cable is specified.

2. Assumes all responsibility for all required backboxes, conduit and power connections not specifically shown as being provided by the Electrical Contractor on the "Suggested Matrix of Scope Responsibility."

3. Assumes all responsibility for providing and installing all ladder rack and other cable management hardware (as defined herein).

4. Responsible for providing the Electrical Contractor with the required grounding lugs or other hardware for each piece of Security equipment which is required to be bonded to the telecommunications ground system.

5. This Contractor is responsible for coordination of utilities with all other Contractors. If any field coordination conflicts are found, the Contractor shall coordinate with other Contractors to determine a viable layout.

1.5 COORDINATION DRAWINGS

A. Definitions:

1. Coordination Drawings: A compilation of the pertinent layout and system drawings that show the sizes and locations, including elevations, of system components and required access areas to ensure that no two objects will occupy the same space.

a. Mechanical trades shall include, but are not limited to, mechanical equipment, ductwork, fire protection systems, plumbing piping, medical gas systems, hydronic piping, steam and steam condensate piping, and any item that may impact coordination with other disciplines.

b. Electrical trades shall include, but are not limited to, electrical equipment, conduit 1.5" and larger, conduit racks, cable trays, pull boxes, transformers, raceway, busway, lighting, ceiling-mounted devices, and any item that may impact coordination with other disciplines.

c. Technology trades shall include, but are not limited to, technology equipment, racks, conduit 1.5" and larger, conduit racks, cable trays, ladder rack, pull boxes, raceway, ceiling-mounted devices, and any item that may impact coordination with other disciplines.

d. Maintenance clearances and code-required dedicated space shall be included.

e. The coordination drawings shall include all underground, underfloor, in-floor, in chase, and vertical trade items.

2. The contractors shall use the coordination process to identify the proper sequence of installation of all utilities above ceilings and in other congested areas, to ensure an orderly and coordinated end result, and to provide adequate access for service and maintenance.

B. Participation:

1. The contractors and subcontractors responsible for work defined above shall participate in the coordination drawing process.

2. One contractor shall be designated as the Coordinating Contractor for purposes of preparing a complete set of composite electronic CAD coordination drawings that include all applicable trades, and for coordinating the activities related to this process. The Coordinating Contractor for this project shall be the Mechanical Contractor.

   a. The Coordinating Contractor shall utilize personnel familiar with requirements of this project and skilled as draftspersons/CAD operators, competent to prepare the required coordination drawings.

3. Electronic CAD drawings shall be submitted to the Coordinating Contractor for addition of work by other trades. IMEG will provide electronic file copies of ventilation drawings for contractor's use if the contractor signs and returns an "Electronic File Transfer" waiver provided by IMEG. IMEG will not consider blatant reproductions of original file copies an acceptable alternative for coordination drawings.

C. Drawing Requirements:

1. The file format and file naming convention shall be coordinated with and agreed to by all contractors participating in the coordination process and the Owner.

   a. Scale of drawings:

      1) General plans: 1/4 Inch = 1 '-0" (minimum).

      2) Mechanical, electrical, communication rooms, and including the surrounding areas within 10 feet: 1/2 Inch = 1'-0" (minimum).

      3) Shafts and risers: 1/2 Inch = 1'-0" (minimum).

      4) Sections of shafts and mechanical and electrical equipment rooms: 1/4 Inch = 1 '-0" (minimum).

      5) Sections of congested areas: 1/2 Inch = 1'-0" (minimum).

2. Ductwork layout drawings shall be the baseline system for other components. Ductwork layout drawings shall be modified to accommodate other components as the coordination process progresses.

3. There may be more drawings required for risers, top and bottom levels of mechanical rooms, and shafts.

4. The minimum quantity of drawings will be established at the first coordination meeting and sent to the A/E for review. Additional drawings may be required if other areas of congestion are discovered during the coordination process.

D. General:

1. Coordination drawing files shall be made available to the A/E and Owner's Representative. The A/E will only review identified conflicts and give an opinion, but will not perform as a coordinator.

2. A plotted set of coordination drawings shall be available at the project site.

3. Coordination drawings are not shop drawings and shall not be submitted as such.

4. The contract drawings are schematic in nature and do not show every fitting and appurtenance for each utility. Each contractor is expected to have included in his/her bid sufficient fittings, material, and labor to allow for adjustments in routing of utilities made necessary by the coordination process and to provide a complete and functional system.

5. The contractors will not be allowed additional costs or time extensions due to participation in the coordination process.

6. The contractors will not be allowed additional costs or time extensions for additional fittings, reroutings or changes of duct size, that are essentially equivalent sizes to those shown on the drawings and determined necessary through the coordination process.

7. The A/E reserves the right to determine space priority of equipment in the event of spatial conflicts or interference between equipment, piping, conduit, ducts, and equipment provided by the trades.

8. Changes to the contract documents that are necessary for systems installation and coordination shall be brought to the attention of the A/E.

9. Access panels shall preferably occur only in gypsum board walls or plaster ceilings where indicated on the drawings.

   a. Access to mechanical, electrical, technology, and other items located above the ceiling shall be through accessible lay-in ceiling tile areas.

   b. Potential layout changes shall be made to avoid additional access panels.

   c. Additional access panels shall not be allowed without written approval from the A/E at the coordination drawing stage.

   d. Providing additional access panels shall be considered after other alternatives are reviewed and discarded by the A/E and the Owner's Representative.

   e. When additional access panels are required, they shall be provided without additional cost to the Owner.

10. Complete the coordination drawing process and obtain sign off of the drawings by all contractors prior to installing any of the components.

11. Conflicts that result after the coordination drawings are signed off shall be the responsibility of the contractor or subcontractor who did not properly identify their work requirements, or installed their work without proper coordination.

12. Updated coordination drawings that reflect as-built conditions may be used as record documents.

1.6 QUALITY ASSURANCE

A. Qualifications:

1. Only products of reputable manufacturers as determined by the Architect/Engineer will be acceptable.

2. Each Contractor and their subcontractors shall employ only workers who are skilled in their respective trades and fully trained. All workers involved in the installation, termination, testing, and placing into operation electronic security devices shall be individually trained by the manufacturer.

3. The Contractor shall be experienced in all aspects of this work and shall be required to demonstrate direct experience on recent systems of similar type and size.

4. The Contractor shall own and maintain tools and equipment necessary for successful installation and testing of electronic security devices and have personnel adequately trained in the use of such tools and equipment.

B. Compliance with Codes, Laws, Ordinances:

1. This Contractor shall conform to all requirements of the City of Madison Codes, Laws, Ordinances and other regulations having jurisdiction over this installation.

2. In the event there are no local codes having jurisdiction over this job, the current issue of the National Electrical Code shall be followed.

3. If there is a discrepancy between the codes and regulations having jurisdiction over this installation, and these specifications, the codes and regulations shall determine the method or equipment used.

4. If the Contractor notes, at the time of bidding, any parts of the drawings and specifications which are not in accordance with the applicable codes or regulations, he shall inform the Architect/Engineer in writing, requesting a clarification. If there is insufficient time to follow this procedure, he shall submit with the proposal, a separate price required to make the system shown on the drawings comply with the codes and regulations.

5. Verify the installation environment prior to purchasing or installing any cable. Cable installed in a plenum environment shall be appropriately rated. Bring all discrepancies between the contract documents and installation conditions to the attention of the Architect/Engineer prior to purchase or installation.

6. All changes to the system made after the letting of the contract, in order to comply with the applicable codes or the requirements of the Inspector, shall be made by the Contractor without cost to the Owner.

C. Permits, Fees, Taxes, Inspections:

1. Procure all applicable permits and licenses.

2. Abide by all applicable laws, regulations, ordinances, and other rules of the State or Political Subdivision wherein the work is done, or as required by any duly constituted public authority.

3. Pay all applicable charges for such permits or licenses that may be required.

4. Pay all applicable fees and taxes imposed by the State, Municipal and/or other regulatory bodies.

5. Pay all charges arising out of required inspections due to codes, permits, licenses or as otherwise may be required by an authorized body.

6. Pay all charges arising out of required contract document reviews associated with the project and as initiated by the Owner or authorized independent agency/consultant.

7. All equipment, and materials shall be as approved or listed by the following: (Unless approval or listing is not applicable to an item by all acceptable manufacturers.)

   a. Factory Mutual
   b. Underwriters' Laboratories, Inc.

D. Examination of Drawings:

1. The drawings for the Security Systems work are diagrammatic, intended to convey the scope of the work and to indicate the general arrangements and locations of equipment etc., and the approximate sizes of equipment.

2. Contractor shall determine the exact locations of equipment and the exact routing of cabling so as to best fit the layout of the job. Scaling of the drawings will not be sufficient or accurate for determining this layout. Where a specific route is required, such route will be indicated on the drawings.

3. Where job conditions require reasonable changes in indicated arrangements and locations, such changes shall be made by the Contractor at no additional cost to the Owner.

4. If an item is either shown on the drawings, called for in the specifications or required for proper operation of the system, it shall be considered sufficient for including same in this contract.

5. The determination of quantities of material and equipment required shall be made by the Contractor from the drawings. Schedules on the drawings and in the specifications, are completed as an aid to the Contractor but where discrepancies arise, the greater number shall govern.

6. Where words "provide", "install", or "furnish" are used on the drawings or in the specifications, it shall be taken to mean, to furnish, install and terminate completely ready for operation, the items mentioned.

E. Electronic Media/Files:

1. Construction drawings for this project have been prepared utilizing Revit.

2. Contractors and Subcontractors may request electronic media files of the contract drawings and/or copies of the specifications. Specifications will be provided in PDF format.

3. Upon request for electronic media, the Contractor shall complete and return a signed “Electronic File Transmittal” form provided by IMEG.

4. If the information requested includes floor plans prepared by others, the Contractor will be responsible for obtaining approval from the appropriate Design Professional for use of that part of the document.

5. The electronic contract documents can be used for preparation of shop drawings and as-built drawings only. The information may not be used in whole or in part for any other project.

6. The drawings prepared by IMEG for bidding purposes may not be used directly for ductwork layout drawings or coordination drawings.

7. The use of these CAD documents by the Contractor does not relieve them from their responsibility for coordination of work with other trades and verification of space available for the installation.

8. The information is provided to expedite the project and assist the Contractor with no guarantee by IMEG as to the accuracy or correctness of the information provided. IMEG accepts no responsibility or liability for the Contractor’s use of these documents.

F. Field Measurements:

1. Before ordering any materials, this Contractor shall verify all pertinent dimensions at the job site and be responsible for their accuracy.

1.7 SUBMITTALS

A. Submittals shall be required for the following items, and for additional items where required elsewhere in the specifications or on the drawings.

1. Submittals list:

Referenced Specification Section	Submittal Item
28 13 00	Electronic Access Control
28 23 00	Video Surveillance

B. General Submittal Procedures: In addition to the provisions of Division 1, the following are required:

1. Transmittal: Each transmittal shall include the following:

   a. Date
   b. Project title and number
   c. Contractor's name and address
   d. Division of work (e.g., plumbing, heating, ventilating, etc.)
   e. Description of items submitted and relevant specification number
   f. Notations of deviations from the contract documents
   g. Other pertinent data

2. Submittal Cover Sheet: Each submittal shall include a cover sheet containing:

   a. Date
   b. Project title and number
   c. Architect/Engineer
   d. Contractor and subcontractors' names and addresses
   e. Supplier and manufacturer's names and addresses
   f. Division of work (e.g., plumbing, heating, ventilating, etc.)
   g. Description of item submitted (using project nomenclature) and relevant specification number
   h. Notations of deviations from the contract documents
   i. Other pertinent data
   j. Provide space for Contractor's review stamps

3. Composition:

   a. Submittals shall be submitted using specification sections and the project nomenclature for each item.

   b. Individual submittal packages shall be prepared for items in each specification section. All items within a single specification section shall be packaged together where possible. An individual submittal may contain items from multiple specifications sections if the items are intimately linked (e.g., pumps and motors).

   c. All sets shall contain an index of the items enclosed with a general topic description on the cover.

4. Content: Submittals shall include all fabrication, erection, layout, and setting drawings; manufacturers' standard drawings; schedules; descriptive literature, catalogs and brochures; performance and test data; wiring and control diagrams; dimensions; shipping and operating weights; shipping splits; service clearances; and all other drawings and descriptive data of materials of construction as may be required to show that the materials, equipment or systems and the location thereof conform to the requirements of the contract documents.

5. Contractor's Approval Stamp:

   a. The Contractor shall thoroughly review and approve all shop drawings before submitting them to the Architect/Engineer. The Contractor shall stamp, date and sign each submittal certifying it has been reviewed.

b. Unstamped submittals will be rejected.

c. The Contractor's review shall include, but not be limited to, verification of the following:

1) Only approved manufacturers are used.
2) Addenda items have been incorporated.
3) Catalog numbers and options match those specified.
4) Performance data matches that specified.
5) Electrical characteristics and loads match those specified.
6) Equipment connection locations, sizes, capacities, etc. have been coordinated with other affected trades.
7) Dimensions and service clearances are suitable for the intended location.
8) Equipment dimensions are coordinated with support steel, housekeeping pads, openings, etc.
9) Constructability issues are resolved (e.g., weights and dimensions are suitable for getting the item into the building and into place, sinks fit into countertops, etc.).

d. The Contractor shall review, stamp and approve all subcontractors' submittals as described above.

e. **The Contractor's approval stamp is required on all submittals. Approval will indicate the Contractor's review of all material and a complete understanding of exactly what is to be furnished. Contractor shall clearly mark all deviations from the contract documents on all submittals. If deviations are not marked by the Contractor, then the item shall be required to meet all drawing and specification requirements.**

6. Submittal Identification and Markings:

a. The Contractor shall clearly mark each item with the same nomenclature applied on the drawings or in the specifications.

b. The Contractor shall clearly indicate the size, finish, material, etc.

c. Where more than one model is shown on a manufacturer's sheet, the Contractor shall clearly indicate exactly which item and which data is intended.

d. All marks and identifications on the submittals shall be unambiguous.

7. Schedule submittals to expedite the project. Coordinate submission of related items.

8. Identify variations from the contract documents and product or system limitations that may be detrimental to the successful performance of the completed work.

9. Reproduction of contract documents alone is not acceptable for submittals.

10. Incomplete submittals will be rejected without review. Partial submittals will only be reviewed with prior approval from the Architect/Engineer.

11. Submittals not required by the contract documents may be returned without review.

12. The Architect/Engineer's responsibility shall be to review one set of shop drawing submittals for each product. If the first submittal is incomplete or does not comply with the drawings and/or specifications, the Contractor shall be responsible to bear the cost for the Architect/Engineer to recheck and handle the additional shop drawing submittals.

13. Submittals shall be reviewed and approved by the Architect/Engineer **before** releasing any equipment for manufacture or shipment.

14. Contractor's responsibility for errors, omissions or deviation from the contract documents in submittals is not relieved by the Architect/Engineer's approval.

C. Electronic Submittal Procedures:

1. Distribution: Email submittals as attachments to all parties designated by the Architect/Engineer, unless a web-based submittal program is used.

2. Transmittals: Each submittal shall include an individual electronic letter of transmittal.

3. Format: Electronic submittals shall be in PDF format only. Scanned copies, in PDF format, of paper originals are acceptable. Submittals that are not legible will be rejected. Do not set any permission restrictions on files; protected, locked, or secured documents will be rejected.

4. File Names: Electronic submittal file names shall include the relevant specification section number followed by a description of the item submitted, as follows. Where possible, include the transmittal as the first page of the PDF instead of using multiple electronic files.

a. Submittal file name: 28 XX XX.description.YYYYMMDD
b. Transmittal file name: 28 XX XX.description.YYYYMMDD

5. File Size: Electronic file size shall be limited to a maximum of 4MB. Larger files shall be transmitted via a pre-approved method.

D. Paper Copy Submittal Procedures:

1. Paper copies are acceptable where electronic copies are not provided.

2. Each set shall be bound in a three-ring binder or presentation binder. Copies that are loose or in pocket folders are not acceptable.

1.8 SCHEDULE OF VALUES

A. The requirements herein are in addition to the provisions of Division 1.

B. Format:

1. Use AIA Document Continuation Sheets G703 or another similar form approved by the Owner and Architect/Engineer.
2. Submit in Excel format.
3. Support values given with substantiating data.

C. Preparation:

1. Itemize work required by each specification section and list all providers. All work provided by subcontractors and major suppliers shall be listed on the Schedule of Values. List each subcontractor and supplier by company name.

2. Break down all costs into:

a. Material: Delivered cost of product with taxes paid.
b. Labor: Labor cost, excluding overhead and profit.

1.9 CHANGE ORDERS

A. The requirements herein are in addition to the provisions of Division 1.

B. A detailed material and labor takeoff shall be prepared for each change order, along with labor rates and markup percentages. Change orders with inadequate breakdown will be rejected.

C. Change order work shall not proceed until authorized.

1.10 EQUIPMENT SUPPLIERS' INSPECTION

A. The following equipment shall not be placed in operation until a representative of the manufacturer has inspected the installation and certified that the equipment is properly installed and that the equipment is ready for operation:

1. Firestopping, including mechanical firestop systems.

1.11 PRODUCT DELIVERY, STORAGE, HANDLING & MAINTENANCE

A. Exercise care in transporting and handling to prevent damage to fixtures, equipment and materials.

B. Store materials on the site so as to prevent damage.

C. Keep fixtures, equipment and materials clean, dry and free from harmful conditions.

1.12 NETWORK / INTERNET CONNECTED EQUIPMENT

A. These specifications may require certain equipment or systems to have network, Internet and/or remote access capability ("Network Capability"). Any requirement for Network Capability shall be interpreted only as a functional capability and is not to be construed as authority to connect or enable any Network Capability. Network Capability may only be connected or enabled with the express written consent of the Owner.

1.13 WARRANTY

A. The requirements herein are in addition to the provisions of Division 1.

B. At a minimum, provide a one (1) year warranty for all equipment, materials, and workmanship. Individual specifications sections within Division 28 may require additional warranty requirements for specific equipment or systems.

C. The warranty period for the entire installation described in this Division of the specifications shall commence on the date of substantial completion unless a whole or partial system or any separate piece of equipment or component is put into use for the benefit of any party other than the installing contractor with prior written authorization. In this instance, the warranty period shall commence on the date when such whole system, partial system or separate piece of equipment or component is placed in operation and accepted in writing by the Owner or their representative.

D. Warranty requirements shall extend to correction, without cost to the final user, of all work and/or equipment found to be defective or nonconforming to the contract documents. The Contractor shall bear the cost of correcting all damage resulting from such defects or nonconformance with contract documents exclusive of repairs required as a result of improper maintenance or operation, or of normal wear as determined by the Architect/Engineer.

1.14 INSURANCE

A. This Contractor shall maintain insurance coverage as set forth in Division 1 of these specifications.

1.15 MATERIAL

A. Where several manufacturers' names are given, the first named manufacturer constitutes the basis for job design and establishes the equipment quality required to be used in this contract.

B. Equivalent equipment manufactured by the other named manufacturers may be used. Contractor shall ensure that all items submitted by these other manufacturers meets all requirements of the drawings and specifications and fits in the allocated space. The Architect/Engineer shall make the final determination of whether a product is equivalent.

C. Any material, article or equipment of other unnamed manufacturers which will adequately perform the services and duties imposed by the design and is of a quality equal to or better than the material, article or equipment identified by the drawings and specifications may be used if approval is secured **in writing** from the Architect/Engineer not later than ten (10) days prior to the bid opening date. The Contractor bears full responsibility for the unnamed manufacturers equipment adequately meeting the intent of design. The Architect/Engineer may reject manufacturer at time of shop drawing submittal. The Contractor assumes all costs incurred by other trades on the project as a result of changes necessary to accommodate the offered material, equipment or installation method.

D. Should this Contractor be unable to secure approval from the Architect/Engineer for other unnamed manufacturers as outlined above, this Contractor may list voluntary add or deduct prices for alternate materials on the bid form. These items will not be used in determining the low bidder. Should a voluntary alternate material be accepted, This Contractor shall assume all costs that may be incurred as a result of using the offered material, article or equipment necessitating extra expense on This Contractor or on the part of other Contractors whose work is affected.

PART 2 - PRODUCTS

2.1 REFER TO INDIVIDUAL SECTIONS

PART 3 - EXECUTION

3.1 JOBSITE SAFETY

A. Neither the professional activities of the Architect/Engineer, nor the presence of the Architect/Engineer or his or her employees and subconsultants at a construction site, shall relieve the Contractor and any other entity of their obligations, duties and responsibilities including, but not limited to, construction means, methods, sequence, techniques or procedures necessary for performing, superintending or coordinating all portions of the work of construction in accordance with the contract documents and any health or safety precautions required by any regulatory agencies. The Architect/Engineer and his or her personnel have no authority to exercise any control over any construction contractor or other entity or their employees in connection with their work or any health or safety precautions. The Contractor is solely responsible for jobsite safety. The Architect/Engineer and the Architect/Engineer's consultants shall be indemnified and shall be made additional insureds under the Contractor's general liability insurance policy.

3.2 GENERAL INSTALLATION REQUIREMENTS

A. Installation of all conduit and cabling shall comply with Sections 26 05 33 and 26 05 13. Additional conduit requirements described within this Division shall be supplemental to the requirement described in Section 26 05 33. Should conflicts exist between the two Divisions the more stringent (more expensive material and labor) condition shall prevail until bidding addendum or construction clarification or RFI can be submitted and responded to. In no case shall the Contractor carry the least stringent condition in the pricing.

B. It is the Contractor's responsibility to survey the site and include all necessary costs to perform the installation as specified.

C. All cables and devices installed in damp or wet locations, including any underground or underslab location, shall be listed as suitable for use in such environments. Follow manufacturer's recommended installation practices for installing cables and devices in damp or wet locations. Any cable or device that fails as a result of being installed in a damp or wet location shall be replaced at the Contractor's expense.

3.3 FIELD QUALITY CONTROL

A. General:

1. Refer to specific Division 28 sections for further requirements.

2. The Contractor shall conduct all tests required and applicable to the work both during and after construction of the work.

3. The necessary instruments and materials required to conduct or make the tests shall be supplied by the Contractor who shall also supply competent personnel for making the tests who has been schooled in the proper testing techniques.

4. In the event the results obtained in the tests are not satisfactory, This Contractor shall make such adjustments, replacements and changes as are necessary and shall then repeat the test or tests which disclose faulty or defective work or equipment, and shall make such additional tests as the Architect/Engineer or code enforcing agency deems necessary.

B. Protection of cable from foreign materials:

1. It is the Contractor's responsibility to provide adequate physical protection to prevent foreign material application or contact with any cable type. Foreign material is defined as any material that would negatively impact the validity of the manufacturer's performance warranty. This includes, but is not limited, to overspray of paint (accidental or otherwise), drywall compound, or any other surface chemical, liquid or compound that could come in contact with the cable, cable jacket or cable termination components.

2. Application of foreign materials of any kind on any cable, cable jacket or cable termination component will not be accepted. It shall be the Contractor's responsibility to replace any component containing overspray, in its entirety, at no additional cost to the project. Cleaning of the cables with harsh chemicals is not allowed. This requirement is regardless of the PASS/FAIL test results of the cable containing overspray. Should the manufacturer and warrantor of the structured cabling system desire to physically inspect the installed condition and certify the validity of the structured cabling system (via a signed and dated statement by an authorized representative of the structured cabling manufacturer), the Owner may, at their sole discretion, agree to accept said warranty in lieu of having the affected cables replaced. In the case of plenum cabling, in addition to the statement from the manufacturer, the Contractor shall also present to the Owner a letter from the local Authority Having Jurisdiction stating that they consider the plenum rating of the cable to be intact and acceptable.

3.4 PROJECT CLOSEOUT

A. Refer to the Division 1 Section: PROJECT CLOSEOUT for requirements. The following paragraphs supplement the requirements of Division 1.

B. Final Jobsite Observation:

1. The Architect/Engineer will not perform a final jobsite observation until the project is ready. This is not dictated by schedule, but rather by completeness of the project.

2. Refer to the end of Section 27 05 00 for a "STATEMENT INDICATING READINESS FOR FINAL JOBSITE OBSERVATION."

3. The Contractor shall sign this form and return it to the Architect/Engineer so that the final observation can commence.

C. Before final payment will be authorized, this Contractor must have completed the following:

1. Submitted operation and maintenance manuals to the Architect/Engineer for review.

2. Submitted bound copies of approved shop drawings.

3. Record documents including edited drawings and specifications accurately reflecting field conditions, **inclusive** of all project revisions, change orders, and modifications.

4. Submitted a report stating the instructions given to the Owner's representative complete with the number of hours spent in the instruction. The report shall bear the signature of an authorized agent of This Contractor and shall be signed by the Owner's representative as having received the instructions.

5. Submitted testing reports for all systems requiring final testing as described herein.

6. Submitted start-up reports on all equipment requiring a factory installation inspection and/or start.

7. Provide spare parts, maintenance, and extra materials in quantities specified in individual specification sections. Deliver to project site, submit receipt to Architect/Engineer prior to final payment being approved.

3.5 OPERATION AND MAINTENANCE MANUALS

A. Refer to the Division 1 Section: OPERATION AND MAINTENANCE MANUALS for requirements. The following paragraphs supplement the requirements of Division 1.

B. General:

1. Provide an electronic copy of the O&M manuals as described below for Architect/Engineer's review and approval. The electronic copy shall be corrected as required to address the Architect/Engineer's comments. Once corrected, electronic copies and paper copies shall be distributed as directed by the Architect/Engineer.

2. Approved O&M manuals shall be completed and in the Owner's possession prior to Owner's acceptance and at least 10 days prior to instruction of operating personnel.

C. Electronic Submittal Procedures:

1. Distribution: Email the O&M manual as attachments to all parties designated by the Architect/Engineer.

2. Transmittals: Each submittal shall include an individual electronic letter of transmittal.

3. Format: Electronic submittals shall be in PDF format only. Scanned copies, in PDF format, of paper originals are acceptable. Submittals that are not legible will be rejected. Do not set any permission restrictions on files; protected, locked, or secured documents will be rejected.

4. File Names: Electronic submittal file names shall include the relevant specification section number followed by a description of the item submitted, as follows. Where possible, include the transmittal as the first page of the PDF instead of using multiple electronic files.

   a. O&M file name: O&M.div28.contractor.YYYYMMDD
   b. Transmittal file name: O&Mtransmittal.div28.contractor.YYYYMMDD

5. File Size: Electronic file size shall be limited to a maximum of 4MB. Larger files shall be divided into files that are clearly labeled as "1 of 2", "2 of 2", etc.

6. Provide the Owner with an approved copy of the O&M manual on compact discs (CD), digital video discs (DVD), or flash drives with a permanently affixed label, printed with the title "Operation and Maintenance Instructions", title of the project and subject matter of disc/flash drive when multiple disc/flash drives are required.

7. All text shall be searchable.

8. Bookmarks shall be used, dividing information first by specification section, then systems, major equipment and finally individual items. All bookmark titles shall include the nomenclature used in the construction documents and shall be an active link to the first page of the section being referenced.

D. Operation and Maintenance Instructions shall include:

1. Title Page: Include title page with project title, Architect, Engineer, Contractor, all subcontractors, and major equipment suppliers, with addresses, telephone numbers, website addresses, email addresses and point of contacts. Website URLs and email addresses shall be active links in the electronic submittal.

2. Table of Contents: Include a table of contents describing specification section, systems, major equipment, and individual items.

3. Copies of all final approved shop drawings and submittals. Include Architect's/Engineer's shop drawing review comments. Insert the individual shop drawing directly after the Operation and Maintenance information for the item(s) in the review form.

4. Copy of final approved test and balance reports.

5. Copies of all factory inspections and/or equipment startup reports.

6. Copies of warranties.

7. Schematic wiring diagrams of the equipment that have been updated for field conditions. Field wiring shall have label numbers to match drawings.

8. Dimensional drawings of equipment.

9. Capacities and utility consumption of equipment.

10. Detailed parts lists with lists of suppliers.

11. Operating procedures for each system.

12. Maintenance schedule and procedures. Include a chart listing maintenance requirements and frequency.

13. Repair procedures for major components.

14. List of lubricants in all equipment and recommended frequency of lubrication.

15. Instruction books, cards, and manuals furnished with the equipment.

3.6 INSTRUCTING THE OWNER'S REPRESENTATIVE

A. Adequately instruct the Owner's designated representative or representatives in the maintenance, care, and operation of the complete systems installed under this contract.

B. Provide verbal and written instructions to the Owner's representative or representatives by FACTORY PERSONNEL in the care, maintenance, and operation of the equipment and systems.

C. Contractor shall make a DVD video recording of instructions to the Owner while explaining the system so additional personnel may view the instructions at a later date. The video recording shall be the property of the Owner.

D. The Architect/Engineer shall be notified of the time and place for the verbal instructions to be given to the Owner's representative so that their representative can be present if desirable.

E. Refer to the individual specification sections for minimum hours of instruction time for each system.

F. Operating Instructions:

1. The Contractor is responsible for all instructions to the Owner and/or Owner's operating staff on the security systems.

2. If the Contractor does not have Engineers and/or Technicians on staff that can adequately provide the required instructions on system operation, performance, troubleshooting, care and maintenance, they shall include in the bid an adequate amount to reimburse the Owner for the Architect/Engineer to perform these services.

3.7 SYSTEM COMMISSIONING

A. The security systems included in the construction documents are to be complete and operating systems. The Architect/Engineer will make periodic job site observations during the construction period. The system start-up, testing, configuration, and satisfactory system performance is the responsibility of the Contractor. This shall include all calibration and adjustments of electrical equipment controls, equipment settings, software configuration, troubleshooting and verification of software, and final adjustments that may be required.

B. All operating conditions and control sequences shall be simulated and tested during the start-up period.

C. The Contractor, subcontractors, and equipment suppliers are expected to have skilled technicians to insure that the system performs as designed. If the Architect/Engineer is requested to visit the job site for the purpose of trouble shooting, assisting in the satisfactory start-up, obtaining satisfactory equipment operation, resolving installation and/or workmanship problems, equipment substitution issues or unsatisfactory system performance, including call backs during the warranty period through no fault of the design; the Contractor shall reimburse the Owner on a time and material basis for services rendered at the Architect/Engineer's standard hourly rates in effect at the time the services are requested. The Contractor shall be responsible for making payment to the Owner for services required that are product, installation or workmanship related. Payment is due within 30 days after services are rendered.

3.8 RECORD DOCUMENTS

A. Refer to the Division 1 Section: PROJECT CLOSEOUT for requirements. The following paragraphs supplement the requirements of Division 1.

B. Mark specifications to indicate approved substitutions, change orders, and actual equipment and materials used.

C. This Contractor shall maintain at the job site, a separate and complete set of Security Drawings which shall be clearly and permanently marked and noted in complete detail any changes made to the location and arrangement of equipment or made to the Technology Systems and wiring as a result of building construction conditions or as a result of instructions from the Architect or Engineer. All Change Orders, RFI responses, Clarifications and other supplemental instructions shall be marked on the documents. Record documents that merely reference the existence of the above items are not acceptable. Should This Contractor fail to complete Record Documents as required by this contract, This Contractor shall reimburse Architect/Engineer for all costs to develop record documents that comply with this requirement. Reimbursement shall be made at the Architect/Engineer's hourly rates in effect at the time of work.

D. The above record of changes shall be made available for the Architect and Engineer's examination during any regular work time.

E. Upon completion of the job, and before final payment is made, This Contractor shall give the marked-up drawings to the Architect/Engineer.

3.9 ADJUST AND CLEAN

A. Contractor shall thoroughly clean all equipment and systems prior to the Owner's final acceptance of the project.

B. Contractor shall clean all foreign paint, grease, oil, dirt, labels, stickers, and other foreign material from equipment.

C. Contractor shall remove all rubbish, debris, etc., accumulated during the Contractor's operations from the premises.

3.10 SPECIAL REQUIREMENTS

A. In accordance with LEED EQc4.1, Low-Emitting Materials - Adhesives and Sealants, all adhesives and sealants used on the interior of the building must comply with the following requirements:

1. Adhesives, sealants and sealant primers must comply with South Coast Air Quality Management District (SCAQMD) Rule #1168.

2. Aerosol adhesives must comply with Green Seal Standard for Commercial Adhesives GS-36 requirements in effect on October 19, 2000.

3.11 CONSTRUCTION WASTE MANAGEMENT

A. This Contractor shall comply with all construction and demolition waste disposal and recycling requirements outlined in LEED MRc2: Construction Waste Management (follow latest edition at the time of bidding or as referenced in these specifications).

1. This Contractor shall coordinate with the General Contractor to develop and implement a construction waste management plan that, at a minimum, identifies the materials to be diverted from disposal and whether the materials will be sorted on-site or co-mingled.

2. The Contractor shall track waste disposal and recycling efforts throughout the construction process for all materials associated with this Contractor’s scope of work. The Contractor shall provide this information to the General Contractor so that it can be incorporated with similar information from all other contractors for the project.

a. Calculations for waste and recycled material can be done by weight or volume, but they must be consistent throughout the project. The Contractor shall coordinate with the General Contractor to establish the preferred calculation method and report the results accordingly.

b. Excavated soil and land-clearing debris do not count towards the waste disposal or recycled material.

3. At a minimum, 50% 75% of the construction and demolition debris for this project must be recycled or salvaged.

END OF SECTION

SECTION 28 13 00
ACCESS CONTROL SYSTEM (KEYSCAN)

PART 1 - GENERAL

1.1. SUMMARY

A. The City of Madison Information Technology Department has been assisting other City agencies with standardizing facilities through the use of access cards, key fobs, and punch pads. All hardware is installed locally at the facility while software controls access to various doors remotely.

B. These specifications describe the materials, equipment, and installation requirements to install an integrated, computerized access control and alarm monitoring system utilized by the City of Madison Information Technology (CoM-IT) Department.

C. The ACS System Contractor shall be responsible for verifying equipment requirements, locations, and coordination with the General Contractor and all other necessary trades as needed for a complete installation.

1.2. RELATED SPECIFICATIONS

A. 01 31 23 Project Management Web Site
B. 01 33 23 Submittals
C. 08 71 00 Door Hardware
D. 27 05 00 Basic Communication Systems Requirements

1.3. RELATED DRAWINGS

A. Refer to all Electrical drawings for locations of distribution panels and equipment as it relates to standard line voltage locations.

B. Refer to all Technical drawings for locations of Access Control System (Keyscan) equipment.

C. Refer to the door hardware schedule and Architectural floor plans for information relating to door access locations and specific hardware requirements.

1.4. REFERENCES

A. The system shall comply with the standards, codes and regulations of the following regulatory bodies:
1. Underwriters Laboratories (UL) Std No. 294 – Access Control System Units
2. Canadian Standards Association (CSA) Std C22.2 No. 205-M1983 – Signal Equipment

3. CE Standards
    a. EN 55022 RF Emissions
    b. EN 55024 RF Immunity
    c. EN 60950-1 Equipment Safety
4. FCC Subpart B – RF Emissions
5. Industry Canada ICES 003 Emissions
6. RoHS

1.5. CONTRACTORS QUALIFICATIONS

A. The Contractor installing the ACS system shall:
1. Be a Certified Keyscan Enterprise Partner
2. Utilize installers who are Keyscan Enterprise Certified Technicians
3. Be based within 25 radial miles of the project location
4. Be able to provide 24/7/365 support during the warranty period of this project
5. Be able to respond and repair or replace most components within 4 hours of notification

1.6. SUBMITTALS

A. The Contractor shall provide a complete submittal package in a timely manner to allow sufficient review time prior to ordering the system components required for a complete installation. The contractor shall be solely responsible for any equipment, purchased/ordered/delivered that is not approved of during the submittal review process.

B. The complete submittal package shall include but not be limited to the following:
1. All certifications of the contractor and contractor's installation team. Certifications shall be current from the start of the contract through the end of the warranty period.
2. Cut sheets indicating, shop drawings, performance data, and other such information that will indicate the component being installed matches the component that was specified.
3. Cut sheets and shop drawing of Contractors recommendations for tags and labels.

1.7. WARRANTY

A. The Contractor shall warrant for one year the complete installation of equipment and components associated with this contract and installation. Contractors warranty shall be in the form of a written letter on company letterhead referring to the contract information, dates of installation and acceptance, signed by an authorized representative of the Contractors Company.
1. The Contractors warranty shall include but not be limited to the following:
    a. Transportation to and from the location as often as needed during the warranty period.
    b. All labor and materials necessary to properly and thoroughly trouble shoot the system.
    c. All fees associated with the shipping of any component that needs to be returned or supplied by the manufacturer for repair or replacement.
    d. All labor and materials required to remove, repair, replace, or re-install any component.

B. The Contractor shall also provide all manufacturers warranties/guarantees associated with installed components of the completed installation.

1.8. QUALITY ASURANCE

A. The Contractor shall be responsible for coordinating his/her Work with other trades and divisions as needed for a complete installation. This shall include pre-installation meetings for locating equipment, conduit, cabling, control devices, and other materials and equipment required by this installation.

B. The General Contractor (GC) shall be responsible for ensuring that all doors requiring controlled access are properly prepared and installed per the contract documents. The GC shall further be responsible for ensuring all project coordination, pre-installation meetings, submittals and other such project management responsibilities are conducted efficiently and according to the project specifications and schedules.

PART 2 - PRODUCTS

2.1. SYSTEM PRODUCTS OVERVIEW

A. The City of Madison Information Technology Department (CoM IT) owns and operates a fully licensed copy of the Keyscan Access Control System software.
1. The Keyscan Access Control System (ACS) provides controlled access to secured doors through the use of electronic door latches, proximity readers, control panels, and a proprietary software program.

2. The Keyscan software allows CoM-IT and the facility the Owner to customize multiple levels of access and system performance through any combination of the following:
    a. Calendar and time based lock/unlock controls
    b. Group access control for common personnel groups
    c. Individual access control for specialized access control
    d. Temporarily disable access control for a specified time period
    e. Remotely unlock/lock a door
    f. Lockdown a facility from one location
    g. Provide customizable alert notifications

2.2. EQUIPMENT AND COMPONENTS

A. The Contractor guarantees that all equipment and components shall be furnished new, undamaged, free of defects, and conform to the drawings and specifications of this contract. The contractor is solely responsible for replacing any damaged or defective item.

B. New ACS components on interior and exterior access doors shall be able to be integrated with the Owners existing Keyscan system.

2.3. DISTRIBUTION SUPPLY PANEL (AC-DS-1)

A. AC-DS-1 brings line voltage into the ACS system with the following performance specifications:
    1. Input
        a. 115VAC, 60Hz, 1.45A
    2. Output
        a. Eight (8) PTC protected outputs
        b. 16VAC output
        c. 16VAC @ 10amp (175 VA) supply current (1.25 amp per device, 2.5 amp max.)
        d. Outputs rated @ 2.5 amp
        e. Main fuse rated @ 15 amp/32V
        f. Surge suppression
    3. Miscellaneous electrical information
        a. Operating temperature 0^{o} C to 49^{o}C ambient
        b. 81.89 BTU/hr
        c. System AC input VA requirement 166.75 AV
    4. Miscellaneous required features
        a. AC power LED indicators
        b. Illuminated master power disconnect circuit breaker with manual reset
    5. Agency Approvals
        a. UL 294 listed for Access Control System Units
        b. CUL listed-CSA Standard C22.2 No 205-M1983 Signal Equipment

B. AC-DS-1 shall be:
    1. Altronix, AL168175CB
    2. Pre-approved equal

2.4. POWER SUPPLY PANEL (AC-PS-1)

A. The AC-PS-1 brings line voltage from the AC-DS-1, reduces then distributes the voltage to the Access Security Panels (AC-SEC-1) with the following performance specifications:
    1. Input
        a. 115VAC, 60Hz, 1.9A
        b. Power supply input options
            i. One (1) common power input for ACM8 and lock power (factory installed)
            ii. Two (2) isolated power inputs; one (1) to power the ACM8 and one (1) for lock accessory power, (external power supply is required). Current is determined by the power supply connected, not to exceed a maximum of 10 amp total
        c. Eight (8) Access control System trigger inputs with the following options:
            i. Eight (8) normally open (NO) inputs
            ii. Eight (8) open collector inputs
            iii. Any combination of the above
    2. Output
        a. 12VDC or 24VDC @ 6 amp supply current

b. Eight (8) independently controlled outputs with the following options:
i. Eight (8) Fail-Safe and/or Fail-Secure power outputs
ii. Eight (8) form "C" 5 amp rated relay outputs
iii. Any combination of the above
c. Eight (8) auxiliary power outputs (un-switched)
d. Output fuses rated @ 3.5 amp
e. Filtered and electronically regulated outputs (built-in power supply).

3. Miscellaneous electrical information
a. Operating temperature 0^{o} C to 49^{o}C ambient
b. BTU/hr:
i. 12VDC = 36.85 BTU/hr
ii. 24VDC = 73.70 BTU/hr
c. ACM8 board main fuse is rated at 10 amp

4. Battery Backup
a. Built-in charger for sealed lead acid or gel type batteries
b. Power supply board maximum charge current 0.7 amp
c. Automatic switch over to stand-by battery when AC fails
d. Zero voltage drop when unit switches over to battery backup (AC failure condition)
e. Battery fail and battery presence supervision (form "C" contact)

5. Miscellaneous required features
a. Fire Alarm disconnect (latching or non-latching) is individually selectable for any or all of the eight (8) outputs.
b. Fire Alarm disconnect input options:
i. Normally open (NO) or normally closed (NC) dry contact input
ii. Polarity reversal input for FACP signaling circuit
c. Alarm output relay indicates that FACP input is triggered (form "C" contact rated @ 1 amp 28VDC)
d. Short circuit and thermal overload protection
e. AC fail supervision (form "C" contact)
f. Red LEDs indicate outputs are triggered (relays energized)
g. Green LED indicates FACP disconnect is triggered
h. AC input and DC output LED indicators
i. Enclosure accommodates up to two (2) 12AH batteries

6. Agency Approvals
a. UL 294 listed for Access Control System Units
b. CUL listed-CSA Standard C22.2 No 205-M1983 Signal Equipment

B. AC-PS-1 shall be:
1. Altronix, AL600ULACM
2. Pre-approved equal

2.5. SECURITY PANEL (AC-SEC-1)

A. The AC-SEC-1 distributes the reduced voltage and control wiring to/from each door with an access control device.
B. AC-SEC-1 shall be:
1. Keyscan CA8500 – 8 Reader Access Control Panel
C. The AC-SEC-1 shall be provided, located and mounted by the Contractor in room B001A (MC-1).

2.6. DOOR CONTROL DEVICES

A. The Contractor shall be responsible for verifying the Door Control Device (DCD) quantities and locations with the door hardware schedule.
B. DCD shall be:
1. Keyscan K-KPR – Keyscan Proximity Reader/Keypad, this reader accepts swipe monitoring of cards, key bobs, and other such devices as well as accepting personal identification numbers (PINs)
i. Plan designation = AC-CR1-W

2.7. DOOR CONTROL CABLES

A. The following cables are required for a complete installation of the ACS, per controlled door, as follows:
1. One (1) 22/6 shielded cable, required; to DCD
2. One (1) 18/2 un-shielded cable, required; lock power

3. One (1) 22/2 un-shielded cable, required; door contact
4. One (1) 22/4 un-shielded cable, required but not used; for future request to exit sensors

B. At the Contractors option he/she may run a manufactured cable bundle containing all four (4) cables listed above. It shall be the sole responsibility of the contractor to appropriately size the conduits for the installation.

PART 3 - EXECUTION

3.1. COOPERATION OF THE ACS CONTRACTOR

A. The Contractor shall be required to coordinate with all trades for a complete and timely installation. This includes attending all pre-installation meetings where equipment locations, conduit locations, and control devices will be installed or may be in conflict with the installation of other trades. The Contractor shall be solely responsible for any additional cost required for removing/replacing/modifying any completed work by other trades because the installation was not properly coordinated.

B. The Contractor shall coordinate with the Owners Representative from City IT for all information necessary to complete the installation and integration with the Owners existing hardware and software.

C. The Contractor shall verify with the appropriate Owners Representative for mounting heights of all hardware and equipment prior to installation. This shall be completed at a pre-installation walk through prior to rough-in.

D. The Contractor shall coordinate with the Owner's Representative from City IT to verify all requirements for all access controlled doors are properly coordinated and understood prior to roughing in the installation.

3.2. GENERAL EQUIPMENT MOUNTING

A. All ACS equipment shall be mounted to the 3/4" AC fire rated plywood panels provided and installed by the General Contractor. Contractor shall tape out all equipment prior to mounting to insure adequate space is allotted for the complete installation per the riser diagrams including all related conduits and cables.

B. All equipment shall be neatly arranged so as to meet or exceed the manufacturer's recommended working space around each component.

C. Equipment to be installed on plywood mounting panels shall include but not be limited to the following:
1. Distribution Service Panel (AC-DS-1)
2. Power Supply Panel (AC-PS-1)
3. Access Control Panel (AC-SEC-1)
4. All required conduits, and boxes for line voltage

3.3. GENERAL CONDUITS AND WIRING

A. This section shall apply to both the ACS Contractor and the Electrical Contractor. The following division of responsibilities shall apply:
1. The Electrical Contractor shall be responsible for furnishing, installing, and connecting all conduits, connectors, conductors, and other related materials associated with providing line voltage to the ACS system as follows:
   a. Providing an 110V, 15A, dedicated circuit from the designated distribution panel to AC-DS-1 as described in Section 2.3 above.
   b. Providing line voltage from AC-DS-1 to AC-PS-1 as described in Section 2.4 above.
2. The ACS Contractor shall be responsible for furnishing installing, and connecting all conduits, connectors, conductors and other related materials required to complete the installation of the low voltage wiring and door controller cabling.

B. All conduits shall be properly sized for the number of wires or wire bundles being pulled through the conduit. The Contractor shall verify with the manufacturer the recommended fill rate by conduit size and shall not exceed the recommendations.

C. The contractor shall neatly lay out all conduits in such a fashion so as to minimize bending, crossovers, etc.

D. Bends, pull boxes, and pull points shall be sized and located as per all applicable codes and standards for the number of wires or wire bundles in the bend, pull box, pull point.

E. CAT6 cables from each AC-SEC-1 shall be neatly run in cable management equipment supplied and installed by the cabling contractor or conduits supplied and installed by the ACS Contractor as needed. The switch to be used for all ACS equipment shall be located in Telecom Room B001A. Cables shall be labeled on both ends per the cabling specification.

F. The General Contractor and the ACS Contractor shall ensure the following Emergency Access requirements are properly installed and operational prior to the final Madison Fire Department inspection for occupancy.
1. CoM IT shall provide a minimum of six (6) swipe cards to each installed Knox Box for emergency entrance. The cards shall be appropriately coded for entry at all controlled access doors.

3.4. EQUIPMENT IDENTIFICATION AND LABLEING

A. The Contractor shall provide and install all equipment identification and labeling to the following specifications.
   1. Tags and labels shall be permanent rigid plastic or metal tags with engraved or machine stamped lettering. Hand written self-stick or metal hand stamped tags will not be accepted.
   2. The Contractor shall work out the labeling scheme for doors with City IT, Owner, and Architect prior to ordering any labels or tags.
   3. The Contractor shall provide all labels and tags associated with this specification. This shall include the line voltage feed to each AC-DS-1 from the electrical distribution panel.

B. Panels and Boxes
   1. All panels and boxes shall be labeled on the outside cover that readily identifies the panel/box as a "Distribution Supply", "Power Supply", "Access Control Panel", etc. An associated number shall also be on each tag and the number "1" shall be used even if there is only one of that type panel/box.
   2. Access Control Panels shall have a card index inside the front cover of each door indicating the controller number, door number, and door location being served by that panel.

C. Conduits
   1. Line voltage from electrical distribution panels shall have conduits labeled on both ends as follows:
      a. At the distribution panel the line voltage conduit shall be labeled with the system supplied, and the ACS distribution supply panel number.
      b. In the Telecommunications Room the line voltage conduit label shall indicate the distribution panel and circuit number(s) controlling the supply line.
   2. Conduits between Access Control Panels and the controlled doors shall be labeled on both ends as follows:
      a. In the Telecommunications Room each conduit shall labeled with the door number(s) being supplied.
      b. Above the finished ceiling where the conduit is exposed prior to going into the wall space that serves the door the conduit shall be labeled with the Door Control Panel and Controller number associated with the door being served.
      c. If the conduit size is reduced as control cabling is supplied to doors along the run each change is conduit size shall be re-labeled as noted in 2.b. above.
   3. Conduits between equipment and components in the Telecommunications Room do not need to be identified.

3.5. INSTALLATION TESTING AND ACCEPTANCE

A. The CoM IT and the Owner shall be responsible for completing all software programming associated with the installation of this contract prior to the completion of the installation of the system components. It is the sole responsibility of the Contractor to notify the Owner no less than two (2) weeks in advance of completing the installation that all codes and time setting shall be prepared for final installation and testing.

B. The Contractor, CoM IT, and the Owner shall test each access control point with swipe cards and PINs to insure the door unlocks.

C. CoM IT shall test each door using the existing fully integrated software. This shall include but not be limited to the following:
   1. Remotely lock/unlock the doors
   2. Verify time clock feature works for locking doors
   3. Verify swipe cards and PINs work on all doors
   4. Verify emergency entrance cards for knox boxes work on all doors for the areas served.

D. A completed and accepted installation shall pass all of the above tests for all controlled access points.

E. The warranty period for the completed and accepted installation shall not begin until the date of the accepted general contract. The Contractor shall coordinate this date with the General Contractor.

END OF SECTION

SECTION 28 20 00
ELECTRONIC SURVEILLANCE
"FOR REFERENCE ONLY"

PART 1 – GENERAL

1.1. SUMMARY

A. The City of Madison requires video surveillance of interior and exterior areas of the Fire Station #14 as indicated in the Technology plan sheets.

B. This specification shall identify major equipment components and accessories required for a complete video surveillance installation. It does not include materials such as cables, boxes, connectors, conduit, supports and other ancillary equipment required to complete the installation.

C. For the purposes of this specification the term Contractor shall refer to the person(s) responsible for installing the Electronic Surveillance System and may or may not be the same contractor installing other Division 27 and 28 related equipment. Other contractors having related work shall be referred to by full title (Electrical Contractor).

1.2. RELATED SPECIFICATIONS

A. 01 31 23 Project Management Web Site
B. 01 33 23 Submittals
C. 01 78 23 Operation and Maintenance Data
D. 01 78 36 Warranties
E. 01 78 39 As-Built drawings
F. All Division 27 specifications that may apply to this installation

1.3. AREAS OF RESPONSIBILITY

A. The General Contractor (GC) shall be responsible for ensuring all of the following:
   1. Coordinate all Contractor related work with the construction schedule.
   2. Coordinate all required Work with the Contractor and other trades during pre-installation meetings and resolve installation issues as needed.

B. The Contractor shall be responsible for all of the following:
   1. For all equipment ordering and purchasing, setup, configuration, and testing of equipment being installed under this specification and connected to City of Madison-Information Technology (CoM-IT) servers and equipment.
      a. Include any mounting brackets required for mounting camera equipment to the structure.
      b. The Contractor shall be responsible for the bridge supports identified in Section 2.2.C below.
   2. Verification of Owner installation requirements prior to installing equipment and accessories.
   3. Provide all ancillary materials and equipment required to complete the installation.

C. CoM-IT shall be responsible for all of the following:
   1. The CoM-IT shall be responsible for the Exacq-Vision system licenses.
   2. Provide connection to servers and other hardware necessary to bring installed equipment on line.
   3. Assist in final testing of equipment and equipment functions installed under this specification.

1.4. SUBMITTALS

A. The Contractor is not required to provide submittals for products provided by the City of Madison.

1.4. WARRANTY

A. The Contractor shall warrant for one year the complete installation of equipment and components associated with this contract and installation. Contractors warranty shall be in the form of a written letter on company letterhead referring to the contract information, dates of installation and acceptance, signed by an authorized representative of the Contractors Company.
   1. The Contractors warranty shall include but not be limited to the following:
      a. Transportation to and from the location as often as needed during the warranty period.
      b. All labor and materials necessary to properly and thoroughly trouble shoot the system.
      c. All fees associated with the shipping of any component that needs to be returned or supplied by the manufacturer for repair or replacement.
      d. All labor and materials required to remove, repair, replace, or re-install of any component.

B. The Contractor shall also provide all manufacturers warranties/guarantees associated with installed components of the completed installation.

PART 2 - PRODUCTS

2.1. EXTERIOR SURVEILLANCE LOCATIONS

A. The exterior camera shall be a high quality outdoor ready PTZ (pan/tilt/zoom) camera as follows:
   1. AXIS Communications, PTZ Dome Network Camera with the minimum requirements listed below:
      a. HDTV minimum 1920 x 1080p
      b. Certified compatible with Exacq Technologies Exacq-Vision Video Management System
      c. 3 year AXIS extended warranty option

B. Exterior camera mounting accessories shall of high quality and rated for outdoor environments.
   1. AXIS Communications, models as required for the installation of the above noted camera and locations as indicated in the plans and specifications, any substitutions in camera placement to be reviewed and approved by City of Madison Department of Information Technology, with all standard features including the following:
      a. 3 year AXIS extended warranty option

2.2. INTERIOR SURVEILLANCE LOCATIONS

A. The interior camera shall be a high quality indoor ready PTZ (pan/tilt/zoom) camera as follows:
   1. AXIS Communications, PTZ Dome Network Camera with the minimum requirements listed below:
      a. HDTV minimum 1920 x 1080p
      b. Certified compatible with Exacq Technologies Exacq-Vision Video Management System
      c. 3 year AXIS extended warranty option

B. Interior camera mounting accessories shall of high quality and rated for indoor environments,
   1. AXIS Communications, models as required for the installation of the above noted camera and locations as indicated in the plans and specifications, any substitutions in camera placement to be reviewed and approved by City of Madison Department of Information Technology, with all standard features including the following:
      a. 3 year AXIS extended warranty option
      b. Surface mount as per plans
      c. Drop ceiling mount as per plans

C. All drop ceiling mount locations shall include tile bridge supports
   1. ERICO, SCMKC Security Camera Mounting Kit
   2. Pre-approved equal

PART 3 - EXECUTION

3.1. COOPERATION OF THE CONTRACTOR

A. All line voltage installations that may be required under this specification shall be installed by the Electrical Contractor. Power shall come from the nearest power panel where the equipment is being installed. Label boxes with panel and circuit number for future reference. Installation shall include any fire stopping as required by code.

B. Data cables shall be installed by the Cabling Contractor as required for this installation. Data cables shall come from the nearest Telecom Room where the equipment is being installed. Installation shall include any fire stopping as required by code.

C. The Contractor shall install all security cameras, mounting hardware, boxes and other equipment necessary for a complete installation of the surveillance system.

3.2. EXTERIOR INSTALLATIONS

A. Provide and install all camera mounting hardware, fastening hardware and anchors as needed for a strong, secure and stable installation as necessary for the building materials being mounted to.

B. Provide and install a high grade clear silicone sealant around all mounting hardware.

C. Provide sufficient cable and install a drip loop if cable is exposed outside of the mounting hardware.

D. Label camera end of data cable with permanent data tag indicating switch location connection id.

E. Label switch end of data cable with permanent data tag indicating camera location.

3.3. INTERIOR INSTALLATIONS

A. Provide and install all camera mounting hardware, fastening hardware and anchors as needed for a strong, secure and stable installation as necessary for the building materials being mounted to.

B. Install tile bridge supports at all drop ceiling locations.

C. Label camera end of data cable with permanent data tag indicating switch location connection id.

D. Label switch end of data cable with permanent data tag indicating camera location.

3.4. INSTALLATION TESTING AND ACCEPTANCE

A. Any required system programming (by Contractor) shall be completed prior to doing any installation testing and acceptance.

B. It is the sole responsibility of the Contractor to notify CoM-IT no less than two (2) weeks in advance of completing the installation to coordinate all final testing of the completed system.

C. The Contractor and CoM-IT shall test each surveillance camera installation to ensure the installed components work per the specifications.

1. All installed components shall be inspected as follows:
    a. All connections are tight, exterior installations are weather proof with clear silicone sealant.
    b. All components are clean and free of dust, finger prints and other general dirt.
    c. Camera lenses and domes are clean and free of lint, dust and finger prints.
    d. Cameras are free to rotate.
    e. All network connectivity is complete and installed properly.
2. Each camera installation at the project site shall be tested from an offsite computer to ensure all pan/tilt/zoom features, focus and other functions are fully operational.

E. A completed and accepted installation shall pass all of the above tests for each installed camera location.

F. The warranty period for the completed and accepted installation shall not begin until the date of the accepted general contract. The Contractor shall coordinate this date with the General Contractor.

END OF SECTION

SECTION 28 31 00
FIRE ALARM AND DETECTION SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Fire alarm and detection systems

1.2 QUALITY ASSURANCE

A. Manufacturer: Company specializing in smoke detection and fire alarm systems with ten years' experience.

B. Installer: A factory-authorized licensed electrical or security contractor with five years' experience in the design, installation and maintenance of fire alarm systems by that manufacturer.

C. Qualifications: The person managing/overseeing the preparation of shop drawings and the system installation/programming/testing shall be trained and certified by the system manufacturer and shall be Fire Alarm Certified by NICET, minimum Level 2. This person's name and certification number shall appear on the start-up and testing reports.

1.3 REFERENCES

A. NFPA 70 - National Electrical Code

B. NFPA 72 - National Fire Alarm and Signaling Code

C. NFPA 101 - Life Safety Code

D. UL 2017 – General Purpose Signaling Devices and Systems

1.4 SUBMITTALS

A. Submit shop drawings and product data under provisions of Section 26 05 00 and as noted below.

1. Failure to comply with all of the following and all of the provisions in 26 05 00 will result in the shop drawing submittal being rejected without review.

2. Failure to submit the fire alarm without all requirements fulfilled in a single comprehensive submittal will be grounds to require a complete resubmittal.

B. Provide product catalog data sheets as shop drawings.

1. Provide a product catalog data sheet for each item shown on the Electrical Symbols List and for each piece of equipment that is not shown on the drawings, but required for the operation of the system.

2. Where a particular Electrical Symbols List item has one or more variations (such as those denoted by subscripts, etc.) a separate additional product catalog data sheet shall be provided for each variation that requires a different part number to be ordered. The corresponding Electrical Symbols List symbol shall be shown on the top of each sheet.

3. Where multiple items and options are shown on one data sheet, the part number and options of the item to be used shall be clearly denoted.

C. Submit CAD floor plans as shop drawings:

1. The complete layout of the entire system, device addresses, auxiliary equipment, and manufacturer's wiring requirements shall be shown.

2. A legend or key shall be provided to show which symbols shown on the submittal floor plans correspond with symbols shown on the Contract Documents.

D. With regard to all fire alarm circuits, provide the following: manufacturer's wiring requirements (manufacturer, type, size, etc.) and voltage drop calculations.

E. Provide installation and maintenance manuals under provisions of Section 26 05 00.

F. Submit manufacturer's certificate that system meets or exceeds specified requirements.

G. Provide information on the system batteries as follows: total battery capacity, total capacity used by all devices on this project, total available future capacity.

H. Submit photocopy proof of NICET certification of the person overseeing the preparation of drawings and installation/testing.

I. When required to comply with local or state regulatory reviews, the fire alarm submittal shall have a Professional Engineer's stamp and signature of the state in which the project is completed. NOTE: The Architect/Engineer cannot stamp and seal submittal drawings not prepared under their supervision.

1.5 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Provide quantity equal to 2 percent (2%) of amount of each type installed, but no less than two (2) units of each type.

a. Smoke and heat detectors, manual pull stations, duct smoke detectors, monitor modules, control modules and relays.

b. Notification appliances: Speakers, speaker strobes, and strobes.

2. Keys: The installing contractor shall collect all equipment spare keys provided with each lockable or resettable device/cabinet [minimum of one (1) set each] and shall turn over to the Owner upon completion.

3. All spare parts shall be housed in metal cabinet labeled "Fire Alarm Spare Parts."

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site under provisions of Section 26 05 00.

B. Store and protect products under provisions of Section 26 05 00.

1.7 REGULATORY REQUIREMENTS

A. System: UL or FM Global listed.

B. Conform to requirements of NFPA 101.

C. Conform to requirements of Americans with Disabilities Act (ADA).

D. Conform to UL 864 Fire Alarm, UL 1076 Security, UL2017 General Signaling, and UL 2572 Mass Notification Communications.

1.8 SYSTEM DESCRIPTION

A. Performance Statement: This specification section and the accompanying fire alarm specific design documents describe the minimum material quality, required features, and operational requirements of the system. These documents do not convey every wire that must be installed and every equipment connection that must be made. Based on the equipment described and the performance required of the system, as presented in these documents, the Vendor and the Contractor are solely responsible for determining all wiring, programming and miscellaneous equipment required for a complete and operational system.

B. This section of the specifications includes the furnishing, installation and connection of the microprocessor controlled, intelligent reporting, fire alarm equipment required to form a complete coordinated system that is ready for operation. It shall include, but is not limited to, alarm initiating devices, control panels, auxiliary control devices, annunciators, power supplies, and wiring as indicated on the drawings and specified herein.

C. Fire Alarm System: NFPA 72; Automatic and manual fire alarm system, non-coded, analog-addressable with automatic sensitivity control of certain detectors, multiplexed signal transmission.

D. System Supervision: Provide electrically supervised system, with supervised Signal Line Circuit (SLC) and Notification Appliance Circuit (NAC). Occurrence of single ground or open condition in initiating or signaling circuit places circuit in TROUBLE mode. Component or power supply failure places system in TROUBLE mode.

E. Alarm Reset: Key-accessible RESET function resets alarm system out of ALARM if alarm initiating circuits have cleared.

F. Lamp Test: Manual LAMP TEST function causes alarm indication at each zone at fire alarm control panel and at annunciator panels.

G. Drawings: Only device layouts and some equipment have been shown on the contract drawings. Wiring and additional equipment to make a complete and functioning system has not been shown, but shall be submitted on the shop drawings.

1.9 PROJECT RECORD DOCUMENTS

A. Submit documents under the provisions of Section 26 05 00.

B. Include location of end-of-line devices.

C. Provide a CAD drawing of each area of the building (minimum scale of 1/16” = 1’-0”) showing each device on the project and its address. The devices shall be shown in their installed location and shall be labeled with the same nomenclature as is used in the fire alarm panel programming.

D. Submit test results of sound pressure level (dBA) and intelligibility (STI) with the rooms tested designated on the floor plan. Notification devices shall have the tap wattage designated.

1.10 OPERATION AND MAINTENANCE DATA

A. Submit data under provisions of Section 26 05 00.

B. Include operating instructions, and maintenance and repair procedures.

C. Include results of testing of all devices and functions.

D. Include manufacturer’s representative's letter stating that system is operational.

E. Include the CAD floor plan drawings.

F. Include shop drawings as reviewed by the Architect/Engineer and the local Authority Having Jurisdiction.

1.11 WARRANTY

A. Provide one (1) year warranty on all materials and labor from Date of Substantial Completion.

B. Warranty requirements shall include furnishing and installing all software upgrades issued by the manufacturer during the one (1) year warranty period.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Simplex
B. Notifier by Honeywell
C. Edwards - EST
D. Siemens Fire Safety
E. Gamewell - FCI

2.2 [FAP-#]: FIRE ALARM CONTROL PANEL (FAP)

A. Control Panel: Modular, power-limited electronic design. Provide wall-mounted enclosure as shown on plans. Enclosure shall be minimum 0.060 steel with provisions for electrical conduit connections into the sides and top. The door shall provide a key lock and shall include a glass or other transparent opening for viewing of all indicators.

B. Each Signaling Line Circuit (SLC loop) shall not be loaded over 80% of the maximum device capacity. For example, in the minimum system capacity column listed below, if the fire alarm manufacturer's system capacity of analog sensors per loop is 99 devices, then no more than 79 devices shall be wired on that loop. The minimum system capacity shall be as follows:

Minimum Total Addressable Points:	500
Minimum Total SLC loops (including board, ready for field connections):	2

C. Signal Line Circuit Board (SLC):

1. Each board shall communicate directly with each addressable analog sensor and binary input to determine normal, alarm, or trouble conditions. Analog signals would be used for automatic test and determination of maintenance requirements.

2. Each board shall contain its own microprocessor and shall be provided to monitor addressable inputs and to control addressable outputs (addressable relays). The board shall communicate and provide power to all devices on its loop over a single pair of wires, except where 4-wire devices require a separate power circuit.

3. Class B, Style 4: Circuits NOT capable of transmitting an alarm beyond the location of the fault condition. Wiring of outgoing and return conductors is permitted to be run in the same conduit or cable.

4. SLC for addressable devices with less than 50 devices can be Class A or B, and more than 50 devices shall be Class A.

D. Notification Appliance Circuit (NAC) Board:

1. Each board shall contain its own microprocessor and shall be provided to control each notification appliance circuit. The board shall communicate and provide power to all devices on its loop.

2. Class B, Style Y: Circuits NOT capable of transmitting an alarm beyond the location of the fault condition. Wiring of outgoing and return conductors is permitted to be run in the same conduit or cable.

E. Central Processing Unit:

1. The central processing unit (CPU) shall communicate with the monitor and control all other modules in the panel. Removal, disconnection or failure of any control panel module shall be detected and reported to the CPU.

2. The CPU shall execute all control-by-event programs for specific action to be taken if a designated situation is detected in the system. A real-time system clock for time annotations on the display and printer shall be included.

3. All power for the unit shall be supervised and supplied by the FAP.

F. Display:

1. The board shall provide all controls and indicators used by the system operator and may also be used to program all control panel parameters.

2. The board shall provide an alphanumeric array for display of custom alphanumeric labels for all addressable points. It shall also provide indicators for AC Power, System Alarm, System Trouble, Display Trouble and Signal Silence.

3. Displayed descriptions of addressable points shall include actual room names/numbers selected by the Owner. This information shall be obtained prior to programming. Room names/numbers shown on floor plans shall not be used.

4. The board shall provide a touch key-pad with control capability to command all system functions and entry of any alphanumeric information. Twenty different passwords with four levels of security shall be supported to prevent unauthorized manual control or programming.

G. Memory: The CPU and display interface board shall be augmented by non-volatile field programmable memory. EPROM memory will also be allowed provided the memory is burned in with minimum expansion capability equal to the total system capacity of the panel. Memory shall not be lost upon primary and secondary power failure.

H. Power Supply:

1. Input power shall be 120 VAC, 60 Hertz. Output power shall be as noted on the device specifications and drawings. Each component of the fire alarm system requiring 120 VAC input power shall be served from a dedicated emergency branch circuit. Provide two #12 conductors and one #12 ground in 3/4" conduit to a dedicated 20A/1P circuit breaker with a red handle and a manufacturer's standard handle lock-on device. Identify/label breaker and branch circuit in accordance with NFPA requirements and Specification Section 26 05 53.

2. Adequate to supply 125% of all control panel and peripheral power needs as well as 125% of power required for all external audio-visual devices. The power supply may be increased as needed by adding additional modular expansion power supplies. Over-current protections shall be provided on all power outputs.

3. All power supplies shall be designed and installed to meet UL and NFPA requirements for power-limited operation on all external initiating and indicating circuits.

4. The power supply shall provide integral charger for use with internal batteries. Battery capacity shall be sufficient for operation of the entire system for 24 hours in a non-alarm state followed by alarm mode for 15 minutes, plus 25% spare capacity for future devices.

I. Surge Protection:

1. All fire alarm control panels, NAC panels, etc. shall be provided with a surge protection device (SPD). The SPD shall be UL listed to Standard 1449 Rev 3. The unit should be clearly labeled in accordance with Identification Section 26 05 53. The SPD shall have thermal fuses to protect against fire in short circuit conditions. The unit shall provide visual indication that the unit is protecting and functioning.

2. Any communications or signaling circuits associated with the fire alarm system, which leave or enter a facility, shall be provided with a surge protection device. The devices shall be as recommended by the fire alarm system manufacturer.

J. Dual Digital Communicator:

1. Provide dual phone line interface capable of fire alarm notification to the local fire department, fire protection agency, or monitoring service. Communicator shall report in SIA and most major communication formats, with the capability of transmitting each device address point in a format compatible with the central station receiver.

2. Communicator shall be fully supervised and shall operate on loop start phase lines ahead of the building PBX system.

3. Communicator shall be FCC registered. Contractor shall provide two RJ31X jacks.

4. Approvals: UL listed - UL 864/NFPA 72, FM approved.

5. The communicator shall be provided integral to the fire alarm panel as furnished by the fire alarm panel manufacturer. If the panel construction requires a separate unit, the unit shall be as manufactured by Silent Knight, Ademco, or fire alarm panel manufacturer approved equal.

K. IP-GSM Digital Cellular Fire Communicator:

1. Provide digital internet / cellular phone interface capable of fire alarm notification to the local fire department, fire protection agency, or monitoring service. Monitoring fees and initial connection charges are not part of this project.

2. Contractor to provide connection of communicator to Owner's Ethernet 10/100 Base network connection. Wiring shall be in 1" conduit.

3. Communicator shall convert fire alarm control panel phone outputs into Ethernet packets and transmit to GSM networks in area including 2G, 3G and 4G.

4. Communication shall include system status including individual addressable device status, power loss, low battery and earth fault, and 24 hour test signal.

2.3 SIGNALING LINE CIRCUIT DEVICES

A. **[FA-120]:** Smoke Detectors:

1. Analog Photoelectric Type Sensor: Shall use the photoelectric principle to measure smoke density and send data to the control panel representing the analog level of smoke density measured.

2. Each smoke detector shall connect directly to an SLC loop.

3. Each detector shall be mounted, where shown on the drawings, on a twist-lock base with all mounting hardware provided. Provide a two-piece head/base design.

4. Each detector shall have a manual switching means to set the internal identifying code (address) of that detector, which the control panel shall use to identify its address with the type of sensor connected.

5. Dual alarm and power indicators shall be provided that flash under normal conditions and remain continuous under alarm or trouble conditions. Remote indicator terminals shall be provided. Provide a remote LED indicator device if detector is not visible from a floor standing position.

6. A test means shall be provided to simulate an alarm condition.

7. Where operation is noted as required below 32ºF and/or above 120ºF, a conventional device shall be installed with a unique monitor module located in the nearest available location with maintained temperatures between 32ºF and 120ºF.

8. Audible sounder detector base for sleeping room applications:

   a. The audible base shall sound an alarm in the local room in UL2017 operation and UL484 for general evacuation. The unit shall be programmable by the main control panel for the duration of operation.

   b. The audible sounder base shall sound Temporal 3 (fire) or Temporal 4 (CO alarm) and be at 75 dB at 10 feet.

9. A subscript is used to identify the device with a specific sequence of operation as follows: E=Elevator Recall, S=Sleeping/Patient Room, D=HVAC Control, A=Atrium, SW=Stairwell, CR=Computer Room, SD=Smoke Dampers, DH=Door Hold Release, FD= Fire Door Release, MP=Medical Procedure Room.

B. **[FA-121]:** Projected Beam Type Detectors:

1. This device shall utilize photoelectric analog smoke sensor technology. Provide with transmitter and associated receiver. Microprocessor-based detector shall provide a minimum of eight sensitivity levels, temperature and dirt compensation, and automatic gain control. Sensor to contain beam alignment adjustments and receiver calibration.

2. Detector shall connect directly to an SLC loop or shall be provided with multiple monitor modules, as required, to connect to the SLC loop and for monitoring alarm and trouble output contacts. The detector shall be provided complete with all mounting hardware provided and installed where indicated on the drawings.

3. Dual alarm and power indicators shall be provided that flash under normal conditions and remain continuous under alarm or trouble conditions. Remote indicator terminals shall be provided.

4. Provide with remote indicator panel providing LED indications of alarm and trouble.

C. **[FA-122]:** Duct Smoke Detectors:

1. Duct-type smoke detectors shall use the same analog photoelectric sensor technology, with the same features specified for standard smoke detectors, except with additional features as specified below.

2. Provide sampling tubes and mounting hardware to match the duct to which it is attached. Where the detector housing is larger than the duct height, the Contractor shall fabricate a mounting bracket for the detector and attach according to the fire alarm manufacturer's recommendations.

3. Provide a remote alarm LED indicator device (FA-240/241) if detector is not visible from a floor-standing position. If detector is located above a suspended ceiling, mount remote indicator in ceiling directly below detector with a white single-gang faceplate labeled: Duct Smoke Detector.

D. **[FA-123]** In-Duct Smoke Detectors:

1. Analog Photoelectric Type Sensor: Shall use the photoelectric principle to measure smoke density and send data to the control panel representing the analog level of smoke density measured.

2. Low Flow Type: Listed for use in duct with 0-2000 feet per minute velocity.

3. Each smoke detector shall connect directly to an SLC loop.

4. Each detector shall be mounted, where shown on the drawings, on a twist-lock base with all mounting hardware provided to match the duct application. Provide a two-piece head/base design.

5. Each detector shall have a manual switching means to set the internal identifying code (address) of that detector, which the control panel shall use to identify its address with the type of sensor connected.

6. Provide a remote LED indicator device (FA-240/241), mounted in ceiling directly below detector with a single-gang faceplate labeled: Duct Smoke Detector.

E. Manual Pull Stations:

1. Manual stations shall match the description on the drawings (refer to the General Electrical Equipment Schedule). The stations shall be mounted where shown on the drawings and be provided with all necessary mounting hardware. WG subscript indicates wire guard is required.

2. **[FA-130]**: Addressable, double action with plastic breakrod, reset key lock, semi-flush mount, red high abuse plastic or cast metal construction with white lettering.

3. **[FA-131]:** Addressable, double action with plastic breakrod, reset key lock, semi-flush mount, red high abuse plastic or cast metal construction with white lettering. Provide device with clear Lexan tamper resistant cover with integral 9V battery powered alarm that sounds when shield is lifted.

4. Manual stations shall connect directly to an SLC loop. Stations shall provide address setting means using rotary decimal or DIP switches.

5. Where operation is noted as required below 32ºF and/or above 120ºF, a conventional device shall be installed with a unique monitor module located in the nearest available location, with maintained temperatures between 32ºF and 120ºF.

F. Heat Detectors:

1. **[FA-140]:** Combination rate of rise and 135°F fixed temperature analog thermal type sensor. Factory programmed to alarm at 135ºF and at 15ºF per minute rate-of-rise. Sensor shall measure heat level and send data to the control panel representing the analog level of thermal measurement and rate-of-rise.

    a. A subscript is used to identify the device with a specific sequence of operation as follows: E=Elevator Shutdown.

2. **[FA-141]:** 200°F fixed temperature. Provide a remote addressable monitor module to interface with addressable system as shown on the plans.

3. Provide a two-piece head/base design, with a manual switching means to set the internal identifying code (address) of that detector, which the control panel shall use to identify its address with the type of sensor connected.

4. Heat detectors shall connect directly to SLC loops. Where fixed temperature or explosion proof detectors are used, one monitor module may be used to monitor all detectors in one room/area as shown on the drawings.

5. Detectors shall be mounted, where shown on the drawings, on a twist-lock base with all mounting hardware provided.

6. Provide a remote LED indicator device if detector is not visible from a floor-standing position.

7. Dual alarm and power indicators shall be provided that flash under normal conditions and remain continuous under alarm or trouble conditions. A connection for attachment of a remote indicator shall be provided.

8. A test means shall be provided to simulate an alarm condition.

9. Where operation is noted as required below 32°F and/or above 120°F, a conventional device shall be installed with a unique monitor module located in the nearest available location with maintained temperatures between 32°F and 120°F.

G. **[FA-150]:** Carbon Monoxide/Heat/Smoke Combination Detector:

1. Multi-criteria sensor for photoelectrical smoke sensing, heat and carbon monoxide (CO) detection. Carbon monoxide electrolytic sensing module shall provide toxic gas sensing to UL2034 and UL2075 standards.

2. The combined photoelectric smoke detection/heat/CO module shall have separate sensors that adjust the detection profile in response to the input from the sensors.

3. The combined photoelectric smoke detection / CO module shall have selectable modes of operation for OSHA compliant toxic gas sensing, enhanced fire sensing, and nuisance alarm reduction mode.

4. The detector shall use only one address on the SLC.

5. CO sensor cartridge element shall be field replaceable.

H. **[FA-151]:** Flame Detector:

1. Microprocessor based design. Ultraviolet and infrared type detector. Swivel mount. Provide with anti-contaminant air shields and a remote test switch located at the fire alarm control panel. Provide two addressable monitor modules for monitoring alarm and fault output contacts.

I. **[FA-160]:** Monitor Modules:

1. Monitor Module shall connect directly to an SLC loop and receive power from a separate 24 VDC circuit. It shall interface initiating devices with the control panel using Style D or Style B circuits. Contractor option: Use an interface module (2-wire operation) for Style B circuits connected to normally-open dry contacts, such as a flow switch.

2. The module shall be mounted in an enclosure located in an accessible service location as near as possible to the device(s) being monitored, or where shown on the drawings. All mounting hardware shall be provided.

3. The module shall supply the required power to operate the monitored device(s).

4. The module shall provide address setting means using rotary decimal or DIP switches.

J. **[FA-161]:** Addressable Relays:

1. Relay that represents an addressable control point used primarily for the control of auxiliary devices as indicated on the drawings. Contractor to provide additional slave relay(s), as required, rated for the electrical load being controlled (contractor to match voltage, amps, etc.).

2. Relay shall connect directly to an SLC loop and receive power from a separate 24 VDC circuit.

3. The relay shall be mounted in an enclosure located in an accessible service location as near as possible to the device(s) being controlled, unless otherwise shown on the drawings. All mounting hardware shall be provided.

4. The relay shall supply 24 VDC power to the device(s) being controlled, unless otherwise indicated on the drawings.

2.4 NOTIFICATION APPLIANCE DEVICES

A. Device Color:

1. Wall Mounted: Red housing with white lettering or pictogram.

2. Ceiling Mounted: Red housing with white lettering or pictogram.

3. WG subscript indicates wire guard is required.

B. Visual Alarm Devices:

1. **[FA-200]:** Wall mounted.

2. **[FA-201]:** Ceiling mounted.

3. High intensity (candela rating as scheduled on the drawings) xenon strobe or equivalent under a lens. Candela rating shall be visible from exterior of the device.

   a. Candela Ratings: V1=15, V3=30, V7=75, VH=110, VS=177.

4. The maximum pulse duration shall be 0.2 seconds with a maximum duty cycle of 40%. The flash rate shall be 1 Hz. Where more than two strobes are visible from any one location, the fire alarm visual devices shall be synchronized.

5. Device, housing, and backbox shall be UL listed for fire alarm/emergency applications.

C. Audio (Horn) Low Frequency 520 Hz Alarm Devices for Sleeping Rooms:

1. **[FA-213]**: Wall mounted.

2. **[FA-214]**: Ceiling mounted.

3. Sound rating: 75 dB at 10 feet.

4. Device shall be capable of a high and low dB setting. Unless noted otherwise, the device shall be set to the high setting at building completion.

5. Device, housing, and backbox shall be UL listed for fire alarm/emergency applications.

D. Audio (Horn) Alarm Devices:

1. **[FA-210]**: Wall mounted.

2. **[FA-230]**: Ceiling mounted.

3. Sound rating: 85 dB at 10 feet. Sound levels for alarm signals shall not exceed 120 dBA in the occupied area.

4. Device shall be capable of a high and low dB setting. Unless noted otherwise, the device shall be set to the high setting at building completion.

5. Device, housing, and backbox shall be UL listed for fire alarm/emergency applications.

E. Combination Audio (Horn) and Visual Notification Device:

1. **[FA-211]**: Wall mounted.

2. **[FA-231]**: Ceiling mounted.

3. Combine horn and visual components into a single device. Refer to the corresponding paragraphs above for requirements of each component.

F. **[FA-203]:** Weatherproof Visual Notification Device:

1. High intensity strobe, square housing, 75 candela rating, suitable for wet locations. Provide with weatherproof back box.

2. Mounting: Semi-flush wall.

3. Conduit shall not be exposed.

G. **[FA-233]:** Mini-Horn Audio Notification Device:

1. Electronic horn.

2. Mounting: single-gang flush wall.

H. **[FA-212]:** Weatherproof Audio/Visual Notification Device:

1. Electronic horn with high intensity strobe, square housing, 75 candela, suitable for wet locations. Provide with weatherproof back box.

2. Mounting: Semi-flush wall.

3. Conduit shall not be exposed.

2.5 DOOR HOLD-OPEN DEVICES

A. **[FA-270]:** Electromagnetic Door Holder Devices:

1. Flush wall mounted Surface wall mounted Floor mounted.

2. Voltage: 120V 24VAC 24VDC.

3. Holding force shall be 25 pounds minimum.

4. Provide fail-safe operation; power failure releases door.

5. Provide self-adjusting swivel catch plate with pivot points to adjust to door alignment changes.

6. Provide all hardware and wiring needed to accommodate the complete functioning door holder installation.

7. Ensure that the door hardware and trim projections are compatible with total projection of door release.

8. Provide firm anchoring for the electromagnet, such that the mounting box and device will not move independently from the wall or floor they are mounted to. This device and mounting will function as a doorstop and hold the force of the door closer mechanism.

9. Follow manufacturer's recommended installation and location instructions unless noted otherwise.

10. Electromagnetic door holder devices, housing, and back box shall be UL listed.

2.6 [NEP-#]: NAC EXTENDER PANELS (NEP)

A. As shown on the plans or as a Contractor's option if not shown, furnish and install NAC extender panels as necessary to provide remote power supply for notification appliance circuits (NAC). Contractor shall indicate quantity and locations of each NEP on the shop drawing submittals.

B. Each NEP shall be self-contained remote power supply with batteries, and battery charger mounted in a surface lockable cabinet. Battery capacity shall be sufficient for operation for 24 hours in a non-alarm state followed by alarm for 15 minutes, plus 25% spare capacity for future devices. Each NEP provides a minimum of up to 4 outputs, 2A continuous, or 6A full load total capacity.

C. Power for each NEP shall be from a local 120 VAC emergency circuit. Provide two #12 conductors and one #12 ground in 1/2" conduit to each NEP from a dedicated 20A/1P circuit breaker with a red handle and a manufacturer's standard handle lock-on device. Coordinate panel and circuit number with Architect/Engineer prior to installation.

D. NAC extender panels may be installed only in locations coordinated with the Architect/Engineer.

E. Mounting: Surface.

2.7 ANNUNCIATION

A. **[FAA-#]:** Remote LCD Annunciators:

1. Auxiliary annunciators shall indicate alarm and trouble conditions visually and audibly as shown on the drawings. Provide local TROUBLE ACKNOWLEDGE, TEST, and ALARM SILENCE capability. Minimum 80-character display.

2. Communications and power to the annunciators shall be supervised. The annunciator shall receive power from the fire alarm control panel.

3. A single key switch shall enable all switches on the annunciator.

4. Mounting: Flush.

B. Facility Management Control System (FMCS) Interface:

1. Provide addressable relays to report the following to the FMCS via dry contact monitoring on the FMCS:

   a. General Alarm
   b. System Trouble
   c. Supervisory Alarm
   d. Other Alarms (if applicable)

C. **[FA-241]**: Fire Alarm Remote Indicator:

1. Red LED type.
2. Mounts flush to a single gang box.

D. **[FA-242]**: Fire Alarm Remote Indicator and Test Switch:

1. Red LED type.
2. Key switch test selector.
3. Mounts flush to a single gang box.

2.8 CONNECTIONS TO AUXILIARY DEVICES PROVIDED BY OTHERS

A. **[FA-250]**: Smoke Damper:

1. Motorized type, furnished and installed by MC. Fire alarm control and power connections by EC. A subscript is used to identify the device with a specific air handler or zone for its sequence of operation. Refer to the Operation Matrix and these specifications for complete requirements.

B. **[FA-254]:** Duct Smoke Detector and Smoke Damper Control:

1. Sampling type duct detector [FA-122] in ducts 18" and larger. In-duct smoke detector [FA-123] in ducts less than 18". Detector shall be mounted within 5' of smoke damper. Motorized type smoke damper furnished and installed by MC. Fire alarm control and power connections by EC. Remote indicator [FA-241] or [FA-242] mounted in visible location. Provide auxiliary relay base or addressable control module. The smoke damper shall close upon activation of the detector, and a supervisory signal shall be sent to the fire alarm control panel.

C. **[FA-260]**: Flow Switch:

1. Connection to flow switch to monitor fire protection flow switch or discharge output contacts. Normally open dry contacts for fire alarm interface. Furnished and installed and MC; wired by EC.

D. **[FA-261]**: Monitor Switch:

1. Connection to monitor switch to monitor fire protection system supervisory switches or output contacts. Normally open dry contacts for fire alarm interface. Furnished and installed by MC; wired by EC.

E. **[FA-262]**: Post Indicator Valve:

1. Connection to post indicator valve for sprinkler system supervisory notification. Normally open dry contacts for fire alarm interface. Furnished and installed by MC; wired by EC. Provide surge protection device as recommended by the fire alarm system manufacturer on line entering/leaving the facility.

F. **[FA-263]**: Electronic Bell:

1. Electronic bell for sprinkler alarm, electro-mechanical type, 120 VAC. Furnished and installed by MC. Fire alarm control and power connections by EC.

G. **[FA-271]**: Door Hold Open Device:

1. Integral with door hardware. Furnished and installed by GC. Fire alarm control and power connections by EC.

H. **[FA-272]**: Hold Open Override:

1. Hold open override connection to GC-provided power door operator. EC shall intercept the hold open switch wiring (unless specific contacts for this purpose are provided on the door) and connect addressable relay to override this switch and allow the door to close. All modifications to the power door operator shall be coordinated with the GC.

2.9 WIRING

A. Fire alarm wiring/cabling shall be furnished and installed by the Contractor in accordance with the manufacturer's recommendations and pursuant to National Fire Codes. Cabling shall be UL listed and labeled as complying with NFPA 70, Article 760 for power-limited fire alarm signal service.

B. Approved manufacturers of fire alarm cable:

1. Comtran Corp.
2. Helix/HiTemp Cables, Inc.
3. Rockbestos-Suprenant Cable Corp.
4. West Penn Wire/CDT.
5. Radix.

2.10 STANDALONE DEVICES

A. Approved Manufacturers:

1. Gentex 9120 Series
2. System Sensor
3. Fenwall
4. Gamewell
5. Kidde

B. **[FA-170]:** Smoke Alarm - Audio:

1. 120 VAC with 9V battery backup (batteries supplied by Contractor), photoelectric type, integral test switch, Form A/Form C contacts, 90 dB piezo solid state horn, low/missing battery alarm, pulsing LED sensing chamber, insect screen, LED condition indicator, UL 217 listed.

C. **[FA-171]:** Smoke Alarm - Audio/Visual:

1. 120 VAC with 9V battery backup (batteries supplied by Contractor), photoelectric type, integral 177 candela strobe, integral test switch, Form A/Form C contacts, 90 dB piezo solid state horn, low/missing battery alarm, pulsing LED sensing chamber, insect screen, LED condition indicator, UL 217 listed.

PART 3 - EXECUTION

3.1 SEQUENCES OF FIRE ALARM OPERATION

A. General:

1. Refer to the Fire Alarm Operation Matrix on the drawings for basic requirements and system operation.

2. All system output programs assigned via control-by-event equations to be activated by the particular point in alarm shall be executed, and the associated system outputs (alarm notification appliances and/or relays) shall be activated.

B. Panel/Annunciator Alarm, Trouble, Supervisory Indication:

1. Appropriate system Alarm, Trouble, or Supervisory LED shall flash at the control panel, transponder, and annunciator locations.

2. A local signal in the control panel shall sound.

3. The LCD display shall indicate all information associated with the condition, including the name of the item, type of device and its location within the protected premises.

4. History storage equipment shall log the information associated with the fire alarm control panel (FAP) condition, along with the time and date.

5. Transmit the appropriate signal (supervisory, trouble, alarm) to the central station via the digital communicator.

6. Transmit the appropriate signal (supervisory, trouble, alarm) to the building automation system via addressable relays tied to contact monitors on the system.

C. Audible Alarms Sequence:

1. Audible alarms throughout the building shall sound.

D. Visual Alarms Sequence:

1. Visual alarms throughout the building shall flash.

E. Fire Protection Electric Sprinkler Bell Sequence:

1. The fire alarm shall utilize an addressable relay to energize the electric sprinkler bell upon activation of the flow switch.

F. Double Interlocked Preaction Sprinkler Activation Sequence:

1. The fire alarm system shall utilize an addressable relay to signal the double-interlock preaction sprinkler system to allow filling with water upon initiation of alarm in zone of sprinkler coverage.

2. Where there are multiple zones to the preaction system, a separate addressable relay shall be provided for each zone and the system shall be programmed to signal only the zone that is in the area of the fire. Coordinate with the fire protection system installer.

3. The fire alarm system shall utilize addressable monitor modules to monitor the control panel supervisory and trouble conditions.

G. Clean Agent Release Sequence:

1. The fire alarm system shall utilize an addressable relay to signal the clean agent release panel to activate upon initiation of alarm in two zones of detection.

2. Where there are multiple clean agent zones, a separate addressable relay shall be provided for each zone, and the system shall be programmed to signal only the zone that covers the area of the fire. Coordinate with the clean agent system installer.

H. Kitchen Hood Fire Suppression System Sequence:

1. The fire alarm system shall utilize an addressable relay to de-energize the hood supply fan controller.

2. The fire alarm system shall utilize an addressable monitor module to monitor the fire suppression system.

I. Smoke Damper Control Sequence:

1. The fire alarm system shall utilize an addressable relay to open the power connection to smoke or fire/smoke dampers and allow them to close. Coordinate other requirements with damper installer.

2. Where a damper is located in a main air duct, where closure of that single damper will entirely block airflow in the duct system, the smoke damper sequence shall also initiate the AHU shutdown sequence for the affected unit.

3. The AHU shutdown sequence shall be initiated only when ALL of the dampers associated with that unit are closed. Otherwise, the AHU shall continue to serve other areas.

4. Smoke and fire/smoke dampers located in branch ductwork shall be closed individually or in groups, as identified on the plans.

J. AHU Shutdown Sequence:

1. The fire alarm system shall utilize addressable relays to de-energize all AHU motor controllers. Coordinate other requirements with HVAC installer.

2. The fire alarm system shall directly shut down the AHU through the local HVAC control device (i.e., variable frequency drive or motor starter).

3. Where a facility has more than one AHU, each shall be shutdown individually based on input from initiation devices in the area served by the unit or designated for each AHU.

K. Fire Door Release Sequence:

1. The fire alarm system shall utilize an addressable relay to signal the fire door or curtain to close. Once the alarm is cleared, the addressable relay shall allow the door to open.

2. Where a facility has more than one fire door, each shall release individually based on input from initiation devices in the vicinity of each door and noted specifically for door closure.

L. Door Holder Release Sequence:

1. The fire alarm system shall utilize an addressable relay to open the power connection to integral and magnetic door holders.

2. The fire alarm system shall utilize an addressable relay to open the 'hold' switch circuitry, integral to the power door.

3. Door holders shall release individually based on initiation devices in the vicinity of the door and noted specifically for door closure.

M. Sound Masking Paging System Shutdown Sequence:

1. The fire alarm system shall utilize addressable relays or RS-485 interface to disconnect the signal source or de-energize the amplifiers to shut down all sound masking paging systems. Coordinate with masking paging system supplier to provide necessary interface at all sound system equipment locations.

2. The fire alarm interface and associated relays, etc. shall not induce any noise onto the audio system and shall not affect the performance or audio-quality of the system during normal use.

3.2 INSTALLATION

A. Install system in accordance with manufacturer's instructions and referenced codes.

B. Fire Alarm Control Panel:

1. Install the control panel where shown on the drawings.

2. All expansion compartments, if required, shall be located at the control panel.

3. The fire alarm voice prerecorded messages shall be verified by the Contractor, as approved by the Owner, prior to the shop drawing submittal process.

C. Devices:

1. General:

a. All ceiling-mounted devices shall be located where shown on the reflected ceiling and floor plans. If not shown on the reflected ceiling or reflected floor drawings, the devices shall be installed in the relative locations shown on the floor drawings in a neat and uniform pattern.

b. All devices shall be coordinated with luminaires, diffusers, sprinkler heads, piping and other obstructions to maintain a neat and operable installation. Mounting locations and spacing shall not exceed the requirements of NFPA 72.

c. Where the devices are to be installed in a grid type ceiling system, the detectors shall be centered in the ceiling tile.

d. The location of all fire alarm devices shall be coordinated with other devices mounted in the proximity. Where a conflict arises with other items or with architectural elements that will not allow the device to be mounted at the location or height shown, the Contractor shall notify the Architect/Engineer to coordinate a different acceptable location.

2. Per the requirements of NFPA, detector heads shall not be installed until after the final construction cleaning unless required by the local Authority Having Jurisdiction (AHJ). If detector heads must be installed prior to final cleaning (for partial occupancy, to monitor finished areas or as otherwise required by the AHJ), they shall not be installed until after the fire alarm panel is installed, with wires terminated, ready for operation. Any detector head installed prior to the final construction cleaning shall be removed and cleaned prior to closeout.

3. Analog Smoke and Heat Detectors:

a. In elevator shafts and elevator equipment rooms, provide a heat detector for elevator shutdown within 2' of every sprinkler head. Coordinate with fire protection contractor.

4. Duct-type Analog Smoke Detectors:

a. Duct-type analog smoke detectors shall be installed on the duct where shown on the drawings and details. The sampling tubes shall be installed in the respective duct at the approximate location where shown on the electrical drawings to meet the operation requirements of the system.

b. All detectors shall be accessible.

c. Duct-type detectors shall be installed according to the manufacturer’s instructions.

5. In-Duct Analog Smoke Detectors:

   a. In-duct analog smoke detectors shall be installed in the duct where shown on the drawings and details. The devices shall be installed in the respective duct at the approximate location where shown on the electrical drawings to meet the operation requirements of the system.

   b. All detectors shall be accessible.

6. Manual Pull Stations:

   a. Stations shall be located where shown and at the height noted on the drawings.

7. Addressable Relays and Monitor Modules:

   a. Modules shall be located as near to the respective monitor or control devices as possible, unless otherwise indicated on the drawings.

   b. All modules shall be mounted in or on a junction box in an accessible location.

   c. Where not visible from a floor standing position, a remote indicator shall be installed to allow inspection of the device status from a local floor standing location.

8. Notification Appliance Devices:

   a. Devices shall be located where shown on the drawings.

   b. Wall-mounted audio, visual and audio/visual alarm devices shall be mounted as denoted on the drawings.

   c. Where ceiling mounted visual alarm devices or combination audio/visual alarm devices are shown where the ceiling is greater than 30'-0" high, they shall be stem mounted so that the entire unit is below 30'-0". This does not apply to audio-only alarm devices.

D. Annunciators:

1. Remote Annunciators: The annunciators shall be located where shown on the drawings and approved by the fire marshal.

E. Wiring:

1. Fire alarm wiring/cabling shall be provided by the Contractor in accordance with the manufacturer's recommendations and pursuant to National Fire Codes.

2. Wiring shall be installed in red-colored conduit.

3. All junction boxes shall be painted red with SLC and NAC circuits identified on cover.

4. Fire Alarm Power Branch Circuits: Building wiring as specified in Section 26 05 13.

5. Notification Appliance Circuits shall provide the features listed below. These requirements may require separate circuits for visual and audible devices.

   a. Fire alarm temporal audible notification for all audio appliances.

   b. Synchronization of all visual devices where two or more devices are visible from the same location.

c. Ability to silence audible alarm while maintaining visual device operation.

6. Notification Appliance Circuits shall not span floors or smoke compartments.

7. Signal line circuits connecting devices shall not span floors or two-hour smoke compartments.

8. No wiring other than that directly associated with fire alarm detection, alarm or auxiliary fire protection functions shall be in fire alarm conduits. Wiring splices shall be avoided to the extent possible, and if needed, they shall be made only in junction boxes, and enclosed by plastic wire nut type connectors. Transposing or changing color coding of wires shall not be permitted. All conductors in conduit containing more than one wire shall be labeled on each end, in all junction boxes, and at each device with "E-Z Markers" or equivalent. Conductors in cabinets shall be carefully formed and harnessed so that each drops off directly opposite to its terminal. Cabinet terminals shall be numbered and coded, and no unterminated conductors are permitted in cabinets or control panels. All controls, function switches, etc. shall be clearly labeled on all equipment panels.

F. Fire Alarm Cabling Color Code: Provide circuit conductors with insulation color coding as follows, or using colored tape at each conductor termination and in each junction box.

1. Power branch circuit conductors: In accordance with Section 26 05 53.
2. Signaling line circuit: Overall red jacket with black and red conductors.
3. DC power supply circuit: Overall red jacket with violet and brown conductors.
4. Notification appliance circuit: Overall red jacket with blue and white conductors.
5. Door release circuit: Gray conductors.
6. Central station trip circuit: Orange conductors.
7. Central station fire alarm loop: Black and white conductors.

G. Devices surface mounted in finished areas shall be mounted on surface backboxes furnished by fire alarm equipment supplier. Backboxes shall be painted to match device, shall be the same shape and size as the device shall not have visible knockouts.

H. Make conduit and wiring connections to door release devices, sprinkler flow and pressure switches, sprinkler valve monitor switches, fire suppression system control panels, duct analog smoke detectors and all other system devices shown or noted on the Contract Documents or required in the manufacturer's product data and shop drawings.

3.3 FIELD QUALITY CONTROL

A. Field inspection and testing will be performed under provisions of Section 26 05 00.

B. Test in accordance with NFPA 72, Chapter 14 and local fire department requirements. Submit documentation with O & M manuals in accordance with Section 14.6 of the Code.

C. Contractor shall test and adjust the fire alarm system as follows:

1. Speaker taps shall be adjusted to the lowest tap setting which achieves a sound level higher than or equal to the greatest of the following:

a. 70dBA.

b. 15 dBA above ambient levels as indicated in NFPA 72 Table A.18.4.3.

c. 15 dBA above measured ambient. 5 dBA above the maximum measured sound level with duration of more than 60 seconds.

d. As specified on the drawings.

2. Sound level measurement procedure shall meet the following requirements:

a. All measurements shall use the 'A' weighted, dBA, sound measurement scale.

b. All measurements shall be taken after furnishings, wall coverings and floor coverings are in place.

c. All measurements shall be taken after fixed equipment (HVAC units, etc.) producing ambient noise is installed and is in operation.

d. All sound level measurements shall be taken at a height of 5' above the finished floor level.

e. Measurements shall be taken in every unique room. If there are multiple rooms, which have the identical dimensions and function, 10%, or a minimum of 2 rooms shall be tested. The results from the rooms tested shall be averaged and the remaining rooms may be adjusted per the average.

f. Measurements shall be taken on a 20' x 20' grid and the results for all points taken shall be averaged. If the room is smaller than 20' x 20' a minimum of two measurements are required.

g. Measurements shall be taken halfway between speakers or halfway between a speaker and the wall. No measurements shall be taken at the extreme edges of the room, nor directly under speakers.

D. Additionally, test the voice alarm communication system intelligibility per IEC 60849:

1. The following acoustically distinguishable spaces shall be tested: All unique rooms shall be tested. If there are multiple rooms with the identical dimensions and function, 10%, or a minimum of two (2) rooms, shall be tested. The results from the rooms tested shall be averaged, and the remaining rooms may be adjusted per the average.

2. Utilize equipment designed to test per IEC 60849 per the equipment manufacturer's instructions. This equipment includes a signal generator, which is input to the fire alarm system and a portable measurement device. This equipment is available from Simplex Grinnell or Gold Line.

3. Testing equipment that can simulate 'crowd babble' shall be used in rooms with occupancy of greater than 200.

4. Wide-area notification intelligibility shall be tested in acoustically distinguishable spaces and areas as designated by the Owner.

5. When testing for intelligibility, the quantity and location of the measurement points shall be the same as the points used for measurement of dBA level.

6. Provide a room by room report, showing the average dBA level and STI for each room tested, the number and location of. The report shall be presented to the Architect/Engineer in an Excel .xls file.

3.4 MANUFACTURER'S FIELD SERVICES

A. Provide manufacturer's field services under provisions of Section 26 05 00.

B. Include services of certified technician to supervise installation, adjustments, final connections, and system testing.

C. Note that room numbers depicted on the architectural/engineering drawings will not necessarily reflect the actual room (signage) numbers that the Owner selects. The Contractor and fire alarm manufacturer shall coordinate the actual room numbers as the Owner directs to identify each device. This list shall be a part of the floor plan record drawing to be turned in at the project closeout.

END OF SECTION

SECTION 31 05 00
COMMON WORK RESULTS FOR EARTHWORK OUTSIDE BUILDING FOOTPRINT

PART 1 - GENERAL

1.1 SCOPE

A. Work Included: Furnish all labor, equipment, and materials to complete all earthwork including:

1. Site clearing, grubbing, stripping, and earth moving.
2. Excavation, filling, backfilling, compaction, and grading.
3. Preparation of subgrade for slabs on grade, walks, pavements, roads, and parking areas.
4. Proof-rolling of Subgrade.
5. Furnish, apply, and rough grade topsoil.
6. Removal of structures at or below grade.
7. Provide and pay for all necessary permits.
8. Shoring, cribbing, and bracing to safely support excavations.
9. Contractor shall determine if the site "balances" and include in their bid any import or export of material including any spoils from utilities.

B. Work Not Included: Excavating and backfilling inside and outside of building as required for plumbing, heating, and electric work installed underground, including tanks, pits, manholes, catch basins and inlets, which are included in other Sections.

1.2 REFERENCE STANDARDS

A. ASTM A444 - Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process for Culverts and Underdrains

B. ASTM C136 - Sieve Analysis of Fine and Coarse Aggregates

C. ASTM C207 - Hydrated Lime for Masonry Purposes

D. ASTM D1556 - Standard Test Method for Density of Soil in Place by the Sand - Cone Method

E. ASTM D422 - Particle Size Analysis of Soils

F. ASTM D423 - Liquid Limit of Soils

G. ASTM D424 - Plastic Limit and Plasticity Index of Soils

H. ASTM D698 - Moisture-Density Relations of Soils and Soil-Aggregate. Mixtures using 5.5 lb. Rammer and 12 inch Drop (Standard Proctor Test)

I. ASTM D1452 - Soil Investigation and Sampling by Auger Borings

J. ASTM D1557 - Moisture Density Relations of Soils and Soil - Aggregate Mixtures using a 10 lb. Rammer and 18 inch Drop (Modified Proctor Test)

K. ASTM D2167 - Density of Soil in Place by the Rubber-Balloon Method

L. ASTM D2487 – Classification of Soils for Engineering Purposes

M. ASTM D2922 - Standard Test Methods for Density of Soil and Soil-Aggregates in Place by Nuclear Methods (Shallow Depth).

N. Standard Specification for Highway and Structure Construction, State of Wisconsin.

O. Specification 01 45 29 Laboratory Testing

1.3 QUALITY ASSURANCE

A. Perform earthwork in compliance with local, state, and OSHA requirements.

B. Project Site Information: A geotechnical report has been prepared for this Project and is available for information only. The opinions expressed in this report are those of the geotechnical engineer and represent interpretations of the subsoil conditions, tests, and results of analyses conducted by the geotechnical engineer. Owner will not be responsible for interpretations or conclusions drawn from this data by Contractor.

1. Contractor shall make additional test borings and conduct other exploratory operations as necessary.

2. The geotechnical report is included in the Existing Conditions section of the Project Manual.

C. Testing and Inspection Service: Owner shall engage soil testing and inspection service (Geotechnical Engineer) for quality control testing during earthwork operations.

1. Additional copies of testing reports shall be sent to the architect.

2. Testing agency representatives on the site are required to read and understand the requirements of the Construction Documents, the Soil Report, and this Section. Contractor shall verify this condition.

3. Proofrolling, undercutting, and fill operations shall be performed under the observation of the Geotechnical Engineer.

4. Approval by Geotechnical Engineer must be given prior to the placing of any concrete or fill material, and whenever the Soil Report or actual conditions encountered indicate loose or variable soil conditions, variable soil coloration, unexpected materials, etc. Do not proceed if unsuitable conditions are encountered. Notify Geotechnical Engineer immediately.

5. Testing agency shall provide to Owner, Architect, and Engineer written field reports that topsoil and unacceptable soils have been removed, reports of actual bearing pressures encountered, and all compaction tests. Provide written verification that existing soils and fill materials achieve specified bearing capacity at all locations including lawn and unpaved areas.

6. Provide Geotextile Fabric Information to Geotechnical Engineer for review.

D. Grading Limits: Confine work to the Construction Limits as indicated on the drawings. In the absence of such a designation on the drawings, confine work to the minimum area reasonably necessary to undertake the work as determined by the Engineer. All areas disturbed by excavation and grading, plus such additional areas as are disturbed by construction related activities including construction access and storage and installation of materials shall be considered the "Construction Area."

E. Wherever provisions of the Specification, Drawings, including supplements and addenda, or the requirements of Geotechnical Engineer conflict (e.g. compaction materials, required percent compaction, etc.), the more stringent requirements shall govern unless approved in writing by Engineer.

F. Conform to Federal, State, and local ordinances with respect to excavations, disposal of waste, burning, air quality, noise, erosion, water runoff, etc.

G. Record Drawings: Maintain record drawings of all underground utilities, drain tiles, or other structures encountered, and/or earthwork made as part of this project on original drawings prepared by the installing Contractor/Subcontractor.

H. Earth Retention System: Contractor is completely responsible for the design and construction of adequate and safe temporary shoring, bracing, retaining structures, and excavations. All systems shall be designed for potential sand seams and water, which may cause cave-ins, and/or require additional bracing, casing of bore holes, dewatering, etc.

1.4 SUBMITTALS

A. None

1.5 QUANTITIES

A. Elevations provided on the plans are finished elevations including topsoil. Finish topsoil depth shall be as specified in this section or as shown on the drawings, whichever is greater.

B. Contractor shall be solely responsible for determining all earthwork quantities based on the existing and proposed elevations provided on the plans. Any geotechnical investigations provided by the Owner apply only to those locations that the data was collected, and may not be indicative of conditions elsewhere on the site. The Contractor is responsible for collecting any additional geotechnical or survey data he deems necessary to complete an accurate estimate of earthwork quantities.

C. Contractor shall be solely responsible for balancing site materials. If onsite excavation and borrow operations do not provide enough suitable material for fill areas, Contractor shall coordinate and pay for excavation, transport, and placement of imported material meeting the specifications of the contract documents. If excavation results in excess materials, Contractor shall coordinate and remove all excess materials from the site (at no cost to the owner). No excess material can remain onsite.

D. If contractor finds the geotechnical information or existing or proposed elevations shown on the plans to be erroneous, he shall notify the Project Manager immediately.

PART 2 - PRODUCTS

2.1 FILL MATERIALS

A. Structural Fill: Well graded, granular material, bankrun sand and gravel, or crushed or natural stone, free of shale, clay, friable materials, and debris; tested in accordance with ANSI/ASTM C136 within the following limits:

1. Maximum size of aggregate shall be 2" with not more than 80% passing on a 3/4 inch sieve, with not less than 50% by weight passing a No. 4 sieve.

2. Not more than 15% shall pass the No. 200 sieve.

3. When used for bedding under pipes, conduits or culverts, fill shall consist of material with greater than 50% by weight passing a No. 4 sieve and all particles passing a l inch sieve. Bedding material shall be selected and placed in accordance with the recommendations of the pipe manufacturers and in accordance with Chapter 6.43 of Standard Specifications for Sewer and Water Construction in Wisconsin, Latest Edition.

    a. Fill above utilities shall be clay where existing soils are clay.

b. For all utilities and other excavations, provide anti-seep, concrete collars or cut-off walls, or other suitable means to cut off water where a water source could flow back to building.

4. Structural Fill shall achieve the required soil bearing pressure specified in the Contract Documents and Soil Report.

B. Fill placed in fabric or geogrid reinforced sub-grade areas in pavement areas shall be granular soil, such as 1-1/4 inch or 3/4 inch crushed stone aggregate, or other as recommended by the geotechnical engineer. Aggregate should not exceed the maximum recommended by the geotextile manufacturer.

C. Drainage Fill: Frost resistant, well graded, clean, angular/fractured, crushed stone or gravel (not sand), free of silt, clay, loam, friable or soluble materials, and organic matter; tested in accordance with ANSI/ASTM C136 within the following limits:

1. Not more than 5% shall pass the No. 200 sieve.

a. Slab on grade subgrade: ASTM C33, Size 67.

b. Building perimeter drain lines shall be surrounded with at least 12 inches of washed aggregate conforming to ASTM C33, Size 67.

c. Perimeter drains at retaining walls shall be surrounded with at least 12 inches of washed aggregate conforming to ASTM C33, Size 67.

D. No. 2 Stone: Angular crushed limestone aggregate having uniform particle size of nominally 2 inches, essentially free of fines.

E. Lean Concrete: Minimum 1,500 psi compressive strength at 28 days.

F. Common Fill: Approved material from site, excavation or offsite, separated from materials which do not compact by tamping or rolling. Crushed stone, bank run gravel, or coarse sand or general earth material free of particles larger than 6 inches, debris, peat, roots, cinders, wood, trash, organic material or other objectionable material.

G. No organic, deleterious or frozen or "contaminated" material may be used for backfilling or fill material.

H. Geotextile Material: Conforming to WISDOT 645 and Soil Report with respect to Grab, Puncture and Burst Strength, Trapezoidal Tear, Permativity, and Apparent Opening Size.

1. Around stone surrounding draintile and trench drains: WISDOT 645.2.4 Type DF, Type A or better:

2. "Mirafi 140-N"

3. "ADS 5000"

4. "Amoco 4547"

5. "Contech C-45NW"

6. Approved equal

7. Under slab-on-grade when specified on plans as required: WISDOT 645.2.2 Type SAS:

8. "Mirafi 180-N"

9. "Mirafi FW404"

10. "ADS 8800"

11. "Amoco 4553"

12. "Contech C-80NW"

13. Terra Tex-N08"

14. Approved equal

15. Soil stabilization and subgrade reinforcement above poor soils: WISDOT 645.2.3 Type MS:

16. "Tensar BX-1200"

17. Approved equal

2.2 TOPSOIL

A. Topsoil to be furnished: If quantity of stored topsoil is inadequate or if none has been salvaged from site, this Contractor shall furnish sufficient topsoil to properly construct lawns. Topsoil furnished shall be a natural, fertile, friable soil, possessing characteristics of representative productive soils in the vicinity. It shall be obtained from naturally, well-drained areas. It shall not be excessively acid or alkaline or contain toxic substances which may be harmful to plant growth. Topsoil shall be without admixtures of stones, stumps, roots, debris or other objects 1" or more in diameter which might be a hindrance to planting operations. Topsoil shall be placed to a minimum depth of 6" after compaction.

B. Landscape Contractor shall provide, spread, and fine grade topsoil.

PART 3 - EXECUTION

3.1 GENERAL

A. Contractor to review specific method of soil preparation as listed in the geotechnical report.

B. Contractor to establish all heights and grades to properly execute work from benchmark established by a surveyor (from original survey work). It is strongly recommended that the original surveyor be contacted and used for all construction layouts as well as as-built surveys in an effort to avoid conflict between datums and horizontal control points used. Prior to construction layout, existing and proposed finished floor elevations shall be checked with respect to current site benchmarks to ensure elevations correspond with layout elevations.

C. Contractor shall provide all construction layout surveys to accurately locate the construction on the site.

D. Prior to start of work, Contractor shall be completely familiar with all conditions at the site, and shall account for conditions that may affect the work including: Geotechnical recommendations and methods, limitations on work access, space limitations, overhead obstructions, traffic patterns, local requirements, adjacent activities, etc. Failure to consider these requirements shall not be cause for claim of job extras.

E. Inspect areas and conditions prior to clearing, excavating, filling, and grading. Do not proceed until unsatisfactory conditions have been corrected.

F. Permits and Fees:

1. Apply for, pay for, and secure all permits required in connection with the work under this section from the governmental authorities having jurisdiction.

2. Pay all highway and dumping fees and repair damage to sidewalks, streets, or other public property, or to any public utilities.

3.2 PROTECTION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout and other hazards created by earthwork and dewatering operations. Protect and maintain all lawns, beds, shrubs, trees, and other work that is to remain in place. See Specification 01 76 00 Protecting Installed Construction for additional information.

1. Should damage occur as a result of work performed under this Contract, restore to existing condition at no additional cost to Owner, in a manner acceptable to Architect.

2. Repair or replace trees and vegetation indicated to remain which are damaged by construction operations, in manner acceptable to Architect.

B. Conduct site clearing operations to ensure minimum interference with roads, streets, walks, and other adjacent occupied or used facilities. Do not close or obstruct roads or other occupied or used facilities without permission from Owner and authorities having jurisdiction.

C. Carefully remove items indicated to be salvaged, and store on Owner's premises where indicated or directed.

D. Provide and maintain temporary fences, planking, lights, warning signs, barricades, and guards necessary for protection of premises and public.

E. Maintain cut at satisfactory slope which will prevent collapse of embankments. Provide bracing and shoring as required to protect existing improvements, including outside contract limits, new construction or excavations. Contractor is solely responsible for strength and adequacy of bracing or shoring and for safety. Conform to OSHA requirements. Restore any damaged improvements to their original condition.

F. Do not load vehicles hauling debris excessively as to cause spillage on to streets and roadways. Do not allow spilled materials to clog drainage of streets.

G. Keep sidewalks and streets adjoining the property broom clean and free of debris, excavated materials, rubbish, trash and obstructions, which might affect the safety of streets, walks, utilities and property. Broom clean daily.

H. Use all means necessary to control dust on and near the work, if such dust is caused by the Contractor's operations during performance of the work, or if resulting from the condition in which the Contractor leaves the site.

I. Provide positive protection (mat/sheet coverings) for all excavation slopes to protect slopes from instability and deterioration due to rain, wind or snow/ice.

J. Construct, maintain and protect erosion and sedimentation controls.

3.3 EXISTING UTILITIES

A. The Contract Drawings show such information as can reasonably be obtained regarding the location and nature of pipe lines, storm sewers, water lines, natural gas lines, underground cables, etc. However, the accuracy or completeness of such information is not guaranteed. It shall be Contractor's responsibility to locate such underground features sufficiently in advance of operations to preclude damage to same.

B. Locate existing underground utilities in the areas of work. If utilities are to remain in place, provide adequate means of support and protection during earthwork operations.

C. Should uncharted or incorrectly charted, piping or other utilities be encountered during excavation, consult Architect and appropriate utility company immediately for directions. Cooperate with Owner and utility companies for keeping respective services and facilities in operation. Repair damaged utilities to satisfaction of utility company. The cost of repair of uncharted or incorrectly charted utilities will not be paid by the Owner.

D. Do not interrupt existing utilities serving facilities occupied and used by Owner or others except when permitted in writing by Architect and then only after acceptable temporary utility services have been provided. Provide minimum of 48-hour notice to Owner, and receive written notice to proceed before interrupting any utility.

E. Demolish and completely remove from site existing underground utilities indicated to be removed. Coordinate with utility companies for shut-off of service if lines are active.

3.4 SITE CLEARING AND GRUBBING

A. Clear area within contract limits of trees, stumps, brush, shrubs, vegetation, rubbish, and other perishable or objectionable matter.

B. Remove all cleared material from site.

C. An effort has been made to show the majority of existing trees on-site on the plans, however, Contractor to visually verify removal limits prior to bidding.

D. Existing bituminous and concrete paving, roads, walks, and curbs shown in areas of proposed improvements or reused grades, shall be removed by this Contractor to a depth of at least 10” below the paved surface.

E. Completely remove stumps, roots, and other debris protruding through ground surface. Use only hand methods for grubbing inside drip line of trees indicated to remain.

F. Remove existing above-grade and below-grade improvements, unsuitable fill, cinders, concrete, old foundations and any other unsuitable material as indicated on Drawings, soil report or interfering with new construction.

G. Burying or burning of materials on the site is not permitted.

H. Trim limbs and branches of trees to be left in place which overhang roadbeds or structure to provide proper clearance.

3.5 SITE GRADING

A. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.

B. Preparation of subgrades after stripping vegetation, organic or other unsuitable materials shall consist of:

1. Proof-rolling under the observation of an experienced Geotechnical Engineer or Technician to detect soft, wet, yielding soils or other unstable materials. Proof rolling shall consist of rolling the subgrade with a heavily loaded rubber tired vehicle such as a loaded scraper or tandem axle dump truck.

a. Undercut soft or unsuitable areas of subgrade 2 to 3 feet or as directed by Geotechnical Engineer. Backfill with granular soil (as indicated in the geotechnical report) fill in maximum 8 inch loose lifts, and compact to the minimum required degree of compaction as specified in Compaction Section.

b. Remove the top 18" of the subgrade where expansive clays (Liquid Limit greater than 50) are encountered. Replace with granular structural fill.

c. Remove, as directed by Geotechnical Engineer, underlying bearing soils that are disturbed by construction, weather or earthwork activities, and replace with structural, engineered fill.

d. In pavement areas, backfill half of undercut with No. 2 stone placed in 8" lifts and compacted until no further vertical and lateral movement is observed. Backfill upper half of undercut with Base Coarse Aggregate placed in 8" lifts and compacted as specified in Compaction Section.

e. Provide Geotextile Fabric before backfilling, if soft soils exist at bottom of excavation.

2. Scarify top 6 to 8 inches.

3. Moisture condition soils as required.

4. Recompaction to same minimum in-situ density required for similar materials.

5. Stone Base course shall be proof-rolled prior to placing pavement section as well.

C. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Architect, without additional compensation.

D. All subgrades shall consist of and be:

1. Underlain by suitable bearing material.

2. Free of all organic, frozen or other deleterious material.

3. Observed, tested and approved by Geotechnical Engineer.

3.6 CUT AND FILL

A. Provide all necessary cutting and filling required to change existing grade specified or as shown on drawings.

1. Note: A vibratory smooth drum roller should not be used on clay soils.

2. In areas under proposed pavement, consult with geotechnical engineer and report for construction methods.

3. Rough grade all seeded areas to 6" below finish grade elevation. Where topsoil of sufficient depth is encountered, grade shall be brought to final established grade. Minimum depth of topsoil shall be 6".

4. All roads, drives, and parking areas etc. shall be rough graded to 15" below finish grade, or as required to install subgrade and finish pavement.

B. Fill in excess of 12" shall be constructed in 8" layers and shall be rolled with rubber tired equipment or sheepsfoot rollers, or compacted with vibratory equipment, whichever is best suited for soil being compacted. Fill under paved areas shall be compacted to 95 percent Modified Proctor, as per ASTM D 1557.

C. Where there is a great change in grade, a maximum slope of three to one (3:1) shall be maintained. Reference Section 31 25 00 - Erosion Control for Specific Requirements.

D. Do no grading until sewers, water mains and other utilities are installed. After backfill has settled and when directed, fill shallow places to bring to proper grade.

E. Excess excavated material from trenches and other excavations will be piled on site if to be reused, or removed from site by respective Contractors. Deposition and spreading shall be done by this Contractor.

1. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.

2. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

3.7 EXCAVATING

A. Excavate and remove whatever materials encountered, including existing pavements, abandoned building foundation walls, footings and slabs, and unsuitable fill as required to place within finish elevations shown, all footings, walls, trenches, pits, ground floor slabs, drain tiles inside and around basement to complete the project.

1. Remove rock to lines and grades indicated, to permit installation of permanent construction without exceeding the following dimensions: 12 inches outside of concrete forms at footings.

2. 6 inches outside of minimum required dimensions of concrete cast against grade.

3. 6 inches beneath bottom of concrete slabs on grade.

B. Maintain pit or pits to which all excavated parts shall be drained. Provide, operate and maintain suction and discharge lines, pumps and other equipment necessary to drain and keep all excavations, trenches and entire subgrade area free of water under any and all circumstances which may arise. Notify Geotechnical Engineer if springs or water seepage are encountered during grading for possible construction procedure revisions or inclusion of subgrade drainage system.

C. Excavated earth shall remain on site, if possible, and placed where directed.

1. After final grading work is complete, remove any excess earth from premises. Where site constraints dictate, excavated earth shall be stored off-site or landfilled.

2. All surplus earth shall be removed from premises.

D. Additional Excavation: When excavation has reached required subgrade elevation, notify Architect and Geotechnical Engineer for inspection of conditions.

E. Unauthorized Excavation: Consists of removal of materials beyond indicated subgrade elevations, limits or dimension without specific direction of Geotechnical Engineer. Unauthorized excavation, as well as remedial work directed by Architect and/or Geotechnical Engineer, shall be at Contractor's expense.

F. Frost Protection: All open footings, trenches and exposed floor slab areas must be protected against frost impregnation.

G. Stability of Excavations:

1. Slope sides or excavations to comply with governing codes and ordinances, including OSHA Subpart P of 29 CFR 1926, or successor regulations. Shore and brace where sloping is not possible because of space restrictions or stability of material excavated. Unless required otherwise by code or unless authorized by Geotechnical Engineer, slopes for excavations 20 feet deep or less should not exceed 1:1 for soil Types A and B and 1-1/2 (horizontal):1 (vertical) for soil, Type C.

2. Maintain side and slopes of excavations in a safe condition until completion of backfilling.

H. Do not place excavated materials where they will inconvenience the public, impede travel, or impede surface drainage unless such drainage is being safely rerouted away from the excavation without causing

other damage. Do not place excavated materials close to a trench or excavation, unless shoring of adequate strength is provided to support the additional loads that are imposed.

I. Tunnel under, or remove and replace, sidewalk and curb in areas of excavation to the nearest joint. Remove all pavements, including curbs and gutters, to neat and straight lines to the limits of removal by a two-step method. Limit the initial removal to the immediate area of the proposed work. Full depth sawcutting is not required for this phase of the removal. After the work is completed, and immediately prior to the pavement replacement, make a full depth sawcut to neat and straight lines outside the widest point of excavation. Make the lines of sawcut parallel to existing joints, or parallel or perpendicular to pavement edges so as to form a neat patch. Carefully remove all remaining pavement within the sawcut area to the lines of the sawcut. Do not disturb existing base materials between the area disturbed by the work and the sawcut line during the sawcutting, pavement removal, or pavement replacement processes.

J. If field tile are encountered during the excavation, the Contractor shall make provisions for continuing the drainage on an interim basis and immediately notify the Architect and Geotechnical Engineer. Field tiles shall be re-routed wherever possible.

3.8 GEOTEXTILE FABRIC

A. Install in accordance with WISDOT 645, Soil Report and Manufacturer's Specification and Requirements with a minimum overlap of two (2) feet.

1. Provide around drain tile, wherever shown on drawings and/or recommended/specified in the Soil Report.

2. Where piping vertically intersects the Geotextile Fabric, run fabric up pipe and tape prior to backfilling.

3. Where horizontal piping is installed after and below the Geotextile,

a. Cut the Geotextile in a line centered on the pipe excavation and fold back.

b. After pipe installation, backfill to the bottom of the Geotextile, fold the fabric back, and tape the joint.

c. Tape a 4 foot wide strip of Geotextile, centered over the cut joint.

B. Geotechnical Engineer shall review and approve installation and provide written report to Architect/Engineer.

3.9 BACKFILL AND FILL

A. General: Place acceptable tested and approved soil material in layers to required subgrade elevations, for each area classification listed below.

1. Structural/Engineered Fill:

a. Use as fill or backfill in excavations against walls (except as noted in Item 2), under walks, steps and pavements and under interior building slabs, except as noted in Item 3 below.

b. Use as bearing material below footings and above natural occurring bearing soil where unsuitable material has been removed.

c. Amount or width of structural fill against walls shall be per this specification, as shown on drawings, or as directed by Geotechnical Engineer. The more stringent requirement shall be used.

2. Drainage Fill:

   a. Use as final 6" minimum layer (or greater as shown on Contract Documents or Soil Report) for granular sub-beds under all exterior floor slabs resting on earth and exterior sidewalks, and steps.

   b. Use around all drain tile, piping, etc. prior to backfilling with structural fill.

3. Exterior Pavement Subbeds: Use as final 6" minimum layer (or greater as specified on the plans, in Section 32 11 23.33 Dense Graded Base or Soil Report) for granular crushed stone sub-bed under exterior drives, parking areas and ramps. See Soil Report for pavement design requirements.

4. Common Fill: Use under unpaved exterior areas.

B. Prior to Backfill Placement: Backfill excavations as promptly as work permits but not until completion of the following:

1. Acceptance by Geotechnical Engineer of construction below finish grade.

2. Inspection, testing and approval of underground utilities and systems.

3. Removal of shoring and bracing, and backfilling of voids with satisfactory materials. Cut off temporary sheet piling driven below bottom of structures and remove in manner to prevent settlement of the structure or utilities, or leave in place if required.

4. Surveying locations of underground utilities for Record Documents.

5. Removal of mud, water, caved-in, softened or disturbed soil, or frozen soil as directed by Geotechnical Engineer.

6. Removal of trash and debris.

7. When existing ground surface has a density less than that specified under "Compaction" for the particular area classification, break up the ground surface, pulverize, moisture-condition to the optimum moisture content, and compact to required percentage of maximum density.

C. Placement and Compaction:

1. Place backfill and fill materials in layers not more than 8" in loose depth for material compacted by heavy compaction equipment, and not more than 4" in loose depth for material compacted by hand-operated tampers. Equipment shall be compatible with type of soil to be compacted.

2. Place backfill and fill materials evenly adjacent to structures, to required elevations. Take care to prevent wedging action of backfill against structures by carrying the material uniformly around structure to approximately same elevation in each lift. Lifts should be placed horizontally and in uniform thicknesses.

3. Extend fill a lateral distance of at least 1 foot for each foot of new fill required, with a minimum of six feet (6') beyond the edge of buildings and foundations. Against walls, free-draining granular structural backfill should extend a lateral distance of at least 4 feet from the outside face of the wall.

4. Notify, coordinate and cooperate with Testing Agency regarding placement of fill. Each layer must be approved before the next layer is started.

3.10 COMPACTION

A. General: Control soil compaction during construction, providing minimum percentage of density specified for each area classification.

B. It is the responsibility of the Contractor to provide all necessary compaction equipment and other grading equipment that may be required to obtain the specified compaction. Compaction of controlled backfill by travel of grading equipment will not be considered adequate for uniform compaction. Hand guided vibratory or tamping compactors will be required whenever controlled backfill may be placed adjacent to walls, footings, columns or in confined areas.

C. Percentage of Maximum Density Requirements:

1. Compact soil to not less than the following percentages of maximum dry density determined in accordance with ASTM D1557, Modified Proctor Test. For clay soils, use ASTM D698 Standard Proctor methods and add 3% to percentages specified below, not to exceed 100%.

2. Foundations Fill: For fills less than or equal to 8 feet thick, compact the top 12" of existing soils and each layer of backfill or fill material to 95% maximum dry density. For fills greater than 8 feet thick, compact to 100% maximum dry density.

3. Lawn or Unpaved Areas: Compact the top 6" of existing soils and each layer of backfill or fill material to 88% maximum dry density, except future expansion areas shall be 95% maximum dry density.

4. Sidewalks: Compact the top 6" of existing soils and each layer of backfill or fill material to 95% maximum dry density.

5. Pavements: Compact the top 12" of existing soils and each layer of backfill or fill material to 95% maximum dry density, or until additional passes over the crushed stone produce visually no additional compaction.

6. Utility trench backfill should be compacted to at least 90% of the Modified Proctor (ASTM D1557) maximum dry density from 1 foot above the top of the pipe or conduit up to final surface grade to minimize subsidence. Under structures and pavements, compaction should be at least 95%. Trench backfill should be placed in lifts of 12 inches or less. Placement shall conform to Standard Specifications for Sewer and Water Construction in Wisconsin.

D. Moisture Control:

1. Where subgrade or layer of soil material must be moisture conditioned before compaction, uniformly apply water to surface of subgrade, or layer of soil material. Scarify or disk as required to distribute water uniformly through soil. Apply water in manner to prevent free water appearing on surface during or subsequent to compaction operations. The moisture content of the soil should be within -1.0% to +2.5% for cohesive soils, -3% to +3% for cohesionless soils, of the optimum moisture content as determined by ANSI/ASTM D1557.

2. Remove and replace, or scarify by repeatedly plowing and discing during favorable weather conditions to air dry, soil material that is too wet to permit compaction to specified density.

3. Soil material that has been removed because it is too wet to permit compaction may be stockpiled or spread and allowed to dry. Assist drying by discing, harrowing or pulverizing until moisture content is reduced to a satisfactory value.

4. Clay soil bearing capacity and compaction levels are highly affected by water and construction activities.

a. Clay soils may require continued moisture control, modification with Portland Cement or hydrated lime, and/or per Maintenance Section of this specification until drainage subgrade and slab on grade are installed.

3.11 FINAL GRADING

A. General: Uniformly grade area within limits of grading under this section, including adjacent transition areas. Smooth finished surface, compact with uniform levels or slopes between points where elevations are shown, or between such points and existing grades. If fill is to be placed and compacted at the edge of a slope steeper than 4H:1V, overfill a minimum of 2 feet laterally beyond the final grade and trim back to design slope after achieving required degree of compaction.

B. Grading Outside Building Lines: Grade areas adjacent to building lines to drain away from structures and to prevent ponding. Finish surfaces free from irregular surface changes.

1. All contours and/or spot elevations shown on Drawings are to finish grade, unless otherwise noted (i.e. top of pavement, topsoil, etc.). Contractor shall be responsible for making excavations or embankments to the subgrade elevations necessary such that the addition of the pavement, topsoil or whatever surface improvement, will ensure that finished grades are met.

2. Contours indicated on drawings are the finished grade elevations. Review all grade elevations before commencing work to insure that proper slopes for drainage, slopes for drives, walks, paving, etc., are maintained. If Contractor believes a deficiency is apparent, he shall notify the Architect for clarification and correction.

3. Pavements:

a. Shape the surface of the areas under pavement to line, grade and cross-section, compacted as specified, and graded to prevent ponding of water after rains. Rough grade tolerance shall conform to +0 in./-1 1/2 in. Fine grading tolerance shall conform to +0 in./-3/4 in.

b. Include such operations as plowing, discing, and any moisture or aerating required to provide the optimum moisture content for compaction.

c. Fill low areas resulting from removal of unsatisfactory soil material, obstructions, and other deleterious materials, using structural fill material. Shape to line, grade, and crosssection as shown.

4. Ditches: Finish ditches to ensure proper flow and drainage. Conduct final rolling operations to produce a hard, uniform and smooth cross-section.

C. Grading Surface of Fill Under Slabs: Grade smooth and even, free of voids, compacted as specified, and to required elevation. Provide final grades within a tolerance of +0 in./-3/4 in.

D. Compaction: After grading, compact subgrade surfaces to the percentage of maximum density for each area classification.

E. Preparation for Lawn Construction: Preparation of Subgrade: Grade and uniformly compact subgrade so that it will be parallel to proposed finished grade. Loosen subgrade materials and mix to a depth of 8". Remove all stones over 1" in size and remove all sticks and rubbish. Do not move heavy objects, except lawn rollers, over lawn areas after the subgrade soil has been prepared unless subgrade soil is again graded and loosened, as specified above, before topsoil is spread.

3.12 GRAVEL SUB-BEDS

A. Grade Control: During construction, maintain lines and grades including crown and cross-slope of subbase course. Grade and compact earth to required level to receive full depth of pavement including sub-beds.

B. Shoulders: Place shoulders along edges of subbase course to prevent lateral movement. Construct shoulders of acceptable soil materials, placed in such quantity to compact to thickness of each subbase course layer. Compact and roll at least 12 in. (0.3 m) width of shoulder simultaneously with compacting and rolling of each layer of subbase course.

C. Placing:

1. Stone base course shall only be installed after successful proof-roll (immediately preceding), observed by geotechnical engineer.

2. Place subbase course material on prepared subgrade in layers of uniform thickness not to exceed 8", conforming to indicated cross-section and thickness.

3. Maintain optimum moisture content (within -1% to +3%) for compacting subbase material during placement operations.

4. Wet down gravel sub-beds before pouring concrete (if applicable).

5. Placing tolerance: +0 in./-3/4 in.

D. If tests indicate work does not meet specified requirements, recompact or remove work, replace and retest at no cost to Owner.

3.13 MAINTENANCE

A. Protection of Graded Areas:

1. Protect newly graded areas from traffic and erosion. Keep free of trash and debris.

2. Repair and re-establish grades in settled, eroded, and rutted areas to specified tolerances.

B. Reconditioning Compacted Areas: Where completed compacted areas are disturbed by subsequent construction operations or adverse weather, scarify surface, re-shape and compact to required density prior to further construction.

C. Settling: Where settling is measurable or observable at excavated areas during general project warranty period, remove surface (pavement, lawn or other finish), add backfill material, compact, and replace surface treatment. Restore appearance, quality, and condition of surface or finish to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

3.14 DISPOSAL OF EXCESS AND WASTE MATERIALS

A. Removal from Owner's Property: Remove excess and waste materials, including excavated material, excess topsoil, trash and debris, and dispose of it off Owner's property.

3.15 UNANTICIPATED SUBSURFACE CONDITIONS

A. If Contractor encounters conditions that are different during earthwork, paving and foundation construction operations than those anticipated, this fact shall immediately (within 24 hours) be brought to Owner's attention. If Owner's representative on the construction site observes subsurface conditions which are different than those anticipated by the Soil Report, this fact shall immediately (within 24 hours) be brought to Contractor's attention. Once unanticipated conditions have been identified, and Consultant has concurred, immediate negotiations will be undertaken between Owner and Contractor to arrive at a change in contract price for additional work or reduction in work because of the unanticipated conditions. Contractor agrees that unit prices as stated in the Bid Form shall apply for additional or reduced work under the Contract.

1 **END OF SECTION**

SECTION 31 22 16.15
ROADWAY SUBGRADE PREPARATION

PART 1 - GENERAL

1.1 SCOPE

A. The work under this section shall consist of providing all work, materials, labor, equipment, and supervision necessary to complete pavement subgrade preparation and provide a surface ready for constructing and supporting the Dense Graded Base, as required in these specifications, on the drawings and as otherwise deemed necessary to complete the work.

1.2 RELATED WORK

A. Applicable provisions of Division 1 govern work under this Section.

B. Related work specified elsewhere:

1. Section 30 05 00 – Common Work Results For All Exterior Improvements
2. Section 31 25 00 – Erosion Control
3. Section 32 11 23.33 – Dense Graded Base
4. Section 01 45 29 - Laboratory Testing

1.3 REFERENCE STANDARDS

A. Where these specifications do not cover portions of the work to be undertaken, the SSHSC in Wisconsin, current edition, shall govern the work.

1.4 QUALITY ASSURANCE

A. The Contractor shall conduct sampling, testing, and analysis as required by this section and elsewhere in the Contract Documents either by retaining the services of an independent construction materials testing consultant or with internal certified testers. The materials testing consultant shall meet the requirements of ASTM E329.

B. The A/E and Contractor's construction materials testing personnel shall observe all proof-rolling operations. The Owner's Project Representative shall also be informed of all proof-rolling operations. Provide minimum of 48 hours notice for all parties.

1.5 PERMITS/FEES

A. Contractor shall be solely responsible for obtaining all permits necessary to complete the work. Contractor shall pay all fees associated with obtaining permits. These include, but are not limited to permits for work within public right-of-way, land disturbance permits and building permits.

PART 2 - MATERIALS

2.1 BREAKER RUN AGGREGATE

A. Crushed stone, rock or gravel meeting the requirements of either Breaker Run or Select Crushed material as defined in WisDOT Section 311.2 or WisDOT Section 312.2, respectively.

2.2 RECYCLED AGGREGATE AND PAVEMENT

A. Recycled or salvaged aggregate and pavement products shall be free of organics, clay, rocks greater than 3-inches in least dimension and all other deleterious materials. The successful Bidder may submit specifications for these materials for consideration by the A/E for use on the project as part of the submittal process following contract award.

2.3 GEOTEXTILE FABRIC

A. Fabric shall be insect, rodent, mildew, and rot resistant woven or nonwoven polyester, polypropylene, stabilized nylon, polyethylene, or polyvinylidene chloride. All fabric shall have the minimum strength values in the weakest primary direction. Fabric shall conform to WisDOT Section 645.2.8.

PART 3 - EXECUTION

3.1 PREPARATION

A. Review drawings and prepare work plan and schedule. Coordinate any necessary interruptions in site access with Owner's Project Representative, in accordance with other specification sections.

B. Remove topsoil from work area. Sawcut and remove pavement from work area as indicated on the drawings. Sawcuts shall be made for the full depth of pavement.

C. Grade roadways and parking areas to drain water away from buildings.

3.2 EXCAVATION

A. Excavate to elevations and dimensions as shown on the drawings and as necessary to complete construction. Excavations shall be sufficiently deep to provide for depth of base course and pavement.

B. Stones over 6-inches in size shall be removed from the loosened portion of the subgrade.

C. Notify OWNER'S Project Representative if correction of unauthorized excavation or over-excavation is necessary. Said excavations will be corrected by placement of Breaker Run Aggregate. Contractor will be responsible for all costs associated with correcting these excavations.

D. Segregate the various materials excavated. Excavated material that does not meet the requirements of backfill and excess excavated material, shall be removed from the site and disposed by the Contractor, unless directed otherwise by other specification sections or the Owner's Project Representative.

E. Locate spoil piles so they do not interfere with public travel, adjacent landowners or other construction activities.

3.3 PREPARING THE FOUNDATION

A. The subgrade shall be constructed to have a uniform stability throughout. Use of recycled and salvaged aggregate and pavements shall be fully incorporated into subgrade soil. Construct the foundation to the required elevation with equipment and methods adapted for the purpose. Shape and compact to provide a smooth foundation, at required density, and at the proper elevation to receive the Dense Grade Base (See Section 32 11 23.33).

B. Compact material to minimize settlement and avoid damage to structures, pipes, utility lines and other features. Hand-place and compact material as necessary.

C. It is the responsibility of the Contractor to provide all necessary compaction equipment and other grading equipment that may be required to obtain a subgrade that satisfies the conditions of a satisfactory subgrade as defined below. Vibratory plate or tamping type walk behind compactors will be required whenever backfill is placed adjacent to structures, pipes, utility lines and other features.

D. The prepared foundation shall be tested for compaction as defined in the paragraph entitled 'Subgrade Approval / Proof Rolling'.

3.4 SUBGRADE APPROVAL / PROOF ROLLING

A. Prior to undercutting or excavating below subgrade (EBS) or placing any Dense Grade Base (See Section 32 11 23.33), contact the Owner's Project Representative to schedule inspection of the subgrade and proof rolling of the subgrade. All proof rolling shall be completed in accordance with the requirements of the paragraph entitled 'Quality Assurance' and shall meet the criteria as defined below.

B. To complete proof rolling, entire pavement subgrade shall be provided with a relatively smooth surface, suitable for observing soil reaction during proof rolling.

C. Contractor shall schedule and provide a fully loaded tri-axle dump truck for proof – rolling. Loaded truck shall have a minimum gross operating weight of 30 tons. Test shall be conducted with "tag" or "pusher" axles retracted from the ground.

D. Proof rolling shall be accomplished in a series of traverses parallel to the centerline of the driveway, street, or parking area. The truck shall traverse the length of the street or parking area once for each 12' of width at speeds less than 5 mph. Additional passes along the traverse shall be completed as directed by the Owner's Project Representative to further define unsatisfactory subgrade.

E. Soft areas, yielding areas, cracked areas or areas where rolling or wave action is observed shall be considered indicative of an unsatisfactory subgrade. Such areas shall be undercut as outlined in subsequent subsections of this specification.

F. Once the subgrade has been proof-rolled and approved, protect the soils from becoming saturated, frozen, or adversely altered.

3.5 UNDERCUTTING/EXCAVATION BELOW SUBGRADE (EBS)

A. Undercutting/EBS shall be completed only when directed by the OWNER'S Project Representative or if unsatisfactory subgrade, as defined above, is observed. The Contractor shall not be compensated for any unauthorized undercutting/EBS. Measure and document undercut areas and depths in consultation with OWNER'S Project Representative.

B. Excavate undercut areas to the depth specified by A/E or Owner's Project Representative using equipment with smooth cutting edge. Excavated undercut material that does not meet the specifications for fill needed elsewhere on site shall be removed from the site and legally disposed.

C. Undercut areas shall be backfilled with Breaker Run (or with a combination of Breaker Run and Geotextile Fabric) in maximum of 9 inch thick lifts (compacted). Breaker Run shall be compacted to 90% Modified Proctor dry density.

D. Following installation and compaction of place Breaker Run material, the area shall be subject to the work defined in the paragraph entitled 'Subgrade Approval / Proof – Rolling'.

E. Undercutting/Excavation Below Subgrade (EBS) work shall include all materials, labor, equipment and supervision necessary to remove the soils from the Project Site considered to be poor from the proof roll and backfill and compact with Breaker Run material brought to the Project Site. The cost of the compacted Breaker Run material is incidental to the unit price item for Undercutting/Excavation Below Subgrade (EBS). If Geotextile Fabric is required and is used in combination with the Breaker Run, the unit price for the Geotextile Fabric shall include all materials, labor and equipment for installation.

3.6 RESTORATION

A. Roll all pavement subgrade surfaces using a smooth drum roller to promote an impervious surface and minimize percolation of water into the subgrade.

1 **END OF SECTION**

SECTION 31 23 00
FOUNDATION EXCAVATING AND BACKFILLING

PART 1 - GENERAL

1.1 DESCRIPTION

A. The General and Supplementary Conditions of the Construction Contract and Division 1 - General Requirements apply to the work specified in this section.

B. This section shall include, but is not limited to the following foundation, excavating and backfilling within five feet of the building perimeter.

1. Removal of all unacceptable soil.
2. Furnish and install acceptable fill as specified herein and on the drawings.
3. Prepare subgrade for footings and slab on grade.

C. The following items are not a part of this specification:

1. Utility trenching and related backfilling outside the building footprint.
2. Subgrade for exterior walks and paving.

D. Structural notes indicated on the drawings regarding foundation excavating and backfilling should be considered part of this specification.

1.2 QUALITY ASSURANCE

A. Codes and Standards: Comply with the provisions of the following codes, specifications and standards, except where more stringent requirements are shown or specified.

1. ASTM C136 – Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
2. ASTM D698 – Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbs/ft^3)
3. ASTM D1557 – Standard Test Methods for Laboratory Compaction Characteristics of Soil Using the Modified Effort. (56,000 ft-lbs/ft^3)
4. ASTM D2487 - Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System).
5. ASTM D2940 - Standard Specification for Graded Aggregate Material for Bases and Sub-bases for Highways or Airports.
6. ASTM D4253 - Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table.
7. ASTM D4254 - Standard Test Method for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density.
8. ASTM D6938 – Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).

B. Comply with all applicable local, state and federal codes.

1.3 SUBMITTALS

A. Material Test Reports: Provide the Owner and Architect with the on-site material test reports from the Inspection Agency indicating the interpreting test results for compliance with this specification.

B. LEED Certification: Submit manufacturer's certification for each engineered fill material including the following:

1. LEED Credit MRc 4.1/4.2 – Recycled content including percentage of pre-consumer (post-industrial) and post-consumer recycled content. Also provide manufacturer's name and product cost.

2. LEED Credit MRc 5.1/5.2 – Location of manufacturing plant, manufacturer's name, product cost and location of extraction or harvest of raw materials.

1.4 TESTING AND INSPECTION

A. Inspection and Testing:

1. The Contractor shall employ an Inspection Agency to perform the duties and responsibilities specified below.

2. Refer to architectural, civil, mechanical, and electrical specifications for testing and inspection requirements of non-structural components.

3. Duties of the Inspection Agency:

a. Perform all testing and inspection required per the Testing and Inspection Schedule indicated below.

b. Furnish inspection reports to the building official, the Owner, the Architect, the Engineer of Record, and the General Contractor. The reports shall be completed and furnished within 48 hours of inspected work.

c. Submit a final signed report stating whether the work requiring Inspection was, to the best of the Inspection Agency's knowledge in conformance with the approved plans and specifications.

4. Structural Component Testing and Inspection Schedule for Section 31 23 00 is as follows:

Foundation Preparation	Continuous	Periodic
Verify materials below shallow footings are adequate to achieve the design bearing capacity.		X
Verify excavations are extended to proper depth and have reached proper material.		X
Perform classification and testing of compacted fill materials.		X
Verify use of proper materials, densities, and lift thicknesses during placement and compaction of compacted fill.	X	
Prior to placement of compacted fill, observe subgrade and verify that the site has been properly prepared.		X

B. Minimum testing frequency and locations:

1. Laboratory Testing:

a. Granular fill: One representative gradation test for each type of material.

b. Cohesive soils: One representative moisture density test for each type of material used.

c. Non-cohesive soils: One representative moisture density test for each type of material used.

2. Field Testing:

a. The Inspector shall determine the location of testing.

b. Testing of final utility trench backfill shall begin at a depth of 2 feet above the top of the pipe.

c. In-place field density test and moisture content tests shall be performed as follows:

1) Fills not within the influence of building foundations and slab on grade: Per civil specifications.

2) Fills within the influence of building foundations and slab on grade, the following criteria shall apply: One test for each 8 inch vertical lift of compacted fill placed per 2,500 square feet of fill area (minimum of two tests per lift per structure for areas smaller than 5,000 square feet).

d. Additional testing may be required by the Inspector if noncompliance or a change in conditions occurs.

e. If a test fails, the Contractor shall rework the material, recompact and retest as necessary until specific compaction is achieved in all areas of the trench. All costs associated with this work, including retesting, shall be the responsibility of the Contractor.

1.5 PROTECTION

A. Contractor shall provide for design, permits and installation of all cribbing, bracing, shoring and other methods required to safely retain earth banks and excavations.

B. Notify the Architect immediately and discontinue work in affected area if adjacent existing footings are encountered during excavation. Underpin other adjacent structures that may be damaged by excavation work, including service utilities and pipe chases.

C. Notify the Architect of unexpected subsurface conditions and discontinue work in affected areas until notification to resume.

D. Protect benchmarks, existing structures, fences, sidewalks, paving, curbing, etc., from excavation equipment and vehicular traffic.

E. Maintain and protect above and below grade utilities that are to remain.

F. Provide temporary heating or protective insulating materials to protect subgrades and foundations soils against freezing temperatures or frost during cold weather conditions.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: Provide borrow soil materials when sufficient acceptable soil materials are not available from excavations.

B. Acceptable soils shall comply with the following:

1. Meet ASTM D2487 soil classification groups GW, GP, GM, SW, SP, SM or a combination of these group symbols;

2. Be free of rock or gravel larger than 3 inches in any dimension;

3. Be free of debris, waste, frozen materials, vegetation and other deleterious materials;

4. Have a liquid limit less than 45 and a plasticity index less than 20.

5. Be approved by the Inspection Agency.

C. Unacceptable soils shall be defined as following:

1. ASTM D2487 soil classification groups GC, SC, ML, MH, CL, CH, OL, OH, PT or a combination of these group symbols.

2. Unacceptable soils also to include acceptable soils not maintained within 2 percent of optimum moisture content at time of compaction.

D. Free-Draining Granular Fill: Free-draining granular fill shall comply with the following:

1. Be a naturally or artificially graded mixture of natural or crushed gravel, crushed stone.

2. Be clean and free of fines.

3. Comply with ASTM D2940.

4. Be uniformly graded as follows:

COARSE AGGREGATE GRADATIONS						
SIEVE SIZE - PERCENT PASSING						
Grade No.	1-1/2"	1"	3/4"	1/2"	3/8"	No. 4
CA7	100	95 ± 5	-	45 ± 15	-	5 max

5. Be approved by the Inspection Agency.

E. Engineered Fill and Utility Base Course shall comply with the following:

1. Be a naturally or artificially graded mixture of natural or crushed gravel, crushed stone, natural or crushed sand; be a recycled concrete crushed to meet the gradation requirements of CA6;

2. Comply with ASTM D2940;

3. Be uniformly graded as follows:

COARSE AGGREGATE GRADATIONS						
SIEVE SIZE - PERCENT PASSING						
Grade No.	1-1/2"	1"	1/2”	No. 4	No. 16	No. 200
CA6	100 to 90	95 ± 5	75 ± 15	43 ± 13	25 ± 15	8 ± 4

4. Be approved by the Inspection Agency.

F. Material Applications: Provide and install material meeting with the above requirements as follows:

1. General fill: Acceptable soils.

2. Backfill at over-excavated areas beneath footings: Engineered fill.

3. Sub-grade layer beneath slabs-on-grade: Refer to Drawings.

2.2 LEED CREDIT

A. LEED Credit MRc 4.1/4.2 – All engineered fill shall contain 100% recycled content.

B. LEED Credit MRc 5.1/5.2 – All fill materials shall be procured from within 500 miles of the project site.

PART 3 - EXECUTION

3.1 PREPARATION

A. Identify and verify required lines, levels, contours and benchmark elevations for the work are as indicated.

B. Protect plant life, lawns, other features and vegetation to remain as a portion of the final landscaping.

C. Groundwater is expected during excavation. Contractor shall provide for de-watering of excavations from surface water, ground water or seepage.

D. Identify known underground utility locations with stakes and flags.

3.2 EXCAVATION

A. All excavations shall be safely and properly backfilled.

B. All abandoned footings, utilities and other structures that interfere with new construction shall be removed.

C. All unacceptable material and organic material shall be removed from below all proposed slabs-on-grade and the exposed natural soil shall be proof rolled and the compaction verified by the soils testing firm prior to placing fill. Proof-roll with a loaded tandem dump truck, loaded ready-mix truck, roller, or equivalent weight vehicle. Materials exhibiting weakness, such as those exhibiting rutting or pumping, shall be removed and replaced with acceptable compacted fill material.

D. Do not excavate within the 45-degree bearing splay of any adjacent foundations.

E. Remove lumped subsoil, boulders and rock up to 1/3 cubic yard (measured by volume). Provide Owner with unit price per cubic yard for obstructions larger than 1/3 cubic yard.

F. Outside 45-degree bearing splay of foundations, correct areas over excavated with aggregate at no additional cost to the Owner.

G. Within the 45-degree bearing splay of foundations, correct areas over excavated with 2000 psi concrete fill at no additional cost to the Owner. Notify the Architect prior to performing such work.

H. Hand trim final excavation to remove all loose material.

I. Contractor shall form all dams and perform other work necessary for keeping the excavation clear of water during the progress of the work and, at his own expense, shall pump or otherwise remove all surface and perched water which accumulates in the excavations. Perched water that cannot be de-watered in 48 hours of continuous pumping at a minimum rate of 60 gpm in dry weather shall be considered ground water.

J. Stockpile excavated material in the area designated and remove excess material not being used, from the site.

3.3 BACKFILLING

A. Support pipe and conduit during placement and compaction of bedding fill.

B. Systematically backfill to allow necessary time for natural settlement. Do not backfill over porous, wet, spongy or frozen subgrade surfaces.

C. Backfill areas to contours and elevations with unfrozen materials.

D. Unless noted otherwise on the Drawings, make grade changes gradual.

E. Unless noted otherwise on the Drawings, slope grade away from the building a minimum of 2 inches in 10 feet.

F. Contractor shall procure the approval of the subgrade from the Inspection Agency prior to the start of any filling or bedding operations.

G. Do not begin any backfill operations against any concrete walls until the concrete has achieved its specified strength.

H. Place and mechanically compact granular fill in continuous layers not to exceed loose lifts of 10-inch depth.

I. Employ a placement method that does not disturb or damage adjacent utilities, vapor barriers, foundation perimeter drainage and foundation waterproofing.

J. All surplus fill materials are to be removed from the site.

K. Fill material stockpiles shall be free of unacceptable soil materials.

L. After work is complete, remove all excess stockpile material and repair stockpile area to its original condition.

3.4 COMPACTION

A. Compact all fill that will support building footings or floor slabs to 95 percent of the maximum dry density in accordance with ASTM D1557. For relative cohesionless fill materials, where the percent passing the #200 sieve is less than 10 and the moisture density curve indicates only slight sensitivity to changing moisture content, compaction requirements should be changed to 75 percent relative density in accordance with ASTM D4253 and ASTM D4254.

B. Compact all fills that support paving and landscape per civil specifications.

3.5 FOUNDATIONS

A. Each footing excavation should be cleared of all obstructions and other organic or deleterious materials.

B. Localized areas of unstable or unacceptable material may be discovered during the stripping and excavation operation and may require over-excavation and backfilling. The Inspection Agency shall be present during the proof rolling to evaluate any localized areas and make recommendations regarding over-excavation, backfilling and recompaction of these areas. Fill placement and compaction shall be inspected and tested by the Inspection Agency.

C. Footing elevations shown on the Drawings designate a minimum depth of footing where a safe soil bearing pressure is expected. Footings, piers and/or walls shall be lowered or extended as required to reach soil meeting the design bearing pressure. This work shall be performed under direct supervision of the Inspection Agency.

D. All footing excavations shall be recompacted by hand-operated, vibratory compaction equipment.

E. All excavation and recompacted surfaces shall be inspected and tested to a depth of 2.0 feet below the excavated elevation by the Inspection Agency. Additional field density tests should be performed for each one foot of fill material placed. Any areas not in compliance with the compaction requirements should be corrected and re-tested prior to placement of fill material.

F. For foundation areas where over excavation is performed, place and mechanically compact Engineered fill material in continuous layers not to exceed loose lifts of 10-inch depth.

3.6 SLAB-ON-GRADE

A. All disturbed areas after the clearing and stripping operation should be proof-rolled and recompacted with a heavy vibratory drum roller (approved by the Inspection Agency) in the static mode. The compactor should make a minimum of 10 passes, with a minimum of one foot overlap of each pass. The compactor speed should be less than 0.2 MPH.

B. The Inspection Agency shall monitor proof-rolling and compaction operations. This area should then be tested for compaction to a depth of 2.0 feet below the compacted surface prior to the placement of any structural fill material.

C. Refer to Drawings for required sub-grade preparation beneath slabs-on-grade.

3.7 UTILITY TRENCH BACKFILL (AT SLAB ON GRADE LOCATIONS)

A. Excavate and backfill utility trenches under wall footings as shown on the Drawings

B. Place utility base course on subgrades free of mud, frost, snow, or ice.

C. Place and compact utility base course on trench bottoms and where indicated.

D. Lay underground utilities on 6” sand bedding, which meets the acceptable criteria of Section 2.1,B.

E. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.

F. After connection joints are made, any misalignment can be corrected by tamping the sand around the utilities.

G. Place and compact initial backfill of acceptable sand to a height of 6 inches over the utility pipe or conduit in 6 inches layer meeting specified compaction requirements.

H. Carefully compact initial backfill under pipe haunches and compact evenly up on both sides and along the full length of utility piping or conduit to avoid damage or displacement of piping or conduit.

I. Place and compact final backfill using acceptable soil to final subgrade elevation meeting specified compaction requirements.

J. Backfill voids with acceptable soil while installing and removing shoring and bracing.

K. Inspection Agency shall monitor and test compacted backfill to verify final compaction meets the specified requirement.

3.8 TOLERANCES

A. Top surface of backfilling under paved areas: Plus or minus ½ inch from required elevation.

B. Top surface of general backfilling: Plus or minus 1 inch from required elevation.

END OF SECTION

SECTION 31 23 19
DEWATERING

PART 1 - GENERAL

1.1 SCOPE

A. The work under this section shall consist of providing all work, materials, labor, equipment, and supervision necessary to provide for dewatering as required in these specifications, on the drawings and as otherwise deemed necessary to complete the work. Included are the following topics:

PART 1 - GENERAL
- Scope
- Related Work
- References
- Submittals
- Quality Assurance
- Permits/Fees Safety
- Erosion and Sedimentation Control
- Environmental Contaminants
- Noise Pollution

PART 2 - MATERIALS
- General

PART 3 - EXECUTION
- General
- Sump Dewatering
- Well Installation
- Operation
- Removal/Abandonment

1.2 RELATED WORK

A. Applicable provisions of the General Conditions and Division 01 govern work under this Section.

Section 31 05 00	Common Work Results for Earthwork (Outside Building Footprint)
Section 31 25 00	Erosion Control

1.3 REFERENCES

A. Wisconsin Department of Safety and Professional Services (SPS):

Chapter NR 141 – Monitoring Well Construction

Chapter NR 812 – Well Construction and Pump Installation

B. Wisconsin Department of Natural Resources Technical Standards for Construction Site Erosion & Sediment Control (Technical Standards)
http://www.dnr.state.wi.us/org/water/wm/nps/stormwater/techstds.htm#Construction

1.4 SUBMITTALS

A. When deep wells or well point systems are utilized, provide system design computations for the removal of groundwater and design information for sediment removal practices.

B. For sump dewatering in trenches of excavations, provide copies of sediment removal practice

selection discharge design calculations of information.

C. When permits are required for dewatering, provide copies of all permits.

D. Provide copies of daily monitoring and testing logs for dewatering practices as described in the DNR Dewatering Technical Standard.

E. Provide copies of all borehole abandonment forms.

1.5 QUALITY ASSURANCE

A. Provide and submit a quality assurance program for maintaining erosion control and sediment control practices. As work progresses through phases of the contract, submit copies of the updated quality assurance program for erosion control and sediment removal processes.

1.6 PERMITS/FEES

A. Pay for and obtain all permits/approval required by local, state and federal regulations.

B. Necessary permits/approval may include, but are not limited to high capacity well approval under NR 812.09 and erosion control permits.

C. When installing by jetting methods, provide own water source. Do not use hydrants as water source without permission from Construction representative and/or local utility, as applicable. Obtain and pay for any required hydrant use and permits.

1.7 SAFETY

A. Prevent public access to hazardous dewatering system components.

B. Abandon boreholes in accordance with applicable local, state and federal codes immediately following use.

1.8 EROSION CONTROL

A. Comply with the requirements of the specification sections listed under related work in part 1 of this section.

B. Selection, installation, operation, and maintenance of erosion control and sediment removal measures related to a dewatering system shall be done in accordance with the DNR Dewatering Technical Standard or equivalent approved by the WDNR.

C. Upon installation of the dewatering system, immediately remove any mud, sediment or drilling fluid generated by jetting or rotary drilling operations.

D. When overland discharge of water is necessary, dissipate energy of water stream using nozzles, deflectors, riprap or other methods.

E. Inspect dewatering system daily for signs of erosion and eliminate cause of erosion.

1.9 ENVIRONMENTALCONTAMINANTS

A. Monitor dewatering system discharge regularly for signs of chemicals or other environmental contaminants.

B. If chemicals or environmental contaminants are observed, terminate dewatering system operation immediately and contact the Construction Representative.

C. Prevent dewatering system from introducing contaminants into the soil or groundwater.

1.10 NOISE POLLUTION

A. Provide mufflers, housing, berms and fencing as necessary to minimize noise pollution resulting from dewatering system operation.

PART 2 - MATERIALS

2.1 GENERAL

A. All deepwell and wellpoint dewatering equipment and well construction/abandonment materials shall meet the requirements of NR 141 and NR 812.

PART 3 - EXECUTION

3.1 GENERAL

A. Comply with all local, state and federal regulations.

B. When deep wells or well point systems are utilized, prepare a system design and obtain permits in accordance with NR 812.09 for high capacity wells as defined by NR 812.07(53). Design system to dewater site as necessary to complete construction, but minimize impact on local water table. Monitor water levels in wells adjacent to construction site. Adjust dewatering system configuration and operation as necessary if neighboring wells are adversely impacted. Do not adversely impact neighboring private wells.

C. Coordinate installation of dewatering system with other contractors. Locate dewatering system components in locations that do not interfere with site operations or other construction activities.

D. Pump groundwater at lowest rate necessary to dewater site as required to accommodate other sitework.

3.2 SUMP DEWATERING

A. Install collection sump in the low point of the excavation(s).

B. Provide filter material, trash screens and other devices around pump or intake to avoid pumping of sediment.

3.3 OPERATION

A. Provide personnel, equipment and power necessary to maintain and operate the dewatering system as required to complete construction at the site.

B. Do not discharge water containing sediment, debris or contaminants into the sanitary sewer system or waters of the state.

3.4 REMOVAL/ABANDONMENT

A. Remove all dewatering system components immediately following use.

B. Clean receiving storm sewer system of any sediment or debris deposits resulting from dewatering system operation.

1 **END OF SECTION**

SECTION 31 25 00
EROSION CONTROL

PART 1 - GENERAL

1.1 SCOPE

A. The work under this section consists of providing all work, materials, labor, equipment, and supervision necessary to provide and construct erosion control measures necessary to protect property and the environment.

1.2 RELATED WORK

A. Applicable provisions of Division 01 govern work under this Section.

B. Section 31 05 00 Common Work Results For Earthwork (Outside Building Footprint)

C. Provide erosion control in accordance with the following references:

1. Wisconsin Department of Natural Resources Technical Standards For Construction Site Erosion and Sediment Control. http://dnr.wi.gov/org/water/wm/nps/stormwater/techstds.htm

2. Erosion Control Product Acceptability List ("PAL"), current version as published by the WisDOT. http://wisconsindot.gov/Documents/doing-bus/eng-consultants/cnslt-rsrces/tools/pal/pal-8-11-2017.pdf

D. Method of measurement and basis of payment sections in any referenced erosion control documents shall not apply to this contract.

E. These documents are available from: State of Wisconsin Document Sales and Distribution 202 South Thornton Avenue; P.O. Box 7840; Madison, WI 53707; 608-266-3358

1.3 PERMITS

A. Contractor shall be responsible for obtaining and maintaining all erosion control permits associated with the project.

1.4 SUBMITTALS

A. The Lead Contractor will submit the following to the A/E:

1. Contractor shall mark-up of the Erosion Control Plan that is included in these documents showing additional or alternate erosion control measures as needed due to the Contractors means and methods throughout all phases of construction. The Contractor may also be required to submit calculations and backup information showing the proposed measures meet applicable regulations.

2. Submittals for materials used to implement the erosion control plan.

B. Submit shop drawings for the following erosion control features:

1. Silt Fence

2. Inlet Sediment Guards

3. Erosion Mat

1.5 EROSION CONTROL PLAN

A. The A/E has prepared an erosion control plan for the project and will apply for the required NOI permit. The Contractor will provide the A/E with submittals for materials used to implement the erosion control plan, as well as any modifications to the erosion control plan that are necessary due to the Contractor's means and methods of construction.

B. Contractor shall comply with all the requirements of the erosion control plan, and the Wisconsin Pollutant Discharge Elimination System, WPDES. The project specific WPDES Construction Site Stormwater Discharge Permit for Erosion Control and the City of Madison Erosion Control Permit shall supersede the General Permit.

C. Erosion control and storm water management practices shall be installed and maintained in accordance with City of Madison and WDNR approved Technical Standards (or equivalent).

D. Contractor shall provide all erosion control practices necessary to protect property and the environment. Erosion control and storm water management practices shall be installed and maintained in accordance with the WDNR approved Technical Standards (or equivalent).

PART 2 - PRODUCTS

2.1 GENERAL

A. Erosion mats, soil stabilizers, and tackifiers shall be listed on the Product Acceptability List for Multi-Modal

B. Applications ("PAL") as published by the Wisconsin Department of Transportation.

C. When the design or contract includes permanent erosion control or stormwater control features, the contractor may employ these items in his control of erosion and stormwater during his construction activities. However, these items shall be fully cleaned, restored, and in every way fully functioning for its intended permanent use prior to acceptance of the work.

2.2 STRAW BALE BARRIERS

A. Rectangular bales of hay or straw, tightly bound with twine, not wire.

B. Anchor stakes shall be "T" or "U" steel posts, or hardwood, 2.0 by 2.0 inches nominal. Rebar shall not be used to anchor bales.

2.3 SILT FENCE

A. Fence fabric shall comply with the requirements of Standard Specifications for Highway Construction 628.2.6, in 3 foot tall rolls, with 4' tall 2" x 2" nominal cross section hardwood posts spaced a maximum of 10' o.c. Silt fence shall be Mirafi, Trevira, Amoco, CFM, or approved equal.

2.4 EROSION MAT

A. A straw/coconut fiber mat encased in an accelerated photodegradable polypropylene top net. Erosion mat shall comply with the requirements of Class I, Type A erosion mat as defined by Standard Specifications for Highway Construction and the PAL. Erosion mat shall be American Excelsior, SI Geosolutions, Erosion Control Systems, North American Green, or approved equal.

B. Concentrated Areas/Channels (as indicated on plans): This mat shall be North American Green SC150, or approved equal.

C. Erosion Mat at Storm Outlets: This mat shall be ProPex LandLok 300, or approved equal.

D. Erosion Mat in bio-filtration and raingarden areas shall be North American Green SC-150BN or approved equal.

2.5 STAPLES

A. Use biodegradable staples in accordance with manufacturer's recommendations for materials being anchored. Wood and metal staples are not allowed.

2.6 RIP-RAP

A. Rip rap shall be the class specified and shall conform to Standard Specifications for Highway Construction Section 606.2.

2.7 TRACKING PAD STONE

A. The aggregate for tracking pads shall be 3 to 6 inch clear or washed stone. All materials shall be retained on a 3-inch sieve.

2.8 SOIL STABILIZERS

A. Soil stabilizers shall be non-asphalt-based products of the type specified, and meeting the requirements of the PAL.

2.9 SOIL TACKIFIERS

A. Soil tackifiers shall be non-asphalt-based products of the type specified, and meeting the requirements of PAL.

2.10 POLYMERS

A. Polymers used to settle suspended sediment shall meet the requirements of the WDNR Technical Standards.

PART 3 - EXECUTION

3.1 GENERAL

A. Install erosion control measures as required by the erosion control plan and contract documents. Provide additional erosion control measures as dictated by Contractor's means and methods, or by differing site conditions. Notify Construction Representative of additional erosion control features that are provided, but not shown on the plan.

B. Contractor shall provide all erosion control measures necessary to protect property and the environment. Include all erosion control measures as required by the most stringent of applicable sections of DNR Technical Standards or the Standard Specifications for Highway Construction.

C. Perform all work in accordance with manufacturer's instruction where these specifications do not specify a higher requirement.

D. Contractor shall comply with all the requirements of the erosion control plan, and if applicable, the WPDES Stormwater Discharge Permit for Erosion Control, including required monitoring and documentation.

3.2 GRADING AND EARTHWORK

A. Install all temporary or permanent erosion control measures prior to any onsite grading or land disturbances.

B. Clear only those areas designated for the placement of improvements or earthwork before placement of the final cover. Perform stripping of vegetation, grading, excavation, or other land disturbing activities in a logical sequence and manner which will minimize erosion. If possible, schedule construction for times of the year when erosion hazards are minimal.

C. Do not clear the site of topsoil, trees, and other natural ground covers before the commencement of construction. Retain natural vegetation and protect until the final ground cover is placed.

D. Temporary stockpiles are to be located greater than 25 feet from any roadway, parking lot, paved area, drainage structure, or channel.

E. Provide temporary stabilization and control measures (seeding, mulching, covering, erosion matting, barrier fencing, etc.) for the protection of disturbed areas and soil piles which will remain uncovered for a period of more than 7 consecutive calendar days.

F. Remove surplus excavation materials from the site immediately after rough grading. The disposal site for the surplus excavation materials shall also be subject to these erosion control requirements.

3.3 DRAINAGE

A. Minimize water runoff and retain or detain on-site whenever possible so as to promote settling of solids and groundwater recharge.

B. Convey drainage to the nearest adequate stormwater facility. Do not discharge water in a manner that will cause erosion or sedimentation of the site or receiving facility.

C. Protect storm sewer inlets and catch basins in accordance with the erosion control plan, if provided, a log with the WDNR Technical Standards and PAL. If not specified, protect inlets with straw bale barriers, silt fencing, filter basket, or other equivalent methods approved by the Engineer which provide the necessary erosion protection.

D. Divert roof drainage and runoff from all areas upslope of the site around areas to be disturbed or channel them through the site in a manner that will not cause erosion.

E. Ditch checks are to be provided in swales or ditches to reduce the velocity of water in the channel. Construct in accordance to DNR Technical Standards and PAL.

F. Minimize the pumping of sediments when dewatering. Discharge to a sedimentation basin/trap or sedimentation vessel to reduce the discharge of sediments. Do not discharge water in a manner that will cause erosion or sedimentation of the site or receiving facility. Refer to section 31 23 19 Dewatering for specifications.

3.4 TRACKING CONTROL

A. Construct and maintain tracking pads in accordance with the Technical Standards. Provide each entrance to the site with a stone tracking pad at least 50 feet in length with a minimum thickness of 12 inches. The tracking pad shall be the full width of the egress point. Inspect tracking pads on a daily basis and replace aggregate when no longer effective.

B. If necessary, provide a crushed aggregate paved parking area.

C. If applicable, wash water shall be discharged to sedimentation basins, sedimentation vessels, or other such control areas.

3.5 MAINTENANCE

A. Inspect all erosion control measures within 24 hours of the end of each rainfall event that exceeds 0.25", or daily during period of prolonged rainfall, or weekly during periods without rainfall. Immediately repair and/or replace any and all damaged, failed, or inadequate erosion control measures.

B. Re-apply soil stabilizers, tackifiers, polymers and anionic polycrylamides as needed to prevent erosion of exposed soil.

C. Maintain records of all inspections and any remedial actions taken.

D. Maintain stockpile stabilization measures as necessary after rainfall events and heavy winds. Replace tarps, re-seed, and reapply mulch, tackifiers and stabilizers as necessary.

E. Remove sediment from stormwater and erosion control structures, basins and vessels as necessary.

F. Repair or replace damaged inlet protection.

G. Replace or supplement stone tracking pads with additional stone when they become ineffective.

H. Remove any sediment reaching a public or private roadway, parking lot, sidewalk, or other paved. Do not remove tracked sediments by flushing. Completely remove any accumulations not requiring immediate attention at least once daily at the end of the workday.

I. Frequently dispose of all waste and unused construction materials in licensed solid waste or wastewater facilities. Do not bury, dump, or discharge, any garbage, debris, cleaning wastes, toxic materials, or hazardous materials on the site, on the land surface or in detention basins, or otherwise allow materials to be carried off the site by runoff onto adjacent lands or into receiving waters or storm sewer systems.

END OF SECTION

SECTION 31 26 00
STEEL HELICAL PILES

PART 1 - GENERAL

1.1 DESCRIPTION:

A. The General and Supplementary Conditions of the Construction Contract and Division 1 - General Requirements apply to the work specified in this section.

B. The work includes all items required for executing and completing the steel helical pile work and related work shown on the drawings or specified herein.

C. Structural notes indicated on the drawings regarding steel helical piles should be considered a part of this specification.

D. No substitutions will be allowed without the Engineer of Record's approval.

1.2 QUALITY ASSURANCE

A. Codes and Standards: Comply with the provisions of the following codes, specifications, and standards except where more stringent requirements are shown or specified herein:

1. ASCE 20 - Standard Guidelines for the Design and Installation of Pile Foundations.

2. ASME B18.2.1 - Square, Hex, Heavy Hex, and Askew Head Bolts and Hex, Heavy Hex, Hex Flange, Lobed Head, and Lag Screws (Inch Series).

3. ASTM A29 - Standard Specification for General Requirements for Steel Bars, Carbon and Alloy, Hot-Wrought.

4. ASTM A36 - Standard Specification for Carbon Structural Steel.

5. ASTM A53 - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.

6. ASTM A123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

7. ASTM A153 - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.

8. ASTM A193 - Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications.

9. ASTM A252 - Standard Specification for Welded and Seamless Steel Pipe Piles.

10. ASTM A320 - Standard Specification for Alloy-Steel and Stainless Steel Bolting for Low-Temperature Service.

11. ASTM A500 - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.

12. ASTM A513 - Standard Specification for Electric-Resistance-Welded Carbon and Alloy Steel Mechanical Tubing.

13. ASTM A536 - Standard Specification for Ductile Iron Castings.

14. ASTM A572 - Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel.

15. ASTM A618 - Standard Specification for Hot-Formed Welded and Seamless High-Strength Low-Alloy Structural Tubing.

16. ASTM A656 - Standard Specification for Hot-Rolled Structural Steel, High-Strength Low-Alloy Plate with Improved Formability.

17. ASTM A958 - Standard Specification for Steel Castings, Carbon, and Alloy, with Tensile Requirements, Chemical Requirements Similar to Standard Wrought Grades.

18. ASTM A1018 - Standard Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Hot-Rolled, Carbon, Commercial, Drawing, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength.

19. ASTM D1143 - Standard Test Methods for Deep Foundations Under Static Axial Compressive Load.

20. ASTM D3689 - Standard Test Methods for Deep Foundations Under Static Axial Tensile Load.

21. ASTM D3966 - Standard Test Methods for Deep Foundations Under Lateral Load.

22. ASTM F3125 - Standard Specification for High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 120 ksi and 150 ksi Minimum Tensile Strength, Inch Dimensions.

23. AWS B2.1 - Specification for Welding Procedure and Performance Qualification.

24. AWS D1.1 - Structural Welding Code.

25. AWS D1.4 - Structural Welding Code – Reinforcing Steel.

26. ICC AC358 - Acceptance Criteria for Helical Piles Systems and Devices.

27. OSHA Excavation Safety Guidelines.

28. SAE J429 - Mechanical and Material Requirements for Externally Threaded Fasteners.

B. Comply with all local building code requirements which are more stringent than those listed above. All referenced codes or standards shall be the most currently adopted as of the date for Receipt of Proposal.

C. Where any provision of other pertinent codes and standards conflict with this specification, the more stringent provision shall govern.

D. Fabrication and Installation Qualifications:

1. All welding of structural steel shall be performed by operators who have been recently qualified as prescribed in “Qualification Procedures” of the American Welding Society (AWS).

2. The Steel Helical Pile Contractor shall be fully experienced in all aspects of helical pile design and construction, and shall furnish all necessary materials, skilled labor, and supervision to carry out the contract. The Contractor shall not have less than five (5) years of continuous experience in fabrication and installation of steel helical pile work. Job supervisor shall have a minimum of three (3) years of method specific experience.

3. Upon request of the Architect/Engineer, Helical Pile Contractor shall submit evidence of successful installation of steel helical piles under similar project scope and size.

4. The Steel Helical Pile Contractor shall not sublet the whole or any part of the contract without the express permission in writing of the Owner.

E. Inspector shall keep a record or log of each pile as installed. Records shall show location, top and bottom elevations, shaft diameters, date installed, type of strata encountered, rated load capacity, grout pressure attained and any other pertinent information. A copy of this record shall be submitted to the Architect and Engineer for their record files.

F. Helical Pile Contractor shall schedule and provide time and means for the Inspection Agency to inspect, take samples, and make tests.

1.3 TESTING AND INSPECTION

A. Inspection and Testing:

1. The Contractor shall employ an Inspection Agency to perform the duties and responsibilities specified below.

2. Refer to architectural, civil, mechanical, and electrical specifications for testing and inspection requirements of non-structural components.

3. Work performed on the premises of a fabricator approved by the building official need not be tested and inspected per the table below. The fabricator shall submit a certificate of compliance that the work has been performed in accordance with the approved plans and specification to the building official and the Architect and Engineer of Record.

4. Duties of the Inspection Agency:

   a. Perform all testing and inspection required per approved testing and inspection program.

   b. Furnish inspection reports to the building official, the Owner, the Architect, the Engineer of Record, and the General Contractor. The reports shall be completed and furnished within 48 hours of inspected work.

   c. Submit a final signed report stating whether the work requiring Inspection was, to the best of the Inspection Agency's knowledge in conformance with the approved plans and specifications.

5. Structural Component Testing and Inspection Schedule for Section 31 26 00 is as follows:

Steel Helical Piles	Continuous	Periodic
Verify element materials, sizes, and lengths comply with the requirements.	X	
Determine capacities of test elements and conduct additional load tests, as required.	X	
Observe drilling operations and maintain complete and accurate records for each element.	X	
Verify placement locations and plumbness, confirm type and size of jack, record pressure per foot of penetration, determine required penetration to achieve design capacity, record tip and butt elevations and document any damage to foundation element.	X	

1.4 DEFINITIONS

A. A partial list follows:

1. Bearing Stratum: The soil or highly weathered rock layer that provides the axial tension resistance for the installed helical pile.

2. Brackets: Cap plate, angle, thread bar, or other termination device that is bolted or welded to the end of a helical pile after completion of installation to facilitate attachment to structures or embedment in cast-in-place concrete.

3. Crowd: Axial compressive force or pressure applied to the helical pile as needed during installation to ensure the pile advances into the ground a minimum of 80% of the distance equal to the helix pitch for each revolution.

4. Deflection: The axial displacement of the pile as measured at the pile head under applied load.

5. Effective Torsional Resistance: The average installation torque typically taken over a distance equal to the last three diameters of penetration of the largest helix plate as close to or in the specified bearing stratum.

6. Extension Section: Helical pile component connecting the lead section to the load transfer device. Extension sections may be plain without helix plates or helical including one or more helix plates.

7. Factored Load: Service load times the required load factor.

8. Geotechnical Capacity: The maximum load that can be resisted through the bearing of the helix plates in the soil or highly weathered rock in which they are embedded as characterized by the available subsurface soils, rock and groundwater information, and geotechnical testing data, without exceeding the specified performance criteria.

9. Helical Pile: Consists of one or more helix plates attached to a central shaft and load transfer device for attachment to a structure. May also include surface coating or other corrosion protection means.

10. Helical Anchor: Same as a Helical Pile. Term generally used when axial tension is the primary service load.

11. Helix Plate (Helices): Generally round steel plate formed into a helical spiral and welded to the central steel shaft.

12. Installation Angle: Angle of inclination between the longitudinal axis of the helical pile and the horizontal.

13. Lead Section: The first helical pile component installed into the soil. It consists of one or more helical plates welded to the central steel shaft.

14. Limit State: A condition beyond which a helical pile component or interface becomes no longer useful for its intended function (serviceability limit state) or to be unsafe (strength limit state).

15. Loads: Forces or other actions as defined that must be resisted by the piles. Permanent loads are those loads in which variations over time are rare or of small magnitude. All other loads are variable loads. Refer also to Service Load below.

16. Load Factor: A factor that accounts for deviations of the actual load from the service load (load resistance factor design).

17. Load Test: A procedure to test the capacity and relation of load to deflection by applying a compression, tension, and/or lateral load on the helical pile.

18. Mechanical Strength: The maximum compressive, tension, and/or lateral load capable of being resisted by the structural elements of a helical pile.

19. Pile Design Professional: Individual or firm responsible for the design of helical piles, helical anchors, and brackets.

20. Reveal: The distance from ground surface to the end of the last installed extension of a pile, measured along the pile's longitudinal axis.

21. Pitch: The distance measured along the axis of the shaft between the leading and trailing edges of the helix plate.

22. Safety Factor: The ratio of the ultimate resistance to the service load used for the design of any helical pile component or interface.

23. Service Load: The total magnitude of the unfactored loads, determined by the Owner's Representative, that must be resisted by the piles.

24. Torque: The measure of the rotational force times the moment arm needed to overcome the shear strength of the soil measured in ft-lb. Torque is used as an empirical approach for predicting the ultimate capacity of a helical pile.

25. Ultimate Resistance: Limit state based on the lesser of mechanical strength or geotechnical capacity of the helical pile defined as the point at which no additional load can be applied without exceeding the specified performance criteria.

1.5 DESIGN

A. Helical pile design shall be designed to meet the specified loading as shown on the drawings and deflection criteria of 1/2" differential settlement and 1" total settlement. Calculations and drawings required from the Helical Pile Contractor shall be submitted to the Architect/Engineer.

B. Helical pile design shall include overall pile length, helix length, and helix configuration. If static load testing is performend, pile design to include a minimum factor of safety of 2.0. If static load testing is not performend, pile design to include a minimum factor of safety of 3.0.

C. Except where noted in the drawings, all pile components shall be designed to provide a minimum safety factor for mechanical strength of 2.0.

D. Except where noted in the drawings, each pile shall be designed to meet a corrosion service life of 50 years.

E. The helical pile design shall take into account pile spacing, soil stratification, long-term soil consolidation, corrosion, settlement, and strain compatibility issues as are present for the project.

F. The helical pile top attachment shall effectively distribute the design load to the concrete foundations such that the concrete bearing stress does not exceed those in the ACI Building Code and the bending stress in the steel plates does not exceed AISC allowable stresses for steel members.

G. If on-site load testing is to be performed, the piles shall be designed such that the maximum test load does not exceed 90% of the manufacturer's rated mechanical strength of any pile component or load transfer device.

1.6 BID REQUIREMENTS

A. Steel Helical Piles: Bids shall be provided for the lump sum amount based on the number of piles, estimated length, and total footage as shown in the drawings and/or specifications.

B. The Pile Contractor shall examine the construction site and conditions under which piles are to be installed, and notify the General Contractor and Architect in writing prior to bidding of any conditions detrimental to proper and timely completion of work.

C. Helical Pile Length: Base the length of the helical piles on the length listed on the drawings and in the Geotechnical Engineering Report. The elevation identifying the bottom of the shaft is an approximate length for consistent bidding purposes only. The actual length will be determined in the field from the actual elevation of the bearing stratum to be verified by the Inspection Agency.

D. Unit prices shall be issued to the Architect prior to construction as part of the submittal package.

E. Adjustments in the Contract Price will be made due to changes in the number and length of piles, based on unit prices established in Section 01 21 00 - Allowances as follows:

1. Payment for helical piles will be made on the total length of helical piles installed and accepted. Actual length and shaft diameter may change due to job conditions. Adjusted payment will be made on the basis of net variations to the total quantities, based on design dimensions.

2. Provide the following unit costs in the event that additions to, or deductions from, work, are required and authorized in writing by Architect/Engineer:

    a. Additional length of helical pile ($/per foot)
    b. Subtracted length of helical pile ($/per foot)
    c. Load test (lump sum per test)

1.7 SUBMITTALS

A. Shop Drawings:

1. Prepare and submit to the Architect/Engineer, for review and approval, working drawings and relevant structural design calculations for the helical pile system or systems intended for use. All design submittal shall be sealed by a Registered Professional Engineer currently licensed in the state where the project is located.

2. Product Data:

    a. Product designations for helix sections, extension sections, and all ancillary products to be supplied at each helical pile location.
    b. Evaluation approved by the applicable building code authority (e.g., International Code Council Evaluation Services (ICC-ES)).
    c. Corrosion protection and pile top attachment.
    d. Manufacturer’s published mechanical strengths for the pile assemblies, including load transfer devices per current ICC-ES report, calculations, and/or full scale testing.

3. Design Data:

    a. Calculated geotechnical capacity of piles based on geotechnical information. The design submittal prepared by the pile designer shall indicate that the selected piles can be installed to achieve the performance requirements.
    b. Minimum effective torsional resistance criteria.
    c. Maximum allowable installation torque of pile.
    d. Proposed production quality control plan, including method and equipment to be used to measure torsional resistance during installation.

e. Procedures and acceptance criteria for any proposed performance and/or proof testing.

4. Submit a detailed description of the construction procedures proposed for use to the Architect/Engineer for review. This shall include a schedule of major equipment resources.

5. The working drawings shall include helical pile installation details giving:

a. Helical pile number, location, and pattern by assigned identification number
b. Helical pile design load
c. Type and size of central steel shaft
d. Number and diameter of helix plates
e. Minimum overall length
f. Minimum effective installation torque
g. Inclination of helical pile
h. Helical pile attachment to structure relative to grade beam, pile cap, etc.
i. Cutoff elevation

6. Submit shop drawings for all structural steel, including the helical pile components, corrosion protection system, pile top attachment, and helix details, to the Architect/Engineer for review and approval.

7. Submit for review and acceptance the proposed helical pile load testing procedure. The testing program shall be provided two (2) weeks prior to starting the load testing. This helical pile verification load testing proposal shall be in general conformance with ASTM D1143 and/or D3689, and shall indicate the minimum following information:

a. Type and accuracy of apparatus for measuring load
b. Type and accuracy of apparatus for applying load
c. Type and accuracy of apparatus for measuring the pile deformation
d. Type and capacity of reaction load system, including sealed design drawings
e. Hydraulic jack calibration report

8. Submit to the Architect/Engineer calibration reports for each test jack, pressure gauge, and master pressure gauge to be used. The calibration tests shall have been performed by an independent testing laboratory, and tests shall have been performed within one year of the date submitted. Testing shall not commence until the Architect/Engineer has approved the jack, pressure gauge, and master pressure gauge calculations.

9. Work shall not begin until the appropriate submittals have been received, reviewed, and approved in writing by the Architect/Engineer. Note that any additional time required due to incomplete or unacceptable submittals shall not be cause for delay or impact claims. All costs associated with incomplete or unacceptable submittals shall be the responsibility of the Contractor.

10. Welding certificates.

11. Unit costs: Submit as outlined in this section.

12. The Contractor shall submit to the Architect copies of calibration reports for each torque indicator or torque motor, and all load test equipment to be used on the project. The calibration tests shall have been performed within 45 working days of the date submitted. Helical pile installation and testing shall not proceed until the Architect/Engineer has received the calibration reports. These calibration reports shall include, but are not limited to, the following information:

a. Name of project and Contractor
b. Name of testing agency
c. Identification (serial number) of device calibrated
d. Description of calibrated testing equipment

e. Date of calibration
f. Calibration data

13. Installation Reports: The installing contractor shall provide the Owner, or his authorized representative, copies of individual helical pile installation records within 24 hours after each installation is completed. Formal copies shall be submitted within 48 hours after installation. These installation records shall include, but are not limited to, the following information:

a. Name of project and Contractor
b. Name of Contractor's supervisor during installation
c. Date and time of installation
d. Installation equipment type and operator name
e. Type of torque indicator used
f. Location of helical pile or helical anchor by grid location, diagram, or assigned identification number
g. Pile reveal
h. Type and configuration of lead section with length of shaft and number and size of helical bearing plates
i. Type and configuration of extension sections with length and number and size of helical bearing plates, if any
j. Final elevation of top of shaft and cutoff length, if any
k. Total length of installed pile
l. As-built installation angle of pile
m. Torque measurements at three-foot depth intervals
n. Final installation torque
o. Effective torsional resistance and calculated geotechnical capacity based on effective torsional resistance and/or as derived from the pre-production test program
p. Comments pertaining to interruptions, obstructions, or other relevant information
q. Unless specified otherwise on the drawings or by local codes, the pile design professional, or an inspection agency accepted by the Architect/Engineer, shall observe and document at least 10 percent of helical pile and helical anchor installations.

B. LEED Certification: Submit manufacturer's certification for each steel product including the following:

1. LEED Credit MRc 4.1/4.2 – Recycled content, including percentage of pre-consumer (post-industrial) and post-consumer recycled content. Also provide manufacturer's name, product cost and steel processing furnace type.

2. LEED Credit MRc 5.1/5.2 – Location of manufacturing plant, manufacturer's name, product cost and location of extraction or harvest of raw materials.

C. Post Construction:

1. The following records shall be prepared for the Owner. The records shall be completed within 24 hours after each pile installation is completed. The records shall include the following minimum information:

a. Pile drilling duration and observations
b. Information on soil and rock encountered, including description of strata, water, etc.
c. Approximate final tip elevation
d. Cutoff elevation
e. Rated load capacities
f. Description of unusual installation behavior or conditions
g. Any deviations from the intended parameters
h. Torque attained, where applicable
i. Pile materials and dimensions
j. Helical pile test records, analysis, and details

2. Submit as-built drawings showing the location of the piles, their depth and inclination, and details of their composition.

1.8 SUBSURFACE CONDITIONS

A. The Geotechnical Report, including logs of soil borings as shown on the boring location plan, shall be considered to be representative of the in-situ subsurface conditions likely to be encountered on the project site. Said Geotechnical Report shall be the used as the basis for helical pile design using generally accepted engineering judgment and methods.

B. The Geotechnical Report shall be provided for purposes of bidding. If, during helical pile installation, subsurface conditions of a type and location are encountered of a frequency that were not reported, inferred, and/or expected at the time of preparation of the bid, the additional costs required to overcome such conditions shall be considered as extras to be paid for by the Owner.

1.9 PILE LOAD TESTING

A. If pile testing is required, the Installing Contractor shall furnish all labor, equipment, and pre-production helical piles necessary to accomplish the testing as shown in the previously submitted and approved pile design submittals. The Installing Contractor shall apply the specified loads for the specified durations and record the specified data for the specified number of piles. No deviations from the test plan(s) will be allowed without explicit approval in writing from the Owner/Owner's Representative. Pile testing shall be in accordance with the load testing procedures and performance requirements deemed suitable for the application by the Owner/Owner's Representative, or pile designer.

B. Helical Pile Compression Tests:

1. Contractor shall perform the number of compression tests shown on the drawings.

2. Compression tests shall be performed following the "quick test" procedure described in ASTM D1143 specifications.

3. Load tests shall be observed and documented by the Inspection Agency.

4. Unless otherwise shown on the drawings, the maximum test load shall be 200% of the allowable load shown on the drawings.

5. The locations of helical piles to be tested shall be determined by the Contractor, unless noted on the drawings.

6. Installation methods, procedures, equipment, products, and final installation torque shall be identical to the production helical piles to the extent practical, except where otherwise approved by the Owner or Architect/Engineer.

7. A load test shall be deemed acceptable provided the maximum test load is applied without helical pile failure and the deflection of the pile head at the design load is less than 1-inch, unless noted otherwise on the drawings. Failure is defined when continuous jacking is required to maintain the load.

C. If a load test fails the foregoing acceptance criteria, the Contractor shall modify the helical pile or helical anchor design and/or installation methods and retest the modified pile or anchor as directed by the Owner or Architect/Engineer. These modifications include, but are not limited to, de-rating the load capacity, modifying the installation methods and equipment, increasing the minimum final installation torque, changing the helical configuration, or changing the product (e.g., duty). Modifications that require changes to the structure shall have prior review and acceptance of the Owner. Any modifications of design or construction procedures, and any retesting required, shall be at the Contractor's expense.

D. The Contractor shall provide the Owner and Architect/Engineer copies of load test reports confirming configuration and construction details within one (1) week after completion of the load tests. This written documentation will either confirm the load capacity as required on the working drawings or propose changes based on the results of the tests. At a minimum, the documentation shall include, but is not limited to, the following information:

1. Name of project and installing contractor
2. Name of installing contractor's supervisor during installation
3. Name of third party test agency, if any
4. Type of test, pre-production or production test
5. Date, time, and duration of test
6. Unique identifier and location of helical pile tested
7. Test procedure (ASTM D1143, D3689, or D3966)
8. List of any deviations from procedure
9. Test criteria, performance or proof
10. Description of calibrated testing equipment and test setup
11. Testing equipment calibration data
12. Type and configuration of helical pile or helical anchor including lead section, number and type of extension sections, and manufacturer's product identification numbers
13. Load steps and duration of each load increment
14. Incremental and cumulative pile-head movement at each load step
15. Comments pertaining to test procedure, equipment adjustments, or other relevant information
16. Reaction frame/pile installation and verification data, as required by Owner or pile designer
17. Incremental and cumulative pile-head movement at each load step
18. Signatures as required by local jurisdiction

1.10 PRODUCT DELIVERY, STORAGE AND HANDLING

A. All helical pile, helical anchor, and bracket assemblies shall be free of structural defects and protected from damage. Store helical piles, helical anchors, and bracket assemblies on wood pallets or supports to keep from contacting the ground. Damage to materials shall be cause for rejection.

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. AB Chance Company, a subsidiary of Hubbel Corp., 210 North Allen Street, Centralia, MO 65240-1395; or Aluma-Form/Dixie, 3625 Old Getwell Road, Memphis, TN 38118.

B. Foundation Supportworks®, Inc., 12330 Cary Circle, Omaha, NE 68128.

C. Pier Tech Systems, 17813 Edison Avenue, Suite 100, Chesterfield, MO 63005.

D. Magnum Piering, Inc., 6082 Schumacher Park Drive, West Chester, OH 45069.

2.2 LEED CREDIT

A. LEED Credit MRc 4.1/4.2:

1. Steel products shall be made using an electric arc furnace and shall have a minimum recycled content of 80%, including at least 65% post-consumer recycled content and 15% post-industrial recycled content.

2. Steel products made using a basic oxygen furnace shall have a minimum recycled content of 25%, including at least 20% post-consumer recycled content and 5% post-industrial recycled content.

B. LEED Credit MRc 5.1/5.2:

1. Steel products shall be manufactured within 500 miles of project site. Recycled scrap products shall be procured from within 500 miles of the project site.

PART 3 - EXECUTION

3.1 SITE CONDITIONS

A. Prior to commencing helical pile installation, the Contractor shall inspect the work of all other trades and verify that all said work is completed to the point where helical piles may commence without restriction.

B. The Contractor shall verify that all helical piles may be installed in accordance with all pertinent codes and regulations regarding such items as underground obstructions, right-of-way limitations, utilities, etc.

C. In the event of a discrepancy, the Contractor shall notify the Architect/Engineer. The Contractor shall not proceed with helical pile installation in areas of discrepancies until said discrepancies have been resolved. All costs associated with unresolved discrepancies shall be the responsibility of the Owner.

3.2 INSTALLATION

A. Installing Contractor shall furnish and install all helical piles per the project plans and approved pile design submittals. In the event of conflict between the project plans and the approved pile design documentation, the Installing Contractor shall not begin construction on any affected items until such conflict has been resolved.

B. Installation of helical piles may be observed by representatives of the Owner for quality assurance purposes. The Installing Contactor shall notify the Owner's Representative at least 24 hours prior to pile installation operations. All helical pile sections and ancillary products shall be marked as necessary to allow correlation with the pile design submittals before shipment from the manufacturer.

C. The helical pile installation technique shall be such that it is consistent with the geotechnical, logistical, environmental, and load carrying conditions of the project. The lead section shall be positioned at the location as shown on the pile design drawings. Inclined helical piles can be positioned perpendicular to the ground to assist in initial advancement into the soil before the required installation angle shall be established. After initial penetration, the required installation angle shall be established. The helical pile sections shall be engaged and advanced into the soil in a smooth, continuous manner at a rate of rotation of 5 to 25 rpm. Sufficient crowd shall be applied to uniformly advance the helical pile sections a minimum of 80% of the distance equal to the pitch of the helix plate per revolution. The rate of rotation and magnitude of crowd shall be adjusted for different soil conditions and depths. Extension sections shall be provided to obtain the required minimum overall depth/length and minimum effective torsional resistance as shown on the project plans.

3.3 TERMINATION CRITERIA

A. The specified minimum overall depth/length criteria and minimum effective torsional resistance criterion must be satisfied prior to terminating the helical pile installation. In the event any helical pile fails to meet these production quality control criteria, the following pre-qualified remedies are authorized:

1. If the installation fails to meet the minimum effective torsional resistance criterion at the minimum embedment depth/length:

a. Continue the installation to greater depth/length in the specified bearing stratum until the effective torsional resistance criterion is met, provided continued installation does not exceed any applicable maximum length. or,

b. Demonstrate acceptable pile performance through load testing. or,

c. Replace the pile with one having a different helix configuration. The replacement pile must not exceed any applicable maximum embedment length and either be embedded to a length that places its last helix at least three times its own diameter beyond the position of the first helix of the replaced pile and meet the minimum effective torsional resistance criterion, or pass load testing.

2. If the torque measured during installation reaches the helical pile's allowable torque rating prior to reaching the minimum embedment depth/length criterion, with approval from the Owner/Owner's Representative, terminate the installation, then proceed with one of the following recommended actions:

a. Replace the pile with one having a shaft with a higher torsional strength rating. This replacement pile must be installed to satisfy the minimum embedment depth/length criterion. It must also be embedded to a depth/length that places its last helix at least three times its own diameter beyond the position of the first helix of the replaced pile without exceeding any applicable maximum embedment depth/length requirements, and it must meet the minimum effective torsional resistance criterion. or,

b. Replace or modify the pile with one having a different helix configuration. This replacement or modified pile must be installed to satisfy the minimum embedment depth/length criterion. It must also be embedded to a depth/length that places its last helix at least three times its own diameter beyond the position of the first helix of the replaced pile without exceeding any applicable maximum embedment depth/length requirements, and it must meet the minimum effective torsional resistance criterion. or,

c. If allowed or approved by the Owner/Owner's Representative, remove and reinstall the pile at a position at least three times the diameter of the largest helix away from the initial location. Original minimum embedment depth/length and effective torsional resistance criteria must be met for the repositioned pile. This pile repositioning may require the installation of additional helical piles with service loads adjusted for these spacing changes.

3. If the installation reaches a specified maximum embedment depth/length without achieving the minimum effective torsional resistance criterion:

a. If approved by the Owner/Owner's Representative, remove and reinstall the pile at a position at least three times the diameter of the largest helix away from the initial location. Original minimum installation depth/length and effective torsional resistance criteria must be met for the repositioned pile. This pile repositioning may require the installation of additional helical piles with service loads adjusted for these spacing changes. or,

b. Demonstrate acceptable pile performance through load testing. or,

c. Reduce the load capacity of the helical pile and install additional pile(s) as necessary. The reduced capacity and additional pile location shall be subject to the approval of the Owner/Owner's Representative. or,

d. Replace the pile with one having a different helix configuration. This replacement pile must be embedded to a depth/length that places its last helix at least three times its own diameter beyond the position of the first helix of the replaced pile. This replacement pile must be installed to satisfy the minimum embedment depth/length criterion, and it must meet the minimum effective torsional resistance criterion.

4. If a helical pile fails to meet acceptance criteria in a load test:

a. Install the pile to a greater depth/length and installation torque and re-test, provided any maximum embedment depth/length criterion is not exceeded. or,

b. Replace the pile with one having more and/or larger helix plates. It must be embedded to a depth/length that places its last helix at least three times its own diameter beyond the position of the first helix of the replaced pile without exceeding any applicable maximum embedment depth/length requirements. This replacement pile must be re-tested. or,

c. If approved by the Owner's Representative, de-rate the load capacity of the helical pile and install additional piles. Additional piles must be installed at positions at least three times the diameter of the largest helix away from any other pile locations and approved by the Owner's Representative. Piles installed in cohesive soils shall not be spaced closer than four helix diameters.

5. Load testing to qualify a helical pile under any of the remedial actions outlined in Article 1.9 shall not be used to satisfy load testing frequency requirements shown in the project plans or the approved design submittals.

6. If a helical pile fails a production quality control criterion for any other reason, including damage during installation, any proposed remedy must be approved by the Owner/Owner's Representative prior to implementation.

3.4 TOLERANCES

A. When helical pile placement is shown on the project plans, production piles shall be placed such that the pile head is within 3 inches laterally and longitudinally and 1/2 inch vertically to plan; and the pile shaft alignment is within 1 degree of the installation angle shown on the project plans. When pile placement is not shown on the project plans, the placements, alignments, and their respective tolerances shall be included as part of the design submittal.

3.5 CLEANUP

A. The Installing Contractor shall remove any and all material, equipment, tools, building materials, concrete forms, debris, or other items belonging to the Installing Contractor or used under the Installing Contractor's direction.

END OF SECTION

SECTION 31 66 13
SHORT AGGREGATE PIER FOUNDATION SYSTEM

PART 1 - GENERAL

1.1 DESCRIPTION

A. The General and Supplementary Conditions of the Construction Contract and Division 1 - General Requirements apply to the Work specified in this section.

B. This Section includes the excavation and construction of short aggregate piers as shown on the Drawings and specified herein.

1. Short aggregate piers shall be defined as columnar-type foundation piers constructed by compacting aggregate with special high-energy impact densification equipment into an excavated shaft to produce an intermediate foundation system for support of foundation loads. The term "pier" shall be used in this section to refer to short aggregate piers.

2. Aggregate piers referenced in this specification refer to both rammed piers and vibro stone columns.

C. Furnish and install all aggregate, reinforcing steel and other accessories as shown on the drawings and herein specified.

D. Structural notes indicated on the drawings regarding short aggregate pier foundation systems shall be considered a part of this specification.

1.2 REFERENCE STANDARDS

A. Design:

1. "Control of Settlement and Uplift of Structures Using Short Aggregate Piers," by Evert C. Lawton (Assoc. Prof., Dept. of Civil Eng., Univ. of Utah), Nathaniel S. Fox (President, Geopier Foundation Co., Inc.), and Richard L. Handy (Distinguished Prof. Emeritus, Iowa State Univ., Dept. of Civil Eng.), reprinted from IN-SITU DEEP SOIL IMPROVEMENT, Proceedings of sessions sponsored by the Geotechnical Engineering Division/ASCE in conjunction with the ASCE National Convention held October 9-13, 1994, Atlanta, Georgia.

2. "Settlement of Structures Supported on Marginal or Inadequate Soils Stiffened with Short Aggregate Piers," by Evert C. Lawton and Nathaniel S. Fox. Geotechnical Special Publication No. 40: Vertical and Horizontal Deformations of Foundations and Embankments, ASCE, 2, 962-974.

1.3 DESIGN REQUIREMENTS

A. The design submitted by the Aggregate Pier Installer shall consider the bearing capacity and settlement of all footings supported by the aggregate piers, and shall be in accordance with acceptable Engineering practice and these specifications. Total and differential settlement shall be considered. The design life of the structure shall be 50 years, unless specified by the Owner.

B. Aggregate Pier Design:

1. Aggregate piers shall be designed in accordance with generally accepted Engineering practices and the method described in "Control of Settlement and Uplift of Structures Using Short Aggregate Piers." The design shall also meet the following criteria:

a. Maximum Allowable Bearing Pressure: 5,000 psf for Aggregate Pier Improved Soil.

b. Minimum Aggregate Pier Area Coverage (Spread Footings): 30%.

c. Maximum Total Long-Term Settlement for Footings: ≤ 1 inch.

d. Maximum Long-Term Differential Settlement: ≤ 0.5 inches for Adjacent Footing.

C. Capacity and Size of the Aggregate Piers:

1. The Installer shall be responsible for delivering a system that will support the structure, while controlling settlement in accordance with these specifications. The Engineer shall approve any modifications in size and spacing of the aggregate piers, unless such modifications result in more conservative design, in which case the Installer may approve them.

D. Design Submittal:

1. The Aggregate Pier Installer shall submit 4 sets of detailed design calculations, construction drawings, and shop drawings for approval at least 2 weeks prior to the beginning of construction. A detailed explanation of the design properties for settlement calculations shall be submitted with the design. Additionally, the quality control test program for the aggregate piers, meeting these design requirements, shall be submitted. All computer-generated calculations and drawings shall be prepared and sealed by a Professional Engineer, licensed in the State or Province where the piers are to be built.

1.4 QUALITY ASSURANCE

A. Codes and Standards: Comply with the provisions of the following codes, specifications and standards, except where more stringent requirements are shown or specified.

1. Modulus Load Testing:

a. ASTM D1143 – Pile Load Test Procedures

2. Materials and Inspection:

a. ASTM D1241 – Aggregate Quality
b. ASTM STP-399 – Dynamic Penotrometer Testing
c. ASTM D422 – Gradation of Soils

B. Where any other pertinent code or specification conflicts with this specification, the more stringent will govern.

C. All piers shall be installed by a Contractor specializing in the installation of short aggregate piers, and who shall have a minimum 5 years of documented experience in the field of aggregate pier construction.

D. Pier Contractor shall keep a record or log of each pier as installed. Records shall show location, top and bottom elevations, shaft and bulb diameters, date pier is filled, type of strata encountered, and any other pertinent information. A copy of this record shall be submitted to the Architect and Structural Engineer for their record files.

E. Contractor shall schedule and provide time and means for the Inspection Agency to inspect, take samples and make tests.

1.5 TESTING AND INSPECTION

A. Inspection and Testing:

1. The Contractor shall employ an Inspection Agency to perform the duties and responsibilities specified below.

2. Refer to architectural, civil, mechanical, and electrical specifications for testing and inspection requirements of non-structural components.

3. Work performed on the premises of a fabricator approved by the building official need not be tested and inspected per the table below. The fabricator shall submit a certificate of compliance that the work has been performed in accordance with the approved plans and specification to the building official and the Architect and Engineer of Record.

4. Duties of the Inspection Agency:

   a. Perform all testing and inspection required per approved testing and inspection program.

   b. Furnish inspection reports to the building official, the Owner, the Architect, the Engineer of Record, and the General Contractor. The reports shall be completed and furnished within 48 hours of inspected work.

   c. Submit a final signed report stating whether the work requiring Inspection was, to the best of the Inspection Agency's knowledge in conformance with the approved plans and specifications.

5. Structural Component Testing and Inspection Schedule for Section 31 66 13 is as follows:

Short Aggregate Pier Foundation System	Continuous	Periodic
Verify element materials, sizes, and lengths comply with the requirements.	X	
Determine capacities of test elements and conduct additional load tests, as required.	X	
Observe driving operations and maintain complete and accurate records for each element.	X	
Verify placement locations and plumbness, confirm type and size of hammer, record number of blows per lift and document any soil that fell into the aggregate pier.	X	

1.6 UNIT PRICES

A. Unit prices shall be issued to the Architect prior to construction as part of the submittal package.

B. Aggregate Pier Size Length and Quantity: The Aggregate Pier Contractor shall determine the exact size, length and quantity of piers for this project as part of their design services. Piers shown on the drawings are a schematic representation of what is anticipated for the final design and is used for coordination purposes only.

   1. Field adjustments to the pier length may be required due to the actual elevation of the bearing stratum verified by the Inspection Agency and Pier Contractor.

C. Adjustments in the Contract Price will be made due to changes in the number and length of piers, based on unit prices established in this Agreement as follows:

   1. Payment for piers will be made on final length of piers in place and accepted. Actual length and pier diameter may change due to job conditions. Adjusted payment will be made on the basis of net variations to the total quantities, based on design dimensions.

2. Provide the following unit costs in the event that additions to, or deductions from, work are required and authorized in writing by Architect/Engineer:

a. Additional length of aggregate pier ($/per lineal feet)

b. Subtracted length of aggregate pier ($/per lineal feet)

1.7 SUBMITTALS

A. The Aggregate Pier Installer shall submit detailed design calculations and construction drawings to the Owner or Owner's Engineer for approval at least 1 week prior to the start of construction. A Professional Engineer licensed in the State where the project is located shall seal all plans and calculations prepared under their supervision.

B. The Aggregate Pier Installer shall submit a notarized manufacturer's certification prior to the start of work, stating that the aggregate and other materials used meet the requirements of this specification.

C. Daily Aggregate Pier Progress Reports – The Testing Agency shall furnish a complete and accurate record of aggregate pier installation to the General Contractor. The record shall indicate the pier location, length, average lift thickness, and final elevations of the base and top of pier. The record shall also indicate the type and size of the densification equipment used. The Aggregate Pier Installer shall immediately report any unusual conditions encountered during the installation to the General Contractor, to the aggregate pier designer, and to the Testing Agency.

D. Post Construction:

1. The Inspector shall prepare and submit the daily aggregate pier progress report as described earlier to the Architect and one file copy to the Structural Engineer of Record.

2. The Pier Contractor shall prepare and submit their record or log of the pier installation as described earlier to the Architect and one file copy to the Structural Engineer of Record.

3. Prepare and submit results of all tests and inspections.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Aggregate shall be Type 1 Grade B in accordance with ASTM D1241

1. Aggregate to be compacted to a densification and strength, which provides resistance to the dynamic penetration test (ASTM STP-399) of a minimum average of 15 blows per 1.75-inch vertical movement.

2. The number of tests performed during a workday by the testing agency shall depend on the consistency of achieving the minimum penetration resistance. Penetration test need not be performed on every pier if average penetration resistances measured exceed 15 blows, and less than 10% of tests fall below 15 blows, then testing may be reduced to spot checks.

3. Observation of questionable aggregate moisture content or questionable aggregate gradation appearance may determine the need for additional dynamic penetration testing to verify that proper densification and strength are being achieved.

B. Aggregate for piers below the water table shall be the same as Type 1 Grade B except that particles passing through the No. 40 sieve shall be eliminated. Pier installer may submit for approval an alternate stone gradation for this type of installation.

PART 3 - EXECUTION

3.1 EXAMINATION

A. General Contractor and Pier Contractor shall examine all Drawings pertaining to this work and shall visit the work site before completing their bids. Verify that site conditions will support equipment required to install piers.

3.2 PREPARATION

A. General Contractor shall conduct all excavating, filling and grading necessary to leave site ready to receive pier work.

B. Situate equipment as to not cause damage to adjacent structures. Contractor to protect adjacent structures from damage if required.

C. Pier Contractor shall be responsible for all shoring, cribbing and planning necessary or required for supporting and manipulating their equipment.

D. Where unstable or unsuitable soils are located, equipment supports shall be keep at least 10 feet away from the pier location to prevent compression or shearing of soil at the top of the pier wall or provide temporary steel casings of adequate strength to protect the excavation from collapse.

E. Pier Contractor shall examine the soil boring logs of geotechnical report prior to design and bidding.

F. In the event that the Pier Contractor hits obstructions, which cannot be removed with standard soil drilling tools, the General Contractor shall seek approval from the Architect to remove the obstruction on a unit price basis. An obstruction shall be defined as any object (boulder, rock, concrete, etc.), which prevents the pier construction with standard soil drilling equipment. Inspector shall determine if objects encountered are classified as obstructions.

3.3 FIELD MEASUREMENT

A. General Contractor shall field locate each pier relative to the building lines and column centerlines.

3.4 INSTALLATION – STONE COLUMNS

A. Install stone columns with a down-hole vibrator capable of densifying the aggregate by forcing it radially into the surrounding soil. The vibrator shall be of sufficient size and capacity to construct stone columns to the diameters and lengths shown on the installer's approved construction drawings.

B. The probe and follower tubes shall be of sufficient length to reach the elevations shown on the installer's approved construction drawings. The probe, used in combination with the available pressure to the tip jet, shall be capable of penetration to the required tip elevation. Pre-boring shall be permitted if it is specified in the installer's approved construction procedure submittal.

C. The probe and follower shall have visible markings at regular increments to enable measurement of penetration and repenetration depths.

D. Provide methods for supplying to the tip of the probe a sufficient quality of air or water to widen the probe hole to allow adequate space for stone backfill placement around the probe.

E. The probe shall penetrate into the foundation soil layer to the minimum depths required in the installer's construction plans.

F. Lift thickness shall not exceed 4 feet. After penetration to the treatment depth, slowly retrieve the vibrator in 12-inch to 18-inch increments to allow backfill placement.

G. Compact the backfill in each lift by repenetrating it at least twice with the vibrating probe to densify and force the stone into the surrounding soil.

H. Install stone columns so that each completed column is continuous throughout its length.

3.5 INSTALLATION – RAMMED PIERS

A. The piers shall be accurately centered at the proper location and installed plumb.

B. All rammed aggregate pier elements shall be pre-augered using mechanical drilling or excavation equipment. Installation of piers without pre-augering shall not be allowed, because this technique results in significant disturbance and remolding of the matrix soils surrounding the piers.

C. Bottom Stabilization Verification Test – After completion of the bottom pier bulb, or at any time during the process of constructing the pier, the energy source may be turned off, and a bottom stabilization verification test may be performed. These tests shall be performed when a new soil formation is encountered, or at the beginning of a project to provide quantitative information on pier stabilization. A reference bar is placed over the cavity, and a mark is made on the tamper shaft that has been placed on top of the compacted aggregate. The energy to the tamper is restarted. If the measured vertical movement exceeds 150% of the value achieved during the load test, added energy is applied to densify the bulb. The procedure for measuring is then repeated. If there is still movement greater than 150% of that achieved during the load test greater than ½ inch, a lift of loose aggregate may be placed on top of the compacted aggregate, and the verification test may be performed on this next lift after it is densified. Movement must be limited to 150% of the values achieved for the load test before completion of 2/3 of the pier depth unless unusually powerful modified hydraulic hammers are being used with tamper heads smaller than 26 inches in diameter.

D. Debris shall be removed from the bottom the shaft by mechanical methods and not by the trade contractor's personnel. At no time shall any field personnel access the pier excavation.

E. If cave-ins occur during excavation such that the sidewalls of the hole are deemed to be unstable, steel casing or a drilling slurry shall be used to stabilize the excavation.

F. If cave-ins occur on top of a lift of aggregate such that the volume of the caved soils is greater than 10 percent of the volume of the aggregate in the lift, then the aggregate shall be considered contaminated and shall be removed and replaced with uncontaminated aggregate.

G. Special high-energy impact densification apparatus shall be employed to densify the aggregate pier elements during installation. The apparatus shall apply direct downward impact energy to each lift of aggregate.

H. A minimum tamper energy level of 250,000 foot-pounds of force per minute shall be applied by the energy source.

I. Remove and dispose of excavated material as directed in Division 31 of this specification.

J. Excavations shall not be left open overnight.

K. Remove any water from shaft prior to aggregate placement.

L. Place aggregate in 1-foot lifts and compact with 45 degree beveled tampered head.

M. Each lift of aggregate shall be tamped for a minimum of 15 seconds.

3.6 TOLERANCES

A. The maximum variation in top elevation of the center of any pier shall be plus 1 inch and minus 3 inches at the cut off elevation.

B. The center of each pier shall be within six inches of the plan locations indicated.

C. The final measurement for the top of aggregate piers shall be the lowest point on the aggregate in the last compacted fill.

D. Piers installed outside the above tolerances and deemed not acceptable shall be rebuilt at no additional expense to the Owner.

3.7 FOOTING BASE PREPARATION

A. All excavations for footing bottoms supported by aggregate pier foundations shall be prepared in the following manner by the Concrete Foundation Contractor:

1. Over excavation below the bottom footing elevation shall be limited to 3 inches. This includes limiting the teeth from excavators from over excavation beyond 3 inches below the footing elevation.

2. Compaction of surface soil and top of aggregate piers shall be prepared using a standard, hand-operated impact compactor. Compaction shall be performed over the entire footing bottom to compact any loose surface soil and loose surface pier aggregate.

3. Footing excavations shall be inspected by the Inspector before placing concrete. Refer to Section 31 23 00 for compaction requirements.

4. Excavation and surface compaction of all footings shall be the responsibility of the Concrete Foundation Contractor.

END OF SECTION

SECTION 32 05 00
COMMON WORK RESULTS FOR EXTERIOR IMPROVEMENTS

PART 1 - GENERAL

1.1 SCOPE

A. This section includes information common to all site work and applies to the entire contract.

B. Unless otherwise noted in the Contract Documents, Contractor shall be responsible for obtaining and paying for all permits necessary to complete the work.

C. Construction Limits are indicated on the drawings. In the absence of such a designation on the drawings, confine work to the minimum area reasonably necessary to undertake the work as determined by the Construction Representative. In no case shall construction activities extend beyond property lines or construction easements.

D. The Contractor shall restore all disturbed areas in accordance with the drawings and specifications. If plans and specifications do not address restoration of specific areas, these areas will be restored to pre-construction conditions as approved by the Construction Representative.

1.2 REFERENCE STANDARDS

A. Work under this section depends on applicable provisions from other sections and the plan set in this contract. Examples of related sections include, but are not limited to:

1. Division 31 — Earthwork

2. Specification 01 76 00 Protecting Installed Construction

B. AASHTO - American Association of State Highway and Transportation Officials

C. ACPA - American Concrete Pipe Association

D. ANSI - American National Standards Institute

E. ASCE - American Society of Civil Engineers

F. ASME - American Society of Mechanical Engineers

G. ASTM - American Society for Testing and Materials

H. AWWA - American Water Works Association

I. AWS - American Welding Society

J. FHA - Federal Highway Administration

K. EPA - Environmental Protection Agency

L. NEC - National Electric Code

M. NEMA - National Electrical Manufacturers Association

N. NFPA - National Fire Protection Association

O. NSF - National Sanitation Foundation

P. OSHA - Occupational Safety and Health Administration

Q. STI - Steel Tank Institute

R. UL - Underwriters Laboratories Inc.

S. WDNR - State of Wisconsin Department of Natural Resources

T. WisDOT - State of Wisconsin Department of Transportation

U. Where reference is made to the "SSHSC", it shall mean the pertinent sections of the State of Wisconsin, Department of Transportation, Standard Specifications for Highway and Structure Construction, current edition, and all supplemental and interim supplemental specifications. Where reference is made to the "STANDARD SPECIFICATIONS", it shall mean pertinent sections of the City of Madison Standard Specifications for Public Works Construction, current edition. Where reference is made to the "BMPH", it shall mean the Wisconsin Construction Site Best Management Practice Handbook, current edition as published by the WDNR. Method of measurement and basis of payment sections in referenced documents shall not apply.

PART 2 - PRODUCTS

2.1 BARRICADES, SIGNS, AND WARNING DEVICES

A. Traffic barricades, traffic signs, and warning devices shall meet the requirements of applicable OSHA standards and the FHA Manual of Uniform Traffic Control Devices (MUTCD).

B. Traffic signing materials shall meet the requirements of Sections 634, 636, and 637 of Standard Specifications for Highway Construction except that signs shall be from aluminum blanks.

C. Galvanized 2" round posts shall be provided for all signs.

2.2 TEMPORARY PLASTIC BARRIER FENCING

A. UV stabilized high-density polyethylene barrier fence free of holes tears and other defects. Provide 4' tall fence in diamond or rectangular pattern. Fencing shall be "safety orange" color, unless otherwise noted.

B. Posts for temporary plastic barrier fencing shall be 5' tall, minimum 12 gauge, painted metal posts.

PART 3 - EXECUTION

3.1 MAINTENANCE OF SITE AND BUILDING ACCESS/EGRESS

A. Unless otherwise shown or directed, maintain existing access and egress to the facility throughout construction. Maintain ANSI A117 compliant access for disabled persons, delivery access, emergency vehicle access, and emergency egress. Do not interrupt access and egress without prior written approval from the Construction Representative.

3.2 CONTINUITY OF EXISTING TRAFFIC/PARKING AND TRAFFIC CONTROL

A. Do not interrupt or change existing traffic, delivery, or parking without prior written approval from the Construction Representative. When interruption is required, coordinate schedule with the Owner agency to minimize disruptions. When working in public right-of-way, obtain all necessary approvals and permits from the City of Madison.

B. When Contractor's activities impede or obstruct traffic flow, Contractor shall provide traffic control devices, signs and flaggers in accordance with other Contract Documents and the current version of the MUTCD, or as shown on the Drawings.

3.3 PROTECTION AND CONTINUITY OF EXISTING UTILITIES

A. Verify the locations of any water, drainage, gas, sewer, electric, drainage, gas, sewer, electric, telephone/communication, fuel, steam lines or other utilities and site features which may be encountered in any excavations or other sitework. All lines shall be properly underpinned and supported to avoid disruption of service.

B. Do not interrupt or change existing utilities without prior written approval from the Construction Representative, affected utilities and users. Notify all users impacted by outages a minimum of 48 hours in advance of outage. Notification shall be provided in writing and describe the nature and duration of outages and provide the name and number of Contractor's foreperson or other contact.

C. Any service connections encountered that are to be removed shall be cut off at the limits of the excavation and capped in accordance with the requirements of applicable codes and any specifications governing such removals.

3.4 PROTECTION OF EXISTING WORK AND FACILITIES

A. Verify the locations of, and protect, any signs, paved surfaces, buildings, structures, landscaping, streetlights, utilities, and all other such facilities that may be encountered or interfered with during the progress of the work. Take measures necessary to safeguard all existing work and facilities that are outside the limits of the work or items that are within the construction limits but are intended to remain. Report any damage to existing facilities to the Construction Representative immediately. Correct and pay for all damages.

3.5 CONSTRUCTION LAYOUT

A. Contractor shall establish all heights and grades to properly execute work from bench mark established by a surveyor (from original survey work). It is strongly recommended that the design engineering firm be contacted and used for all construction layout as well as as-built surveys in an effort to avoid conflict between datums and horizontal control points used. Prior to construction layout, existing and proposed finished floor elevations shall be checked with respect to current site benchmarks to ensure elevations correspond with layout elevations.

B. Contractor shall provide all construction layout surveys to accurately locate the construction on the site.

3.6 STORMWATER/EXCAVATION WATER MANAGEMENT

A. Control grading around structures, pitch ground to prevent water running into excavated areas.

B. Pits, trenches within building lines and other excavations shall be maintained free of water.

C. Provide trenching, pumping, other facilities required.

D. Notify Architect/Engineer if springs or running water are encountered in excavation; provide discharge by trenches, drains, pumping to point outside of excavation. Provide information to Architect/Engineer of points and areas that water will be discharged. At the Engineer's option, the Contractor shall drain the spring to the storm sewer system by the use of field tile.

E. Be responsible for control measures to prevent damage from flooding, erosion, and sedimentation to on-site and off-site areas.

END OF SECTION

SECTION 32 11 23.33
DENSE GRADED BASE

PART 1 - GENERAL

1.1 SCOPE

A. This section includes information common to dense graded base using crushed stone or crushed gravel and applies to all sections in this Division.

1.2 REFERENCE STANDARDS

A. Work under this section depends on applicable provisions from other sections and the plan set in this contract. Examples of related sections include, but are not limited to:

1. Division 31 — Earthwork

B. Wherever WisDOT or SSHSC appears in this specification it shall be construed to mean the pertinent sections of the State of Wisconsin, Department of Transportation, Standard Specifications for Highway and Structure Construction (SSHSC), current edition, and all supplemental and interim supplemental specifications, as they may pertain, except this contract shall be a lump sum contract and measurement and basis of payment methods shall not apply.

C. Dense Graded Base shall conform to City of Madison standard specification Article 401 – Crushed Aggregate Base Course.

1.3 SUBMITTALS

A. Provide copies of record drawings.

B. Provide copies of material testing reports.

C. Provide the following prior to construction:

1. Manufacturers product information (cut sheets)

2. Mix designs and specifications

3. Aggregate Gradations

D. Materials conforming to the WisDOT Standard Specifications for Highway and Structure Construction (Latest Edition, hereafter called “Standard Specifications for Highway Construction” and supplied from a WisDOT approved source need not be tested. The contractor shall furnish evidence of such WisDOT approval to the A/E and/or Construction Representative.

E. Maintain record drawings showing actual locations of utilities and other features encountered, modifications to proposed grades and site features, and other deviations from the original design.

PART 2 - PRODUCTS

2.1 GENERAL

A. Use dense graded base. Materials shall conform to Section 301.2 of the WisDOT Standard Specifications for Highway and Structure Construction. Material gradations shall conform to Section 305.2.2 of the WisDOT Standard Specifications for Highway and Structure Construction unless specified elsewhere in the contract documents.

B. Base Course Gradation: 1-1/4" Crushed Aggregate

C. Materials shall conform to Gradation No. 2 per the City of Madison specification 401.1(b).

2.2 BREAKER RUN AGGREGATE

A. Crushed stone, rock or gravel meeting the requirements of either Breaker Run or Select Crushed material as defined in Section 311.2 or Section 312.2 of Standard Specifications for Highway Construction, respectively.

PART 3 - EXECUTION

3.1 CONSTRUCTION

A. Preparing The Pavement Foundation (Sub-Grade):

1. Prepare the foundation, or resurface the previously placed base layer, as specified in WisDOT Section 211 before placing base. Do not place base foundations that are soft, spongy, or covered by ice or snow. Water and rework or re-compact dry foundations as necessary to ensure proper compaction, or as the representative designates.

    a. In proposed pavement areas, all organic solid shall be removed.

    b. Excavation shall be reasonably free of water prior to beginning filling. Do not place material on frozen surfaces or use frozen material.

    c. In areas of existing pavement to be modified or adjusted in grade, the existing pavement section shall be removed by an acceptable method. The new pavement section shall match the construction details.

    d. Place and compact material to minimize settlement and avoid damage to structures, pipes, utility lines and other features. Hand place and compact material as necessary.

    e. Moisture condition backfill material as necessary to achieve density required for given use.

    f. Compact fill material as required for the given use.

    g. It is the responsibility of the Contractor to provide all necessary compaction equipment and other grading equipment that may be required to obtain the specified density. Vibratory plate or tamping type walk behind compactors will be required whenever backfill is placed adjacent to structures, pipes, utility lines and other features.

    h. Where additional filling or excavation is necessary, or placement of base course will be delayed, roll surface of proposed roadway or parking lot with a smooth drum roller to provide relatively impervious surface and promote drainage.

2. Proof-roll all subgrade areas that are to receive aggregate base or pavement. Proof-roll with a loaded dump truck prior to the placement of base courses to locate soft spots that yield under loading. Overexcavate (undercut) areas of soft subgrade that will not compact readily when proof-rolled or tamped. Backfill with breaker run or select crushed material as approved by the project representative.

    a. Prior to undercutting or excavating below subgrade (EBS) or placing any base course, contact the Construction Representative to schedule inspection of subgrade and proof-rolling. Provide minimum of 24 hrs confirmed notice. All proof-rolling shall be completed in the presence of the Construction Representative and Geotechnical Consultant.

b. To complete proof-rolling, entire roadway subgrade shall be provided with a relatively smooth surface, suitable for observing soil reaction during proof-rolling.

c. Contractor shall schedule and provide a fully loaded tri-axle dump truck for proof-rolling. Loaded truck shall have a minimum gross operating weight of 30 tons. Test shall be conducted with “tag” or “pusher” axles retracted from the ground.

d. Test-rolling shall be accomplished in a series of traverses parallel to the centerline of the street or parking area. The truck shall traverse the length of the street or parking area once for each 12’ of width. Additional passes along the traverse shall be completed as directed by the Geotechnical Consultant, to further define unsatisfactory subgrade.

e. Soft areas, yielding areas, cracked areas or areas where rolling or wave action is observed shall be considered indicative of an unsatisfactory subgrade. Such areas shall be undercut as outlined in Section 31 05 00.

f. Once the subgrade has been proof-rolled and approved, protect the soils from becoming saturated, frozen, or adversely altered.

g. Contractor shall assume 15% of proposed paved areas may require undercutting. This work shall be included in base bid. Undercut as outlined in Section 31 05 00.

B. Stockpiling:

1. If continuous compliance with material specifications is questionable, the project representative may require the contractor to supply material from a stockpile of previously tested material. Maintain a sufficiently large stockpile to preclude the use of material not previously approved.

2. Build and maintain stockpiles using methods that minimize segregation and prevent contamination. If the contract specifies location, place stockpiles where specified. Clear and prepare stockpile areas to facilitate the recovery of the maximum amount of stockpiled material.

C. Constructing Base:

1. Place aggregate in a manner that minimizes hauling on the subgrade. Do not use vehicles or operations that damage the subgrade or in-place base. Deposit material in a manner that minimizes segregation.

2. Construct the base to the width and section the plans show. Shape and compact the base surface to within 0.04 feet (12 mm) of the plan elevation.

3. Ensure there is adequate moisture in the aggregate during placing, shaping, and compacting to prevent segregation and achieve adequate compaction.

4. Maintain the base until paving over it, or until the project representative accepts the work, if paving is not part of the contract. The contractor is not responsible for maintaining material placed on detours.

D. Standard Compaction: Compact the base until there is no appreciable displacement, either laterally or longitudinally, under the compaction equipment. Route hauling equipment uniformly over previously placed base. Compact each layer before placing a subsequent layer. If the material is too dry to readily attain the required compaction, add water as necessary to achieve compaction

E. Special Compaction: If the contract requires special compaction, compact each layer to 95 percent of maximum density, or more, before placing the subsequent layer. The geotechnical engineer will determine the maximum density according to AASHTO T 99 method C or D and in-place density according to AASHTO T 191.

F. Controlling Dust: Apply water or other engineer-approved dust control materials to control dust during construction and maintenance of the base and shoulders.

3.2 COMPACTION

A. Compact each base layer, including shoulder foreslopes, with equipment specified in WisDOT Section 301.3.1. Use standard compaction conforming to WisDOT Section 301.3.4.2. Final shaping of shoulder foreslopes does not require compaction.

B. Compacting 1 1/4-Inch Base and 3/4-Inch Base. If using a pneumatic roller, do not exceed a compacted thickness of 6 inches (150 mm) per layer. For the first layer placed over a loose sandy subgrade, the contractor may, with the geotechnical engineer's approval, increase the compacted layer thickness to 8 inches (200 mm). If using a vibratory roller, do not exceed a compacted thickness of 8 inches (200 mm) per layer.

C. Compacting 3-Inch Base: Compact with a vibratory or pneumatic roller. Do not exceed a compacted thickness of 9 inches (225 mm) per layer.

3.3 UNDERCUTTING/EXCAVATION BELOW SUBGRADE (EBS)

A. Undercutting/EBS shall be completed only when directed by the Geotechnical Consultant. The Contractor shall not be compensated for any unauthorized undercutting/EBS. Measure and document undercut areas and depths in consultation with Geotechnical Consultant. Work shall comply with Section 31 05 00. Contractor shall assume 15% of proposed paved areas may require undercutting. This work shall be included in base bid.

3.4 CLEANUP

A. After the project is completed, thoroughly clean up all debris that may have accumulated during the placement of dense graded base. Replace or repair as required, all surfaces and/or landscape features damaged or disturbed under this item of work.

END OF SECTION

SECTION 32 12 00
ASPHALTIC PAVEMENT

PART 1 - GENERAL

1.1 SCOPE

A. This section includes information common to bituminous concrete paving work as shown on the drawings and applies to all sections in this Division.

1.2 REFENCE STANDARDS

A. Work under this section depends on applicable provisions from other sections and the plan set in this contract. Examples of related sections include, but are not limited to:

1. Division 31 — Earthwork

B. City of Madison Standard Specifications for Public Works Construction.

C. Part 4, “Pavements” of the latest edition of the Standard Specifications for Highway and Structure Construction of the State of Wisconsin, Department of Transportation.

1. 3 SUBMITTALS

A. Results from the Freeze / Thaw Test (AASHTO T103) for quarried course aggregates used in the work produced from limestone/dolomite sources. The maximum percent loss for aggregates used in the work shall be four percent (4%).

B. Asphalt Pavement mix designs in accordance with the aforementioned Part 4 of the latest edition of the Standard Specifications for Highway and Structure Construction of the State of Wisconsin, Department of Transportation. The asphaltic materials used shall comply with the current City of Madison specification Article 402 Asphalt Construction.

1.4 QUALITY ASSURANCE

A. Do not apply asphalt materials if subgrade is wet or excessively damp, if rain is imminent or expected before time required for adequate cure, or if the following conditions are not met:

1. Tack Coat: Minimum surface temperature of 60°F.

2. Asphalt Base Course: Minimum surface temperature of 40°F and rising at time of placement.

3. Asphalt Surface Course: Minimum surface temperature of 60°F at time of placement.

B. Pavement Marking Paint: Proceed with pavement marking only on clean, dry surfaces and at a minimum ambient or surface temperature of 40°F for oil-based materials, and not exceeding 95° F.

C. The paving crew shall be under the supervision of an experienced supervisor who shall be on the project at all times, and who shall not operate equipment, such as paving machines or rollers, at any time during the paving operation. Under no circumstances shall the workers, or others, be allowed to walk across recently laid asphalt mixture behind the paving machine and ahead of the roller.

D. A mechanical vibratory plate compactor shall be available on the job site at all times during asphalt pavement placement and shall be used for compaction around access structures, catchbasins, water valves and other castings which appear in the paved areas. The mechanical vibratory plate compactor shall be equipped with a working water reservoir and shall be of sufficient size and capability to attain the compaction requirements of these specifications.

E. Asphalt mixtures intended for use on City projects will be tested by the City in order to determine aggregate gradations, asphalt content, air voids and VMA. Asphalt mixtures shall be tested per section 460.2.8 of the latest edition of the Standard Specifications for Highway and Structure Construction of the State of Wisconsin, Department of Transportation

PART 2 - PRODUCTS

2.1 MATERIALS

A. The materials intended for use in base, lower, and upper layer mixtures, tack and seal coats, surface treatments, and similar work, shall comply with the requirements of Part 4, "Pavements" of the latest edition of the Standard Specifications for Highway and Structure Construction of the State of Wisconsin, Department of Transportation.

B. The Contractor shall provide Asphalt Pavement mix designs in accordance with the aforementioned Part 4 of the latest edition of the Standard Specifications for Highway and Structure Construction of the State of Wisconsin, Department of Transportation. The asphaltic materials used shall comply with the current City of Madison specification Article 402 Asphalt Construction.

2.2 RECYCLED ASPHALTIC MATERIALS

A. The contractor may use recycled asphaltic materials from FRAP, RAP, and RAS in HMA mixtures. Stockpile recycled materials separately from virgin materials and list each as individual JMF components.

B. Control recycled materials used in HMA by evaluating the percent binder replacement, the ratio of recovered binder to the total binder. Conform to the following:

Maximum Allowable Percentage Binder Replacement		
Recycled Asphaltic Material	Lower Layers	Upper Layer
RAS if used alone	25	20
RAP and FRAP in any combination	40	25
RAS, RAP and FRAP in combination	35	25
When used in combination the RAS component cannot exceed 5 percent of the total weight of the aggregate blend.		

C. This work shall consist of the construction of a plant mixed recycled asphalt mixture furnished and placed all in accordance with Article 460 of the latest edition of the Standard Specifications for Highway and Structure Construction of the State of Wisconsin, Department of Transportation, except as listed below.

D. The City of Madison shall approve the sources of recycled asphalt material, including shingles.

2.3 ASPHALT TACK COAT

A. Unless otherwise specified in the contract, or directed by the Engineer, the types and grades of asphalt materials and rates of applications in gallons per square yard and shall be type MS-2, SS-1, SS-1h, CSS-1, or an approved modified emulsified asphalt.

B. For existing concrete or asphalt pavements, the rate of application shall be between 0.05 and 0.10 gallons per square yard.

PART 3 - EXECUTION

3.1 SPREADING AND FINISHING

A. Pave at a constant speed, according to the paver specifications and mixture, for uniform spreading and strike-off with a smooth, dense texture and no tearing or segregation. In any event, the speed of placing asphalt mixtures shall not exceed that which coincides with the average rate of delivery to the paver, so as to provide as nearly as possible continuous operation of the paver.

B. The roller shall pass over an unprotected end of freshly laid mixture only when the laying of the course is to be discontinued long enough to permit the mixture to become cooled. In the event of such discontinuance, the end of the course shall be treated as a transverse construction joint as specified below.

3.2 COMPACTION

A. Where the edges are not supported by a curb and gutter or similar structure, the outside edges of the lower and upper layers shall be sloped and pressed in place by means of a self-adjusting constant pressure edge plate held in proper position on the finishing machine. A string line shall be used as a guide for the finishing machine in order to maintain a uniform edge alignment. If any other method is used, it shall meet the approval of the Engineer. The edge of the pavement shall be sloped approximately one (1) inch from the vertical and no material shall extend beyond the limits of the base. Irregularities in alignment along the outside edges and along the longitudinal joints shall be corrected by adding or removing paving mixtures before the edges are rolled.

B. The mixture shall be spread sufficiently so that after compaction the finished surface shall be one-eighth (1/8) to one-fourth (1/4) inch above the edges of curbs, gutters, access structures and similar structures. Each roller, while the paving is under way, shall be kept as nearly as practicable in continuous operation and the speed shall at all times be slow enough to avoid undue displacement of the mixture. When pneumatic-tired rollers are used, they shall be operated continuously at a rate of speed which will not cause damage to the mat and which will provide the maximum number of coverages possible while the temperature of the mat is conducive to densification and surface sealing. Rollers shall be operated with the drive roll or wheels nearest the paver.

C. Each roller, while the paving is under way, shall be kept as nearly as practicable in continuous operation and the speed shall at all times be slow enough to avoid undue displacement of the mixture. When pneumatic-tired rollers are used, they shall be operated continuously at a rate of speed which will not cause damage to the mat and which will provide the maximum number of coverages possible while the temperature of the mat is conducive to densification and surface sealing. Rollers shall be operated with the drive roll or wheels nearest the paver.

Minimum Required Density		
Layer	Percent of Target Maximum Density	
	Mixture Type	
	E-0.3, E-1, E-3	E-10

Lower	91.5	92
Upper	91.5	92

3.3 JOINTS

A. Longitudinal joints including mainline interior joints for all pavement layers shall be "hot" joints. "Hot" joints will be defined as joints with a temperature at or above the asphalt mixture compaction temperature. The Contractor shall provide the compaction temperature as part of the mix design submittal.

B. Where reheating of joints is needed to create a "hot" joint, reheating equipment and methods shall be in accordance with the latest edition of the Standard Specifications for Highway and Structure Construction of the State of Wisconsin, Department of Transportation, specifically Reheating HMA Pavement Longitudinal Joints, Item 460.4100S.

C. Where "Michigan" joints are placed to allow traffic use, the joint shall be milled, reheated and tacked in accordance with the above stated reheating specification before continuation of paving.

D. Contractor's operations shall not result in additional transverse joints unless approved by the Engineer.

3.4 ASPHALT PAVEMENT

A. Unless otherwise specified or directed by the Engineer, asphalt driveways and asphalt terrace paving shall be constructed of three (3) inches of upper layer pavement installed in one (1) lift on select fill, or as directed by the Engineer. E-0.3 mixture with 9.5mm nominal aggregate size or an approved commercial mix shall be used, unless a substitute is approved by engineer.

B. The composition for the various asphalt mixtures shall conform to the limits specified in Part 4 of the latest edition of the Standard Specifications for Highway and Structure Construction of the State of Wisconsin, Department of Transportation. Warm mix HMA is not approved.

C. The mixture shall be laid and compacted so that the average yields in pounds per square yard shall conform to the following charts showing the various thicknesses of installation:

Upper & Lower Layer(s) Yield-#S.Y.		
Thickness	Min.	Max.
1.5"	172	180
1.75"	201	210
2"	230	240
2.5"	287	300

3”	345	360
4”	460	480
5”	575	600

D. Unless otherwise specified in the contract, or directed by the Engineer, the upper layer mixtures shall be installed in one course of one and one-half (1-3/4) inches in depth.

E. For installations of the upper layer which are specified to be other than one and one-half (1-1/2) inches in depth, the allowable yields for such installations shall be in proportion to the allowable yields specified above.

F. Whenever the yields fall below the minimum allowable yields specified above, the Engineer shall determine the corrective action to be taken. The corrective action may include removal and replacement of the area of deficient thickness, an overlay with approved material of the area of deficient thickness, or such other action as the Engineer shall determine. The area of deficient thickness shall be determined on the basis of project area or area covered in one day’s operation, whichever is less. The Engineer’s determination will be based on the circumstances of the area involved, and will include a determination of the distribution of costs of the corrective work required.

END OF SECTION

SECTION 32 13 00
CONCRETE WORK OUTSIDE THE BUILDING ENVELOPE

PART 1 - GENERAL

1.1 SCOPE

A. Work Included: Cast-in-place concrete required for this Work is indicated on the drawings and includes, but is not necessarily limited to:

PART 1 – General
- Scope
- Quality Assurance
- Submittals
- Product Handling
- Reference Specifications
- LEED Certification Requirements

PART 2 – Products
- Concrete Materials
- Miscellaneous Materials
- Mixes and Delivery
- Detectable Warning Field

PART 3 – Execution
- Field Quality Control
- Preparation
- Concrete Placement
- Concrete Joints
- Expansion/ Isolation Joints
- Concrete Curing and Protection
- Tolerances
- Dense Graded Base
- Concrete Curb and Gutter
- Concrete Sidewalks, Pads and Driveways
- Curb Ramps
- Miscellaneous Concrete and Cement Work

B. Provide all work, materials, labor, equipment and supervision necessary.

C. Related work described elsewhere:

Section 31 05 00	Common Work Results for Earthwork (Outside the Building Footprint)
Section 32 11 23.33	Dense Grade Base

1.2 QUALITY ASSURANCE

A. All work shall be in accordance with applicable manufacturer's and supplier's instructions.

B. Qualifications of Workers:

1. Provide at least one person who will be present at all times during execution of this portion of the work who is thoroughly trained and experienced in placing the types of concrete specified and who will direct all work performed under this Section.

2. For finishing of exposed surfaces of concrete, use only thoroughly trained and experienced concrete finishers.

3. Concrete field tests for water content, slump, air content, yield and strength cylinders shall be conducted by a certified Wisconsin Concrete Technician, or technician of equivalent certification.

C. Correction of Defective Work: All concrete work which does not conform to the requirements of the Contract Documents and ACI 301, including function, durability, appearance, strength, cracking, tolerances and finishing, shall be corrected as directed by Architect at Contractor's expense. Additional testing, engineering, reinforcement and removal and replacement of defective concrete shall be paid for by Concrete Contractor. Contractor shall also be responsible for the cost of corrections to any other work affected by or resulting from corrections to the concrete work.

1. Concrete repairs including, but not limited to, patching, epoxy injection, routing and sealing, shall be performed by a specialty repair/restoration contractor, certified by the material supplier.

a. Provide qualifications to Architect and Structural Engineer for review and approval.

b. Restoration contractor shall provide material lists, and describe means and methods to Architect and Structural Engineer for review, prior to commencement of work.

c. Acceptance of units, repaired pursuant to written approval, is contingent upon repairs being skillfully done so as to be sound, permanent, flush with adjacent surfaces and, when exposed, of color and texture matching similar adjoining surfaces and showing no apparent line of demarcation between original and repaired work.

1.3 SUBMITTALS

A. Materials List: Within 30 days after award of Contract, and before any concrete is delivered to the job site, submit to Architect, in accordance with General Conditions, a complete list of all materials proposed to be furnished and installed under this portion of the Work, showing manufacturer's name and catalog number of all items such as admixture and membrane, and the name and address of transit-mix concrete supplier. Prior to starting construction, General Contractor shall also furnish a statement to Architect giving source, sieve analysis and specific gravity of both fine and coarse aggregate, proportions by weight (dry) of cement, fine and coarse aggregates, admixtures, and water that will be used in the manufacture of each class of concrete specified. No change in source of materials shall be made without prior notification to Architect.

B. Concrete Mix Design: Submit Mix Design to Architect for review. This submittal shall include the following:

1. Required cylindrical compression strength for f'c (28 day).

2. Element (curb, driveway, etc.) in which each class (strength of concrete) will be used.

3. Cylinder compressive strength test results or complete standard deviation analysis in accordance with ACI 318 Section 5.3.

4. Proportions of Materials.

5. Source of materials - Cement (type and brand), gravel pit.

6. Aggregate size and certification from an independent testing lab that gradation, specific gravity, soundness, absorption, and impurities meet ASTM requirements.

7. Admixture brand, dosage, literature.

8. Air content.

9. Water content and target slump.

10. Range of ambient temperature and humidity for which design is valid.

11. Special characteristics of mix which require precautions in mixing, placing, or finishing techniques to achieve finished product specified.

C. Product Data: Submit manufacturer's product data for review with application and installation instructions for proprietary materials and items including: patching compounds, epoxies, curing compounds, dry-shake finish materials, hardeners, sealers etc. for all items specified and used in materials list.

D. Substitutes to Specified Items:

1. Provide all product literature for substitutes to Architect for review.

2. Manufacturer's Representative shall certify in writing that the proposed substitute product meets or exceeds all requirements, test results, etc. in the Specification and the specified product's literature. Provide test results performed by an independent testing agency using the same test methods.

3. Specify amount of credit to owner if substitute is approved.

E. Construction Joints: Submit drawing of proposed construction joints for review for slabs on grade if different from those shown on drawings or if none shown on drawings.

F. Transit-mix delivery slips: With each load of concrete delivered to job, there shall be furnished by ready-mixed concrete producer duplicate delivery tickets, one (1) for Contractor and one (1) for Owner's representative. Delivery tickets shall provide following information:

1. Date

2. Name of ready-mixed concrete plant

3. Job location

4. Contractor

5. Type (Standard, A.E. or H.E.S.) and brand name of cement

6. Class and specified cement content in pounds per cubic yard of concrete

7. Truck number

8. Time dispatched

9. Amount of concrete in load in cubic yards

10. Admixtures in concrete

11. Maximum size of aggregate

12. Water added at job, if any.

13. Make the record available to Architect for inspection upon request.

G. Provide samples of broomed finish, stamped patterns, and dye colors.

H. Provide copies of all quality assurance testing reports.

I. Provide manufacturers product information (cut sheets) for truncated domes.

J. Sample Color Samples for Architectural Concrete (if applicable)

1. Provide to Architect for review 18" x 18" x 2" samples of concrete made with cement from various manufacturers for color selection and to establish the "Design Reference Standard" per ACI 303.1. Each sample shall be marked with name of cement manufacturer and type of aggregate used. Provide one (1) screed finish and one (1) trowel finish sample of each type.Color as selected by Architect.

2. Before any forms are constructed for exterior or exposed architectural concrete, erect sample wall panel of size shown on drawings, or of size sufficient to show full range of finishes, showing both vertical board and smooth finish surfaces, and meeting the requirements of ACI 301 and 303.1. No work shall proceed until sample has been approved by Architect.

1.4 PRODUCT HANDLING

A. Protection: Use all means necessary to protect cast-in-place concrete materials before, during and after installation and to protect the installed work and materials of all other trades.

B. Replacements: In the event of damage, immediately make all repairs and replacements necessary to the approval of Architect at no additional cost to Owner.

C. Do not use aluminum pipe if concrete is to be transported by means of pumping. Aluminum will not be allowed in concrete.

1.5 REFERENCE SPECIFICATIONS

A. The following latest edition reference specifications, guides and standards shall become part of this specification as if herein written. If provisions conflict, the more stringent provisions shall apply.

ACI 117 - Specifications for Tolerances for Concrete Construction and Materials and Commentary.

ACI 211.1 - Recommended Practice for Selecting Proportions for Normal Mass and Heavyweight Concrete.

ACI 211.2 - Recommended Practice for Selecting Proportions for Lightweight Concrete.

ACI 212 - Chemical Admixtures for Concrete.

ACI 214 - Recommended Practice for Evaluation of Results of Tests used to Determine the Strength of Concrete.

ACI 302.1 - Guide for Concrete Floor and Slab Construction.

ACI 303.1 - Standard Specification for Cast-In-Place Architectural Concrete.

ACI 304 - Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete.

ACI 304.2R - Placing Concrete by Pumping Method

ACI 305.1 - Specification for Hot Weather Concreting ACI 306 - Cold Weather Concreting.

ACI 306.1 - Standard Specification for Cold Weather Concreting.

ACI 308.1 - Standard Specification for Curing Concrete.

ACI 309 - Recommended Practice for Consolidation of Concrete.

ACI 318 - Building Code Requirements for Reinforced Concrete.

ACI ITG-4.1 - Specification for High-Strength Concrete in Moderate to High Seismic Applications (IBC Seismic Design Categories C-F)

ASTM C 31 - Method of Making and Curing Concrete Specimens in the Field.

ASTM C 33 - Standard Specification for Concrete Aggregate.

ASTM C 39 - Test Method for Compressive Strength of Cylindrical Concrete Specimens.

ASTM C 94 Standard Specification for Ready-Mixed Concrete.

ASTM C 138 - Standard Method of Test for Weight per Cubic Foot, Yield, and Air Content (Gravimetric) of Concrete.

ASTM C 143 - Standard Method of Test for Slump of Portland Cement Concrete.

ASTM C 150 - Specification for Portland Cement. ASTM C 171 - Sheet Materials for Curing Compound. ASTM C 172 - Method of Sampling Fresh Concrete.

ASTM C 173 - Standard Method of Test for Air Content of Freshly Mixed Concrete by the Volumetric Method.

ASTM C 192 - Standard Method of Making and Curing Concrete Test Specimens in the Laboratory.

ASTM C 231 - Standard Method of Test for Air Content of Freshly Mixed Concrete by the Pressure Method.

ASTM C 260 - Specification for Air-Entraining Admixtures for Concrete.

ASTM C 330 - Standard Specification for Lightweight Aggregates for Structural Concrete

ASTM C 494 - Specification for Chemical Admixtures for Concrete.

ASTM C 595 - Specification for Blended Hydraulic Cements.

ASTM C 618 - Specification for Fly Ash and Raw or Calcinated Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete.

ASTM C989 - Standard Specification For Slag Cement For Use in Concrete and Mortars.

ASTM C1017 - Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete.

OSHA Standard "Safety and Health Regulations for Construction", Part 1926 Subpart Q: "Concrete and Masonry Construction."

ANSI A10.9 "Safety Requirements for Concrete Construction and Masonry Work."

Standard Specification for Highway and Structure Construction, State of Wisconsin.

AASHTO T 318 - "Standard Method of Test for Water Content of Freshly Mixed Concrete Using Microwave Oven Drying".

1.6 LEED CERTIFICATION REQUIREMENTS

A. Ready-mixed concrete including coarse and fine aggregate shall be supplied within a 500-mile radius of the Project site.

B. Liquid materials including sealers, hardeners, curing compounds, etc., shall be VOC-compliant (low-odor or zero- odor type).

C. LEED SUBMITTALS. Unless otherwise indicated, submit the following for each type of product provided under work of this Section:

1. Recycled Content: MR4

   a. Indicate recycled content; indicate percentage of pre-consumer and post-consumer recycled content per unit of product.

   b. Indicate relative dollar value of recycled content product to total dollar value of product included in project.

   c. If recycled content product is part of an assembly, indicate the percentage of recycled content product in the assembly by weight.

   d. If recycled content product is part of an assembly, indicate relative dollar value of recycled content product to total dollar value of assembly.

   e. If any fly ash, slag cement, silica fume, or other waste material is used in mix designs to replace Portland cement, submit the total volume of concrete cast in place and mix design(s) used showing the quantity of Portland cement replaced. Use LEED New Product Content Form.

2. Local/Regional Materials: MR5

   a. Sourcing location(s): Indicate location of extraction, harvesting, and recovery; indicate distance between extraction, harvesting, and recovery and the project site.

   b. Manufacturing location(s): Indicate location of manufacturing facility; indicate distance between manufacturing facility and the project site.

   c. Product Value: Indicate dollar value of product containing local/regional materials; include materials cost only.

   d. Product Component(s) Value: Where product components are sourced or manufactured in separate locations, provide location information for each component. Indicate the percentage by weight of each component per unit of product.

3. Refer to Division 1 for additional requirements.

PART 2 - PRODUCTS

2.1 CONCRETE MATERIALS

A. General: Concrete shall conform to Sections 501 and 601 of the Standard Specifications for Highway Construction.

B. General: All concrete, unless otherwise specifically permitted by Architect, shall be transit-mixed in accordance with ASTM C 94.

1. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, each aggregate from one source, and each admixture from the same manufacturer.

2. In regions where Alkali Silica Reactions (ASR) occur concrete mixes shall be provided with proven performance history to mitigate the problems through the use of:

   a. Low-alkali cement

   b. Non-reactive aggregates

c. Pozzolans

d. Lithium-based admixtures

C. Portland Cement:

1. Standard Portland Cement: ASTM C 150, Type 1.

2. High Early Strength Portland Cement: ASTM C 150, Type 3.

3. Self-Consolidating Concrete (SCC): A highly flowable, non-segregating concrete that spreads into place, fills formwork, and encapsulates congested reinforcement, which can be placed by means of its own weight, with little or no vibration. The flowability of SCC is measured in terms of spread when using a modified version of the slump test (ASTM C143). The spread (slump flow) of SCC typically ranges from 18 to 32 inches and shall depend on the requirements for the project. The viscosity, as visually observed by the rate at which concrete spreads, shall be controlled when designing the mix to suit the type of application being constructed.

4. Mass Concrete: ASTM C 150, Type 2 or Type 5.

D. Aggregates:

1. In general, comply with ASTM C 33.

2. Fine natural sand, clean, hard, strong, durable, uncoated grains, free from all injurious, deleterious substances passing No. 4 sieve.

3. Coarse gravel or crushed stone, clean, hard, strong, durable, uncoated pieces free from deleterious substances.

a. 1-1/2" (3.8 cm) maximum size aggregate shall conform to gradation for size No. 4 and 3/4" (1.9 cm) aggregate to size No. 67 in Table II of ASTM C 33.

b. When 1-1/2" (3.8 cm) size is used, it shall be proportioned with 3/4" (1.9 cm) aggregate so as to produce gradation conforming to size No. 467 in Table II of ASTM C 33.

4. Where concrete is exposed to view, aggregate shall not contain iron or other staining elements.

5. For exterior exposed surfaces, sidewalks, drives, etc. and parking structures, do not use fine or coarse aggregates containing spalling-causing substances. The amount of chert with a specific gravity less than 2.40 shall be limited to 1.0% of the weight of the coarse aggregate.

E. In regions where Alkali Silica Reactions (ASR) occur concrete mixes shall be provided with proven performance history to mitigate the problems through the use of:

1. Low-alkali cement

2. Non-reactive aggregates

3. Pozzolans

4. Lithium-based admixtures

F. Fly Ash: ASTM C-618 Class "C", the product of only one manufacturer using one source of coal. Maximum loss of ignition shall not exceed three percent (3%). Use Class "F" Fly Ash for mass concrete. Use only when permitted by Engineer.

G. Slag Cement: ASTM C 989, Grade 100 or Grade 120 ground granulated blast-furnace slag.

H. Chemical Admixtures:

1. Admixtures shall not contain more chloride ions than are present in municipal drinking water.

2. Water Reducing Admixtures - conform to ASTM C 494, Type A

   a. "Eucon A+" (Euclid Chemical Co.)

   b. "Polyheed 997" (BASF)

   c. "WRDA with HYCOL" or "WRDA - 82" (W.R. Grace)

   d. "Catexol 1000N" (Axim)

   e. Approved equal

3. Water Reducing, Retarding Admixture - conform to ASTM C 494, Type D

   a. "Eucon Retarder - 75" or "Eucon DS" (Euclid Chemical Co.)

   b. "Pozzolith 100XR" (BASF)

   c. "Daratard - 17" (W.R. Grace)

   d. "Catexol 1000R" (Axim)

   e. Approved equal

4. High Range Water Reducing Admixture (Superplasticizer) - conform to ASTM C 494, Type F or G (retarding), site applied only.

   a. "Eucon 37/1037" or Plastol Series(Euclid Chemical Co.)

   b. "Rheobuild 1000" or "Glenium 3000 NS" (BASF)

   c. "Sikament" (Sika Chemical Corp.)

   d. "Daracem" or "ADVA" Series (W.R. Grace)

   e. "Catexol 1000SP-MN" (Axim)

   f. Approved equal

5. Mid-Range Water Reducing Admixture (MRWR) - conform to ASTM C 494, Type A.

   a. "Eucon MR", "Eucon X15" or "Plastol 341" (Euclid Chemical Co.)

   b. "Polyheed" or "Polyheed 997" (BASF)

   c. "Daracem" or "Mira" Series (W.R. Grace & Co.)

   d. Approved equal

6. Non-Corrosive, Non-Chloride Accelerator - conform to ASTM C 494, Type C or E. The admixture manufacturer shall provide long-term, non-corrosive test data from an independent testing laboratory (of at least 1 year duration) using an acceptable accelerated corrosion test method such as that using electrical potential measures.

a. "Accelguard 80, 90 or NCA" (Euclid Chemical)

b. "Polarset" (W.R. Grace)

c. "Pozzolith NC 534" or "Pozzutec 20+" (BASF)

d. "Catexol 2000RHE" (Axim)

e. Approved equal

7. Air Entraining Admixture - conform to ASTM C 260

a. "Air-mix" or "Air-mix 200" (Euclid Chemical Co.)

b. "Daravair" or "Darex" Series (W.R. Grace)

c. "MBAE 90" or "Micro-Air" (BASF)

d. "Catexol AE260" (Axim)

e. Approved equal

8. Viscosity Modifying Admixture for use in Self - Consolidating Concrete:

a. "Visctrol", (Euclid Chemical)

b. "V-mar3", (W.R. Grace)

c. "Rheomac VMA", (BASF)

d. "Sika Stabilizer 4", (Sika Corp.)

e. Approved equal

9. Prohibited Admixtures: Calcium chloride, thiocyanates or admixtures containing more than 0.05% chloride ions by weight of admixture are not permitted.

10. Certification: Written conformance to the above mentioned requirements and the chloride ion content of the admixture is required from the admixture manufacturer.

I. Synthetic Fibers shall be used in concrete mix design in lieu of welded wire fabric. Synthetic fibers shall not replace reinforcing rebar/dowels as depicted on the Construction Details.

1. For concrete sidewalks:

a. Matrix Bi-Blend micro fiber – FRC Industries. Application dosage shall be 1.5 pounds per cubic yard.

b. Approved equal

J. Evaporation retardant and finish aid:

1. "Confilm", BASF

2. "Eucobar", Euclid Chemical Co.

3. "Sealtight Evapre", W.R. Meadows, Inc.

4. Approval equal

K. Water: potable

L. Curing and Sealing Compound:

1. Curing and sealing compounds shall be used for interior or exterior applications where concrete is left exposed with no other finish coating or hardener. Compound shall be compatible with paint or striping applications.

2. Liquid type, membrane forming curing and sealing compound complying with ASTM 1315 Type 1, Class A with 25% solids, VOC compliant.

a. Provide test data from an independent testing laboratory indicating a maximum moisture loss of 0.04 grams per sq. cm. when applied at a coverage rate of 300 sq. ft. per gallon.

b. Colorless, clear or with fugitive dye or pigment, non-yellowing, U.V. resistant, resin based, not wax based.

1) "Sealtight Vocomp-25", W.R. Meadows, Inc. (Interior or exterior use - water base)

2) "Super Aqua Cure VOX", Euclid Chemical

3) "Super Diamond Clear VOX", Euclid Chemical

4) Approved equal

3. Provide a second application for sealing and dust- proofing after 30 days, unless noted otherwise.

M. Colored Concrete: Where colored concrete is specified by the Architect, provide integrally colored concrete with pure pigments containing no fillers or artificial adulterants. Colors shall meet standards of ASTM C979. Add to concrete in proportions recommended by manufacturer for type of concrete and installation. Color as selected by Architect.

1. Butterfield Color, Aurora, IL

2. Davis Colors, Beltsville, MD

3. Euclid Chemical Co., Cleveland, OH

4. Lambert Corp., Orlando, FL

5. Approved equal

2.2 MISCELLANEOUS MATERIALS

A. Expansion/Isolation Joints:

1. Premolded expansion joint strips 3/4” thick of premolded resilient, compressible, re-expanding, Non-extruding, bituminous and fiber materials, conforming to ASTM D 994.

2. Plastic joint fillers where called for on drawings or specified shall be foamed polyvinyl chloride plastic premolded joint filler, thickness and width as shown.

a. "Rodofoam, Grade 327" (Electrovert, Inc.)

b. Approved equal

3. Joint Filler and Sealants: Polyurethane joint sealant for slab-on-grade control and construction joints required for all exposed concrete including exterior construction.

a. "Sikaflex 2CSL" (Sika)

b. "THC-900", (Tremco), level surfaces

c. "Vulkem 245SL"

d. "THC-901", (Tremco), sloped surfaces

e. "Eucolastic II", (Euclid Chemical)

f. "Sonolastic SL2", (Sonneborn)

g. Approved equal

B. Felt: 15 lb. (6.8kg) asphalt saturated. ASTM D 250.

C. Edge Forms and Screeds: Proper wood or metal screeds, accurately leveled and securely fastened, shall be provided to bring the slabs to the required elevation for the concrete strike-off operation.

D. Moisture Absorptive Cover: Burlap cloth made from jute or kenaf, weighing approximately 9 oz. per sq. yd., complying with AASHTO M 182, Class 2.

E. Moisture Retaining Cover: One of the following, complying with ASTM C 171, for moist-curing concrete:

1. Waterproof Paper

2. Polyethylene sheet not less than 6 mills thick

3. Polyethylene-coated burlap

F. Bonding Compound: Polyvinyl acetate or acrylic base, re-wettable type, for cosmetic nonstructural repairs.

1. "Euco Weld" (Euclid Chemical)

2. "Weldcrete" (Larsen Co.)

G. Epoxy Products: Two component material suitable for use on dry or damp surface, complying with ASTM C 881, for use in all structural concrete repairs.

1. Products for Crack Repair:

a. "Eucopoxy Injection Resin" or "Dural 50"; Euclid

b. "Concresive Standard LVI"; BASF

c. "Product R303", Concrete Injection Resin; "Rescon" Technology Corp.

d. "Sikadur 35 Hi Mod LV"; Sika Chemical Company

e. Approved equal

2. Products for Epoxy Mortar Patches, Interior use:

a. "Concresive 3007" or "Concresive LPL Liquid"; BASF

b. "Euco Epoxy #452" or "Duralcrete System"; Euclid

c. "Product R616, Concrete Bonder" or "Product R404, Epoxy Mortar Resin"; Rescon Technology

d. "Sikadur 21 Lo Mod LV"; Sika Chemical Company

e. "Sikadur 23 Lo Mod Gel"; (overhead, vertical)

f. Approved equal

3. Products for Epoxying Bolts or Reinforcing Steel into Concrete:

a. "Euco 452 Gel" or "Euco 452MV" or "Duralcrete Gel"; Euclid

b. "Concresive 1420 Cartridge System"; BASF

c. "Product R606, Concrete Bonder"; Rescon Technology Corp.

d. "Sikadur 31 Hi-Mod Gel"; (vertical use) Sika Corporation

e. "Sikadur 32 Hi-Mod Gel"; (horizontal use) Sika Corporation

f. Approved equal

H. Polymer Modified Mortars for interior or exterior concrete surface repairs including spalls and patches in non- corrosive environments:

1. "Sika Repair 222 with Sikalatex R"; horizontal repairs; Sika Chemical Corp.

2. "Sika Repair 223 with Sikalatex R"; vertical repairs; Sika Chemical Corp.

3. "Euco Verticoat Supreme" or "Speed Crete Red Line"; Euclid Chemical

4. "Euco Thin Top Supreme" or "Tammspatch II"; Euclid Chemical

5. Approved equal

2.3 MIXES AND DELIVERY

A. Concrete Mix:

1. Ready-mixed concrete shall be subject to the following:

a. Concrete must meet all requirements of the ASTM C 94, ACI 211, ACI 318 Chapter 4 Durability Requirements, and those herein specified for materials, proportioning, mixing and other details of manufacturer, quality and deliver.

b. Submit suitable evidence as to experience, equipment and capacity of plant to Architect for approval.

B. Mix Proportioning: Furnish ready-mixed concrete in accordance with the following:

Type of Construction	Min. Comp. Strength at 28 day (U.N.O.) PSI	Max Slump In.	Max. Agg. In.	Min Cement Lbs/C.Y.	Air Entrained	Footnotes
Exterior Slab on Grade						
	4000	2-4	---	587	Yes	(1)(2)

FOOTNOTES:

(1) Air entrained concrete: Use for all exterior slabs, walls, walks, platforms, ramps, steps, all portions of parking ramps, and all other concrete exposed to freezing and thawing. Maximum water/cementitious ratio = 0.45.

(2) Minimum compressive strength at 3 days: 1800 psi. Maximum aggregate size shall not exceed one third of the slab on grade thickness. Coordinate with Contractor as to project schedule. Reduce water/cementitious ratio to 0.40, with MRWR or HRWR, to achieve required water vapor emission rates for installation of finish materials.

C. Additional Mix Requirements

1. Cement content specified above is minimum, except:

   a. If concrete mix test results in accordance with ACI 318 Section 5.3 indicate strength greater than that specified, reduction of specified cement content is allowed.

   b. Should test results indicate strength below that specified, additional cement shall be added without cost to Owner.

2. Fly Ash may be used as a pound for pound replacement of cement up to 20% of the total cementitious content, 25% for footings, except for finished flatwork during winter construction, subject to Architect's approval.

   a. Mixes shall develop sufficient strength to meet contractor's schedule for flatwork finishing and formwork removal. Adjust proportions of fly ash as required.

3. Combination of Fly Ash and Slag, at a 1:1 ratio, may be used as a pound-for-pound replacement of cement as follows:

   a. 30% of the total cementitious content, except for finished flatwork during winter construction.

   b. Mixes shall develop sufficient strength to meet contractor's schedule for flatwork finishing and formwork removal. Adjust proportions of fly ash and slag as required.

4. Air-Entrained Concrete:

   a. Concrete requiring air entrainment shall contain six (6) percent plus or minus one and a half (1.5) percent air by volume, (at end of discharge hose if pumped) for 3/4" dia. aggregate. Conform to ACI 318, Chapter 4. Give proper consideration to the reduction of air content when fly ash is used.

5. Where synthetic or steel fibers are used in slabs, mix designer shall adjust the admixture dosage and/or water content to maintain the specified slump and adjust mix for increase in air content from fibers.

D. Admixture Usage:

1. All concrete must contain the specified water-reducing admixture or water-reducing -retarding admixture and/ or the specified high-range water-reducing admixture (superplasticizer).

2. Specified cement contents shall be increased 10 percent (10%) when no water-reducing admixtures are used.

3. When temperature is at or below 40 degrees F when placing or within next 24 hours, all concrete, less than 8" in thickness, shall contain the specified non-corrosive, non-chloride accelerator.

4. All concrete required to be air entrained shall contain an approved air entraining admixture.

5. All pumped concrete, concrete for industrial slabs, synthetic fiber concrete, architectural concrete, self-consolidating concrete (SCC), concrete for wall pours exceeding 14 feet in height or with high rebar congestion which makes consolidation difficult (bars at 4" on center or less), concrete required to be watertight and concrete with a water/cementitious ratio below 0.41 shall contain the specified site applied high-range water-reducing admixture (Superplasticizer). Mid-range plasticizers may be substituted for high-range when water- cementitious ratios exceed 0.45. Do not use HRWR or MRWR at the batch plant.

6. When high temperatures and/or placing conditions dictate and/or when concrete temperatures exceed 80 degrees F. use a water-reducing- retarding admixture (Type D) in lieu of the water-reducing admixture (Type A).

7. Self-Consolidating Concrete (SCC) shall be used as noted on the plans. The concrete shall contain the specified high-range water-reducing admixture and viscosity-modifying admixture where required. Minimum slump/flow of 20"-30" is required by the successful test placement. The workability, pumpability, finishability, and setting time of the proposed mix design shall be verified with a successful test placement onsite.

8. Admixture Certifications must be submitted with the proposed mix design for review by the Architect.

9. No other admixtures will be permitted.

E. Measuring Materials: Cement, aggregates, water and admixtures shall be measured and combined strictly in accordance with ASTM Specification C 94.

F. Mixing and Delivery:

1. Ready-mixed concrete shall be mixed and delivered to point designated by means and standards set forth by ASTM Specification C 94.

2. Mixers and agitators may be examined by a representative of Owner for changes in conditions due to accumulation of hardened concrete or mortar or through wear of blades.

3. When concrete is mixed in a truck mixer loaded to its maximum rated capacity, number of revolutions of drums or blades at a mixing speed shall not be less than 70 or more than 100.

4. When a truck mixer or a truck agitator is used for transporting concrete, concrete shall be delivered to site of work, and discharge shall be completed within one and one-half (1-1/2) hours or before drum has revolved a total of 300 revolutions, whichever comes first, after introduction of mixing water to the cement and aggregates, or mixing of cement and aggregates, unless a longer time is specifically authorized by Architect. In hot weather, or under conditions contributing to quick stiffening of concrete, concrete delivery and discharge shall be completed within 45 minutes.

5. Water may be added on the job site in the presence of a testing laboratory representative, to bring the slump to the specified level, but not to exceed 1 gallon per cubic yard and prior to any superplasticizer use. For concrete with w/c less than 0.41 and for concrete exceeding 4,600 PSI strength, concrete supplier's representative and Engineer shall provide approval prior to addition of any water. Mixing time shall be appropriately increased with a minimum of twenty (20) revolutions of the drum. The maximum slump shall not be exceeded with the addition of water. Concrete with higher slumps will be rejected. Contractor may exceed specified slump only if a superplasticizer is used. Amount of water added on the jobsite shall be recorded on each delivery ticket and concrete test report. All slump tests shall be taken after all water has been added. Water shall not be added to the batch at any later time.

6. Drivers may not wash concrete trucks, or discharge water at any time into pump hoppers used for concrete pumping operation.

2.4 DETECTIBLE WARNING FIELD

A. Detectable warning fields to be Neenah Foundry Detectable Warning Fields (or approved equal), unpainted natural color and field-weathered prior to installation. The color shall be verified with the owner prior to ordering and installation.

PART 3 - EXECUTION

3.1 FIELD QUALITY CONTROL

A. The individuals who sample and test concrete to determine if the concrete is being produced in accordance with this specification, and that slump, air content, temperature and cylinder tests are in conformance with this Specification shall have demonstrated a knowledge and ability to perform the necessary test procedures equivalent to the ACI Minimum Guidelines for Certification of Concrete Field Testing Technicians, Grade 1. A current certificate shall be presented upon request by Architect.

B. All preparing of specimens and testing shall be performed by an independent laboratory hired by the Owner. Test reports shall be sent to Architect with copies to Contractor and ready mixed concrete producer.

1. This Contractor shall cooperate in taking of test samples and shall make adjustments in mix based on results of tests as directed by Architect.

2. Technician shall have full knowledge of required specifications prior to performance of field tests. Any non-conformance to specification shall be reported by email or fax immediately to Structural Engineer prior to field placement of concrete.

C. Samples of concrete shall be obtained in accordance with ASTM Method C 172 and shall be transported to a place on site where cylinders can be made and stored without being disturbed during first 24 hours.

D. Slump tests shall be performed in accordance with ASTM C143. Make one slump test of the first truck of each mix, each day, one test for each compression test and other tests as often as required thereafter, whenever consistency changes.

1. For parking structures, slump tests shall be performed for each truck load for flatwork.

E. When air-entrained concrete is used, air content tests shall be made from the first truck of each mix, each day and when- ever test cylinders are made, in accordance with ASTM C 173 or ASTM C231. Test more often when required air contents are not achieved.

1. For pumped concrete, air content tests shall be performed at point of discharge in addition to at the truck; once at the beginning of each pour and whenever the pumping orientation is significantly altered. Air contents shall be adjusted at the batching point as required.

2. Air entraining admixture may be added at the jobsite when air content tests too low.

F. Concrete Temperature: Test hourly when air temperature is 40 Degrees F (4 Degrees C) and below, and when 80 Degrees F (27 Degrees C) and above; and each time a set of compression test specimens is made.

G. If measured slump, air content or concrete temperature falls outside limits specified, a check test shall be made immediately on another portion of same sample. In event of a second failure, concrete shall be considered to have failed to meet requirements of specifications and shall not be used in structure. Notify Architect immediately.

H. Cylinders for strength tests shall be made in accordance with ASTM Method C 31. During first 24 hours all laboratory test specimens shall be covered and kept at air temperatures between 60 and 80 degrees F. (16 and 27 C). At the end of 24 hours, specimens shall be carefully transported to testing laboratory where molds shall be removed and cylinders shall be cured in a moist condition of 65 to 75 degrees F. (18 to 24 C.) until time of test. Strength tests shall be made frequently at direction of Architect. In no case shall any given class of concrete be represented by less than five (5) tests for entire job.

I. A strength test for any class of concrete shall consist of standard cylinders made from a composite sample secured from a single load of concrete in accordance with ASTM C-172.

1. All concrete less than 6000 psi:

a. After 24 hours four cylinders shall be carefully transported to the testing laboratory for moist curing.

b. One laboratory cured cylinder shall be tested at 7 days and two laboratory cured cylinders to be tested at 28 days; retain one cylinder for later testing, if necessary.

J. Strength tests shall be made for each of the following conditions:

1. Each day's pour,

2. Each class of concrete,

3. Each change of supplies or source,

4. Each 150 cubic yards of concrete or fraction thereof

5. Each 5000 square feet of surface area for slabs or walls.

K. To conform to requirements of this Specification, the strength level shall be considered satisfactory so long as the average of all sets of three (3) consecutive strength test results equals or exceeds the specified f'c and no individual strength test result falls below the specified strength f'c by more than 500 psi. Architect shall be notified immediately of nonconformance.

L. A record shall be made by a representative of testing laboratory of delivery ticket number for particular batch of concrete tested and exact location in work at which each load represented by a strength test is deposited.

M. Additional field-cured cylinder tests, in-place cylinders, non-destructive testing, and/or maturity testing may be performed, at Contractor's option and expense, to determine early strength of concrete to facilitate form or shoring removal and shorten construction schedules.

N. If, in the opinion of Architect, concrete of poor quality has been placed, additional tests shall be made as directed. Concrete quality shall be based on visual inspection of the concrete and review and analysis of the cylinder strengths. Additional tests shall be at the expense of Contractor. Tests may be compression tests on cored cylinders obtained by the Testing Laboratory per ASTM C42 or load tests per ACI 318 or as recommended by the Testing Laboratory and directed by the Architect. All testing costs chargeable to

Contractor will be obtained from him by means of a credit change order to the Contract.

3.2 PREPARATION

A. Notification:

1. Notify Architect at least 48 hours in advance before pouring.

B. Preparation:

1. Before Placing Concrete:

a. Clean all mixing and transporting equipment.

b. Remove all ice, snow, dirt, chips and other debris from forms or place to receive concrete.

c. Flush and wet down forms thoroughly to close any cracks between boards.

d. Wet down subgrade with as much water as it will absorb readily. Remove standing water.

e. Do not place concrete in dry forms or on dry subgrade.

3.3 CONCRETE PLACEMENT

A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.

B. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.

1. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.

2. Place all concrete in accordance with ACI 304, ACI 304.2R and ACI 302 for slabs. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.

3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.

4. Crane or dump bucket may be used to transport concrete where concrete cannot be delivered to forms directly from chutes, into forms, wheelbarrows or two (2) wheeled concrete carts.

5. Specified superplasticizers, or approved alternative admixtures, are required in the concrete mix if concrete pumping is used for placement.

6. Delivery carts or buggies and/or pumping equipment shall be kept on temporary runways built over floor systems. Runway supports shall not bear on reinforcing steel or fresh concrete.

7. Concreting operation shall not alter location of reinforcing bars. Extreme care by workmen is required. Do not drag or drop equipment, such as pumping hose on reinforcement.

8. In no case shall concrete be delivered or placed with a free fall exceeding 10 feet for concrete containing superplasticizer, 15 feet for self-consolidating concrete (SCC) or 5 feet for other concrete. Spreading of concrete with hoes and shovels for distance greater than 6'0" from delivery end of chutes, carts or buggies will not be permitted.

9. Consistency of concrete to be such that it will be:

   a. Uniform throughout with mortar clinging to coarse aggregate;

   b. Plastic enough that concrete will work readily into corners and angles of forms and around reinforcement without excessive puddling or spading and without segregation of material or collecting of free water on surface while transporting or placing;

   c. Of sufficient mortar content in mass to fill all voids, prevent harshness or honeycombing in the structure and uniform distribute coarse aggregate.

10. Concrete shall be deposited in such a manner as to secure most thorough consolidation. Vibration with an approved "spud" type internal vibrator with flexible shaft shall be used where possible. Vibrator shall not come in contact with reinforcing or forms. Use and type of vibrators shall conform to ACI 309.

C. Deposit and consolidate concrete for slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.

1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.

2. Maintain reinforcement in position on chairs during concrete placement.

3. Screed slab surfaces with a straightedge and strike off to correct elevations.

4. Slope surfaces uniformly to drains where required.

5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.

D. Concreting In Cold Weather:

1. Follow ACI 306 and 306.1 for mixing, placing and protection, and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.

   a. When temperature is at or below 40 degrees F. (4 C.) when placing or within next 24 hours.

   b. Temperature of all surfaces in contact with newly placed contact shall be a minimum of 37ºF and shall not be more than 10ºF higher than minimum concrete placement temperatures specified in ACI 306.

   c. Provide heated concrete material with temperature of concrete when placed as recommended by ACI guidelines.

   d. Only the specified non-corrosive non-chloride accelerator shall be used. Calcium chloride, thiocyanates or admixtures containing more than 0.05% chloride ions are not permitted.

   e. Do not place on frozen subgrades.

f. Do not place concrete when the air temperature does not exceed 10F during the day.

g. Provide adequate housing covering and heating for freshly placed concrete for a minimum period of 72 hours after placing; maintain temperatures above 55^{O}F. Do not allow carbon dioxide from heating units to contact freshly placed concrete surfaces for a minimum of 48 hours. Vent all heaters outside of any enclosure.

h. All slabs on grade shall be protected from the penetration of frost by use of heaters, insulation, backfill, enclosures or other means. This protection shall exist throughout the entire construction period. Architect may inspect the frost penetration during construction. If frost is within 6 inches of the bottom of any construction in place, the Contractor shall take immediate steps to insulate or heat to prevent further frost penetration.

i. If the protection provided by Contractor is inadequate and frost penetration extends beneath the bottom of the construction, this shall be a basis for rejecting that portion of the work. This rejected work shall be removed and properly replaced at the expense of Contractor.

2. Contractor's Responsibility: Repair or replace, in manner acceptable to Architect, all concrete work damaged due to water, snow, freezing, excessive heating and too rapid drying out.

E. Hot Weather Concreting:

1. Conditions warranting hot weather concreting practices are defined as any combination of high air temperature, low relative humidity and wind velocity tending to impair the quality of fresh or hardened concrete or otherwise result in abnormal properties. Place concrete, cure and protect in compliance with ACI 305, Hot Weather Concreting. Do not place concrete when the air temperature is expected to reach 90^{O} F or greater when placing or within next 24 hours.

2. Temperature of concrete when placed shall not be less than 50 degrees F nor exceed 85 degrees F. Control by:

a. Cooling aggregates;

b. Using cement with maximum temperature of 170 degrees F. (77c);

c. Using cold water or ice.

3. Sprinkle forms, subgrade and reinforcing with cool water prior to placing concrete. Keep buggies, chutes and other equipment shaded.

4. Cover reinforcing steel with water-soaked burlap if it becomes too hot, so that the steel temperature will not exceed the ambient air temperature immediately before embedment in concrete.

5. Mixing, Placing and Protection:

a. Keep mixing to minimum requirement which will insure adequate quality.

b. Do not expose mixers to hot sun.

c. Use concrete promptly.

d. Provide fog spraying operation immediately following placement and prior to final curing.

e. Finish promptly.

f. Protect and cure properly.

g. Do not use retarding agents unless approved by Architect.

h. Maintain concrete temperature not less than 50 degrees F nor more than 90 degrees F for the first three days after placing. Protect from temperatures over 90 degrees F for the next five days.

6. When high temperatures and/or placing conditions dictate, use a water-reducing-retarding admixture (Type D) in lieu of the water-reducing admixture (Type A).

F. Evaporation Retardant/Finishing Aid: During rapid drying conditions (high concrete or ambient temperatures, low humidity, high winds, direct sunlight, etc.) apply a concrete evaporation retardant and finishing aid to minimize plastic cracking. The compound may be required to be applied one or more times during the finishing operation. The initial application is usually made after the strike-off operation.

1. Use is subject to approval of membrane or sealer manufacturer.

3.4 CONCRETE JOINTS

A. Use and location of expansion, contraction, control and construction joints as approved by Engineer or as shown on drawings. Construct joints true to line with faces perpendicular to surface plane of concrete.

3.5 EXPANSION/ISOLATION JOINTS AND CONTROL JOINTS

A. At joints between slabs on earth and vertical surfaces, including columns, piers and walls, provide premolded joint filler strips. Before placing concrete, set isolation joint material in designated areas. Top of joint material shall be level to 1/4" below finished surface of concrete. Provide adequate means to maintain proper positioning of joint material during concrete placement. The minimum depth of isolation joint material shall be equal to the smaller of the concrete slab thickness with which it comes in contact.

B. Control (contraction) joints shall be provided in all slabs on earth by means of 1/8" to 1/4" wide saw cuts to a depth of 1/4 slab thickness when using conventional saws, 1.25" for early entry cut saws, approximately 12'-0" o/c each way as directed by Architect or as shown on drawings/details. It is preferred that saw-cutting while concrete is "green" to minimize dust and provide for better quality control. Provide dust barriers during cutting operations. Vacuum/clean surfaces following cutting operations to reduce residual concrete dust.

C. Where joint compound is indicated for control and construction joints, install premolded expansion joint filler strips topped with tapered, dressed, oiled wood strip to form groove at least 1" (2.5 cm) deep unless shown otherwise. After concrete has set, per manufacturer's exact specification, remove strip, grind or sandblast surfaces, prime, and fill groove with specified elastomeric sealant.

1. Required at exposed concrete surfaces including slabs, exterior driveways, garages, and parking areas.

3.6 CONCRETE CURING AND PROTECTION

A. General:

1. Protect freshly placed concrete from premature drying and excessive cold or hot temperatures in conformance with ACI 301 and ACI 308. After placement and prior to finishing of slabs, contractor shall use evaporation retardants, fogging, windscreens, etc. to prevent plastic shrinkage cracking caused by excessive drying of the top surface. For surfaces floated and broomed, place curing compound immediately where allowed.

2. Start initial curing as soon as free water has disappeared from concrete surface after placing and finishing. Keep continuously moist for not less than 24 hours.

3. Begin final curing procedures immediately following initial curing and before concrete has dried. Continue final curing for at least 7 days in accordance with ACI procedures. Avoid rapid drying at end of final curing period.

B. Curing Methods: Perform curing of concrete by curing compound, curing and sealing compound, by moist curing, by moisture-retaining cover curing and by combinations thereof, as herein specified.

1. Provide moisture curing by following methods:

a. Keep concrete surface continuously wet by covering with water.

b. Continuous water-fog spray.

c. Cover concrete surface with specified burlap absorptive cover, thoroughly saturating cover with water and keeping continuously wet. Place absorptive cover to provide coverage of concrete surfaces and edges with 4" lap over adjacent absorptive covers.

2. Provide moisture-cover curing as follows: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width sides and ends lapped at least 3" and sealed by waterproof tape or adhesive. Immediately repair any holes or tears during curing period using cover material and waterproof tape.

3. Provide curing compound or curing and sealing compound to slabs as follows:

a. Apply curing compound, per manufacturer's specification, to concrete slabs, including construction joints, after form removal as soon as final finishing operations are complete (within two hours). Apply uniformly in continuous operation by power-spray or roller in accordance with manufacturer's directions. Recoat areas subjected to rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period. Cover with moisture retaining cover for 48 hours.

b. Exterior slabs shall have fugitive dye or pigment.

c. Apply at dosage rates per Manufacturer's written recommendation.

3.7 TOLERANCES

A. The construction tolerances for cast-in-place concrete shall meet the requirements of ACI 117 and 347 and the special project tolerance requirements listed below. Where requirements conflict, the more stringent shall govern.

1. Linear and Vertical Lines (When Forms are Stripped):

a. Perimeter slab edges shall be within + or - 3/8" of established lines.

2. Elevations:

a. Top of slab at perimeter edge shall be within + or - 1/4" of established elevations.

3. Slab Thickness: - 1/4" maximum.

3.8 DENSE GRADED BASE

A. Dense Graded Base, required to bring to proper level, are specified in Section 32 11 23.33.

3.9 CONCRETE CURB AND GUTTER

A. Concrete work shall meet the requirements of Division 03.

B. Provide curb and gutter of type and dimensions shown on the drawings, or to match adjacent existing curb and gutter.

C. Trowel and broom the face surface of curb and gutter. Fill any honeycombed or void areas remaining on the back of curbs with mortar.

D. Concrete curb and gutter shall be placed in accordance with WisDOT Section 601 to the dimensions and shapes shown in the standard detail drawings. Where curb and gutter details are not provided, curb and gutter shape and dimensions shall match existing adjacent curb and gutter.

E. A minimum 4 inch thick layer of compacted dense graded base shall be provided beneath the full width and a minimum 6 inches behind all curb and gutter. At sections of the curb and gutter to be replaced, the existing base course may be reused provided it conforms to the above requirement and is placed over a stable subgrade. Prior to placement of concrete, the base shall be thoroughly compacted and moistened.

F. All curved curb and gutter shall form smooth curves and shall not be a series of chords. Radius forms shall be used for all curved curb and gutter where the radius of curvature is 100 feet or less.

G. Driveway openings in the curb line shall be staked by CONTRACTOR in the field. The details for concrete gutter sections through a driveway are shown in the standard detail drawings.

H. A 3/4-inch thick expansion joint filler shall be provided in accordance with Section 415 of the WisDOT Specifications, through the curb and gutter at:

1. The ends of radii on curved sections including intersection radii.

2. At storm sewer inlets (5 feet away from each side);

3. At a maximum interval of 100 feet.

I. Expansion joint filler shall extend through the entire thickness of concrete, be perpendicular to the surface and at right angles to the line of the curb and gutter, and be left 1/4-inch below the gutter line.

J. At equally spaced, nominal intervals of not less than 6 feet nor more than 15 feet, with 10 feet typical, a contraction joint shall be tooled to a depth of 1/5 of the total concrete thickness with a 1/4-inch radius jointer. The contraction joint shall be tooled at right angles to the line of the curb and gutter from the top back of curb to the gutter flag.

K. CONTRACTOR shall provide curb and gutter with the following steel reinforcement:

1. Provide two 20-foot No. 4 rebars centered on each utility crossing with 3-inch bottom clearance. One bar shall be positioned 3-inches from the gutter flag and one bar shall be poisoned 3-inches from the back of curb.

2. Provide two 5-foot No. 4 rebars centered on each storm sewer inlet casting having a minimum 4 inches of concrete between the casting and the finished pavement. Rebars shall be positioned 2 inches from the gutter flag. One rebar shall be positioned 2 inches from the top gutter surface. The other rebar shall be positioned 4 inches from the top gutter surface.

L. The location and type of joints in curb and gutter shall match joints in adjacent pavement whenever possible.

3.10 CONCRETE SIDEWALKS, PADS AND DRIVEWAYS

A. Provide concrete pavement having the thickness and reinforcement as shown on the drawings, or to match

adjacent existing pavement.

B. Concrete shall have a minimum 28 day compressive strength of 4000 psi with 4% to 7% air entrainment.

C. Tie bars should be placed at all construction joints parallel to traffic and consist of No. 4 reinforcing bars, 24 inches in length and 48 inches on center.

D. 3/4 inch diameter epoxy-coated smooth dowel bars should be at all control joints perpendicular to traffic. Dowel bars shall be 18 inches long and 12" on center.

E. Expansion joints shall be provided where pavement abuts fixed objects, such as buildings and light poles. Control joints shall be in accordance with American Concrete Institute (ACI) recommendations.

F. Concrete sidewalk and driveway shall be placed in accordance with WisDOT Section 602 to the dimensions and thicknesses shown in the standard detail drawings.

G. A minimum 5 inch thick layer of compacted dense graded base shall be provided beneath all new sidewalks and driveways, unless otherwise noted in the standard details. Where sidewalks and driveways are to be replaced, existing base material may be reused provided it conforms to the above requirement and is placed over a stable subgrade.

H. Sidewalks shall slope toward the roadway at 1/4-inch per foot except the transverse slope of sidewalks at a driveway or alley entrance shall match slope of driveway or alley, but shall not exceed 3/4-inch per foot, unless otherwise noted on the drawings or requested by the engineer.

I. Concrete sidewalk shall be segmented into 5-foot long rectangular blocks with tooled joints made at right angles to the centerline of the sidewalk. Sidewalk intended as a multi-use path shall be segmented with sawcut joints instead of tooled joints. Tooled edges and joints shall be rounded with an edging tool of 1/4-inch radius. Concrete driveways shall be segmented into uniform rectangular blocks with sawcut joints at a maximum spacing of 12 feet in each direction (or as recommended by ACI). Joint depth must extend at least 1.25" for early entry saws or 1/4 of slab thickness if a conventional saw is used.

J. A 3/4-inch thick expansion joint filler shall be provided in accordance with Section 415 of the WisDOT Specifications, through the sidewalk. Filler shall be placed at:

1. The ends of radii on curved sections including intersection radii.
2. interfaces of sidewalks and driveways.
3. interfaces of driveways and curbs.
4. interfaces of sidewalks and curbs.
5. interfaces of sidewalks at corners.
6. at box-outs for castings;
7. at 100-foot intervals in sidewalks.

K. Where an existing curb stop box will lie within a proposed sidewalk or driveway apron, CONTRACTOR shall install a frost-proof collar prior to CONTRACTOR pouring concrete.

L. The final floating shall be done with a wooden float. Before the concrete is given the final surface finish, the surface of the walk shall be checked with a ten-foot straightedge, and any areas which show a variation or departure from the testing edge of more than 1/4-inch shall be corrected by adding or removing concrete as necessary while the concrete is still plastic. Before the mortar has set, the surface shall be brushed or lightly broomed. Review finishes and patterns on architectural and landscape plans if applicable.

M. Cure immediately after final finishing.

N. Replace any existing sidewalks, curbs, drives etc. damaged during the construction process.

3.11 CURB RAMPS

A. Curb ramps shall have a maximum slope as indicated in details.

B. Each curb ramp shall be provided with a detectable warning field installed in fresh concrete of all sidewalk and multi- use trails at legal crosswalks, and as shown in the detail drawings. A detectable warning field shall not be installed in asphalt pavements. The detectable warning field shall be installed per manufacturer's recommendations.

3.12 MISCELLANEOUS CONCRETE AND CEMENT WORK

A. Flag Pole Base:

1. Construct concrete base and install foundation tube, all in accordance with flag pole manufacturer's instructions, detail drawings and shop drawings.

2. Consult and work in cooperation with Contractor furnishing flagpole.

B. Building sign monument as detailed.

END OF SECTION

SECTION 32 14 13.19
PERMEABLE ARTICULATING CONCRETE BLOCK (P-ACB)

PART 1 - GENERAL

1.1 Definitions

A. Contract Documents – the Contract Documents establish the rights and obligations of the parties and include the Agreement, Addenda (which pertain to the Contract Documents), CONTRACTOR's Bid (including documentation accompanying the Bid and any post Bid documentation submitted prior to the Notice of Award) when attached as an exhibit to the Agreement, the Notice to Proceed, the Bonds, the General conditions, the Supplementary Conditions, the Specifications and the Drawings as the same are more specifically identified in the Agreement, together with all Written Amendments, Change Orders, Work Change Directives, Field Orders, and ENGINEER's written interpretations and clarifications issued on or after the Effective Date of the Agreement. Approved Shop Drawings and the reports of subsurface and physical conditions are not Contract Documents. Only printed hard copies of the items listed in this paragraph are Contract Documents. Files in electronic media format, of text, data, graphics, and the like that may be furnished by OWNER to CONTRACTOR are not Contract Documents.

B. CONTRACTOR – The individual or entity with whom OWNER has entered into the Agreement.

C. Drawings – That part of the Contract Documents prepared or approved by the ENGINEER which graphically shows the scope, extent, and character of the Work to be performed by the CONTRACTOR. Shop Drawings and other CONTRACTOR submittals are not Drawings as so defined.

D. ENGINEER- The individual or entity named as such in the Agreement.

E. OWNER – The individual, entity, public body, or authority with whom the CONTRACTOR has entered into the Agreement and for whom the Work is to be performed.

F. Project – The total construction of which the Work to be performed under the Contract Documents may be the whole, or part as may be indicated elsewhere in the Contract Documents.

G. Resident Project Representative – The authorized representative of the ENGINEER who may be assigned to the Site or any part thereof.

H. Samples – Physical examples of materials, equipment, or workmanship that are representative of some portion of the Work and which establish the standards by which such portions of the Work will be judged.

I. Shop Drawings – All drawings, diagrams, illustrations, schedules, and other data or information which are specifically prepared or assembled for the CONTRACTOR and submitted by the CONTRACTOR to illustrate some portion of the Work.

J. Site – Lands or areas indicated in the Contract Documents as being furnished by the OWNER upon which the Work is to be performeed, including the rights-of-way and easements for access thereto, and such other lands furnished by OWNER which are designated for the use of the CONTRACTOR.

K. Specifications – That part of the Contract Documents consisting of written technical descriptions of materials, equipment, systems, standards, and workmanship applied to the Work and certain adminstrative details applicable there to.

L. Subcontractor – An individual or entity having a direct contract with CONTRACTOR or with any other Subcontractor for the performance of a part of the Work at the Site.

M. Supplier – A manufaturer, fabricator, supplier, distributor, material man, or vendor having a direct contract with CONTRACTOR or with any Subcontractor to furnish materials or equipment to be incorporated in the Work by the CONTRACTOR or Subcontractor.

N. Work- The entire completed construction of the various separately identifiable parts thereof required to be provided under the Contract Documents. Work includes and is the result of performing or providing all labor, services and documentation necessary to produce such construction and furnishing, installing, and incorporating all materials and equipment into such construction, as required by the Contract Documents.

1.2 Samples

A. A Natural Gray full-sized P-ACB can be supplied upon request. Alternate color samples can be supplied in 4" x 4" coupons.

B. A minimum of 3 lbs. samples of proposed subbase and/or base aggregate materials must be supplied to the engineer of record for approval in accordance with Aggregate Subbase listed in Part 3 below.

1. 3 Scope of Work

A. The CONTRACTOR shall furnish all labor, materials, equipment, and incidentals required and perform all operations in connection with the installation of the Permeable Articulating Concrete Block (P-ACB) in accordance with the lines, grades, design and dimensions shown on the Contract Drawings and as specified herein.

1.4 Submittal

A. The CONTRACTOR shall submit to the engineer all manufacturer's performance research results and calculations in support of the permeable articulating concrete blocks P-ACB system and geotextile proposed for use.

B. The CONTRACTOR shall furnish to the engineer all manufacturer's specifications, literature, and installation drawings of the P-ACB.

1.5 Preconstruction Conference

A. Within 2 weeks prior to the installation of the P-ACB, a conference attended by CONTRACTOR, ENGINEER, Supplier, and others as appropriate will be held to establish a working understanding among the parties as to the Work and to discuss the schedules, procedures for handling Shop Drawings and other submittals, processing Applications for Payment, and maintaining required records.

PART 2 PRODUCTS

2.1 GENERAL

A. Permeable Articulating Concrete Blocks (P-ACB) shall be premanufactured of individual concrete blocks with specific stormwater runoff and storage capacities. Blocks shall be hand-placed or mechanically installed with the use of a clamping or suction lifting device.

B. Individual blocks in the P-ACB shall be staggered, beveled, and interlocked for enhanced stability. The blocks shall be constructed of closed cell blocks with an arched storage chamber for additional stormwater runoff as shown on the contract drawings. Each row of blocks shall be laterally offset by one-half block width from the adjacent row so that any given block is interlocked to four other blocks (two in the row above and two in the row below). Six adjacent blocks shall also surround each block.

C. Each block shall incorporate interlocking surfaces that prevent lateral displacement of the blocks. The interlocking surfaces shall not protrude beyond the perimeter of the blocks to such an extent that they reduce the flexibility or articulating capability of the system. Backfilling of the joints between the P-ACB with rock chips or sand is not required and shall not be done or included in the Work.

D. **Infiltration Performance**: The P-ACB will only be accepted when accompanied by documented third party infiltration performance characteristics based on ASTM C1701/C1701M-09, or C1781. The infiltration rate

shall be no less than 1,000 inches per hour on an outdoor working surface, with typical base material utilized for the test.

E. **Structural Performance:** The design of the P-ACB shall be capable of supporting AASHTO H-25 and HS-25 truck loading. The blocks shall be analyzed as unreinforced concrete arches supporting a uniform truck tire load with impact per AASHTO standards. The subgrade soil, geosynthetic and base preperation for the P-ACB shall be properly designed by a Registered Professional Engineer and inspected by the ENGINEER or the Resident Project Representative during and following the installation of the Work.

2.2 Cellular Concrete Blocks

A. Materials

1. Cementitious Materials - Materials shall conform to the following applicable ASTM specifications:

2. Portland Cements - Specification C 150, for Portland Cement.

3. Blended Cements - Specification C 595, for Blended Hydraulic Cements.

4. Hydrated Lime Types - Specification C 207, for Hydrated Lime Types.

5. Pozzolans - Specifications C 618, for Fly Ash and Raw or Calcinated Natural Pozzolans for use in Portland Cement Concrete.

6. Aggregates shall conform to the following ASTM specifications. Normal Weight - Specification C 33, for Concrete Aggregates.

B. Visual Inspection

1. All units shall be sound and free of defects that would interfere with the proper placing of the unit or impair the strength or permanence of the construction. Surface cracks incidental to the usual methods of manufacture, or surface chipping resulting from customary methods of handling in shipment and delivery, shall not be deemed grounds for rejection. Cracks exceeding 0.25 inches in width and/or 1.0 inch in depth shall be deemed grounds for rejection.

C. Physical Requirements

1. At the time of delivery to the work site, the units shall conform to the physical requirements prescribed in Table 1, Physical Characteristics.

TABLE 1: PHYSICAL CHARACTERISTICS

Item	Description	Values
Dimensions	Length x Width x Height	12” x 12” x 5.65” (+/- 1/8”)
Compressive Strength	ASTM D-6684 / C-140	Avg. of Three: 4,000 psi min. Individual units: 3,500 psi min.
Block Weight		Arched Block: 45-50 lbs/sf Solid Block: 55-60 lbs/sf
Loading Capabilities	Truck Load Traffic Rating	AASHTO H-20, HS-20, HS-25
Joint Filler Between Blocks	Material Used	NONE Required

Percent Open Space		Surface: 7% Storage: 20%
Water Absorption (%) Density (lbs/cf)	ASTM D-6684 Table 1 / ASTM C-140	9.1% Avg. of Three, 11.7% Individual 130 Avg of Three, 125 Individual
Storage Capacity	Above Aggregate Within Arch	0.0833 cf/block
Post-Installation, Verified Surface Infiltration Rate	ASTM C1701/C1701M-09 ASTM C1781	Ave of three tests: 1,000 inches/hour/sf (MIN. 3 tests)

D. Sampling and Testing

1. The OWNER, ENGINEER or their authorized representative shall be accorded proper access to the manufacturer to inspect and obtain samples of the Permeable Articulating Concrete Blocks at the place of manufacture from lots ready for delivery.

E. Expense of Tests

1. Additional testing and associated costs, other than that provided by the manufacturer, shall be borne by the OWNER.

F. Manufacturer

1. The Permeable Articulating Concrete Blocks shall be PaveDrain® or pre-approved equal, as represented or distributed by:

LOCALY	NATIONAL
Hanes Geo Components	PaveDrain, LLC
PH. (608) 712-3839	PH. (888) 575-5339
scott.bordeau@hanescompanies.com	info@pavedrain.com
www.hanesgeo.com	www.pavedrain.com

2. *"Or-Equal" Items:* If in ENGINEER's sole discretion an item of material or equipment proposed by CONTRACTOR is functionally equal to that named and sufficiently similar so that no change in related Work will be required, it may be considered by ENGINEER as an "or-equal" item, in which case review and approval of the proposed item may, in ENGINEER's sole discretion, be accomplished without compliance with some or all of the requirements for approval of proposed substitute items. A proposed item of material or equipment will be considered functionally equal to an item so named if:

a. in the exercise of reasonable judgment ENGINEER determines that: (i) it is at least equal in quality, durability, appearance, strength, and design characteristics; (ii) it will reliably perform at least equally well the function imposed by the design concept of the completed Project as a functioning whole, and;

b. CONTRACTOR certifies that: (i) there is no increase in cost to the OWNER; and (ii) it will conform substantially, even with deviations, to the detailed requirements of the item named in the Contract Documents.

PART 3 - FOUNDATION PREPARATION AND BLOCK INSTALLATION

3.1 Foundation and Preparation

A. General. Areas on which permeable articulating concrete blocks are to be placed shall be constructed to the lines and grades shown on the Drawings and to the tolerances specified in the Contract Documents. Any proposed changes shall be reviewed and approved by the ENGINEER.

B. References. Standard Specifications for Highway Construction, State of Wisconsin Department of Transportation.

C. Subgrade. Unless required on the Drawings, compaction of underlying subgrade soil shall be avoided or minimized in order to encourage infiltration of stormwater. A Geotechnical Engineer should be consulted to determine the CBR values of the subgrade prior to the installation of the subbase materials and geotextile stabilizing fabrics and grids.

D. Geotextile Separator or Geogrid Stabilization. Monofilament or multifilament geotextile, that include Mirafi RS380i or its equivalent, or other geotextile material as shown on the Drawings shall be installed on the bottom and sides of the excavation to prevent in – situ soil contamination of the clean aggregate subbase. A geogrid may be required for sub base stabilization, but is not recommended on the sides of the aggregate sub base to separate the in-situ soils from the clean sub base aggregate.

E. Aggregate Subbase. If more than 6" of base aggregate is required, as shown on the Drawings, only the top 4-6" shall be AASHTO #57 aggregate; this is the leveling course directly beneath the P-ACB blocks. Additional aggregate depth shall consist of either AASHTO #2 or #3 or as shown on Drawings. All aggregate shall be clean, angular on all sides with no less than 90% fractured faces. Do not use rounded river gravel or fractured river gravel for any application.

ASTM No. 57 Base
Grading Requirements

Sieve Size	Percent Passing
37.5 mm (1 1/2 in.)	100
25 mm (1 in.)	95 to 100
12.5 mm (1/2 in.)	25 to 60
4.75 mm (No. 4)	0 to 10
2.36 mm (No. 8)	0 to 5

ASTM No. 2 Subbase
Grading Requirements

Sieve Size	Percent Passing
75 mm (3 in.)	100
63 mm (2 1/2 in.)	90 to 100
50 mm (2 in.)	35 to 70
37.5 mm (1 1/2 in.)	0 to 15
19 mm (3/4 in.)	0 to 5

F. Crushed Aggregate Base Course: Follow State Specifications

G. Compaction: Standard compaction.

1. 95 percent maximum density determined by Modified Proctor.

2. Allow ENGINEER to inspect prepared base course and to witness proof roll test by a fully loaded dump truck. Reconstruct where deflection is greater than ½ inch.

3. Allowable deviation from design grade: ½ inch.

4. The base course shall be firm and non-yielding, compacted until it does not creep or weave in front of the roller or compacting vehicle.

5. The aggregate bedding layer shall be compacted to a smooth plane surface to ensure intimate and positive contact is achieved between the legs of the permeable articulating concrete blocks and the compacted aggregate subbase layer and the Geogrid Separator.

6. AASHTO #2 or #3 subbase aggregate shall be compacted in 6-8" lifts with a roller-compactor. The AASHTO #57 aggregate leveling subbase shall be rolled and then compacted with a minimum 10,000 psi plate compactor in both the perpendicular and parallel directions in the area of coverage.The CONTRACTOR shall compact a 2" layer of the AASHTO #57 Aggregate into AASHTO #2 or #3 aggregate.

H. Geogrid Separator. Install Terratex RX1100, (or equal) geogrid separator shall be directly on top of the compacted leveling course. The geogrid seperator may be installed prior to the compaction of the leveling course. This will create a "snow shoe" effect and minimize damage from foot traffic prior to placement of the P-ACB.

I. Inspection. Immediately prior to placing the P-ACB the prepared area shall be inspected by the ENGINEER or Resident Project Representative, the OWNER's representative, and or by the manufacturer's representative. No blocks shall be placed thereon until that area has been approved by the ENGINEER.

3.2 Placement of Permeable Articulating Concrete Blocks

A. General. Permeable articulating concrete blocks shall be constructed within the specified lines and grades shown on the Drawings.

B. Placement. The P-ACB shall be placed on the geogrid separator so as to produce a smooth plane surface. No individual block within the plane of placed articulating concrete mats shall protrude more than one-quarter of an inch unless otherwise specified by the ENGINEER.

C. Consultation. The Supplier will provide design and construction advice during the design and installation phases of the project. The Supplier will not supervise, direct, control, or have authority over or be responsible for CONTRACTOR's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of CONTRACTOR to comply with Laws and Regulations applicable to the performance of the Work.

D. Finishing. The joints between the P-ACB shall not be backfilled with smaller aggregates or sand in order to function properly. The joints shall be left open. This includes following maintenance of the P-ACB. If the joints are filled with smaller aggregates or sand, the CONTRACTOR shall be responsible for the removal of the material and perform infiltration tests to assure that the P-ACB meets the minimum infiltration tests described in this specification.

E. Post Installation Certification. Upon completion of the P-ACB installation, the surface infiltration rate of the pavement shall be verified by ASTM C1701M-09 or ASTM C1781 to confirm the required infiltration rate of the pavement (per Table 1). If the system fails to perform as required in section Table 1 of this spec, it shall be removed and replaced at the supplier's cost.

3.3 Maintenance of Permeable Articulating Concrete Blocks

A. General. The maintainabilty of the permeable articulating concrete blocks shall be based on a maintenance study of at least 24 months conducted by an independent or third party representation.

1. The study shall include multiple pre and post testing documentations in multiple locations of infiltration rates according to ASTM C1701 or a modified version of ASTM C1701 where the infiltration rate is recorded without a head pressure.

2. Subsurface aggregate performance of pre and post testing shall also be documented over a 24 month period.

3. The study shall show that following proper maintenance the original performance of the P-ACB can effectively be restored to at least 90% of its original performance.

B. Inspection & Maintenance. The manufacturer's representative of the P-ACB shall provide a minimum 36 month maintenance program; including a visual inspection report with photos and a recommended

cleaning schedule with a Vacuum truck such as the Elgin® Whirlwind® or Megawind® or with the PaveDrain® Vac Head and associated combination sanitation vac truck. The visual inspection and recommended cleaning schedule shall be included with the price of the system.

1. Maintenance utilizing a combination sanitation vaccum truck with the PaveDrain vac head will be quoted and supplied by others based on the maintenance program.

2. Maintenance shall be required when either of the following are reached:

   a. The surface infiltration rates of more than 75% of the surface area fall below 10% of the rate required in Table 1.

   b. Surface ponding remains for 24 hours in an area larger than 10 square feet.

END OF SECTION

SECTION 32 16 13
CONCRETE CURB AND GUTTER

PART 1 - GENERAL

1.1 SCOPE

A. This section includes information common to concrete curb and gutter and applies to all sections in this Division.

B. This work shall consist of constructing concrete curb and gutter, with or without reinforcement, of the dimensions and design as indicated, and placed in one course on the prepared foundation or base, at the locations and to the required lines and grades.

C. The Contractor shall mark the top of the curb where the sanitary sewer and water service cross the curb and gutter. The mark may be made by sawcutting. The depth shall be a minimum of one-sixteenth (1/16") inch deep. The laterals and services will be located by the City.

D. All work done in the vicinity of any tree located in the terrace shall be completed in accordance with City of Madison Standard Specifications for Public Works Construction Section 107.13 Tree Protection.

1.2 REFERENCE STANDARDS

A. Work under this section depends on applicable provisions from other sections and the plan set in this contract. Examples of related sections include, but are not limited to:

1. Division 03 — Concrete
2. Division 31 — Earthwork
3. 32 13 00 - Concrete Work Outside The Building Envelope

B. City of Madison Standard Specifications for Public Works Construction

PART 2 - EXECUTION

2.1 PREPARATION OF FOUNDATION

A. The Contractor shall be responsible for replacement with 1-1/2" crushed stone, mechanically compacted, of any material necessary to bring the subbase to grade, where the Contractor has undercut the subbase without the direction of the Engineer.

2.2 FORMS

A. Curb and gutter forms shall be of steel construction and conform to the design of the type of curb and gutter being installed. Wooden forms may be used only with the Engineer's approval on short radius curves and in special cases where accessibility is limited. All forms shall be free of hardened concrete, mud, dirt, and debris, and shall be free of bends and twists which would make their use unacceptable on the project.

B. All forms shall be oiled to the satisfaction of the Engineer before depositing or placing concrete in them.

C. When concrete curb and gutter is constructed on a curve, flexible forms shall be used for all curves having a radius of two hundred (200) linear feet or less.

2.3 PLACING AND FINISHING CONCRETE

A. Wherever directed by the Engineer, driveway gutters shall be built instead of regular curb and gutters.

B. The curb and gutter over ditches shall be installed in twenty (20) foot lengths centered over the ditch. A dummy joint shall be cut at the center of the 20 foot section.

C. Unless otherwise specified, curb and gutter shall be installed in minimum lengths of six (6) feet and maximum lengths of 15 feet.

D. The Contractor shall install a header at the end of each pour. At no time shall the Contractor be allowed to spread excess concrete as a base for the next or any succeeding pour.

E. Wherever different types of curb and gutter are employed, the Contractor shall take care that transitions from one type of curb and gutter to another type are done smoothly without loss of flow line grade or curb head shape.

F. The reconnection of existing drains from adjacent properties to the curb and gutter shall be incidental to concrete curb and gutter.

G. The slope of the curb and gutter shall not exceed 1” in 12” thru handicap accessible ramps.

2.4 JOINTS

A. Full contraction joints shall be a minimum of three (3) inches in depth, and shall be uniformly spaced not less than six (6) feet nor more than fifteen (15) feet apart unless otherwise directed by the Engineer.

B. If machine methods are used for forming and finishing curb and gutter the Contractor may saw contraction joints or planes of weakness may be created by the insertion of approved partial depth separator plates having a minimum depth of three (3) inches. The depth of cut and equipment used in sawing shall meet the approval of the Engineer. The sawing shall be done as soon as practicable after the concrete has set sufficiently to preclude raveling during the sawing and before any shrinkage cracking takes place in the concrete. If this method results in random cracking the Contractor shall be required to use the partial depth separator plates.

C. Transverse expansion joints shall be one-half (1/2) inch in width and shall be placed across the curb and gutter perpendicular to the curb line at all radius points of curves having a radius of two hundred (200) feet or less, and on both sides of all inlets installed in curb and gutter. All expansion joints shall extend through the entire thickness of the curb and gutter and shall be perpendicular to the surface. All expansion joints shall be formed by inserting during construction, and leaving in place, the required thickness of joint filler which shall extend through the entire thickness of both curb and gutter.

D. Where curb and gutter and concrete sidewalk or concrete driveways join, an expansion joint one (1) inch in width must be constructed between walks and curb.

E. The joint filler in transverse joints shall be flush with the finished surface of the gutter. The concrete adjacent to these joints shall be finished with a wooden float which is divided through the center and which will permit finishing on both sides of the filler at the same time. Before the curb and gutter is opened to traffic, excess joint filler shall be cut off level with the finished surface.

2.5 REINFORCEMENT

A. Where reinforcement is required it shall conform to and be placed in accordance with the Standard Detail Drawings, details shown on the plans, as specified in the contract, or as directed by the Engineer.

B. Where directed by the Engineer, the Contractor shall install three (3) one-half (1/2) inch round reinforcing rods fifteen (15) feet long in concrete curbs and gutters which span ditches.

2.6 PROTECTION

A. The curb and gutter must be protected from injury by traffic or other causes, and also from the rays of the sun until completely set.

B. In the event that concrete sidewalk, drives or curb and gutter are placed in cold weather, “Cold Weather Protection” shall be applied in accordance with The City of Madison Standard Specifications, Section 301.8(a) “Cold Weather Protection.”

2.7 HAND FORMED CURB AND GUTTER

A. The work under this item shall consist of manually forming and pouring curb and gutter at tight locations or where other structures prevent the use of a curb machine, as designated by the Engineer.

END OF SECTION

SECTION 32 17 23
PAVEMENT MARKINGS

PART 1 - GENERAL

1.1 SCOPE

A. The work under this section consists of providing all work, materials, labor, equipment, and supervision necessary to provide and install pavement markings as provided for in these specifications and on the drawings.

1.2 RELATED WORK

A. Applicable provisions of Division 01 govern work under this Section.

B. Related Work Specified Elsewhere:

1. Section 30 05 00 – Common Work Results For All Exterior Improvements

1.3 SUBMITTALS

A. Submit the manufacturer specifications for each pavement marking. The submittal for each material shall include the following at a minimum:

1. Pavement Marking Material and Manufacturer
2. Color and Batch Number
3. Date Manufactured (Material more than one year old will not be accepted)
4. Manufacturer Name and Address

PART 2 - MATERIALS

2.1 PAVEMENT MARKINGS

A. Furnish paint pavement markings conforming to WisDOT Section 646.2 as specified in the drawings.

B. Paint markings shall be the color yellow for all pavement markings.

PART 3 - EXECUTION

3.1 PAVEMENT MARKINGS

A. Preparing The Pavement Foundation (Sub-Grade):

1. Prepare surface to receive markings and install them in accordance with WisDOT Section 646.3.
2. Apply pavement markings at the locations and to the dimensions and colors as shown on the drawings. If not otherwise specified, marking lines shall be yellow and have a minimum width of 4 inches.

3. Apply pavement markings at a rate per the manufacturers recommended application rate based on the temperature and surface material.

END OF SECTION

SECTION 32 91 13.50
STORMWATER BIOINFILTRATION

PART 1 - GENERAL

1.1 SCOPE

A. The work under this section shall consist of providing all work, materials, labor, equipment and supervision necessary to construct Stormwater Bioinfiltration Devices. The work under this section does not include providing all work, materials, labor, equipment, and supervision necessary to install plantings for the Stormwater Bioinfiltration Device.

1.2 RELATED WORK

A. Applicable provisions of Division 1 govern work under this Section.

1. Section 32 05 00 – Common Work Results For All Exterior Improvements
2. Section 31 25 00 – Erosion Control
3. Section 33 40 00 – Storm Drainage Utilities
4. Section 32 93 00 – Exterior Plants

1.3 REFERENCE STANDARDS

A.	WISDOT PAL	Wisconsin Erosion Control Product Acceptability List (PAL)
B.	WISDOT SSHSC	Standard Specifications for Highway and Structure Construction
C.	WI DNR	Standard 1002 – Site Evaluation for Stormwater Infiltration
D.	WI DNR	Standard 1004 – Bioretention for Infiltration
E.	WI DNR	S100 – Specification for Compost

1.4 SUBMITTALS

A. Provide product data for the following materials:

1. Geotextile Fabrics
2. Pipe
3. Aggregates
4. Sand
5. Compost
6. Engineered Soil
7. Erosion Mat

B. Provide product data for engineered soil blend components: Sand and Compost in compliance with WI DNR Standard 1004 – Bioretention for Infiltration for review and approval by DFD Project Representative.

1.5 QUALITY ASSURANCE

A. Contractor shall submit, in writing to the City Project Representative, a certification from compost supplier that any compost used on the project is in compliance with the requirements outlined in WDNR Specifications S100.

B. Contractor shall submit, in writing to the City Project Representative, a certification from engineered soil supplier that any engineered soil used on the project is in compliance with the requirements outlined in WI DNR Standard 1004 Bioretention for Infiltration.

PART 2 - MATERIALS

2.1 GEOTEXTILE FABRIC

A. Pipe Sock: The openings of the geotextile fabric shall be small enough to prevent sand particles from entering the underdrain pipe. The fabric shall meet the requirements of the WisDOT SSSHC Section 612.2.8.

B. Filter Fabric: The fabric shall meet the requirements of the WisDOT SSSHC Section 645.2.4, Geotextile Fabric Type DF, Schedule B.

2.2 PIPE

A. Underdrain Pipe

1. Pipe shall be corrugated HDPE or PVC, Schedule 40.
2. Pipe shall have a minimum diameter of 6-inches.
3. Pipe shall have perforations.
4. The pipe shall be covered with a filter sock if the storage layer is sand. The filter sock shall conform to the material requirement for Geotextile Fabric.

B. Cleanout Pipe: The cleanout pipe shall be rigid, non-perforated PVC covered with a watertight cap.

2.3 AGGREGATES

A. All aggregates used in the construction of Stormwater Bioinfiltration devices shall be double washed and free of organic material and fines.

B. Storage Layer Aggregate: The aggregate used for the storage layer shall meet the following gradation requirements:

Sieve Size	Percent Passing by Weight
2-inch	100
1 ½-inch	90-100
1-inch	20-55
3/4 –inch	0-15
3/8 – inch	0-5

C. Clear Stone Bedding: Washed angular stone or pea gravel shall be used to cover the underdrain pipe. Washed angular stone or pea gravel, graded from 3/8” to 1/4”.

2.4 SAND

A. The preferred sand component consists of mostly SiO_2, but sand consisting of dolomite or calcium may be used.

B. Manufactured sand or stone dust is not allowed.

C. The sand shall be washed and drained to remove clay and silt particles prior to mixing.

D. Sand shall meet one of the following gradation requirements:

1. USDA Coarse Sand (0.02-0.04 inches)

2. ASTM C33 (Fine Aggregate Concrete Sand)

3. WisDOT SSHSC Section 501.2.5.3.4 (Fine Aggregate Sand)

2.5 COMPOST

A. Compost shall meet the requirements of WI DNR Specification S100 – Compost.

2.6 ENGINEERED SOIL

A. Engineered Soil shall comply with WI DNR Standard 1004. Engineered Soil hall be a blend of Sand and Compost

B. Engineered Soil shall consist of a mixture of 70 to 85% Sand and 15 to 30% Compost. The percentages are based on volume.

C. Engineered soil mix shall be free of rocks, stumps, roots, brush or other material over 1 inch in diameter. No other materials shall be mixed with the planting soil that may be harmful to plant growth or prove a hindrance to planting or maintenance.

D. Engineered soil mix shall have a pH between 5.5 and 8.0.

E. Do not fertilize.

F. Thoroughly blend engineered soil off-site before delivering to site and installing.

G. Engineered soil shall be delivered to the site and stored on plastic sheeting.

H. The moisture content shall be low enough to prevent clumping and compaction during placement.

2.7 EROSION MAT

A. Erosion Mat shall comply with the PAL for Urban, Class 1, Type B as defined by Standard Specifications for Highway and Structure Construction and the PAL. Erosion mat shall be American Excelsior-Curlex Net-Free, Erosion Control Blanket-S32BD, Western Excelsior-Excel SS-2 All Natural, Ero-Guard EG-25 (NN), Erosion Tech ETRS2BN or approved equal.

PART 3 - EXECUTION

3.1 PROTECTION MEASURES

A. Pre-Installation Meeting: Prior to the installation of the Stormwater Bioinfiltration Device, the A/E, the City Project Representative, and the Contractor shall conduct a pre-installation meeting.

B. Stabilization: Construction of the Stormwater Bioinfiltration Device shall not begin until after the contributing drainage area has been stabilized with vegetation and/or hardscapes. Construction site runoff from disturbed areas shall not be allowed to enter the Stormwater Bioinfiltration Device.

C. Weather

1. Construction shall be suspended during periods of rainfall or snowmelt. Construction shall remain suspended of ponded water is present or if residual soil moisture contributes significantly to the potential for soil smearing, clumping, or other forms of compaction.

2. Delays resultant from weather shall not serve as a basis for a Change Order.

D. Compaction Avoidance

1. Compaction and smearing of the soils beneath the floor and side slopes of the Stormwater Bioinfiltration area, and compaction of the soils used for backfill shall be minimized.

2. During construction, the area dedicated to the Stormwater Bioinfiltration Device shall be cordoned off to prevent access by heavy equipment.

3. Acceptable equipment for constructing the Stormwater Bioinfiltration Device includes excavation hoes, light equipment with turf type tires, marsh equipment, or wide-track loaders.

E. Compaction Remediation

1. If compaction occurs at the base of the Stormwater Bioinfiltration Device, the soil shall be refractured to a depth of at least 24-inches.

2. If smearing occurs, the smeared areas shall be corrected by raking or roto-tilling.

3. Compaction and smearing remediation shall be conducted by the Contractor at no additional costs to the Owner.

F. Field Infiltration Testing

1. Immediately after rough grading of Stormwater Bioinfiltration Devices, provide field infiltration testing conducted by a third-party testing agency to verify infiltration rates for all Stormwater Bioinfiltration Devices. Field tests shall be conducted using a Double-Ring Infiltrometer per ASTM D3385. Calculate infiltration rates in accordance with Wisconsin Department of Natural Resources (WDNR) Site Evaluation for Stormwater Infiltration, Standard 1002. Frequency of testing shall be 1 test per 5000 square feet of surface area of the Stormwater Infiltration Device measured at the design high water level and at least one test per device. Furnish a report of the test results to Architect/Engineer.

3.2 TEMPORARY EROSION AND SEDIMENT CONTROLS

A. The Contractor shall install temporary erosion and sediment controls prior to beginning construction of the Stormwater Bioinfiltration Device. The temporary erosion and sediment controls shall divert stormwater runoff away from the Stormwater Bioinfiltration Device until it is completed.

3.3 Excavation

A. Excavation equipment shall work from the sides of the Stormwater Bioinfiltration Device to excavate the area to the depths and dimensions as shown on the Drawings. Excavation equipment shall have adequate reach so that they do not need to be located within the footprint of the Stormwater Bioinfiltration Device to excavate it.

B. Any accidental compaction shall be remediated as prescribed above.

3.4 STORAGE LAYER

A. Place the Storage Layer Aggregate to the depth as indicated in the Drawings.

3.5 UNDERDRAIN PIPE

A. Install underdrain pipe at the invert elevations indicated in the Drawings. Pipe shall be installed with a minimum slope of 0.005 ft/ft. Pipe joints shall be made in accordance with the manufacturer's recommendation. Standard pipe fittings shall be used.

B. Install cleanouts where shown. Cleanouts shall be installed with a watertight cap located flush with the surface of the Stormwater Bioinfiltration Device.

C. Connect pipe to drainage structure as indicated in the Drawings.

3.6 CLEAR STONE BEDDING

A. Clear Stone Bedding above the underdrain pipe to a thickness indicated in the Drawings.

B. Clear Stone Bedding layer shall be installed between the Storage Layer Aggregate and the Engineered Soil.

3.7 FILTER FABRIC

A. Install filter fabric around engineered soil extents including sides and bottom to separate from Engineered Soil and Storage Layer as shown in the Construction Drawings, overlapping edges a minimum of 6".

3.8 ENGINEERED SOIL

A. Verify moisture condition of Engineered Soil is low enough to prevent clumping and compaction during placement. Engineered Soil shall not be placed unless it meets these conditions.

B. Place Engineered Soil in lifts not to exceed 12 inches in depth until the desired elevation of the Stormwater Bioinfiltration Device is achieved.

C. Re-examine the surface within 48 to 72 hours following placement of Engineered Soil. Place additional Engineered Soil until desired elevation of the Stormwater Bioinfiltration Device is achieved at no additional costs to the Owner.

D. Steps may be taken to induce mild settling of the Engineered Soil as needed to prepare a stable planting medium and to stabilize the ponding depth.

E. Vibrating plate style compactors shall not be used to induce settling.

F. No equipment travel on or across placed Engineered Soil is permitted.

G. Install silt fence or other means of erosion control around the perimeter of the engineered soil to protect from siltation or contamination from adjacent landscape or paved surfaces and construction activities. Leave erosion control in place until site landscape establishment and construction is complete.

3.9 EROSION MAT

A. Install Erosion Mat on top of surface prior to installation of vegetation.

END OF SECTION

SECTION 32 92 19
SEEDING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Preparation of subsoil.

B. Placing topsoil and compost.

C. Final Seeding and applying stabilizers, mulching material, and fertilizer.

D. Maintenance.

1.2 RELATED REQUIREMENTS

A. Section 31 2500 - Erosion Control: Temporary seeding

1.3 DEFINITIONS

A. Weeds: Include Dandelion, Jimsonweed, Quackgrass, Horsetail, Morning Glory, Rush Grass, Mustard, Lambsquarter, Chickweed, Cress, Crabgrass, Canadian Thistle, Nutgrass, Poison Oak, Blackberry, Tansy Ragwort, Bermuda Grass, Johnson Grass, Poison Ivy, Nut Sedge, Nimble Will, Bindweed, Bent Grass, Wild Garlic, Perennial Sorrel, and Brome Grass.

1.4 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

1.5 REGULATORY REQUIREMENTS

A. Comply with regulatory agencies for fertilizer and herbicide composition.

B. All seed shall conform to the requirements of the Wisconsin Statutes regarding noxious weed seed content. No seed shall be used o the work later than one year after the germination test date which appears on the label.

C. Seed shall be tested when required in accordance with the methods and procedures used in making purity analyses and germination tests as adopted by the US Department of Agriculture in the Administration of the Federal Seed Act.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver grass seed mixture in sealed containers. Seed in damaged packaging is not acceptable. Deliver seed mixture in containers showing percentage of seed mix, year of production, net weight, date of packaging, and location of packaging.

B. Deliver fertilizer in waterproof bags showing weight, chemical analysis, and name of manufacturer.

PART 2 PRODUCTS

2.1 APPROVED SEED MIXTURES

A. No Mow Turf

1. Unless specified otherwise, Contractor shall supply the No Mow with annual rye variety. The following formulation is as manufactured by Prairie Nursery of Westfield, WI. Any substitution must have prior approval of the Landscape Architect and Owner.

NO MOW WITH ANNUAL RYE	ORIGIN/GERM
SR5130 Chewings Fescue - Festuca communtata - 23.75%	OR-85%
Sheep Fescue - Festuca ovina - 23.44%	Canada - 85%
Chariot Hard Fescue - Festuca longifolia - 11.94%	OR-85%
Heron Hard Fescue - Festuca rubra - 11.85%	OR-85%
Sea Link Creeping Red Fescue - Festuca rubra - 11.82%	OR-85%
SR5250 Creeping Red Fescue - Festuca rubra - 11.68%	OR-85%
Annual Ryegrass - Lolium multiflorum - 3.95%	OR - 90%

2. 1.53% Inert matter
3. .02% other crop seed
4. .02% weed seed
5. Noxious weed seed - none

2.2 SOIL MATERIALS

A. Topsoil: Fertile, agricultural soil, typical for locality, capable of sustaining vigorous plant growth, taken from drained site; free of subsoil, clay or impurities, plants, weeds and roots; pH value of minimum 5.4 and maximum 7.0. or below:

B. Topsoil: Excavated from site and free of weeds.

C. Compost: Well decomposed, stable, weed free; derived from food, agricultural or industrial residuals, biosolids, yard trimmings, or source-separated or mixed solid waste; with no objectionable odors and not resembling the raw material from which it was made; no substances toxic to plants.
1. Gradation: 100 percent passing 3/8 inch screen.
2. Moisture Content: 35 to 55 percent by weight.
3. pH: 5.5 to 8.9.
4. Not more than 1 percent man-made matter and without plastic items more than 2 inches in length.

2.3 ACCESSORIES

A. Mulching Material: Oat or wheat straw, free from weeds, foreign matter detrimental to plant life, and dry. Chopped cornstalks are not acceptable.

B. Fertilizers, intended for use in connection with seeding, sodding, or other planting, shall be standard commercial products conforming to the requirements of the Wisconsin Statues. Native plant seedings or temporary seeding to be followed by native seedings should not be fertilized. Each package of fertilizer shall be plainly marked with the analysis of the phosphoric acid and soluble potash. Fertilizers shall meet the following minimum requirements:
1. Nitrogen, not less than.....10%
2. Phosphoric Acid, not less than.....10%
3. Potash, not less than.....10%

C. Soil Stabilizers: Soil stabilizers intended as soil bonding agents to prevent or minimize erosion.
1. Soil stabilizers must be environmentally benign; harmless to fish, wildlife, and plants; along with being non-toxic and non-combustible at the rate of application specified by the manufacturer. Asphalt based products will not be approved for use. Only products approved for field testing and field tested by Wisconsin Department of Transportation will be approved for use. Soil stabilizers are considered a short term duration (6 month) erosion control device for use on slope 3:1 or flatter. In addition to the above requirements, soil stabilizers must meet the same vegetative density and sediment loss standards as required for erosion mats.
2. Soil stabilizer shall be a polyacrylamide (PAM) and calcium solution intended to reduce the erodability of bare soils during construction activities or to enhance the performance of mulching on permanent slopes. Polyacrylamide Soil Stabilizer shall have proven abilities to bond soil particles, effectively increasing the soil particle size to 1.0 millimeter or larger. It shall reduce the movement of soil through chemical bonding, increase the particle size thus making silt fence more effective, and increase the water absorption of the soil.
3. Polyacrylamide Soil Stabilizers shall conform to the Wisconsin Department of Transportation's Product Acceptability List (PAL) for Soil Stabilizers, Type B. Presently, the only acceptable product is Natural Earth PolyStable Plus, manufactured by Earth & Road.

D. Water: Clean, fresh and free of substances or matter that could inhibit vigorous growth of grass.

E. Erosion Control: Reference Civil drawings and specifications for erosion control products.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that prepared soil base is ready to receive the work of this Section.

3.2 PREPARATION

A. Grading, topsoiling, and fertilizing shall be completed before seeding, except when equipment designed for the purpose is used, the fertilizer and seed mixture may be placed in one operation. The areas to be seeded shall be worked with discs, harrows, or other appropriate equipment until it becomes a reasonably even and loose seed bed immediately in advance of the seeding.

3.3 FERTILIZING

A. Apply fertilizer in accordance with manufacturer's instructions.

3.4 SEEDING

A. The seed mixes shall be applied at the following rates:

SEED MIX	RATE
No Mow Turf	5lbs per 1,000 SF / 220 lbs per Acre

B. Final seeding shall be limited to the following period:
   1. Late August - Mid October

C. Any seeding outside the dates listed above shall be at the risk of the Contractor and reseeding after October 15th or in the spring shall be completed at no additional cost to the City of Madison with the same seed mix that was specified in the contract.

D. Unless otherwise specified, seed may be shown at the option of the Contractor by either Method A or Method B as described below:
   1. Method A: The seed mixture shall be shown by means of equipment adapted to the purpose, or it may be scattered uniformly over the areas to be seeded, and lightly raked or dragged to cover the seeding with approximately one-forth inch of soil. After seeding, the areas shall be lightly rolled or compacted by means of suitable equipment, preferably of the cultipacker type when such equipment can be operated, or by means of light hand tampers.
   2. Method B: Upon the prepared seed bed, the seed shall be sown or spread by means of a stream of spray of water under pressure operated from an approved type of machine designated for that purpose. The selected seed mixture and water shall be placed into a tank, provided within the machine, in sufficient quantities that when the contents of the tank are sprayed on a given area the seed will be uniformly spread at the required rate of application. During the process the contents of the tank shall be keep stirred or agitated to provide uniform distribution of the seed.
   3. Scattering seed by hand shall be done only with satisfactory hand seeders and only at such times when the air is sufficiently quiet to prevent seeds from blowing away.

3.5 MULCHING

A. Mulch shall be placed on those areas which are specified for permanent seeding within three (3) days after the seeding has been completed unless the area is specified to receive erosion matting. Mulch is not required in areas to received erosion matting provided matting is placed within three (3) days of seeding.

B. Mulching operations shall not be performed during periods of excessively high winds which would preclude the proper placing of the mulch.

C. The placed mulch shall be loose enough to allow some sunlight to penetrate and air to slowly circulate but thick enough to shade the ground, conserve soil moisture, and prevent or reduce erosion.

D. The Contractor shall maintain the mulched areas and shall repair any areas damaged by wind, erosion, traffic, fire, or other causes prior to final or partial acceptance of the work under contractor.

E. The Contractor shall perform the work with either Method A or Method B, at the direction of the Landscape Architect and Owner.
   1. Method A: The mulching material shall be uniformly spread over the designated areas to a loose depth of one (1) to two (2) inches, using seventy (70) to ninety (90) pounds of mulch per 1,000 SF. The mulch material from compacted bales shall be well loosened or made fluffy before being spread in place. Unless otherwise directed, mulching operations shall begin at the top of slopes and proceed downward.

a. The mulch cover, except when composed of wood excelsior fiber, shall be securely anchored in place by means of heavy twine fastened by pegs or staples to form a grid of from six (6) to ten (10) feet spacing.

2. Method B: Straw or hay shall be treated with asphalt material blown from a machine, and uniformly deposited over designated areas in one operation.
   a. The mulch shall be placed uniformly over the area to a loose depth of one (1) to two (2) inches, using one and one-half to two tons of mulch per acre and 75 to 100 gallons of emulsified asphalt per ton of straw or hay. Within the above designated limits, the Architect will determine, on the job, the rate of application of the mulch and the asphalt, and the right is reserved for the Architect to vary the rates during mulching operations to produce the desired results.
   b. The machine for placing the mulch shall be of an approved type, which will blow or eject by constant air stream a controlled amount of mulch and which will introduce into the air stream a spray of asphalt to partially coat the straw or hay, producing a spotty tack sufficient to hold together and retain in place the deposited hay or straw.
3. Wood fiber shall be applied in the same manner as straw or hay except that the wood excelsior fiber shall not be treated with asphalt material.
4. Throughout the process, the mulch material shall be fed into the blowing machine to produce a constant and uniform ejection from the discharge spout, operated in a position to produce a mulch of uniform depth and coverage.
5. The mulch material shall not contain moisture in excess of that which will permit uniform feeding through the machine.

3.6 WATERING

A. All seeded areas shall be watered as necessary to meet germination and seed growth as defined in ACCEPTANCE AND GUARANTEE below.

B. The Contractor shall be permitted to delay seeding only when the City of Madison is classified by the U.S. Drought Monitor as D-3 Drought Extreme Status. In these circumstances, the Contractor must seed within 10 days of the end of the D-3 Drought Extreme classification. During this time, the Contractor is required to maintain erosion control until seeded areas are accepted as defined in ACCEPTANCE AND GUARANTEE below.

C. Weekly updates provided by the U.S. Drought Monitor are available at: http://droughtmonitor.unl.edu/Home/StateDroughtMonitor.aspx?WI

3.7 SOIL STABILIZERS

A. Soil stabilizers shall be used on all areas seeded.

B. Application is intended to be done with conventional hydraulic seeding equipment. Polyacrylamide Soil Stabilizer may also be placed through dry spreading. Application rates shall be as recommended by the manufacturer and shall meet the approval of the Architect. In general, rate of application shall be 20 lbs. per acre (0.46 lbs per 1,000 SF).

C. Where soil stabilizers are used in the terrace or near any other pedestrian walk areas, the sidewalk and/or pedestrian walk areas shall be protected to keep the soil stabilizers from being deposited on them. After getting wet, any soil stabilizers on these surfaces can result in a slipping hazard. If soil stabilizers are deposited on a sidewalk the contractor shall clean the sidewalk sufficiently to remove the soil stabilizers. The Contractor shall be aware that conventional methods (sweeping) will not be sufficient to remove the polymer due to the nature of the polymer and other methods (vacuum) will be required to meet this requirement.

D.

3.8 ACCEPTANCE

A. Upon completion of seeding, the Contractor shall request approval from the Architect and Engineer for acceptance of seeded areas for the purposes of issuing the certificate of completion and removal of erosion control devices (including, but not limited to inlet protection, silt sock and/or fence, turbidity barrier and/or silt curtain). If the certificate of completion is authorized by the Architect and Engineer with pending or without acceptance of seeded areas, the Contractor is responsible for maintaining erosion control devices until authorized by the Architect.

B. Acceptance shall be defined as healthy and flourishing germination of 95% of perennial grass seed to a minimum height of 1 inch, with no or few bare patches.

C. All seeded areas which are dead or found not to be in a normal, healthy condition or do not conform to the specifications, in the judgement of the Architect will not be accepted. All rejected work shall be replaced by the Contractor, including removal and repair of all work affected by the replacement, at no cost to the City.

3.9 GUARANTEE

A. All areas that have been seeded with turf shall be guaranteed to be in a healthy and flourishing condition as defined in section 3.8 ACCEPTANCE for a period of 1 year from the date on the certificate of completion.

B. At any time within the period of the guarantee, the Contractor shall replace any seeded areas which, for any reason, have died or are in a dying condition, or which have failed to flourish in such a manner or to such a degree that their usefulness or appearance has been impaired. Replacement shall include removal and repair of all affected work. Seeded areas that have perished for any reason shall be reseeded or overseeded with the exact variety of turf seed that was originally specified.

C. Following the completion of the repair, a re-inspection will be made prior to final acceptance.

END OF SECTION

SECTION 32 92 23

SODDING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Preparation of subsoil.

B. Placing topsoil.

C. Top dressing with compost.

D. Fertilizing.

E. Sod installation.

F. Maintenance.

1.2 RELATED REQUIREMENTS

A. Section 31 2500 - Erosion Control: Temporary seeding

1.3 DEFINITIONS

A. Weeds: Includes Dandelion, Jimsonweed, Quackgrass, Horsetail, Morning Glory, Rush Grass, Mustard, Lambsquarter, Chickweed, Cress, Crabgrass, Canadian Thistle, Nutgrass, Poison Oak, Blackberry, Tansy Ragwort, Bermuda Grass, Johnson Grass, Poison Ivy, Nut Sedge, Nimble Will, Bindweed, Bent Grass, Wild Garlic, Perennial Sorrel, and Brome Grass.

1.4 REFERENCE STANDARDS

A. TPI (SPEC) - Guideline Specifications to Turfgrass Sodding; 2006.

1.5 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Certification: Submit certification of grass species and location of sod source.

1.6 QUALITY ASSURANCE

A. Sod Producer: Company specializing in sod production and harvesting with minimum five years experience, and certified by the State of Wisconsin.

B. Installer Qualifications: Company approved by the sod producer.

1.7 REGULATORY REQUIREMENTS

A. Comply with regulatory agencies for fertilizer and herbicide composition.

B. Provide certificate of compliance from Wisconsin Statutes indicating approval of fertilizer and herbicide mixture.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver sod in rolls or on pallets. Protect exposed roots from dehydration.

B. Do not deliver more sod than can be laid within 24 hours.

PART 2 PRODUCTS

2.1 MATERIALS

A. Sod: Shall consist of a dense, well-rooted growth of permanent and desirable grasses, indigenous to the general locality where it is to be used, and shall be practically free from weeds or undesirable grasses; type indicated below.

1. Black Beauty Tall Fescue Kentucky Bluegrass (TFKB Sod); a 50/50 blend of tall fescue and Kentucky Bluegrass as produced by Paul's Turf and Tree Nursery of Marshall, WI; or approved equal.

a. At the time the sod is cut, the grass on the sod shall have a length of approximately two inches (if longer, the grass shall be cut to approximately this length) and the sod shall have been raked free from debris.
b. The sod shall be cut in uniform strips and be of a uniform thickness; shall have no holes; shall be free of weeds, insects, and diseases; shall be uniformly green and not discolored due to drying or heating, and shall be moist.
c. The thickness of the sod shall be uniform at approximately 1/2 to 3/4 inch depending on the nature of the sod, so that practically all of the dense root system of the grasses will be retained, but exposed, in the sod strip and so that the sod can be handled without undue tearing or breaking.
d. In the event the sod which is to be cut is in a dry condition so as to cause crumbling or breaking during cutting operations, at least twelve (12) hours before cutting the sod, the Contractor, at no additional cost to the City, shall apply water to the sod in sufficient quantities to provide a well moistened condition of the sod to the depth to which is is to be cut.

B. Topsoil: Excavated from site or

C. Topsoil: Fertile, agricultural soil, typical for locality, capable of sustaining vigorous plant growth, taken from drained site; free of subsoil, clay or impurities, plants, weeds and roots; pH value of minimum 5.4 and maximum 7.0.

D. Compost: Well decomposed, stable, weed free, organic matter source. Derived from agricultural, food, or industrial residuals; biosoilds (treated sewage sludge); yard trimmings; source-separated or mixed solid waste. Compost shall contain no substances toxic to plants and shall be reasonably free (<1% by dry weight) of man-made foreign matter. The compost will possess no objectionable odors and shall not resemble the raw material from which is was derived. Compost shall be certified through the US Composting Council's (USCC) Seal of Testing Assurance (STA) Program.
1. pH Range: 6.0-8.5
2. Soluble Salt Concentration: Maximum of 10 dS/m
3. Moisture Content: 30-60% wet weight basis
4. Organic Matter Content: 30-65% dry weight basis
5. Particle Size: 98% passing through 3/4" screen or smaller

E. Fertilizers, intended for use in connection with seeding, sodding, or other planting, shall be standard commercial products conforming to the requirements of the Wisconsin Statues. Native plant seedings or temporary seeding to be followed by native seedings should not be fertilized. Each package of fertilizer shall be plainly marked with the analysis of the phosphoric acid and soluble potash. Fertilizers shall meet the following minimum requirements:
1. Nitrogen, not less than.....10%
2. Phosphoric Acid, not less than.....10%
3. Potash, not less than.....10%

F. Water: Clean, fresh and free of substances or matter that could inhibit vigorous growth of grass.

2.2 ACCESSORIES

A. Wood Pegs: Softwood, twelve (12) inches in length.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that prepared soil base is ready to receive the work of this section.

3.2 PREPARATION

A. Remove any existing vegetation within planting area.

B. Existing soils exposed to construction activity shall be cleaned of any stones, roots, rubble or debris and de-compacted to a depth of 12" minimum.

C. Spread topsoil where existing topsoils have been removed during construction activities.

D. Top dress topsoils with 1/2" compost

E. Till soils to a depth of 4", rake and remove any additional debris or rubble, smooth soil surface

F. Lightly roll soil

3.3 FERTILIZING

A. Apply fertilizer in accordance with manufacturer's instructions.

B. Apply after smooth raking of topsoil and prior to installation of sod.

C. Apply fertilizer no more than 48 hours before laying sod.

D. Mix thoroughly into upper 2 inches of topsoil.

E. Lightly water to aid the dissipation of fertilizer.

3.4 LAYING SOD

A. Frozen sod shall not be placed, nor shall any sod be placed upon frozen soil.

B. Moisten prepared surface immediately prior to laying sod.

C. Lay sod immediately after delivery to site to prevent deterioration.

D. Lay sod smooth and tight with no open joints visible, and no overlapping; stagger end joints 12 inches minimum. Do not stretch or overlap sod pieces.

E. As the sod is being laid it shall be rolled or firmly, but lightly, tamped with a suitable wooden or metal tampers, sufficiently only to 'set' or press the sod into the underlaying soil.

F. Where new sod adjoins existing grass areas, align top surfaces.

G. Where sod is placed adjacent to hard surfaces, such as curbs, pavements, etc., place top elevation of sod 1 inch below top of hard surface.

H. On all slopes steeper than one foot vertical to four feet horizontal, the sod shall be staked or pegged with wooden stakes spaced as required by the nature of the soil and steepness of slope, from 18 inches to 36 inches apart along the longitudinal axis of the sod strip. Stakes shall preferably be placed near the top edges of the sod strip and shall be driven approximately plumb through the sod to be almost flush with the sod.

I. All sod placed in ditches, flumes, or other appurtenances, where a concentrated flow of water may be expected, shall be staked regardless of slopes.

J. At points where water will flow over a sodded area, the upper edges of the sod strips shall be turned into the soil below the adjacent area and a layer of earth placed over this juncture, which earth shall be thoroughly compacted to conduct the surface water over the upper edge of the sod.

K. At the limits of sodded areas, wherever practical or feasible, the end strips shall be placed to effect a broken line, and ends of the strips shall be turned in and treated as described above.

L. Water sodded areas immediately after installation. Saturate sod to 4 inches of soil.

M. During periods of extreme drought, defined as category D-3 Drought Extreme by the U.S. Drought Monitor, the Contractor shall refrain from installing sod until after the City of Madison is no longer within this classification. The Contractor must install sod within ten (10) days of the end of the D-3 Drought Extreme Classification. During this time, the Contractor must maintain all perimeter erosion control until directed by the Architect and Engineer.

3.5 WATERING

A. After staking and cleanup, the sod shall be thoroughly moistened by sprinkling with water. All sodded areas shall be kept thoroughly moist by watering or sprinkling when rainfall is not sufficient to achieve rooting of the sod to the earth bed. Water shall be applied in a manner to preclude washing to erosion.

B. No additional compensation will be given to Contractors for watering related to dry conditions, except as specified in subsection 3.6 Drought Watering.

3.6 DROUGHT WATERING

A. The Contractor shall receive additional compensation for watering required to keep sod in flourishing condition ONLLY when the following conditions are present and have been met:

1. The U.S. Drought Monitor has classified the City of Madison as D-3 Drought Extreme status. Weekly updates provided by the U.S. Drought Monitor are available at: http://droughtmonitor.unl.edu/Home/StateDroughtMonitor.aspx?WI
2. The sod was installed greater than ten (10) days from the date seeking additional compensation.

B. Once the U.S. Drought Monitor has classified the City of Madison as D-3 Drought Extreme, the Contractor must notify the Architect of the dates of additional watering(s) to occur within the next seven (7) days, and of watering(s) that occurred seven (7) days prior to classification of the D-3 Drought Extreme Classification. The Contractor shall receive compensation for up to four (4) additional drought waterings performed seven (7) days prior to the classification f D-3 Drought Extreme and four (4) additional waterings during the seven (7) day period after the U.S. Drought Monitor has classified the City of Madison as D-3 Drought Extreme. The Contractor will not receive double payments for waterings during periods of consecutive weeks of D-3 Drought Extreme Status.

C. The request for additional watering(s) will be made on a weekly basis according to the weekly reports from the U.S. Drought Monitor.

D. In the event that there is a significant rainfall (> 1"), after the U.S. Drought Monitor has classified the City of Madison as D-3 Drought Extreme, the Contractor must notify the Architect of the revised dates of additional watering(s) that will occur within the next seven (7) days.

E. The Architect shall not be held responsible for informing the Contractor that additional watering(s) are necessary because of the D-3 Drought Extreme status by the U.S. Drought Monitor. Plants that perish or do not thrive because of lack of watering(s) shall be the responsibility of the Contractor per below sections ACCEPTANCE and GUARANTEE.

3.7 ACCEPTANCE

A. Upon completion of all required sodding, an inspection of the work will be made by the Architect. All sodded areas which are dead or found not to be in a normal, healthy condition or do not conform to specifications, in the judgement of the Architect will not be accepted. All rejected work shall be replaced by the Contractor, including removal and repair of all work affected by the replacement, at no cost to the City.

3.8 GUARANTEE

A. All areas that have been sodded shall be guaranteed to be in a healthy and flourishing condition for a period of 1 year from the date on the certificate of completion.

B. At any time within the period of the guarantee, the Contractor shall replace any sodded areas which, for any reason, have died or are in a dying condition, or which has failed to flourish in such a manner or to such a degree that its usefulness or appearance has been impaired. Replacement shall include removal and repair of all affected work. Sodded areas that have perished for any reason shall be resodded with the exact variety of sod that was originally installed.

C. Following the completion of the repair, a re-inspection will be made prior to final acceptance.

END OF SECTION

SECTION 32 93 00

PLANTS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Preparation of subsoil.

B. Topsoil.

C. Compost top-dressing.

D. New trees and plants.

E. Mulch and Fertilizer.

F. Accessories

G. Tree Pruning.

1.2 DEFINITIONS

A. Weeds: Include Dandelion, Jimsonweed, Quackgrass, Horsetail, Morning Glory, Rush Grass, Mustard, Lambsquarter, Chickweed, Cress, Crabgrass, Canadian Thistle, Nutgrass, Poison Oak, Blackberry, Tansy Ragwort, Bermuda Grass, Johnson Grass, Poison Ivy, Nut Sedge, Nimble Will, Bindweed, Bent Grass, Wild Garlic, Perennial Sorrel, and Brome Grass.

B. Plants: Living trees, plants, and ground cover specified in this Section, and described in ANSI Z60.1.

1.3 REFERENCE STANDARDS

A. ANSI/AHIA Z60.1 - American National Standard for Nursery Stock; 2014.

B. ANSI A300 Part 1 - American National Standard for Tree Care Operations -- Tree, Shrub and Other Woody Plant Maintenance -- Standard Practices; 2008 (R2014).

C. Standardized Plant Names - 1942, American Joint Committee on Horticulture Nomenclature.

D. Pruning Standards for Shade Trees - current edition, National Arborist Association.

1.4 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Submit list of plant life sources.

1.5 QUALITY ASSURANCE

A. Nursery Qualifications: Company specializing in growing and cultivating the plants with a minimum of 5 years documented experience.

B. Installer Qualifications: Company specializing in installing and planting the plants with a minimum of 5 years experience.

C. Tree Pruner Qualifications: Company specializing in pruning trees with proof of Arborist Certification.

D. Maintenance Services: Performed by installer.

1.6 REGULATORY REQUIREMENTS

A. Comply with regulatory agencies for fertilizer and herbicide composition.

B. Provide certificate of compliance from authority having jurisdiction indicating approval of plants, fertilizer and herbicide mixture.

C. Plant Materials: Certified by federal department of agriculture; free of disease or hazardous insects.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver fertilizer in waterproof bags showing weight, chemical analysis, and name of manufacturer.

B. Protect and maintain plant life until planted.

C. Deliver plant life materials immediately prior to placement. Keep plants moist.

1.8 FIELD CONDITIONS

A. Do not install plant life when ambient temperatures may drop below 35 degrees F or rise above 90 degrees F.

B. Do not install plant life when wind velocity exceeds 30 mph.

PART 2 PRODUCTS

2.1 PLANTS

A. Plants: All plants shall be typical of their species and have well-formed tops (crowns) and root systems and shall be free from injurious insects, plant diseases, or other plant pests. All plants shall be grown within the States of Wisconsin, Minnesota, Iowa, Michigan, or the parts of Illinois, Indiana, or Ohio located within Zone 5 of the Plant Hardiness Zone Map of the USDA. Plants furnished shall conform to the American Standard for Nursery Stock and be free from the following defects:
   1. Serious injuries to leader, branches (crown), trunk, bark, or roots
   2. Dried out roots
   3. Girdling or encircling roots
   4. Prematurely opened buds
   5. Thin or poor tops (crowns) or root systems
   6. Evidence of molding
   7. Dry, loose, or broken ball of earth in balled and burlapped (B&B) stock
   8. Dried out or damaged soil mass in bare root (BR), balled and burlapped (B&B), or container grown (CG) stock

B. Grading Standards: Plant stock shall conform to the code of standards set forth in the current edition of the American Standards for Nursery Stock.

2.2 SOIL MATERIALS

A. Topsoil: Excavated from site to the greatest extent possible and supplemented with the below as necessary.

B. Topsoil: Fertile, agricultural soil, typical for locality, capable of sustaining vigorous plant growth, taken from drained site; free of subsoil, clay or impurities, plants, weeds and roots; minimum pH value of 5.4 and maximum 7.0.

C. Compost: Well decomposed, stable, weed free; derived from food, agricultural or industrial residuals, biosolids, yard trimmings, or source-separated or mixed solid waste; with no objectionable odors and not resembling the raw material from which it was made; no substances toxic to plants.
   1. Gradation: 100 percent passing 3/8 inch screen.
   2. Moisture Content: 35 to 55 percent by weight.
   3. pH: 5.5 to 8.9.
   4. Not more than 1 percent man-made matter and without plastic items more than 2 inches in length.

D. Planting Soil: a unform blend consisting of 50% topsoil, 30% course sand, and 20% compost. Place topsoil in 12 inch lifts and water in to review drainage and prevent future settlement.

2.3 SOIL AMENDMENT MATERIALS

A. Fertilizer: When/where specified, shall be of the slow release type contained in polyethylene perforated bags with micropore holes. Each bag shall contain a minimum of one (1) once of soluble fertilizer with an analysis of 16-8-16 per unit or approved equal. The minimum guaranteed analysis shall be total nitrogen 16%; 9% ammoniacal nitrogen, 7% nitrate nitrogen. Available phosphoric acid P2 O5 (from ammonium phosphate) 8%, soluble potash (from potassium chloride) 16%.

2.4 MULCH MATERIALS

A. Organic Mulch: Shredded Cedar Mulch free of coloring agents or objectionable foreign material.

2.5 ACCESSORIES

A. Wrapping: When/where specified, shall consist of a two-ply waterproofed crepe tree wrapping paper, laminated with a layer of pliable asphalt material. The wrap shall tightly cover the entire surface of the trunk, overlapped one

and one-half inches in spiral fashion, starting at the base of the tree and extending to the height of the first branches. The wrapping shall be secured in at least three (3) places with masking tape. The Contractor shall be responsible for removing and disposing of the tree wrap after a one year period.

B. Protection: When/where specified, shall consist of galvanized hardware cloth, extruded aluminum mesh or a durable pre-formed plastic material. The hardware cloth or aluminum mesh, if used, shall have at least three meshes per linear inch and shall be used in conjunction with a steel rod having a minimum size of 3/8" x 48". The plastic material shall be a durable, resilient, preformed plastic spiral acceptable to the Architect. Such material shall have a natural, earth-tone color. The Contractor shall be responsible for removing and disposing of the protection at the end of the guarantee period unless otherwise specified by the Architect.

C. Below-Grade Tree Stabilizing System, similar or equal to:
   1. Tree Staple Stabilizer, manufactured by Tree Staple Inc., 877-873-3749, www.treestaple.com

D. Weed Barrier Fabric: 5 oz., woven, needlepunched, polypropylene fabric with ground anchoring pins. Limit use to areas described in landscape details.

E. Landscape Edging: Concrete 'bullet' style edgers, approximately 4"h x 12"l x 4"d with one rounded and one concave end for alignment. Color: Charcoal gray. Set in straight line with outer face of edger in alignment with outside edge of adjacent pavement where applicable.

F. Anti-Desiccant: When/where specified, shall be an approved emulsion which will provide a film over plant surfaces permeable enough to permit transpiration.

G. Watering Equipment: The Contractor shall furnish and have available sufficient watering equipment, including tanks, pumps, hoses, root feeders, and incidentals to fully perform all of the watering. Water will be furnished to the Contractor by the City from existing facilities if requested by the Contractor in accordance with these specifications. When the Contractor chooses to use City of Madison water for any part of the project, then the Contractor must proceed as follows:
   1. Request Water Utility in install valve on convenient hydrant
   2. Agree to pay Water Utility charges for installation, use, and removal of the valve
   3. Notify Water Utility immediately when use of valve is no longer necessary.
   4. The Contractor shall not make connections to the Water Utility facilities without permission from the Water Utility.

2.6 SOURCE QUALITY CONTROL

A. Substitution: Where evidence is submitted that a specified plant cannot be obtained, substitution may be made only upon specific approval of the Architect.

B. Inspection and Approval of All Plant Material: All plants shall be subject to the approval of the Architect. Trees that will be inspected and tagged at the nursery or place of collection will be done at a time agreeable to the Contractor and Architect. Approval of plants at the source does not alter the right of rejection at the project site. It is the right of the Architect to reject plant material(s) at the project site. It is the responsibility of the Contractor to notify the Architect forty-eight (48) hours prior to any plantings, as to which plants are to be planted and their location(s). Contractor shall furnish to the Architect an invoice or order form from each nursery indicating the sources from which he proposes to obtain plant materials for the work at this time confirming what will be delivered. This list shall include species name, cultivar, root condition, and size. All plants shall conform to the measurements specified in the plant list. Measurements specified shall be the minimum size acceptable for each variety. Plants that meet the requirements specified in the itemized plant list, but that do not possess a normal balance between height and spread, will not be accepted. Plants shall not be pruned prior to delivery. Tree branching shall be evenly spaced around the trunk without excessive gaps between the whorls. Trees with multiple leaders, unless specified, will be rejected. Central leaders shall be left intact.

PART 3 EXECUTION

3.1 GENERAL

A. All plant stock shall be freshly dug and handled with care to prevent injuries to the leaders, branches, trunk, and roots.

3.2 DIGGING AND HANDLING OF PLANT MATERIAL

A. Care shall be taken to prevent any damage to plant material during transit and handling. The Architect shall check trees for any shipping or handling damages. Trees with excessive damage as determined by the Architect shall be rejected.

B. Plant stock to be furnished balled and burlapped (B&B) shall be moved with a compact dug ball of earth so firmly wrapped in burlap that upon delivery the soil in the ball is still firm and compact about the root system. Each ball shall be of sufficient size to encompass all the fibrous roots necessary to ensure successful recovery and development of the plant. Root balls shall not be allowed to dry out between digging and planting. The minimum sizes of balls, ball depth and diameters, and increased ball sizes for collected stock shall be in accordance with Recommended Balling and Burlapping Specifications as set forth in the current edition of the American Association of Nurserymen. No plant will be accepted when the burlap, twine, wire, or ropes required to secure the root ball have been removed. Ropes, strings, wire baskets, burlap, and other wrappings shall be removed from the entire plant before installation is complete. The balance of the wrappings may be left intact around the bottom of the ball. All balled and burlapped plants than cannot be planted immediately on delivery shall be set on the ground and the balls covered with soil or other acceptable mulch material and shall be kept moist until planted.

C. Plants marked 'CONT.' shall be container grown with a well-established root system. Container grown plants are to be well-established within the container, with a root system sufficiently developed to retain its shape and hold together when removed from the container. Roots should be be noticeable when removed from the container, but not protruding outside the container. Soil within the container should be held together by the roots, in form and whole. Plants shall not be bound nor have kinked, circling, or bent roots.

D. All plants shall be handled so that the roots are adequately protected at all times. During shipment, all plants shall be properly protected by a tarpaulin or other suitable covering. No plant shall be so bound with rope or wire at any time as to damage the bark, break branches, or destroy its natural shape.

3.3 EXAMINATION

A. Plants shall be marked for identification and for checking as designated on the plant list. Each grouping of plants and all separate plants shall have legible, waterproof labels securely attached thereto before delivery to the site.

B. Prior to any excavation, the Contractor shall notify Diggers Hotline at 1-800-242-8511 to determine the location of all electric, gas, water, sewer, oil, and other utility lines, including tanks or other subsurface encumbrances, and precautions shall be taken by the Contractor not to disturb or damage any utility lines. In the event of a conflict of a utility with the planting, the Contractor shall promptly request, in writing, from the Architect a revised location for plant material.

C. Verify that prepared subsoil is ready to receive work.

D. Saturate soil with water to test drainage.

3.4 PREPARATION OF SUBSOIL

A. Prepare subsoil to eliminate uneven areas. Maintain profiles and contours. Make changes in grade gradual. Blend slopes into level areas.

B. Remove foreign materials, weeds and undesirable plants and their roots. Remove contaminated subsoil.

C. Scarify subsoil to a depth of 4 inches where plants are to be placed. Repeat cultivation in areas where equipment, used for hauling and spreading topsoil, has compacted subsoil.

3.5 PLACING TOPSOIL AND COMPOST

A. Spread topsoil to a minimum depth of 12 inches over area to be planted. Rake smooth.

B. Place topsoil during dry weather and on dry unfrozen subgrade.

C. Remove vegetable matter and foreign non-organic material from topsoil while spreading.

D. Grade topsoil to eliminate rough, low or soft areas, and to ensure positive drainage.

E. Top dress topsoil with 1 inch of compost.

F. Mix compost into topsoil to a depth of 6 inches.

G. Rake and smooth soils to 3 inches below finish grade to allow for placement of mulch.

3.6 FERTILIZING

A. Apply fertilizer in accordance with manufacturer's instructions.

B. Apply after initial raking of topsoil.

C. Mix thoroughly into upper 2 inches of topsoil.

D. Lightly water to aid the dissipation of fertilizer.

3.7 PLANTING

A. Planting Dates - Unless otherwise specified on plans, the planting seasons are as follows:
   1. Deciduous grass, or perennial container grown plants may be planted from the time frost is out of the ground through October 15th.
   2. Fall planting season for deciduous trees shall begin no earlier than October 1st
   3. Fall planting for evergreen trees and shrubs shall be done between August 15th and September 15th

B. Unless otherwise approved, planting shall not be done when the ground is frozen or when soil is in an unsatisfactory condition for planting.

C. Contractor to locate trees, shrubs, and perennial groupings as shown on plans.

D. Set plants vertical.

E. For plants in containers, the container shall be removed before planting. If roots are crowded or coiled on the bottom, sides, or surface of the root ball, they shall be gently separated from the edges or surface.

F. Balled and burlapped plants shall have the ropes, strings, wire baskets, burlap, and other wrappings removed from the top 1/2 of the ball after the plant has been set. The balance of the wrappings may be left intact around the bottom of the ball.

G. Plants shall be set with the root flare at the finished grade (root flare shall be determined 1" above the upper-most woody support root).

H. Planting holes shall be backfilled with excavated soil. Salvaged topsoil shall be placed in layers around the roots or ball. Frozen or muddy soil will not be acceptable backfill material. Backfilling shall be carefully done to avoid injury to the roots or ball without disturbing the position of the plant. When holes are approximately 2/3's full, they shall be thoroughly watered to eliminate air pockets. Once water has drained from the hole, complete backfilling to the top of the hole and again water thoroughly. Puddled soil conditions shall be avoided.

I. At deciduous and evergreen tree plantings, install below-grade tree stabilizing system per manufacturer's recommendations.

J. Planting areas shall be finish-graded to conform to drawings after full settlement has occurred.

K. All plants shall be mulched to a depth of 3" to the extents shown on the plans.

3.8 TREE PRUNING

A. Perform pruning of trees as recommended in ANSI A300.

B. Prune newly planted trees as required to remove dead, broken, and split branches.

3.9 CARE

A. The Contractor shall properly care for all plants while the payment and performance bond remains in effect. The performance and payment bond shall remain in effect for one year from the date on the certificate of completion.

B. Proper care of plants shall consist of doing such watering, weeding, cultivating, pruning, spraying, resetting of stabilizing systems, wrapping, re-mulching, and such other work as may be necessary to keep the plants in a neat appearance and in a healthy growing condition. No additional compensation will be given to Contractors for watering related to dry conditions, except as specified in subsection 3.10 DROUGHT WATERING.

C. It shall be the Contractor's responsibility to thoroughly water and care for plants, especially during the ten (10) day period after initial planting. No additional compensation will be given for watering during the first ten (10) days of initial planting, regardless of drought status.

D. Additional waterings may be ordered by the Architect at any time, for the duration of the guarantee period. Should conditions require such waterings, Contractor shall water within three (3) days of notification. The volume of each

watering and intervals between waterings shall depend upon weather conditions and soil moisture. Contractor shall monitor weather and soil condition at each planting.

E. Care must be taken when watering not to wash away mulch and topsoil. Mulch and topsoil displaced by the Contractor must be replaced immediately and at no additional cost to the City.

F. Street trees shall be pruned by the City Forester.

3.10 DROUGHT WATERING

A. The Contractor shall receive additional compensation for watering required to keep plants in a healthy growing condition ONLY when the following conditions are present and have been met:
   1. The U.S. Drought Monitor has classified the City of Madison as D-3 Drought Extreme status. Weekly updates provided by the U.S. Drought Monitor are available at: http://droughtmonitor.unl.edu/Home/StateDroughtMonitor.aspx?WI
   2. The plantings were installed greater than ten (10) days from the date seeking additional compensation.

B. Once the U.S. Drought Monitor has classified the City of Madison as D-3 Drought Extreme, the Contractor must notify the Architect of the dates of additional watering(s) to occur within the next seven (7) days, and of watering(s) that occurred seven (7) days prior to classification of the D-3 Drought Extreme Classification. The Contractor shall receive compensation for up to four (4) additional drought waterings performed seven (7) days prior to the classification f D-3 Drought Extreme and four (4) additional waterings during the seven (7) day period after the U.S. Drought Monitor has classified the City of Madison as D-3 Drought Extreme. The Contractor will not receive double payments for waterings during periods of consecutive weeks of D-3 Drought Extreme Status.

C. The request for additional watering(s) will be made on a weekly basis according to the weekly reports from the U.S. Drought Monitor.

D. In the event that there is a significant rainfall (> 1"), after the U.S. Drought Monitor has classified the City of Madison as D-3 Drought Extreme, the Contractor must notify the Architect of the revised dates of additional watering(s) that will occur within the next seven (7) days.

E. The Architect shall not be held responsible for informing the Contractor that additional watering(s) are necessary because of the D-3 Drought Extreme status by the U.S. Drought Monitor. Plants that perish or do not thrive because of lack of watering(s) shall be the responsibility of the Contractor per below sections ACCEPTANCE and GUARANTEE.

3.11 ACCEPTANCE

A. Upon completion of all required planting, and inspection of the work will be made by the Architect. All plants which are dead or found not to be in a normal, healthy condition or do not conform to specifications, in the judgement of the Architect, will not be accepted. All rejected work shall be replaced by the Contractor, including removal and repair of all work affected by the replacement, at no cost to the City.

3.12 GUARANTEE

A. Plants shall be guaranteed for two years from the date on the certificate of completion.

B. At any time within the period of the guarantee, the Contractor shall replace any plant which, for any reason, has died or is in a dying condition, or which has failed to flourish in such a manor or to such a degree that its usefulness or appearance has been impaired. Replacement shall include removal and repair of all affected work. The decision of the City as to the necessity of replacing any plants shall be conclusive and binding on the Contractor. No more than two (2) replacements per plant shall be required after acceptance.

C. Following completion of the replacements, a re-inspection will be made prior to final acceptance.

D. All replacement plantings are to be selected and tagged by the Architect prior to being brought to the job site. It is the responsibility of the Contractor to notify the Architect forty-eight (48) hours prior to any replacement plantings as to what they are to be planting and in what location.

E. Prior to the termination of the guarantee period, the Contractor shall request a final inspection by the City. All plants found unacceptable for reasons herein before stated shall be replaced at the first planting season and thereafter the responsibility for such plants or material shall lie with the City, no additional guarantee period will be required for these plantings.

END OF SECTION

SECTION 33 11 00
WATER UTILITY DISTRIBUTION PIPING

PART 1 - GENERAL

1.1 SCOPE

A. This section includes information common to water distribution system components and applies to all sections in this Division.

B. Madison Water Utility shall be involved in the following tasks, but are not necessarily limited to, water main filling, flushing, testing, and live-tap installations. Schedule all Water Utility supplemental construction services to occur between the hours of 7:00 AM and 3:00 PM, Monday through Friday. Requests for construction services occurring outside of these hours will be subject to any associated overtime charges being billed to the Contractor. Madison Water Utility reserves the right to decline any construction services which are requested to occur outside of the approved hours. No live-tap installations shall be scheduled to occur outside of the approved hours unless authorized in writing by Madison Water Utility.

C. Contractor shall be solely responsible for obtaining all permits necessary to complete the work. Contractor shall pay all fees associated with obtaining permits. These include, but are not limited to permits for work within public right-of-way, street opening permits, testing, utility connection permits, plumbing permits and municipal fees for completing work (e.g. live taps and water connections to City main).

D. All work shall conform to the City of Madison's Standard Specifications Part VII – Water Mains and Service Laterals. The specifications can be found here: http://www.cityofmadison.com/business/pw/documents/StdSpecs/2017/Part7.pdf

END OF SECTION

SECTION 33 30 00
SANITARY SEWERAGE UTILITIES

PART 1 - GENERAL

1.1 SCOPE

A. This section includes information common to sanitary sewage utilities and applies to all sections in this Division.

B. This specification shall apply to all sanitary sewer work beginning at a point five 5' outside of the building wall, unless otherwise specified.

C. Construct sewer system in a manner that will facilitate future extension or connection.

D. Review plans prior to installation, and notify Construction Representative if proposed design does not appear to accommodate future extension or connection.

E. When drawings indicate future connection at a manhole or other structure, install a full length of pipe beyond the structure, providing plugged bell at terminal end of pipe. Provide marker board at terminal end of stubbed pipe.

F. Contractor, prior to excavation work, shall notify all utilities, governmental agencies, or entities, known to, or which can reasonably be assumed to, have above or below ground pipe, conduit cables, structures or similar items within limits of project, to locate and mark location of such items. The Contractor shall expose potential pipe conflicts prior to installation of sewers to allow for any field changes to the design to be made.

1.2 REFERENCE STANDARDS

A. Work under this section depends on applicable provisions from other sections and the plan set in this contract. Examples of related sections include, but are not limited to:

1. Division 31 — Earthwork

B. ASTM - American Society for Testing and Materials

1. ASTM C425-04 Standard Specification for Compression Joints for Vitrified Clay Pipe and Fittings

2. ASTM C700-05 Standard Specification for Vitrified Clay Pipe, Extra Strength, Standard Strength, and Perforated

3. ASTM D1784-03 Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated

4. ASTM Poly(Vinyl Chloride) (CPVC) Compounds

5. ASTM D2235-04 Standard Specification for Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings

6. ASTM D2564-04 Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems

7. ASTM D2680-01 Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) and Poly(Vinyl Chloride) (PVC) Composite Sewer Piping

8. ASTM D3034-04a Standard Specification for Type PSM Poly (VinylChloride) (PVC) Sewer Pipe and Fittings

9. ASTM D3212-96a(2003)e1 Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals

10. ASTM D3350-05 Standard Specification for Polyethylene Plastics Pipe and Fittings Materials

11. ASTM D4673-02 Standard Classification System for Acrylonitrile-Butadiene-Styrene (ABS) Plastics and Alloys Molding and Extrusion Materials

12. ASTM F477-02e1 Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe

13. ASTM F679-03 Standard Specification for Poly Vinyl Chloride (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings

C. AWWA - American Water Works Association

1. AWWA C104/ANSI A21.4-95 Standard For Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water

2. AWWA C151/ANSIA21.53-00 Standard for Ductile Iron Pipe, Centrifugally Cast for Water or Other Liquids

3. AWWA C153/A21.53 Standard for Ductile Iron Compact Fittings for Water Service

D. Where these specifications do not cover portions of the work to be undertaken, the City of Madison Standard Specifications for Public Works Construction, current edition, shall govern the work, hereafter called "Standard Specifications" in this spec section.

1.3 SUBMITTALS

A. Provide reports documenting pressure testing, mandreling, and televising.

B. Maintain record drawings that show the actual locations, sizes, and types of utilities and other features encountered.

C. Note any modifications to proposed sewer system size, location, or elevation. Record any other deviations from the drawings. Record drawings shall be in compliance with specification section 01 78 39 Asbuilt Drawings. Record drawings shall also include digital record site plans generated by the land surveyor contractor.

PART 2 - PRODUCTS

2.1 PIPE

A. Provide the size, type, and class/schedule of pipe as indicated on the drawings.

B. Use only pipe supplied from the same manufacturer, and of the same type, unless otherwise specified or approved in advance by the Engineer.

C. Only pipe, joints, material and installation approved by Wisconsin Department of Natural Resources and/or the Department of Commerce for the intended use in the State of Wisconsin shall be used.

D. Install all pipe in accordance with ASTM specifications which pertain to the specified type of pipe material and the installation situation.

E. Do not use any pipe or fittings cracked in cutting or handling or otherwise not free from defects.

F. Clean all pipe of any dirt and/or debris both inside and out prior to placing in the trench.

G. Make joints in accordance with manufacturer's directions with due care to avoid damaging pipe and/or disturbing previously laid pipe.

H. Cut pipe only according to manufacturer's directions.

I. Lay all sewer pipes to horizontal alignment and grade shown on the plans with bell ends up hill. Establish and maintain horizontal alignment using total station, transit or theodolite. Use pipe laser or level to establish and maintain grade of pipe. Discrepancies from the required horizontal alignment or grade at any location shall not be greater than 0.10' or 0.05', respectively.

J. Do not exceed specified trench widths.

2.2 PVC PIPE

A. Polyvinyl Chloride (PVC) pipe fittings shall meet the requirements for type PSM Polyvinyl Chloride (PVC) Sewer Pipe and Fittings of ASTM D3034 for pipe sizes up through 15 inches and ASTM F679 for pipe sizes 18 inches through 36 inches. All PVC sanitary sewer pipe shall have a maximum standard dimension ratio (SDR) of 35.

B. The wall thickness shall conform to requirements for a T-1 wall per ASTM F69-01. PVC material shall have cell classification 12454-B or 12454-C as defined in ASTM D1784 with minimum modulus of elasticity of 400,000 psi in tension. Pipe stiffness shall be minimum 46 psi when tested in accordance with ASTM D2412.

C. Acceptance of piping shall be subject to tests conducted by an approved testing agency.

D. Pipe and fittings shall be the product of one manufacturer and the manufacturer shall have experience records substantiating acceptable performance of the pipe to be furnished.

E. Fittings such as saddles, elbows, tees, wyes and others shall be of material and construction corresponding to and have a joint design compatible with the adjacent pipe. Approved adapters shall be provided for transitions to other types of pipe. Fittings shall be injection molded PVC.

F. Joints shall be of the elastomeric type. Elastomeric joints shall be a bell and spigot joint conforming to ASTM D3212 sealed by a rubber gasket conforming to ASTM F477 so that the assembly will remain watertight under all conditions of service, including the movements resulting from the expansion, contraction, settlement, and deformation of the pipe. Bells shall be formed integrally with the pipe and shall contain a factory installed positively restrained gasket.

2.3 CONNECTIONS FOR DISSIMILAR PIPE MATERIALS

A. Where new sewer connects to and existing dissimilar pipe, the connection shall be made with a no hub type coupling meeting the requirements of CISPI 310. Couplings shall have neoprene gaskets with stainless steel shield, and multiple stainless steel clamps with worm gear tightening device. The couplings shall be made specifically for the type and size of pipe materials being connected. Couplings shall be Fernco RC Strongback.

2.4 PIPE INSULATION

A. Rigid closed-cell extruded polystyrene insulation shall be suitable for buried insulation.

B. Individual boards shall have dimensions of 8" x 4" x 2".

C. Insulation shall follow the requirements of COMM Code82.

D. Dow Styrofoam, or approved equal.

E. Provide insulation when indicated on the drawings or where depth of cover is less than 6'. Unless otherwise noted, install 2" thick polystyrene board insulation.

F. Install insulation on compacted initial cover material, 6" above the top of pipe. Stagger joints where more than one layer of insulation is required. Provide insulation with a minimum of 1' of initial cover material. Place cover and backfill material in a manner that does not damage insulation; replace any damaged insulation.

PART 3 - EXECUTION

3.1 BEDDING/INITIAL COVER

A. Sanitary sewer and sewer services shall be provided with 4" of bedding material and 12" of initial cover material (both measured at the bell of the pipe).

B. Crushed stone bedding shall be used for both bedding and initial cover.

C. Backfill within paved areas of R.O.W. shall consist of aggregate slurry.

3.2 CONNECTIONS TO EXISTING STRUCTURES

A. Make all necessary openings into existing structures or sewers including the reconstruction of existing inverts or benches, as necessary. Patch all openings permanently watertight with concrete brick and mortar, or hydraulic cement and water stops, or for sanitary sewer, hydraulic cement and flexible water tight boots.

3.3 SEWER LATERALS

A. Connect existing sewer laterals in accordance with all of the requirements of the sewer mains, including bedding, backfill, compaction and jointing of the pipe. Connect sewer laterals to the sewer main by means of an approved "wye" fitting. Connect the new pipe to the existing lateral material using a no-hub coupling or approved transition fitting. Coupling/fitting shall be selected for the specific pipe material being connected.

B. Subject to local municipality requirements, cut-in type saddle wyes are permitted on existing sanitary sewers where service laterals are to be connected to the sewer. Unless otherwise indicated, the saddle fitting shall be gasketed PVC with stainless steel bands and hardware.

3.4 ELECTRONIC MARKERS OVER LATERAL

A. Each sanitary lateral shall have a minimum of 2 electronic markers: One shall be located above the wye on the sewer main, and one shall be located above the lateral at the property line. Additional markers shall be placed at each change in horizontal direction. Markers shall be installed per manufacturer's written instruction.

B. The key constraint is the maximum depth of the marker. The signal range of the 3M™ Electronic Marker System (EMS) 4" EXTENDED RANGE 5' BALL MARKER - WASTEWATER (MODEL 1404-XR) is 5 feet.

C. Upon completion, the City will test each electronic marker to confirm that it is installed and functioning properly. If it is determined that the marker has not been installed correctly and/or is not functioning properly, the contractor will be responsible for the all work associated with the installation of a properly functioning marker.

3.5 LEAKAGE TESTING

A. All new sanitary sewer lines shall be leakage tested in accordance with the Low Pressure Air Test per 501.3(b).

3.6 SEWER TELEVISING

A. Sanitary sewers may be videotaped by OWNER. If videotaping reveals a defect that requires repair, CONTRACTOR shall reimburse OWNER for cost of videotaping that section of pipe. All sanitary sewers with defects, including but not limited to cracked or deformed pipe, misaligned joints, unsealed lift holes, and incorrect gradelines, as identified through videotaping, shall be re-laid or shall be paid for at 50% of the price bid. Relaying the pipe or reducing payment shall be at OWNER's discretion.

B. The Contractor shall provide to the Construction Representative with 2 copies of the televising tape or DVD.

3.7 ABANDON SEWER

A. Where indicated on the plans, existing sewer to be left in

B. Place shall be abandoned in accordance with the Standard Specifications. Sewer shall not be abandoned until existing services have been reconnected to the replacement sewer. Abandoning sewers is considered incidental to the construction.

C. In paved areas or current/future building pad areas, existing storm sewer facilities are required to be abandoned as follows:

1. Remove existing pipes or fill them with sand or grout and seal ends with a minimum 2-foot thick grout plug.

2. Remove existing inlets, catch basins, and manholes to at least 4 feet below finished grade. Provide a minimum 6 inch hole in the bottom of the structure and fill the remaining portion with bedding stone.

END OF SECTION

SECTION 33 40 00
STORM DRAINAGE UTILITIES

PART 1 - GENERAL

1.1 SCOPE

A. This section includes information common to storm drainage utilities and applies to all sections in this Division.

B. The work under this section shall consist of providing all work, materials, labor, equipment, and supervision necessary to provide for the storm sewer work required in these specifications and on the drawings. This specification shall apply to all storm sewer work beginning at a point 5' outside of the building wall, unless otherwise specified.

C. Construct sewer system to convey flow from the bioretention areas.

D. Review plans prior to installation, and notify Construction Representative of any concerns.

E. Contractor, prior to excavation work, shall notify all utilities, governmental agencies, or entities, known to, or which can reasonably be assumed to, have above or below ground pipe, conduit cables, structures or similar items within limits of project, to locate and mark location of such items. The Contractor shall expose potential pipe conflicts prior to installation of sewers to allow for any field changes to the design to be made.

1.2 REFERENCES

A. Work under this section depends on applicable provisions from other sections and the plan set in this contract. Examples of related sections include, but are not limited to:

1. Division 31 — Earthwork

B. ASTM - American Society for Testing and Materials

1. ASTM C76-05b Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe

2. ASTM C443-05a Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets

C. Where these specifications do not cover portions of the work to be undertaken, the City of Madison Standard Specifications for Public Works Construction, current edition, shall govern the work.

1.3 SUBMITTALS

A. Provide manufacturers product information, for storm sewer materials including pipe, fittings, structure, outfalls, and castings.

B. Provide reports documenting any required testing.

C. Maintain record drawings that show the actual locations, sizes and types of utilities and other features encountered. Record drawings shall be in compliance with specification section 01 78 39 Asbuilt Drawings. Record drawings shall also include digital record site plans generated by the land surveyor contractor.

D. Note any modifications to proposed sewer system size, location or elevation. Record any other deviations from the drawings.

PART 2 - PRODUCTS

2.1 PIPE (GENERAL)

A. Provide the size, type and class/schedule of pipe as indicated on the drawings.

B. Use only pipe supplied from the same manufacturer, and of the same type, unless otherwise specified or approved in advance by the Engineer.

C. When applicable, only pipe, joints, material, and installation approved by Wisconsin Department of Natural Resources and/or the Wisconsin Department of Safety and Professional Services (SPS) for the intended use in the State of Wisconsin shall be used.

2.2 REINFORCED CONCRETE PIPE

A. Pipe and fittings shall conform to ASTM C-76 for circular pipe and ASTM C-507 for elliptical pipe. Unless otherwise specified, provide Class III for circular pipe and Class HE-III for elliptical pipe.

B. Joints for reinforced concrete pipe shall be bell and spigot or tongue and groove. Joints shall be provided with rubber gaskets conforming to ASTM C433. Joints for elliptical pipe shall be provided with trowelable impervious bituminous joint sealer that is manufactured for sealing reinforced concrete sewer pipe joints.

C. When required, external sealing bands shall meet the requirements of ASTM C877 (Type II), and shall be Mar Mac Mac Wrap, or approved equal.

2.3 PVC PIPE (SOLID)

A. Conform to ASTM D-3034 with solvent weld or elastomeric joints. Pipe shall be SDR-26, unless otherwise noted. Pipe over 15 inches in diameter shall meet the requirements of ASTM F679-03.

B. The wall thickness shall conform to requirements for a T-1 wall. PVC material shall have cell classification 12454-B or 12454-C as defined in ASTM D1784 with minimum modules of elasticity of 400,000 psi in tension. The pipe wall shall be homogeneous and contain no seams. Minimum pipe stiffness per ASTM D2412 shall be 60 psi for pipe sizes through 18-inch and 46 psi for 21-inch and larger pipe sizes. Pipe shall withstand impact of 210 foot-pounds for pipe sizes through 8-inch and 220 foot-pounds on larger sizes.

C. Pipe and fittings shall be the product of one manufacturer and the manufacturer shall have experience records substantiating acceptable performance of the pipe to be furnished.

D. Fittings shall be injection molded. Fittings such as saddles, elbows, tees, wyes and others shall be of material and construction corresponding to and have a joint design compatible with the adjacent pipe. Approved adapters shall be provided for transitions to other types of pipe.

E. Joints shall be of the elastomeric type. Elastomeric joints shall be a bell and spigot joint conforming to ASTM D3212 sealed by a rubber gasket conforming to ASTM F477 so that the assembly will remain watertight under all conditions of service, including the movements resulting from the expansion, contraction, settlement and deformation of the pipe. Bells shall be formed integrally with the pipe and shall contain a factory installed positively restrained gasket.

F. All exposed end sections shall be provided with steel apron end walls.

2.4 HDPE PIPE (SOLID WALL AND SLOTTED)

A. Conform to ASTM-D-3350 for PE material with a cell classification of 335434C or better. Pipe shall be thermal butt fusion in accordance with manufacturer's recommendation.

B. Perforates pipe shall be Slotted HDPE pipe; ADS N12 with AASHTO Class I perforations, or approved equal.

2.5 CONNECTIONS FOR DISSIMILAR PIPE MATERIALS

A. Where new sewer connects to and existing dissimilar pipe, the connection shall be made with a no hub type couplings meeting the requirements of CISPI 310. Couplings shall have neoprene gaskets with stainless steel shield, and multiple stainless steel clamps with worm gear tightening device. The couplings shall be made specifically for the type and size of pipe materials being connected. Couplings shall be Fernco RC Strongback.

2.6 ROUND CATCH BASINS

A. Round catch basins shall be 48” (MIN) inside diameter precast concrete unless otherwise shown or required. (See plans for specific sizes.)

B. Submit manufacturer's preproduction (shop) drawings for approval prior to the start of manufacturing.

C. Contractor shall carefully locate all pipe locations, sizes, orientation and elevation prior to ordering catch basin.

D. Round catch basins shall meet the requirements of ASTM C478.

E. Pre-cast catch basin wall thickness shall be minimum of 5”.

F. Provide 8” (min.) thick pre-cast catch basin base. Catch basin bottom section may be pre-cast with integral base.

G. Catch basins shall be provided with precast reinforced concrete in-bell cover designed to accommodate AASHTO H20 loading. In-bell cover shall be provided with 24” opening for casting.

H. Joints

1. Catch basins requiring separate base and riser sections must be provided with standard pipe tongue and groove joints.

2. Seal joints watertight with prefabricated rubber or plastic gaskets or formed in place butyl rubber seal.

3. Joint sealers shall be Kent Seal, ConSeal or approved equal circular o-ring conforming to ASTM C443: Ramnek, Mas-Stik, butyl rubber gasket, or butyl rubber rope.

I. Connections

1. Provide custom knock-outs/cut-outs based on project and location specific conditions.

2. A minimum of 2” of the precast structure is required between the top of a knock-out/cut-out and the top of the structure. A minimum of 2” of precast structure is required between the side of a knock-out/cut-out and the inside face of an adjacent sidewall.

J. Steps

1. Provide steps at 16 inches o.c.± and project approximately 6" from wall.

2. Unless otherwise indicated on the drawings, locate steps over the downstream pipe opening.

3. Steps shall be steel reinforced polypropylene with 1/2-inch diameter deformed reinforcing bar. Steps shall be permanently secured in the catch basin wall. Steps shall be M.A. Industries No. PS1-PF or approved equal.

K. Flowline

1. Provide either pre-cast or cast-in-place flowline that provides positive flow through the structure. Provide bench that directs water towards the flowline.

2. Flowlines and benches shall be formed with gradual, uniform sweeps directed towards the downstream pipe. Provide smooth, troweled finish for flowlines.

L. Adjusting Rings

1. Adjusting rings shall be injection molded high density polyethylene (HDPE), manufactured by Ladtech,IPEX, or equal. Joints shall be sealed with approved silicone or butyl sealant in accordance with manufacturer's recommendations. Materials shall conform to ASTM D-1248 using 100% recycled material. Rings shall be tested to assure compliance in meeting H-20 loading capacity per AASHTO Standards.

2. Where casting adjustment requirements cannot be met by the use of HDPE adjustment rings and upon ENGINEER's approval, CONTRACTOR shall provide precast concrete adjusting rings. Fiber-reinforced pre-cast concrete adjusting rings meeting the requirements of ASTM C-478. Provide rings of 2" or 4" thickness.

3. Precompressed butyl gasket, 3/8"x3 ½" shall be used between the top of the manhole and first adjustment ring, and between all subsequent rings. Butyl material shall be E-Z Stick, or equal.

2.7 CASTINGS

A. All castings shall be heavy duty iron conforming to ASTM A48, Class 20 and rated for AASHTO H-20 loading. Provide non-rocking or machined castings with concealed pickhole.

B. Frames and grates shall be as noted on the plans.

C. Install casting type as indicated on the plans or in the specifications. If the plans and specifications are in conflict, the plans shall govern.

D. Provide butyl sealant material between last adjusting ring and casting base. Adjust casting elevation and slope to match adjacent proposed grades.

PART 3 - EXECUTION

3.1 LAYING PIPE

A. Install all pipes in accordance with ASTM specifications which pertain to the specified type of pipe material and the installation situation.

B. Do not use any pipe or fittings cracked in cutting or handling or otherwise not free from defects.

C. Clean all pipe of any dirt and/or debris both inside and out prior to placing in the trench.

D. Make joints in accordance with manufacturer's directions with due care to avoid damaging pipe and/or disturbing previously laid pipe.

E. Cut pipe only according to manufacturer's directions.

F. Lay all sewer pipes to horizontal alignment and grade shown on the plans with bell ends up hill. Establish and maintain horizontal alignment using total station, transit or theodolite. Use pipe laser or level to establish and maintain grade of pipe. Discrepancies from the required horizontal alignment or grade at any location shall not be greater than 0.10' or 0.05', respectively.

G. Do not exceed specified trench widths.

3.2 BEDDING/INITIAL COVER

A. Provide bedding and initial cover in accordance with the City of Madison Standard Specifications for Public Works Construction, current edition.

B. Storm sewer and sewer services shall be provided with 4" of bedding material and 12" of initial cover material (both measured at the bell of the pipe). Crushed Stone Bedding shall be used for both bedding and initial cover.

3.3 STRUCTURES (INLETS AND CATCH BASINS)

A. Contractor shall determine the proper location, size, elevation, and orientation of all pipes entering new structures before ordering. Do not connect abandoned pipes to new structures. Structures having improper location and/or orientation of the pipe connections will be rejected. Field repairs or adjustments of connection points are not permitted.

B. Limit the excavation for structures so as to provide only the necessary amount of space to sufficiently prepare the subgrade, set the base, set the structure, and lay pipe. Provide a minimum of 1' of clearance between structure and trench wall for adequate backfilling and compaction.

C. Where excavation occurs below the bottom elevation of the structure's base, bring the excavation to the required elevation by the use of compacted crushed stone bedding. A minimum of 8 inches of compacted Crushed Stone Bedding shall be placed below the bottom of the structure base.

D. Set structure base in accordance with elevation and location as indicated on the plans. Install base plumb and level. Install subsequent pre-cast sections in accordance with shop drawing layout. Provide watertight gaskets between each section.

E. Pour inverts with smooth surface draining to downstream pipe. Where two or more lines meet at an angle, provide curved channel. Slope bench or floor at 2 inches/ft towards flow channel.

F. Structures shall be provided with between 4" and 8" of adjusting rings, with the top adjusting ring being 2" thick. Provide butyl sealant material between rings. Once rings are in place, tuck point the exterior joint and provide the entire exterior surface of the adjusting ring riser with a coating of mortar.

3.4 CONNECTIONS TO EXISTING STRUCTURES

A. Make all necessary openings into existing structures or sewers including the reconstruction of existing inverts or benches, as necessary. Patch all openings permanently watertight with concrete brick and mortar, hydraulic cement, or flexible watertight boots.

3.5 ELECTRONIC MARKERS OVER LATERAL

A. Each sanitary lateral shall have a minimum of 2 electronic markers: One shall be located above the wye on the sewer main, and one shall be located above the lateral at the property line. Additional markers shall be placed at each change in horizontal direction. Markers shall be installed per manufacturer's written instruction.

B. The key constraint is the maximum depth of the marker. The signal range of the 3M™ Electronic Marker System (EMS) 4" EXTENDED RANGE 5' BALL MARKER - WASTEWATER (MODEL 1404-XR) is 5 feet.

C. Upon completion, the City will test each electronic marker to confirm that it is installed and functioning properly. If it is determined that the marker has not been installed correctly and/or is not functioning properly, the contractor will be responsible for the all work associated with the installation of a properly functioning marker.

3.6 LEAKAGE TESTING

A. Storm sewers shall be visually inspected for excessive water infiltration and soil leakage into sewers or structures. Contractor shall repair/correct any infiltration or soil leakage that is considered excessive by the Construction Representative.

3.7 SEWER TELEVISING

A. Storm sewers may be videotaped by owner. If video recording reveals a defect that requires repair, the CONTRACTOR shall reimburse the OWNER for the cost of videotaping that section of pipe. All storm sewers with defects, including but not limited to cracked or deformed pipe, misaligned joints, unsealed lift holes, and incorrect gradelines, as identified through videotaping, shall be re-laid or shall be paid for at 50% of the price bid. Relaying the pipe or reducing payment shall be at OWNER's discretion.

3.8 ABANDONMENT OF EXISTING STORM SEWER FACILITIES

A. Where indicated on the plans, existing sewer to be left in place shall be abandoned in accordance with the City of Madison Standard Specifications for Public Works Construction. Sewer shall not be abandoned until existing services have been reconnected to the replacement sewer. Abandoning sewers is considered incidental to the construction.

B. In paved areas or current/future building pad areas, existing storm sewer facilities are required to be abandoned as follows:

1. Remove existing pipes or fill them with sand or grout and seal ends with a minimum 2-foot thick grout plug.

2. Remove existing inlets, catch basins, and manholes to at least 4 feet below finished grade. Provide a minimum 6-inch hole in the bottom of the structure and fill the remaining portion with bedding stone.

END OF SECTION

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Facilities & Sustainability
Jeanne E. Hoffman, Manager

Mapping Section Manager
Eric T. Pederson, P.S.

Financial Manager
Steven B. Danner-Rivers

November 16, 2017

NOTICE OF ADDENDUM
ADDENDUM NO. 1

CONTRACT NO. 8027, PROJECT NO. 17451
MADISON FIRE STATION 14

Revise and amend the contract document(s) for the above project as stated in this addendum, otherwise, the original document shall remain in effect.

This addendum consists of the following documents:

1. **GENERAL CONTRACT CONDITIONS**

   Q1: We are working on soliciting SBE contractors for bids and have a question that should be addressed regarding the SBE list online before the SBE pre bid meeting for this project on 12/8. There are quite a few contractors on the list with expired SBE certification. Is this list up to date and are the companies shown with expired SBE certification no longer qualified?

   A1: The list published online as of 11/9/17 (version 10/3/2017-SBEDirectory.mdb) and up to 11/15/17 included SBE companies that are no longer certified SBEs. SBE's with certifications of 6/30/17 or before are no longer certified SBEs. SBE's with certifications of 9/30/17 or after are considered certified SBEs. An updated list of certified SBE companies is now available at https://www.cityofmadison.com/dcr/aaTBDir.cfm

2. **GENERAL QUESTIONS AND ANSWERS**
   No Change

3. **SUBSTITUTION REQUESTS**
   No Change

4. **SPECIFICATIONS**
   No Change

5. **DRAWINGS**
   No Change

6. **PROPOSAL**
   No Change

Please attach these Addendum documents to the Drawings and Project manual in your possession.

Please acknowledge this addendum on page E1 of the contract documents and/or in Section E: Bidder's Acknowledgement on Bid Express.

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December 8, 2017

NOTICE OF ADDENDUM
ADDENDUM NO. 3

CONTRACT NO. 8027, PROJECT NO. 17451
MADISON FIRE STATION 14

Revise and amend the contract document(s) for the above project as stated in this addendum, otherwise, the original document shall remain in effect.

This addendum consists of the following documents:

1. **GENERAL CONTRACT CONDITIONS**
   No Changes

2. **GENERAL QUESTIONS AND ANSWERS**

   Q1: Is there a detail for the handicap parking area or is it the same as the driveway?
   A1: Yes, the handicap areas are the same as the rest of the concrete pavement. This is noted by the same hatch colors as the rest of the pavement.

   Q2: I think your detail numbers are wrong on the site plan for the sidewalk and the thickened edge sidewalk?
   A2: Yes, there is a numbering error (should be 3, but it is 8 for thickened edge). Drawing will be updated.

   Q3: There are not any unit prices for EBS (excavation below subgrade). How will this be handled/paid for if poor soils are encountered and undercutting is required?
   A3: Unit pricing for pavement and slab on grade undercut were added to the proposal page. Unit pricing for sidewalk or pervious pavement unit pricing for undercut was deemed to not be necessary at this time. Since the foundation will be supported by piers/piles unit pricing for undercut was deemed to not be necessary at this time.

   Q4: We are to use a 50 ft depth for bidding purposes but the loads on some columns and on the foundation footers are so light that 50 ft is going to be way too deep before we would achieve actual loads called for on the drawings. I would assume then that as far as installation goes we are simply trying to achieve twice the design load no matter what that depth is or are we required to install to 50 ft?
   A4: The 50-ft depth is for bidding purposes only (as indicated in note 3 on S002), in order to get consistency between bidders. See spec section 31 26 00 for details on how this will work on the contract side. Proposal page was updated and now includes unit pricing for helical piles.

Q5. Are the loads shown on Sheet S002 individual pier loads or a total for the column location?
A5. Total column loads, not individual pier loads. Has been clarified via Addendum 3

Q6. If the loads shown on Sheet S002 are individual pier loads, the shear loads may be high. Can the shear load be resisted using battered piers? If so, provide the shear direction.
A6. See answer above.

Q7. Can shorter pier lengths (i.e., less than 50') be used if load tests are performed and confirm an adequate Factor of safety?
A7. Per specification 31 2600, section 1.5, A, the safety factor can be revised if load tests are performed. Refer to section 1.6 and the drawings for length of pier required for bidding purposes.

Q8: Can you provide the roof slope?
A8: Run is ~225' (ignoring the wing wall at the north end). Rise is ~12'. Slope is ~3 degrees or approximately 1/2" / 1'-0".

Q9. Are the washer and dryers OFCI?
A9. No, they are Owner Furnished Owner Installed.

Q10. Please provide a spec for cubicle track and curtain per note 31 on A101.B
A10. Specification 10 21 23 was added to Addendum 3.

Q11. Is the ice machine per note 52 on A101.B and shown on 2/A401 OFCI?
A11. No, it is Owner Furnished Owner Installed.

Q12. There is a spec for sanitary napkin holders but they're not shown on the drawings. Please advise on quantities. 1 per bathroom?
A12. Sanitary Napkin Holders were removed from project. Specification has also now been removed.

Q13. Mop/Broom holders are shown in the drawings but there's no spec provided in 10 28 00. Please include.
A13. Specification 10 28 00 revised to include Mop/Broom information.

Q14. There appears to be a shower seat and a shower grab bar in the shower in Unisex ADA 135 but no spec on those. Is this part of the project? If so, please add a spec if we're to provide.
A14. Specification 10 28 00 revised for restroom accessories.

Q15. Per note 26 on A101.B as shown in rooms 136 and 137 we are to provide some folding seats, but there's no spec. Please provide.
A15. Specification 10 28 00 revised for restroom accessories

Q16. On 27/A404 there is an outline of a detox sauna. We don't need to provide or install that correct?
A16. Correct, the detox sauna is Owner Furnished Owner Installed.

Q17. The Kitchen hood does not appear on the equipment schedule. What Kitchen hood is

being specified?

A17. Refer to Keynote 4 on M101 and Specification Section 23 37 00 for additional information.

Q18. Can you provide specs for the roof insulation on this project? I can't find any reference to thickness, r value, density, etc in either 07 21 00 or 07 41 13. I also need to know if this is intended to be a nailbase insulation?

A18. Refer to 5/A002 Assembly Types. Roof Detail assemblies, insulation type, minimum R-Value/Inch are listed. The insulation in NOT intended to be a nailbase.

Q19. On A141, note 5 & 7 have the same description but different hash markings. Are they the same system or two different systems?

A19. Keynote 5 is snow drift protection, Keynote 7 is ice break. The difference of system depends on manufacturer selected.

Q20. In specification section 05012 23, page 4, paragraph 1.4, item 4. It is called out for AESS steel. Where on the drawings does this section apply to?

A20. The canopy utilizes AESS Steel.

Q21. On A141, note 4 talks about roof safety equipment tie-off hooks. What are they? There is no mention of them further in the plans or specs.

A21. Information regarding fall protection system has been added to A141 in Addendum 3. Additional information was included in Structural drawings for Addendum 2.

Q22. Page A601 has tile at 8 foot high walls but when you add the tile sizes up per drawing the tile add up to 12 feet high

A22. The accent band tile begins at A.F.F. Tile pattern continues above accent band as required.

Q23. There is a spec for turn out gear lockers, but note 5 on A101.B says they're OFCI. Is that spec for our reference or do we actually need to supply them? Please advise.

A23. No, Turn-out Gear Lockers Contractor Furnished Contractor Installed. Note has been revised in Addendum 3.

Q24. The spec for window shades has manual and motorized shades. However, I can't find anything on the plans showing which windows receive shades and if they're manual or motorized. Please advise.

A24. Drawings have been revised. Refer to A121

Q25. Working on the Fire Station 14 project and have looked through plans searching for the location of the fabric wrapped AC panels. Can you point me in the direction of the location of these, please? Also, can you confirm the only location for Resilient Athletic Flooring is in the Fitness room?

A25. Fabric Wrapped AC panels have been removed from the project, The Athletic flooring is only in the Fitness, There are non-athletic rubber tiles in other locations and Resilient flooring (urethane flooring) is also in the apparatus bay and other locations.

Q26. Section 074213.23 - 1.1 C lists interior column covers– are there interior column covers?

A26. No.

Q27. 074213.23 - 2.3 – 1 states 3mm for panel thickness – this should be 4mm – 3mm is flimsy and used for gas station canopies – 4mm is industry standard for commercial buildings – can this be changed to 4mm
A27. Yes. 4mm is the basis of design. This has been updated in the specs.

Q28. 074213.23- 3.3 – ACM is already a tested system and the barrier is supposed to make the building water tight. Can the field testing be eliminated?
A28. Yes. Removed from Specifications

Q29. 074213 - 2.1 C & 2.2 A -2a – you are listing 2 different thermal girts – the cascade clip is a non-continuous clips spaced within the insulation and need a continuous galv zee off the front of it to attach the panel system to and the smart ci girt is a continuous zee you can attach your panel system to – please research these and eliminate one from the spec.
A29. The (2) options are considered equal and will remain in the specifications. The (2) fiberglass clips selected to ensure a competitive bid. The unique detailing from either system is addressed via the "Contractor's Option" added to A002.

Q30. 074213 – 2.3 – A 10 – copings are picked up by roofer and should be eliminated –there is not a coping above the phenolic
A30. I cannot find the reference to the spec item listed. Check the revised specifications to make sure the referenced spec is still listed.

Q31. Can a section cut of the wall be provided for the phenolic on the east side of the building between column lines 8 & 11?
A31. No. Please refer to SIM details (specifically from A311)

Q32. 074213 – 3.5 – field testing should be eliminated – this is an open joint system – the barrier is supposed to make the building water tight and this would be a waste of money- can this be eliminated?
A32. Yes. Field testing requirement is removed for OPEN joint systems.

Q33. Is the same ACM jamb wrap required at the jambs of the curtain walls above the overhead doors – no detail is given – ex cw13,cw14,cw15,cw16,cw17,cw18,cw19?
A33. Yes. The ACM jambs are needed to insulate the structural steel angle.

Q34. The #14 sign that is called out to be phenolic is too wide for the panel sheet available (sheet size is 48" x 96") and will have to have a joint in it. Would you like to reduce the sign to fit into the sheet size parameters or have a joint in the #4 of the sign at the size currently shown?
A34. Building Signage has been revised. Please refer to A220 with Addendum 3.

Q35. All the cabinets are laminate with 3mm edge banding but no colors are listed on the finish schedule on A601.
A35. Color to be selected by architect from supplier full line of laminate selections.

Q36. Stainless steel cabinets, 5/A403 notes reference stainless steel cabs and tops. Sections 5, 6, and 7 only show stainless tops with p.lam cabinets. Please confirm they are stainless cabinets.
A36. All Cabinets in the Kitchen (including the island) are stainless steel with a stainless steel counter top. The section references a typical configuration.

Basis of Design: Stainless Steel Kitchens, Inc Designer-MP Series Stainless Steel and Marine Plywood Cabinets and Countertops

Cabinet Specifications

Cabinet Body	Heavy duty 5/8" marine plywood, with Wilsonart laminate (fashion grey)
Doors and Drawers	Exteriors covered with 18 ga, 304 #4 stainless steel (marine plywood core)
Shelves	Marine plywood, laminated with Wilsonart laminate
Toe Kicks	Not included. Cabinets sit on terrazzo base that will remain in place.
Handles	Stainless Steel Rod Handle
Construction	All components securely assembled using stainless steel fasteners and corner stiffeners. Very rigid cabinet. Fully assembled and ready to install. Dimensions and quantity per plans.
Functional Hardware	Blumotion "clip top" (removable without tools). Concealed, 125 degree open. All metal (nickel plate) Adjustable X, Y, Z axis. Rated 200,000 cycles Soft close feature. Slides: Blumotion full extension drawer slides, with stainless steel drawer sides. Soft close feature.
Style	Frameless, with full overlay doors and drawers.

Q37. Do the roof safety tie-offs penetrate the standing seam metal roof? If so, where is the detail?

A37. Yes. See Addendum 3 – Detail 3/A141.

Q38. Is there a spec for the roof type 1 acoustical deck?

A38. Yes. Acoustical Steel Decking is detailed in 05 31 00 "Steel Deck" Part 2.2.

Q39. Is there a spec for the roof insulation?

A39. This spec was missing from 07 21 00. Roof insulation requirements have been added to 07 21 00 as part of Addendum 3.

3. **SUBSTITUTION REQUESTS**
No further substitution requests will be evaluated. Deadline for submission was 12/1/17.

APPROVED

04 20 01	Custom Cast Stone (Masonry Veneer)
05 31 00	Versa Dek 3.5 LS Acoustical (Structural Decking)
07 21 00	Thermal Insulation – Mineral Wool (Johns Manville)
07 42 13	Composite Wood Veneer Panels (Parklex via Arcspec)
07 42 13.2	Composite Wood Veneer – Fiberglass Clips (Cascadia via Tegan)
08 62 23	Skylights – Velux
10 22 43	Sliding Glass Partitions – Sunflex
10 51 10	Turnout Gear Lockers – Weldon Company, LLC (Ready Rack)
10 51 13	Welded Metal Lockers – Weldon Company, LLC (Tiffin Metal Products)
23 21 00	Expansion Tank – John Wood
23 21 00	Glycol Feed – John Wood
31 26 00	Helical Pier – Techno Metal Post
31 26 00	Helical Pier - Helical Anchors Inc. (Veit)

DENIED (NOT APPROVED)

04 20 01	RockCast (Masonry Veneer)
07 41 13	Meatal Roof Panels – Berridge Standing Seam
08 45 10	Insulated Translucent Wall Panel System – Kalwall
08 45 10	Insulated Translucent Wall Panel System – Exterior Technologies
08 62 23	Skylights – Tubular Skylights, Inc
10 22 43	Sliding Glass Partitions – Panda Windows and Doors
12 24 13	Window Blinds – CE Contract
12 24 13	Window Blinds – SWF Contract
23 25 00	Vector Industries, JL Wingert and Neptune
23 52 16	Condensing Boilers – Laars
32 14 13.19	H20 Pavers – County Materials
--	Heat Trace / Snow Melt – not used on this project

4. **SPECIFICATIONS**

07 21 00 – MODIFIED to include polyisocyanate roof insulation requirements

07 42 13 – DELETED 3.5

07 42 13_23 - MODIFIED Aluminum Composite Panels to 4mm thickness (2.3 A 1) and DELETED 3.5

08 43 13 - MODIFIED Aluminum-Framed Storefronts to painted per drawings (2.2 A)

08 44 13 – MODIFIED BSD-Glazed Aluminum Curtain Walls to painted per drawings (2.5)

08 71 00 – MODIFIED door hardware to update hardware packages

08 80 00 – MODIFIED BSD-Glazing to include spandrel glass (2.5 B)

10 21 23 - ADDED Cubicle Curtains and Track section

10 28 00 - REVISED BSD-toilet accessories

Removed sanitary napkin dispenser per plan

Added Mop/Broom holders

Added shower seat

23 74 23.13 – REVISED paragraph 2.1, B, 5 to the following:

"5. Controls shall include terminal connections for burner modulation and supply fan start/stop and vfd alarm."

31 26 00 – REMOVED line 21 from section 1.9, B.

31 26 00 - REVISED section 1.6, E to the following:
"Adjustments in the Contract Price will be made due to changes in the number and length of piles, based on unit prices provided on the proposal page as follows:"

32 11 23.33 – MODIFIED language in paragraph 3.3A to coordinate undercutting with proposal page (unit costs).

5. **DRAWINGS**

A002 MODIFIED - Rain-screen Wall Type Assemblies to show 1" vertical air space and information regarding Contractor's Option

A003 MODIFIED - Code Review per DSPS review comments. Reclassification of "S-2 Warehouse" and lower occupancy mezzanine count to comply with IBC 1104.4.

A101.B CLARIFICATIONS to procurement keynotes

- Keynote 5 – Turnout Lockers – CFCI
- Keynote 45 – Commercial Washer – OFOI
- Keynote 46 – Commercial Dryer – OFOI
- Keynote 52 – Ice Machine – OFOI
- Keynote 63 – Detox Sauna – OFOI
- Keynote 64 – Laundry Extractor – OFOI
- Keynote 65 – Gear Dryer – OFOI

A102 MODIFED – Wire Mesh Partition Fence and ADDED plywood shelving to comply with DSPS review comments

A121 ADDED – Locations for Manual and Automatic Roller Shades, CLARIFIED ceiling cloud edge trim

A141 MODIFIED – Fall Protection Spacing, ADDED Roof Safety Tie-Off Detail

A220 MODIFIED – Rainscreen wall type to show 1" air space and information regarding Contractor's Option. REVISED Building signage "14"

A311 ADDED – Access Hatches in overhang void spaces – typ.

A341 REVISED – Tube connection for channel fascia at parapet connection

A343 REVISED – Tube connection for channel fascia at parapet connection

A403 ADDED – Kitchen Hood Exhaust chase with (2) access hatches at elbows to be coordinated in field

A407 CLARIFIED – (14) Personal Lockers – CFCI

A601 REVISED – Typical PCT wall layout, MODIFED Ceiling Finish and Remarks in Room Finish Schedule

C201 REVISED Detail Callout for Thickened Edge 3/C301

C301 MODIFIED Undercut Section 11/C301

C302 MODIFIED Permeable Pavement Notes

EL101 REVISED - lighting layout to match with shifting walls. Add downlight to lieutenant restroom to match its larger square footage.

EP101 REVISED - receptacle layouts to match with shifting walls.

M101 REVISED - location of control sensors.
M102 REVISED - location of DDC control panels.

M451 REVISED - Apparatus Bay Controls.

M500 REVISED - mechanical equipment schedules

P101 REVISED - sanitary and vent routing due to revised floor plans.

P102 REVISED - sanitary and vent routings.

P104 REVISED - orientation of solar collector array.

P200 REVISED - sanitary, vent, and domestic water routings due to revised floor plans.

P400 REVISED - sanitary and vent isometrics due to revised floor plans.

P401 REVISED - sanitary and vent isometrics due to revised floor plans.

P402 REVISED - domestic water isometrics due to revised floor plans.

P500 REVISED - plumbing material list descriptions.

S002 REVISED - note regarding foundation loads.

S101 REVISED - continuous footing schedule.

S102 REVISED - lintel schedule and lintel on east side of building.

S103 ADDED – information regarding fascia detailing. Add solar panel support framing. Revise lintel on east side of building.

S301 ADDED – detail 10.

S401 REVISED - details 10 and 15.

S402 REVISED - wall elevations 1 and 3.

S501 REVISED - detail 5. Add detail 15.

S502 REVISED - details 2, 3, 4, 5, 11, 12 and 13.

6. **PROPOSAL**

Proposal page was updated to reflect unit pricing for undercut of pavement and slab on grade.

Proposal page was also updated to reflect unit pricing for helical piles (if used).

Please attach these Addendum documents to the Drawings and Project manual in your possession.

Please acknowledge this addendum on page E1 of the contract documents and/or in Section E: Bidder's Acknowledgement on Bid Express.

Electronic version of these documents can be found on the Bid Express web site at:

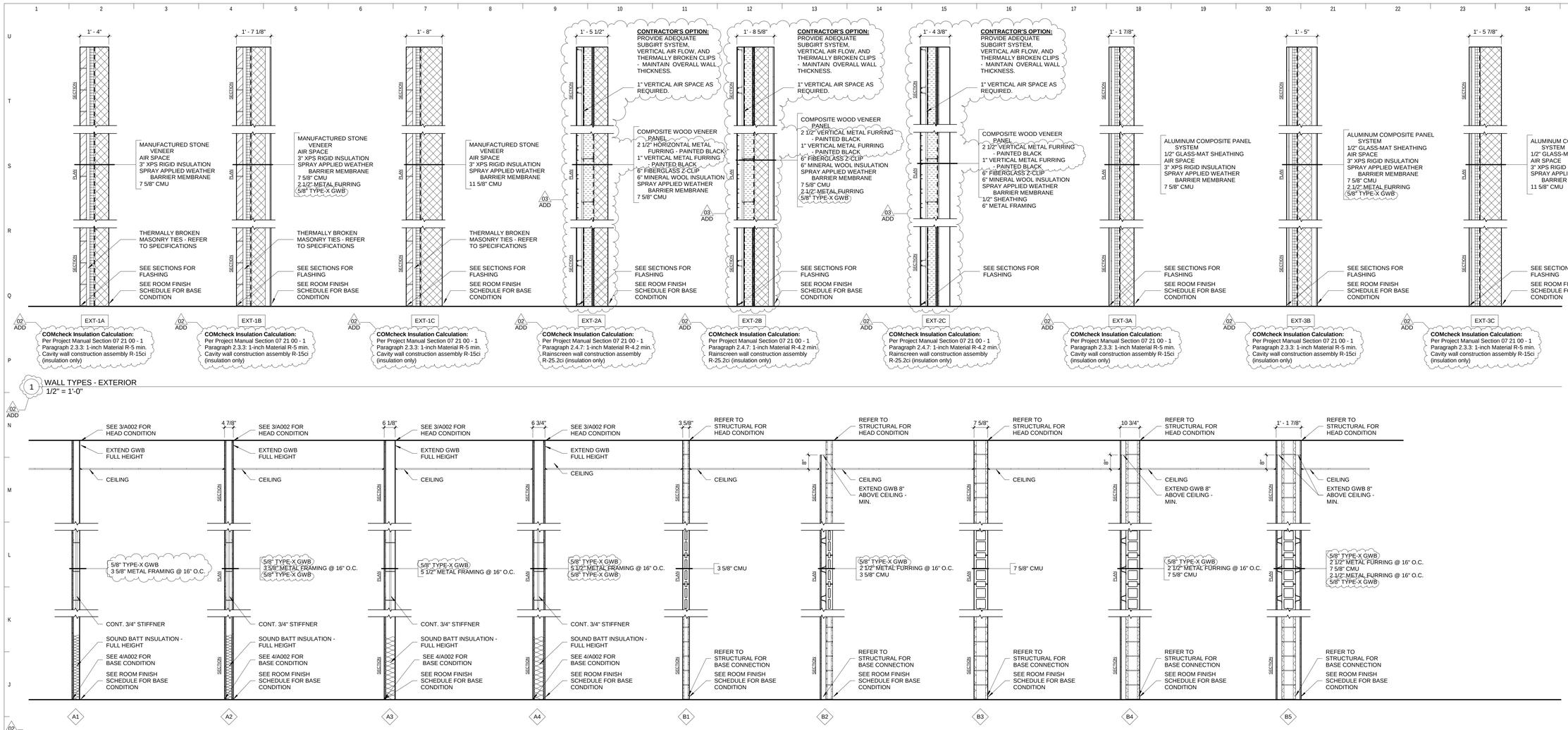
http://www.bidexpress.com

If you are unable to download plan revisions associated with the addendum, please contact the Engineering office at 608-266-4751 receive the material by another route.

Sincerely,

Robert F. Phillips, P.E., City Engineer

Cc: Greg Fries, Kathy Cryan



1 WALL TYPES - EXTERIOR
1/2" = 1'-0"

2 WALL TYPES - INTERIOR
1/2" = 1'-0"

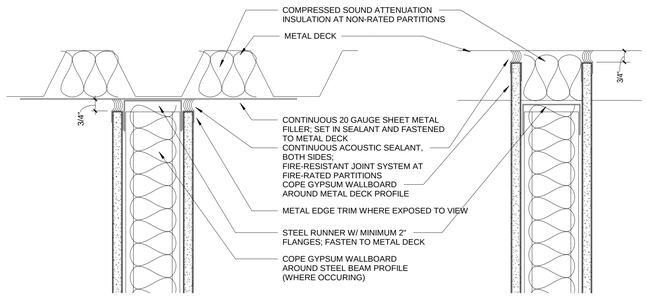
02 ADD

FIRE RATED WALL LEGEND

WALLTYPE	FIRE RATING	STC RATING	UL NUMBER
A1	--	--	N/A
A2	1 HR	51	U419
A3	--	--	N/A
A4	1 HR	51	U419
B1	1 HR	40	U905
B2	1 HR	45.8	U905
B3	1 HR	55	U905
B4	1 HR	60.8	U905
B5	1 HR	61.2	U905

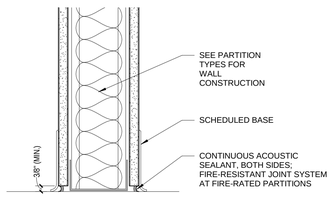
GENERAL NOTES

1. REFER TO CODE PLANS ON A003 FOR FIRE RATED ASSEMBLY LOCATIONS AND RATING REQUIREMENTS

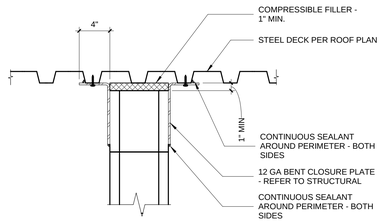


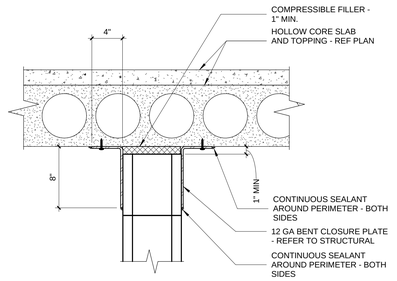
NOTE:
FASTEN STEEL RUNNER TO METAL DECK; FRICTION FIT METAL STUDS TO RUNNER AND FASTEN GYPSUM WALLBOARD TO STUDS (DO NOT FASTEN TO RUNNER); MAINTAIN GAP AS INDICATED BETWEEN METAL DECK AND METAL STUD / GYPSUM WALLBOARD TO ACCOMODATE DEFLECTION OF STRUCTURE

3 TYPICAL HEADS AT METAL STUD PARTITIONS
3" = 1'-0"

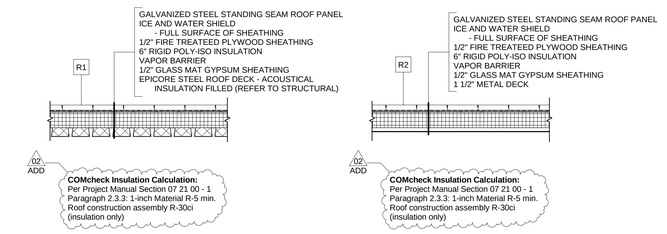


4 TYPICAL BASE AT METAL STUD PARTITIONS
3" = 1'-0"





6 TYPICAL HEADS AT CMU PARTITIONS
1 1/2" = 1'-0"



5 ROOF TYPES
1/2" = 1'-0"

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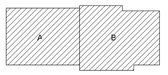
Key Plan



Sheet Issue Date
BID DOCUMENTS 11/03/17

Revision	Date
ADDENDA #2	11/22/17
ADDENDA #3	12/06/17

BID DOCUMENTS

Drawing
ASSEMBLY TYPES

City of Madison Contract No. **8027**
OPN Project No. **17207000**

A002

Code Summary

Applicable Code
Wisconsin Commercial Building Code - Wisconsin Department of Safety and Professional Services Chapters SPS 360- SPS 366 incorporating:
International Building Code 2009
International Energy Conservation Code 2009
International Mechanical Code 2009
International Fuel Gas Code 2009
International Existing Building Code 2009
ICC/ANSI Standard A117.1 for Accessibility

Building Description
The City of Madison Fire Department Station 14 is a proposed new structure comprised of approximately 19,232 GSF on 1 story and a 2,526 GSF mezzanine. Station 14 represents a hybrid as a City of Madison Fire Department training facilities and a functioning station, including a community room/training room.

Proposed Uses include: Apparatus bays (6), offices, kitchen, fitness and sleeping facilities for fire personnel, and a multipurpose training and community room.

Occupancy Classification: B (with Separated and Non-separated uses)
Type of Construction: II-B
Building Height: 30'-0" – One Story

Proposed Building will be have an Automatic Sprinkler System per IBC Section 903.

Total Gross Building Area: 19,232 GSF*
Total Fire Area: 21,758 GSF**

***505.1 General -** A mezzanine or mezzanines in compliance with section 505 shall be considered a portion of a story in which it is contained. Such mezzanines shall not contribute to either the building area or number of stories as regulated by Section 503.1. ...

****505.1 General (Cont) -** The area of the mezzanine shall be included in determining the fire area defined in Section 902.

Building Code Summary

Chapter 3 – Use and Occupancy Classification
303 Assembly Group A-3 - Occupancy consists of a duel-functioning training room and community room, capacity based unconcentrated seating of 15 SF per occupant.

304 Business Group B - Occupancy includes: offices, work rooms, small storage rooms, training and meeting rooms, day and break rooms, restrooms, and building support rooms.

310 Residential Group R-2 - Occupancy includes sleeping rooms for fire fighting personnel.

311.3 Storage Group S-2 - Occupancy for low-hazard storage of fire fighting vehicles and apparatus, and equipment.

Chapter 4 – Special Detailed Requirements Based on Use and Occupancy
420.2 Group R Separation Walls - Walls separating dwelling units in the same building, walls separating sleeping units in the same building and walls separating dwelling or sleepin gunits from other occupancies contiguous to them in the same building shall abe constructed as fire partitions in accordance with Section 709.

709.3 Fire-resistance rating - Fire Partitions shall have a fire-resistance rating of not less than 1 hour.

Excpetion 2 - Dwelling units and sleeping units separations in buildings of Type IIB...construction shall have fire-resistance rating of not less than 1/2-hour in building equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.1.

Chapter 5 – General Building Heights and Areas
508.3.1 - Non-Separated Occupancies - Building or portions of building that comply with the provision of this section shall be considered as non-separated occupancies.

508.3.2 - Allowable building area and height - The allowable building area and height of the building or portion thereof shall be based on the most restrictive allowances for the occupancy groups under consideration for the type of construction of the building in accorance with Section 503.1.

The most restrictive height and area allowances for Madison Fire Station 14 is Occupancy B. For the purposes of height and area calculations Occupancy Group B shall be utilized. Areas with S-2 occupancy shall be treated as NON-SEPARATED occupancies. Occupancy Groups A-3 and R-2 shall be treated as accessory occupancies to the main occupancy as they each represent less than 10 percent of the First Floor building area.

The seperation walls for the dwelling units are still required to comply with 420.2.

Table 503 – Allowable Building Height in Feet above the Grade Plane
Occupancy Group B or Type II-B Construction with Spinkler System Increase per 504.2

	Allowable	Proposed
Height	75 ft	*<30 ft*
Stories	4 Stories	*1 Story*
Area	69,000 sf	*19,232 sf*

The proposed Madison Fire Station 14 complies with the allowable building heights and areas when classified as B occupancy.

505.1 (Mezzanines) General - A mezzanine or mezzanines in compliance with Section 505 shall be considered a portion of the story in which it is contained. Such mezzaninse shall not contribue to either the building area or number of stories as regulated by Section 503.1

505.2 Area Limitations - The aggregate area of a mezzanine or mezzanines within a room shall not exceed one-third of the floor area of that room or space in which they are located.

505.3 Egress - Each occupant of a mezzanine shall have access to at least two independent means of egress where the common path of egress travel exceeds the limitations of Section 1014.3

Exception - A Single means of egress shall be permitted in accordance with Section 1015.1

1015.1 Exits or exit access doorways from spaces - two exits or exit access doorways from any space shall be provided where one of the following conditions exists:

Exception - Where a buildng contains mixed occupancies, each individual occupancy shall comply with the applicable requirements for that occupancy.

Table 1015.1 Spaces with one exit or exit access doorway
A,B = 49 Occupants
R = 10 Occupants
S = 29 Occupants

Permitted and Non-permitted use of the mezzanine space
Occupancy Group B and S are permitted use
Occupancy Group A and R are NON-permitted use

The mezzanine for the Madison Fire Station 14 is only occupied by Occupancy Group S (both Mechanical Room and Warehouse S-2 classifications therefore is compliant with the occupancy limits in table 1015.1

The mezzanine for the Madison Fire Station 14 has an occupancy of less than 10. This is compliant with the strictest occupancy limits in table 1015.1 therefore one exit out of the mezzanine is permitted.

505.4 Openness - A mezzanine shall be open and unobstructed to the room in which such mezzanine is located except for walls not more than 42 inches high, columns and posts.

Exception 1 - Mezzanines or portions thereof are not required to be open to the roomm in which the mezzanines are located, provided thatt the occupant load of the aggregate area of the enclosed space does not exceed 10.

The mezzanine for the Madison Fire Station 14 has an occupancy of less than 10. Therefore closing portions of the mezzanine for fire fighter training permitted.

Chapter 6 – Types of Construction
Table 601 Fire-Resistance Rating Requirements for Building Elements
Type II-B Construction:
0HR Primary Structural Frame
0HR Exterior Bearing Walls
0HR Interior Bearing Walls
0HR Non-bearing walls and partitions Exterior
0HR Non-bearing walls and partitions Interior
0HR Floor construction and associated secondary members
0HR Roof Construction and associated secondary members

Table 602 Fire-Resistance Rating for Exterior Walls Based on Fire Separation Distance
The exterior walls for the proposed Madison Fire Station 14 are to be a distance of at least 30' from the nearest property line (or centerline of street).

Per Table 602, a B-Occupancy Type II-B Construction requires 0-HR rating for exterior walls.

Chapter 7 – Fire and Smoke Protection Features
705.8.1 Allowable area of openings - The maximum are of unprotected and protected openings permitted in an exterior wall in any story of a building shall not exceed the the percentages specified in Table 705.8.

Exception 2 - Buildings whose exterior bearing walls, exterior nonbearing walls and exterior primary stuctural frame are not required to be fire-resistance rated shall be permitted to have unlimited unprotected openings.

705.11 Parapets - Parapets shall be provided on exterior walls of buidings.

Exception 1 - The wall is not required to be fire-resistance rated in accordance with Table 602 because of fire separation distance.

708.2.9 Shaft enclosure required - A shaft enclosure is not required for floor openings vetween a mezzanine and the floor below.

713 Penetrations - *Penetrations through fire-rated wall or floor assemblies shall meet the requirements of this Section.*

714 Fire-Resistant Joint Systems - *Joints installed in or between fire-rated wall or floor assemblies shall meet the requirements of this Section.*

715 Opening Protection - *Doors and fire shutters in fire rated assemblies shall meet the requirements of this Section. Refer to the Door Schedule.*

716 Ducts and Transfer Openings - *Duct penetrations and air transfer openings in fire-rated assemblies shall meet the requirements of this Section.*

Chapter 9 - Fire Protection Systems
The proposed Madison Fire Station 14 be fully sprinkered per 903 Automatic Sprinkler Systems.

Chapter 10 – Means of Egress
Table 1004.1.1 Occupant Load

15	Net / Occ.	= Assembly without fixed Seating
50	Gross / Occ.	= Dormitories, Fitness Rooms, Locker Rooms
100	Gross / Occ.	= Business
200	Gross / Occ	= Kitchen, Commercial
300	Gross / Occ.	= Accessory Storage areas, Mechanical Equipment, Equipment Room
500	Gross / Occ.	= Warehouse

First Floor Occupants = 187
Second Floor Occupants = 5
Total Occupant Load = 192

1005.1 Egress Width.

Stairway	0.3 IN/Occ x 5 Occ	= 1.5 IN Required (48 IN Provided)*
Other Exit Component	0.2 IN/Occ x 194 Occ	= 48 IN Minimum (180 IN Provided)

**1.5 IN is required occupancy multiplier for egress width. The stairway will still need to comply with the provisions 1007.1.*

1007.1 Accessible Means of Egress - Accessible means of egress shall comply with this section. Accessible spaces shall be provided with not less than one accessible means of egress. Where more than one means of egress is required by Section 1015.1 or 1019.1 from any accessible space, each accessible portion of the space shall be served by not less than two accessible means of egress.

Exception 2 - One accessible means of egress is required from an accessible mezzanine level in accordance with Section 1007.3, 1007.4 or 1007.5

The mezzanine in the proposed Madison Fire Station 14 is for mechanical equipment and warehouse storage. Per Section 1104.4 Exception 4, the stair is note required to be an accessible mezzanine. As a result, the minimum stairway width will comply with 1009.1

All Exits in the proposed Madison Fire Station 14 will be accessible means of egress.

1007.3 Stairways - In order to be considered part of an accessible means of egress, an exit access stairway as permitted by Section 1016.1or exit stairway shall have a clear width of 48 inches between handrails and shall either incorporate an area of refuge within an enlarged floor-level landing or ahall be access from either an area of refuge complying with Section 1007.6 or a horizontal exit.

Exception 1 - The area of refuge is not required at open exit access or exit stairways as permitted by Sections 1016.1 and 1022.1 in buildings with an automatic sprinkler system installed in accordance with Section 903.3.1.1 or 903.3.1.2.

The mezzanine stairway for the proposed Madison Fire Station 14 does not require an area of refuge.

1009.1 Stairway width - The width of stairways shall be determined as specified in Section 1005.1, but such width shall not be less than 44 inches...

Exception 1 - Stairways serving an occupant load of less than 50 shall have a width of not less than 36 inches.

The required stairway width for the mezzanine stairway for the proposed Madison Fire Station 14 is 36 inches. The proposed design complies with both the Occupant Egress width per Section 1005.1 and required minimum width per Section 1009.1.

1014.3 Common Path of Egress Travel

Exception 1 - The length of a common path of egress travel in Group B, F and S occupancies shall not be more than 100 feet, provided that the building is equipped throughout with an automatic sprinkler system installed in accordance with Section 903.3.1.1.

Table 1016.1 Exit Access Travel Distance

Occupancy Group B	= 300 FT
Occupancy Group A-3	= 250 FT
Occupancy Group S-2	= 400 FT

Table 1018.1 Corridor Fire Resistance Rating.
B and S occupancy groups with automatic sprinkler system require 0 HR .

Table 1021.1 Minimum Number of Exits for Occupant Load
Minimum two exits required for 1-500 occupant load.

1029.1 Emergency Escape and Rescue. In addition to the means of egress required by this chapter, provisions shall be made for emergency escape and rescue...shall have at least one extreior emegency exit and rescue opening in accordance with this section...

Exception 1 - In other than Group R-3 occupancies, buildings equipped throughout with an approved automatic sprinkler system in accordance with Section 903.3.1.1.

Chapter 11 Accessibility
1104.4 / SPS 362.1104(2) - Multilevel Building Accessibility - At least one accessible route shall connect each accessible level, including mezzanines in multilevel building and facilities.

Exception 4 - Where a two story building or facility has one story with an occupant load fo five or fewer persons that does not contain public use spaces, that story shall not be required to connect by an accessible route to the story above.

The mezzanine contains both Warehouse and Mechanical room S-2 storage classifications. The occupancy of the mezzanine is (5) and satisfies the requirement of 1104.4 Exception 4. Therefore an accessible route to the mezzanine is NOT required.

Chapter 12 Interior Environment
1207.2 Sound Transmission - Walls and partitions and floor/ceiling assemblies separating sleeping units from each other and from public or service areas shall have an STC rating not less than 50.... Penetrations or openings in construction assemblies for piping, electrical devices, recessed cabinets, bathtubs, soffits, or heating, ventilation or exhaust ducts shall be sealed, lined, insulated or otherwise treated to maintain the required ratings.

Chapter 29 Plumbing Systems
Table 2902.1 Minimum Number of Required Plumbing Fixtures

2902.2 Separate facilities - Where plumbing fixtures are required, separate facilities shall be provided for each sex.

Business (B)

Water Closets	= 1 per 25 for the first 50 and 1 per 50 for the remainder exceeding 50
Lavatories	= 1 per 40 for the first 80 and 1 per 80 for the remainder exceeding 80
Drinking Fountains	= 1 per 100
Other	= 1 Service Sink

194 Occupants

Water Closets	= 5 Required (8 Provided) (1 Men's, 1 Womens and 6 Unisex)
Lavatories	= 3 Required (8 Provided)
Drinking Fountains	= 2 Required (3 Provided)
Service Sink	= 1 Required (2 Provided)

Photovoltaic Canopy Code Summary

3105.1 General - Awnings or canopies shall comply with the requirements of this section and other applicable sections of this code.

3105.4 Canopy materials - Canopies shall be constructed of a rigid framework with an approved covering that meets the fire propagation performance criteria of NFPA 701 or has a flame spread index not greater than 25 when tested in accordance with ASTM E 84 or UL 723.

The Photovoltaic module used for Madison Fire Station 14 has a flame spread index of 6. This index classification satisfies the requirement of Canopy Materials and is permitted.

8.15.7 (NFPA 13). Exterior projections

8.15.7.2 (NFPA 13). Unless the requirements of 8.15.7.2, 8.15.7.3 or 8.15.7.4 are met, sprinklers shall be installed under exterior projections exceeding 4 ft (1.2 m) in width.

8.15.7.2 (NFPA 13). Sprinklers shall be permitted to be omitted where the exterior canopies, roofs, porte-cocheres, balconies, decks, and similar projections are constructed with materials that are non-combustible, limited-combustible, or fire retardant treated wood as defined in NFPA 703.

The Photovoltaic module, aluminum sub-girt, and steel structure used for Madison Fire Station 14 are non-combustible material per IBC 1505. This satisfies the requirements of NFPA 8.15.7.2

1505.1 General. Roof assemblies shall be divided into the classes defined below. Class A, Band C roof assemblies and roof coverings required to be listed by this section shall be tested in accordance with ASTM E 108 or UL 790. In addition, fire-retardant-treated wood roof coverings shall be tested in accordance with ASTM D 2898. The minimum roof coverings installed on buildings shall comply with Table 1505.1 based on the type of construction of the building.

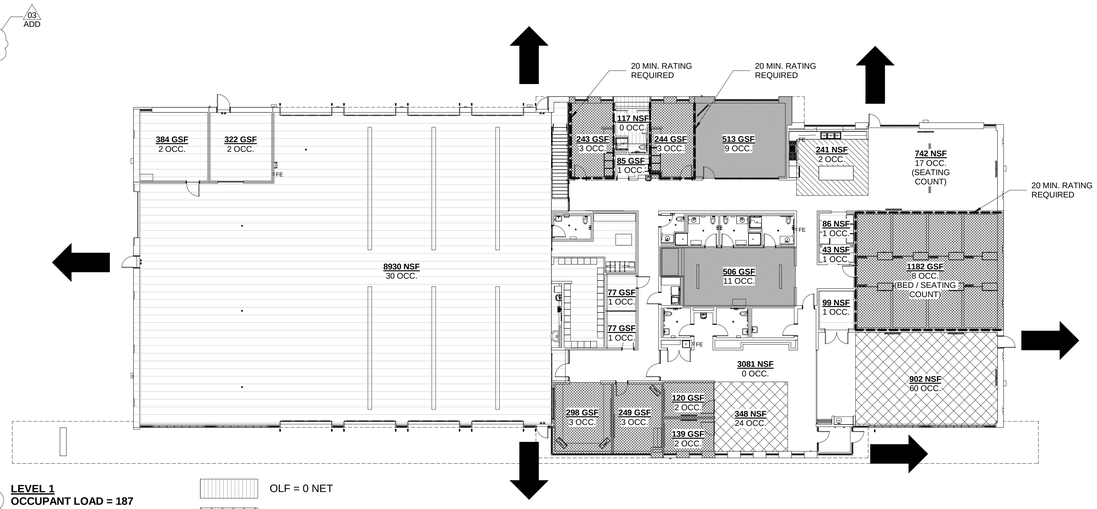
Table 1505.1 Minimum Roof Covering Classification for Types of Construction
Construction Type II-B requires C* Classification

1505.8 (IBC 2015) Building-Integrated Photovoltaic Products. Building-Integrated Photovoltaic products installed as the roof covering shall be tested, listed and labeled for fire classification in accordance with Section 1505.1

1505.9 (IBC 2015) Photovoltaic Panels and Modules. Rooftop-mounted photovoltaic panel systems shall be tested, listed and identified with a fire classification in accordance with UL 1703. The fire classification shall comply with Table 1505.1 based on the type of construction of the building.

The Photovoltaic module used for Madison Fire Station 14 is A-classified according the UL 1703. This classification exceeds the C-Classification requirement outlined in Table 1505.1 and is permitted.*

No automatic sprinkler system is not required under the photovoltaic canopy.



LEVEL 1
OCCUPANT LOAD = 187
EGRESS CAPACITY = 1,080 (PROVIDED)

TOTAL FLOOR AREA = 19,232 GSF

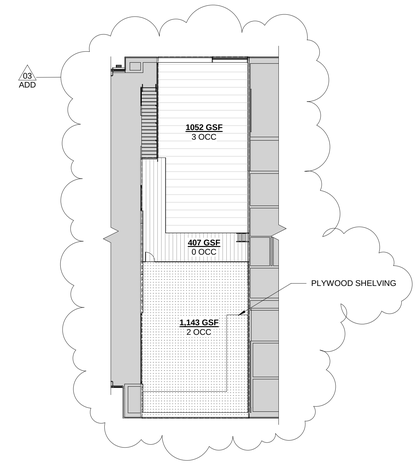
OLF = 0 NET
OLF = 15 NET
OLF = 50 NET
OLF = 100 GROSS
OLF = 200 GROSS
OLF = 300 GROSS
EXIT

1 LEVEL 1 FLOOR PLAN
1/16" = 1'-0"

MEZZANINE
OCCUPANT LOAD = 5
EGRESS CAPACITY = 160 (PROVIDED)

TOTAL FLOOR AREA = 2,526 GSF

OLF = 0 NET
OLF = 15 NET
OLF = 50 NET
OLF = 100 GROSS
OLF = 200 GROSS
OLF = 300 GROSS
OLF = 500 GROSS
EXIT



2 MEZZANINE CODE PLAN
1/16" = 1'-0"

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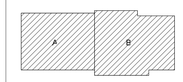


Sheet Issue Date
BID DOCUMENTS 11/03/17

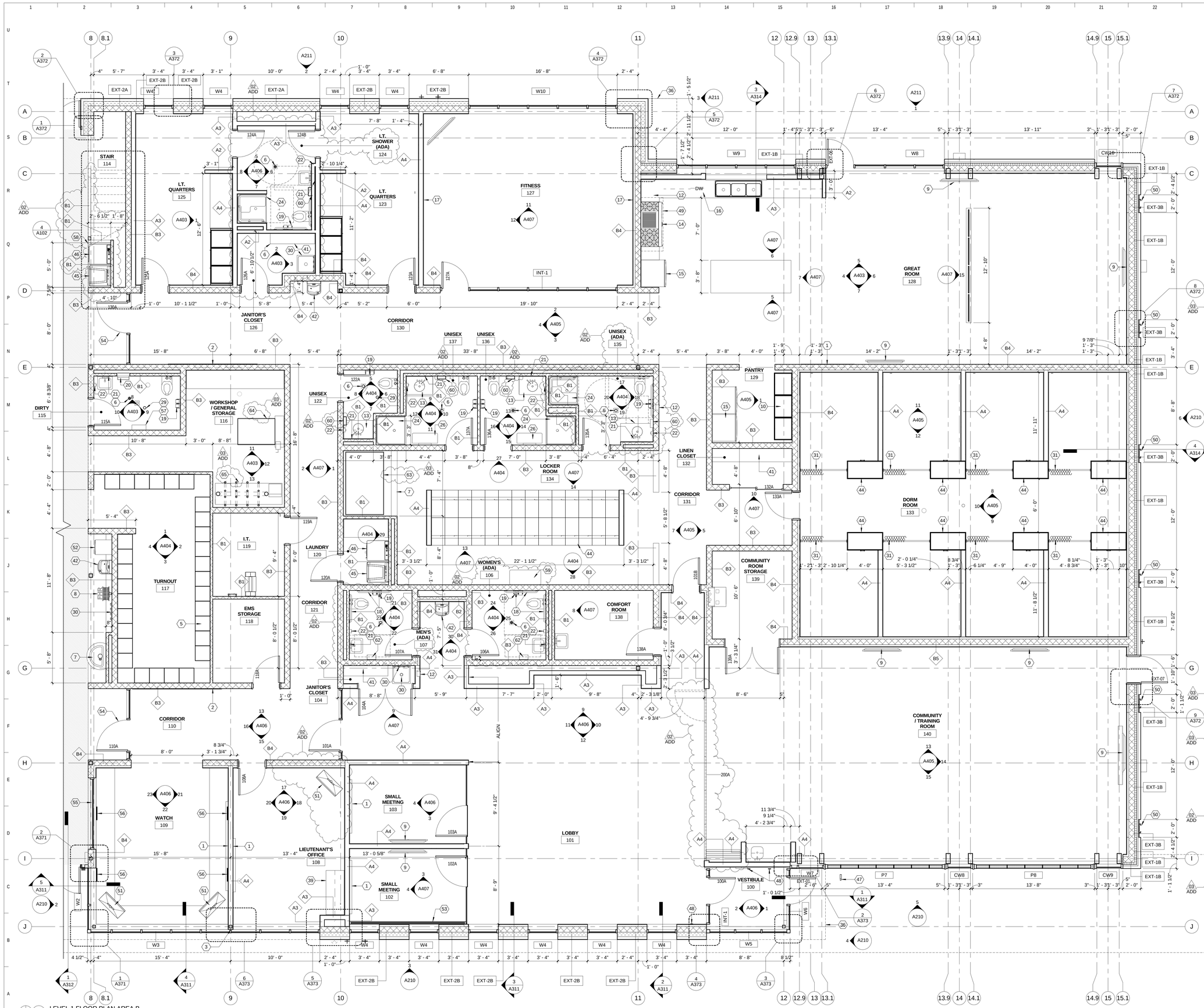
Revision	Date
ADDENDA #2	11/22/17
ADDENDA #3	12/06/17

BID DOCUMENTS

Drawing
CODE REVIEW

City of Madison Contract No. **8027**
OPN Project No. **17207000**

A003



1 LEVEL 1 FLOOR PLAN AREA B
1/4" = 1'-0"

GENERAL NOTES

1. DIMENSIONS ARE MEASURED FACE-OF-FINISH TO FACE OF FINISH OR ROUGH OPENING UNLESS NOTED OTHERWISE – TYPICAL FOR ALL DRAWINGS.
2. IN THE EVENT OF A DISCREPENCY BETWEEN ARCHITECTURAL AND CONSULTANT DRAWINGS, NOTIFY ARCHITECT IMMEDIATELY PRIOR TO COMMENCING WORK – TYPICAL FOR ALL DRAWINGS.
3. REFER TO ENLARGED FLOOR PLANS FOR ADDITIONAL WALL TYPE LOCATIONS, DIMENSIONS AND KEYNOTES.
4. REFER TO WALL TYPES SHEET FOR PARTITION WALL TYPES
5. PROVIDE CONCEALED, FIRE TREATED BLOCKING AT ALL ACCESSORIES AND CASEWORK LOCATIONS. EXTEND BLOCKING A MINIMUM OF 6" BEYOND EACH END AND 6" ABOVE AND BELOW ALL ACCESSORY ITEMS.
6. ALL WALLS WITH SOUND ATTENUATION BLANKETS ARE TO HAVE ACOUSTICAL SEALANT AT TOP AND BOTTOM AND ALL WALL PENETRATIONS.
7. ALL PENETRATIONS IN FIRE RATED WALLS MUST BE SEALED WITH APPROPRIATE FIRESTOPPING SYSTEMS.
8. COORDINATE LOCATIONS OF ALL FLOOR DRAINS WITH MECHANICAL. SLOPE AROUND DRAINS 1/8" PER 12" MIN. U.N.O.
9. PROVIDE BULLNOSE CMU AT ALL EXPOSED INTERIOR OUTSIDE CORNERS.
10. PROVIDE ALUMINUM THRESHOLD AND WEATHERSTRIPPING AT EXTERIOR DOORS – TYP.
11. ALL WOOD BLOCKING / SHEATHING USED IN THIS CONSTRUCTION SHALL BE FIRE-RETARDANT TREATED AS DEFINED BY II-B CONSTRUCTION.
12. PROVIDE VERTICAL GYPSUM BOARD CONTROL JOINTS AT 30'-0" O.C. MAX. – U.N.O.

FLOOR PLAN LEVEL 1 KEYNOTES

1	MARKER BOARD
2	MAP AREA
3	CENTER WALL ON MULLION
4	TACKBOARD
5	TURN OUT GEAR LOCKERS – CFCI. REFER TO INTERIOR ELEVATIONS FOR MOUNTING HEIGHTS
6	FLOOR DRAIN
7	FLOOR TRENCH DRAIN - SET FLUSH WITH FLOOR. FLOOR TO PITCH TOWARD DRAIN AT ¼": 1'-0" (MIN)
8	WALL MOUNTED HOSE REEL
9	MONITOR – REFER TO TECHNOLOGY DRAWINGS AND INTERIOR ELEVATIONS FOR SIZING AND MOUNTING INFORMATION. PROVIDE BLOCKING AS REQUIRED.
10	(3) 24" DEEP PANTRY UNITS - REFER TO CASEWORK DETAILS FOR ADDITIONAL INFORMATION.
11	CONCRETE FILLED PIPE BOLLARD
12	SEMI-RECESSED FIRE EXTINGUISHER CABINET AND STANDARD EXTINGUISHER
13	24" DEEP CABINET AT SINK
14	RANGE - OFCI
15	REFRIGERATOR - OFCI
16	DISHWASHER - OFCI
17	¾" PLYWOOD UNDER GYP. – ENTIRE WALL
18	GRAB BARS – 36" HORIZONTAL BEHIND TOILET, 42" HORIZONTAL AND 18" VERTICAL ADJACENT TO TOILET. PROVIDE BLOCKING AS REQUIRED. REFER TO GENERAL INFORMATION DRAWINGS FOR ADDITIONAL INFORMATION
19	DOUBLE ROLL TOILET DISPENSER – O.F.C.I. PROVIDE BLOCKING AS REQUIRED
20	HAND TOWEL DISPENSER – O.F.C.I. PROVIDE BLOCKING AS REQUIRED
21	FRAMELESS MIRROR 24" X 48" W/ STAINLESS STEEL CLIPS FASTENERS
22	WALL MOUNTED SOAP DISPENSER – O.F.C.I. PROVIDE BLOCKING AS REQUIRED
23	COAT HOOK
24	SHOWER - SOLID SURFACE SHOWER BASIN, SOLID SURFACE SHOWER WALLS
25	SHOWER TRANSFER ACCESSIBLE FOLDING SEAT
26	FOLDING SEAT
27	WALL MOUNTED LADDER HANGERS
28	MOP SINK – REFER TO PLUMBING FOR ADDITIONAL INFORMATION
29	IN-FLOOR CATCH BASIN – REFER TO PLUMBING DRAWINGS FOR ADDITIONAL INFORMATION
30	MOP / BROOM HOLDER – WALL MOUNTED. REFER TO INTERIOR ELEVATIONS FOR ADDITIONAL INFORMATION
31	CUBICLE CURTAIN AND CEILING MOUNTED TRACK
32	HVAC EQUIPMENT – REFER TO MECHANICAL DRAWINGS.
33	WALL MOUNTED OSCILLATING FAN. REFER TO MECHANICAL DRAWINGS FOR ADDITIONAL INFORMATION
34	RECESSED SLAB. REFER TO ROOM FINISH SCHEDULE
35	BUILDING SIGNAGE
36	DASHED LINE INDICATES EXTERIOR SOFFIT ABOVE
37	DASHED LINE INDICATES CANOPY STRUCTURE ABOVE
38	ELECTRICAL EQUIPMENT – REFER TO ELECTRICAL FOR ADDITIONAL INFORMATION
39	CASEWORK - REFER TO ELEVATIONS AND DETAILS
40	REINFORCED CONCRETE FROST STOOP - REFER TO STRUCTURAL
41	ADJUSTABLE SHELVES
42	WATER FOUNTAIN/BOTTLE FILLER STATION
44	PERSONAL STORAGE LOCKERS - CFCI
45	COMMERCIAL WASHER - OFOI
46	COMMERCIAL DRYER - OFOI
47	PUSH BUTTON BOLLARD FOR DOOR
48	PUSH BUTTON
49	DASHED LINE INDICATES HOOD
50	GALVANIZED STEEL DOWNSPOUT
51	CEILING MOUNTED MONITOR
52	ICE MACHINE - OFOI
53	RADIANT PANEL, REFER TO MECHANICAL DRAWINGS
54	INTERIOR DOOR - THERMALLY BROKEN ALUMINUM STOREFRONT WINDOW SYSTEM, 1" INSULATED GLASS UNITS, WEATHER STRIPPING AND DOOR THRESHOLD.
55	INTERIOR WINDOW - THERMALLY BROKEN ALUMINUM STOREFRONT WINDOW SYSTEM, 1" INSULATED GLASS UNIT
56	WIRE BRUSH GROMET
57	EMERGENCY EYEWASH STATION
58	4" CONCRETE HOUSEKEEPING PAD (UNDERSTAIR CANE DETECTION
59	WALL MOUNTED ACCESSIBLE LOCKER ROOM BENCH (42" X 20")
60	HAND TOWEL DISPENSERS - OFCI
61	SURFACE MOUNTED KNOX BOX
62	HAND DRYER - OFCI
63	DETOX SAUNA - OFOI
64	LAUNDRY EXTRACTOR - OFOI
65	GEAR DRYER - OFOI

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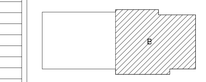
Key Plan



Sheet Issue Date
BID DOCUMENTS 11/03/17

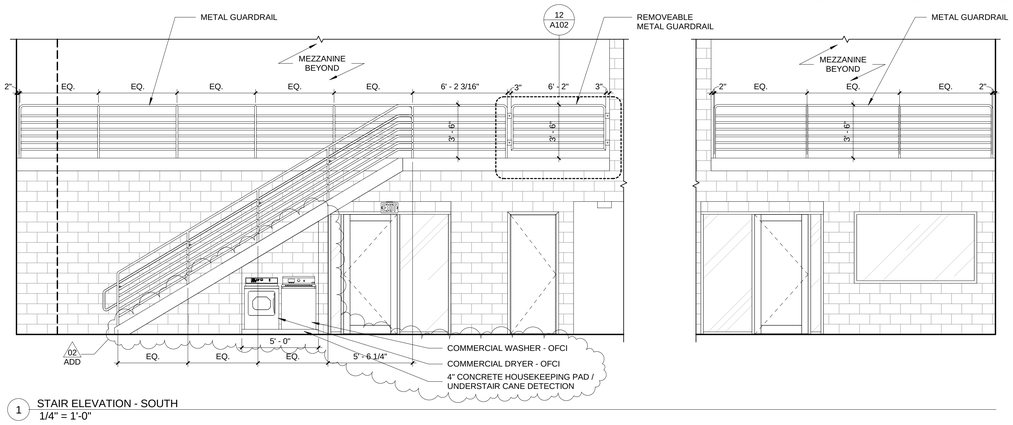
Revision	Date
ADDENDA #2	11/22/17
ADDENDA #3	12/06/17

BID DOCUMENTS

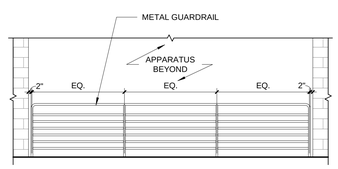
Drawing
FLOOR PLAN LEVEL 1.B

City of Madison Contract No. **8027**
OPN Project No. **17207000**

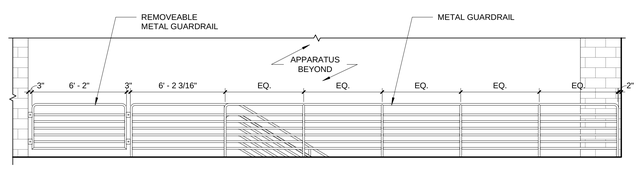
A101.B

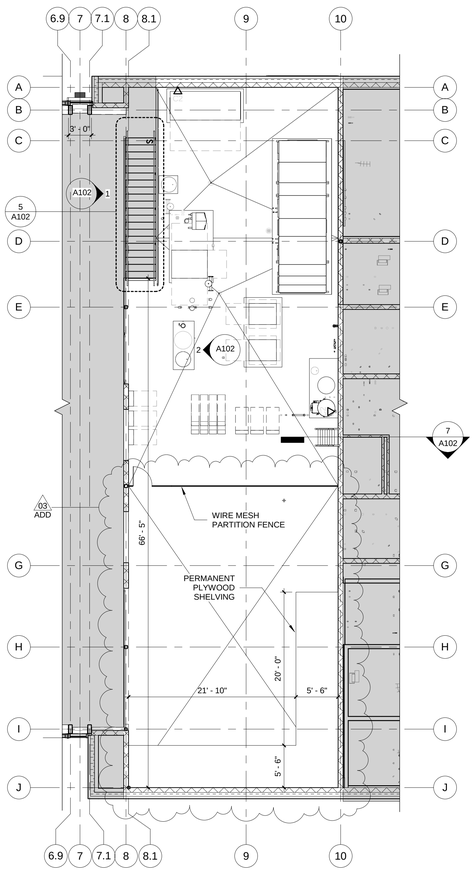


1 STAIR ELEVATION - SOUTH
1/4" = 1'-0"

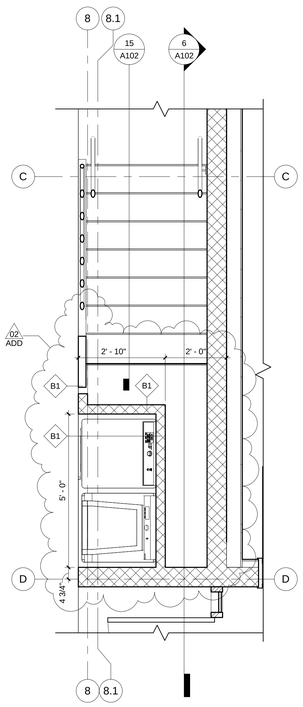


2 GUARDRAIL ELEVATION
1/4" = 1'-0"

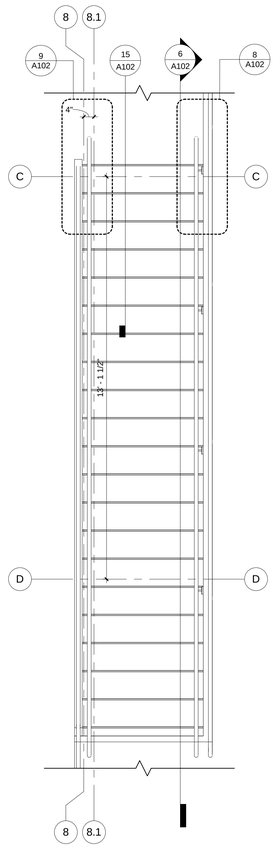




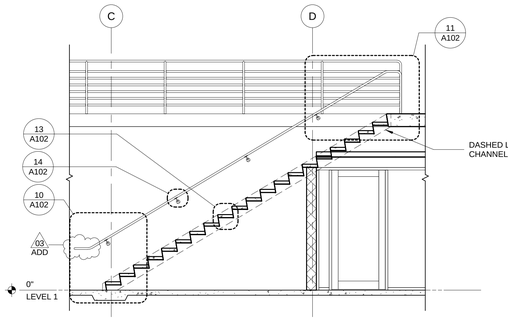
3 MEZZANINE PLAN
1/8" = 1'-0"



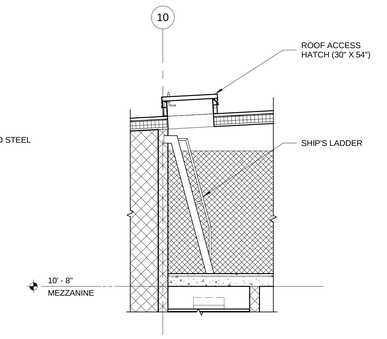
4 MEZZANINE STAIR (BELOW) - PLAN
1/2" = 1'-0"



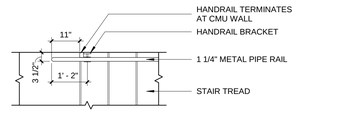
5 MEZZANINE STAIR (ABOVE) - PLAN
1/2" = 1'-0"



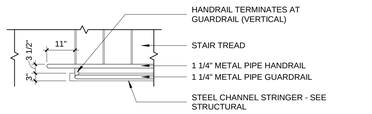
6 MEZZANINE STAIR - SECTION
1/4" = 1'-0"



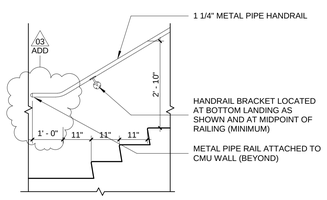
7 SHIP LADDER - SECTION
1/4" = 1'-0"



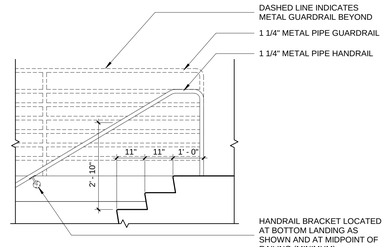
8 HANDRAIL EXTENSION PLAN DETAIL - BOTTOM LANDING (EAST)



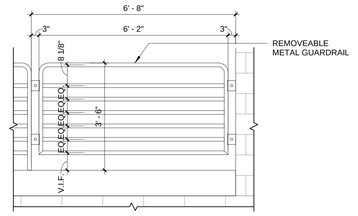
9 HANDRAIL EXTENSION PLAN DETAIL - BOTTOM LANDING (WEST)
1/2" = 1'-0"



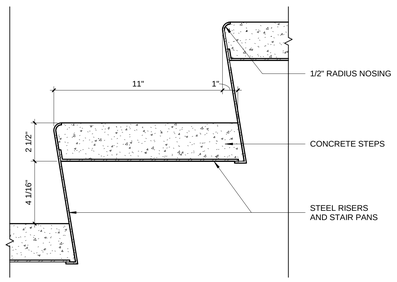
10 HANDRAIL EXTENSION - BOTTOM LANDING
1/2" = 1'-0"



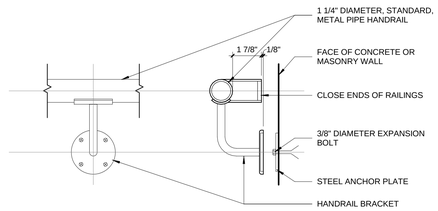
11 HANDRAIL EXTENSION - TOP LANDING
1/2" = 1'-0"



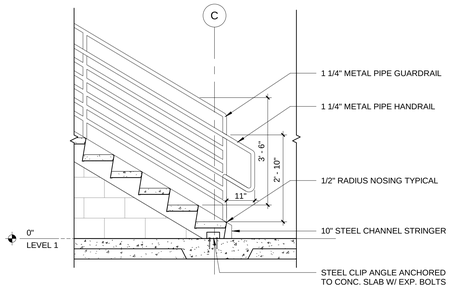
12 REMOVEABLE METAL GUARDRAIL
1/2" = 1'-0"



13 METAL PAN TREAN AND RISER
3" = 1'-0"



14 HANDRAIL WALL BRACKET
3" = 1'-0"



15 STAIR BOTTOM RAILING
1/2" = 1'-0"

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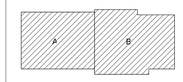

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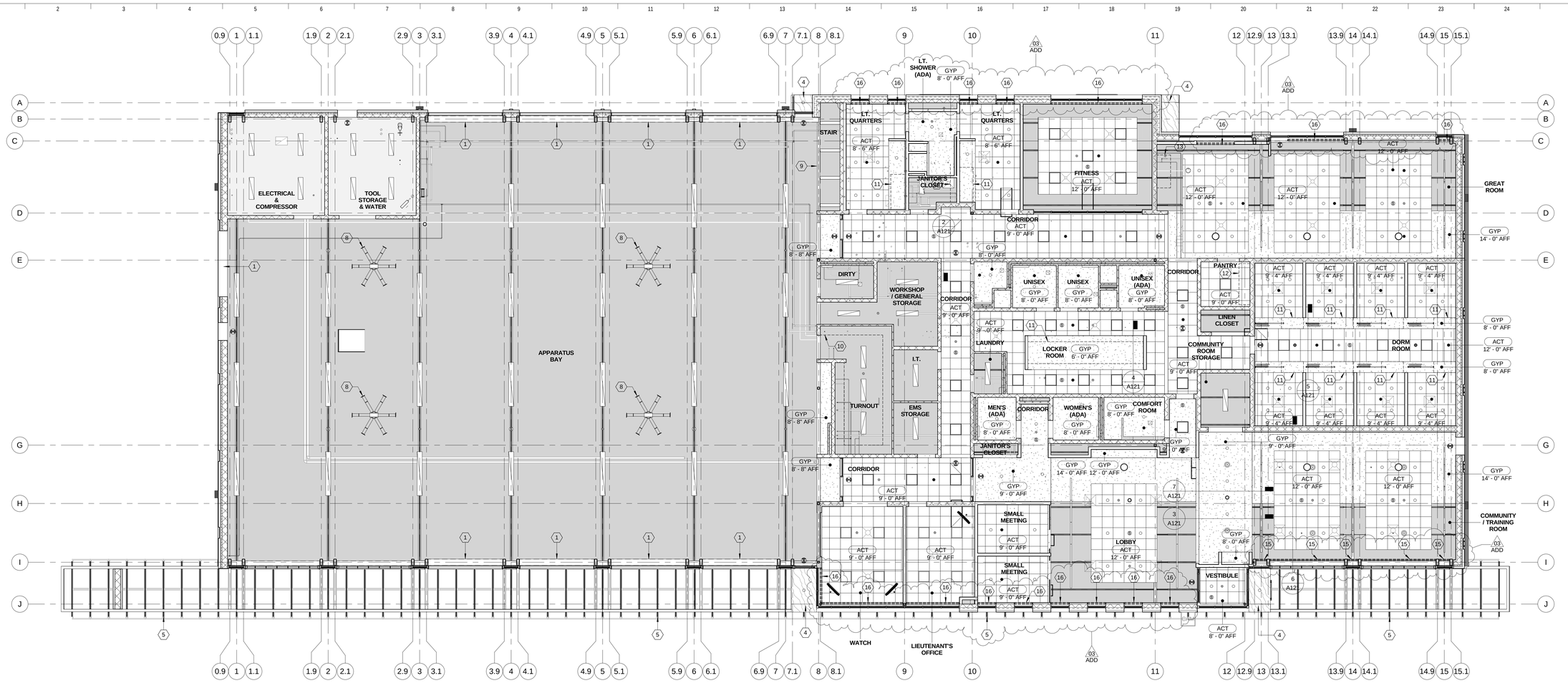
Drawing

MEZZANINE PLAN

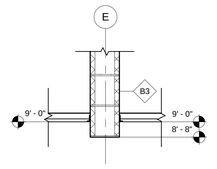
City of Madison Contract No. **8027**
OPN Project No. **17207000**

02 ADD

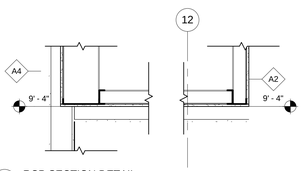
A102



1 LEVEL 1 RCP
1/8" = 1'-0"



2 RCP SECTION DETAIL
3/4" = 1'-0"



3 RCP SECTION DETAIL
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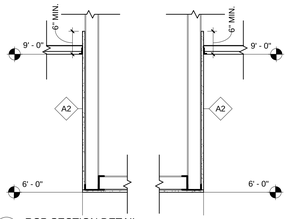

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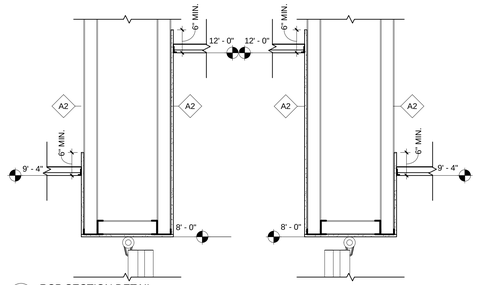
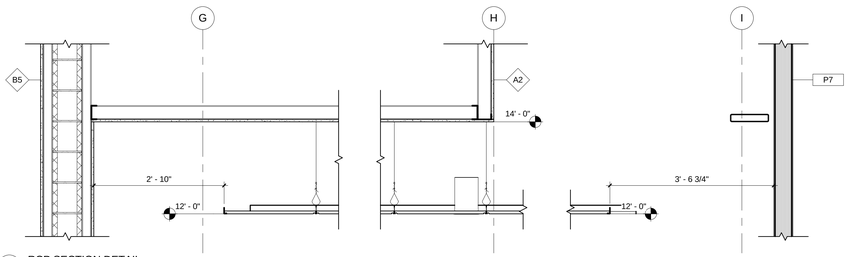
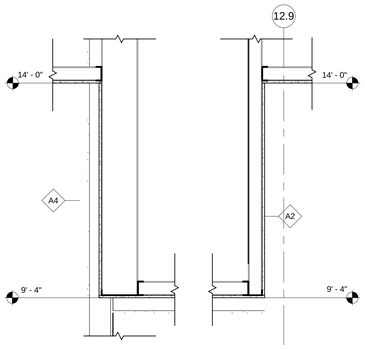
3/4" = 1'-0"



5 RCP SECTION DETAIL



6 RCP SECTION DETAIL
3/4" = 1'-0"



7 RCP SECTION DETAIL
3/4" = 1'-0"

FAN

METALUX SUSPENDED COOPER INDUSTRIAL LED LINEAR BAY - 8'-0"

METALUX SUSPENDED COOPER INDUSTRIAL LED LINEAR BAY - 4'-0"

2' X 2' TROFFER

RECESSED DOWNLIGHT

LIGHT 2 3/4" X 4'-0"

VANITY LIGHT - 3'-4"

VANITY LIGHT - 3'-0"

VANITY LIGHT - 2'-6"

VANITY LIGHT - 2'-0"

PAGING SPEAKER

OCCUPANCY SENSOR

FIRE STROBE

EXIT SIGN

SECURITY CAMERA

AV SPEAKER

MICROPHONE

SMOKE DETECTOR

INFORMATION OUTLETS

HEAT DETECTOR

CEILING MOUNTED TELEVISION

REFLECTED CEILING PLAN SYMBOLS/LEGEND

REFLECTED CEILING PLAN...

1	OVERHEAD DOOR AND ACTUATOR
4	EXTERIOR SOFFIT ABOVE
5	CANOPY STRUCTURE ABOVE
8	DESTRATIFICATION FAN – REFER TO MECHANICAL DRAWINGS FOR ADDITIONAL INFORMATION
9	DASHED LINE INDICATES STAIR
10	DASHED LINE INDICATES TURNOUT GEAR LOCKERS
11	DASHED LINE INDICATES PERSONAL STORAGE LOCKERS
12	DASHED LINE INDICATES DEEP PANTRY UNITS
13	DASHED LINE INDICATES HOOD
14	DASHED LINE INDICATES UPPER CASEWORK
15	AUTOMATIC ROLLER SHADES - DUAL ROLL
16	MANUAL ROLLER SHADE

03 ADD

GENERAL NOTES

1. PAINT ALL EXPOSED STRUCTURE, DECK, DUCTWORK, CONDUIT, SPRINKLER PIPING, ETC. IN AREAS NOTED TO BE "OPEN TO STRUCTURE" – U.N.O. PAINTING OF EXPOSED STRUCTURE TO BE DONE AFTER ALL UTILITIES INSTALLED. REFER TO FINISH SCHEDULE.
2. CEILING HEIGHTS ARE LISTED NEXT TO APPROPRIATE KEYNOTE. HEIGHT IS GIVEN ABOVE FINISHED FLOOR U.N.O.
3. PERIMETER CEILING TILES SHALL NOT BE LESS THAN 4" – TYP.
4. LOCATE ALL SPRINKLER HEADS, SMOKE DETECTORS, AUDIO SPEAKER AND CEILING MOUNTED EQUIPMENT IN THE CENTER OF CEILING TILE – TYP.
5. CENTER CEILING GRID IN ROOMS AS SHOWN U.N.O.
6. LIGHT FIXTURES IN APPARATUS BAY TO BE MOUNTED TO BOTTOM OF STRUCTURAL JOIST – TYP.
7. ALL MECHANICAL DIFFUSERS SHALL BE PAINTED BY MANUFACTURER TO MATCH ADJACENT SOFFIT/ACP – U.N.O.
8. REFER TO ARCHITECTURAL DRAWINGS FOR ALL MECHANICAL AND ELECTRICAL DEVICE LOCATIONS AND MOUNTING HEIGHTS. IF NOT CLEARLY SPECIFIED, CONTACT ARCHITECT FOR FURTHER CLARIFICATION. MECHANICAL AND ELECTRICAL DRAWINGS ARE FOR FIXTURE TYPE REFERENCE ONLY.
9. CAULK JOINT BETWEEN GYPSUM WALL BOARD ASSEMBLIES AND FACE OF CMU AT ALL WALL AND SOFFIT CONDITIONS. CAULKING TO BE CONTINUOUS VERTICALLY AND EXTEND ABOVE LAY-IN CEILING A MINIMUM OF 18". CAULK PRIOR TO PAINTING.
10. SKYLIGHT DIFFUSER TO CENTER ON CEILING GRID AS SHOWN. - TYP
11. EXTRUDED ALUMINUM CEILING CLOUD EDGE (BASIS OF DESIGN: ARMSTRONG AXIOM CLASSIC 4IN STRAIGHT (AX4STR)) AROUND PERIMETER OF CEILING CLOUDS - TYP.
12. SEGMENTED ROLLER SHADES TO ALIGN WITH MULLION LOCATIONS. CONFIRM LOCATIONS WITH ARCHITECT DURING SHOP DRAWING PHASE.

03 ADD

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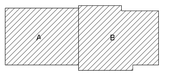

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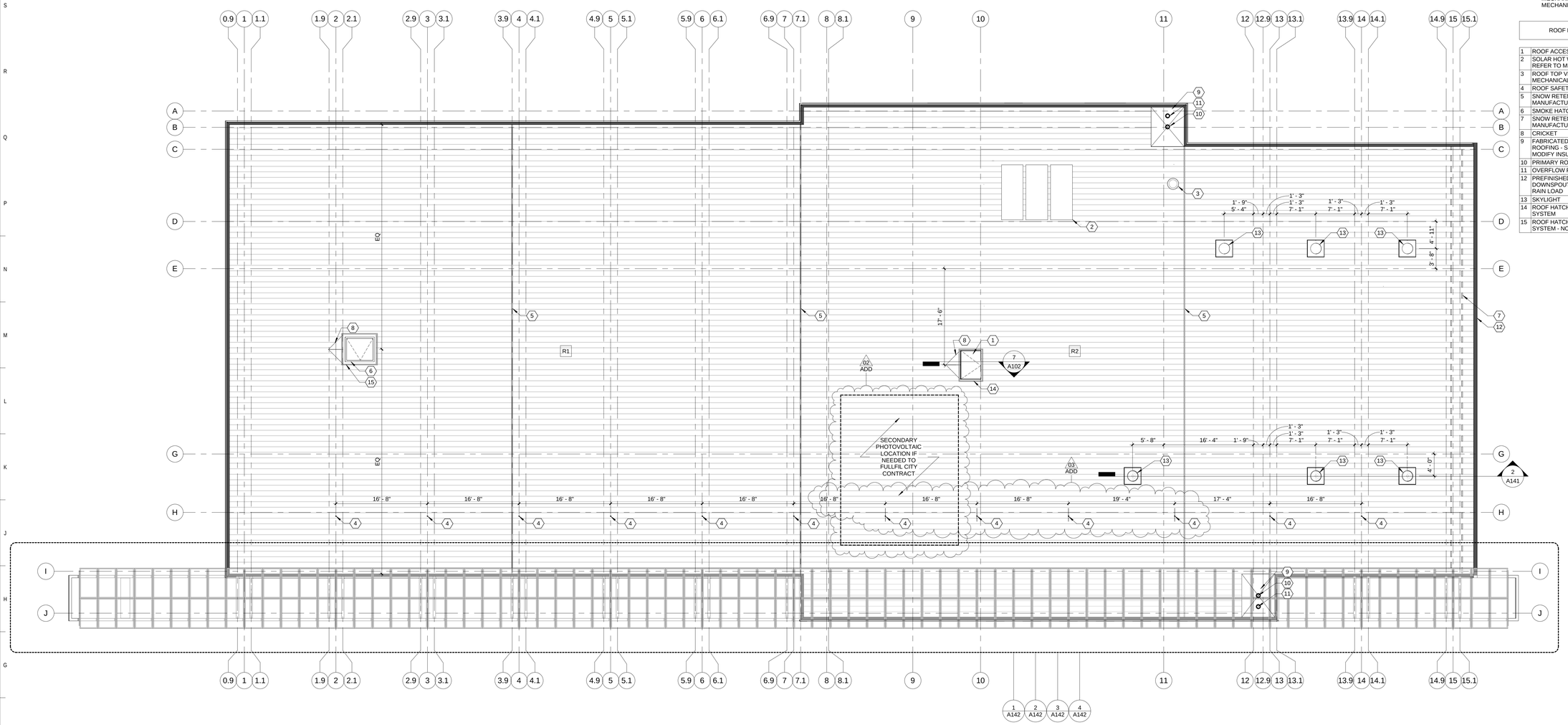
ADDENDA #3	12/06/17

BID DOCUMENTS

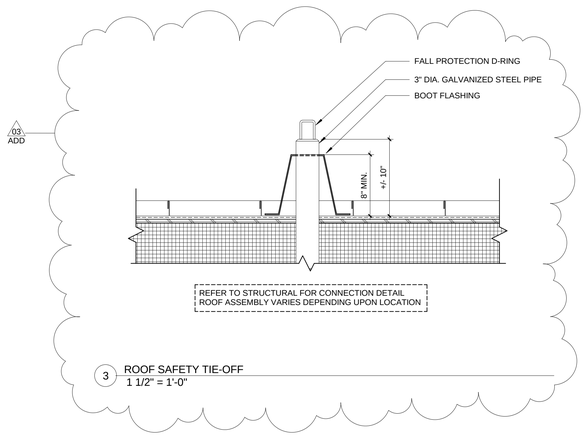
Drawing
REFLECTED CEILING PLAN

City of Madison Contract No. **8027**
OPN Project No. **17207000**

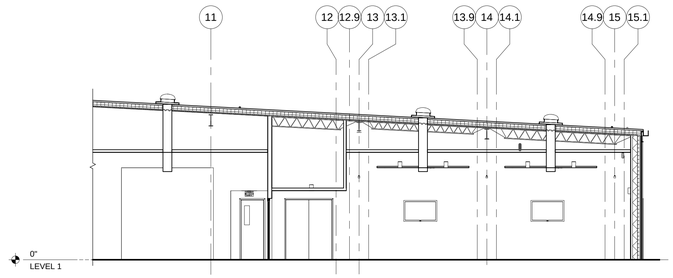
A121



1 ROOF LEVEL FLOOR PLAN
1/8" = 1'-0"



3 ROOF SAFETY TIE-OFF
1 1/2" = 1'-0"



2 SKYLIGHT DIAGRAM
1/8" = 1'-0"

GENERAL NOTES

1. NOT ALL ROOF PENETRATIONS ARE SHOWN. VERIFY LOCAITONS OF ALL ROOF PENETRATIONS. PROVIDE BOOTS, FLASHING AND OTHER ACCESSORIES REQUIRED TO PROVIDE A COMPLETE, WATERTIGHT WARRANTIED SYSTEM.
2. PROTECT SECTIONS OF THE ROOF THAT HAVE ALREADY BEEN INSTALLED FROM DAMAGE. DO NOT USE THE ROOF AS A STAGING AREA UNLESS FACTORY, MUTUALLY APPROVED PROTECTION MEASURES ARE USED TO PROTECT THE ROOF.
3. COORDINATE LOCATION OF MECHANICAL EQUIPMENT WITH MECHANICAL DRAWINGS.

ROOF PLAN KEYNOTES

1	ROOF ACCESS HATCH
2	SOLAR HOT WATER HEATER MODULE - REFER TO MECHANICAL
3	ROOF TOP VENTILATOR - REFER TO MECHANICAL
4	ROOF SAFETY EQUIPMENT TIE-OFF
5	SNOW RETENTION BARS PER MANUFACTURER RECOMMENDATIONS
6	SMOKE HATCH
7	SNOW RETENTION BARS PER MANUFACTURER RECOMMENDATIONS
8	CRICKET
9	FABRICATED GALVANIZED STEEL ROOFING - SLOPES TO ROOF DRAIN - MODIFY INSULATION AS REQUIRED
10	PRIMARY ROOF DRAIN
11	OVERFLOW ROOF DRAIN
12	PREFINISHED ALUMINUM GUTTER AND DOWNSPOUTS SIZED TO ACCOMIDATE RAIN LOAD
13	SKYLIGHT
14	ROOF HATCH SAFETY RAILING SYSTEM
15	ROOF HATCH SAFETY RAILING SYSTEM - NO ACCESS

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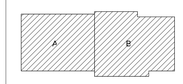

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ADDENDA #2	11/22/17
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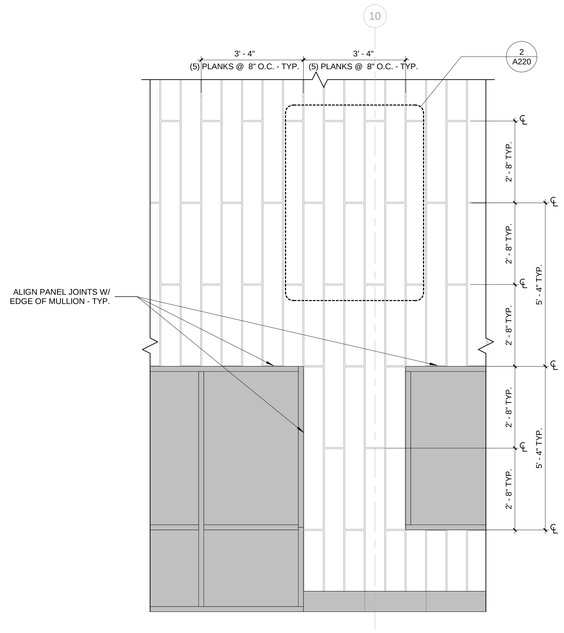
Drawing
ROOF PLAN

City of Madison Contract No. **8027**
OPN Project No. **17207000**

A141



1 TYPICAL COMPOSITE WOOD VENNER PANEL - CONFIGURATION
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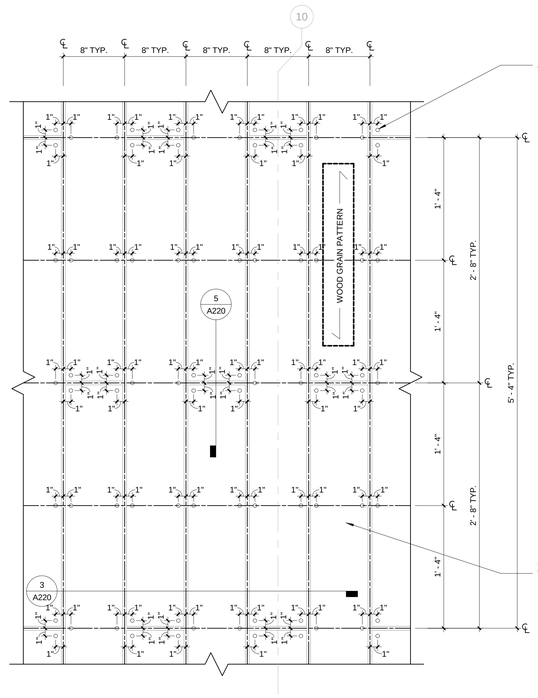
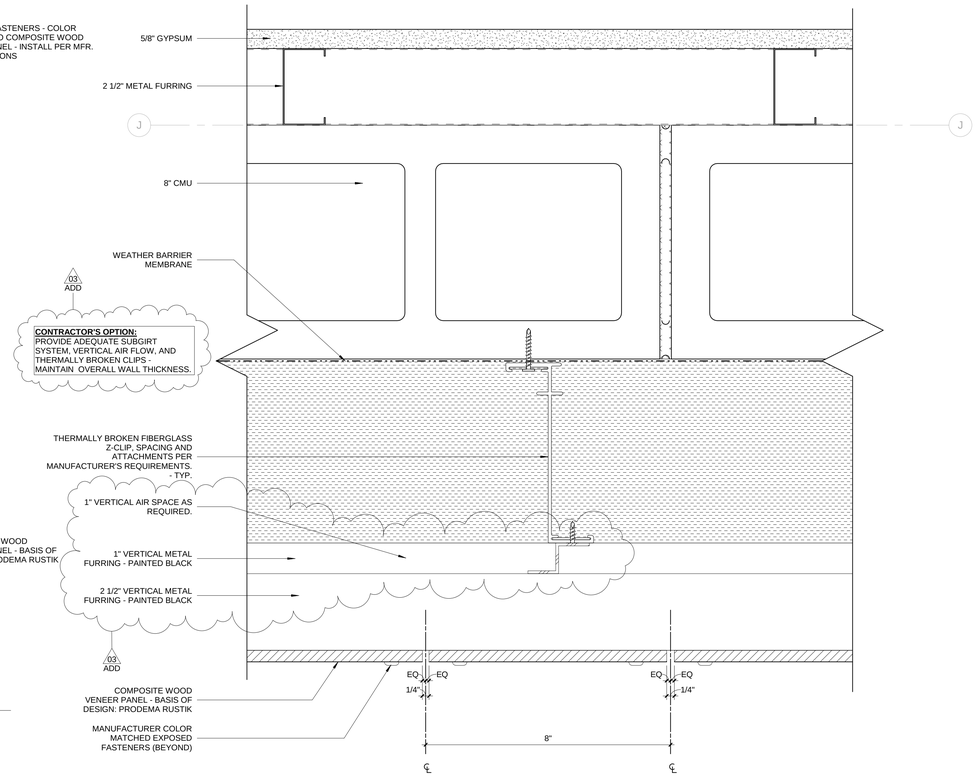
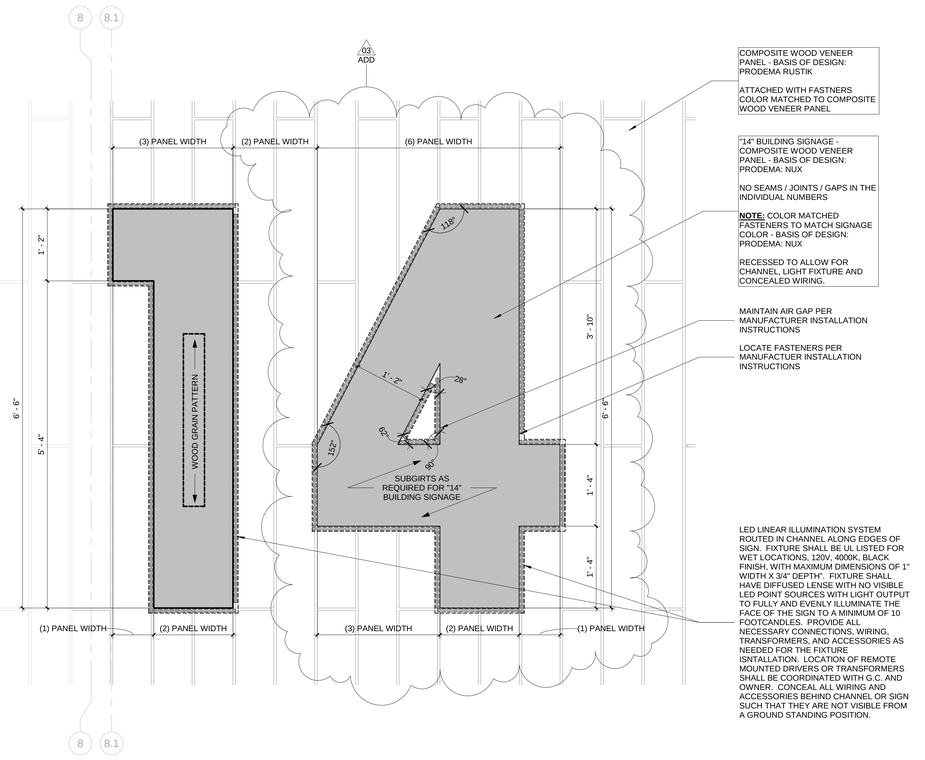


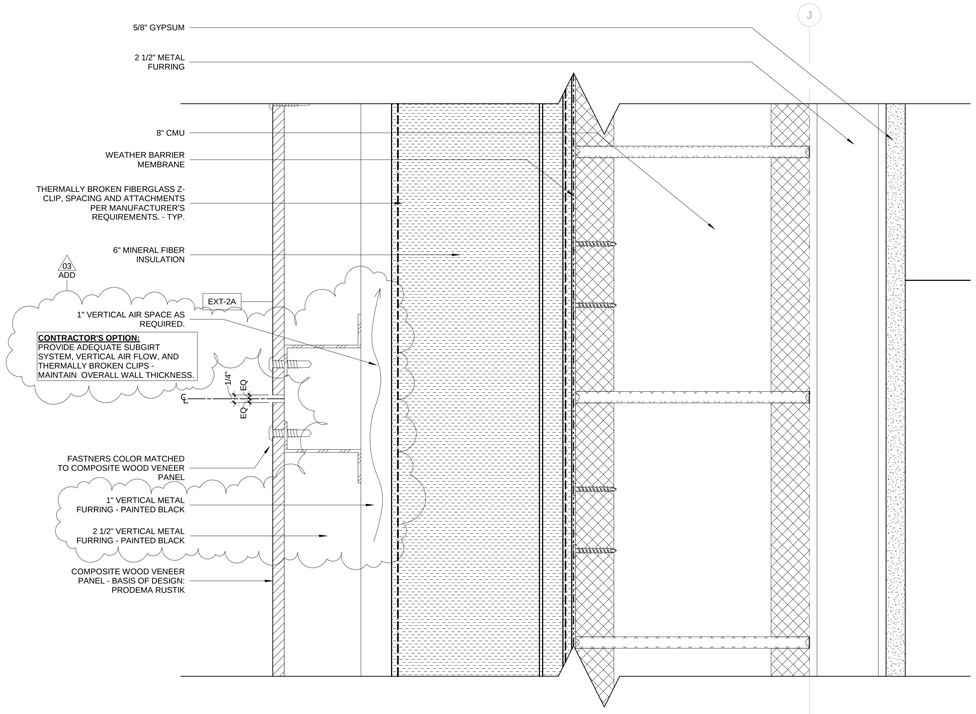
2 TYPICAL COMPOSITE WOOD VENEER PANEL - CONNECTIONS
1 1/2" = 1'-0"



3 COMPOSITE WOOD VENEER PANEL - PLAN DETAIL
6" = 1'-0"



4 COMPOSITE WOOD VENEER PANEL - "14" BUILDING SIGNAGE
1" = 1'-0"



5 COMPOSITE WOOD VENEER PANEL - SECTION
6" = 1'-0"

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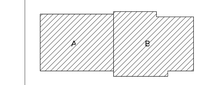

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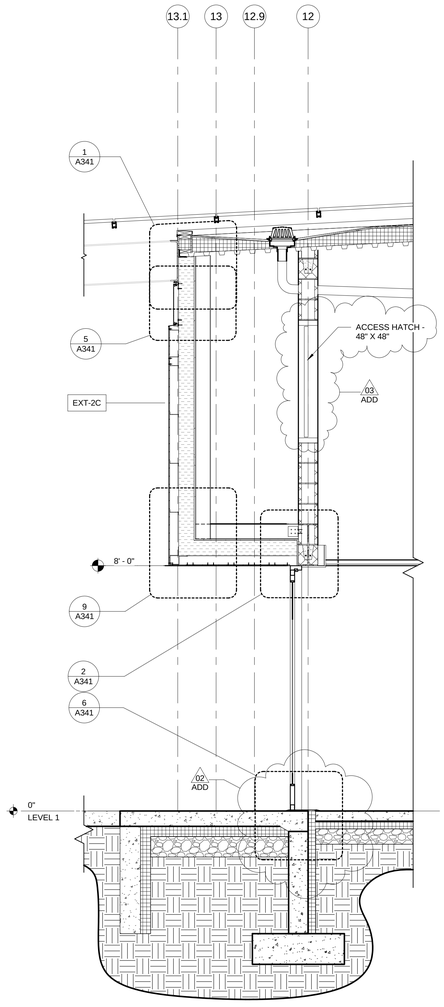
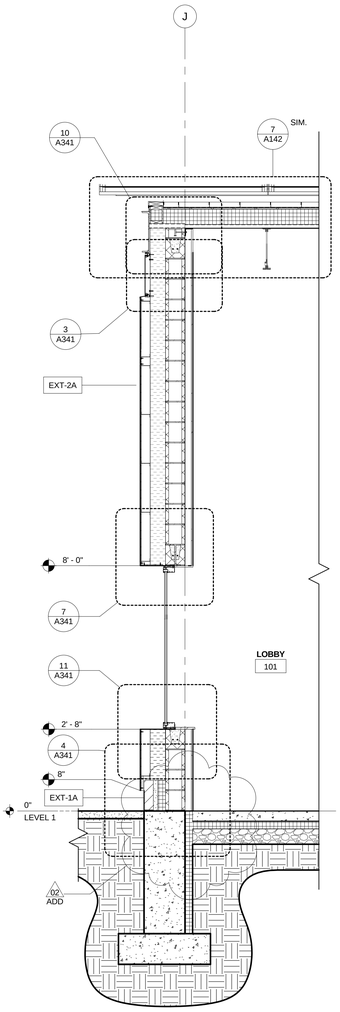
Drawing
STANDARD DETAILS

City of Madison Contract No. **8027**
OPN Project No. **17207000**

A220



1 WALL SECTION
1/2" = 1'-0"



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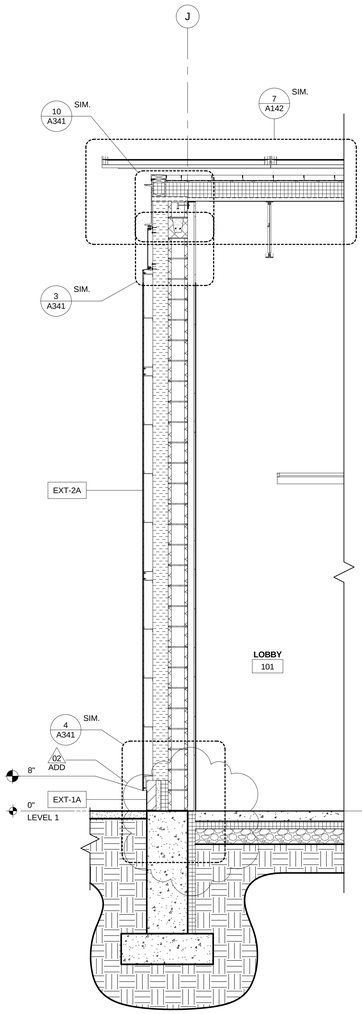

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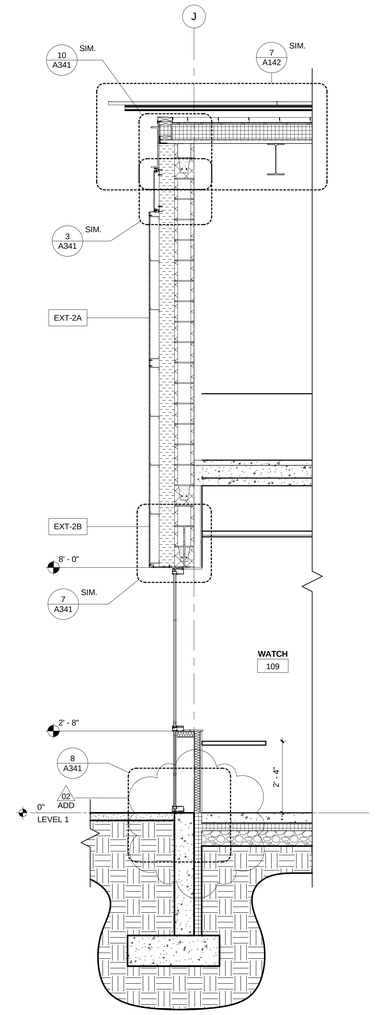
1/2" = 1'-0"



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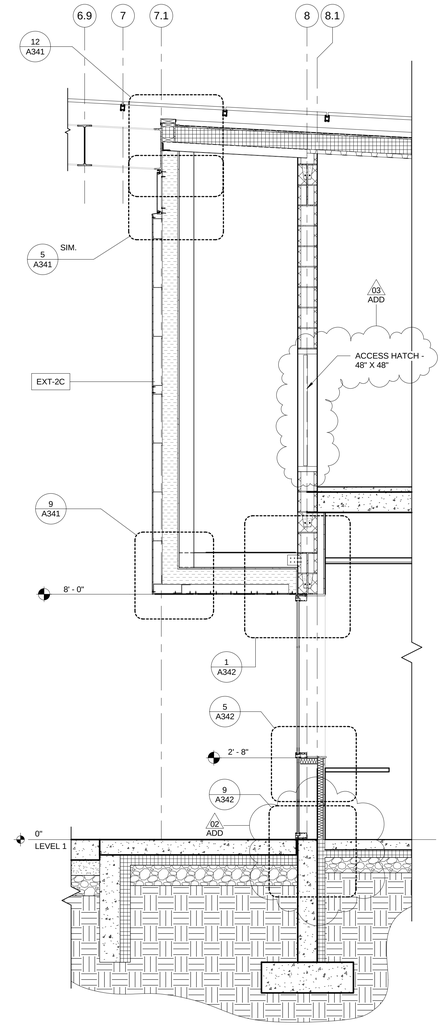
1/2" = 1'-0"



5 WALL SECTION
1/2" = 1'-0"

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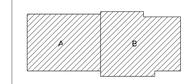

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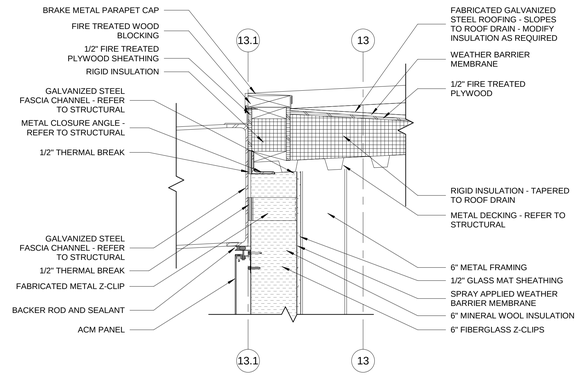
Drawing

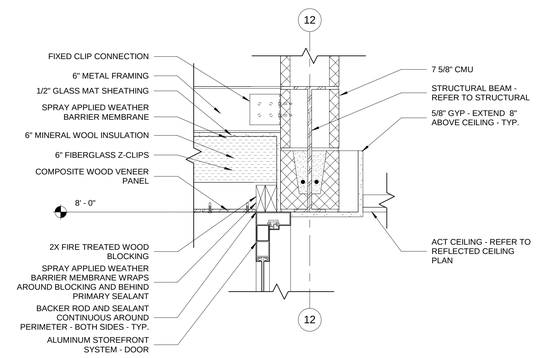
WALL SECTIONS

City of Madison Contract No. **8027**
OPN Project No. **17207000**

A311



1 SECTION DETAIL
1 1/2" = 1'-0"



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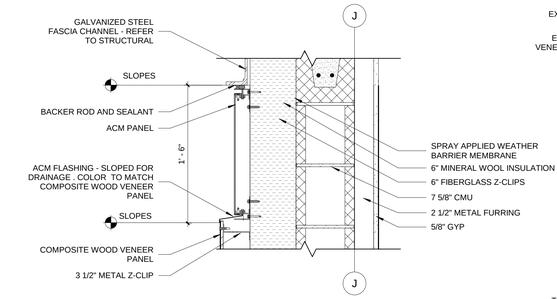

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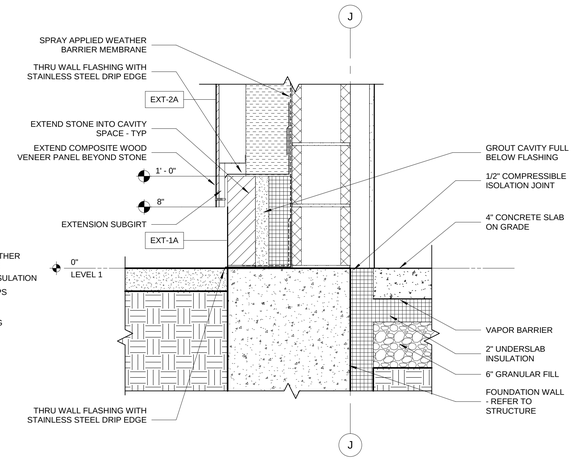


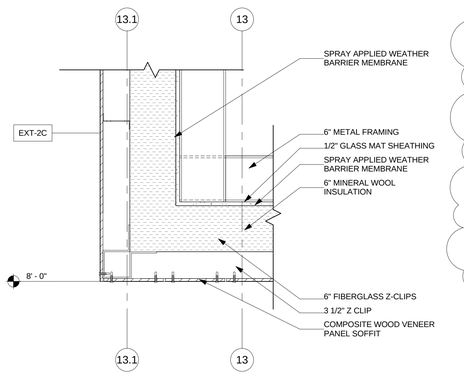
4 SECTION DETAIL
1 1/2" = 1'-0"

5 SECTION DETAIL
1 1/2" = 1'-0"

6 SECTION DETAIL
1 1/2" = 1'-0"

7 SECTION DETAIL
1 1/2" = 1'-0"

8 SECTION DETAIL
1 1/2" = 1'-0"



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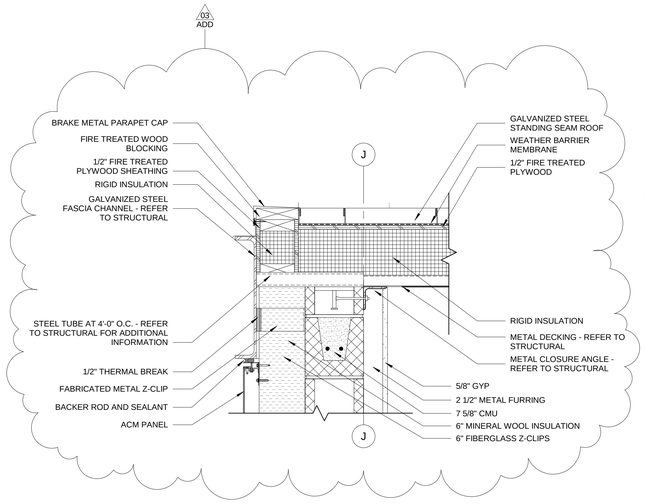

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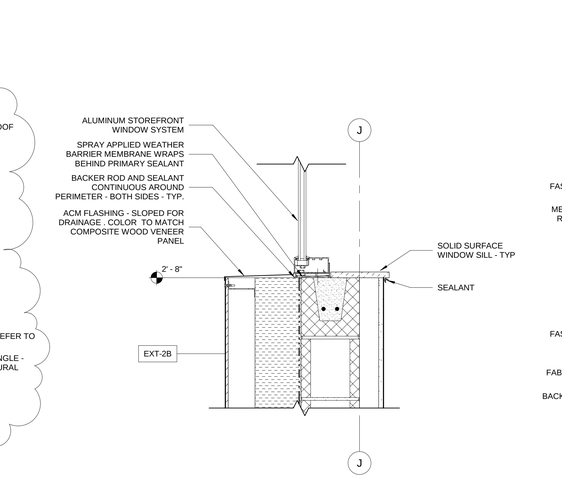

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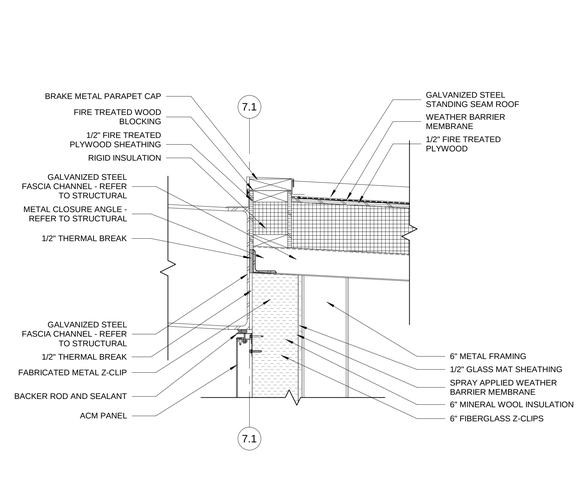

12 SECTION DETAIL
1 1/2" = 1'-0"

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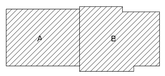

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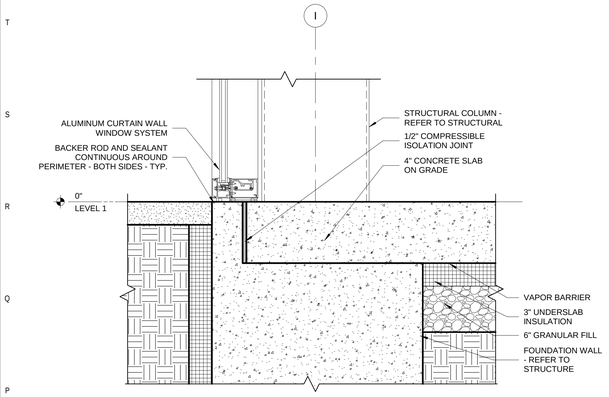
Drawing
SECTION DETAILS

City of Madison Contract No. **8027**
OPN Project No. **17207000**

A341



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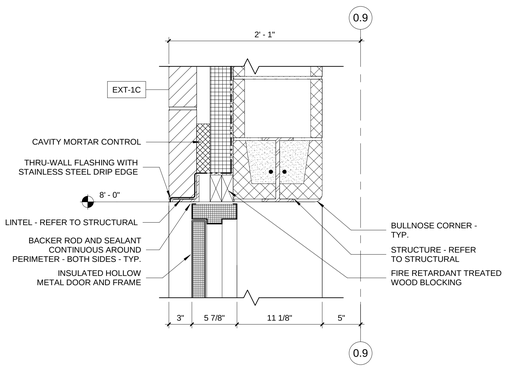

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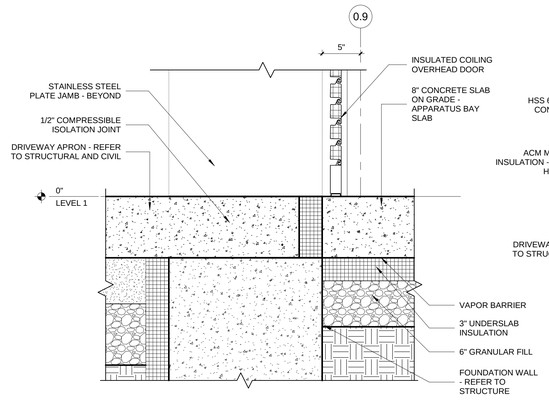

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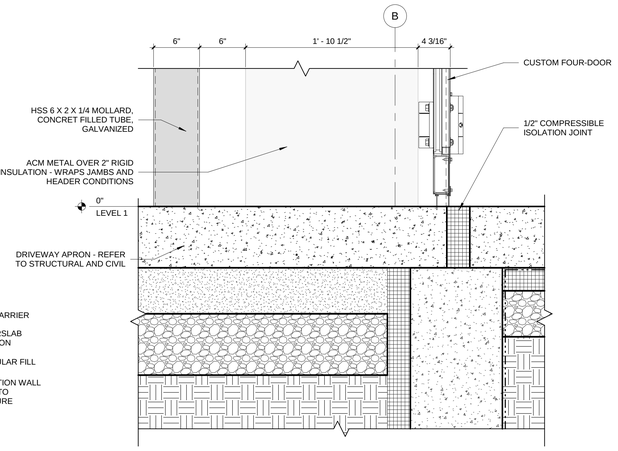

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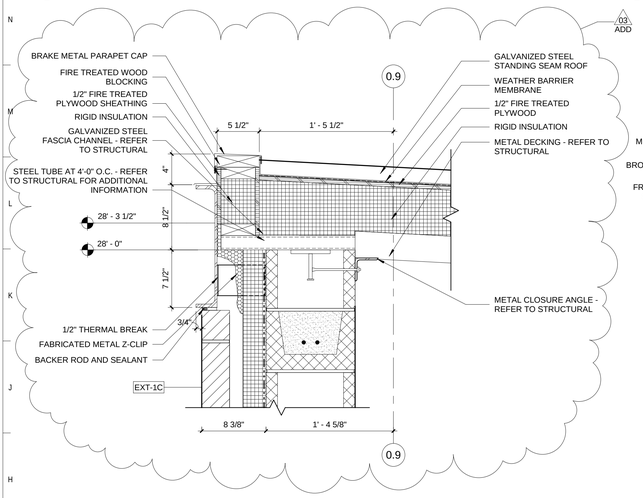

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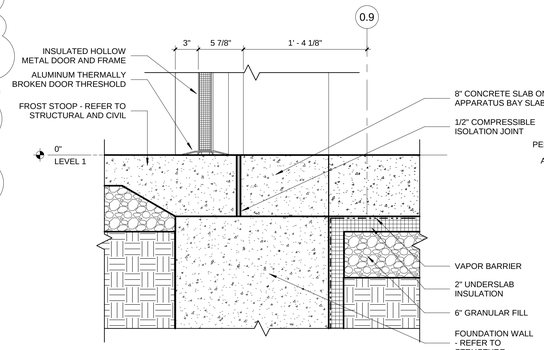

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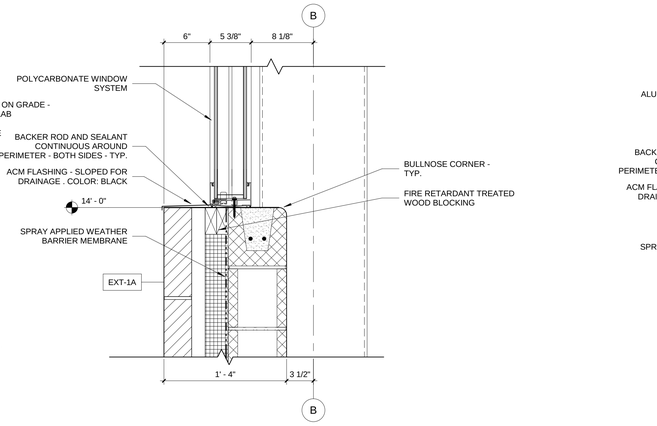

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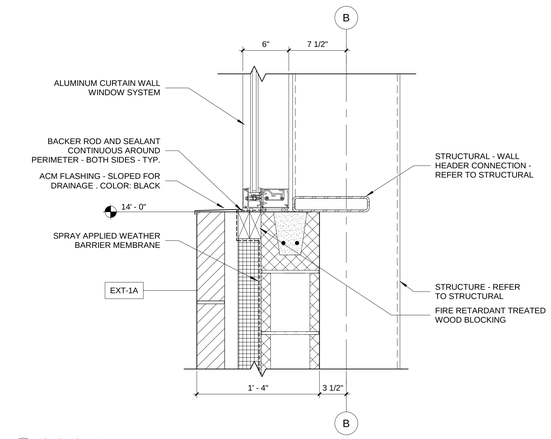

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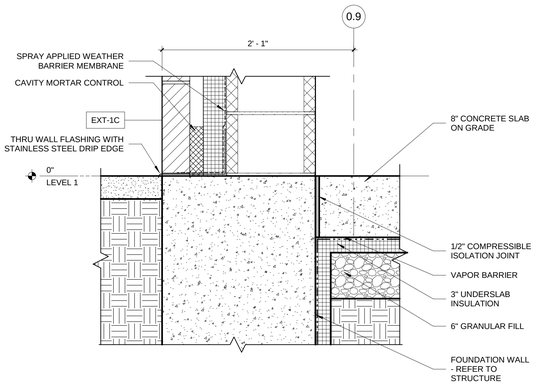

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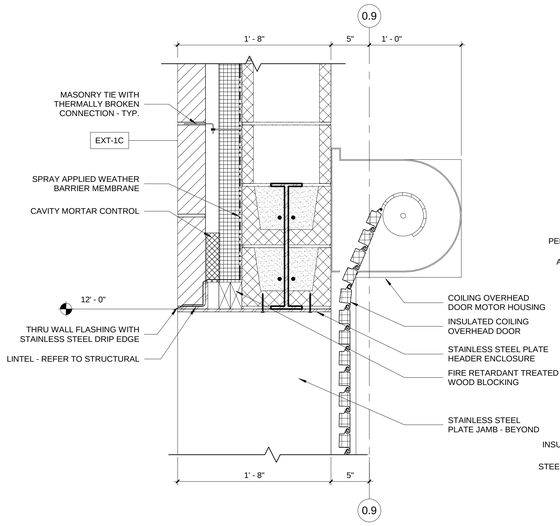

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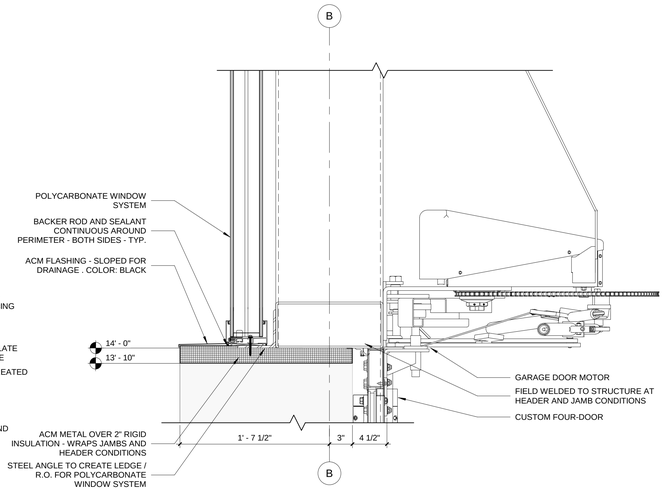

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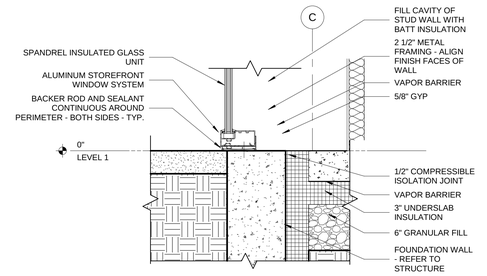

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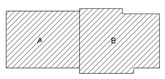

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ADDENDA #3	12/06/17

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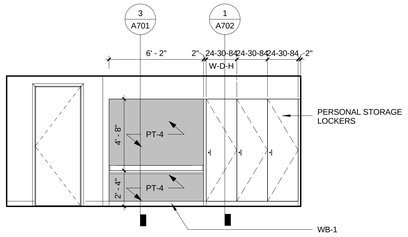
Drawing
SECTION DETAILS

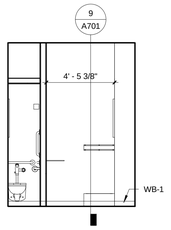
City of Madison Contract No. **8027**
OPN Project No. **17207000**

A343

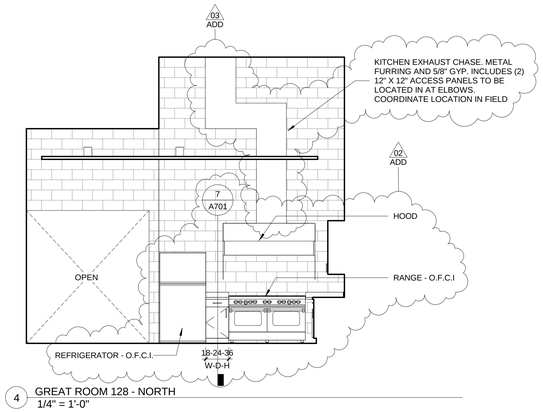


1 LT. QUARTERS 125 - SOUTH
1/4" = 1'-0"

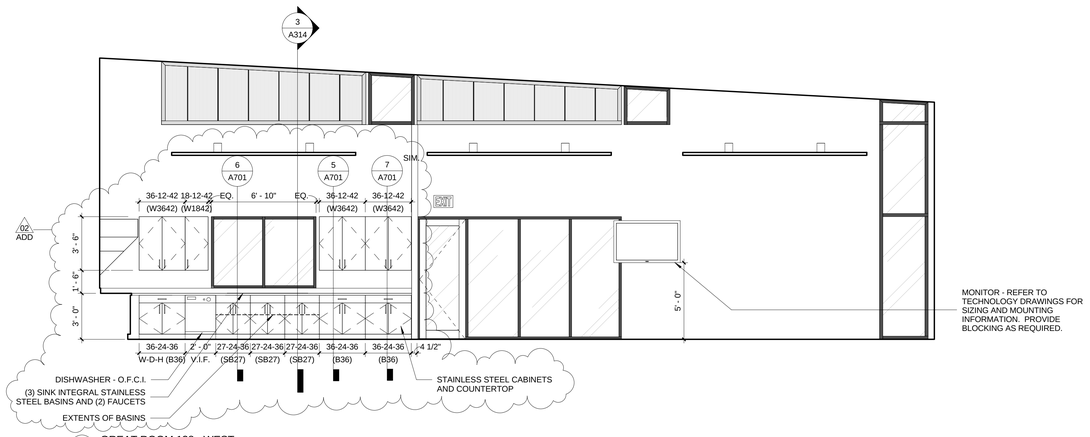
2 JANITOR'S CLOSET 126 - EAST
1/4" = 1'-0"



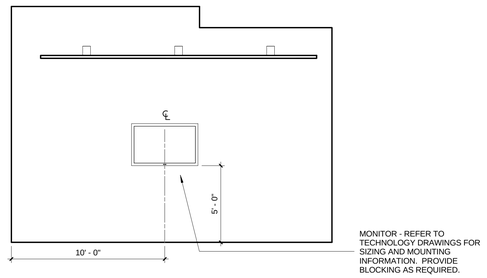
3 JANITOR'S CLOSET 126 - SOUTH
1/4" = 1'-0"



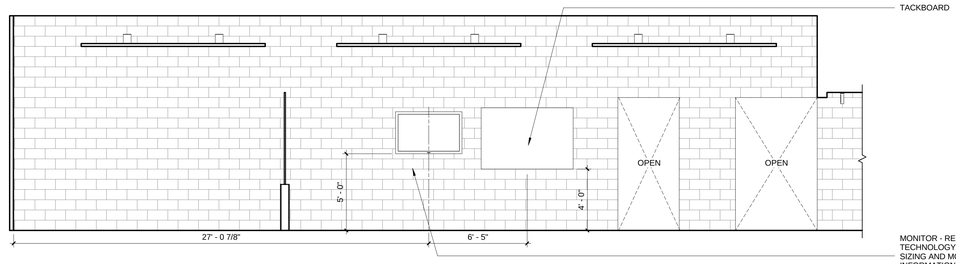
4 GREAT ROOM 128 - NORTH
1/4" = 1'-0"



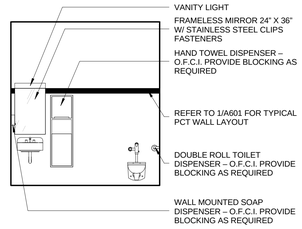
5 GREAT ROOM 128 - WEST
1/4" = 1'-0"



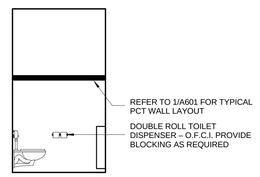
6 GREAT ROOM 128 - SOUTH
1/4" = 1'-0"



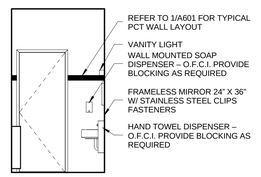
7 GREAT ROOM 128 - EAST
1/4" = 1'-0"



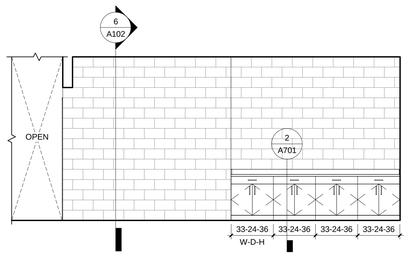
8 DIRTY 115 - EAST
1/4" = 1'-0"



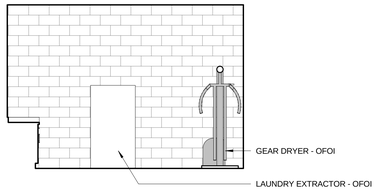
9 DIRTY 115 - SOUTH
1/4" = 1'-0"



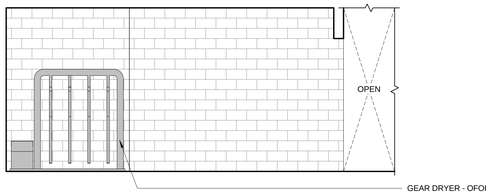
10 DIRTY 115 - NORTH
1/4" = 1'-0"



11 WORKSHOP / GENERAL STORAGE 116 - EAST
1/4" = 1'-0"



12 WORKSHOP / GENERAL STORAGE 116 - SOUTH
1/4" = 1'-0"



13 WORKSHOP / GENERAL STORAGE 116 - WEST
1/4" = 1'-0"

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Structural Engineer
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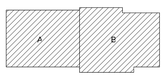
Key Plan



Sheet Issue Date
BID DOCUMENTS 11/03/17

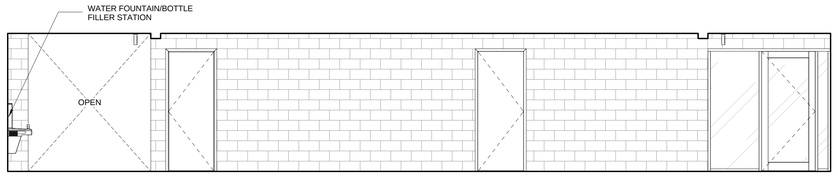
Revision	Date
ADDENDA #2	11/22/17
ADDENDA #3	12/06/17

BID DOCUMENTS

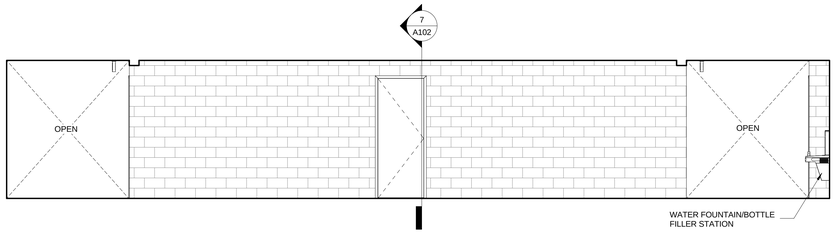
Drawing
INTERIOR ELEVATIONS

City of Madison Contract No. **8027**
OPN Project No. **17207000**

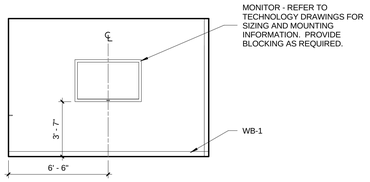
A403



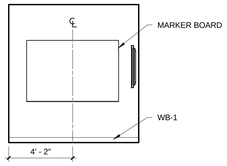
1 CORRIDOR 122 - SOUTH
1/4" = 1'-0"



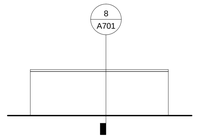
2 CORRIDOR 122 - NORTH
1/4" = 1'-0"



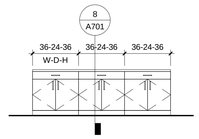
3 SMALL MEETING 102 - EAST
1/4" = 1'-0"



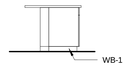
4 SMALL MEETING 102 - NORTH
1/4" = 1'-0"



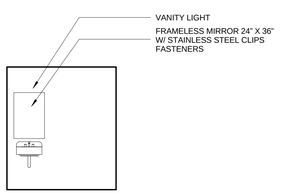
5 GREAT ROOM ISLAND 128 - EAST
1/4" = 1'-0"



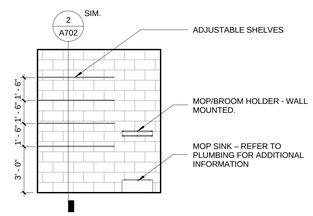
6 GREAT ROOM ISLAND 128 - WEST
1/4" = 1'-0"



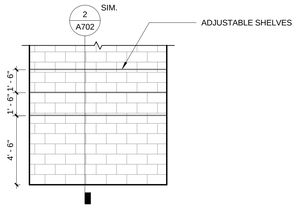
7 GREAT ROOM ISLAND 128 - NORTH
1/4" = 1'-0"



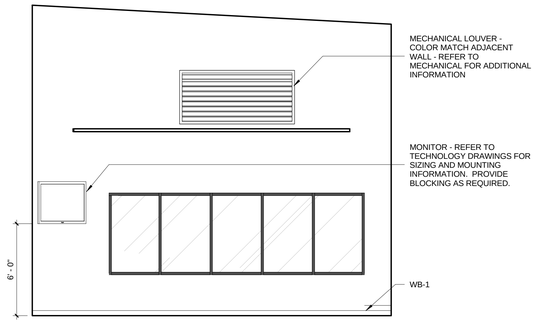
8 COMFORT ROOM 138 - NORTH
1/4" = 1'-0"



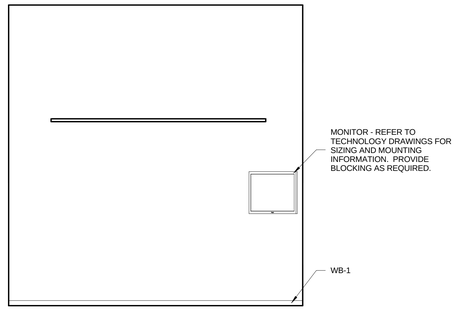
9 JANITOR'S CLOSET 104 - EAST
1/4" = 1'-0"



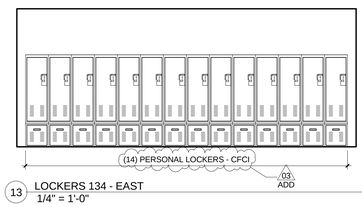
10 LINEN CLOSET 132 - EAST
1/4" = 1'-0"



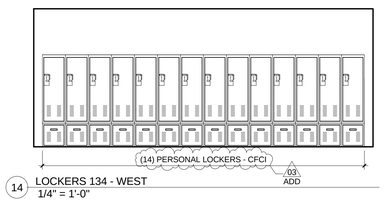
11 FITNESS 127 - EAST
1/4" = 1'-0"



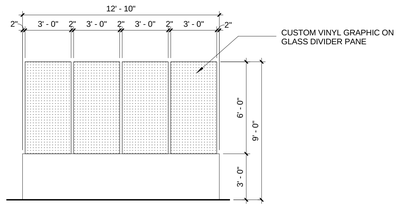
12 FITNESS 127 - NORTH
1/4" = 1'-0"



13 LOCKERS 134 - EAST
1/4" = 1'-0"



14 LOCKERS 134 - WEST
1/4" = 1'-0"



15 GREAT ROOM 128 - DIVIDING WALL - SOUTH
1/4" = 1'-0"

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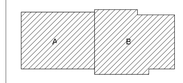
Key Plan



Sheet Issue Date
BID DOCUMENTS 11/03/17

Revision	Date
ADDENDA #3	12/06/17

BID DOCUMENTS

Drawing
INTERIOR ELEVATIONS

City of Madison Contract No. **8027**
OPN Project No. **17207000**

A407

ROOM FINISH SPECIFICATIONS:

CARPET:

CPT-1	MANUFACTURER:	INTERFACE CARPET
	STYLE:	OFF LINE - 138740AK00
	COLOR:	104334 PEWTER/CLOUD
	SIZE:	25CM X 1M
	INSTALLATION:	ASHLAR / REFER TO FINISH PLAN
CPT-2	MANUFACTURER:	INTERFACE CARPET
	STYLE:	ON LINE - 138700AK00
	COLOR:	103788 PEPPER
	SIZE:	25CM X 1M
	INSTALLATION:	ASHLAR / REFER TO FINISH PLAN
CPT-3	MANUFACTURER:	INTERFACE CARPET
	STYLE:	ON LINE - 138700AK00
	COLOR:	105272 BERRY
	SIZE:	25CM X 1M
	INSTALLATION:	ASHLAR / REFER TO FINISH PLAN

CORNER GUARD:

CG-1	MANUFACTURER:	KOROSEAL
	STYLE:	BENT METAL
	COLOR:	ALUMINUM
	SIZE:	1" WIE - FLOOR TO CEILING (A.F.F.)
	INSTALLATION:	REFER TO FINISH PLANS FOR LOCATION
	NOTE:	TYPICAL TYPES INCLUDE: 90 DEGREE ANGLE

GROUT:

GT-1	MANUFACTURER:	BOSTIK - TRU COLOR
	COLOR:	DELOREAN GRAY - H160
	APPLICATION:	WALLS AND FLOORS

PAINT:

PT-1	MANUFACTURER:	SHERWIN WILLIAMS
	COLOR:	SNOWBOUND SW 7004
	FINISH:	SATIN/EG-SHEL
PT-2	MANUFACTURER:	SHERWIN WILLIAMS
	COLOR:	MINDFUL GRAY SW 7016
	FINISH:	SATIN/EG-SHEL
PT-3	MANUFACTURER:	SHERWIN WILLIAMS
	COLOR:	DOVETAIL SW 7018
	FINISH:	SATIN/EG-SHEL
PT- 4	MANUFACTURER:	SHERWIN WILLIAMS
	COLOR:	BOLERO SW 7600
	FINISH:	SATIN/EG-SHEL

PORCELAIN TILE:

PCT-1	MANUFACTURER:	RBC TILE & STONE
	STYLE:	MARATHON
	COLOR:	WHITE
	SIZE:	12" X 24"
	APPLICATION:	RESTROOM / LOCKER ROOM WALLS (NOTE - SHOWER WALLS ARE SOLID SURFACE)
PCT-2	MANUFACTURER:	RBC TILE & STONE
	STYLE:	MARATHON
	COLOR:	WHITE
	SIZE:	18" X 24"
	APPLICATION:	RESTROOM / LOCKER ROOM WALLS (NOTE - SHOWER WALLS ARE SOLID SURFACE)
PCT-3	MANUFACTURER:	RBC TILE & STONE
	STYLE:	MARATHON
	COLOR:	BLACK
	SIZE:	RANDOM MOASIC - 4" TALL BAND
	APPLICATION:	ACCENT BAND IN RESTROOM / LOCKER ROOM WALLS (NOTE - SHOWER WALLS ARE SOLID SURFACE)
PCT-4	MANUFACTURER:	DALTILE
	STYLE:	EXHIBITION
	COLOR:	BLACK EX05 - UNPOLISHED
	SIZE:	24" X 48"
	APPLICATION:	FLOOR TILE

RUBBER FLOORING:

RB-1	MANUFACTURER:	NORA SYSTEMS, INC.
	STYLE:	NORAMENT GRANO 4881
	COLOR:	HEMATITE
	SIZE:	~39.53 (1004MM) X 39.53" (1004MM)
	INSTALLATION:	ASHLAR
RB-2	MANUFACTURER:	NORA SYSTEMS, INC.
	STYLE:	NORAMENT GRANO 4881
	COLOR:	CEPHALOPOD
	SIZE:	~39.53 (1004MM) X 39.53" (1004MM)
	INSTALLATION:	ASHLAR
RB-3	MANUFACTURER:	MONDO
	STYLE:	SPORT IMPACT
	COLOR:	BLACK
	SIZE:	ROLLS (6' WIDE, 3/8" THICK)
	INSTALLATION:	MONOLITHIC

SOLID SURFACE:

SLD-1	MANUFACTURER:	CORIAN
	COLOR:	GRAY
	APPLICATION:	SHOWER WALLS
SLD-2	MANUFACTURER:	CORIAN
	COLOR:	GLACIER WHITE
	APPLICATION:	WINDOW SILLS

SOLID SURFACE SHOWER TRAY:

ST	MANUFACTURER:	CORIAN
	COLOR:	GRAY
	SIZE:	CASUAL 800mm
	APPLICATION:	SHOWER TRAY

WALL BASE

WB-1	MANUFACTURER:	JOHNSONITE
	STYLE:	RUBBER COVE BASE
	SIZE:	2 1/2"
	COLOR:	63 BURNT UMBER

WOOD:

WD-1	MANUFACTURER:	MARSHFIELD DOOR SYSTEMS
	SPECIES:	WHITE MAPLE
	COLOR/FINISH:	AMBER 30 - 95
	APPLICATION:	DOORS

02 ADD

ROOM FINISH SCHEDULE

ROOM NAME	Number	FLOOR FINISH	FLOOR BASE	WALL FINISH NORTH	WALL FINISH EAST	WALL FINISH SOUTH	WALL FINISH WEST	CEILING FINISH	Remarks
LOBBY	101	POLISH CONC.	WB-1	SEE ELEVATION	SEE ELEVATION	SEE ELEVATION	PT-1	PT-1, PT-2	2
SMALL MEETING	102	CPT-1, CPT-3	WB-1	PT-4	PT-1	--	PT-1	--	
SMALL MEETING	103	CPT-1, CPT-3	WB-1	PT-4	PT-1	--	PT-1	--	
JANITOR'S CLOSET	104	POLISH CONC.	WB-1	PT-1	PT-1	PT-2	PT-1	PT-2	
CORRIDOR	105	PCT-4	PCT	PT-1	PT-1	PT-1	PT-1	PT-1	3
WOMEN'S (ADA)	106	PCT-4	PCT	PCT-1, PCT-2, PCT-3	PCT-1, PCT-2, PCT-3	PCT-1, PCT-2, PCT-3	PCT-1, PCT-2, PCT-3	PT-1	1, 3
MEN'S (ADA)	107	PCT-4	PCT	PCT-1, PCT-2, PCT-3	PCT-1, PCT-2, PCT-3	PCT-1, PCT-2, PCT-3	PCT-1, PCT-2, PCT-3	PT-1	1, 3
LIEUTENANT'S OFFICE	108	POLISH CONC.	WB-1	PT-1	PT-1	PT-1	PT-1	--	
WATCH	109	POLISH CONC.	WB-1	PT-1	PT-1	PT-1	PT-1	--	
CORRIDOR	110	POLISH CONC.	WB-1	PT-1	PT-1	PT-1	PT-1	--	
APPARATUS BAY	111	RF-1, RF-2, RF-3	WB-1	PT-2	PT-2	PT-2	PT-2	PT-3	
ELECTRICAL & COMPRESSOR	112	RF-1	WB-1	PT-2	PT-2	PT-2	PT-2	PT-3	
TOOL STORAGE & WATER	113	RF-1	WB-1	PT-2	PT-2	PT-2	PT-2	PT-3	
STAIR	114	--	WB-1	PT-1	PT-1	PT-1	PT-1	PT-3	
DIRTY	115	PCT	PCT	PCT-1, PCT-2, PCT-3	PCT-1, PCT-2, PCT-3	PCT-1, PCT-2, PCT-3	PCT-1, PCT-2, PCT-3	PT-3	1
WORKSHOP / GENERAL STORAGE	116	RF-1	WB-1	PT-2	PT-2	PT-2	PT-2	PT-3	
TURNOUT	117	RF-1	WB-1	PT-2	PT-2	PT-2	PT-2	PT-3	
EMS STORAGE	118	POLISH CONC.	WB-1	PT-1	PT-1	PT-1	PT-1	PT-3	
I.T.	119	POLISH CONC.	WB-1	PT-1	PT-1	PT-1	PT-1	PT-3	
LAUNDRY	120	POLISH CONC.	WB-1	PT-1	PT-1	PT-1	PT-1	PT-2	
CORRIDOR	121	POLISH CONC.	WB-1	PT-1	PT-1	PT-1	PT-1	--	
UNISEX	122	PCT-4	PCT	PCT-1, PCT-2, PCT-3	PCT-1, PCT-2, PCT-3	PCT-1, PCT-2, PCT-3	PCT-1, PCT-2, PCT-3	PT-1	1,3
LT. QUARTERS	123	RB-1	WB-1	PT-1	PT-1	PT-1	PT-1	--	
LT. SHOWER (ADA)	124	PCT	PCT	PCT-1, PCT-2, PCT-3	PCT-1, PCT-2, PCT-3	PCT-1, PCT-2, PCT-3	PCT-1, PCT-2, PCT-3	PT-1	1
LT. QUARTERS	125	POLISH CONC.	WB-1	PT-1	PT-1	PT-1	PT-1	--	
JANITOR'S CLOSET	126	POLISH CONC.	WB-1	PT-1	PT-1	PT-1	PT-1	PT-2	
FITNESS	127	RB-3	WB-1	PT-4	PT-1	PT-1	PT-1	PT-2	2
GREAT ROOM	128	POLISH CONC., PCT	WB-1	PT-1	PT-1	PT-1	PT-1	PT-1, PT-2	2
PANTRY	129	POLISH CONC.	WB-1	PT-1	PT-1	PT-1	PT-1	--	
CORRIDOR	130	POLISH CONC.	WB-1	PT-1	PT-1	PT-1	PT-1	--	
CORRIDOR	131	POLISH CONC.	WB-1	PT-1	PT-1	PT-1	PT-1	--	
LINEN CLOSET	132	POLISH CONC.	WB-1	PT-1	PT-1	PT-1	PT-1	PT-2	
DORM ROOM	133	RB-1, RB-2	WB-1	PT-4	PT-1	PT-4	PT-1	PT-1	
LOCKER ROOM	134	POLISH CONC.	WB-1	PT-1	PT-1	PT-1	PT-1	--	
UNISEX (ADA)	135	PCT-4	PCT	PCT-1, PCT-2, PCT-3	PCT-1, PCT-2, PCT-3	PCT-1, PCT-2, PCT-3	PCT-1, PCT-2, PCT-3	PT-1	1, 3
UNISEX	136	PCT-4	PCT	PCT-1, PCT-2, PCT-3	PCT-1, PCT-2, PCT-3	PCT-1, PCT-2, PCT-3	PCT-1, PCT-2, PCT-3	PT-1	1, 3
UNISEX	137	PCT-4	PCT	PCT-1, PCT-2, PCT-3	PCT-1, PCT-2, PCT-3	PCT-1, PCT-2, PCT-3	PCT-1, PCT-2, PCT-3	PT-1	1, 3
COMFORT ROOM	138	PCT-4	PCT	PCT-1, PCT-2, PCT-3	PCT-1, PCT-2, PCT-3	PCT-1, PCT-2, PCT-3	PCT-1, PCT-2, PCT-3	PT-1	3
COMMUNITY ROOM STORAGE	139	POLISH CONC.	WB-1	PT-1	PT-1	PT-1	PT-1	PT-2	
COMMUNITY / TRAINING ROOM	140	SEE FINISH PLAN	WB-1	PT-1	PT-1	PT-1	PT-1	PT-1, PT-2	2

03 ADD

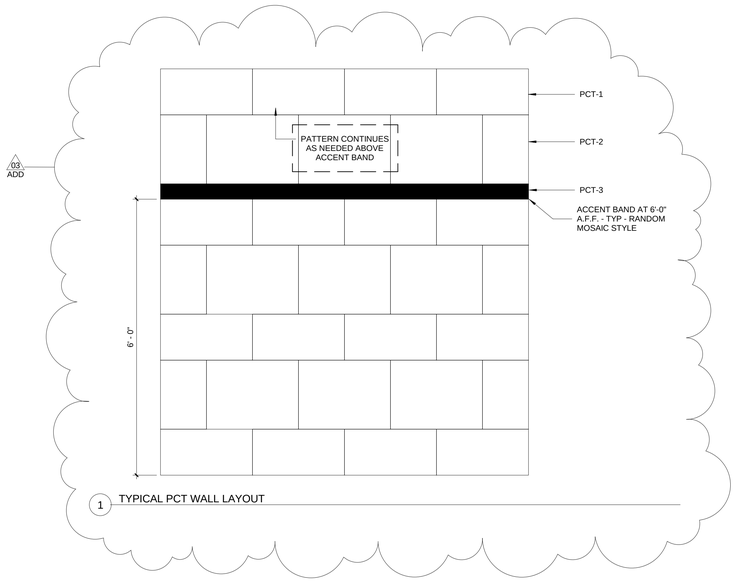
REMARKS

1. REFER TO TYPICAL PCT WALL LAYOUT BELOW (1 / A601)

2. PT-1 IS INTENDED FOR HARD-LID SURFACES, PT-2 IS INTENDED TO OPEN TO STRUTURE ELEMENTS. CONFIRM WITH ARCHITECT

3. RECESS PCT-4 IN CONCRETE SLAB, PROVIDE TRANSITION STRIPS AS NEEDED.

03 ADD



03 ADD

1 TYPICAL PCT WALL LAYOUT

OPN ARCHITECTS

301 N BROOM STREET #100
MADISON, WI 53703
608-819-0260 PHONE
www.opnarchitects.com
opn@opnarchitects.com

Owner

City of Madison Fire Department
314 W. Dayton St.
Madison, WI 53703

Project

Madison Fire Station 14
3201 Dairy Drive
Madison, WI 53718

Civil Engineer

Snyder & Associates, Inc
5010 Voges Rd
Madison WI, 53718
P. 608-838-0444

Structural Engineer

IMEG
1800 Deming Way #200
Middleton, WI 53562
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Mechanical Engineer

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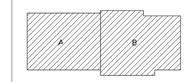
Key Plan



Sheet Issue Date

BID DOCUMENTS 11/03/17

Revision	Date
ADDENDA #2	11/22/17
ADDENDA #3	12/06/17

BID DOCUMENTS

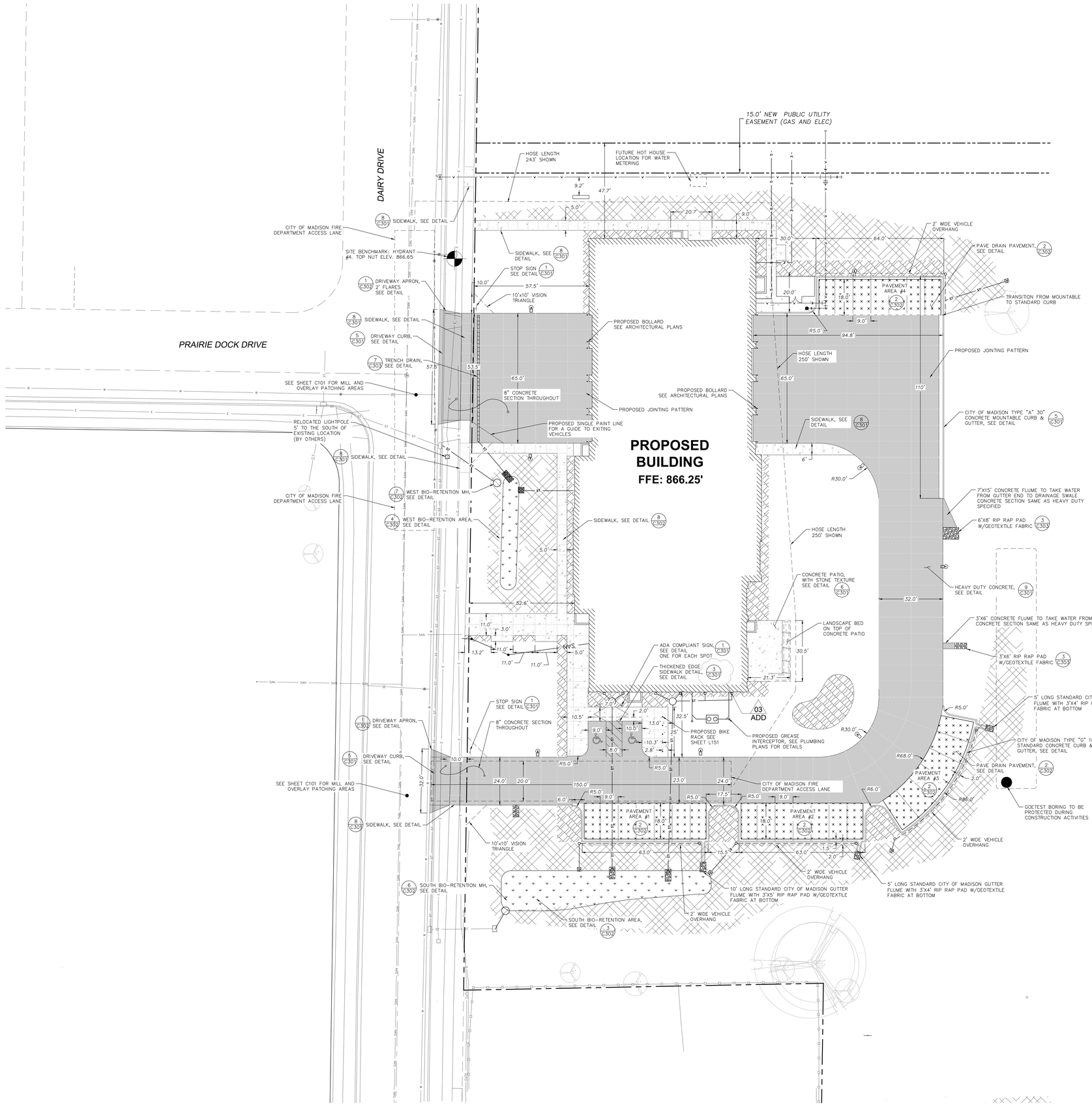
Drawing

FINISH SCHEDULE AND SPECIFICATIONS

City of Madison Contract No. **8027**
OPN Project No. **17207000**

A601

PRINTED:



NORTH

0 20 40

SCALE: 1" = 20'

TO OBTAIN LOCATION OF PARTICIPANTS' UNDERGROUND FACILITIES BEFORE YOU DIG IN WISCONSIN

CALL DIGGERS HOTLINE
1-800-242-8511
TOLL FREE

WIS. STATUTE 182.0175 (1974) REQUIRES MIN. OF 3 WORK DAYS NOTICE BEFORE YOU EXCAVATE

LEGEND

- PROPOSED CONCRETE SIDEWALK
- PROPOSED HEAVY DUTY CONCRETE PAVEMENT
- PROPOSED BIORETENTION AREA
- PROPOSED PERMEABLE PAVEMENT
- PROPOSED LANDSCAPE AREA REFERENCE L SHEETS
- PROPOSED BUILDING
- PROPOSED TRENCH DRAIN
- PROPOSED LIGHT POLE LOCATION

NOTES:

1. ALL DIMENSIONS ARE FROM FACE OF CURB TO FACE OF CURB.
2. MADISON FIRE STATION 14
   3201 DAIRY DRIVE
   MADISON WI, 53718
3. WHEN WORKING IN THE RIGHT OF WAY, ALL CITY OF MADISON PATCHING CRITERIA FOR SIDEWALK, CURB & GUTTER AND PAVEMENT SHALL BE FOLLOWED AT ALL TIMES
4. SITE LIGHTING LOCATIONS ARE FOR REFERENCE ONLY. EXACT LOCATION OF SIGHT LIGHTING FIXTURES SHALL BE FIELD DETERMINED BY SITE ELECTRICAL CONTRACTOR.
5. ALL PAVEMENT MARKINGS SHALL BE 4" WIDTH AND YELLOW IN COLOR.
6. THE RIGHT OF WAY IS THE SOLE JURISDICTION OF THE CITY OF MADISON AND IS SUBJECT TO CHANGE AT ANYTIME PER THE RECOMMENDATION/PLAN OF TRAFFIC ENGINEERING AND CITY ENGINEERING DEPARTMENTS.

SITE DATA

ZONING DISTRICT:	SE SUBURBAN EMPLOYMENT DISTRICT
TOTAL SITE AREA:	481,950 SF
PRO. IMPERVIOUS:	45,218 SF
PRO. PERMEABLE PAVEMENT	4,558 SF
PROPOSED GREEN AREA:	427,616 SF

PARKING REQUIREMENTS

PARKING PROVIDED = 29
BICYCLE PARKING PROVIDED = 10

PER CODE, FOR 26-50 TOTAL PARKING STALLS
2 HANDICAP PARKING STALLS MUST BE PROVIDED

2 HANDICAP PARKING STALLS ARE SHOWN ON PLAN

BUILDING SETBACKS
FRONT = NONE
REAR = 20'
SIDE YARD = ONE STORY 5'
TWO STORY 6'
MAX LOT COVERAGE = 85%

OPN ARCHITECTS

301 N BROOM STREET #100
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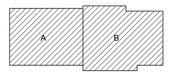
Key Plan



Sheet Issue Date
BID DOCUMENTS 11/03/17

Revision	Date
ADDENDA #3	12/6/17

BID DOCUMENTS

Drawing
Site Plan

City of Madison Contract No. **8027**
OPN Project No. **17207000**

C201

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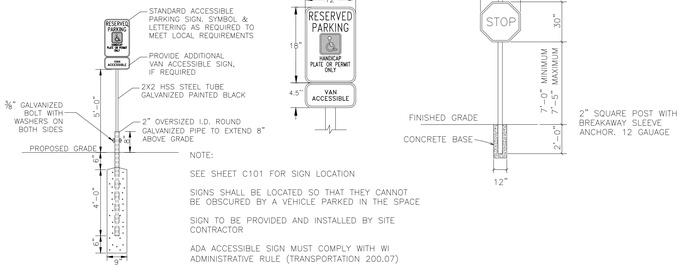
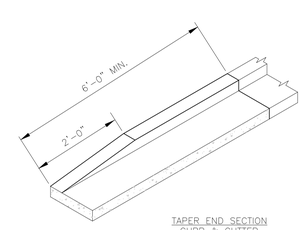
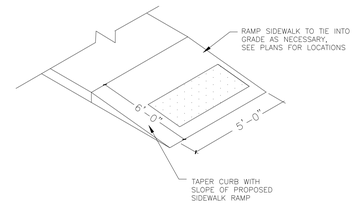


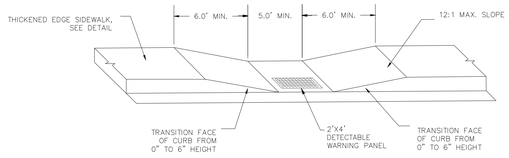
1 C301 SIGNAGE DETAILS
NOT TO SCALE



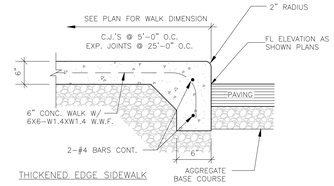
TAPER END SECTION
CURB & GUTTER



TAPER END SECTION
CURB & GUTTER

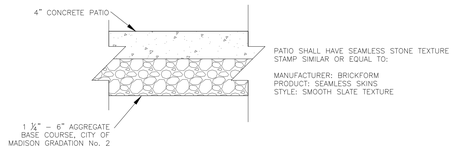


DEPRESSED SIDEWALK RAMP



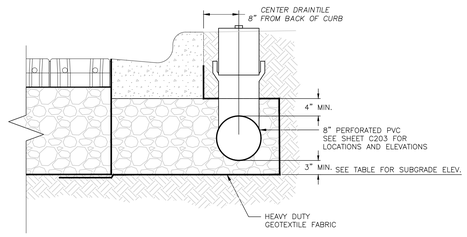
THICKENED EDGE SIDEWALK

3 C301 SIDEWALK DETAILS



4" CONCRETE PATIO DETAIL

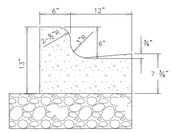
6 C301 PATIO DETAIL
NOT TO SCALE



NOTE:

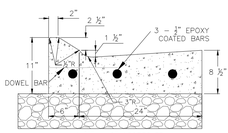
1. SEE DETAIL #2 SHEET C302 FOR CONCRETE PAVEMENT SECTION DETAILS

4 C301 STORM SEWER CLEANOUTS DETAIL
NOT TO SCALE



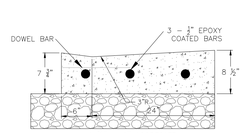
1 ¼" – 6" AGGREGATE BASE COURSE, CITY OF MADISON GRADATION No. 2 EXTEND MINIMUM 6" PAST BACK OF CURB

CITY OF MADISON TYPE "G" STANDARD CONCRETE CURB & GUTTER



1 ¼" – 6" AGGREGATE BASE COURSE, CITY OF MADISON GRADATION No. 2 EXTEND MINIMUM 6" PAST BACK OF CURB

CITY OF MADISON TYPE "A" MOUNTABLE CURB & GUTTER



1 ¼" – 6" AGGREGATE BASE COURSE, CITY OF MADISON GRADATION No. 2 EXTEND MINIMUM 6" PAST BACK OF CURB

CITY OF MADISON TYPE "A" MODIFIED DRIVEWAY SECTION CURB & GUTTER

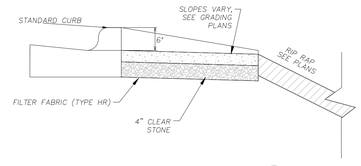
NOTES:

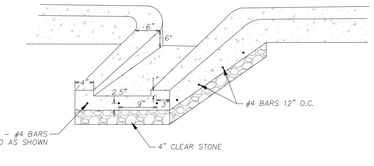
LATERAL CONTRACTION JOINTS SHALL BE PLACED AT INTERVALS OF NOT MORE THAN 15' NOR LESS THAN 6' IN LENGTH. THE JOINTS SHALL BE A MINIMUM OF 3" IN DEPTH EXPANSION JOINTS SHALL BE PLACED TRANSVERSELY AT RADIUS POINTS ON CURVES OF RADIUS 200' OR LESS, AND AT ANGLE POINTS, OR AS DIRECTED BY THE ENGINEER.

THE EXPANSION JOINT SHALL BE A ONE PIECE ASPHALTIC MATERIAL HAVING THE SAME DIMENSIONS AS CURB & GUTTER AT THAT STATION AND BE 1/2" THICK. IN ALL CASES, CONCRETE CURB & GUTTER SHALL BE PLACED ON THOROUGHLY COMPACTED CRUSHED STONE THAT IS 6" THICK.

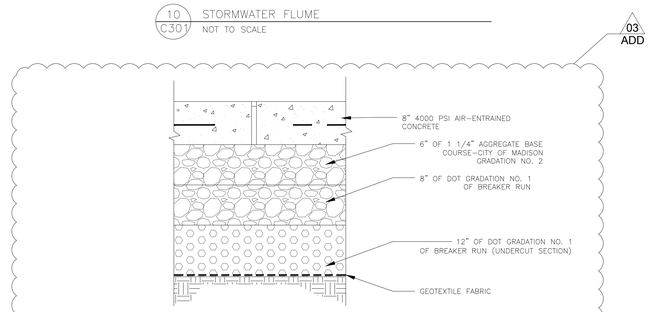
IN ALL CASES, CONCRETE CURB & GUTTER SHALL BE PLACED ON 6" OF THOROUGHLY COMPACTED AGGREGATE BASE COURSE (MADISON GRADATION NO.2).

5 C301 CONCRETE CURB AND GUTTER
NOT TO SCALE

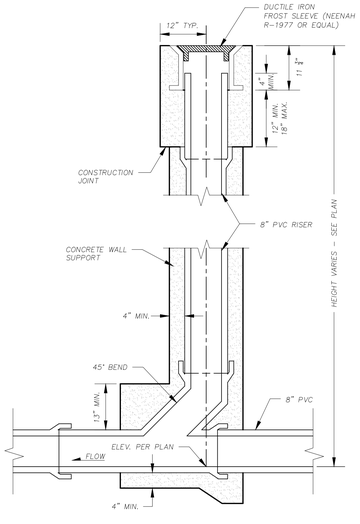




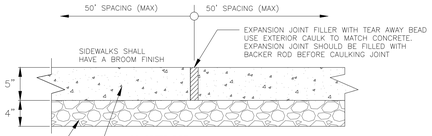
10 C301 STORMWATER FLUME
NOT TO SCALE



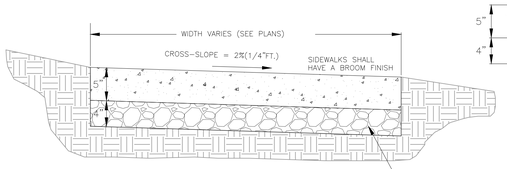
11 C301 UNDERCUT SECTION
NOT TO SCALE



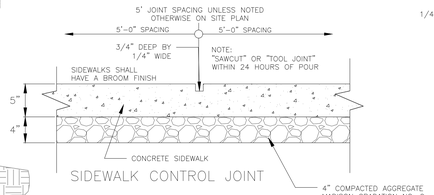
7 C301 SANITARY SEWER CLEANOUT DETAIL
NOT TO SCALE



SIDEWALK EXPANSION JOINT

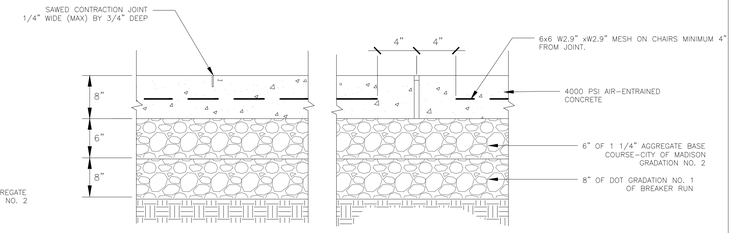


5" SITE SIDEWALK



SIDEWALK CONTROL JOINT

8 C301 5" SIDEWALK
NOT TO SCALE



COMPACTED SUBGRADE

NOTE:
PROVIDE #4 – 8" DOWEL CONNECTION BETWEEN ADJACENT SLABS AT 12" O.C. EPOXY-COATED.

9 C301 HEAVY DUTY CONCRETE
NOT TO SCALE

OPN ARCHITECTS
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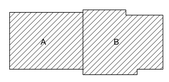
Key Plan



Sheet Issue Date
BID DOCUMENTS 11/03/17

Revision	Date
ADDENDA #3	12/6/17

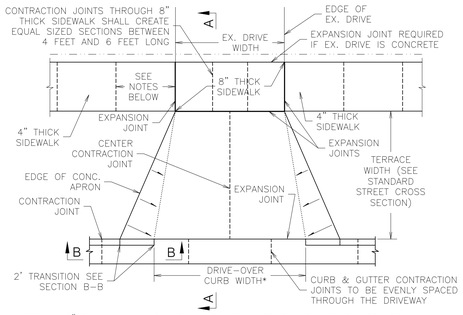
BID DOCUMENTS

Drawing
Plan Details

City of Madison Contract No. 8027
OPN Project No. 17207000

C301

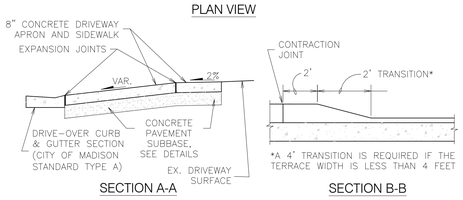
PRINTED:



NOTES: – 8" THICK WALK WIDTH SHALL BE EQUAL TO THE EX. DRIVE WIDTH OR A MINIMUM OF 12' CENTERED ON THE EX. DRIVE. THE DRIVE-OVER CURB WIDTH SHALL BE EQUAL TO THE 8" THICK WALK WIDTH PLUS 2', CENTERED ON THE EX. DRIVE.

– CONTRACTION JOINTS IN 4" THICK SIDEWALKS SHALL BE PLACED EVERY 5'. EXPANSION JOINTS SHALL BE PLACED AT INTERVALS NOT TO EXCEED 96 FEET.

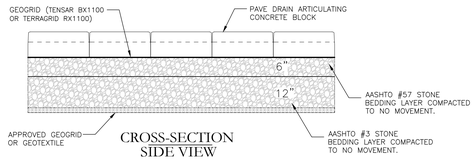
PLAN VIEW



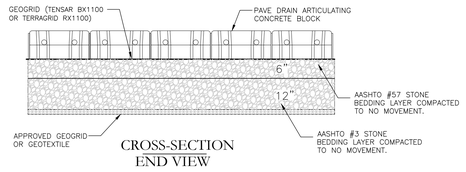
SECTION A-A

SECTION B-B

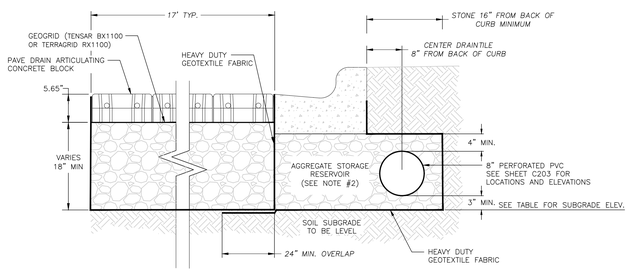
1 C302 DRIVEWAY ENTRANCE DETAIL
NOT TO SCALE



CROSS-SECTION SIDE VIEW



CROSS-SECTION END VIEW



PAVE DRAIN PAVEMENT

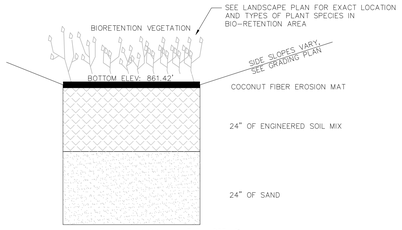
NOTES:

1. PAVEMENT SURFACE PERCENT VOIDS SHALL BE LESS THAN 25%.
2. PAVER BEDDING COURSE SHALL CONSIST OF 6" of AASHTO #57 AND 12" OF ASSHTO #3 AGGREGATE BASE COURSES.
3. AGGREGATE STORAGE RESERVOIR DEPTH SHALL BE A MINIMUM OF 18 INCHES.
4. IF UNDERCUT IS NEEDED UNDER THE PAVE DRAIN SECTION, ADDITIONAL AGGREGATE OF THE SAME TYPE WILL BE USED.

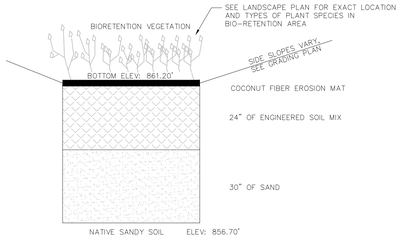
03 ADD

PAVEMENT AREAS		
AREA #	SUBGRADE ELEV.	DRAINTILE I.E.
#1	862.64	862.89
#2	862.70	862.95
#3	862.14	862.39
#4	862.16	862.86

2 C302 PERMEABLE PAVEMENT DETAIL
NOT TO SCALE

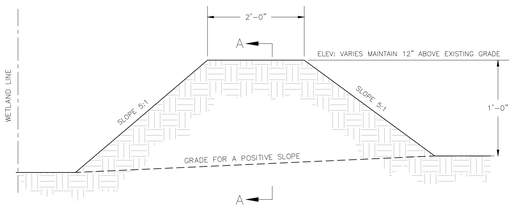


3 C302 SOUTH BIORETENTION PROFILE
NOT TO SCALE



4 C302 WEST BIORETENTION PROFILE
NOT TO SCALE

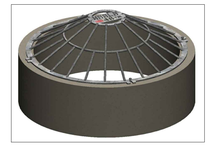
SECTION A-A



5 C302 BERM DETAIL
NOT TO SCALE

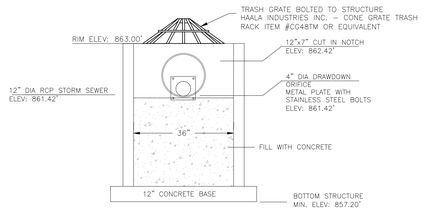
BIORETENTION NOTES

1. BIORETENTION SHALL CONFORM TO WIS. DNR TECH STANDARD 1004.
2. ENGINEERED SOIL SHALL CONSIST OF 70%–85% SILICA SAND AND 15%–30% COMPOST WITH A PH OF 5.5–6.5
3. BIORETENTION BASINS SHALL BE EXCAVATED AND USED AS SEDIMENT TRAPS DURING CONSTRUCTION. UPON COMPLETION OF CONSTRUCTION AND SITE STABILIZATION, THE BASINS SHALL BE OVER-EXCAVATED 3 FEET MINIMUM AND THEN THE SAND LAYER AND ENGINEERED SOIL SHALL BE PLACED TO WITHIN THREE INCHES OF FINAL GRADE. ONCE THE ENGINEERED SOIL IS PLACED, THREE INCHES OF HARDWOOD MULCH SHALL BE ADDED ON TOP OF THE ENGINEERED SOIL.
4. SPECIFIC SPECIES OR CONTAINER SIZE SUGGESTED SUBSTITUTIONS SHALL BE PRESENTED TO CONSULTANT ALONG WITH THE REASONS FOR THE SUGGESTIONS. WITH CONSULTANT OR PROJECT ENGINEER'S APPROVAL, SUBSTITUTIONS MAY BE MADE. IF SUBSTITUTIONS ARE MADE, CONTRACT PRICES MAY NEED TO BE ADJUSTED ACCORDINGLY.
5. LIVE PLANTS CAN BE PLANTED IN THE FIELD DURING THE GROWING SEASON FROM MAY 1 THROUGH OCTOBER 15. ANY SUGGESTED PLANTING TIMES NOT IN THIS WINDOW SHALL BE APPROVED BY CONSULTANT OR ENGINEER. IF PLANTING OCCURS OUTSIDE OF THIS WINDOW ADDITIONAL MEASURES MAY NEED TO BE TAKEN (I.E. MULCH) TO ENSURE PLANT SURVIVAL. IN THESE INSTANCES, THE CONTRACT PRICE MAY NEED TO BE ADJUSTED ACCORDINGLY.
6. ALL PLANTED MATERIALS WILL BE WARRANTED BY INSTALLATION CONTRACTOR TO BE IN HEALTHY CONDITION WITH A REPLACEMENT GUARANTEE FOR A PERIOD OF TWO YEARS FROM THE DATE OF PLANTING.
7. SEE LANDSCAPE PLAN FOR LOCATION, SPACING, AND TYPE OF PLANTS FOR BIO-RETENTION AREAS.



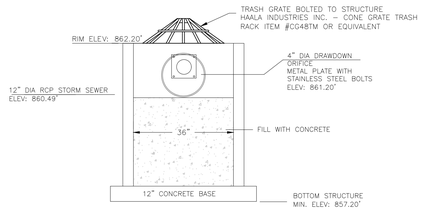
TRASH RACK
(HAALA INDUSTRIES INC)

NOTES:
1. TRASH GRATE TO BE BOLTED TO STRUCTURE
2. GRATE SHALL BE PAINTED OR COATED PER CITY OF MADISON STANDARD SPECIFICATIONS 506.2(b).
3. LEVEL SPREADER SHALL BE 12'X2'X2' WITH TOP ELEVATION AT 884.85'. ROCK SHALL CONSIST OF 2"–3" CLEAR STONE, BOTTOM SHALL BE WRAPPED IN GEOTEXTILE FABRIC.



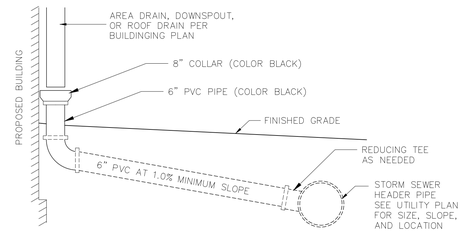
SOUTH BIORETENTION

6 C302 SOUTH BIORETENTION OVERFLOW MH#1
NOT TO SCALE



WEST BIORETENTION

7 C302 WEST BIORETENTION OVERFLOW MH#2
NOT TO SCALE



8 C302 ROOF DRAIN CONNECTION DETAIL
NOT TO SCALE

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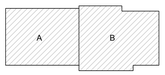

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Revision	Date
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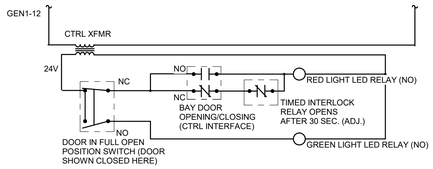
Drawing
Plan Details

City of Madison Contract No. 8027
OPN Project No. 17207000

C302



2 BAY DOOR ANNUNCIATION WIRING DIAGRAM

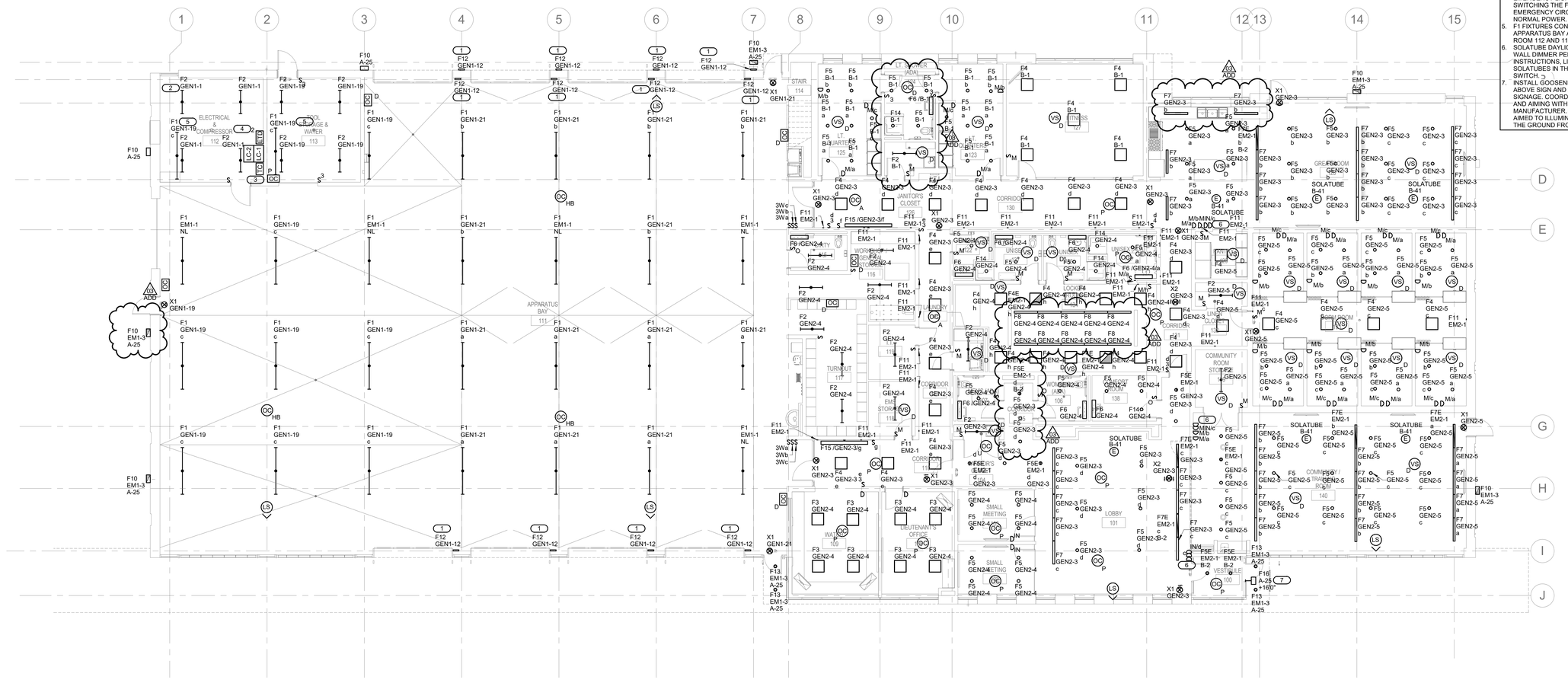
NO SCALE

SHEET NOTES :

1. COORDINATE HANGING OF EQUIPMENT AND DEVICES IN APARATUS BAY AND SURROUNDING SPACES WITH STRUCTUAL METAL ROOF DECK, DECK MANUFACTURER'S REQUIREMENTS, AND OTHER TRADES. UTILIZE DECK MANUFACTURER HANGERS TO SUPPORT EQUIPMENT AND DEVICES WHERE APPLICABLE. ENSURE DECK HANGER LOADING LIMITS AND SQUARE FOOT LOADING LIMITS ARE NOT EXCEEDED FOR EQUIPMENT FROM ALL TRADES.
2. CONCEAL ALL CONDUITS WHERE POSSIBLE. WHERE NOT POSSIBLE, ROUTE EXPOSED CONDUITS IN INCONSPICUOUS LOCATIONS APPROVED BY ARCHITECT.
3. PROVIDE EMERGENCY TRANSFER DEVICE SHOWN ON EL102 MONITORING AN UNSWITCHED PORTION OF GEN2-3. UPON LOSS OF NORMAL POWER, TRANSFER DEVICE IS TO TRANSFER F11 FIXTURES TO AN UNSWITCHED PORTION OF THEIR LIGHTING CIRCUIT.
4. F1 FIXTURES TO BE MOUNTED TIGHT TO BEAMS.

KEYNOTES: (#)

1. DOOR OPEN AND CLOSE SIGNAL LIGHTS TYPE "SR" AND "SG" MOUNTED AT APPROXIMATELY 8'-0" AFF, CENTERED VERTICALLY ON STEEL PURLIN WITH ANY JUNCTION BOXES PAINTED TO MATCH THE STRUCTURAL STEEL. ("SR" RED ABOVE "SG" GREEN LIGHT). INTERLOCK WITH N.O. 2-SPOT DOOR POSITION SWITCH (SQ. "D" HD IND. XCKT4-SERIES) IN NEMA 1 ENCLOSURE. PROVIDE (120/24 VOLT) TRANSFORMER FOR DOOR POSITION CONTROL WITH TOGGLE SWITCH DISCONNECT. SEQUENCE: RED LIGHT SHALL BE ACTIVATED UPON BAY DOOR OPENING; GREEN LIGHT COMES ON WITH BAY DOOR IN FULL OPEN POSITION; RED LIGHT COMES ON WITH DOOR CLOSING AND REMAINS ON UNTIL 30 SECONDS (TIME DELAY ADJ.) AFTER DOOR CLOSES. REFER TO DETAIL 2/EL101 FOR MORE INFORMATION.
2. ROUTE CONDUIT IN THIS AREA ALONG THE WALL TO AVOID THE TRANSPARENT WALL ABOVE.
3. REFER TO 2/E050.
4. EMERGENCY TRANSFER DEVICE TO MONITOR UNSWITCHED PORTION OF EXTERIOR EMERGENCY LIGHTING CIRCUIT A-25, SWITCHING THE FIXTURES TO THE EMERGENCY CIRCUIT EM1-3 UPON LOSS OF NORMAL POWER.
5. F1 FIXTURES CONTINUE ACROSS THE APPARATUS BAY ABOVE THE HARD LID OF ROOM 112 AND 113.
6. SOLATUBE DAYLIGHT TO BE CONTROLLED VIA WALL DIMMER PER MANUFACTURERS INSTRUCTIONS. LINKED TOGETHER WITH SOLATUBES IN THE SAME ROOM TO ONE WALL SWITCH.
7. INSTALL GOOSENECK FIXTURE CENTERED ABOVE SIGN AND AIMED TO ILLUMINATE SIGNAGE. COORDINATE EXACT PLACEMENT AND AIMING WITH ARCHITECT AND SIGN MANUFACTURER. ENSURE LIGHTS ARE NOT AIMED TO ILLUMINATE ABOVE PARALLEL TO THE GROUND FROM THE LIGHT.



1 FLOOR PLAN LEVEL 1 - LIGHTING

1/8" = 1'-0"

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ADDENDA #2	11/22/17
ADDENDA #3	12/06/2017

Drawing
FLOOR PLAN LEVEL 1 - LIGHTING

City of Madison Contract No. **8027**
OPN Project No. **17207000**

EL101

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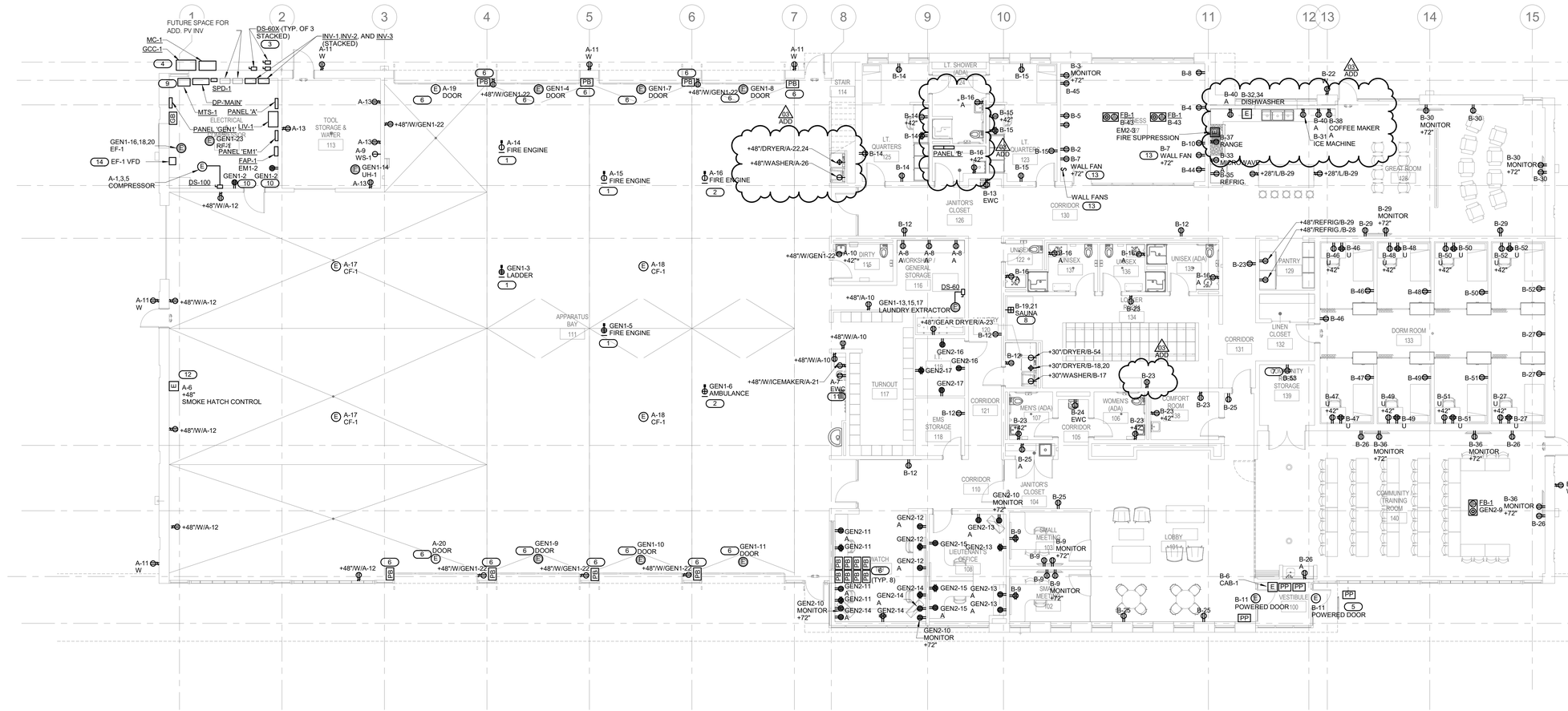

FLOOR PLAN LEVEL 1 - POWER

1/8" = 1'-0"

NORTH

SHEET NOTES :

1. COORDINATE HANGING OF EQUIPMENT AND DEVICES IN APARATUS BAY AND SURROUNDING SPACES WITH STRUCTUAL METAL ROOF DECK, DECK MANUFACTURER'S REQUIREMENTS, AND OTHER TRADES. UTILIZE DECK MANUFACTURER HANGERS TO SUPPORT EQUIPMENT AND DEVICES WHERE POSSIBLE. ENSURE DECK HANGER LOADING LIMITS AND SQUARE FOOT LOADING LIMITS ARE NOT EXCEEDED FOR EQUIPMENT FROM ALL TRADES.
2. CONCEAL ALL CONDUITS WHERE POSSIBLE. WHERE NOT POSSIBLE, ROUTE IN INCONSPICUOUS LOCATIONS APPROVED BY ARCHITECT.

KEYNOTES: (#)

1. DROP CORD RECEPTACLE SERVES FIRE ENGINE. COORDINATE EXACT LOCATION AND CORD LENGTH WITH OWNER PRIOR TO INSTALLATION. REFER TO 2/E300 FOR DROP CORD DETAIL.
2. DROP CORD RECEPTACLE SERVES AMBULANCE. COORDINATE EXACT LOCATION AND CORD LENGTH WITH OWNER PRIOR TO INSTALLATION. REFER TO 3/E300 FOR DROP CORD DETAIL.
3. PROVIDE LABEL ON EACH DISCONNECT SWITCH. LABEL SHALL READ "UTILITY PHOTOVOLTAIC INTERCONNECT DISCONNECT".
4. GENERATOR CONNECTION CABINET, GCC-1, SHALL BE WALL MOUNT, UL LISTED, STAINLESS STEEL NEMA 3R OR 4X HOUSING WITH LOCKABLE DOOR, 400 AMPS, 208/120 VOLT, 3 PHASE, 4 WIRE WITH COLOR-CODED CAM-LOCK CONNECTORS. APPROVED MANUFACTURERS INCLUDE BERTHOLD ELECTRIC CO. AND POWERTRON SERIES 400UL. SUBMIT PRODUCT DATA AND DIMENSIONED DRAWINGS UNDER DIVISION 26 05 00.
5. REFER TO LANDSCAPING PLANS FOR ADA BOLLARD LOCATIONS.
6. APPARATUS BAY DOOR CONTROLLERS AND PUSHBUTTONS ARE PROVIDED BY G.C. AND INSTALLED BY E.C. LOCATE PUSHBUTTON STATIONS FOR WEST DOORS AT WEST LOCATION SHOWN AND EAST DOORS AT EAST LOCATION SHOWN. REMOTE MOUNT DOOR CONTROLLERS ON MEZZANINE. COORDINATE WITH MANUFACTURERS INSTALLATION REQUIREMENTS. BASE BID IS SECTIONALIZED OVERHEAD DOORS. ADD ALTERNATE BID IS FOUR-FOLD DOORS CIRCUITED AT 208V, 3 PHASE. COORDINATE FINAL CIRCUITING REQUIREMENTS WITH FOUR-FOLD DOOR SHOP DRAWINGS. REFER TO ARCHITECTURAL FOR ADDITIONAL INFORMATION.
7. MOUNT RECEPTACLES AT A/V RACK LOCATION. COORDINATE EXACT LOCATION WITH OWNER.
8. COORDINATE LOCATION OF SAUNA RECEPTACLE WITH OWNER AND MANUFACTURER'S INSTALLATION REQUIREMENTS PRIOR TO INSTALLATION.
9. ROUTE CONDUIT IN THIS AREA ALONG THE WALL TO AVOID THE GLASS WINDOW ABOVE.
10. RECEPTACLES TO BE RED.
11. DUE TO THE NATURE OF THE APPARATUS BAY, E.C. TO INSTALL EWC OUTLET SUCH THAT IT IS FULLY ENCLOSED BY THE WATER COOLER ENCLOSURE AND PROTECTED FROM INCIDENTAL WATER SPRAY.
12. E.C. TO PROVIDE NECESSARY EQUIPMENT, COORDINATED WITH MANUFACTURER OF SMOKE HATCH DOOR, TO POWER 24V LINEAR ACTUATOR AND PROVIDE CONTROLS TO OPEN/CLOSE THE HATCH FROM THIS LOCATION. ANY EQUIPMENT ENCLOSURES AND CONTROLS ARE TO BE WET-LOCATION LISTED.
13. RECEPTACLES SERVING WALL FANS SHALL BE CONTROLLED BY WALL SWITCH.
14. VFD PROVIDED BY M.C. AND INSTALLED BY E.C. COORDINATE LOCATION WITH M.C.

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Drawing
FLOOR PLAN LEVEL 1 - POWER

City of Madison Contract No. **8027**
OPN Project No. **17207000**

EP101

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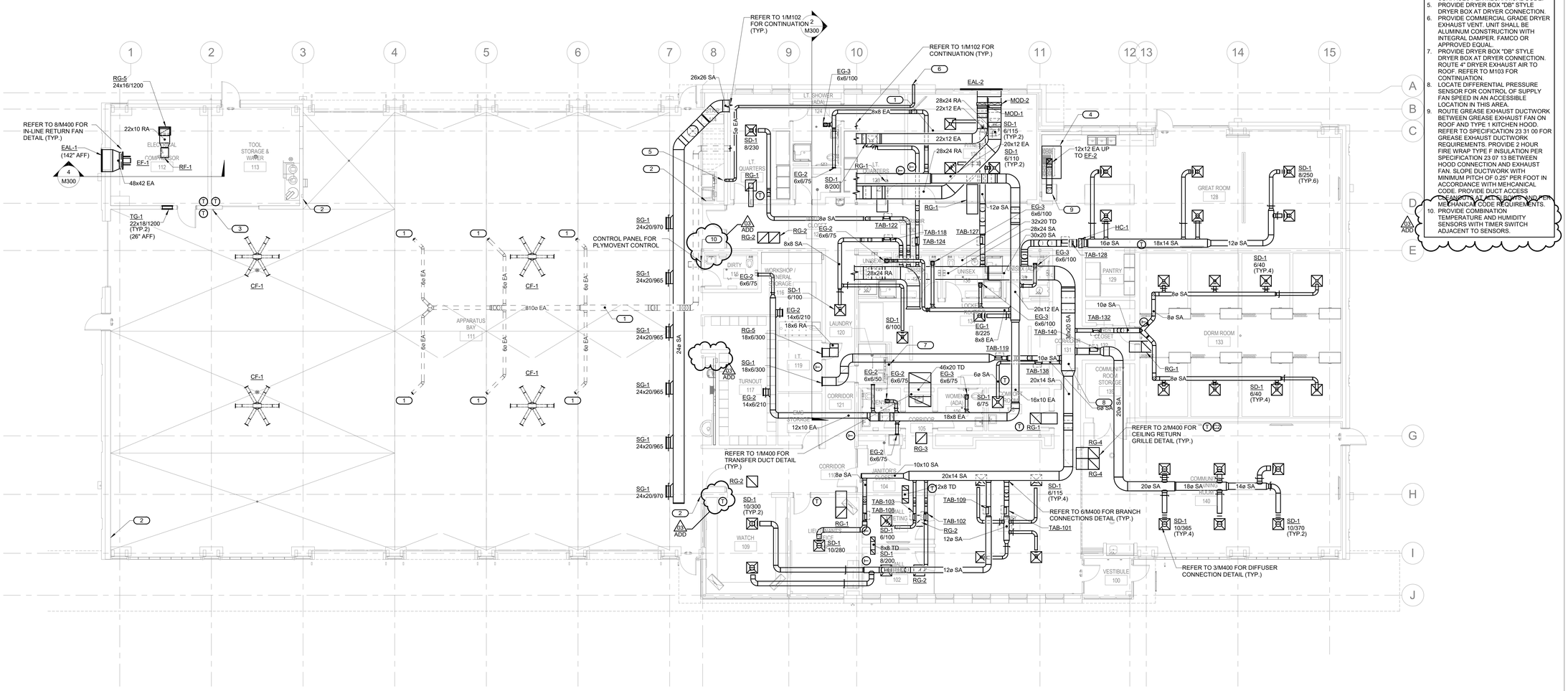

NORTH

1 FLOOR PLAN LEVEL 1 - VENTILATION

1/8" = 1'-0"

KEYNOTES: (#)

1. OWNER FURNISHED AND OWNER INSTALLED PLYMOVENT VEHICLE EXHAUST SYSTEM. COORDINATE ROUTING OF UTILITIES WITH OWNER AND THE INSTALLING CONTRACTOR.
2. PROVIDE CO/NOX SENSOR FOR CONTROL OF APPARATUS BAY EXHAUST SYSTEM. REFER TO 1/M453 FOR ADDITIONAL INFORMATION.
3. INSTALL LOCAL FAN CONTROLLERS FOR GROUPS OF CEILING FANS SERVING APPARATUS BAY. ONE FAN CONTROLLER SHALL SERVE FOUR DESTRATIFICATION FANS (CF-1). LABEL CONTROLLERS WITH NAMEPLATE AS "CEILING FANS". REFER TO CEILING FAN SPECIFICATIONS AND CONTROL SEQUENCES FOR ADDITIONAL REQUIREMENTS ON CONTROL OF THE DESTRATIFICATION FANS.
4. DIVISION 23 CONTRACTOR TO PROVIDE TYPE 1 KITCHEN EXHAUST HOOD. BASIS OF DESIGN IS CAPTIVEAIR MODEL 4224ND-2 THAT IS 72" LONG X 42" DEEP. BASIS OF DESIGN IS 1050 CFM UNIT AT 0.75" STATIC PRESSURE. RANGE BASIS OF DESIGN IS BLUE STAR RNB606GV2. REFER TO SPECIFICATION 23 37 00 FOR ADDITIONAL CONSTRUCTION REQUIREMENTS ON THE HOOD AND DSPS SUBMITTAL REQUIREMENTS. CONTRACTOR RESPONSIBLE FOR ANY MODIFICATIONS TO AIRFLOWS BASED ON FINAL KITCHEN HOOD SELECTION. HOOD SHALL BACK AND SHALL INCLUDE INSULATION TO MEET ZERO INCH REQUIREMENTS FOR CLEARANCE TO COMBUSTIBLE SURFACES PER MECHANICAL CODE.
5. PROVIDE DRYER BOX "DB" STYLE DRYER BOX AT DRYER CONNECTION.
6. PROVIDE COMMERCIAL GRADE DRYER EXHAUST VENT. UNIT SHALL BE ALUMINUM CONSTRUCTION WITH INTEGRAL DAMPER. FAMCO OR APPROVED EQUAL.
7. PROVIDE DRYER BOX "DB" STYLE DRYER BOX AT DRYER CONNECTION. ROUTE 4" DRYER EXHAUST AIR TO ROOF. REFER TO M103 FOR CONTINUATION.
8. LOCATE DIFFERENTIAL PRESSURE SENSOR FOR CONTROL OF SUPPLY FAN SPEED IN AN ACCESSIBLE LOCATION IN THIS AREA.
9. ROUTE GREASE EXHAUST DUCTWORK BETWEEN GREASE EXHAUST FAN ON ROOF AND TYPE 1 KITCHEN HOOD. REFER TO SPECIFICATION 23 31 00 FOR GREASE EXHAUST DUCTWORK REQUIREMENTS. PROVIDE 2 HOUR FIRE WRAP TYPE F INSULATION PER SPECIFICATION 23 07 13 BETWEEN HOOD CONNECTION AND EXHAUST FAN. SLOPE DUCTWORK WITH MINIMUM PITCH OF 0.25" PER FOOT IN ACCORDANCE WITH MECHANICAL CODE. PROVIDE DUCT ACCESS OPENINGS AT ALL BENDS AND PER MECHANICAL CODE REQUIREMENTS.
10. PROVIDE COMBINATION TEMPERATURE AND HUMIDITY SENSORS WITH TIMER SWITCH ADJACENT TO SENSORS.

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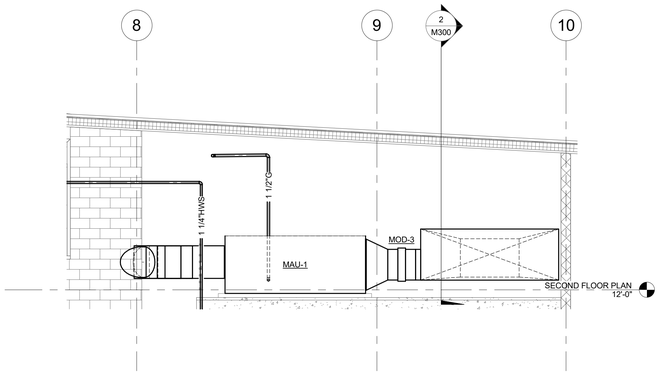
Drawing
FLOOR PLAN LEVEL 1 - VENTILATION

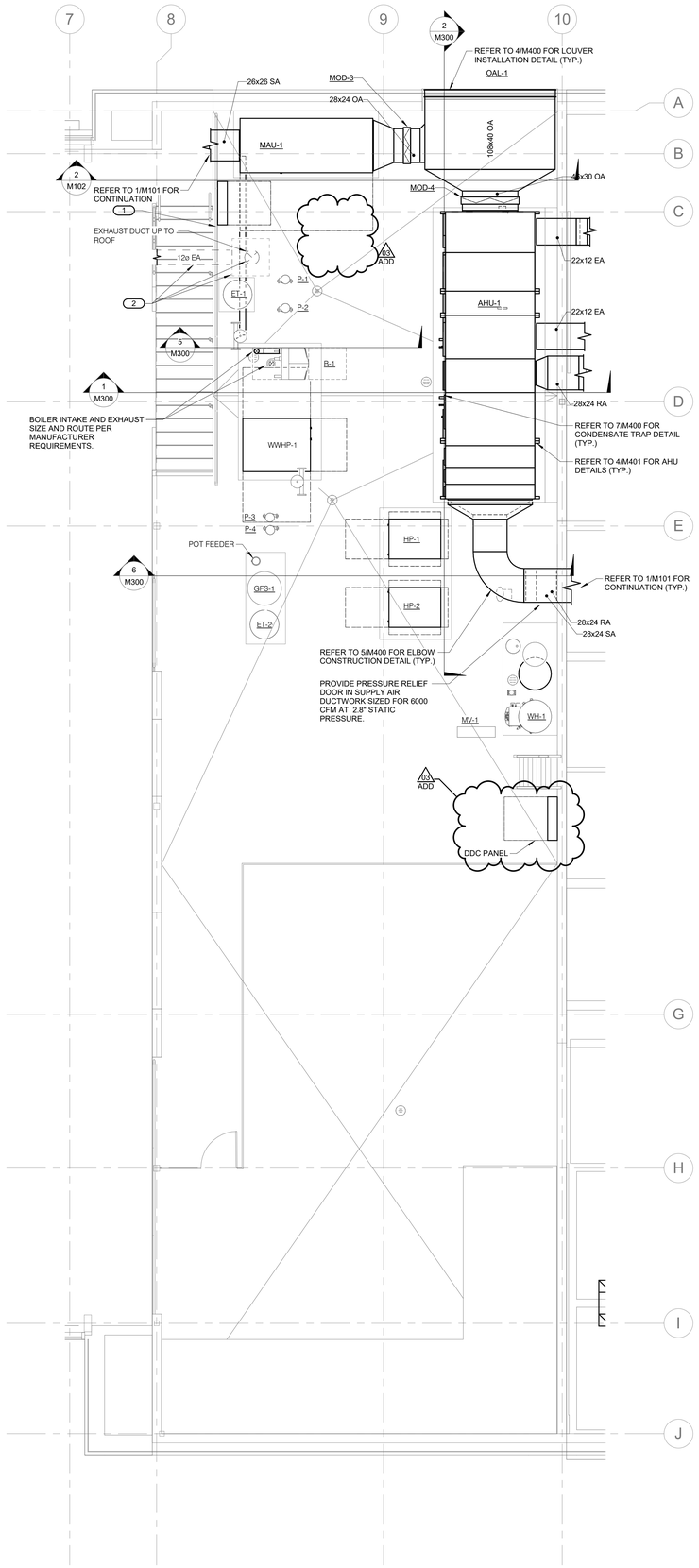
City of Madison Contract No. **8027**
OPN Project No. **17207000**

M101



2 SECTION FOR MAU - MECHANICAL

1/4" = 1'-0"



1 MEZZANINE PLAN - VENTILATION

1/4" = 1'-0"

NORTH

KEYNOTES: (#)

1. DDC CONTROL PANEL, MOUNT CONTROL PANEL ON UNISTRUT SUPPORT SYSTEM FROM FLOOR TO ROOF STRUCTURE.
2. OWNER FURNISHED AND OWNER INSTALLED PLYMOVENT VEHICLE EXHAUST SYSTEM. COORDINATE ROUTING OF UTILITIES WITH OWNER AND THE INSTALLING CONTRACTOR.

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Drawing
MEZZANINE PLAN - VENTILATION

City of Madison Contract No. **8027**
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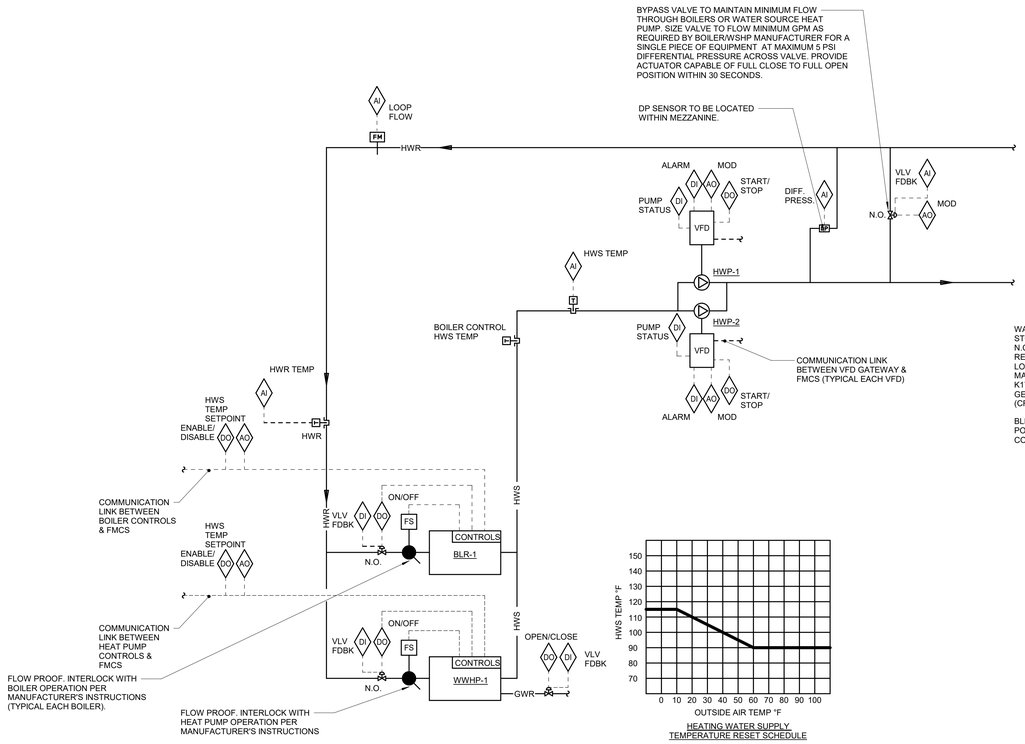
M102



SEQUENCE OF OPERATION:
HEATING WATER BOILER AND WATER-TO-WATER HEAT PUMP SHALL HAVE UNIT MOUNTED CONTROLS PROVIDED BY THE BOILER AND HEAT PUMP MANUFACTURER. TCC SHALL INTERFACE WITH BOILER AND HEAT PUMP MANUFACTURER CONTROLS AS DESCRIBED IN THIS SEQUENCE OF OPERATION. BOILER AND HEAT PUMP MANUFACTURER SHALL PROVIDE A GATEWAY INTERFACE CARD THAT IS COMPATIBLE WITH THE COMMUNICATION PROTOCOL OF THE FMCS NETWORK. SEQUENCES OF OPERATION FOR BOTH BOILER CONTROL SYSTEM AND FMCS SHALL BE AS FOLLOWS:

FMCS SHALL OPERATE HEATING WATER SYSTEM. WHENEVER OUTSIDE AIR TEMPERATURE IS BELOW 70°F AND THERE ARE AT LEAST 2 CALLS FOR HEAT. IF OUTSIDE AIR TEMPERATURE IS BELOW 40°F HEATING SYSTEM SHALL BE ENABLED REGARDLESS OF CALLS FOR HEAT.

HOT WATER PUMPS SEQUENCE OF OPERATION:
ONLY ONE HEATING WATER PUMP SHALL RUN AT TIME. THE SECOND HEATING WATER PUMP IS FULLY REDUNDANT. FMCS SHALL AUTOMATICALLY ROTATE THE LEAD HEATING WATER PUMP ONCE/WEEK (10:00 AM EACH TUESDAY, ADJ.) TO EQUALIZE RUN TIME BETWEEN PUMPS. PROVIDE GRAPHICAL BUTTON ON OPERATOR WORKSTATION GRAPHICAL SCREEN TO ALLOW FMCS OPERATOR TO SWITCH LEAD PUMP TO NEXT ROTATION IN THE EVENT THE CURRENT LEAD PUMP REQUIRES MAINTENANCE.

FMCS SHALL MODULATE SIGNAL TO LEAD PUMP VFD AS REQUIRED TO MAINTAIN HEATING WATER DIFFERENTIAL PRESSURE (DP) SETPOINT. FMCS SHALL RESET HEATING WATER DIFFERENTIAL PRESSURE (DP) SETPOINT AS REQUIRED TO MAINTAIN AT LEAST ONE HEATING WATER VALVE 95% (ADJ.) OPEN. FMCS SHALL UTILIZE COMMAND TO ALL HEATING WATER VALVE POSITIONS TO RESET THE HEATING WATER DIFFERENTIAL PRESSURE. IN NO EVENT SHALL THE FMCS DECREASE THE HEATING WATER (DP) SETPOINT BELOW 4 PSI (ADJ.) OR ABOVE 10 PSI (ADJ.).

BOILER & HEAT PUMP SEQUENCE OF OPERATION:
THE FMCS SHALL ENABLE THE WATER-TO-WATER HEAT PUMP AS THE LEAD SYSTEM IF THE GEOTHERMAL LOOP TEMPERATURE RETURNING FROM THE GEOTHERMAL BORIELD IS ABOVE 38°F (ADJ.) AND OPEN THE ASSOCIATED TWO-POSITION ISOLATION VALVES ON THE HEAT PUMP'S CONDENSER AND EVAPORATOR SECTIONS. THE FMCS SHALL ENERGIZE THE LEAD PUMP. THE HEAT PUMP TWO-POSITION ISOLATION VALVES SHALL BE OPEN EVEN IF THE HEAT PUMP IS NOT FIRING TO ALLOW CIRCULATION THROUGH THE VARIABLE PRIMARY HEATING WATER SYSTEM.

WHEN FMCS ENABLES WATER-TO-WATER HEAT PUMP FMCS SHALL OPEN WATER-TO-WATER HEAT PUMP GWR ISOLATION VALVE. WHEN FMCS DISABLES WATER-TO-WATER HEAT PUMP FMCS SHALL CLOSE ASSOCIATED GWR ISOLATION VALVE.

IF THE GEOTHERMAL LOOP TEMPERATURE RETURNING FROM THE GEOTHERMAL BOREFIELD IS BELOW 38°F (ADJ.) THE FMCS SHALL SWITCH THE BOILER TO THE LEAD HEATING SYSTEM AND HAVE THE WATER-TO-WATER HEAT PUMP AS THE LAG SYSTEM. TWO-POSITION BOILER ISOLATION VALVE OPERATION SHALL BE CONTROLLED BY THE BOILER CONTROL PANEL OF THE RESPECTIVE BOILER THEY SERVE.

THE FMCS SHALL OUTPUT AN ANALOG SIGNAL TO LEAD HEATING SYSTEM (BOILER OR WATER-TO-WATER HEAT PUMP) TO MAINTAIN THE HEATING WATER SUPPLY TEMPERATURE SETPOINT PER THE HEATING WATER SUPPLY TEMPERATURE RESET SCHEDULE. THE BOILER OR WATER-TO-WATER HEAT PUMP'S INTERNAL CONTROLS SHALL MODULATE HEAT AS REQUIRED TO MAINTAIN SETPOINT. THE FMCS SHALL STAGE ON THE LAG HEATING SYSTEM (BOILER OR WATER-TO-WATER HEAT PUMP) TO MAINTAIN THE SYSTEM HEATING WATER SUPPLY TEMPERATURE PER THE HEATING WATER SUPPLY TEMPERATURE RESET SCHEDULE. FMCS SHALL LIMIT LAG HEAT SOURCE FROM OPERATING UNLESS PRIMARY HEAT SOURCE IS AT 100% FIRING RATE (ADJ.) FOR 10 (ADJ.) MINUTES WITH HEATING WATER SUPPLY TEMPERATURE BELOW SETPOINT AND HEATING WATER FLOW RATE IS ABOVE MINIMUM FLOW RATE OF BOTH BOILERS. THIS IS TO PREVENT OVERPUMPING OF SYSTEM.

THE FOLLOWING HEAT PUMP CONTROL PANEL POINTS (TO INCLUDE BUT NOT LIMITED TO) SHALL BE CONTROLLED BY THE FMCS AND DISPLAYED ON THE OPERATOR WORKSTATION GRAPHICAL SCREEN:
- HEAT PUMP STATUS: ENABLE/DISABLE
- HEAT PUMP OUTPUT: PERCENTAGE
- HEAT PUMP OUTLET WATER TEMPERATURE SETPOINT: [°F]

THE FOLLOWING BOILER CONTROL PANEL POINTS (TO INCLUDE BUT NOT LIMITED TO) SHALL BE CONTROLLED BY THE FMCS AND DISPLAYED ON THE OPERATOR WORKSTATION GRAPHICAL SCREEN:
- BOILER STATUS: ENABLE/DISABLE
- BOILER OUTLET WATER TEMPERATURE SETPOINT: [°F]

THE FOLLOWING BOILER CONTROL PANEL POINTS (TO INCLUDE BUT NOT LIMITED TO) SHALL BE MONITORED BY THE FMCS AND DISPLAYED ON THE OPERATOR WORKSTATION GRAPHICAL SCREEN:
- BOILER STATUS: DISABLED/STANDBY/MANUAL OPERATION/REMOTE OPERATION/AUTO/FAULT
- FIRING RATE INPUT: [0 - 100%]
- FIRING RATE OUTPUT: [0 - 100%]
- ACTIVE SETPOINT: [°F]
- SYSTEM HWR TEMP: [°F]
- SYSTEM HWS TEMP: [°F]
- FAULT MESSAGE DISPLAY CODE: [NUMERICAL]
- RUN CYCLES: [NUMERICAL]
- RUN HOURS: [NUMERICAL]

ALARMS, INTERLOCKS & SAFETIES:
BOILER CONTROLS SHALL BE PROGRAMMED TO MAINTAIN CONSTANT SETPOINT (LAST KNOWN VALUE) IN THE EVENT THE FMCS NETWORK COMMUNICATION SIGNAL IS LOST.

ALL CONTROLLED AND MONITORED POINTS LISTED IN THE BOILER CONTROL PANEL SEQUENCE ABOVE SHALL BE DISPLAYED ON THE OPERATOR WORKSTATION GRAPHICAL SCREEN.

MINIMUM HEATING WATER FLOW CONTROL:
FMCS SHALL MODULATE THE HEATING WATER BYPASS CONTROL VALVE AS REQUIRED TO MAINTAIN MINIMUM FLOW THROUGH EACH OPERATIONAL WATER-TO-WATER HEAT PUMP AND BOILER. TCC SHALL VERIFY THE MINIMUM FLOW LIMIT OF EACH HEAT PUMP/BOILER WITH EQUIPMENT MANUFACTURER. ADEQUATE FLOW THROUGH EACH HEAT PUMP/BOILER SHALL BE DETERMINED BY THE FLOW METER IN THE HEATING WATER RETURN PIPING. MINIMUM FLOW SHALL BE STAGED WITH THE RESPECTIVE EQUIPMENT IN OPERATION SO AS MORE EQUIPMENT IS IN CALLED INTO OPERATION THE MINIMUM FLOW IS THE SUMMATION OF THE MINIMUM FLOWS OF ALL PIECES OF OPERATING EQUIPMENT.

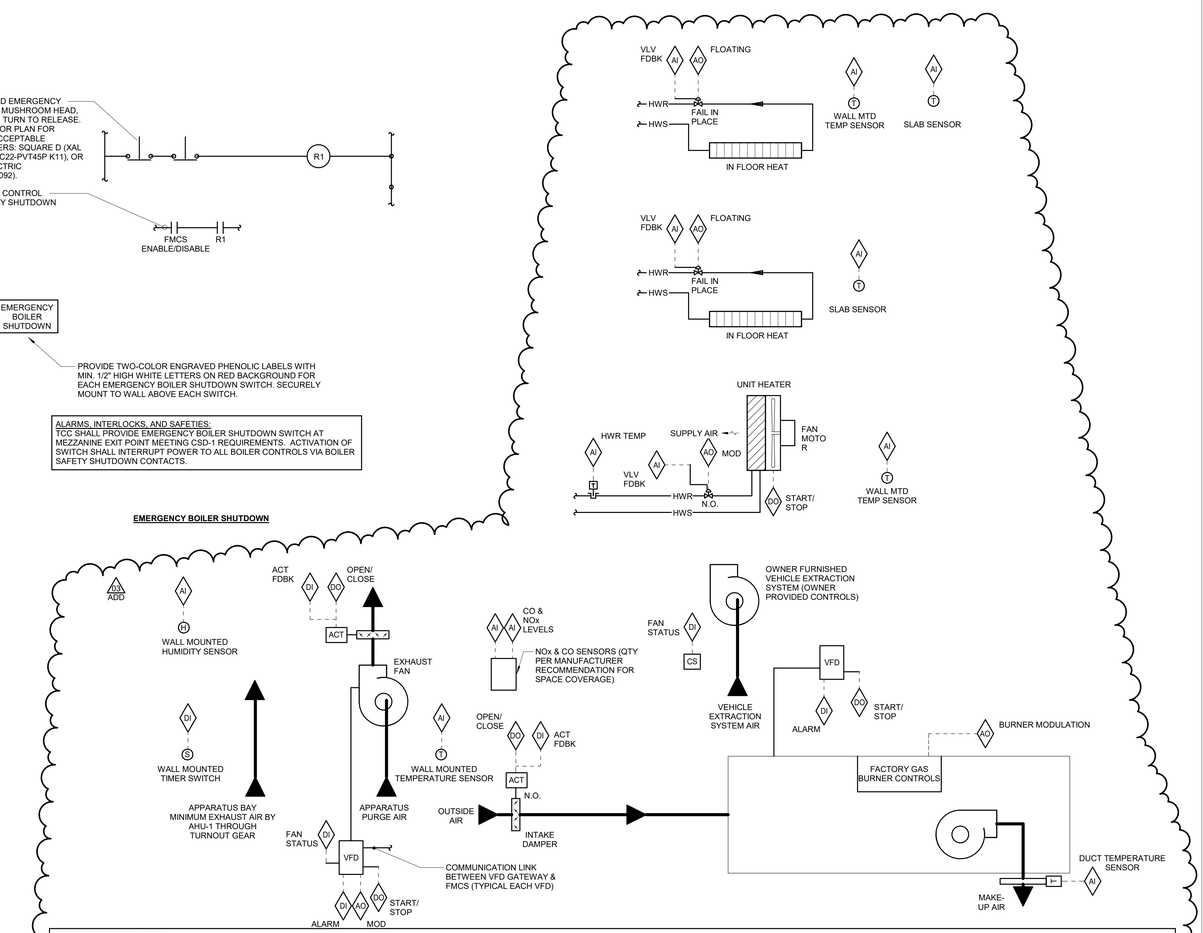
ALARMS, INTERLOCKS & SAFETIES:
TCC SHALL COORDINATE ALL SAFETY AND INTERLOCK REQUIREMENTS WITH BOILER MANUFACTURER. TCC SHALL COORDINATE AND PROVIDE THE INSTALLATION AND WIRING OF BOILER WATER DIFFERENTIAL PRESSURE/FLOW SWITCHES AND OTHER COMPONENTS PROVIDED WITH THE BOILER AS REQUIRED FOR PROPER OPERATION. TCC SHALL PROVIDE AND TERMINATE ALL SAFETY AND INTERLOCK WIRING WITH BOILER CONTROL PANELS AS REQUIRED.

FMCS SHALL AUTOMATICALLY ENABLE THE LAG HEATING WATER PUMP TO RUN IN THE EVENT THE LEAD HEATING WATER PUMP FAILS TO OPERATE.

TCC SHALL VERIFY THE ACCEPTABLE TEMPERATURE RANGES THE BOILERS ARE APPROVED TO OPERATE AT AS PUBLISHED IN THE BOILER MANUFACTURER'S LITERATURE. IF THE TEMPERATURE RANGES LISTED IN THE MANUFACTURER'S LITERATURE DIFFER FROM THOSE IN THIS SEQUENCE OF OPERATION, CONTACT PROJECT ARCHITECT/ENGINEER FOR DIRECTION.

AN ALARM SHALL BE INDICATED TO THE FMCS OPERATOR WORKSTATION IN THE EVENT ANY OF THE FOLLOWING OCCUR:
- HWR TEMPERATURE DROPS BELOW 50°F (ADJ.) FOR 5 MINUTES (ADJ.) (AUTO RESET).
- HWS TEMPERATURE RISES MORE THAN 10°F (ADJ.) ABOVE SETPOINT (AUTO RESET).
- HWS TEMPERATURE DROPS MORE THAN 10°F (ADJ.) BELOW SETPOINT (AUTO RESET).
- AN ALARM IS INDICATED AT ANY BOILER ALARM PANEL.
- AN ALARM IS INDICATED AT ANY HEAT PUMP ALARM PANEL.
- AN ALARM IS INDICATED AT ANY PUMP VFD
- SHOULD THE FMCS COMMAND THE LEAD HEATING WATER PUMP TO OPERATE AND THE PUMP FAILS TO DO SO AS DETERMINED BY THE VFD STATUS, AN ALARM SHALL BE INDICATED AT THE FMCS OPERATOR WORKSTATION AND THE LAG HW PUMP SHALL AUTOMATICALLY START.

1 CONDENSING HEATING WATER BOILER CONTROL - VARIABLE PRIMARY
NO SCALE



SEQUENCE OF OPERATION:
APPARATUS BAY MINIMUM EXHAUST AIR IS PROVIDED THROUGH OPERATION OF AHU-1'S EXHAUST FAN. SYSTEM SHALL RUN CONTINUOUSLY 24 HOURS/DAY, 7 DAYS/WEEK. REFER TO AHU SEQUENCE FOR DETAILS.

EXHAUST FAN PURGE FAN (EF-1) SHALL BE STARTED AND STOPPED THROUGH A HAND-OFF-AUTO SWITCH ON THE FACE OF THE MOTOR STARTER. WHEN PLACED IN THE HAND POSITION THE EXHAUST FAN SHALL RUN CONTINUOUSLY. WHEN PLACED IN THE AUTO POSITION THE FMCS SHALL CONTROL FAN OPERATION. WHEN PLACED IN THE OFF POSITION THE EXHAUST FAN MOTOR SHALL BE DE-ENERGIZED.

EXHAUST FAN PURGE FAN (EF-1) SHALL BE CONTROLLED AS FOLLOWS:
- TO PROVIDE COOLING TO THE SPACE WHEN SPACE TEMP RISES ABOVE 76°F (ADJ.) AND OUTSIDE AIR IS AT LEAST 4°F (ADJ.) COOLER THAN SPACE TEMPERATURE FMCS SHALL COMMAND INTAKE AIR DAMPER AND EXHAUST AIR DAMPER TO FULLY OPEN. MAU AND EXHAUST FAN SHALL BE ENABLED AFTER A 30 SECOND DELAY TO ALLOW FOR OPENING OF THE DAMPERS. EXHAUST FAN SPEED SHALL BE AT FULL AIRFLOW IF OWNER FURNISHED VEHICLE EXTRACTION SYSTEM IS NOT OPERATING. IF OWNER FURNISHED VEHICLE EXTRACTION SYSTEM IS OPERATING AS DETECTED BY THE CURRENT SENSOR THE EXHAUST FAN SPEED SHALL BE REDUCED BY 3500 CFM. FINAL RATE SHALL BE DETERMIEND BY BALANCING CONTRACTOR BASED ON EXHAUST RATE OF THE VEHICLE EXTRACTION SYSTEM.
- WHEN SPACE TEMP DROPS BELOW 72°F (ADJ.) MAU AND EXHAUST FAN SHALL BE DISABLED AND THE INTAKE AIR DAMPER AND EXHAUST AIR DAMPER SHALL FULLY CLOSE.
- IN THE EVENT THE CO DETECTORS SENSE THE CONCENTRATION OF CARBON MONOXIDE RISES ABOVE 25 PPM (ADJ.) OR THE CONCENTRATION OF NITROGEN DIOXIDE RISES ABOVE 1 PPM (ADJ.) , FMCS SHALL COMMAND THE INTAKE AIR DAMPER AND EXHAUST AIR DAMPER TO FULLY OPEN. AFTER DAMPERS HAVE PROVEN OPEN THE MAU AND EXHAUST FAN SHALL BE ENABLED. EXHAUST FAN SPEED SHALL BE AT FULL AIRFLOW IF OWNER FURNISHED VEHICLE EXTRACTION SYSTEM IS NOT OPERATING. IF OWNER FURNISHED VEHICLE EXTRACTION SYSTEM IS OPERATING AS DETECTED BY THE CURRENT SENSOR THE EXHAUST FAN SPEED SHALL BE REDUCED BY 3500 CFM. FINAL RATE SHALL BE DETERMIEND BY BALANCING CONTRACTOR BASED ON EXHAUST RATE OF THE VEHICLE EXTRACTION SYSTEM. PURGE FAN OPERATION SHALL CONTINUE UNTIL BOTH CO AND NOx LEVELS FALL BELOW 10 PPM (ADJ.) FOR CO AND 0.4 PPM (ADJ.) FOR NOx.
- A SEPERATE TIMER SWITCH (0-120 MINUTES) SHALL BE PROVIDED TO MANUALLY ENABLE THE EXHAUST FAN AND MAKEUP AIR UNIT. WHEN TIMER SWITCH IS ENABLED FMCS SHALL COMMAND INTAKE AIR DAMPER AND EXHAUST AIR DAMPER TO FULLY OPEN. MAU AND EXHAUST FAN SHALL BE ENABLED AFTER THE DAMPERS HAVE PROVEN OPEN. EXHAUST FAN SPEED SHALL BE AT FULL AIRFLOW IF OWNER FURNISHED VEHICLE EXTRACTION SYSTEM IS NOT OPERATING. IF OWNER FURNISHED VEHICLE EXTRACTION SYSTEM IS OPERATING AS DETECTED BY THE CURRENT SENSOR THE EXHAUST FAN SPEED SHALL BE REDUCED BY 3500 CFM (ADJ.). FINAL RATE SHALL BE DETERMIEND BY BALANCING CONTRACTOR BASED ON EXHAUST RATE OF THE VEHICLE EXTRACTION SYSTEM.
- A RELATIVE HUMIDITY SENSOR SHALL BE PROVIDED TO ENABLE ENABLE THE EXHAUST FAN AND MAKEUP AIR UNIT IF THE SPACE RELATIVE HUMIDITY EXCEEDS 40% (ADJ.) WHEN THE OUTSIDE AIR TEMPERATURE IS BELOW 20°F(ADJ.) OR IF THE SPACE RELATIVE HUMIDITY EXCEEDS 30% (ADJ.) WHEN THE OUTSIDE AIR TEMPERATURE IS BELOW 0°F (ADJ.). WHEN CONDITIONS ARE MET FMCS SHALL COMMAND INTAKE AIR DAMPER AND EXHAUST AIR DAMPER TO FULLY OPEN. MAU AND EXHAUST FAN SHALL BE ENABLED AFTER THE DAMPERS HAVE PROVEN OPEN. EXHAUST FAN SPEED SHALL BE AT FULL AIRFLOW IF OWNER FURNISHED VEHICLE EXTRACTION SYSTEM IS NOT OPERATING. IF OWNER FURNISHED VEHICLE EXTRACTION SYSTEM IS OPERATING AS DETECTED BY THE CURRENT SENSOR THE EXHAUST FAN SPEED SHALL BE REDUCED BY 3500 CFM (ADJ.). FINAL RATE SHALL BE DETERMIEND BY BALANCING CONTRACTOR BASED ON EXHAUST RATE OF THE VEHICLE EXTRACTION SYSTEM. ONCE RELATIVE HUMIDITY IS 5% (ADJ.) BELOW SETPOINT SYSTEM SHALL BE DISABLED.

ONCE ENERGIZED, EXHAUST PURGE FAN AND MAU SHALL CONTINUE TO RUN FOR MIN. 10 MINUTES (ADJ.) TO PREVENT SHORT CYCLING.

MAU SHALL HAVE SAFETY CONTROLS PER SPECIFICATION 23 74 23.13. FMCS SHALL CONTROL FAN START/STOP AND BURNER MODULATION TO THE MAU TO MAINTAIN A DISCHARGE AIR TEMPERATURE THAT IS 5°F (ADJ.) ABOVE SPACE HEATING SETPOINT.

MAU SPEED SHALL BE SET BY THE BALANCING CONTRACTOR AT THE VFD.

HEATING OF APPARATUS BAY IS SERVED BY TWO IN-FLOOR RADIANT HEATING MANIFOLD ZONES PLUS A UNIT HEATER. A SPACE TEMPERATURE SENSOR SHALL SERVE EACH INDIVIDUAL RADIANT MANIFOLD (NORTH BAY VS SOUTH BAY) OF APPARATUS BAY. WHEN OUTSIDE AIR TEMPERATURE IS BELOW 55°F (ADJ.) THE FMCS SHALL MODULATE THE INFLOOR HEAT CONTROL VALVE TO MAINTAIN A SPACE TEMPERATURE SETPOINT OF 60°F (ADJ.). WHEN THE OUTSIDE AIR TEMPERATURE IS ABOVE 55°F THE CONTROL VALVE SHALL BE FULLY CLOSED. IF EITHER OF THE SPACE TEMPERATURE SENSORS INDICATES THE SPACE IS 10°F (ADJ.) BELOW SPACE SETPOINT THE UNIT HEATER SHALL BE ENABLED AND THE UNIT HEATER FAN SHALL BE ENERGIZE AND ASSOCIATED CONTROL VALVE SHALL MODULATE TO REHEAT THE SPACE BACK UP TO ORIGINAL SPACE SETPOINT QUICKLY. ONCE TEMPERATURE SETPOINT HAS BEEN ACHIEVED THE UNIT HEATER SHALL BE DISABLED. MAXIMUM TEMPERATURE OF IN-FLOOR HEAT SHALL BE LIMITED FROM EXCEEDING 85° (ADJ.).

ALARMS, INTERLOCKS AND SAFETIES:
AN ALARM SHALL BE GENERATED AT THE FMCS OPERATOR WORKSTATION IN THE FOLLOWING EVENTS:
- THE GAS DETECTORS SENSE A CONCENTRATION OF CARBON MONOXIDE ABOVE 50 PPM (ADJ.) OR A CONCENTRATION OF NITROGEN DIOXIDE ABOVE 5 PPM (ADJ.)
- THE FMCS COMMANDS THE EXHAUST PURGE FAN TO OPERATE AND THE CURRENT SENSING RELAY DETECTS INSUFFICIENT CURRENT DRAW.
- THE FMCS COMMONDS THE MAU TO OPERATE AND THE CURRENT SENSING RELAY DETECTS INSUFFICIENT CURRENT DRAW.
- THE FMCS COMMANDS THE MAU TO OPERATE AND THE DAT IS 10°F (ADJ.) BELOW SETPOINT AFTER A 3 MINUTE (ADJ.) DELAY TO ALLOW FOR BURNER WARMUP. IF THIS ALARM OCCURS MAU AND EXHAUST PURGE FAN SHALL BE DISABLED.
- IF SPACE TEMPERATURE FALLS BELOW 40°F (ADJ.)

2 APPARATUS BAY CONTROLS
NO SCALE

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Key Plan

Sheet Issue Date
BID DOCUMENTS 11/03/17

Revision	Date
ADDENDA #3	12/06/2017

Drawing
CONTROL DIAGRAMS - MECHANICAL

City of Madison Contract No. **8027**
OPN Project No. **17207000**

M451

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REFERENCE SCALE IN INCHES
0 1 2 3

AIR HANDLING SCHEDULE

NOTES:
1.PROVIDE SHAFT GROUNDING AS REQUIRED IN THE MOTOR SPECIFICATION 23 05 13.

		SUPPLY FAN (NOTE 1)										RETURN FAN (NOTE 1)										EXHAUST FAN (NOTE 1)													DX COOLING/HEATING COIL- COOLING							DX COOLIN/HEATING COIL - HEATING								DX VENTILATION AIR COOLING COIL										
								DISCONNECT		CONTROLLER/ STARTER						DISCONNECT		CONTROLLER/ STARTER						DISCONNECT		CONTROLLER/ STARTER																														
TAG NAME	AREA SERVED	CFM	MIN. CFM	EXT. S.P.	TYPE	RPM (NOTE D)	BHP (NOTE E)	MHP (NOTE E)	BY (NOTE A)	TYPE (NOTE B)	BY (NOTE A)	TYPE (NOTE C)	CFM	EXT. S.P.	TYPE	RPM (NOTE D)	BHP (NOTE E)	MHP (NOTE E)	BY (NOTE A)	TYPE (NOTE B)	BY (NOTE A)	TYPE (NOTE C)	CFM	MIN CFM	EXT. S.P.	TYPE	RPM (NOTE D)	BHP (NOTE E)	MHP (NOTE E)	BY (NOTE A)	TYPE (NOTE B)	BY (NOTE A)	TYPE (NOTE B)	MINIMUM OUTSIDE AIR CFM	VOLTAGE	PHASES	EAT DB °F	EAT WB °F	LAT DB °F	LAT WB °F	TOTAL MBH	MAX. A.P.D. IN. W.C.	SAT SUC °F	REFRIGERANT	CFM	EAT DB °F	EAT WB °F	LAT DB °F	LAT WB°F	TOTAL MBH	MAX. A.P.D. IN. W.C.	SAT SUC °F	CFM	REFRIGERANT	EAT DB °F	EAT WB °F	LAT DB °F	LAT WB °F	TOTAL MBH	MAX. A.P.D. IN. W.C.	SAT SUC °F	CFM	MANUFACTURER	MODEL	NOTES
AHU-1	FIRST FLOOR	6000	1850	1.25	PLENUM	1986	5.1	7.5	MC	VFD/B	MC	VFD/B	4400	0.75	PLENUM	1594	1.9	3	MC	VFD/B	MC	VFD/B	1675	1550	75	PLENUM	3082	.95	1.5	MC	VFD/B	MC	VFD/B	2900	208	3	66.3	59.4	52.7	51.0	140	0.4	40.0	R410a	6000	49.4	35.9	70.4	46.7	136	0.35	40	6000	R401A	80.8	69.3	57.2	56.0	125	0.4	49.0	2900	DAIKIN APPLIED	CAH	NOTE 1

AIR HANDLING SCHEDULE CONTD..

		FILTER											
		EA FILTER			RA FILTER			OA FILTER					
TYPE	FACE VELOCITY	PRESSURE DROP DIRTY	PRESSURE DROP CLEAN	TYPE	FACE VELOCITY	PRESSURE DROP DIRTY	PRESSURE DROP CLEAN	TYPE	FACE VELOCITY	PRES SURE DROP DIRTY	FINAL FILTER PRESSURE DROP CLEAN	MANUFACTURER	MODEL	NOTES
MERV 8	4400	0.6	0.75	MERV 8	260	0.60	0.1	MERV 13	355	0.60	0.22 in-wg	DAIKIN APPLIED	CAH	NOTE 1

ENERGY RECOVERY WHEEL SCHEDULE

NOTES:
1.REFER TO SPECIFICATION 23 72 00 FOR REQUIREMENTS. REFER TO AIR HANDLING UNIT SCHEDULE FOR ADDITIONAL UNIT REQUIREMENTS.

				OUTSIDE/SUPPLY AIR STREAM									RETURN/EXHAUST AIR STREAM											WHEEL	ELECTRICAL								
					SUMMER		WINTER						SUMMER				WINTER									DISCONNECT		CONTROLLER/STARTER				
AIR HANDLING UNIT TAG NAME	AREA SERVED	TYPE	WINTER TOTAL EFFECTIVENSS	CFM	EAT DB °F	EAT WB °F	LAT DB °F	LAT WB °F	EAT DB °F	EAT WB °F	LAT DB °F	LAT WB °F	APD	CFM	EAT DB °F	EAT WB °F	LAT DB °F	LAT WB °F	EAT DB °F	EAT WB °F	LAT DB °F	LAT WB °F	APD	RECOVERED SUMMER MBH	RECOVERED WINTER MBH	MOTOR HP	VOLTAGE	PHASE	BY (NOTE A)	TYPE (NOTE B)	BY (NOTE A)	TYPE (NOTE C)	MANUFACTURER	MODEL
AHU-1	FIRST FLOOR	ENTHALPY	93%	2,900	87	75	80.8	69.3	-15	-15	29.1	22.7	0.87	1,550	75	62.5	86.3	73.9	70	48	-9.9	-9.9	0.46	66	150	0.13	115	1	MFR	VFD	MFR	VFD	DAIKIN APPLIED	SXA-1200-MW

SCHEDULE GENERAL NOTES:

A. DISCONNECT AND CONTROLLER STARTER FURNISHED AND INSTALLED BY:
MFR = MANUFACTURER
EC = ELECTRICAL CONTRACTOR.
MC = FURNISHED BY MECHANICAL CONTRACTOR, INSTALLED BY ELECTRICAL CONTRACTOR.
MFR/EC = FURNISHED LOOSE BY MANUFACTURER INSTALLED BY ELECTRICAL CONTRACTOR....

B. DISCONNECT TYPE:
F = FUSED
NF = NON-FUSED

C. CONTROLLER STARTER TYPE:
FV = FULL VOLTAGE
WYE = WYE-DELTA
SS = SOLID STATE (SOFT START)
MS = MANUAL STARTER
VFD = VARIABLE FREQUENCY DRIVE
VFD/B = VARIABLE FREQUENCY DRIVE WITH BYPASS

D. FAN RPM SHALL NOT EXCEED 110% OF SCHEDULED VALUE, WITH THE SCHEDULED WHEEL TYPE. SUBSTITUTION OF BI OR BIA FANS FANS FOR FC IS ACCEPTABLE IF EFFICIENCY IS NOT LOWER.

E. NO EQUIPMENT SHALL BE SELECTED ABOVE 90% OF MOTOR NAME PLATE RATING.

F. MUST BE WITHIN +/- 10% OF SCHEDULED RPM.

G. CURB TYPE:
MFR = STANDARD CURB BY MANUFACTURER
GC = BY GENERAL CONTRACTOR
SAC = SOUND ATTENUATOR CURB

WATER TO WATER HEAT PUMP SCHEDULE

NOTES:
1. REFER TO SPECIFICATION SECTION 23 64 17 FOR ADDITIONAL INFORMATION.
2. WATER TO WATER HEATING ONLY UNIT.
3. REFER TO 1/M202 FOR SIZE AND CLEARANCE REQUIREMENTS FOR THE UNIT.
4. UNIT SHALL HAVE BE SELECTED WITH FOULING FACTOR OF 0.0001 ON EVAPORATOR AND CONDENSER HEAT EXCHANGERS.
5. UNIT SHALL HAVE TWO COMPRESSORS WITH DIGITAL SCROLLS OR VARIABLE SPEED COMPRESSORS.
6. UNIT SHALL BE SCCR RATING OF 42000.

			CAPACITY/PERFORMANCE		EVAPORATOR PERFORMANCE - 25% PROPYLENE GLYCOL				CONDENSER PERFORMANCE				ELECTRICAL												
																		DISCONNECT		CONTROLLER/ STARTER					
TAG NAME	AREA SERVED	REFRIGERANT TYPE	TOTAL MBH	HEATING COP BASED ON WATER CONDITION LISTED	EWT °F	LWT °F	GPM	MAX. PRESS. DROP FT. HEAD	EWT °F	LWT °F	GPM	MAX. PRESS. DROP FT. HEAD	VOLTAGE	PHASES	FLA	MCA	MOCP	BY (NOTE A)	TYPE (NOTE B)	BY (NOTE A)	TYPE (NOTE C)	MANUFACTURER	MODEL	NOTE
WWHP-1	BUILDING	R-410A	332.00	3.2	38	30	61.2	9.000	100	120	33.4	5.40	208	3	118.4	148.0	225	EC	-	MFR	FV	MULTISTACK	HS520	NOTES 1, 2, 3, 4, 5, 6

MAKE-UP AIR UNIT SCHEDULE

NOTES:
1. PROVIDE SHAFT GROUNDING AS REQUIRED IN THE MOTOR SPECIFICATION 23 05 13.
2. UNIT SHALL HAVE 4" MERV 13 FILTER SECTION.

		MAX. DIMENSIONS											ELECTRICAL											
																	DISCONNECT		CONTROLLER/ STARTER					
TAG NAME	AREA SERVED	LENGTH	WIDTH	HEIGHT	CFM	FAN TYPE	FAN RPM (NOTE D)	EXT. S.P. IN. W.C.	MIN. EFFICIENCY AFUE	MIN. MBH OUTPUT	EAT °F	LAT °F	BHP (NOTE E)	MHP (NOTE E)	VOLTAGE	PHASES	BY (NOTE A)	TYPE (NOTE B)	BY (NOTE A)	TYPE (NOTE C)	FUEL TYPE	FUEL PRESSURE (IN. W.C.)	MANUFACTURER	MODEL	NOTES
MAU-1	APPARATUS BAY	109	44	45	5800	PLENUM	1736	0.75	92	469	-15.0	60.0	3.15	5	208	3	MFR	NF	MFR	VFD	NG	12	GREENHECK	DGX-P120-H22	NOTE 1, 2

ADD

FAN SCHEDULE

NOTES:
1. PROVIDE SHAFT GROUNDING AS REQUIRED IN THE MOTOR SPECIFICATION 23 05 13.
2. FAN SHALL HAVE FINGED VENTED CURB AND FAN SHALL MEET UL762 REQUIREMENTS. UNIT SHALL HAVE ECM TYPE MOTOR WITH 0-10 VDC OUTPUT FROM KITCHEN HOOD CONTROLLER TO CONTROL FAN SPEED AND START/STOP FUNCTION.
3. UNIT SHALL HAVE ECM TYPE MOTOR WITH MANUAL SPEED ADJUSTMENT ON FAN CONTROLLER FOR BALANCING.

										ELECTRICAL (NOTE 1)									
															DISCONNECT		CONTROLLER/ STARTER		
TAG NAME	AREA SERVED	CFM	S.P. IN. W.C.	WHEEL DIA. INCHES	FAN RPM (NOTE F)	DRIVE TYPE	MAX. AMCA SONES	BACKDRAFT DAMPER TYPE	CURB TYPE (NOTE G)	BHP	MHP	VOLTAGE	PHASES	BY (NOTE A)	TYPE (NOTE B)	BY (NOTE A)	TYPE (NOTE C)	MANUFACTURER	MODEL	NOTES
EF-1	APERATUS BAY	5800	0.25	30	709	DIRECT	10.4	ELECTRIC	N/A	0.51	2	208	3	MC	VFD/B	MC	VFD/B	GREENHECK	SE2-30-620-B	NOTE 1
EF-2	KITCHEN	1050	1.20	14.625	1392	DIRECT	9.9	N/A	MFR	0.4	0.75	115	1	MFR	NF	TCC	FV	GREENHECK	CUE-141-VG	NOTE 2
RF-1	ELECTRICAL 112	1200	0.40	11.187	1651	DIRECT	10.5	N/A	MFR	0.21	0.25	115	1	MFR	NF	TCC	FV	GREENHECK	SQ-100-VG	NOTE 3

ADD

RADIANT FLOOR MANIFOLD SCHEDULE

NOTES: REFER TO DRAWINGS M201 AND M403 FOR ADDITIONAL INFORMATION ON SPACE SERVED. REFER TO SPECIFICATION SECTION 23 83 00 FOR ADDITIONAL REQUIREMENTS. MAXIMUM WATER SUPPLY TEMPERATURE AVAILABLE IS 115°F. RADIANT FLOOR MANUFACTURER REQUIRED TO CALCULATE TUBE SPACING, TUBE SIZE, AND FLOW RATES REQUIRED TO MEET SCHEDULED REQUIRED HEAT OUTPUT FOR EACH ZONE.

MANIFOLD NAME	AREA SERVED	# OF LOOPS	TUBING SIZE (IN.)	PRESSUDE DROP (FT. HD)	MAX. MANIFOLD FLOW (GPM)	SUPPLY WATER TEMP	WATER TEMP DIFFERENCE	TUBE SPACING (IN.)	REQUIRED HEAT OUTPUT (MBH)
1	MECH. STOR.	1	3/4"	3.5	1.1	105	20	12	11.2
2	APPARATUS BAY	9	3/4"	10	15.2	107	20	12	151.1
3	APPARATUS BAY	8	3/4"	7.6	10.8	110	20	12	107
4	WATCH	2	5/8"	2.1	1.4	109	20	12	13.8
5	TRAINNING ROOM	4	5/8"	5.8	3.8	114	20	12	37.9
6	LOCKER ROOM	3	5/8"	1.1	1.2	90	20	12	11.6
7	LT OFFICE 123	1	5/8"	1.2	0.5	105	20	12	5.5
8	WORKSHOP	5	5/8"	.6	1.4	85	20	12	13.6
9	LT OFFICE 125/ SHOWER	1	5/8"	2.7	0.8	104	20	12	7.8
10	SMALL MEETING ROOM 102	1	5/8"	2.7	0.6	92	20	12	6
11	SMALL MEETING ROOM 103	1	5/8"	.3	0.4	110	20	12	3.5
12	LT OFFICE	1	5/8"	1.4	0.6	105	20	12	6
13	DORM ROOM	3	5/8"	11.7	1.4	92	20	12	13.6
14	GREAT ROOM	3	5/8"	1.7	3.9	111	20	12	38.8
15	LOBBY/ VEST	2	5/8"	5.6	1.8	102	20	12	17.8
16	STORAGE/ WATER	1	3/4"	1.3	0.7	108	20	12	7.4
17	FITNESS	2	5/8"	2.6	1.5	110	20	12	14.8

COIL SCHEDULE - WATER

		SIZE			EAT		LAT								
TAG NAME	AREA SERVED	L	H	CFM	DB °F	WB °F	DB °F	TOTAL MBH	A.P.D. IN. W.C.	EWT °F	LWT °F	GPM	W.P.D. FT. HEAD	MANUFACTURER	MODEL	NOTES
HC-1	GREAT HALL	20	16	1500	55.0	54.0	70.0	24	0.10	115	95	2.4	5.0	TRANE	HTCL	

PUMP SCHEDULE

NOTES:
1.PROVIDE SHAFT GROUNDING AS REQUIRED IN THE MOTOR SPECIFICATION 23 05 13.
2.PUMP SHALL BE SELECTED BASED ON 25% PROPYLENE GLYCOL AND 36° F TEMPERATURE.

							ELECTRICAL (NOTE 1)								
										DISCONNECT		CONTROLLER/ STARTER				
TAG NAME	AREA SERVED	GPM	PUMP FT. HEAD AT DESIGN	MINIMUM PUMP EFFICIENCY	INLET SIZE	IMPELLER SIZE	HP (NOTE E)	RPM	VOLTAGE	PHASES	BY (NOTE A)	TYPE (NOTE B)	BY (NOTE A)	TYPE (NOTE C)	MANUFACTURER	MODEL	NOTES
P-1	PRIMARY LOOP	65.0	65.00	53.3	1 1/2"	8.375	3	1800	208	3	MC	VFD/B	MC	VFD/B	B & G	e-80	
P-2	PRIMARY LOOP	65.0	65.00	53.3	1 1/2"	8.375	3	1800	208	3	MC	VFD/B	MC	VFD/B	B & G	e-80	
P-3	GEOTHERMAL	110.0	60.00	58.8	2 1/2"	8.000	5	1800	208	3	MC	VFD/B	MC	VFD/B	B & G	e-80	NOTE 2
P-4	GEOTHERMAL	110.0	60.00	58.8	2 1/2"	8.000	5	1800	208	3	MC	VFD/B	MC	VFD/B	B & G	e-80	NOTE 2

BOILER SCHEDULE - HOT WATER

	MAX. DIMENSIONS											ELECTRICAL								
															DISCONNECT		CONTROLLER/ STARTER			
TAG NAME	LENGTH	WIDTH	HEIGHT	FUEL	INLET FUEL PRESSURE (IN. W.C.)	TURNDOWN RATIO	BOILER MINIMUM FLOW (GPM)	INPUT BTUH/HR	EWT °F	LWT °F	OPERATING PRESSURE PSI	MOCP	VOLTAGE	PHASES	BY (NOTE A)	TYPE (NOTE B)	BY (NOTE A)	MANUFACTURER	MODEL	NOTES
B-1	30'-1/2"	26'-1/4"	53'-1/2"	NG	14	10:1	10	400000	95	115	160	20	115	1	MFR	F	MFR	LOCHINVAR	FTX400	

HEAT PUMP SCHEDULE - WATER-TO-DIRECT EXPANSION COIL

NOTES:
1.PROVIDE UNIT WITH DIGITAL SCROLL COMPRESSORS.

				CONDITIONS BASED ON 25% PROPYLENE GLYCOL			CONDITIONS BASED ON 25% PROPYLENE GLYCOL					ELECTRICAL											
																	DISCONNECT		CONTROLLER/ STARTER				
TAG NAME	AREA SERVED	CONFIGURATION	UNIT NOMINAL TONNAGE	EWT	LWT	MIN. EER	EWT	LWT	MIN. COP	COND. GPM	W.P.D. FT. HEAD	VOLTAGE	PHASES	FLA	MCA	MOCP	BY (NOTE A)	TYPE (NOTE B)	BY (NOTE A)	MANUFACTURER	MODEL (NOTE 1)	NOTES
HP-1	AHU-1 VENTILATION COIL	WATER SOURCE CONDENSING UNIT	10	90.0	94.3	13.3	0.0	0	0	30.0	9.00	208	3	30.0	38	60	EC	-	MFR	AAON	SB	NOTE 1
HP-2	AHU-1 HEATING/COOLING COIL	WATER SOURCE HEAT PUMP	14	90.0	99.6	10.2	38.0	31.2	2.98	40.0	8.00	208	3	48.0	60	100	EC	-	MFR	AAON	SB	NOTE 1

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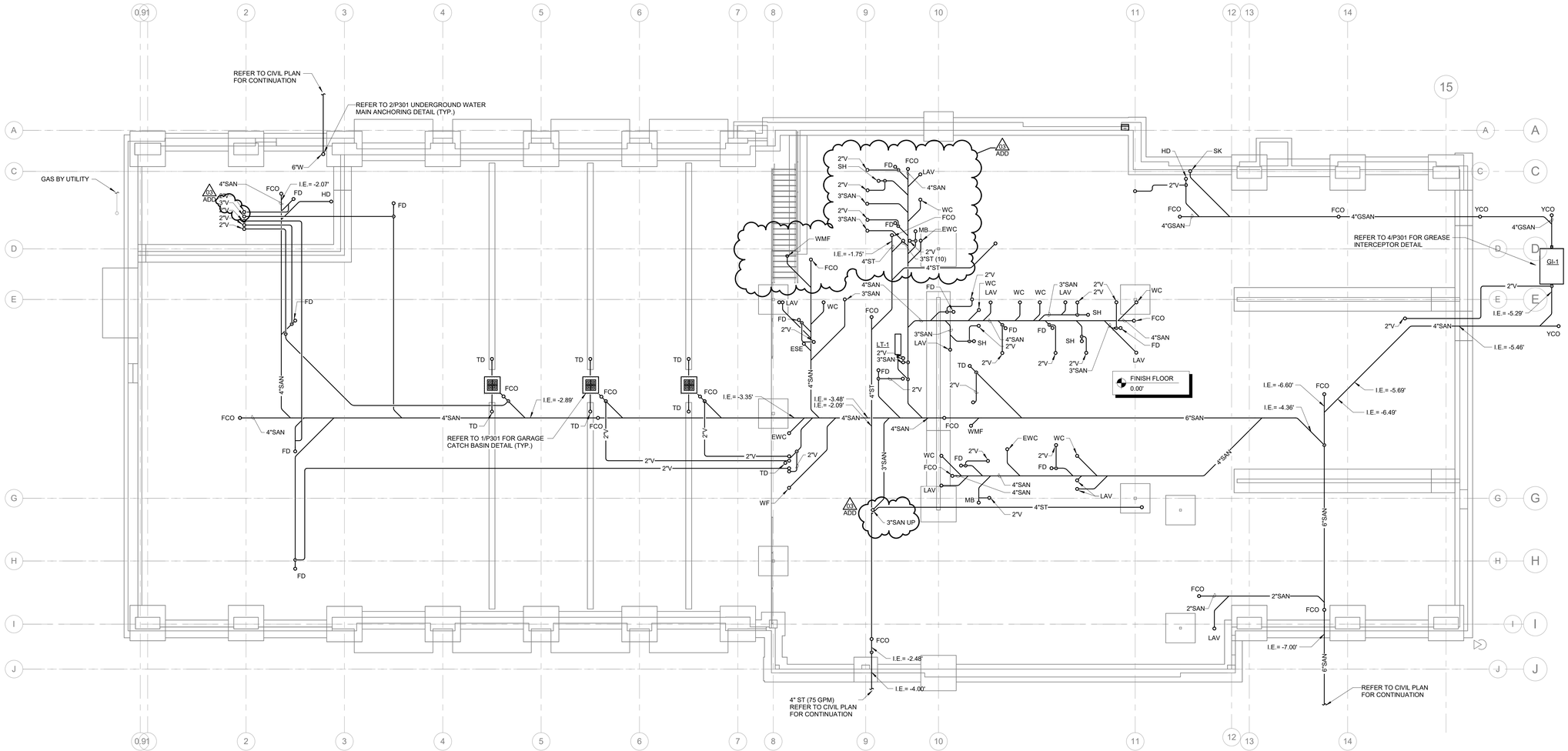
REFERENCE SCALE IN INCHES
0 1 2 3

Drawing
SCHEDULES - MECHANICAL

City of Madison Contract No. **8027**
OPN Project No. **17207000**

M500



1 UNDERFLOOR PLAN PLUMBING

1/8" = 1'-0"

NORTH

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Drawing

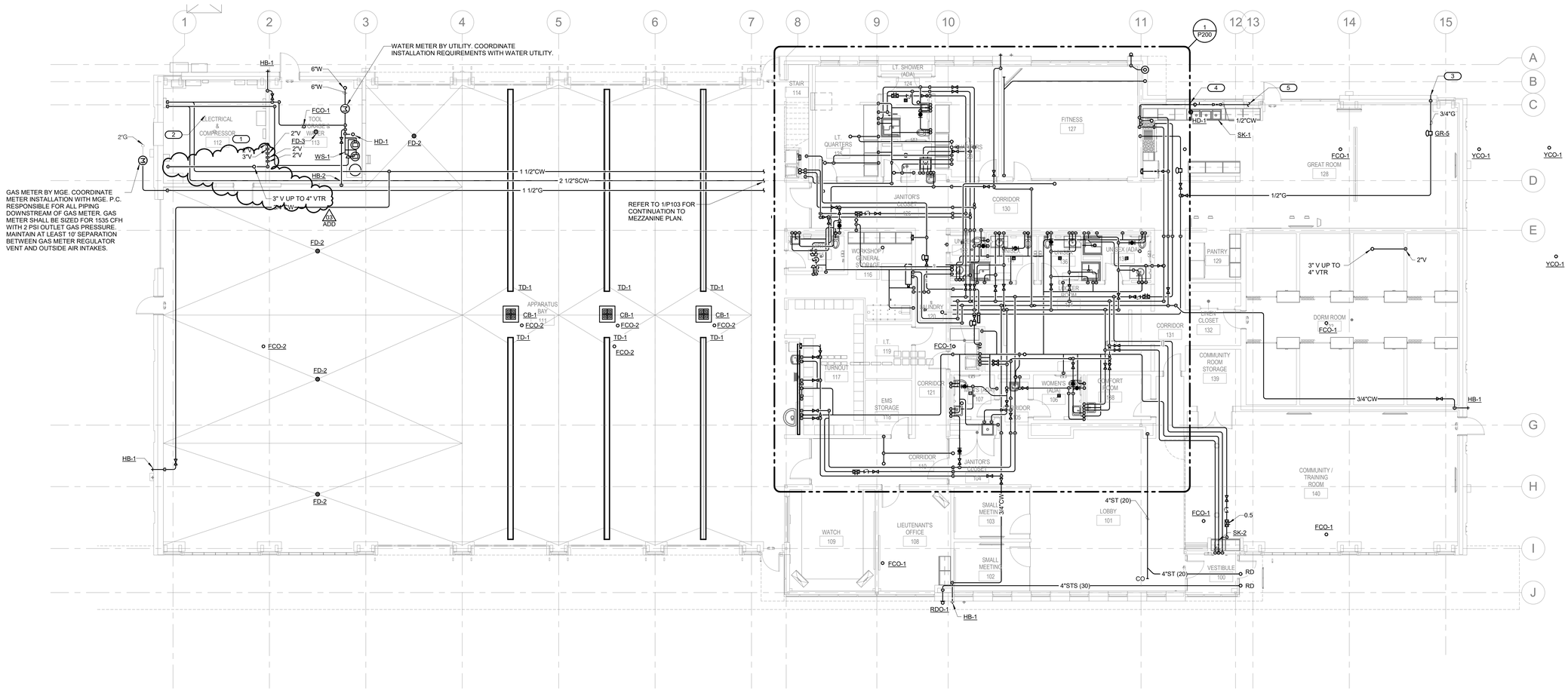
UNDERFLOOR PLAN - PLUMBING

City of Madison Contract No. **8027**
OPN Project No. **17207000**

P101

KEYNOTES: (#)

1. INSTALL OWNER FURNISHED AIR COMPRESSOR PER MANUFACTURER REQUIREMENTS. AIR COMPRESSOR IS BAUER MANUFACTURER WITH MODEL NUMBER UNICUS III.
2. PIPING SHALL BE ROUTED ABOVE CEILING LID OF ELECTRICAL ROOM NEAR EAST EXTERIOR WALL, BUT BELOW POLYCARBONATE GLAZING. PIPING SHALL THAN ROUTE UP INTERIOR OF NORTH EXTERIOR WALL TO TRUSS SPACE BEFORE ROUTING TO MEZZANINE AREA. REFER TO RISER DIAGRAMS FOR ADDITIONAL INFORMATION.
3. PROVIDE 1/2" G DOWN TO GAS CONNECTION FOR EXTERIOR NATURAL GAS GRILLE. PROVIDE EXTERIOR SHUTOFF VALVE AND QUICK CONNECT COUPLING. COORDINATE EXACT CONNECTIONS WITH OWNER.
4. ROUTE HW PIPING TO RESIDENTIAL DISHWASHER PER MANUFACTURER'S REQUIREMENTS.
5. ROUTE 1/2" CW TO COFFEE MAKER HOOKUP ON COUNTER. LOCATE BFP-2 UNDER SINK TO SERVE COFFEE MAKER.



1 FLOOR PLAN LEVEL 1 - PLUMBING

1/8" = 1'-0"

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FLOOR PLAN LEVEL 1 - PLUMBING

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P102

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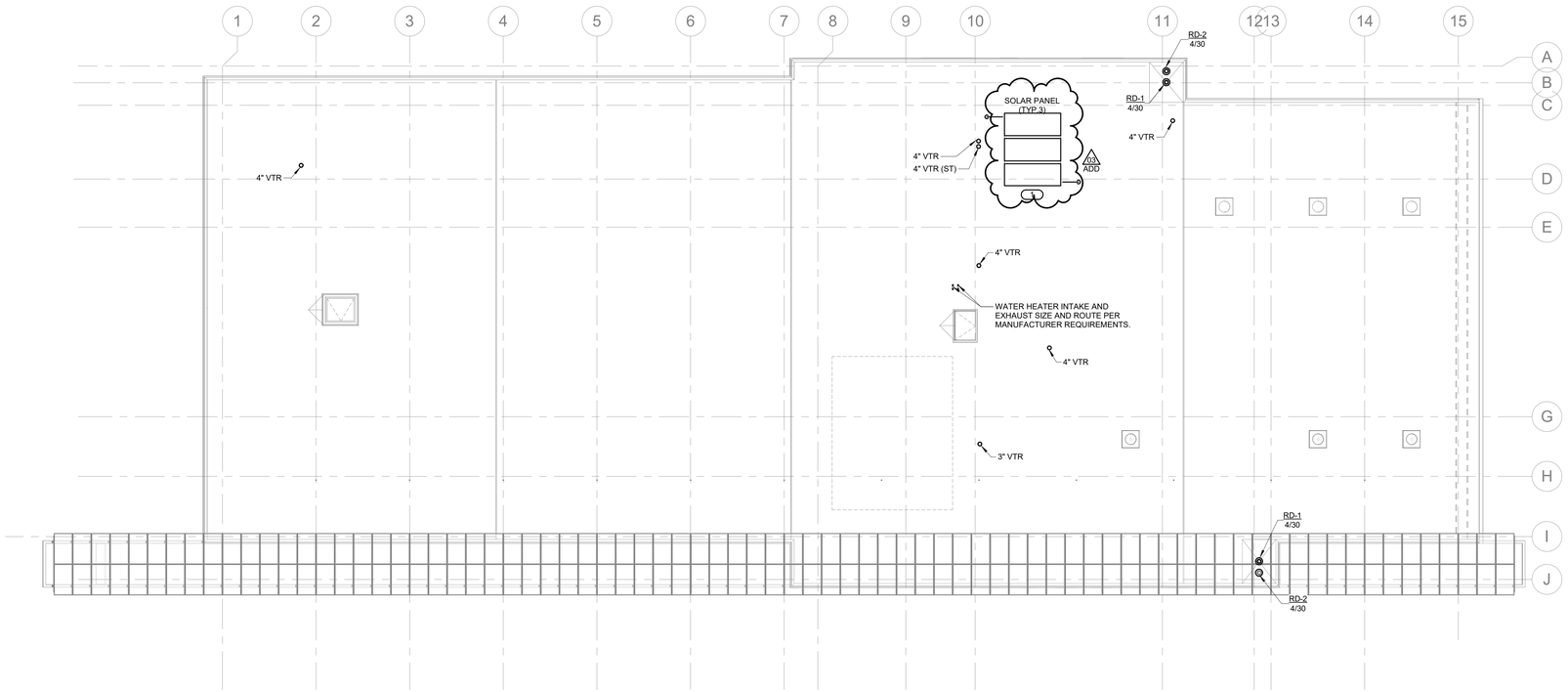
KEYNOTES: (#)

1. SOLAR PANEL PROVIDED BY P.C. REFER TO WH-1 DESCIPTION AND PLUMBING SPECIFICATION 22 3 39 FOR REQUIREMENTS.



1 ROOF PLAN - PLUMBING

3/32" = 1'-0"

NORTH

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Drawing
ROOF PLAN - PLUMBING

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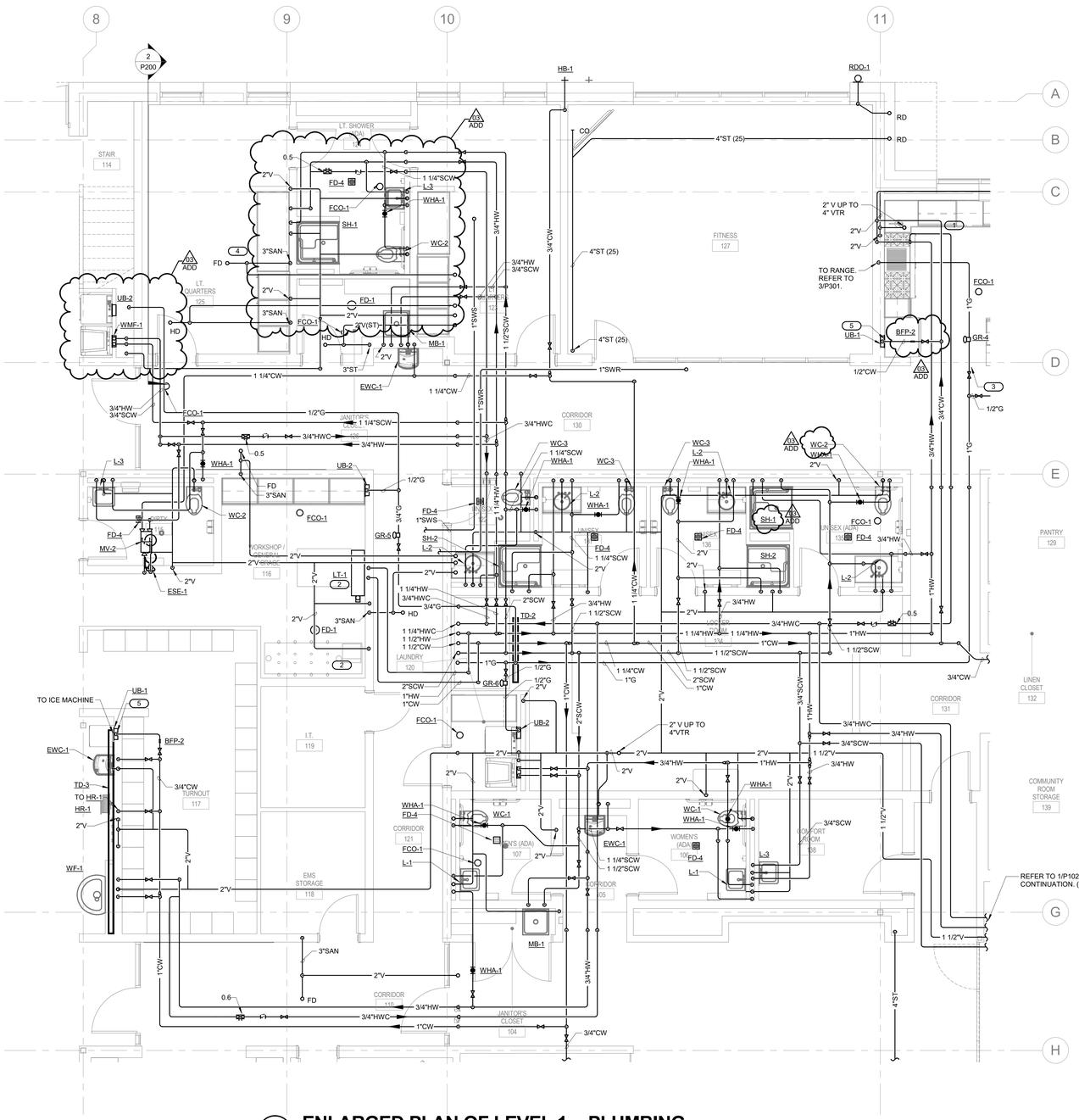
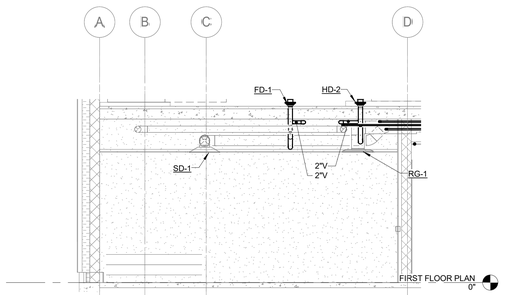
OPN Project No. **17297000**

P104



1 ENLARGED PLAN OF LEVEL 1 - PLUMBING

1/4" = 1'-0"



2 SECTION FOR LT. OFFICE 125

1/4" = 1'-0"

KEYNOTES: (#)

1. 1" HW AND 1" CW ROUTED TO COMMERCIAL WASHING MACHINE. PROVIDE BALL VALVES WITH 3/4" HOSE THREAD CONNECTIONS OUTSIDE OF THE WALL.
2. PROVIDE L.T.-1 RECESSED IN SLAB. PROVIDE AIR GAP ON DISCHARGE OF WASHING MACHINE DRAIN LINE INTO TROUGH.
3. INSTALL MECHANICAL GAS SHUTOFF VALVE IN GAS LINE. MECHANICAL GAS VALVE FURNISHED BY KITCHEN HOOD SUPPLIER. GAS VALVE CONTROLLED BY KITCHEN HOOD FIRE SUPPRESSION SYSTEM.
4. REFER TO 2/P200 SECTION FOR PLUMBING PIPING ROUTING ABOVE L.T. QUARTERS 125.
5. PROVIDE UB-1 AT REFRIGERATOR OR ICE MAKER.

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Drawing
ENLARGED PLAN - PLUMBING

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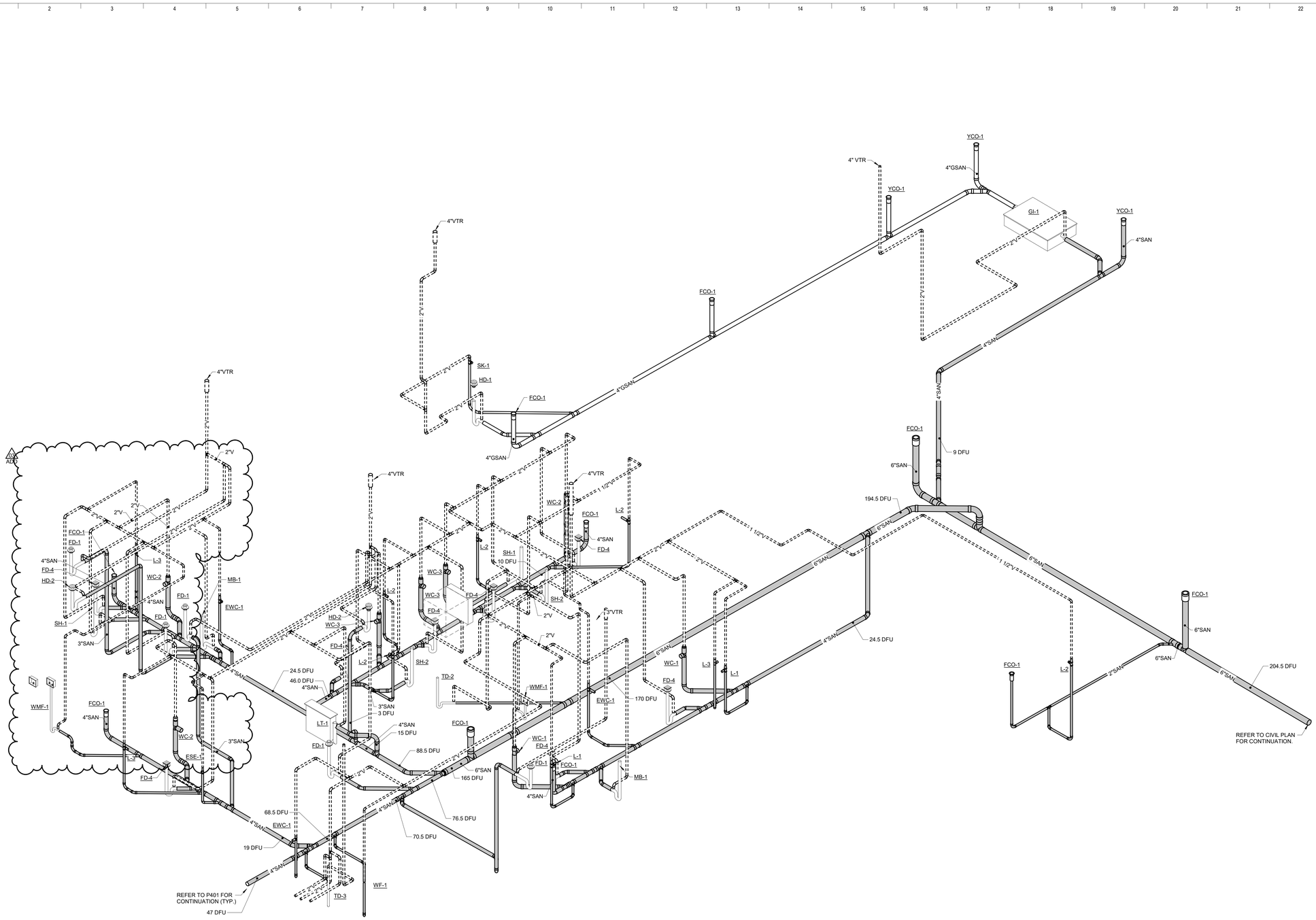
OPN Project No. **17207000**

P200



1 SAN-VENT RISER DIAGRAM - FIRST FLOOR - SOUTH - PLUMBING

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RISER DIAGRAM - SOUTH - PLUMBING

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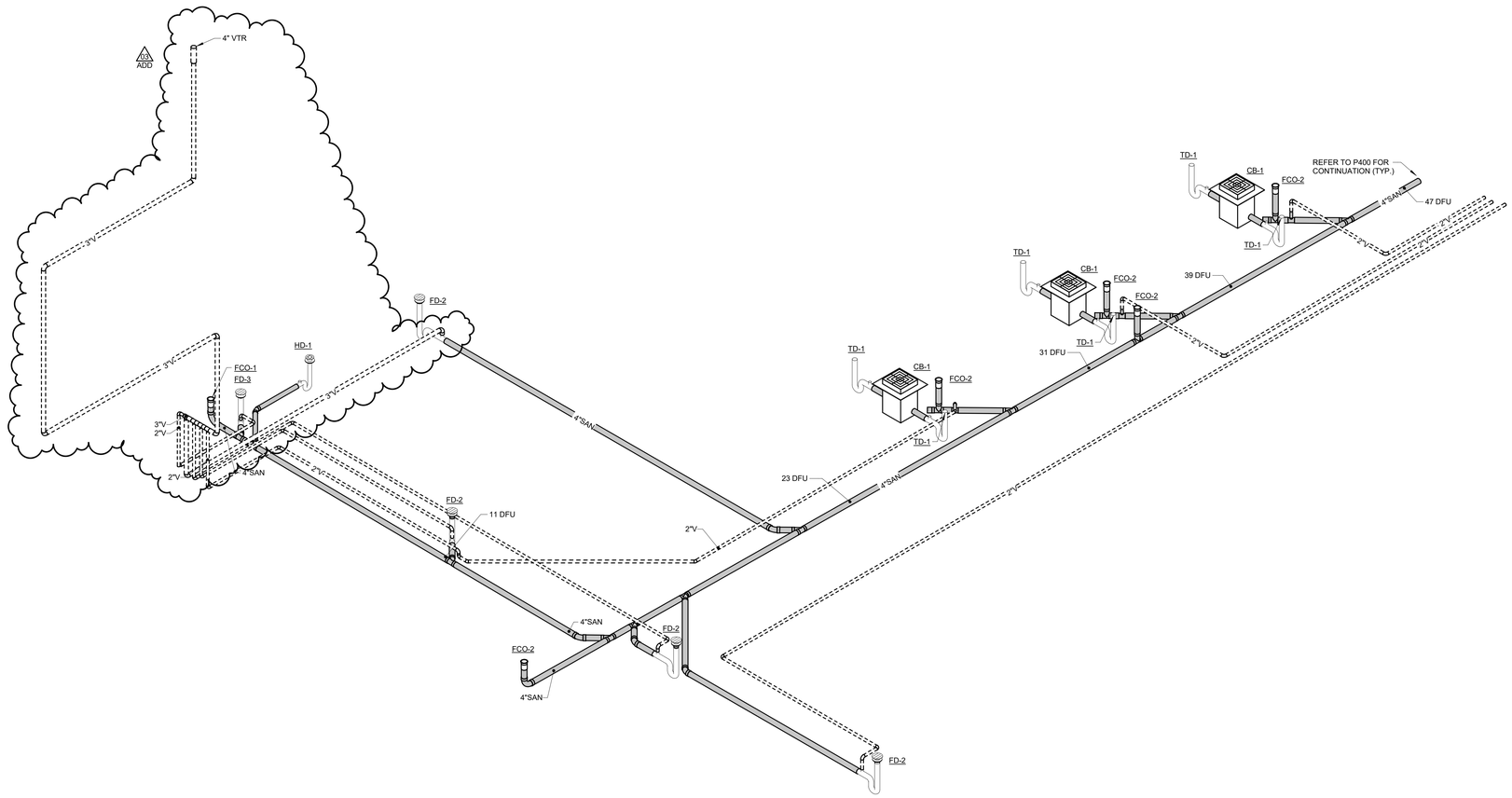
OPN Project No. 17207000

P400



1 SAN-VENT RISER DIAGRAM - FIRST FLOOR - NORTH - PLUMBING

NO SCALE

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RISER DIAGRAM - NORTH - PLUMBING

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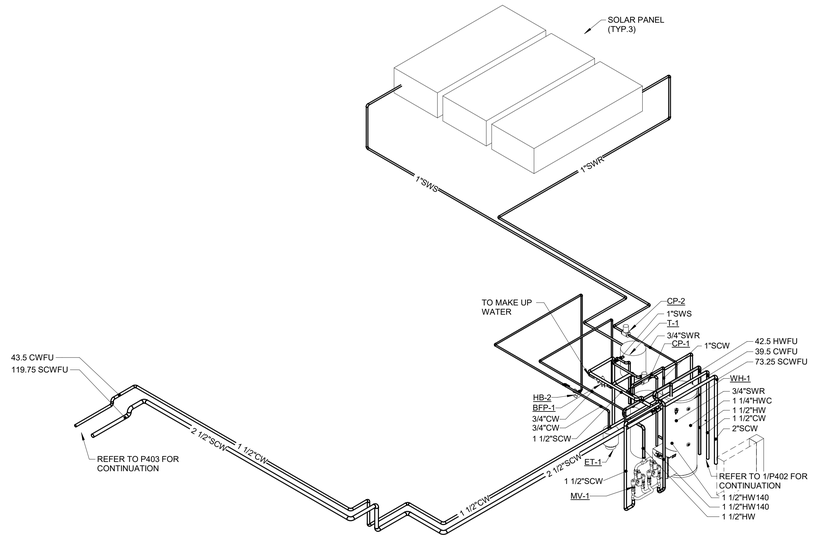
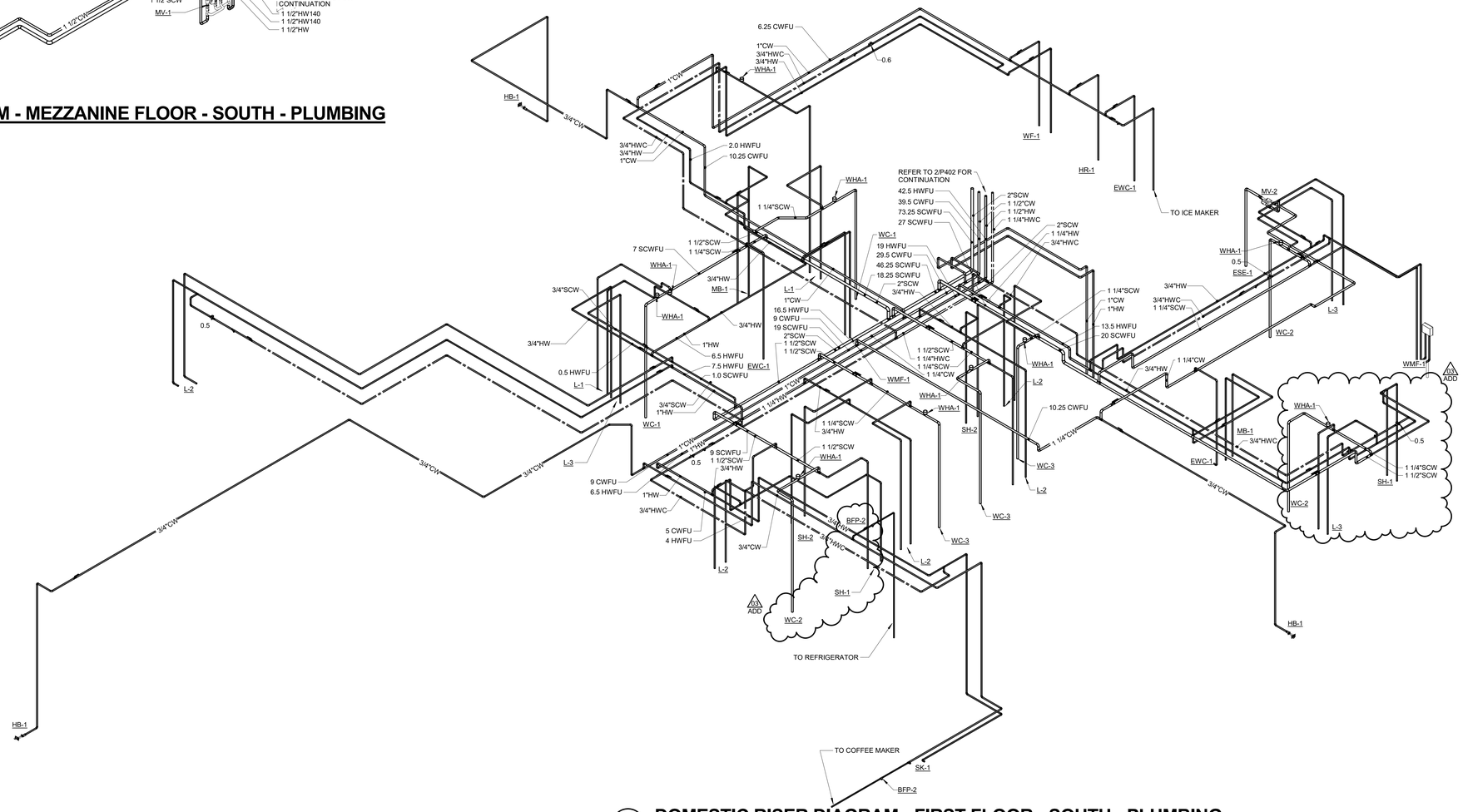


2 DOMESTIC RISER DIAGRAM - MEZZANINE FLOOR - SOUTH - PLUMBING

NO SCALE



1 DOMESTIC RISER DIAGRAM - FIRST FLOOR - SOUTH - PLUMBING

NO SCALE

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RISER DIAGRAM - SOUTH - PLUMBING

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P402

PLUMBING FIXTURE SCHEDULE

TAG NAME	DESCRIPTION	MANF. & MODEL
BFP-1	BACK FLOW PREVENTER - REDUCED PRESSURE ZONE, LEAD FREE BRONZE OR STAINLESS STEEL CONSTRUCTION, SIZE SAME AS PIPE, NON-CORROSIVE INTERNAL PARTS, STAINLESS STEEL SPRINGS, DIFFERENTIAL PRESSURE RELIEF VALVE BETWEEN SPRING-LOADED CHECK VALVES, SHUT-OFF VALVES ON INLET AND OUTLET OF UNIT, BALL STYLE SHUTOFF VALVES FOR 3/4"-2" AND GATE STYLE VALVES FOR 2 1/2"-10", AIR GAP DRAIN FITTING, TEST PORTS WITH SHUT-OFF VALVES, RATED FOR 175 PSI AT 33°F TO 140°F, 15 PSI (MAXIMUM) PRESSURE DROP AT 10 FPS, FACTORY TESTED, ALL PARTS TO BE SERVICEABLE WITHOUT REMOVING UNIT FROM LINE, APPROVED BY USC FCCC & HR, AWWA C511-92, ASSE 1013, IAPMO AND SBCCI LISTED. MOUNT WITHIN 60" OF FINISHED FLOOR. PROVIDE AND INSTALL BRONZE OR EPOXY COATED STRAINER UPSTREAM OF EACH UNIT AND ADDITIONAL VALVE UPSTREAM OF EACH STRAINER. FLOW PRESSURE DROP CURVES SHALL BE SUBMITTED.	APOLLO (RPLF4A), WATTS (LF919 / 994), WILKINS (975XL2 / 375AST)
BFP-2	BACK FLOW PREVENTER - DUAL CHECK WITH ATMOSPHERIC PORT, LEAD FREE STAINLESS STEEL BODY, STRAINER, HEAVY DUTY FDA APPROVED RUBBER DIAPHRAGMS, 3/8" SIZE, RATED FOR 150 PSI AT 33°F TO 130°F, APPROVED BY ASSE 1022. PROVIDE 3/8" DRAINAGE TUBING FROM DISCHARGE PORT TO NEARBY DRAIN.	WATTS (SD-3), WILKINS (740)
CB-1	CATCH BASIN - REFER TO DETAILS SHEET FOR REQUIREMENTS.	N/A
CP-1	CIRCULATING PUMP - VARIABLE SPEED CONTROLLER WITH SETTINGS TO ADJUST AND MAINTAIN A CONSTANT: SPEED, FIXED PRESSURE, OR PROPORTIONAL PRESSURE. LEAD FREE BRONZE OR STAINLESS STEEL CONSTRUCTION, PERMANENTLY LUBRICATED SEALED BEARINGS, MECHANICAL SEAL, OIL LUBRICATED, ECM MOTOR WITH INTEGRATED VARIABLE SPEED CONTROL, FLANGED CONNECTIONS, RATED FOR 125 PSIG AT 225°F, UL LISTED. 4 GPM @ 10 FEET OF HEAD. MOTOR SHALL BE 0.65 AMPS. ELECTRICAL REQUIREMENTS - 115V, 1 PHASE HARD WIRED AQUASTAT - LINE VOLTAGE, ADJUSTABLE SETTING OF 90-180°F WITH STRAP-ON REMOTE SENSOR BULB, UL LISTED. PROVIDE WITH TRANSFORMER IF REQUIRED. INSTALL PER MANUFACTURERS INSTRUCTIONS.	PUMP - GRUNDFOS (ALPHA SERIES), B&G (ECOCIRC SERIES), ARMSTRONG (COMPASS 20-20 SS SERIES) AQUASTAT - HONEYWELL, WHITE-RODGERS, JOHNSON CONTROLS, SAME AS PUMP MANUFACTURER
CP-2	SOLAR CIRCULATING PUMP - VARIABLE SPEED CONTROLLER WITH SETTINGS TO ADJUST AND MAINTAIN A CONSTANT: SPEED, FIXED PRESSURE, OR PROPORTIONAL PRESSURE. LEAD FREE BRONZE OR STAINLESS STEEL CONSTRUCTION, PERMANENTLY LUBRICATED SEALED BEARINGS, MECHANICAL SEAL, OIL LUBRICATED, ECM MOTOR WITH INTEGRATED VARIABLE SPEED CONTROL, FLANGED CONNECTIONS, RATED FOR 125 PSIG AT 225°F, UL LISTED. APPROXIMATE FLOW RATE OF 3 GPM. FINAL FLOW RATE AND HEAD DETERMINED BY SOLAR COLLECTOR SUPPLIER. ELECTRICAL REQUIREMENTS - 115V, 1 PHASE HARD WIRED PUMP SHALL BE CONTROLLED BY SOLAR COLLECTOR CONTROLLER. REFER TO SPECIFICATION 22 33 39 FOR ADDITIONAL REQUIREMENTS.	PUMP - GRUNDFOS (ALPHA SERIES), B&G (ECOCIRC SERIES), ARMSTRONG (COMPASS 20-20 SS SERIES)
ESE-1	EMERGENCY SHOWER & EYE/FACE WASH - ACCESSIBLE, COMBINATION UNIT, RECESSED EYEWASH AND EXPOSED SHOWER HEAD, STAINLESS STEEL SHOWER HEAD, BRASS/BRONZE STAY OPEN BALL VALVE, RECESSED STAINLESS STEEL SHOWER PULL HANDLE, RECESSED STAINLESS STEEL 16 GAUGE EYEWASH COVER AND DRAIN PAN, EYEWASH SHALL DRAIN BACK INTO INTERNALLY COLLECTED PAN WITH DIRECT CONNECTION TO SANITARY WASTE PIPING, EYE/FACE WASH SHALL BE ACTIVATED BY PULLING COVER/DRAIN PAN DOWN WITH HANDLE, EYE/FACE WASH SHALL HAVE PLASTIC SPRAY HEADS WITH CAPS AND RETAINING CHAINS/STRAPS, INTEGRAL FLOW CONTROL FITTINGS, STAINLESS STEEL SUPPLY PIPING AND FITTINGS, UNIVERSAL IDENTIFICATION SIGN, ANSI Z358.1-2009 COMPLIANT. MINIMUM FLOW RATE OF SHOWER SHALL BE 20 GPM AT 30 PSI. MINIMUM FLOW RATE OF EYE/FACE WASH SHALL BE 3.0 GPM AT 30 PSI. ACTIVATION TIME SHALL BE 1 SECOND OR LESS. BRASS/BRONZE PIPING, FITTINGS, AND VALVES SHALL BE CHROME-PLATED OR CHEMICAL-RESISTANT POWDER COATED. MOUNT SHOWER HEAD, SHOWER ACTIVATION HANDLE, AND EYE/FACE WASH OUTLET HEADS IN COMPLIANCE WITH LATEST A.D.A. AND ANSI 117.1 STANDARDS.	EMERGENCY SHOWER - GUARDIAN (GBF2150), BRADLEY (S19345 SERIES), ACORN SAFETY (S3160 SERIES), HAWS (8356WCC SERIES), SPEAKMAN (SE-575-DP-238)
ET-1	EXPANSION TANK - WELDED BLACK STEEL CONSTRUCTION, GUARANTEED AIRTIGHT AND LEAKPROOF, STAINLESS STEEL SYSTEM CONNECTION, HEAVY DUTY BUTYL DIAPHRAGM AND RIGID POLYPROPYLENE LINER MECHANICALLY BONDED TO TANK TO PROVIDE A 100% NON-CORROSIVE WATER RESERVOIR, DIAPHRAGM AND LINER SHALL BE APPROVED FOR USE IN POTABLE WATER SYSTEMS, ALL WETTED COMPONENTS OF FDA APPROVED MATERIALS. PROVIDE STANDARD SCHRADER AIR VALVE FOR FIELD CHARGING. TANK SHALL COMPLY WITH FEDERAL ACT S.3874. TANK SHALL HAVE A WORKING TEMPERATURE OF 200°F AND A WORKING PRESSURE OF 125 PSIG. MINIMUM TANK VOLUME TO BE 10 GALLONS, MINIMUM ACCEPTING VOLUME TO BE 6 GALLONS. FACTORY PRE-CHARGED FOR SHIPPING. FIELD CHARGE TANK TO 55 PSIG.	AMTROL (THERM-X-TROL), B&G (PT), ELBI (DT), TACO (PAX SERIES), WATTS (DETA), WESSELS (TX)
EWC-1	ELECTRIC WATER COOLER - WALL HUNG, 18 GAUGE STAINLESS STEEL CABINET AND NON-SPLASH BASIN WITH STAINLESS STEEL FINISH, STREAM PROJECTOR WITH PROTECTIVE HOOD, PUSH BAR OR LEVER OPERATING CONTROLS ON FRONT AND SIDES, BUILT-IN FLOW REGULATOR, PLASTIC P-TRAP ASSEMBLY, ADJUSTABLE THERMOSTAT, MOUNTING ACCESSORIES, TANK DRAIN AND ANGLE STOPS, HERMETIC COMPRESSOR TO OPERATE ON HFC-134a REFRIGERANT. COMPLIANT TO LATEST ANSI A117.1 AND ADA STANDARDS. UNIT SHALL COMPLY WITH FEDERAL ACT S.3874. BOTTLE FILLING STATION - UNIT MOUNTED, STAINLESS STEEL CONSTRUCTION AND FINISH, INTEGRAL DRAIN, SENSOR OPERATED WITH AUTOMATIC SHUTOFF, REPLACEABLE LEAD-CHLORINE-TASTE-ODOR WATER FILTER, BOTTLE COUNTER. UNIT SHALL PROVIDE 8.0 GPH OF WATER FROM 80°F TO 50°F AT 90°F AMBIENT. WATER SYSTEM SHALL BE OF LEAD FREE CONSTRUCTION. TANK SHALL BE TESTED TO 125 PSIG. ORIFICE SHALL BE AT 36" (MAXIMUM) ABOVE FINISHED FLOOR. BOTTOM OF APRON SHALL BE AT 27" ABOVE FINISHED FLOOR IN COMPLIANCE WITH LATEST ADA STANDARDS. ELECTRICAL REQUIREMENTS - 115V-1 PHASE, CORD AND PLUG, 1/5 HP MOTOR	ELKAY (LZS8), HALSEY-TAYLER (HTHB-HAC8WF), ACORN (A111)
FCO-1	FLOOR CLEANOUT - ADJUSTABLE, CAST IRON HOUSING, ANCHOR FLANGE, TAPERED THREAD PLUG, SECURED NICKEL BRONZE TOP. TOP STYLE SHALL MATCH FLOOR FINISH AS FOLLOWS: UNFINISHED FLOOR - ROUND SOLID SCORIATED TOP TILE OR TERRAZZO - SQUARE RECESSED TOP CARPET - ROUND TOP WITH CARPET MARKER	ZURN (Z1400), JOSAM (55000), MIFAB (C1100), SMITH (4000), WADE (6000), WATTS (CO-200)
FCO-2	FLOOR CLEANOUT - ADJUSTABLE, CAST IRON HOUSING, ANCHOR FLANGE, TAPERED THREAD PLUG, EXTRA HEAVY DUTY SOLID TOP.	ZURN (Z1400), JOSAM (55000), MIFAB (C1100), SMITH (4000), WADE (6000), WATTS (CO-200)
FD-1	FLOOR DRAIN - CAST IRON BODY, NICKEL BRONZE ADJUSTABLE TOP, 5" ROUND, 3" BOTTOM OUTLET, FLASHING COLLAR, SURFACE MEMBRANE CLAMP, DEEP SEAL TRAP.	FLOOR DRAIN - ZURN (Z-415), SMITH (2005), WADE (1100), JOSAM (30000), WATTS (FD-100), MIFAB (F1100), SUN (FD1000)
FD-2 03 ADD	FLOOR DRAIN - EPOXY COATED CAST IRON BODY, EXTRA HEAVY DUTY CAST IRON SELF CLOSING HINGED GRATE, 12" ROUND ANTI-PONDING SLOTS, 4" BOTTOM OUTLET, CAST IRON SUSPENDED PERFORATED SEDIMENT BUCKET.	FLOOR DRAIN - ZURN, WATTS, SMITH, WADE, JOSAM, MIFAB
FD-3	FLOOR DRAIN - CAST IRON BODY, NICKEL BRONZE ADJUSTABLE TOP, 7" ROUND , 4" BOTTOM OUTLET, FLASHING COLLAR, SURFACE MEMBRANE CLAMP, DEEP SEAL TRAP.	FLOOR DRAIN - ZURN (Z-550), SMITH (2110), WADE (1310), JOSAM (32100). WATTS (FD-300), MIFAB (F1320)
FD-4	FLOOR DRAIN - CAST IRON BODY, NICKEL BRONZE ADJUSTABLE TOP, 6" SQUARE, 3" BOTTOM OUTLET, FLASHING COLLAR, SURFACE MEMBRANE CLAMP, DEEP SEAL TRAP.	FLOOR DRAIN - ZURN (Z-415), SMITH (2005), WADE (1100), JOSAM (30000), WATTS (FD-100), MIFAB (F1100), SUN (FD1000)
GI-1	GREASE INTERCEPTOR - RECESSED, POLYETHYLENE, FIBERGLASS REINFORCED POLYESTER, OR EPOXY COATED STEEL CONSTRUCTION, REMOVABLE OR CLEANABLE INTAKE AND DISCHARGE BAFFLES, INTERNAL FLOW CONTROL FITTING IF NECESSARY FOR OPERATION, GASKETED H-20 RATED COVER, PDI G101 COMPLIANT, PDI APPROVED AND LISTED FOR USE, 30 YEAR WARRANTY. PROVIDE RISERS FOR EXTENDING COVER TO GRADE. PROVIDE TWO-WAY CLEANOUTS UPSTREAM AND DOWNSTREAM OF GREASE INTERCEPTOR. PROVIDE UNIT WITH AK1 HIGH WATER LEVEL ANCHOR KIT AND INSTALL ANCHOR KIT PER MANUFACTURERS INSTRUCTIONS FOR HIGH WATER TABLE APPLICATIONS. 100 GPM FLOW, 1,076 LB. GREASE CAPACITY, 275 GALLONS HOLDING CAPACITY, 4" PIPE INLET AND OUTLET. CONTRACTOR HAS OPTION TO PROVIDE 750 GALLON CONCRETE GREASE INTERCEPTOR PER WISCONSIN SPS 382 REQUIREMENTS. GREASE INTERCEPTOR SIZING CRITERIA FOR STANDARD CONCRETE INTERCEPTOR: 18 MEALS PER DAY (6 FIRE-FIGHTERS PER SHIFT STAFFED 24/7) C = (M x G x H) / (2 x P) = (24 x 3 x 6) / (2 x 3) = 72 GALLONS SIZING CRITERIA FOR SCHIER GREASE INTERCEPTOR: MEALS PER DAY x GREASE PRODUCTION VALUE x DAYS PER PUMP OUT = GREASE CAPACITY NEEDED. 24 MEALS PER DAY x 0.0455 LBS/MEAL x 365 DAYS = 399 LBS GREASE	SCHIER (GREAT BASIN SERIES)
GR-1	GAS PRESSURE REGULATOR - CAST IRON BODY, INTERNAL PRESSURE RELIEF, THREADED CONNECTIONS, ADJUSTABLE PRESSURE SETTING, TIGHT SHUTOFF. 2 PSI INLET PRESSURE, 7" W.C. OUTLET PRESSURE, 400 CFH CAPACITY, MINIMUM CONTROLLABLE FLOW AS PER EQUIPMENT REQUIREMENT	MAXITROL 325 OR APPROVED EQUAL.
GR-2	GAS PRESSURE REGULATOR - CAST IRON BODY, VENTLESS TYPE, THREADED CONNECTIONS, ADJUSTABLE PRESSURE SETTING, TIGHT SHUTOFF. 2 PSI INLET PRESSURE, 7" W.C. OUTLET PRESSURE, 200 CFH CAPACITY, MINIMUM CONTROLLABLE FLOW AS PER EQUIPMENT REQUIREMENT	MAXITROL 325 OR APPROVED EQUAL.

PLUMBING FIXTURE SCHEDULE

TAG NAME	DESCRIPTION	MANF. & MODEL
GR-3	GAS PRESSURE REGULATOR - CAST IRON BODY, VENTLESS TYPE, THREADED CONNECTIONS, ADJUSTABLE PRESSURE SETTING, TIGHT SHUTOFF. 2 PSI INLET PRESSURE, 7" W.C. OUTLET PRESSURE, 515 CFH CAPACITY, MINIMUM CONTROLLABLE FLOW AS PER EQUIPMENT REQUIREMENT	MAXITROL 325 OR APPROVED EQUAL.
GR-4	GAS PRESSURE REGULATOR - CAST IRON BODY, VENTLESS TYPE, THREADED CONNECTIONS, ADJUSTABLE PRESSURE SETTING, TIGHT SHUTOFF. 2 PSI INLET PRESSURE, 7" W.C. OUTLET PRESSURE, 185 CFH CAPACITY, MINIMUM CONTROLLABLE FLOW AS PER EQUIPMENT REQUIREMENT	MAXITROL 325 OR APPROVED EQUAL.
GR-5	GAS PRESSURE REGULATOR - CAST IRON BODY, VENTLESS TYPE, THREADED CONNECTIONS, ADJUSTABLE PRESSURE SETTING, TIGHT SHUTOFF. 2 PSI INLET PRESSURE, 7" W.C. OUTLET PRESSURE, 100 CFH CAPACITY, MINIMUM CONTROLLABLE FLOW AS PER EQUIPMENT REQUIREMENT	MAXITROL 325 OR APPROVED EQUAL.
GR-6	GAS PRESSURE REGULATOR - CAST IRON BODY, VENTLESS TYPE, THREADED CONNECTIONS, ADJUSTABLE PRESSURE SETTING, TIGHT SHUTOFF. 2 PSI INLET PRESSURE, 7" W.C. OUTLET PRESSURE, 35 CFH CAPACITY, MINIMUM CONTROLLABLE FLOW AS PER EQUIPMENT REQUIREMENT	MAXITROL 325 OR APPROVED EQUAL.
HB-1	HOSE BIBB - FREEZELESS WALL HYDRANT, BRASS VALVE BODY AND SEAT, STANDARD FINISH, NON-FERROUS METAL STEM, AUTOMATIC DRAINING, VACUUM BREAKER, 3/4" MALE HOSE THREAD, WALL CLAMP, CONCEALED IN FLUSH MOUNTED LOCKABLE WALL BOX, KEY OPERATED, ASSE 1019 OR 1052 LISTED AND APPROVED. VERIFY NUMBER OF KEY OPERATORS TO BE PROVIDED WITH OWNER. BOX COVER AND HYDRANT SHALL USE A COMMON KEY. MOUNT AT 18" ABOVE GRADE UNLESS NOTED OTHERWISE ON DRAWINGS.	PRIER (C-634BX), WOODFORD (B67), ZURN (Z1300), WATTS (HY-725), MIFAB (MHY-20), SMITH (5509QT), WADE (8700)
HB-2	HOSE BIBB - FOR INDOOR USE, BRASS CONSTRUCTION, STANDARD FINISH, ASSE 1011 APPROVED VACUUM BREAKER, 3/4" MALE HOSE THREAD, METAL WHEEL HANDLE. MOUNT AT 18" ABOVE FINISHED FLOOR.	PRIER (C-155NP.75), WOODFORD (24), CHICAGO FAUCET (293), ACORN (8121), T&S BRASS (B-0736), MIFAB (MHY-90)
HD-1	HUB DRAIN - OPEN SITE HUB DRAIN, PVC TRAP AND STANDPIPE EXTENDED 2" AFF, 3" BOTTOM OUTLET, DEEP SEAL TRAP	NOT APPLICABLE
HD-2	HUB DRAIN - OPEN SITE HUB DRAIN, CAST IRON TRAP AND STANDPIPE EXTENDED 2" AFF, 3" BOTTOM OUTLET, DEEP SEAL TRAP	NOT APPLICABLE
HR-1	HOSE REEL - WALL MOUNTED RETRACTABLE HOSE REEL, STEEL CONSTRUCTION, GUIDE ARM, 3/8" I.D. X 70 FT WATER HOSE INCLUDED. POWDER COAT FINISH, AUTO REWIND, STEEL SUPPORT BASE MEANT FOR WALL INSTALLATION, 300 PSI RATED, 150°F WORKING TEMPERATURE INCLUDE ANIT-SPILL VACUUM BREAKER WATTS LF008PCQT (ASSE 1056 APPROVED).	REELCRAFT 7000 SERIES OR APPROVED EQUAL
L-1	LAVATORY - ACCESSIBLE, WALL MOUNTED, WHITE VITREOUS CHINA, 20"x18", 4" HIGH CONTOURED BACKSPLASH, SINGLE FAUCET HOLE, DRILLED FOR CONCEALED ARM CARRIER. LAVATORY TRIM - SINGLE HANDLE MIXING FAUCET, SELF CLOSING, BRASS CONSTRUCTION, CHROME-PLATED FINISH, CONVENTIONAL SPOUT WITH AERATOR, WASHERLESS BLADE HANDLE WITH SUPPLIES AT 4" CENTERS, OPERATING FORCE OF 5.0 LBS. (MAXIMUM), PERFORATED GRID STRAINER WITH 1-1/4" 17 GAUGE TAILPIECE, ADJUSTABLE TEMPERATURE LIMIT STOP. MAXIMUM FLOW SHALL BE 0.175 GALLONS PER CYCLE IN COMPLIANCE WITH ENERGY POLICY ACT OF 2005 AND ASME/ANSI STANDARD A112.18.1M. FAUCET SHALL COMPLY WITH FEDERAL ACT S.3874. MINIMUM FLOW TIME SHALL BE 15 SECONDS. INSULATION KIT - PRE-MANUFACTURED FOR P-TRAP, STOP VALVES AND SUPPLY LINES. ACCESSORIES - QUARTER-TURN 3/8" CHROME PLATED HEAVY BRASS ANGLE SUPPLY LOOSE KEY STOPS, CHROME PLATED SOFT COPPER SUPPLY LINES, DRAIN AND OFFSET TAILPIECE, 1-1/4" 20 GAUGE CAST BRASS P-TRAP, SUPPORT CARRIER. MOUNT LAVATORY WITH SUPPORT CARRIER BOLTED SECURELY TO FLOOR. TOP OF RIM SHALL BE AT 34" ABOVE FLOOR IN COMPLIANCE WITH LATEST ADA STANDARD. PROVIDE 29" MINIMUM CLEARANCE FROM FLOOR TO BOTTOM OF APRON IN COMPLIANCE WITH LATEST ANSI A117.1 AND ADA STANDARDS. ARMAFLEX WITH TAPE IS NOT ACCEPTABLE IN LIEU OF INSULATION KIT.	LAVATORY - AMERICAN STANDARD (0356.421), KOHLER (K-2007), SLOAN (SS-3103), TOTO (LT307), ZURN (Z5361) LAVATORY TRIM - SYMMONS (S-60), CHICAGO FAUCET (3300-ABCP) INSULATION KIT - TRUEBRO (LAV-GUARD), BROCAR PRODUCTS (TRAP WRAP), MCGUIRE (PROWRAP), PLUMBEREX (PRO-EXTREME)
L-2	LAVATORY - PROVIDED AND INSTALLED BY G.C. STRAINER AND TAILPIECE PROVIDED BY PLUMBING CONTRACTOR AND INSTALLED BY PLUMBING CONTRACTOR. LAVATORY TRIM - SINGLE HANDLE MIXING FAUCET, BRASS CONSTRUCTION, CHROME-PLATED FINISH, CONVENTIONAL SPOUT WITH AERATOR, WASHERLESS PUSH-PULL LEVER HANDLE WITH SUPPLIES AT 4" CENTERS, CERAMIC DISC CARTRIDGE, PERFORATED GRID STRAINER WITH 1-1/4" OFFSET 17 GAUGE TAILPIECE. MAXIMUM FLOW TO BE 0.35 GPM IN COMPLIANCE WITH PROJECT WATER CONSERVATION REQUIREMENTS (LEED). FAUCET SHALL COMPLY WITH FEDERAL ACT S.3874. PROVIDE RESTRICTIVE DEVICE AS REQUIRED. ACCESSORIES - QUARTER-TURN 3/8" CHROME PLATED HEAVY BRASS ANGLE SUPPLY LOOSE KEY STOPS, CHROME PLATED SOFT COPPER SUPPLY LINES, DRAIN AND OFFSET TAILPIECE, 1-1/4" 20 GAUGE CAST BRASS P-TRAP. COORDINATE OPENINGS REQUIRED IN COUNTERTOP WITH GENERAL CONTRACTOR. FIELD CUT OPENINGS WILL NOT BE ACCEPTABLE.	LAVATORY TRIM - CHICAGO FAUCET (2200-E2805ABCP), DELTA (22C631), AMERICAN STANDARD (6114.116.002), , MOEN (8417), ZURN (Z822200-XL)
L-3	LAVATORY - ACCESSIBLE, WALL MOUNTED, WHITE VITREOUS CHINA, 20"x18", 4" HIGH CONTOURED BACKSPLASH, SINGLE FAUCET HOLE, DRILLED FOR CONCEALED ARM CARRIER. LAVATORY TRIM - SINGLE HANDLE MIXING FAUCET, BRASS CONSTRUCTION, CHROME-PLATED FINISH, CONVENTIONAL SPOUT WITH AERATOR, WASHERLESS PUSH-PULL LEVER HANDLE WITH SUPPLIES AT 4" CENTERS, CERAMIC DISC CARTRIDGE, PERFORATED GRID STRAINER WITH 1-1/4" 17 GAUGE TAILPIECE. MAXIMUM FLOW TO BE 0.35 GPM IN COMPLIANCE WITH PROJECT WATER CONSERVATION REQUIREMENTS (LEED). FAUCET SHALL COMPLY WITH FEDERAL ACT S.3874. PROVIDE RESTRICTIVE DEVICE AS REQUIRED. INSULATION KIT - PRE-MANUFACTURED FOR P-TRAP, STOP VALVES, AND SUPPLY LINES. ACCESSORIES - QUARTER-TURN 3/8" CHROME PLATED HEAVY BRASS ANGLE SUPPLY LOOSE KEY STOPS, CHROME PLATED SOFT COPPER SUPPLY LINES, DRAIN AND OFFSET TAILPIECE, 1-1/4" 20 GAUGE CAST BRASS P-TRAP, SUPPORT CARRIER. MOUNT LAVATORY WITH SUPPORT CARRIER BOLTED SECURELY TO FLOOR. TOP OF RIM SHALL BE AT 34" ABOVE FLOOR IN COMPLIANCE WITH LATEST ADA STANDARD. PROVIDE 29" MINIMUM CLEARANCE FROM FLOOR TO BOTTOM OF APRON IN COMPLIANCE WITH LATEST ANSI A117.1 AND ADA STANDARDS. ARMAFLEX WITH TAPE IS NOT ACCEPTABLE IN LIEU OF INSULATION KIT.	LAVATORY - AMERICAN STANDARD (0356.421), KOHLER (K-2007), SLOAN (SS-3103), TOTO (LT307), ZURN (Z5361) LAVATORY TRIM - CHICAGO FAUCET (2200-E2805ABCP), DELTA (22C631), AMERICAN STANDARD (6114.116.002), , MOEN (8417), ZURN (Z822200-XL) INSULATION KIT - TRUEBRO (LAV-GUARD), BROCAR PRODUCTS (TRAP WRAP), MCGUIRE (PROWRAP), PLUMBEREX (PRO-EXTREME)
LT-1	LAUNDRY TROUGH - IN GROUND LAUNDRY TROUGH. OVERALL SIZE SHALL BE 42" L X 12" W X 24" DEEP MINIMUM DIMENSIONS WITH TOP FLUSH WITH SURFACE. LINT SCREEN SHOULD BE POSITIONED 3" FROM END OF UNIT SO STORAGE CAPACITY UPSTREAM OF LINT SCREEN IS 39"X12"X24" MINIMUM. UNIT SHALL BE 4" END DISCHARGE. UNIT SHALL INCLUDE TROUGH LID AND LINT SCREEN. UNIT CONSTRUCTION SHALL BE POLYPROPYLENE WITH PVC LINT FILTER. UNIT SHALL BE RATED FOR MAXIMUM WATER TEMPERATURE OF 200°F AND INCLUDE STAINLESS STEEL SCREWS FOR ATTACHING LID TO BODY. CONTRACTOR SHALL INSTALL P-TRAP AND VENT IN 4" SANITARY PIPING CONNECTING TO THE UNIT. UNIT SHALL INCLUDE TROUGH LID AND LINT SCREEN. UNIT CONSTRUCTION SHALL BE POLYPROPYLENE WITH PVC LINT FILTER. UNIT SHALL BE RATED FOR MAXIMUM WATER TEMPERATURE OF 200°F AND INCLUDE STAINLESS STEEL SCREWS FOR ATTACHING LID TO BODY. CONTRACTOR SHALL INSTALL P-TRAP AND VENT IN 4" SANITARY PIPING CONNECTING TO THE UNIT.	H-M COMPANCY OR APPROVED EQUAL
MB-1 02 ADD	MOP BASIN - MOLDED STONE, WHITE WITH BLACK ACCENTS, 24"x24"x10", STAINLESS STEEL DRAIN WITH COMBINATION DOME STRAINER AND LINT BASKET, 3" OUTLET, VINYL BUMPER GUARD ON EXPOSED SIDES. TRIM - EXPOSED TWO HANDLE MIXING FAUCET, BRASS CONSTRUCTION, CHROME-PLATED FINISH, SINGLE WING HANDLES, 1/4 TURN CERAMIC DISC CARTRIDGE, 3/4" HOSE THREAD SPOUT WITH SEPERATE ASSE 1011 RATED VACUUM BREAKER, WALL BRACE, PAIL HOOK, CHECK STOPS OR INLINE CHECK VALVES TO PREVENT THERMAL CROSSOVER. FAUCET SHALL COMPLY WITH FEDERAL ACT S.3874. ACCESSORIES - MOP HANGER, HOSE AND HOSE BRACKET, DEEP SEAL TRAP	MOP BASIN - FIAT (MSB), WILLIAMS (MTB), SWAN (MS), ZURN (Z-1996), MUSTEE (63M) TRIM - DELTA (28C2383), AMERICAN STANDARD (8344.012), CHICAGO FAUCETS (897-CP), MOEN (8124), SPEAKMAN (SC-5812), SYMMONS (S-2490), ZURN (Z841M1-XL) VACUUM BREAKER - WATTS (8A), OR APPROVED EQUAL

PLUMBING FIXTURE SCHEDULE

TAG NAME	DESCRIPTION	MANF. & MODEL
MV-1	MIXING VALVE - HI/LO MASTER THERMOSTATIC MIXING VALVE ARRANGEMENT FOR TEMPERED WATER CONTROL, ALL BRONZE/BRASS CONSTRUCTION, ROUGH BRASS FINISH, UNION INLETS WITH STRAINERS, COMBINATION CHECK STOPS OR SEPARATE SUPPLY CHECK VALVES AND SHUT OFF VALVES, DIAL THERMOMETER ON OUTLET. RATED FOR 30 GPM OUTPUT MAXIMUM AT 5 PSI DIFFERENTIAL AND 2 GPM OUTPUT MINIMUM BASED UPON CONTINUOUS RECIRCULATION. UNIT TO MIX 125 DEGREE F HOT WATER SUPPLY AND 40 DEGREE F COLD WATER SUPPLY FOR 120 DEGREE F OUTLET. DUE TO SOLAR SYSTEM HOT WATER SUPPLY TEMPERATURE MAX REACH TEMPERATURES OF 160 DEGREE F DURING PERIODS OF MINIMAL USE. WATER HEATER SET POINT IS 120°F. PROVIDE FIELD ADJUSTMENT BY FACTORY AUTHORIZED REPRESENTATIVE. UNIT SHALL SHALL BE ASSE 1017 LISTED AND APPROVED. ASSEMBLY SHALL COMPLY WITH FEDERAL ACT S.3874. RATED FOR 30 GPM OUTPUT MAXIMUM AT 5 PSI DIFFERENTIAL AND 2 GPM OUTPUT MINIMUM BASED UPON CONTINUOUS RECIRCULATION. UNIT TO MIX 125 DEGREE F HOT WATER SUPPLY AND 40 DEGREE F COLD WATER SUPPLY FOR 120 DEGREE F OUTLET. DUE TO SOLAR SYSTEM HOT WATER SUPPLY TEMPERATURE MAX REACH TEMPERATURES OF 160 DEGREE F DURING PERIODS OF MINIMAL USE. PROVIDE FIELD ADJUSTMENT BY FACTORY AUTHORIZED REPRESENTATIVE. UNIT SHALL SHALL BE ASSE 1017 LISTED AND APPROVED. ASSEMBLY SHALL COMPLY WITH FEDERAL ACT S.3874.	LEONARD (TM-LF SERIES), ACORN CONTROLS (SFMV SERIES), APOLLO (34HL), BRADLEY (HL SERIES), LAWLER (800 SERIES), POWERS (LFSH1430/LFMM430 SERIES), SYMMONS (TEMPCONTROL SERIES 7)
MV-2	MIXING VALVE - THERMOSTATIC MIXING VALVE FOR EMERGENCY SHOWER OR COMBINATION SHOWER/EYEWASH FIXTURE, BRONZE BODY CONSTRUCTION, COLD WATER BYPASS, INLET AND OUTLET THERMOMETERS, COMBINATION CHECK STOPS OR SEPARATE SUPPLY CHECK VALVES AND SHUT OFF VALVES, MOUNTING BRACKET. SUPPLY SHUT OFF VALVES SHALL BE LOCKED OPEN TO PREVENT UNAUTHORIZED CLOSURE. DUAL THERMOSTATIC MIXING AND PRESSURE REGULATING VALVE TO DELIVER 25 GPM OF TEMPERED WATER (60-100 DEGREE F) WITH 5 PSI PRESSURE DIFFERENTIAL. UNIT SHALL BE ASSE 1071 LISTED AND APPROVED. VALVE SHALL COMPLY WITH FEDERAL ACT S.3874.	MIXING VALVE - LEONARD (TM-LF), ACORN CONTROLS (ET71 SERIES), ARMSTRONG (Z358), BRADLEY (S19), HAWS (9201H), LAWLER (911), POWERS (ETV400), OR PRE-PACKAGED WITH EMERGENCY SHOWER FROM SAME MANUFACTURER.
RD-1	ROOF DRAIN - CAST IRON BODY, SECURED CAST IRON DOME, 15" ROUND, BOTTOM OUTLET, FLASHING CLAMP, GRAVEL STOP, UNDERDECK CLAMP, BEARING PAN, ADJUSTABLE EXTENSION TO MATCH INSULATION THICKNESS, OUTLET SIZE AS LISTED ON DRAWINGS.	ZURN (Z-100), SMITH (1010), WADE (3000), JOSAM (21500), WATTS (RD-300), MIFAB (R1200), SUN (RD4000)
RD-2	ROOF DRAIN - CAST IRON BODY, SECURED CAST IRON DOME, 15" ROUND, BOTTOM OUTLET, FLASHING CLAMP, GRAVEL STOP, UNDERDECK CLAMP, BEARING PAN, EXTENSION TO MATCH INSULATION THICKNESS, 2" TALL INTERNAL STANDPIPE, OUTLET SIZE AS LISTED ON DRAWINGS.	ZURN (Z-100), SMITH (1070), WADE (3000), JOSAM (21500), WATTS (RD-300), MIFAB (R1200)
RDO-1	ROOF DRAIN OUTLET - LAMBS TONGUE DOWNSPOUT NOZZLE, BRONZE BODY, INTEGRAL ANCHORING FLANGE. OUTLET SIZE AS LISTED ON DRAWINGS.	ZURN (Z-199), SMITH (1770), WADE (3940), JOSAM (25010), WATTS (RD-940), MIFAB (R1940), SUN (RD4500)
SH-1 03 ADD	SHOWER BASE - ONE PIECE, PRECAST TERRAZZO, 36"x36" (NOMINAL), 2" DRAIN, STAINLESS STEEL REMOVABLE STRAINER. INSTALL UNIT IN PIT TO ALL ADA ACCESS WITH MAXIMUM 1/2" LIP. SHOWER VALVE - ACCESSIBLE, SINGLE HANDLE PRESSURE BALANCED MIXING FAUCET, BRASS OR BRONZE CONSTRUCTION, WASHERLESS DESIGN, OFF-COLD-HOT TEMPERATURE RANGE INDICATOR DIAL, POLISHED CHROME CAST METAL LEVER HANDLE, INTEGRAL CHECK STOPS, ADJUSTABLE TEMPERATURE LIMIT STOP. ASSE 1016 LISTED. ACCESSORIES - CHROME-PLATED BRASS SHOWERHEAD WITH SWIVEL BALL JOINT, CHROME-PLATED BRASS ARM AND FLANGE, HAND HELD SHOWER WITH 60" CHROME-PLATED METAL HOSE AND QUICK DISCONNECT, CHROME-PLATED BRASS SWIVEL CONNECTOR, 30" CHROME-PLATED MOUNTING RAIL, CHROME-PLATED BRASS SUPPLY ELBOW FLANGE, CHROME-PLATED ELEVATED VACUUM BREAKER WITH CHROME-PLATED PIPING AND FLANGES, CHROME-PLATED BRASS 2 FUNCTION TRANSFER VALVE. INSTALL ALL CONTROLS BETWEEN 38" AND 48" ABOVE FINISHED FLOOR IN COMPLIANCE WITH LATEST ADA STANDARDS. MAXIMUM FLOW TO BE 1.5 GPM IN COMPLIANCE WITH PROJECT WATER CONSERVATION REQUIREMENTS (LEED). SET SAFETY LIMIT STOP TO 110 DEGREE F DISCHARGE.	TERRAZZO SHOWER BASE - FIAT (MFT), CREATIVE INDUSTRIES (74832), WILLIAMS (56), FLORESTONE SHOWER VALVE - MOEN COMMERCIAL (8346), SYMMONS (1-25-FSB), AMERICAN STANDARD (1662.221), DELTA (R10000-UNWS/T13H152-20), LEONARD (PAM-II), POWERS (PB413-9)
SH-2	SHOWER BASE - ONE PIECE, PRECAST TERRAZZO, 36"x36" (NOMINAL), 2" DRAIN, STAINLESS STEEL REMOVABLE STRAINER. SHOWER VALVE - SINGLE HANDLE PRESSURE BALANCED MIXING FAUCET, BRASS OR BRONZE CONSTRUCTION, POLISHED CHROME CAST METAL LEVER HANDLE, WASHERLESS DESIGN, OFF-COLD-HOT TEMPERATURE RANGE INDICATOR DIAL, INTEGRAL CHECK STOPS, ADJUSTABLE TEMPERATURE LIMIT STOP, ASSE 1016 LISTED. ACCESSORIES - CHROME-PLATED PLASTIC SHOWERHEAD WITH SWIVEL BALL JOINT, ADJUSTABLE SPRAY, CHROME-PLATED BRASS ARM AND FLANGE. INSTALL BOTTOM OF SHOWERHEAD AT 72" ABOVE FINISHED FLOOR. MAXIMUM FLOW TO BE 1.5 GPM IN COMPLIANCE WITH PROJECT WATER CONSERVATION REQUIREMENTS (LEED). SET SAFETY LIMIT STOP TO 110 DEGREE F DISCHARGE.	TERRAZZO SHOWER BASE - FIAT (MFT), CREATIVE INDUSTRIES (74832), WILLIAMS (56), FLORESTONE SHOWER VALVE - (8375EP15), SYMMONS (1-100), AMERICAN STANDARD (T675.501), DELTA (R10000-UNWS/T13H122), LEONARD (PAM-II), POWERS (PB413-K1)
SK-1	SINK - TRIPLE COMPARTMENT, COUNTER MOUNTED 18 GAUGE TYPE 304 STAINLESS STEEL, 63" (SIDE-TO-SIDE) x 22" (FRONT-TO-BACK) OVERALL SIZE, EACH COMPARTMENT 19" x 16" x 10" DEEP, 3-1/2" DIAMETER DRAIN OUTLETS. SINK TRIM - (2) SEMI-PROFESSIONAL KITCHEN FAUCET, BRASS SWIVEL SPOUT, SWING ARM, METAL LEVER HANDLE, PULL-DOWN SPRAY WITH ADJUSTABLE SPRAY PATTERN AND PUSH BUTTON ACTIVATION, METAL REINFORCED HOSE WITH STAINLESS STEEL PROTECTOR COIL, 2.2 GPM MAXIMUM FLOW RATE. ACCESSORIES - (2) TYPE 304 STAINLESS STEEL BODY AND REMOVABLE CONICAL BASKET STRAINER, 1-1/2" CENTER OUTLET CONTINUOUS WASTE, (2) CHROME-PLATED BRASS P-TRAP, (2) 1/2" CHROME PLATED BRASS SUPPLIES WITH LOOSE KEY STOPS, CHROME PLATED SOFT COPPER SUPPLY LINES. GARBAGE DISPOSER - CONTINUOUS FEED, SINGLE DIRECTION, CORROSION PROTECTION SHIELD, SERVICE WRENCH, STAINLESS STEEL GRINDING ELEMENTS, MANUALLY RESET OVERLOAD PROTECTION, FULL 4 YEAR WARRANTY. ELECTRICAL REQUIREMENTS - 115V-1 PHASE, CORD AND PLUG HARD WIRED, 3/4 HP MOTOR, 15 AMPS.	SINK - ELKAY (LTR632210) SINK TRIM - AMERICAN STANDARD 4332.350 IN-SINK-ERATOR (EVOLUTION SERIES), SINKMASTER (950), WASTE KING (3300)
TD-1	TRENCH DRAIN - MODULAR, PRE-SLOPED, HEAVY DUTY PRECAST POLYMER CONCRETE, 8" WIDE CHANNEL, 0.6% SLOPE, EXTRA HEAVY DUTY LOCKING CLASS E RATED DUCTILE IRON GRATE, 4" OUTLETS, LENGTH AS SHOWN ON DRAWINGS. SYSTEM SHALL BE CLASS E RATED.	ACO (S200), SMITH, ABT, WATTS, ZURN, NDS/FILCOTEN 02 ADD
TD-2	TRENCH DRAIN - LOW PROFILE TRENCH SYSTEM FOR SHOWERS, 60" TRENCH LENGTH, PRE-SLOPED, TYPE 304 STAINLESS STEEL CHANNEL, MEMBRANE CLAMP, SURFACE MEMBRANE CLAMP, REMOVABLE STAINLESS STEEL GRATE WITH HORIZONTAL SLOTS, 2" OUTLET CONNECTION.	SIOUX CHIEF (823-TX SERIES), BLUCHER (BWS SERIES), OR APPROVED EQUAL
TD-3	TRENCH DRAIN - MODULAR, PRE-SLOPED, POLYESTER FIBERGLASS CHANNEL, 6" WIDE, STAINLESS STEEL SLOTTED GRATE - CLASS B, INTERLOCKING ENDS, HEAVY DUTY STEEL FRAME AND ANCHORING DEVICE, CATCH BASIN WITH 3" SIDE OUTLET AND SEDIMENT BUCKET, LENGTH AS SHOWN ON DRAWINGS.	ZURN (Z806/812), SMITH (9812), ACO (FG200), NDS
UB-1	UTILITY BOX - GALVANIZED STEEL ENCLOSURE, ANGLE VALVE WITH 1/4" COMPRESSION OUTLET, INTREGAL WATER HAMMER ARRESTOR.	GUY GRAY (BIM875AB), OATEY (39140)
UB-2	UTILITY BOX - GALVANIZED STEEL ENCLOSURE, 1/2" IPS CSA LISTED GAS VALVE.	GUY GRAY, OATEY 03 ADD
WC-1	WATER CLOSET - ACCESSIBLE, WALL MOUNTED, FLUSH VALVE TYPE, WHITE VITREOUS CHINA, SIPHON JET, WATER SAVING, ELONGATED BOWL, 1-1/2" TOP SPUD. FLUSH VALVE - EXPOSED, SENSOR OPERATED, BATTERY POWERED, DUAL FLOW 1.1/1.6 GALLONS PER FLUSH, CHROME PLATED 1" I.P.S. SCREWDRIVER STOP-CHECK VALVE, CHEMICAL RESISTANT MATERIAL, VACUUM BREAKER, SPUD COUPLING AND FLANGE, WALL FLANGE WITH SET SCREW, MECHANICAL OVER-RIDE BUTTON, LOW BATTERY INDICATOR LIGHT, RANGE ADJUSTMENT SCREW, 3 YEAR WARRANTY. SEAT - WHITE, EXTRA HEAVY, OPEN FRONT, INJECTION MOLDED SOLID PLASTIC, SELF-SUSTAINING HINGE, STAINLESS STEEL OR PLATED STEEL POSTS AND NUTS. CONTRACTOR OPTION: COMBINATION WATER CLOSET/FLUSH VALVE PACKAGED SYSTEM BY AMERICAN STANDARD, KOHLER, SLOAN, OR ZURN ACCESSORIES - WATER CLOSET SUPPORT CARRIER RATED FOR 500 LBS. MOUNT WATER CLOSET WITH CARRIER BOLTED SECURELY TO FLOOR. TOP OF SEAT SHALL BE AT 17"-19" ABOVE FINISHED FLOOR (VERIFY EXACT MOUNTING HEIGHT WITH MANUFACTURER). FLUSH HANDLE SHALL BE LOCATED ON THE WIDE SIDE OF THE TOILET STALL AND BE AT 12" (MAXIMUM) ABOVE BOWL RIM AND OPERATE WITH NO GREATER THAN 5 LB FORCE IN COMPLIANCE WITH LATEST ADA STANDARDS. VERIFY EQUIPMENT REQUIREMENTS AND ROUGH-IN LOCATIONS.	WATER CLOSET - AMERICAN STANDARD (2257.101), SLOAN (ST-2052), ZURN (Z5610), GERBER (25-030), KOHLER (K-4325), TOTO (CT708) FLUSH VALVE - ZURN (ZR6000AV-DF), SLOAN (111-DFSM), AMERICAN STANDARD (6065.761) SEAT - BEMIS (1655C), CHURCH (9500C), BENEKE (533), KOHLER (K-4666-C), OLSONITE (95), SAME AS WATER CLOSET MANUFACTURER

PLUMBING FIXTURE SCHEDULE

TAG NAME	DESCRIPTION	MANF. & MODEL
WC-2	WATER CLOSET - ACCESSIBLE, WALL MOUNTED, FLUSH VALVE TYPE, WHITE VITREOUS CHINA, SIPHON JET, WATER SAVING, ELONGATED BOWL, 1-1/2" TOP SPUD. FLUSH VALVE - EXPOSED, MANUAL OPERATION, DUAL FLOW 1.1/1.6 GALLONS PER FLUSH, 11-1/2" ROUGH-IN, CHROME PLATED, 1" I.P.S. SCREWDRIVER STOP-CHECK VALVE WITH VANDAL RESISTANT CAP, HIGH BACK PRESSURE VACUUM BREAKER, SPUD COUPLING AND FLANGE, WALL FLANGE WITH SET SCREW, NON-HOLD-OPEN HANDLE, ADJUSTABLE TAILPIECE, ADA COMPLIANT, 3 YEAR WARRANTY. SEAT - WHITE, EXTRA HEAVY, OPEN FRONT, INJECTION MOLDED SOLID PLASTIC, SELF-SUSTAINING HINGE, STAINLESS STEEL OR PLATED STEEL POSTS AND NUTS. CONTRACTOR OPTION: COMBINATION WATER CLOSET/FLUSH VALVE PACKAGED SYSTEM BY AMERICAN STANDARD, KOHLER, SLOAN, OR ZURN ACCESSORIES - WATER CLOSET SUPPORT CARRIER RATED FOR 500 LBS. MOUNT WATER CLOSET WITH CARRIER BOLTED SECURELY TO FLOOR. TOP OF SEAT SHALL BE AT 17"-19" ABOVE FINISHED FLOOR (VERIFY EXACT MOUNTING HEIGHT WITH MANUFACTURER). FLUSH HANDLE SHALL BE LOCATED ON THE WIDE SIDE OF THE TOILET STALL AND BE AT 12" (MAXIMUM) ABOVE BOWL RIM AND OPERATE WITH NO GREATER THAN 5 LB FORCE IN COMPLIANCE WITH LATEST ADA STANDARDS. VERIFY EQUIPMENT REQUIREMENTS AND ROUGH-IN LOCATIONS.	WATER CLOSET - AMERICAN STANDARD (2257.101), GERBER (25-030), KOHLER (K-4325), SLOAN (ST-2053), TOTO (CT708), ZURN (Z5610) FLUSH VALVE - ZURN (Z6000AV-DF), SLOAN (WES-111) SEAT - BEMIS (1655C), CHURCH (9500C), BENEKE (533), KOHLER (K-4666-C), OLSONITE (95), SAME AS WATER CLOSET MANUFACTURER
WC-3	WATER CLOSET - WALL MOUNTED, FLUSH VALVE TYPE, WHITE VITREOUS CHINA, SIPHON JET, WATER SAVING, ELONGATED BOWL, 1-1/2" TOP SPUD. FLUSH VALVE - EXPOSED, MANUAL OPERATION, DUAL FLOW 1.1/1.6 GALLONS PER FLUSH, 11-1/2" ROUGH-IN, CHROME PLATED, 1" I.P.S. SCREWDRIVER STOP-CHECK VALVE WITH VANDAL RESISTANT CAP, HIGH BACK PRESSURE VACUUM BREAKER, SPUD COUPLING AND FLANGE, WALL FLANGE WITH SET SCREW, NON-HOLD-OPEN HANDLE, ADJUSTABLE TAILPIECE, ADA COMPLIANT, 3 YEAR WARRANTY. SEAT - WHITE, EXTRA HEAVY, OPEN FRONT, INJECTION MOLDED SOLID PLASTIC, SELF-SUSTAINING HINGE, STAINLESS STEEL OR PLATED STEEL POSTS AND NUTS. CONTRACTOR OPTION: COMBINATION WATER CLOSET/FLUSH VALVE PACKAGED SYSTEM BY AMERICAN STANDARD, KOHLER, SLOAN, OR ZURN ACCESSORIES - WATER CLOSET SUPPORT CARRIER RATED FOR 500 LBS. MOUNT WATER CLOSET WITH CARRIER BOLTED SECURELY TO FLOOR. TOP OF SEAT SHALL BE AT 15"-16" ABOVE FINISHED FLOOR (VERIFY EXACT MOUNTING HEIGHT WITH MANUFACTURER). FLUSH HANDLE SHALL BE LOCATED ON THE WIDE SIDE OF THE TOILET STALL AND BE AT 12" (MAXIMUM) ABOVE BOWL RIM AND OPERATE WITH NO GREATER THAN 5 LB FORCE	WATER CLOSET - AMERICAN STANDARD (2257.101), GERBER (25-030), KOHLER (K-4325), SLOAN (ST-2053), TOTO (CT708), ZURN (Z5610) FLUSH VALVE - ZURN (Z6000AV-DF), SLOAN (WES-111) SEAT - BEMIS (1655C), CHURCH (9500C), BENEKE (533), KOHLER (K-4666-C), OLSONITE (95), SAME AS WATER CLOSET MANUFACTURER
WF-1	WASH FOUNTAIN - FLOOR MOUNTED, 3 STATION, 14 GAUGE 304 STAINLESS STEEL, 36" SEMI-CIRCULAR, SLOW CLOSING FOOT VALVE AND VOLUME CONTROL, BACKSPLASH PLATE, INTEGRAL SOAP DISPENSER, SUPPLY/WASTE/VENT THROUGH WALL, THERMOSTATIC MIXING VALVE WITH CHECK STOPS AND STRAINERS IN ENCLOSED PANEL.	BRADLEY (WF), ACORN (3460), WILLOUGHBY (WWF-3603)
WH-1	WATER HEATER - COMBINATION SOLAR WATER HEATER WITH GAS FIRED BACK-UP. CONDENSING, VERTICAL, MINIMUM 96% EFFICIENT, SEALED COMBUSTION, METAL CABINET, BAKED ENAMEL FINISH, GLASS-LINED STEEL OR STAINLESS STEEL TANK, INTEGRAL COPPER NICKEL HEAT EXCHANGER FOR SOLAR WITH SINGLE WALL CONSTRUCTED COIL, 160 PSI WORKING PRESSURE, FIBERGLASS OR FOAM INSULATION, BRASS WATER CONNECTIONS AND DRAIN VALVE, ASME APPROVED T&P RELIEF VALVE, MULTIPLE MAGNESIUM ANODE RODS, VENT PIPING KIT, HIGH TEMPERATURE GAS SHUT OFF, AUTOMATIC WATER THERMOSTAT, BUILT-IN GAS REGULATING VALVE, ADJUSTABLE TEMPERATURE RANGE, 3-YEAR WARRANTY, UL LISTED, COMPLIANT TO NAECA, ASHRAE 90.1 AND ASHRAE 90A. 119 GALLON CAPACITY, 199,000 BTUH INPUT NATURAL GAS, 237 GPH RECOVERY AT 100°F RISE. DRAIN BACK TANK: PROVIDE 15 GALLON DRAIN BACK TANK. SOLAR STORAGE TANK: METAL CABINET, BAKED ENAMEL FINISH, GLASS-LINED STEEL OR STAINLESS STEEL TANK, 160 PSI WORKING PRESSURE, FIBERGLASS OR FOAM INSULATION, BRASS WATER CONNECTIONS AND DRAIN VALVE. TANK SHALL INCLUDE INTEGRAL SINGLE WALL COPPER NICKEL HEAT EXCHANGER COIL WITHIN STORAGE TANK. SOLAR COLLECTOR: THREE (3) 40,000 BTU/DAY PANELS. INCLUDE SAFETY RELIEF VALVE ON SOLAR HEAT EXCHANGER LOOP WITH PRESSURE RATING OF 30 PSI OR LESS. ELECTRICAL REQUIREMENTS - 120V CIRCUIT FOR BLOWER AND CONTROLS, HARD-WIRED SET WATER TEMPERATURE AT 120°F. SET SUPPLY GAS PRESSURE AT 7" W.C.	WATER HEATER - HTP (PH199-119S) SOLAR STORAGE TANK - HTP (SSU-119C) DRAIN BACK TANK - HTP (SSU-15DB) SOLAR COLLECTOR - HTP (SS-40-FP-VW) 02 ADD
WHA-1	WATER HAMMER ARRESTER - BELLOWS TYPE, PRE-CHARGED, ALL LEAD FREE STAINLESS STEEL CONSTRUCTION, ASSE 1010 APPROVED, PDI CERTIFIED, RATED FOR 1-11 FIXTURE UNITS. INSTALL PER MANUFACTURER'S RECOMMENDATIONS.	ZURN (Z1700), JR SMITH (5005-5050), WADE (W5-100), JOSAM (75000 SERIES), WATTS (SS), MIFAB (WHB)
WMF-1	UTILITY BOX - GALVANIZED STEEL ENCLOSURE, ANGLE VALVE WITH 1/4" COMPRESSION OUTLET, INTREGAL WATER HAMMER ARRESTOR.	GUY GRAY (BIM875AB), OATEY (39140)
WS-1	WATER SOFTENER - AUTOMATIC REGENERATION TYPE, DUPLEX SOFTENER TANKS, DEMAND RECALL CONTROLS, POWER SUPPLY WITH CORD AND PLUG. CONTINUOUS FLOW RATE OF 32.5 GPM AT 14 PSI PRESSURE DROP PER TANK, MAXIMUM FLOW RATE OF 65 GPM AT 14 PSI PRESSURE DROP FOR THE SYSTEM, CONTINUOUS FLOW RATE OF 90 GPM AT 25 PSI PER SYSTEM. MINIMUM CAPACITY OF 56,000 GRAINS PER 20LBS SALT PER TANK AT MEDIUM SALT CAPACITY. BRINE TANK SIZE MINIMUME SHALL BE 24" DIAMETER. ELECTRICAL REQUIREMENTS - 120V-1 PHASE RECEPTACLE REFER TO SPECIFICATIONS FOR ADDITIONAL REQUIREMENTS.	REFER TO SPECIFICATIONS
YCO-1	YARD CLEANOUT - ROUND, DURA-COATED CAST IRON, SIZE AS LISTED ON DRAWINGS, DOUBLE FLANGED HOUSING, HEAVY DUTY SECURED SCORIATED DURA-COATED CAST IRON COVER, LIFTING DEVICE, BRONZE CLEANOUT PLUG WITH GAS/WATER-TIGHT SEAL.	ZURN (Z1474), SMITH (4261), WADE (8401), JOSAM (58680), WATTS (CO-300-MF)

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REFERENCE SCALE IN INCHES
0 1 2 3

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Key Plan

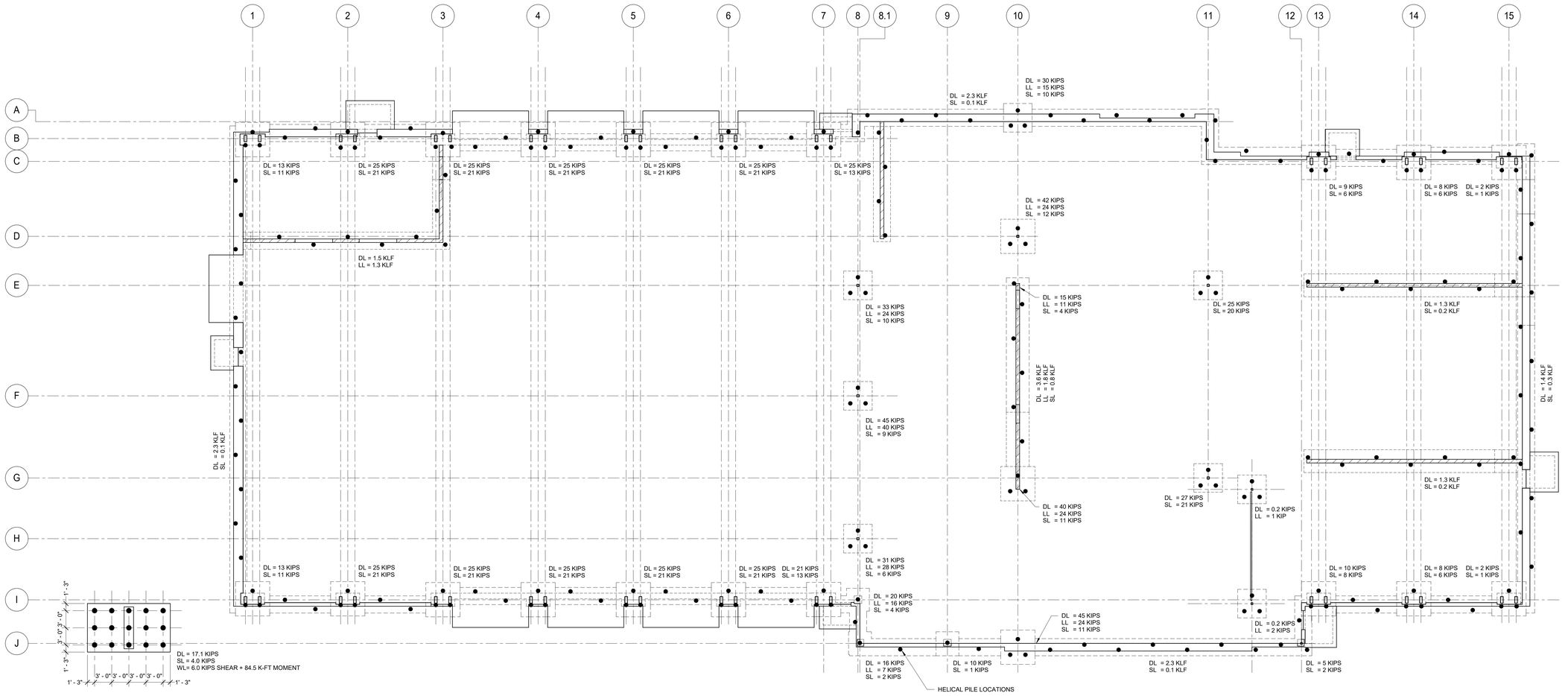
Sheet Issue Date
BID DOCUMENTS 11/03/17

Revision	Date
ADDENDA #2	11/22/17
ADDENDA #3	12/06/2017

Drawing
MATERIAL LIST - PLUMBING

City of Madison Contract No. **8027**
OPN Project No. **17207000**

P500



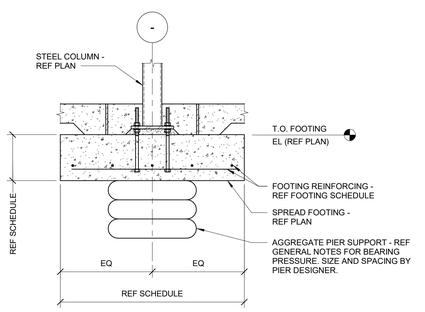
1 FOUNDATION LOADS AND HELICAL PILE LAYOUT

1/8" = 1'-0"

NORTH

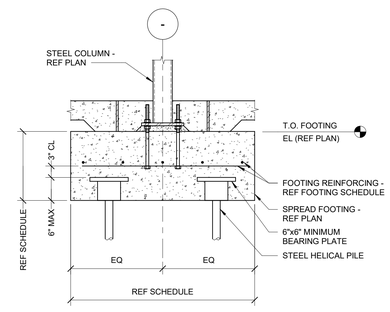
NOTES:

1. FOUNDATIONS TO BE SUPPORTED BY EITHER AGGREGATE PIERS OR STEEL HELICAL PILES. GIVEN LOADS ARE UNFACTORED VERTICAL LOADS, UNO.
   LOADS PROVIDED ARE EITHER COLUMN OR WALL LOADS APPLIED TO THE CONCRETE FOUNDATIONS. 03 ADD
2. AGGREGATE PIERS:
   AGGREGATE PIER (AP) SIZE, QUANTITY, SPACING, AND DEPTH TO BE DETERMINED BY AP DESIGNER TO MEET FOUNDATION BEARING CAPACITIES SHOWN IN GENERAL NOTES. CONTACT A/E IF MODIFICATIONS TO FOOTING SIZES ARE REQUIRED. TOP OF AP EQUAL TO BOTTOM OF FOOTING. REFER TO DETAIL 2/S002.
3. HELICAL PILES:
   HELICAL PILE (HP) DESIGN SHALL MEET THE SPECIFIED LOADING AS SHOWN ON PLAN. FOR BIDDING PURPOSES, HP QUANTITY SHALL BE AS SHOWN ON PLAN AND DEPTH SHALL BE 50-FEET BELOW THE BOTTOM OF FOUNDATION ELEVATION. REFER TO DETAILS 3 AND 4/S002 FOR FOUNDATION DESIGN PARAMETERS. CONTINUOUS FOOTINGS DESIGNED FOR MAX HP SPACING OF 6'-0" OC, STAGGERED ALONG LENGTH OF FOOTING. CONTACT A/E IF MODIFICATIONS TO FOOTING SIZES ARE REQUIRED.



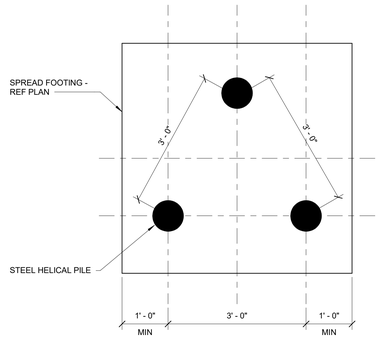
2 AGGREGATE PIER DETAIL

3/4" = 1'-0"



3 HELICAL PILE DETAIL

3/4" = 1'-0"



4 HELICAL PILE DETAIL

3/4" = 1'-0"

OPN ARCHITECTS

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Key Plan

Sheet Issue Date
BID DOCUMENTS 11/03/17

Revision	Date
ADDENDA #2	11/22/17
ADDENDA #3	12/01/17

BID DOCUMENTS

Drawing
FOUNDATION LOAD PLAN

City of Madison Contract No. **8027**
OPN Project No. **17207000**

S002

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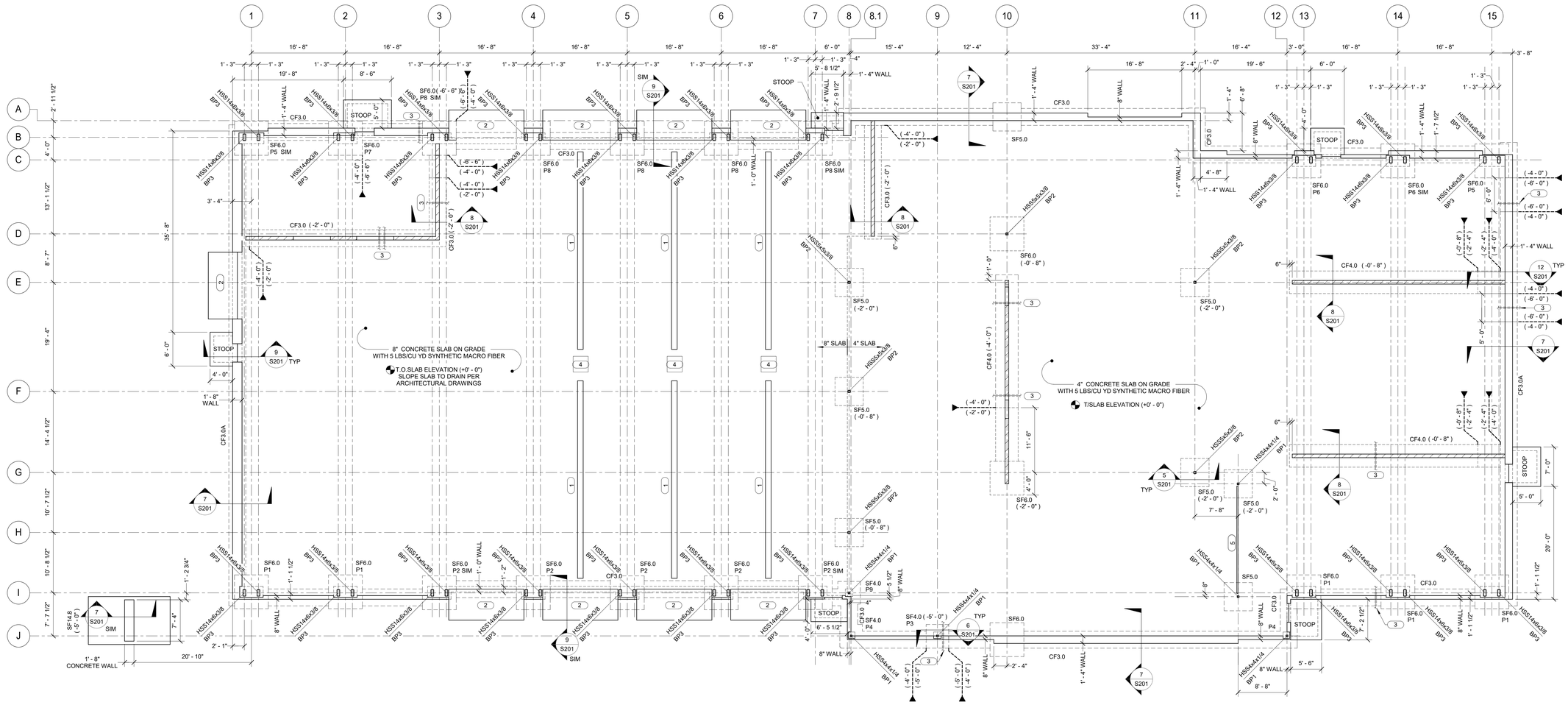

CONTINUOUS FOOTING SCHEDULE					
		THICKNESS		REINFORCING	
MARK	WIDTH	AGGREGATE PIERS	HELICAL PILES	LONG DIRECTION	SHORT DIRECTION
CF3.0	3' - 0"	1' - 0"	03 1' - 9" ADD 1' - 9"	(3) #5	WALL DOWELS
CF3.0A	3' - 0"	1' - 0"		(4) #5 AT BOTTOM & (3) #5 AT TOP	#5 @ 12" OC, BOTTOM
CF4.0	4' - 0"	1' - 0"	1' - 9"	(4) #5 TOP AND BOTTOM	#5 @12" OC, BOTTOM

SPREAD FOOTING SCHEDULE						
			THICKNESS		REINFORCING	
MARK	LENGTH	WIDTH	AGGREGATE PIERS	HELICAL PILES	LONG DIRECTION	SHORT DIRECTION
SF4.0	4' - 0"	4' - 0"	1' - 0"	1' - 9"	(4) #5	(4) #5
SF5.0	5' - 0"	5' - 0"	1' - 3"	1' - 9"	(6) #5	(6) #5
SF6.0	6' - 0"	6' - 0"	1' - 3"	1' - 9"	(6) #6	(6) #6
SF14.8	14' - 6"	8' - 6"	2' - 0"	2' - 9"	(8) #8 TOP AND BOTTOM	(14) #8

NOTES:

1. MAINTAIN MINIMUM DEPTH OF 4' - 0" FROM FINISH GRADE TO BOTTOM OF FOUNDATION WALL ELEVATION. STEP BOTTOM AS REQUIRED.

FOUNDATION WALL REINFORCING SCHEDULE				
WALL THICKNESS	VERTICALS		HORIZONTALS	
	INTERIOR FACE	EXTERIOR FACE	INTERIOR FACE	EXTERIOR FACE
8"	#4 @16" OC		#4 @12" OC	
1' - 0" TO 1' - 4"	#4 @16" OC	#4 @16" OC	#4 @12" OC	#4 @12" OC
1' - 8"	#4 @16" OC	#4 @16" OC	#5 @12" OC	#5 @12" OC

1 FOUNDATION PLAN

1/8" = 1'-0"

NOTES:

1. SF# AND CF# INDICATES SPREAD AND CONTINUOUS FOOTINGS. REFER TO THIS SHEET FOR SCHEDULES. TOP OF FOOTING ELEVATION (-4' - 0") UNO.
2. TOP OF FOUNDATION WALL ELEVATION (+0' - 0") UNO. REFER TO SCHEDULE THIS SHEET FOR REINFORCING.
3. P# INDICATES CONCRETE PIER. REFER TO S202 FOR DETAILS. TOP OF PIER ELEVATION (-0' - 8") UNO.
4. BP# INDICATES BASE PLATE. REFER TO S501 FOR ANCHOR ROD AND BASE PLATE DETAILS.
5. REFER TO 1, 2 AND 3/S201 FOR TYPICAL SLAB ON GRADE CONSTRUCTION DETAILS.
6. PROVIDE 2' - 6" x 2' - 6" CORNER BARS FOR FOOTING AND WALL INTERSECTIONS. BAR SIZE AND QUANTITY TO MATCH LONGITUDINAL AND HORIZONTAL BARS.
7. PROVIDE THICKENED SLAB AT ALL NON-STRUCTURAL MASONRY WALLS PER 11/S201.
8. ▶------ INDICATES FOOTING STEP. REFER TO 12 AND 13/S201 FOR FOOTING STEP DETAILS.

KEYNOTES:

1. TRENCH DRAIN. COORDINATE LOCATION AND SIZE WITH PLUMBING AND ARCHITECTURAL DRAWINGS. REFER TO 4/S201 FOR TRENCH DRAIN DETAIL.
2. SITE PAVING AT O.H. DOORS, REFER CIVIL DRAWINGS.
3. SLEEVE UTILITIES THROUGH FOUNDATION PER 10/S201. COORDINATE SIZE AND LOCATION WITH MECHANICAL AND PLUMBING CONTRACTORS.
4. IN-FLOOR CATCH BASIN. REFER TO PLUMBING DRAWINGS FOR ADDITIONAL INFORMATION.
5. THICKEN SLAB AT RECESSED TRACK FOR OPERABLE WALL SIMILAR TO 4/S201. COORDINATE LOCATION WITH WALL SUPPLIER.

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Key Plan

Sheet Issue Date
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ADDENDA #2	11/22/17
ADDENDA #3	12/01/17

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Drawing
FOUNDATION PLAN

City of Madison Contract No. **8027**
OPN Project No. **17207000**

S101

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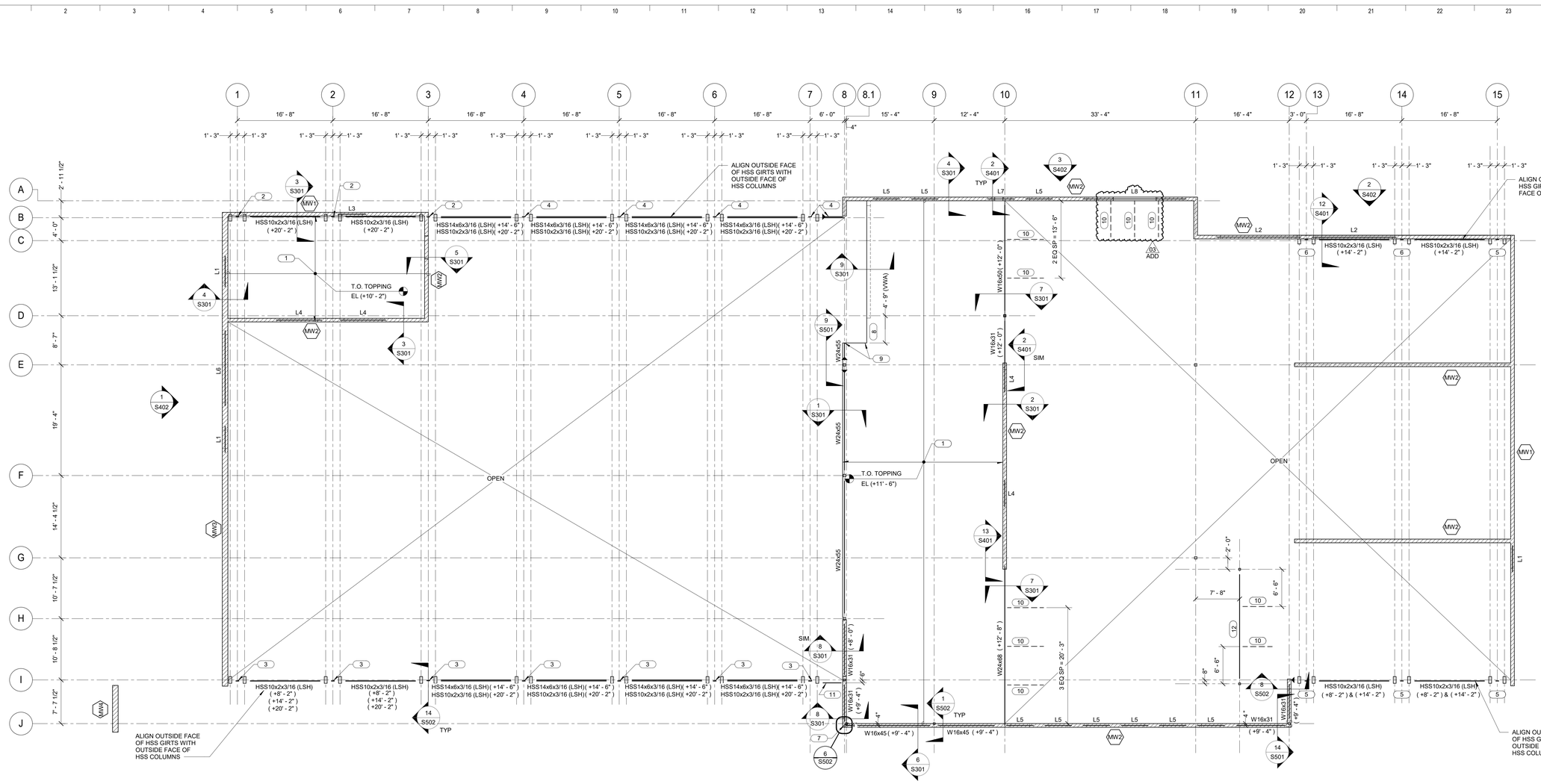

MASONRY LINTEL SCHEDULE

MARK	MEMBER BEARING, EACH END	MEMBER SIZE	REFERENCE DETAIL	NOTES
L1	0' - 8"	8" DEEP BOND BEAM WITH (2) #5 BARS + L4x3 1/2x3/8 (LLV)	8/S401	-
L2	0' - 8"	W16x31 +L5x5x3/8	10/S401	-
L3	0' - 8"	16" DEEP BOND BEAM WITH (2) #5 BARS + L4x3 1/2x3/8 (LLV)	8/S401	-
L4	0' - 8"	16" DEEP BOND BEAM WITH (2) #5 BARS	9/S401	-
L5	0' - 8"	8" DEEP BOND BEAM WITH (2) #5 BARS	9/S401	-
L6	0' - 8"	24" DEEP BOND BEAM WITH (2) #5 BARS + L5x5x3/8	11/S401	-
L7	0' - 8"	24" DEEP BOND BEAM WITH (2) #5 BARS	9/S401	-
L8	0' - 8"	W16x31	15/S401	-

03 ADD

MASONRY WALL REINFORCING SCHEDULE

MARK	WALL THICKNESS	VERTICAL WALL REINFORCING SIZE AND SPACING	HORIZONTAL WALL REINFORCING SIZE AND SPACING
MW1	8"	#5 @ 24" OC	TYPICAL @ 16" OC
MW2	8"	#5 @ 32" OC	TYPICAL @ 16" OC
MW3	12"	(2) #5 @ 24" OC	TYPICAL @ 16" OC
MW4	12"	(2) #8 @ 8" OC	TYPICAL @ 16" OC

NOTES:

1. TYPICAL HORIZONTAL REINFORCING IS AS PER SPECIFICATIONS. IT IS INTENDED TO BE A 'DUROWAL - TRUSS TYPE' OR EQUIVALENT.
2. REINFORCED CORES ARE ALWAYS GROUTED.
3. REFER TO 6/S401 FOR TYPICAL MASONRY OPENING DETAIL.
4. PROVIDE 2'-0" x 2'-0" CORNER BARS AT WALL INTERSECTIONS. BAR SIZE AND QUANTITY TO MATCH HORIZONTAL BOND BEAM BARS.

1 MEZZANINE FLOOR FRAMING PLAN - OVERALL

1/8" = 1'-0"

NOTES:

1. REFER TO 4 AND 5/S501 FOR TYPICAL SHEAR CONNECTION.
2. ▶ INDICATES MOMENT CONNECTION .
3. L# INDICATES LINTEL IN STRUCTURAL MASONRY WALL - REFER TO THIS SHEET FOR SCHEDULE.
4. FOR LINTEL IN NON-STRUCTURAL WALLS. REFER TO GENERAL NOTES FOR SCHEDULE.
5. PROVIDE BRACING BRACING OF NON-STRUCTURAL MASONRY PARTITION PER 5/S401.
6. MW# INDICATES MASONRY WALL - REFER TO THIS SHEET FOR SCHEDULE.

KEYNOTES:

1. 8" HOLLOW CORE SLAB WITH 2" NON-COMPOSITE TOPPING WITH 3 LBS/CU YD SYNTHETIC MACRO FIBER. REFER TO PLAN FOR TOP OF TOPPING ELEVATION. PRECASTER TO DESIGN FOR THE FOLLOWING LOADS: DL = 10 PSF (EXCLUDING TOPPING SELF-WEIGHT) AND LL = 125 PSF.
2. HSS10x2x3/16 (LSH) AT (+20' - 2").
3. HSS10x2x3/16 (LSH) AT (+8' - 2"), (+14' - 2") AND (+20' - 2").
4. HSS10x2x3/16 (LSH) AT (+14' - 2") AND (+20' - 2").
5. HSS10x2x3/16 (LSH) AT (+8' - 2") AND (+14' - 2").
6. HSS10x2x3/16 (LSH) AT (+14' - 2").
7. PROVIDE PLATE AT CORNER TO SUPPORT MASONRY WALL CONSTRUCTION. REFER TO DETAIL 9/S502.
8. HEADER FRAMING AT STAIR BY PRECAST SUPPLIER.
9. PRECASTER TO DESIGN FOR STAIR STRINGER LOADS: DL = 660 LBS, LL = 2,200 LBS.
10. L4x4x1/4 KICKER.
11. W8x24 (+8' - 8") WITH 1/2"Ø x 6" LONG HEADED WELDED STUDS @ 16" OC ON TOP FLANGE.
12. W12x22 PARTITION SUPPORT BEAM. COORDINATE ELEVATION WITH PARTITION SUPPLIER AND REFLECTED CEILING PLAN.

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Drawing
MEZZANINE FRAMING PLANS - AREA A AND B

City of Madison Contract No. **8027**
OPN Project No. **17207000**

S102

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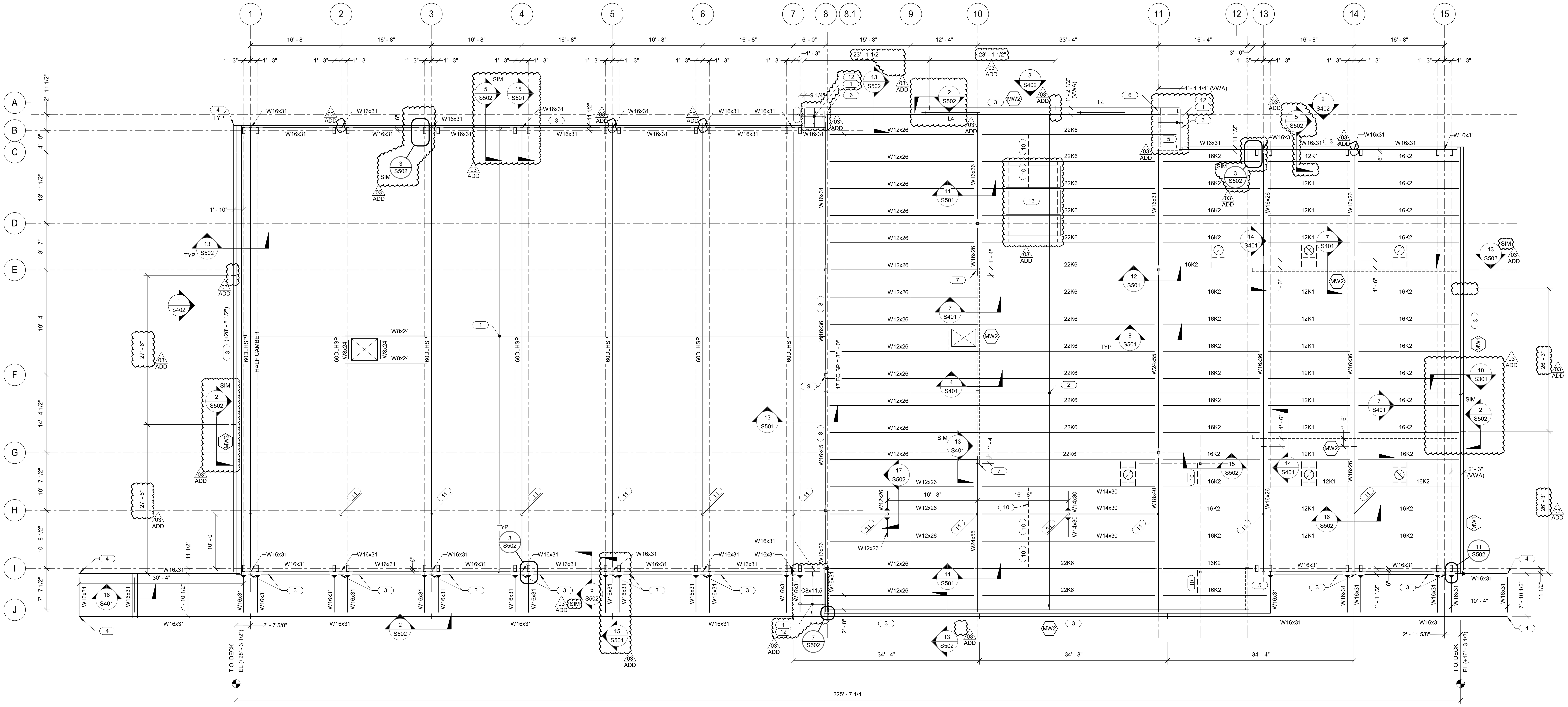

ROOF FRAMING PLAN

1/8" = 1'-0"

NORTH

NOTES:

1. REFER TO 4 AND 5/S501 FOR TYPICAL SHEAR CONNECTION.
2. ▶ INDICATES MOMENT CONNECTION.
3. PROVIDE BRACING OF NON-STRUCTURAL MASONRY PARTITION PER 5/S401.
4. L# INDICATES LINTEL IN STRUCTURAL MASONRY WALL - REFER TO S102 FOR SCHEDULE.
5. FOR LINTEL IN NON-STRUCTURAL WALLS. REFER TO GENERAL NOTES FOR SCHEDULE.
6. PROVIDE ANGLE FRAMING AROUND OPENING PER 6/S501.
7. REFER TO 10/S501 FOR JOIST MODIFICATION DETAIL.
8. MW# INDICATES MASONRY WALL. REFER TO S102 FOR SCHEDULE
9. 60DLHSP JOISTS: JOIST SUPPLIER TO DESIGN FOR UNIFORM DL = 585 PLF, SL = 420 PLF AND SAFETY TIE-OFF LOADING.

KEYNOTES:

1. EPICORE ER3.5A (16 GA) STEEL ROOF DECK, 2 SPAN MINIMUM WITH FASTENING = 24/3 PATTERN WITH 3/4" PUDDLE WELDS AND #12 SIDELAP SCREWS @ 24" OC OR EQUIVALENT. 03 ADD
2. 1 1/2" (20 GA) STEEL ROOF DECK, 2 SPAN MINIMUM. FASTENING = 36/4 (2) WITH 5/8" PUDDLE WELDS AND #10 SIDELAP SCREWS.
3. CONTRACTOR OPTION: W16x31 BEAM WITH FLANGES CUT OFF AND GRIND SMOOTH OR 7/16" BENT PLATE TO MATCH W16x31 DIMENSIONS.
4. PROVIDE FULLY WELDED, MITERED CORNER CONNECTION.
5. PROVIDE TYPE S10 JOIST EXTENSION.
6. BEAM OR BENT PLATE PER KEYNOTE 3 TO CANTILEVER PAST CORNER OF MASONRY WALL TO SUPPORT ROOF. REFER TO DETAIL 13/S502 @ CANTILEVER CONDITION FOR DETAIL.
7. PROVIDE 16" BEAM BEARING. REFER 4/S501 FOR BEAM TO BEAM SHEAR CONNECTION.
8. FRAMING DESIGNED FOR SAFETY TIE-OFF POINT AT THIRD POINTS ALONG BEAM.
9. COLUMN DESIGNED FOR SAFETY TIE-OFF POINT AT TOP OF COLUMN.
10. L5x5x3/8 ANGLE FRAMING.
11. SAFETY TIE-OFF:
    STEEL BEAM FRAMING DESIGNED FOR SAFETY TIE-OFF POINT AT LOCATIONS INDICATED.

    AT "SP" JOISTS, JOIST SUPPLIER TO DESIGN FOR ULTIMATE LOAD OF 5 KIPS SHEAR AND 10 K-FT MOMENT ACTING IN E-W DIRECTION AT LOCATIONS INDICATED.
12. PROVIDE DECK SUPPORT ANGLES PER 1/S401 AND 5/S502.
13. SOLAR PANEL: PROVIDE ANGLE FRAMING AT PANEL SUPPORT POINTS PER 6/S501. COORDINATE LOCATIONS WITH EQUIPMENT SUPPLIER.

03 ADD

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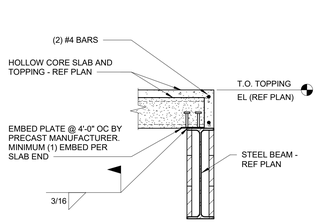
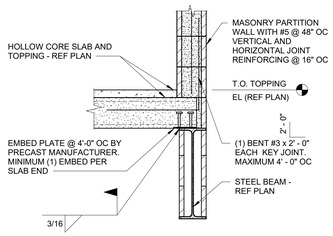
Drawing
ROOF FRAMING PLAN

City of Madison Contract No. 8027
OPN Project No. 17207000

S103



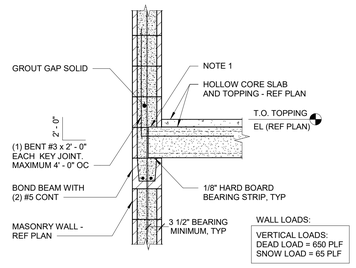


1 TYPICAL HOLLOW CORE SLAB BEARING AT STEEL BEAM

3/4" = 1'-0"

NOTES:

1. REFER TO ARCHITECTURAL DRAWINGS FOR WALL EXTENTS ABOVE HOLLOW CORE FLOOR.

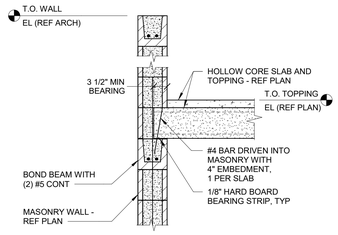


2 HOLLOW CORE SLAB BEARING AT INTERIOR WALL

3/4" = 1'-0"

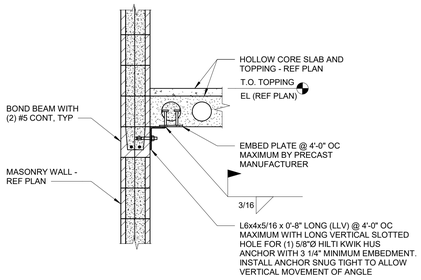
NOTES:

1. PRECAST MANUFACTURER TO DETERMINE IF ENDS OF HOLLOW CORE SLABS REQUIRE SOLID ENDS DUE TO WALL LOADS.



3 HOLLOW CORE SLAB BEARING AT CMU WALL

3/4" = 1'-0"



4 HOLLOW CORE SLAB PARALLEL TO EXTERIOR WALL

3/4" = 1'-0"

5 HOLLOW CORE SLAB PARALLEL TO CMU WALL

3/4" = 1'-0"

6 FLOOR EDGE DETAIL

3/4" = 1'-0"

7 FLOOR EDGE DETAIL

3/4" = 1'-0"

NOTES:

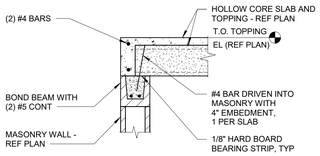
1. AT SIM: REFER TO DETAIL FOR KICKER CONNECTIONS. PROVIDE 3/8" STIFFENER PLATE AT ROOF BEAM ON GRID LINE 13 FOR KICKER ATTACHMENT.

8 HOLLOW CORE SLAB BEARING AT CMU WALL

3/4" = 1'-0"

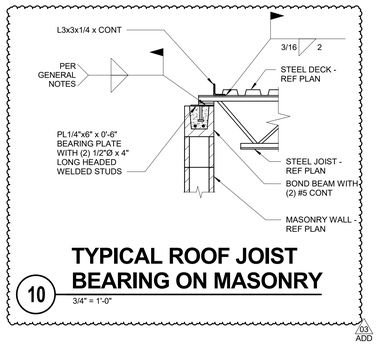
NOTES:

1. AT SIM: REFER TO ARCHITECTURAL DRAWINGS FOR WALL EXTENTS ABOVE HOLLOW CORE FLOOR.



9 HOLLOW CORE SLAB BEARING AT CMU WALL

3/4" = 1'-0"



10 TYPICAL ROOF JOIST BEARING ON MASONRY

3/4" = 1'-0"

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Drawing

PRECAST DETAILS

City of Madison Contract No. **8027**
OPN Project No. **17207000**

S301

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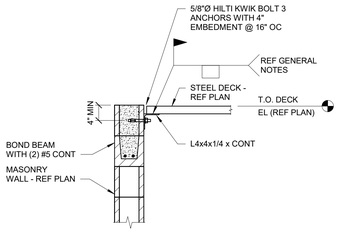
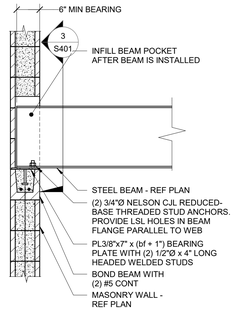


1 ROOF DECK SUPPORT AT MASONRY

3/4" = 1'-0"

NOTES:

1. REFER TO ARCHITECTURAL DRAWINGS FOR T.O. WALL ELEVATION. ROTATE ANGLE LEG UP WHERE MASONRY HEIGHT ALLOWS.

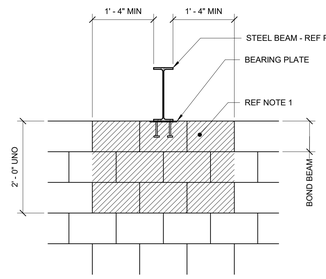


2 TYPICAL BEAM BEARING ON MASONRY

3/4" = 1'-0"

NOTES:

1. SIM CONDITION AT BEAM BEARING PARALLEL TO THE MASONRY WALL UNO.

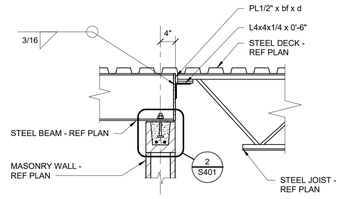


3 TYPICAL BEAM BEARING ON MASONRY

3/4" = 1'-0"

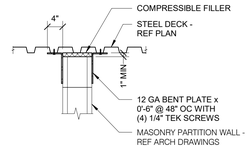
NOTES:

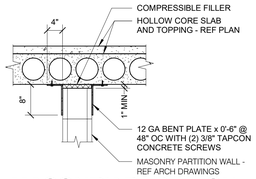
1. IN SHADED AREA, FILL ALL CORES IN WALL WITH GROUT MINIMUM AT CORNER CONDITION: 1'-4", EACH WAY.



4 FRAMING DETAILS

3/4" = 1'-0"



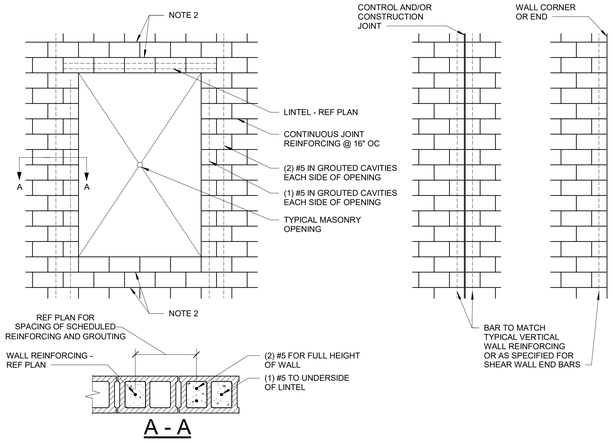


5 MASONRY PARTITION WALL AT STEEL DECK

3/4" = 1'-0"

NOTES:

1. PROVIDE THE BENT PLATE CLIP ANGLES ON ALL INTERIOR NON-LOAD BEARING MASONRY PARTITION WALLS. REFERENCE ARCHITECTURAL DRAWINGS FOR LOCATION OF ALL MASONRY PARTITION WALLS.
2. BENT PLATE CLIPS MAY BE ELIMINATED IF ALL THE FOLLOWING CONDITIONS ARE MET.
   A. LENGTH OF WALL BETWEEN PERPENDICULAR INTERSECTING WALLS IS LESS THAN THE FOLLOWING:
      a. 15'-0" FOR 6" CMU
      b. 20'-0" FOR 8" CMU
      c. 22'-0" FOR 10" CMU
      d. 25'-0" FOR 12" CMU
   B. WALL AND INTERSECTION HAVE PROPERLY INSTALLED (9 GA) TRUSS TYPE HORIZONTAL JOINT REINFORCING @ 16" OC.

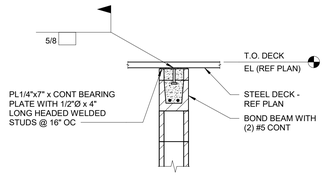


6 TYPICAL MASONRY WALL DETAIL

3/4" = 1'-0"

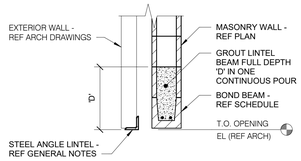
NOTES:

1. REFER TO ARCHITECTURAL ELEVATIONS FOR MASONRY CONTROL JOINT LOCATIONS.
2. TWO COURSES OF JOINT REINFORCING ARE REQUIRED ABOVE THE LINTEL AND BELOW THE SILL AND SHALL EXTEND A MINIMUM OF 24 INCHES PAST THE OPENING.



7 SHEAR WALL CONNECTION DETAIL

3/4" = 1'-0"

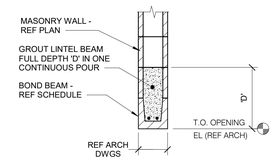


8 LINTEL DETAIL

3/4" = 1'-0"

NOTES:

1. REFERENCE ARCHITECTURAL DRAWINGS FOR INSULATION, THROUGH-WALL FLASHING, AND WEEP HOLES.
2. SHORE MASONRY UNTIL GROUT FOR LINTEL HAS REACHED ITS SPECIFIED STRENGTH.

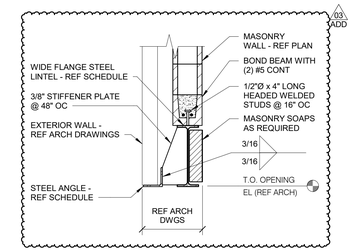


9 LINTEL DETAIL

3/4" = 1'-0"

NOTES:

1. SHORE MASONRY UNTIL GROUT FOR LINTEL HAS REACHED ITS SPECIFIED STRENGTH.

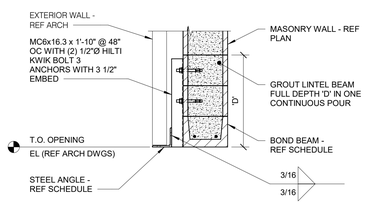


10 LINTEL DETAIL

3/4" = 1'-0"

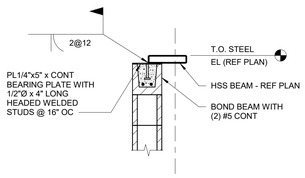
NOTES:

1. REFERENCE ARCHITECTURAL DRAWINGS FOR INSULATION, THROUGH-WALL FLASHING, AND WEEP HOLES.



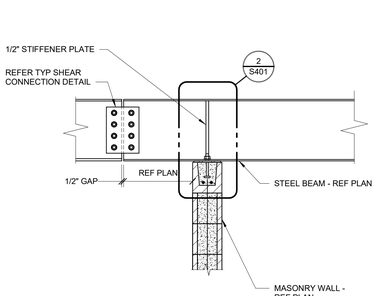
11 LINTEL DETAIL

3/4" = 1'-0"



12 WALL SUPPORT DETAIL

3/4" = 1'-0"



13 BEAM BEARING PARALLEL TO MASONRY

3/4" = 1'-0"

NOTES:

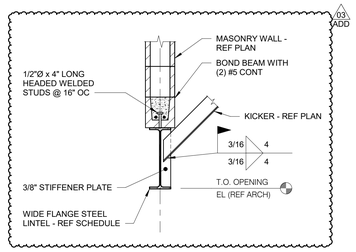
1. AT SIM: REFER TO PLAN FOR BEARING LENGTH. EXTEND BEARING PLATE 1" LONGER THAN BEARING LENGTH.

14 TYPICAL BEAM BEARING ON MASONRY

3/4" = 1'-0"

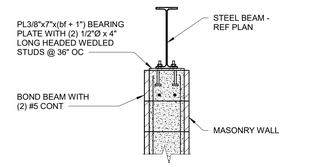
NOTES:

1. EITHER WELDED OR BOLTED CONNECTIONS MAY BE EMPLOYED.



15 LINTEL DETAIL

3/4" = 1'-0"



16 BEAM BEARING ON MASONRY WALL

3/4" = 1'-0"

OPN ARCHITECTS
301 N BROOM STREET #100
MADISON, WI 53703
608-819-0260 PHONE
www.opnarchitects.com
opn@opnarchitects.com

Owner

City of Madison Fire Department
314 W. Dayton St.
Madison, WI 53703

Project

Madison Fire Station 14
3201 Dairy Drive
Madison, WI 53718

Civil Engineer

Snyder & Associates, Inc
5010 Voges Rd
Madison WI, 53718
P. 608-838-0444

Structural Engineer

IMEG
1800 Deming Way #200
Middleton, WI 53562
P. 608-223-9600

Mechanical Engineer

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Electrical Engineer

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P. 608-223-9600

Key Plan

Sheet Issue Date

BID DOCUMENTS 11/03/17

Revision	Date
ADDENDA #3	12/01/17

BID DOCUMENTS

Drawing

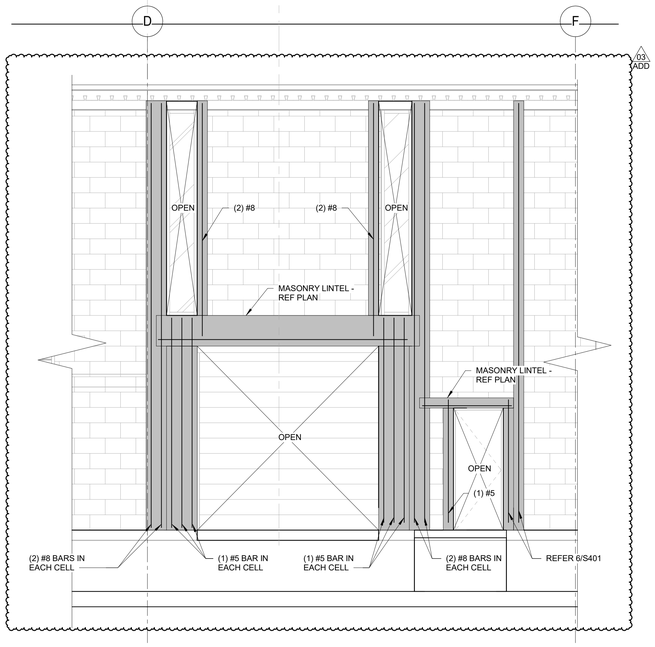
MASONRY DETAILS

City of Madison Contract No. **8027**
OPN Project No. **17297000**

S401

IMEG 1800 DEMING WAY, SUITE 200 MIDDLETON, WI 53562
608.223.9600 FAX: 608.836.0415
www.imegcorp.com
PROJECT # 17001140.00

REFERENCE SCALE IN INCHES
0 1 2 3

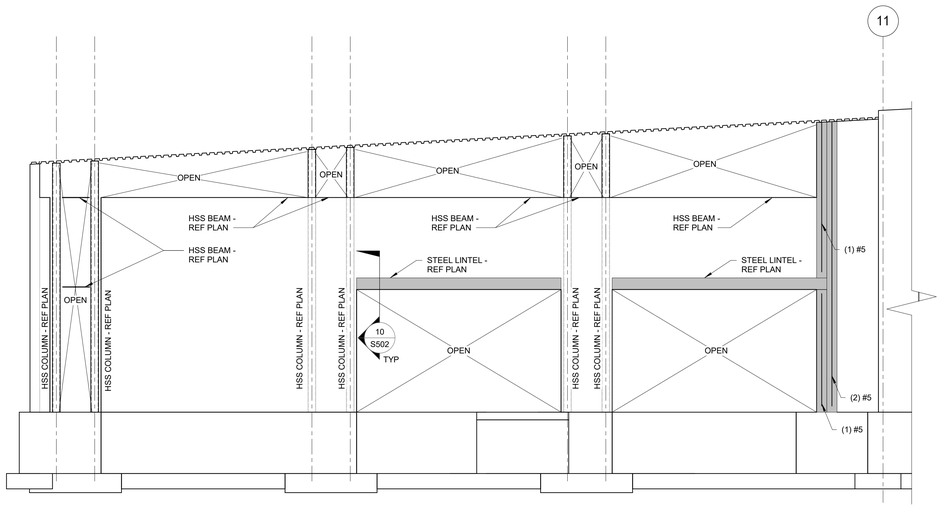


1 NORTH ELEVATION

1/4" = 1'-0"

NOTES:

1. TYPICAL WALL REINFORCEMENT NOT SHOWN FOR CLARITY.

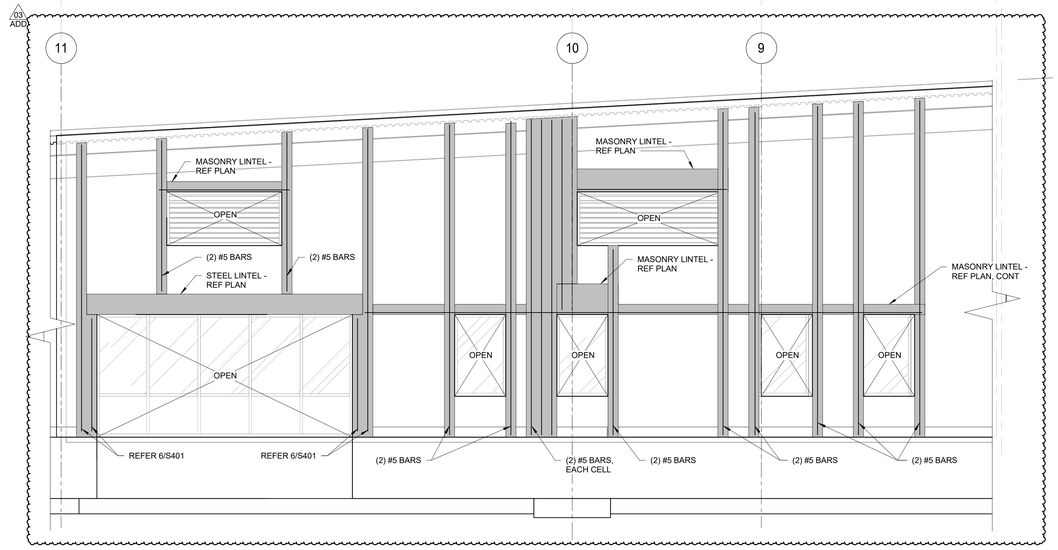


2 EAST ELEVATION

1/4" = 1'-0"

NOTES:

1. TYPICAL WALL REINFORCEMENT NOT SHOWN FOR CLARITY.



3 EAST ELEVATION

1/4" = 1'-0"

NOTES:

1. TYPICAL WALL REINFORCEMENT NOT SHOWN FOR CLARITY.

OPN ARCHITECTS

Owner

City of Madison Fire Department
314 W. Dayton St.
Madison, WI 53703

Project

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Key Plan

Sheet Issue Date
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ADDENDA #3	12/01/17

BID DOCUMENTS

Drawing
MASONRY WALL ELEVATIONS

City of Madison Contract No. **8027**
OPN Project No. **17207000**

S402

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MIDDLETON, WI 53562
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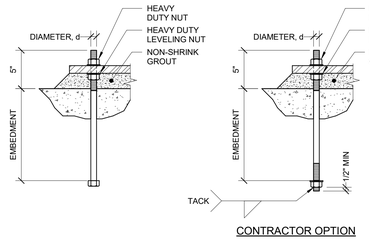
www.imegcorp.com
PROJECT # 17001140.00

REFERENCE SCALE IN INCHES
0 1 2 3



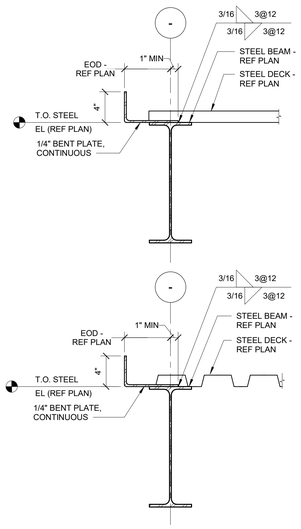
CONTRACTOR OPTION

1 TYPICAL ANCHOR ROD

1 1/2" = 1'-0"

NOTES:

1. REFERENCE BASE PLATE DETAILS FOR DIAMETER AND EMBEDMENT.
2. REFERENCE GENERAL NOTES FOR MATERIAL REQUIREMENTS.
3. ANCHOR RODS SHALL BE SET PRIOR TO PLACEMENT OF CONCRETE.
4. PROTECT ANCHOR RODS FROM DAMAGE.
5. ANCHOR SHALL BE SET SO AS NOT TO VARY FROM THE DIMENSIONS SHOWN ON THE ERECTION DRAWINGS BY MORE THAN THE FOLLOWING:
   A. 1/8" CENTER TO CENTER OF ANY TWO RODS WITHIN AN ANCHOR ROD GROUP.
   B. 1/4" CENTER TO CENTER OF ADJACENT ANCHOR ROD GROUPS.
   C. ELEVATION OF THE TOP OF ANCHOR RODS ± 1/2".
   D. MAXIMUM ACCUMULATION OF 1/4" PER HUNDRED FEET ALONG THE ESTABLISHED COLUMN LINE.
   E. 1/4" FROM THE CENTER OF ANY ANCHOR ROD GROUP TO THE ESTABLISHED COLUMN LINE THROUGH THAT GROUP.
   F. REFERENCE AISC CODE OF STANDARD PRACTICE FOR ADDITIONAL INFORMATION.
6. SET ANCHOR RODS PERPENDICULAR TO BEARING SURFACE, UNLESS NOTED OTHERWISE.
7. PROVIDE 1 1/2" NON-SHRINK GROUT AT ALL BASE PLATES.

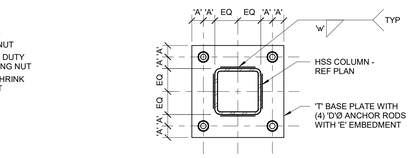


7 TYPICAL CLOSURE PLATE DETAIL

1 1/2" = 1'-0"

NOTES:

1. REFER TO PLAN FOR DECK ORIENTATION.



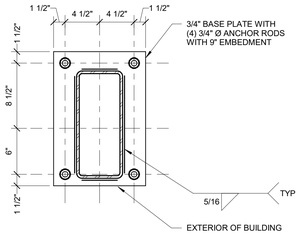
HSS BASE PLATE SCHEDULE							
MARK	COLUMN	'T'	'A'	'D'	'E'	'w'	COMMENTS
BP1	HSS4x4	3/4"	1 1/2"	3/4"	9"	1/4"	-
BP2	HSS6x5	1"	1 1/2"	3/4"	9"	1/4"	-

2 HSS COLUMN BASE PLATE DETAIL

1 1/2" = 1'-0"

NOTES:

1. REFER TO TYPICAL ANCHOR ROD DETAIL FOR ADDITIONAL INFORMATION.
2. NO WELDS REQUIRED AT RADIUSES.

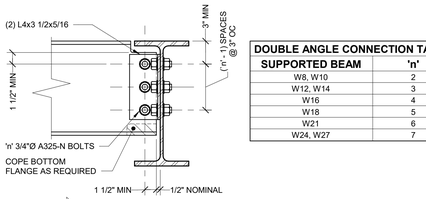


3 BASE PLATE (BP3) DETAIL

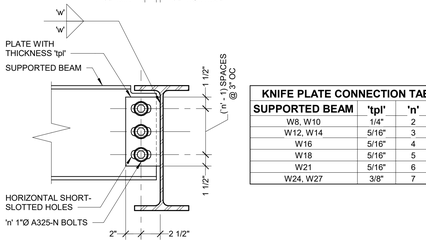
1 1/2" = 1'-0"

NOTES:

1. REFER TO TYPICAL ANCHOR ROD DETAIL FOR ADDITIONAL INFORMATION.
2. NO WELDS REQUIRED AT RADIUSES.



DOUBLE ANGLE CONNECTION TABLE	
SUPPORTED BEAM	'n'
W8, W10	2
W12, W14	3
W16	4
W18	5
W21	6
W24, W27	7



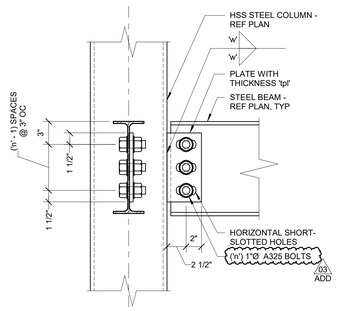
KNIFE PLATE CONNECTION TABLE			
SUPPORTED BEAM	'tpl'	'n'	'w'
W8, W10	1/4"	2	3/16"
W12, W14	5/16"	3	1/4"
W16	5/16"	4	1/4"
W18	5/16"	5	1/4"
W21	5/16"	6	1/4"
W24, W27	3/8"	7	1/4"

4 TYPICAL SHEAR CONNECTION

1 1/2" = 1'-0"

NOTES:

1. BOTH DOUBLE ANGLE AND KNIFE PLATE CONNECTION CONFIGURATIONS ARE ACCEPTABLE, UNLESS NOTED OTHERWISE. FABRICATOR AND DETAILER SHALL SELECT WHICH OPTION IS BEST SUITED FOR THEIR FABRICATION PROCESS AND THE ANTICIPATED ERECTION PROCEDURES.
2. DETAIL TO BE SIMILAR AT CONNECTIONS TO WIDE FLANGE OR HSS COLUMNS.
3. UNLESS NOTED OTHERWISE, PROVIDE SHEAR CONNECTIONS AS INDICATED BY THIS DETAIL.
4. DETAILER IS RESPONSIBLE FOR FULLY DEVELOPING GEOMETRY AND DIMENSIONAL INFORMATION REQUIRED TO FABRICATE.
5. WHERE TYPICAL SHEAR CONNECTION DETAIL IS NOT APPLICABLE, FABRICATOR SHALL SELECT AND DETAIL ALTERNATE CONNECTION CAPABLE OF DEVELOPING EQUAL STRENGTH. ALTERNATE CONNECTION SHALL BE SELECTED IN ACCORDANCE WITH AISC ASD CONNECTION TABLES.



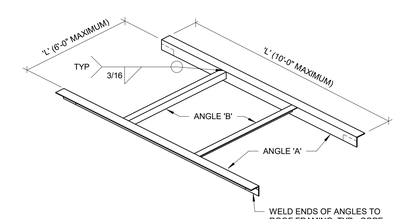
KNIFE PLATE CONNECTION TABLE			
SUPPORTED BEAM	'tpl'	'n'	'w'
W8, W10	1/4"	2	3/16"
W12, W14	5/16"	3	1/4"
W16	3/8"	4	1/4"
W18	1/2"	5	5/16"
W21	1/2"	6	5/16"
W24	1/2"	7	5/16"

5 TYPICAL BEAM TO TUBE COLUMN SHEAR CONNECTION

1 1/2" = 1'-0"

NOTES:

1. WHERE TYPICAL SHEAR CONNECTION DETAIL IS NOT APPLICABLE, FABRICATOR SHALL SELECT AND DETAIL ALTERNATE CONNECTION CAPABLE OF DEVELOPING EQUAL STRENGTH. ALTERNATE CONNECTION SHALL BE SELECTED IN ACCORDANCE WITH AISC ASD CONNECTION TABLES.



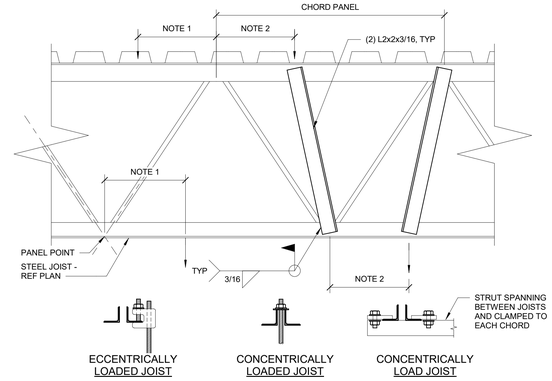
'L'	ANGLE 'A'	ANGLE 'B'
UP TO 1'-0"	NONE - SUMP PAN ONLY	NONE - SUMP PAN ONLY
1'-1" TO 4'-6"	L4x4x1/4	L4x4x1/4
4'-7" TO 6'-0"	L4x4x5/16	L4x4x1/4
6'-1" TO 8'-0"	L4x4x3/8	-
8'-1" TO 10'-0"	L6x4x3/8 (LLV)	-

6 DECK OPENING FRAMING DETAIL

3/4" = 1'-0"

NOTES:

1. USE ABOVE FRAMING AT ALL OPENINGS EXCEEDING 1'-0" UNO.
2. REFERENCE ARCHITECTURAL AND MECHANICAL DRAWINGS FOR SIZE AND LOCATION OF ALL OPENINGS.
3. ROOF OPENING FRAMING NOT REQUIRED AT SIDE DISCHARGE ROOF DRAINS. COORDINATE WITH MECHANICAL CONTRACTOR.

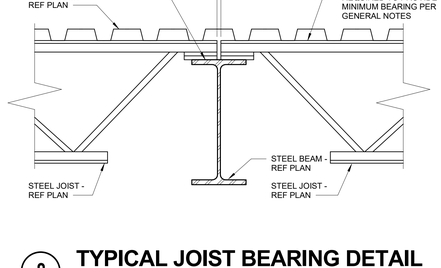


10 JOIST MODIFICATION DETAIL

1 1/2" = 1'-0"

NOTES:

1. FOR ATTACHMENTS TO JOISTS THAT ARE CONCENTRICALLY LOADED ON THE JOIST, A MAXIMUM OF 100 POUNDS MAY BE ATTACHED TO THE JOIST WITHIN A CHORD PANEL WITHOUT AN ADDITIONAL ANGLE. FOR ATTACHMENTS TO JOIST THAT ARE ECCENTRICALLY LOADED, A MAXIMUM OF 25 POUNDS MAY BE ATTACHED TO THE JOIST WITHIN A CHORD PANEL WITHOUT AN ADDITIONAL ANGLE. MULTIPLE ATTACHMENTS ARE ALLOWED IN EACH CHORD PANEL AS LONG AS THE SUM OF THE LOADS DO NOT EXCEED THE MAXIMUM LOAD INDICATED.
2. FOR LOADS BETWEEN 100 POUNDS AND 200 POUNDS, ADDITIONAL ANGLES ARE REQUIRED AND JOIST MUST BE CONCENTRICALLY LOADED.
3. FOR LOADING CONDITIONS IN NOTES 1 AND 2 ABOVE, TOTAL SUM OF LOADS SHALL NOT EXCEED 200 LBS FOR AN 8 FOOT SEGMENT OF JOIST. FOR LOADS GREATER THAN 200 POUNDS AND NOT NOTED ON THE DRAWINGS, CONTACT ENGINEER PRIOR TO INSTALLATION.
4. NO LOADS SHALL BE SUPPORTED FROM JOIST BRIDGING.

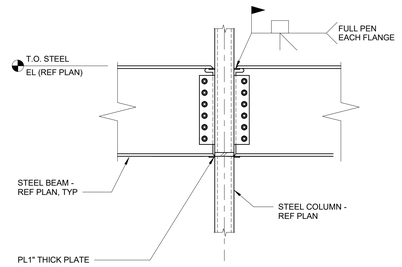


8 TYPICAL JOIST BEARING DETAIL

1 1/2" = 1'-0"

NOTES:

1. JOISTS AT OR IMMEDIATELY ADJACENT TO COLUMNS SHALL BE BOLTED WITH (2) BOLTS ON BEAM GAGE. REFER TO GENERAL NOTES FOR BOLT DIAMETER.

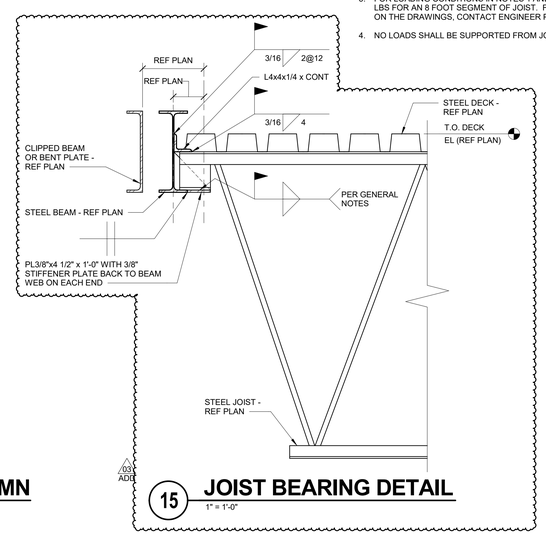


9 MOMENT CONNECTION DETAIL

3/4" = 1'-0"

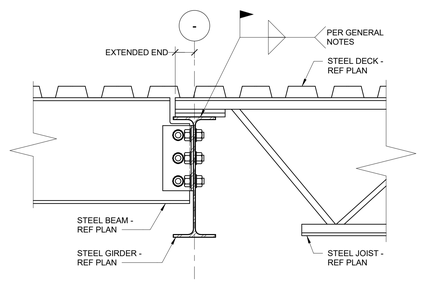
NOTES:

1. DETAIL SIMILAR FOR MOMENT CONNECTION OF BEAMS IN OPPOSITE DIRECTION.
2. STIFFENER PLATE THICKNESS SHALL MATCH LARGER FLANGE THICKNESS OR CONNECTOR PLATE UNO.



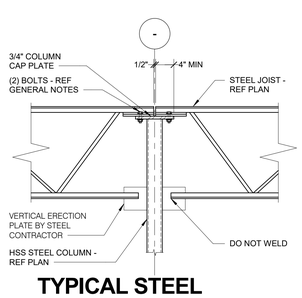
15 JOIST BEARING DETAIL

1" = 1'-0"



11 SECTION AT ROOF GIRDER

1 1/2" = 1'-0"

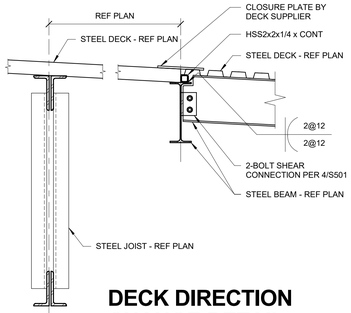


12 TYPICAL STEEL JOIST AT HSS COLUMN

3/4" = 1'-0"

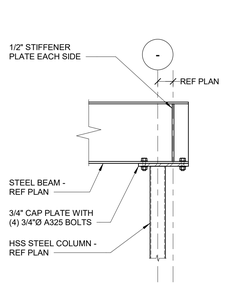
NOTES:

1. GIRDER NOT SHOWN FOR CLARITY.
2. DECK NOT SHOWN FOR CLARITY.
3. CONNECTION SHOWN IS BASED ON STEEL JOIST INSTITUTE REQUIREMENTS FOR K-SERIES BAR JOISTS. CONNECTION DETAIL NOT APPLICABLE FOR LH-SERIES JOISTS OR JOIST GIRDERS.



13 DECK DIRECTION CHANGE DETAIL

3/4" = 1'-0"



14 BEAM BEARING ON COLUMN

3/4" = 1'-0"

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301 N BROOM STREET #100
MADISON, WI 53703
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Key Plan

Sheet Issue Date	
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Drawing

STEEL DETAILS

City of Madison Contract No. **8027**
OPN Project No. **17207000**

S501

IMEG
1800 DEMING WAY, SUITE 200
MIDDLETON, WI 53562
608.223.9600 FAX: 608.836.0415
www.imegcorp.com
PROJECT # 17001140.00

REFERENCE SCALE IN INCHES
0 1 2 3

Department of Public Works
Engineering Division
Robert F. Phillips, P.E., City Engineer

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engineering@cityofmadison.com
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Assistant City Engineer
Gregory T. Fries, P.E.
Kathleen M. Cryan

Principal Engineer 2
Christopher J. Petykowski, P.E.
John S. Fahrney, P.E.

Principal Engineer 1
Christina M. Bachmann, P.E.
Eric L. Dundee, P.E.

Facilities & Sustainability
Jeanne E. Hoffman, Manager

Mapping Section Manager
Eric T. Pederson, P.S.

Financial Manager
Steven B. Danner-Rivers

December 12, 2017

NOTICE OF ADDENDUM
ADDENDUM NO. 4

CONTRACT NO. 8027, PROJECT NO. 17451
MADISON FIRE STATION 14

Revise and amend the contract document(s) for the above project as stated in this addendum, otherwise, the original document shall remain in effect.

This addendum consists of the following documents:

1. **GENERAL CONTRACT CONDITIONS**
   No Change

2. **GENERAL QUESTIONS AND ANSWERS**
   Q1: Is there a basis of design for ACT Ceiling tile?
   A1: Manufacturer: Armstrong
   Style: Ultima
   Color: White
   Edge Profile: Beveled Tegular
   Gird: 9/16”
   Size: 24” x 24”
   Application: As Scheduled

   Q2: Is there a basis of design for the Roller Finish Material?
   A2: Manufacturer: Lutron
   Style: Basketweave
   Openness Factor: 1%
   Color: Charcoal
   Note: Refer to RCP for locations with Double Roller with room darkening capabilities.

   Q3: There is a spec for corner guards but I don’t see where they are to be installed.
   A3: Provide corner guards at exposed outside corners with gypsum board finish – typ.
   Exception: Do not provide (2) corner guards for the art work display area. See elevation 9/A406.

   Q4: Can you provide additional info on the concrete polishing?

A4: Polishing criteria added to specification attached to this addendum.

Q5: Is there a basis of design for the glass wall on 11/A406?
A5: Interior Tempered Glass sized by manufacturer.
Recessed Track Manufacturer: C.R. Lawrence
Style: CRL 98" Brite Anodized U-Channel
Catalog Number: SDCF38BA
Finish: Brite Anodized

3. **SUBSTITUTION REQUESTS**
No Change

4. **SPECIFICATIONS**
ADDED 05 41 00 COLD FORMED STEEL FRAMING SYSTEM
(Cold Form Exterior Applications)

MODIFIED 03 35 11 CONCRETE FLOOR FINISHES to include polishing criteria

5. **DRAWINGS**
No Change

6. **PROPOSAL**
No Change

Please attach these Addendum documents to the Drawings and Project manual in your possession.

Please acknowledge this addendum on page E1 of the contract documents and/or in Section E: Bidder's Acknowledgement on Bid Express.

Electronic version of these documents can be found on the Bid Express web site at:

http://www.bidexpress.com

If you are unable to download plan revisions associated with the addendum, please contact the Engineering office at 608-266-4751 receive the material by another route.

Sincerely,

Robert F. Phillips, P.E., City Engineer

Cc: Greg Fries, Kathy Cryan

SECTION 03 35 11

CONCRETE FLOOR FINISHES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Surface treatments for concrete floors and slabs.

1.2 RELATED REQUIREMENTS

A. Section 03 30 00 - Cast-in-Place Concrete: Finishing of concrete surface to tolerance; floating, troweling, and similar operations; curing.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordinate the work with concrete floor placement and concrete floor curing.

1.4 SUBMITTALS

A. Product Data: Manufacturer's published data on each finishing product, including information on compatibility of different products and limitations.

B. Maintenance Data: Provide data on maintenance and renewal of applied finishes.

1.5 PREINSTALLATION CONFERENCE

A. Preinstallation Conference: Conduct conference at Project site.
   1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Architect, , and Owner's Representative of scheduled meeting dates.

1.6 QUALITY ASSURANCE

A. Polisher Qualifications:
   1. Experience: Company experienced in performing specified work similar in design, products, and extent to scope of this Project; with a record of successful in-service performance; and with sufficient production capability, facilities, and personnel to produce specified work.
   2. Manufacturer Qualification: Approved by manufacturer to apply liquid applied products.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in manufacturer's sealed packaging, including application instructions.

1.8 FIELD CONDITIONS

A. Maintain light level equivalent to a minimum 200 W light source at 8 feet above the floor surface over each 20 foot square area of floor being finished.

B. Do not finish floors until interior heating system is operational.

C. Maintain ambient temperature of 50 degrees F minimum.

PART 2 PRODUCTS

2.1 DENSIFIERS AND HARDENERS

A. Liquid Densifier/Hardener: Penetrating chemical compound that reacts with concrete, filling the pores and dustproofing; for application to concrete after set or as otherwise recommended by manufacturer.
   1. Composition: Lithium silicate.
   2. Products:
      a. ProSoCo; Consolideck LS.
      b. W.R. Meadows, Inc; Liqui-Hard Ultra: www.wrmeadows.com/sle.

2.2 COATINGS

A. Enhancing Sealer: High-gloss, enhancing sealer for hardened concrete.
   1. Products:
      a. ProSoCo; Consolideck LS Guard.
      b. W.R. Meadows, Inc.; Bellatrix.

2.3 POLISHING EQUIPMENT

A. Field Grinding and Polishing Equipment:
   1. Variable speed, multiple head, counter-rotating, walk-behind machine with not less than 600 pounds of down pressure on grinding or diamond polishing pads.
   2. If dry grinding, honing, or polishing, use dust extraction equipment with flow rate suitable for dust generated, with squeegee attachments.

B. Edge Grinding and Polishing Equipment: Hand-held or walk-behind machines which produces same results, without noticeable differences, as field grinding and polishing equipment.

C. Burnishing Equipment: High speed walk-behind or ride-on machines capable of generating 1000 to 2000 revolutions per minute and with sufficient head pressure of not less than 20 pounds to raise floor temperature by 20 degrees F.

D. Metal Bonded Pads: Grinding pads with embedded industrial grade diamonds of varying grits fabricated for mounting on equipment.

E. Resin Bonded Pads: Polishing pads with embedded industrial grade diamonds of varying grits fabricated for mounting on equipment.

F. Burnishing Pads: Maintenance pads for use with high speed burnishing equipment.

PART 3 EXECUTION

04ADD

3.1 EXAMINATION

A. Verify that floor surfaces are acceptable to receive the work of this section.

B. Verify that flaws in concrete have been patched and joints filled with methods and materials suitable for further finishes.

C. Starting work within a particular area will be construed as acceptance of surface conditions.

3.2 PREPARATION

A. Alkalinity:
   1. Test Method: Measure pH according to method indicated in ASTM F 710.
   2. Acceptable Results: pH between 8 and 10.

B. Moisture Vapor Transmission Rate:
   1. Test Method: Perform anhydrous calcium chloride test according to ASTM F 1869.
   2. Acceptable Results: Not more than 5 pounds per 1000 square feet in 24 hours.

C. Relative Humidity:
   1. Test Method: Perform relative humidity test using in situ probes according to ASTM F 2170.
   2. Acceptable Results: Not more than 75 percent.

3.3 GENERAL

A. Apply materials in accordance with manufacturer's instructions.

3.4 COATING APPLICATION

A. Verify that surface is free of previous coatings, sealers, curing compounds, water repellents, laitance, efflorescence, fats, oils, grease, wax, soluble salts, residues from cleaning agents, and other impediments to adhesion. Remove if present. Clean in accordance with concrete floor finish manufacturer's written instructions.

B. Protect adjacent non-coated areas from drips, overflow, and overspray; immediately remove excess material.

C. At concrete surfaces indicated to be sealed, but not polished, provide the following:
   1. Confirm that concrete slab is acceptable to concrete floor finish manufacturer for application of hardener. Apply hardener/densifier in accordance with manufacturer's instructions. Allow to dry per manufacturer's instructions prior to applying enhancing sealer.
   2. Apply two coats of enhancing sealer after hardener/densifier has dried per manufacturer's instructions.
   3. Once enhancing sealer is dry, brunish after each coat using a high speed burnisher in accordance with manufacturer's instructions.
   4. At Substantial Completion, apply and burnish two additional coats of enhancing sealer to all sealed floor areas.

04ADD

3.5 CONCRETE POLISHING

A. Execute using materials, equipment, and procedures specified by manufacturer, using manufacturer approved installer.

B. Initial Grinding:
   1. Use grinding equipment with metal bonded grinding pads.
   2. Begin grinding in one direction using sufficient size grit pad.
   3. Make sequential passes with each pass perpendicular to previous pass using finer grit pad with each pass, up to 150 grit.
   4. Achieve maximum refinement with each pass before proceeding to finer grit pads.
   5. Vacuum floor using squeegee vacuum attachment after each pass.
   6. Continue grinding until aggregate exposure matches approved field mock-ups.

C. Treating Surface Imperfections:
   1. Mix patching compound and grout material with dust created by grinding operations to match color of adjacent concrete surface.
   2. Fill surface imperfections including, but not limited to, holes, surface damage, small and micro cracks, air holes, pop-outs, and voids.
   3. Work compound and treatment until color differences between concrete surface and filled surface imperfections are not reasonably noticeable when viewed from 10 feet away under lighting conditions that will be present after construction.

D. Liquid Densifier Application: Apply undiluted to point of rejection, remove excess liquid, and allow to cure according to manufacturers instructions.

E. Polishing:
   1. Use polishing equipment with resin bonded polishing and burnishing pads.
   2. Begin polishing in one direction starting with 800 grit pad.
   3. Make sequential passes with each pass perpendicular to previous pass using finer grit pad with each pass, up to 1500 grit.
   4. Achieve maximum refinement with each pass before proceeding to finer grit pads.
   5. Auto scrub or vacuum floor using squeegee vacuum attachment after each pass.
   6. Continue polishing until gloss appearance, as measured according to ASTM E 430, matches approved field mock-ups.

F. Final Polished Concrete Floor Finish:
   1. Fine Aggregate (Salt and Pepper) Finish: Remove not more than 1/16 inch of concrete surface by grinding and polishing resulting in majority of exposure displaying fine aggregate with no, or small amount of, medium aggregate at random locations.
   2. Apply one of the following polish levels to match approved field mock-up.
      a. Level C:
         1) Procedure: Not less than 6 steps with full refinement of each diamond pad up to 1500 grit resin bonded pad with one application of densifier.
         2) Gloss Reading: Not less than 60 according to ASTM E 430 before enhancing sealer application.

G. Enhancing Sealer Application: Apply after completion of polishing.
   1. Clean polished surfaces prior to application of enhancing sealer.
   2. Apply two coats of enhancing sealer in accordance with manufacturer's instructions.
   3. Once enhancing sealer is dry, brunish after each coat using a high speed burnisher in accordance with manufacturer's instructions.

3.6 PROTECTION

A. Cover floors with masonite during construction. Remove at Substantial Completion.

3.7 FINAL APPLICATION

A. At Substantial Completion, apply two coats of enhancing sealer to concrete surfaces receiving hardener/densifier.

END OF SECTION

SECTION 05 40 00
COLD-FORMED STEEL FRAMING (CFSF) SYSTEM

new section added 04ADD

PART 1 - GENERAL

1.1 DESCRIPTION

A. The General and Supplementary Conditions of the Construction Contract and Division 1 - General Requirements apply to the work specified in this section.

B. Load bearing structural steel studs of 20 to 12 gauge (33 mil to 97 mil) members along with fasteners and related accessories.

C. Furnish and install cold-formed steel framing system as shown on Drawings and herein specified.

1. Work shall include, but not be limited to the following items:

a. Bearing and non-load bearing formed steel stud exterior wall.

b. Provide tracks, blocking, lintels, clips angles, bridging, shoes, reinforcements, fasteners and accessories to construct a complete steel framing system.

D. Structural notes indicated on Drawings regarding cold-formed steel framing system shall be considered a part of this Specification.

E. Refer to Division 9 for non-load bearing studs of 20 gauge (30 mil) or lighter.

1.2 QUALITY ASSURANCE

A. Workmen Qualifications:

1. For the actual erection of cold-formed steel framing system, use only skilled journeymen steel framing erectors who are thoroughly experienced with the materials and methods specified.

2. Use qualified welders and comply with AWS standards.

B. Codes and Standards: Comply with the provisions of the following codes, specifications, and standards, except where more stringent requirements are shown or specified:

1. AISI - Specification for the Design of Cold Formed Steel Structural Members, Current Edition.

2. AISI General Provisions 2004 Edition.

3. AWCI - Association of Wall and Ceiling Industries, Current Edition.

4. AWS D1.3 - Structural Welding Code - Sheet Steel

5. ASTM A653 - Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot Dip Process.

6. ASTM A1008 -Structural Steel (SS), Sheet, Carbon, Cold-Rolled

7. ASTM C955 - Load Bearing (Transverse and Axial) Steel Studs, Runners (Track) and Bracing or Bridging for Screw Applications of Gypsum Board and Metal Plaster Base.

8. ASTM C1007 - Installation of Load Bearing Steel Studs and Related Accessories.

9. SSMA - Steel Stud Manufacturers Association.

C. Where any provisions of other pertinent codes and standards conflict with this specification, the more stringent provision shall govern.

D. Performance Requirement:

1. Provide CFSF capable of withstanding design loads indicated on the plans.

2. Design CFSF to withstand design loads meeting the following deflection limits:

a. Exterior walls backing up brick or stone veneer: Horizontal deflection of 1/600 of wall height.

b. Exterior walls cladded with metal siding, exterior insulated finish systems or other flexible non-brittle finishes: Horizontal deflection of 1/360 of wall height.

3. Design CFSF to provide for movement of framing members without damage or overstressing, sheathing failure, connection failure, undue strain on fasteners and anchors, or other detrimental effects when subject to a maximum ambient temperature change of 120°F.

4. Design system to accommodate construction tolerances, deflection of building structural members (1 inch maximum), and clearances of intended openings.

5. CFSF shall be designed in accordance with “Standard for Cold-Formed Steel Framing - General Provisions”, current edition.

1.3 SUBMITTALS

A. Shop Drawings:

1. Prepare and submit complete erection and detailed shop drawings for Engineer’s approval, including framing plans indicating size, gauge, weight and location of all framing members. Shop drawings shall indicate the following:

a. Component details, framed openings, bearing, anchorage, loading, welds, type and location of fasteners, bracing, bridging, strapping, connections, and accessories or items required of other related work. Provide stud layout.

b. Describe method for securing studs to tracks and for bolted/welded framing connections.

c. Provide calculations for loadings and stresses of steel framing system, including specially fabricated components and roof trusses, shall be prepared by a registered professional engineer, with registration from the state in which the building is located.

d. Detail size and location of all bridging, strapping, bracing, splices, and accessories required for installation.

B. Product Data:

1. Provide product data on standard framing members. Describe materials and finish, product criteria and limitations. Submit manufacturer's installation instructions.

1.4 QUALIFICATIONS

A. MANUFACTURER: Company specializing in performing the work of this section with a minimum of five (5) years documented experience at manufacturing cold-formed steel and framing systems and related accessories. Manufacturer shall be a current and “full” member of the Steel Stud Manufacturers Association (SSMA) or Steel Framing Industry Association (SFIA).

B. All steel studs and track furnished under this section shall be supplier by a manufacturer who is a current member of the Steel Stud Manufacturers Association (SSMA) or Steel Framing Industry Association (SFIA).

C. Steel studs, headers, and other elements used for this project are sized based on SSMA. Elements of equal or greater capacity may be exchanged.

D. Preparation of shop drawings, design calculations, and other structural data by a qualified Professional Engineer licensed in the State of Wisconsin.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Steel members shall be transported, stored and erected in a manner that will avoid any damage or deformation. Bent or deformed members will be rejected and shall be replaced or repaired at the expense of the responsible party. Store clear of ground and in such a manner so as to eliminate excessive handling.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Framing Materials:

1. Studs shall be minimum 20 gauge (33 mil) thick sheet steel conforming to ASTM A653 Grade 33 for 18 gauge and thinner and/or Grade 50 for 16 gauge and thicker, formed to channel shape, punched web, with nominal size as indicated on Drawings.

2. Track shall be minimum 20 gauge (33 mil) thick sheet steel, channel shaped, solid web, same width as above studs. Track shall provide a tight fit for studs.

B. Accessories:

1. Bracing, furring and bridging shall consist of formed sheet steel with thickness determined for conditions encountered. Provide manufacturer's standard shapes, complete with finish same as framing members.

2. Plates, gussets and clips shall consist of formed sheet steel with thickness determined for conditions encountered. Provide manufacturer's standard shapes, complete with finish same as framing members.

C. Fasteners:

1. Self-drilling, self-tapping screws, bolts nuts and washers shall conform to ASTM A90, complete with hot-dip galvanized.

2. Expansion anchors shall be "Kwik" bolts, as manufactured by Hilti, Inc.

3. All other fasteners shall be as indicated on Drawings or as recommended by the above stud manufacturer.

4. Welding connections are to be performed in accordance with American Welding Society (AWS) D1.3 latest edition “Specification for Welded Sheet Steel in Structures.” Consult AWS D19.0 latest edition “Welding Zinc Coated Sheet” and ANSI Standard Z49.1 for information regarding welding procedures.

D. Finishes:

1. Furnish all studs system components with a factory galvanized (G60) finish.

2.2 FABRICATION

A. Fabricate assemblies of framed sections, of sizes and profiles required with framing members fitted, reinforced and braced to suit design requirements.

B. Fit and assemble in largest practical sections for delivery to Worksite, ready for installation.

PART 3 - EXECUTION

3.1 INSPECTION

A. Verify that substrate surfaces and building framing components are ready to receive work.

B. Beginning of installation means acceptance of existing conditions and substrate.

3.2 INSTALLATION

A. General:

1. Cold-formed steel framing system shall consist of structural steel studs with locations as shown on Drawings. All work shall be in accordance with approved shop drawings and manufacturer's latest printed specifications. Framing members shall be securely attached by mechanical fasteners as indicated on Drawings and as recommended by the manufacturer.

    a. All field welding shall be in accordance with AWS previously cited.

    b. Wire tying of stud or components in system will not be allowed.

    c. Complete framing system ready to receive subsequent facing material.

2. Provision shall be made in studs for rigid fastening of all blocking and special braces or framing and for attachment and support of electrical outlets or other equipment indicated to be supported by stud construction.

    a. All anchorage, bracing and blocking shall be in accordance with approved shop drawings and as recommended by the manufacturer.

3. Surfaces abraded by handling, weld locations and other miscellaneous defects shall be touched-up with zinc-rich galvanizing compound (ZRC) coating.

B. Erection Of Studding:

1. Top and bottom runner members shall be the same size and gauge as the stud and be continuous for the total length of framing system or as long as practical and shall be securely attached a maximum of 24 inches on centers with approved fastening devices. Studs shall extend in one piece full height vertically between runners, spaced no greater than 24 inches on centers, with all web cut-outs in perfect alignment. Studs shall provide solid backing at corners and jambs. Install joists with all components property aligned and braced with all work plumb and true ready and acceptable to receive surface materials.

    a. Coordinate installation of sealant with floor and ceiling tracks.
    b. Field cutting of studs shall be done by sawing.
    c. Splices in axial load studs will not be permitted.
    d. Erect load bearing studs, brace and reinforce to develop full strength to meet design requirements.
    e. Extend stud framing through ceiling to underside of floor or roof structure above.

f. Install intermediate studs above and below openings with studs equally spaced to correspond to adjacent stud spacing.

g. Provide deflection allowance in stud track, directly below horizontal building framing for non-load bearing framing.

h. Framing fabricator shall ensure punchout alignment when assembling framing and field cutting to length.

i. All framing components shall be cut squarely for attachment to perpendicular members.

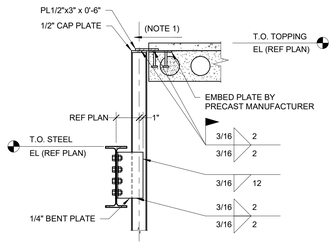
j. In the event a track butt joint occurs within a panel, abutting pieces of track shall be butt welded or spliced together. No such splices shall occur at any head or sill condition.

2. Steel studs shall be located not more than 2 inches from all door, abutting partitions, partition corners and other construction. Unless detailed otherwise, runner track or stud member shall be used as a runner over door frames. Structural studs and joists shall be securely and rigidly anchored in place to give a total and complete support to subsequent materials attached thereto. All studs shall be securely attached to jamb and head anchor clips of each door frame by manufacturer's recommended method.

a. Construct corners using minimum three studs. Jamb studs at doors, windows, and other wall openings shall be designed to resist the tributary load of the opening and meet specified performance requirements.

b. Cold-rolled steel channel stiffeners or bridging shall be provided and installed horizontally every 60 inches in all framing systems through stud web cut-outs with welding clips welded in place at each stud.

END OF SECTION

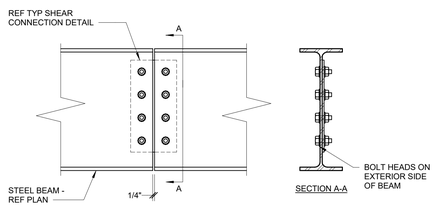


1 FRAMING DETAIL

3/4" = 1'-0"

NOTES:

1. PRECAST MANUFACTURER TO DESIGN EMBED FOR THE FOLLOWING UNFACTORED SERVICE LOADS: DEAD LOAD = 200 LB AND REVERSIBLE WIND LOAD = 1250 LB.
2. MASONRY WALL NOT SHOWN FOR CLARITY.



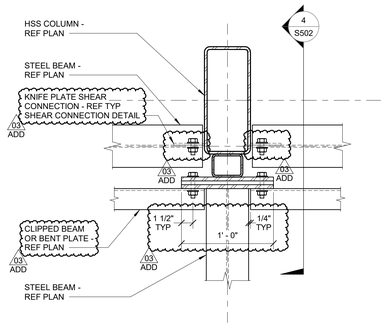
2 SPLICE DETAIL

1 1/2" = 1'-0"

NOTES:

1. AT SIM: PROVIDE 1/4" GAP BETWEEN STEEL FRAMING MEMBERS. BOLTED CONNECTION WITH CONNECTION PLATE NOT REQUIRED.

03 ADD



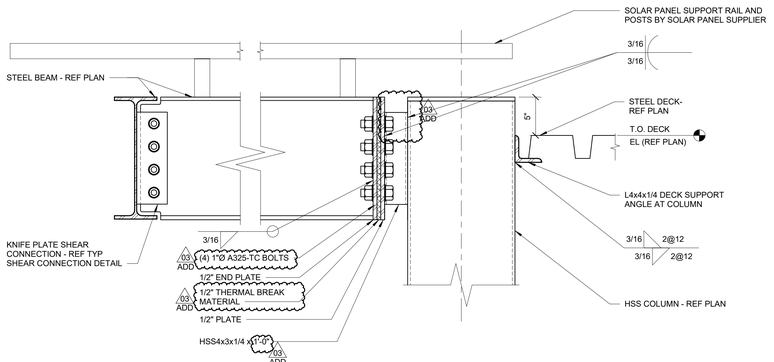
3 OVERHANG CONNECTION DETAIL

1 1/2" = 1'-0"

NOTES:

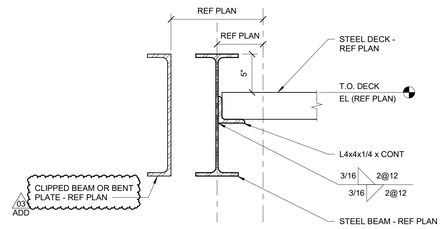
1. AT SIM: EXTEND CLIPPED BEAM OR BENT PLATE FRAMING ACROSS CONNECTION PLATE TO JOIST CENTERLINE WITH 1/4" GAP BETWEEN ENDS. SIMILAR TO 2/S502 ONLY ONE LINE OF BOLTS REQUIRED AT CONNECTION PLATES, PROVIDE BOLTED CONNECTION AT INSIDE FACES OF COLUMN GROUPS.

03 ADD



4 OVERHANG CONNECTION DETAIL

1 1/2" = 1'-0"



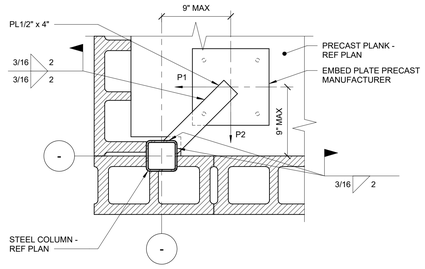
5 OVERHANG CONNECTION DETAIL

1 1/2" = 1'-0"

NOTES:

1. AT SIM: DECK SPAN IS PARALLEL TO FRAMING.

03 ADD



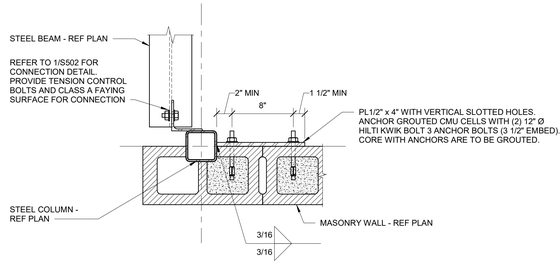
6 FRAMING DETAIL

1 1/2" = 1'-0"

NOTES:

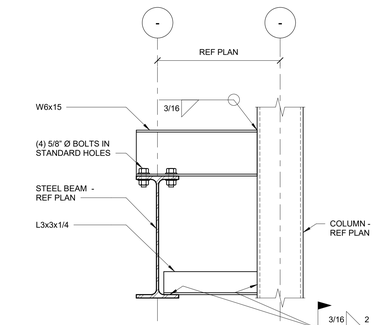
1. P# INDICATES HORIZONTAL LOAD REQUIRED TO BRACE COLUMN. PRECAST MANUFACTURER TO DESIGN EMBED FOR THE FOLLOWING UNFACTORED SERVICE LOADS:

P1 - DEAD LOAD (1.0DL)	=	150 LB
LIVE LOAD (1.0LL)	=	125 LB
REVERSIBLE WIND LOAD (1.0WL)	=	425 LB
P2 - DEAD LOAD (1.0DL)	=	100 LB
REVERSIBLE WIND LOAD (1.0WL)	=	850 LB



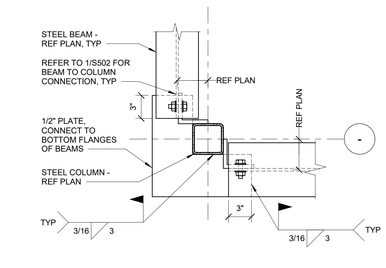
7 FRAMING DETAIL

1 1/2" = 1'-0"



8 FRAMING DETAIL

1 1/2" = 1'-0"

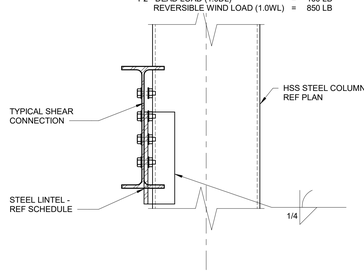


9 FRAMING DETAIL

1 1/2" = 1'-0"

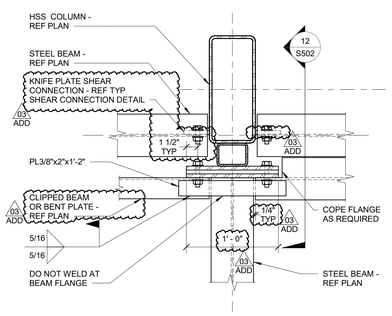
NOTES:

1. MASONRY WALL NOT SHOWN FOR CLARITY.



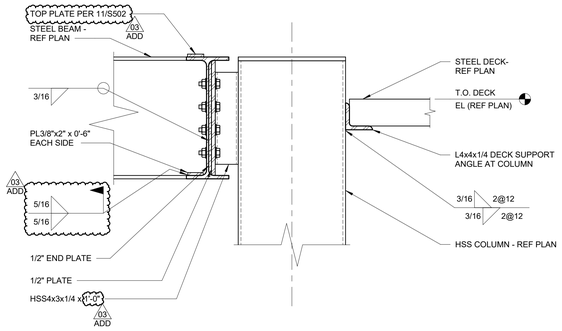
10 STEEL LINTEL CONNECTION DETAIL

1 1/2" = 1'-0"



11 OVERHANG CONNECTION DETAIL

1 1/2" = 1'-0"



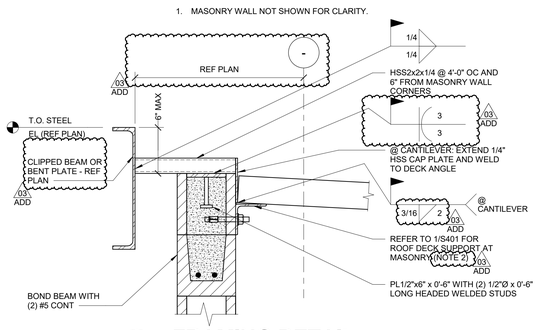
12 OVERHANG CONNECTION DETAIL

1 1/2" = 1'-0"

NOTES:

1. REFER TO 4/S502 FOR ADDITIONAL CONNECTION INFORMATION.

03 ADD

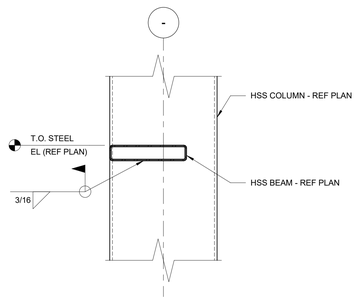


13 FRAMING DETAIL

1 1/2" = 1'-0"

NOTES:

1. AT SIM: DECK SPAN IS PARALLEL TO WALL. COORDINATE EMBED PLATE LOCATIONS WITH JOIST BEARING DETAIL 10/S401. 03 ADD
2. COORDINATE WITH DETAIL 1/S401 TO PREVENT OVERLAP OF HILTI FASTENERS AND HEADED WELDED STUDS.

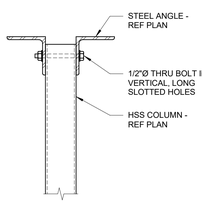


14 FRAMING DETAIL

1 1/2" = 1'-0"

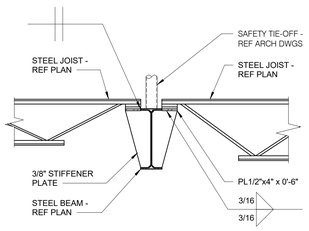
NOTES:

1. ANY TEMPORARY ERECTION SEATS USED TO SUPPORT FRAMING SHALL BE REMOVED.



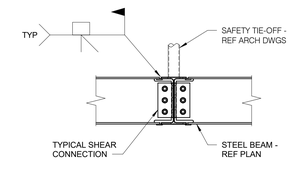
15 COLUMN SUPPORT DETAIL

1 1/2" = 1'-0"



16 FRAMING DETAIL

3/4" = 1'-0"



17 FRAMING DETAIL

3/4" = 1'-0"

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City of Madison Fire Department

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Project

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Civil Engineer

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Structural Engineer

IMEG

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Middleton, WI 53562
P. 608-223-9600

Mechanical Engineer

IMEG

1800 Deming Way #200
Middleton, WI 53562
P. 608-223-9600

Electrical Engineer

IMEG

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P. 608-223-9600

Key Plan

Sheet Issue Date

BID DOCUMENTS 11/03/17

Revision	Date
ADDENDA #2	11/22/17
ADDENDA #3	12/01/17

BID DOCUMENTS

Drawing

STEEL DETAILS

City of Madison Contract No. **8027**
OPN Project No. **17207000**

S502

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REFERENCE SCALE IN INCHES

0 1 2 3

SECTION 07 21 00
THERMAL INSULATION

ADD 3
added polyisocyanurate roofing insulation requirements to specification

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Board insulation at perimeter foundation wall, underside of floor slabs, and exterior wall behind masonry wall finish and roof

B. Mineral wool insulation in exterior wall construction.

1.2 REFERENCE STANDARDS

A. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus; 2015.

B. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications; 2013.

C. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation; 2016.

D. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation; 2014.

E. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2016.

F. ASTM C1289 - Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board; 2014.

1.3 SUBMITTALS

A. Product Data: Provide data on product characteristics, performance criteria, and product limitations.

B. Manufacturer's Installation Instructions: Include information on special environmental conditions required for installation and installation techniques.

C. Submit surface temperature and dew point analysis. Analytical models shall include building areas clad with Composite Wood Veneer Panels, Aluminum Composite Panels and Fiber Reinforced Cement Panels, regardless of whether those materials are included in this Section or not. Identify temperatures for all surfaces, not just surfaces exposed to view. Analyze typical details and sufficient number of non-typical details to assure that the worst case has been identified. Required data includes:

1. Identification of dewpoint temperature.
2. Isothermal plots with color legend and numerical temperature values for: coldest indoor surface; indoor surfaces at or below dew point; indoor surfaces 0 to 5 degrees warmer than dewpoint.
3. Tabulation identifying solid materials, conductiveness and emissivities.
4. Tabulation identifying cavity dimensions, temperatures and emissivities.
5. Tabulation identifying boundary condition temperatures and film coefficients.

PART 2 PRODUCTS

2.1 LEED REQUIREMENTS

A. Recycled Content: Preference for products with a recycled content greater than 35 percent.

B. VOC Content: for adhesives applied on the interior, comply with requirements of Section 01 35 47 VOC CONTENT RESTRICTIONS.

2.2 APPLICATIONS

A. Insulation Under Concrete Slabs: Extruded polystyrene board.

B. Insulation at Perimeter of Foundation: Extruded polystyrene board.

C. Insulation in Exterior Wall Cavity: Mineral wool insulation.

D. Insulation Inside Masonry Cavity Walls: Extruded polystyrene board.

E. Insulation Over Roof Deck: Polyisocyanurate board.

2.3 FOAM BOARD INSULATION MATERIALS

A. Extruded Polystyrene Board Insulation: Extruded polystyrene board; ASTM C578; with either natural skin or cut cell surfaces, and the following characteristics:
   1. Flame Spread Index (FSI): Class A - 0 to 25, when tested in accordance with ASTM E84.
   2. Smoke Developed Index (SDI): 450 or less, when tested in accordance with ASTM E84.
   3. R-value; 1 inch of material at 72 degrees F: 5, minimum.
   4. Board Edges: Square.
   5. Water Absorption, Maximum: 0.3 percent, by volume.
   6. Compressive Strength: 25 psi.
   7. Manufacturers:
      a. Dow Chemical Company; STYROFOAM: www.dow.com/sle.
      b. Owens Corning Corporation; FOAMULAR Extruded Polystyrene (XPS) Insulation: www.ocbuildingspec.com/sle.

B. Polyiscyanurate Board Insulation with Facers Both Sides: Rigid cellular foam, complying with ASTM C1289; Type 1, Class 1, non-reinforced foam core.
   1. Flame Spread Index (FSI): 75 or less, when tested in accordance with ASTM E84
   2. Smoke Developed Index (SDI): 450 or less, when tested in accordance with ASTM E84.
   3. Board Size: 48 x 96 inch.
   4. Board Thickness: As indicated on drawings
   5. Board Edges: Square.

2.4 MINERAL WOOL INSULATION MATERIALS

A. Mineral Wool Insulation: Semi-rigid mineral fiber, ASTM C612; unfaced flame spread index of 0 (zero) when tested in accordance with ASTM E84.
   1. Smoke Developed Index: 0 (zero), when tested in accordance with ASTM E84.
   2. Combustion: Rated non-combustible per NFPA Standard 220 in accordance with ASTM E 136
   3. Board Size: As required for application.
   4. Board Thickness: As indicated on drawings.
   5. Board Edges: Square.
   6. Moisture Absorption: 1% max. per ASTM C1104.
   7. Thermal Resistance: R-value of 4.2 degrees F hr sq ft/Btu at 75 degrees F, minimum, when tested according to ASTM C518.
   8. Products:
      a. Thermafiber, Inc; RainBarrier: www.thermafiber.com.
      b. ROXUL, Inc; CAVITYROCK: www.roxul.com/sle.

2.5 ACCESSORIES

A. Tape: Foil tape, self-adhering type, not less than 2 inch wide.

B. Tape joints of rigid insulation in accordance with roofing and insulation manufacturer's instructions.

C. Insulation Fasteners: Impaling clip of unfinished steel with washer retainer and clips, to be adhered to surface to receive insulation, length to suit insulation thickness and substrate, capable of securely and rigidly fastening insulation in place.

D. Insulation Fasteners: Appropriate for purpose intended and approved by roofing manufacturer.
   a. Length as required for thickness of insulation material and penetration of deck substrate.

E. Adhesive: Type recommended by insulation manufacturer for application and compatible with adjacent surfaces.

F. Spray Foam: Closed cell, Hilti CF812.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that substrate, adjacent materials, and insulation materials are dry and that substrates are ready to receive insulation.

3.2 BOARD INSTALLATION AT FOUNDATION PERIMETER

A. Install boards vertically over waterproofing systems on foundation perimeter where indicated on Drawings.
   1. Butt edges and ends tightly to adjacent boards and to protrusions.
   2. Start board installation flush with foundation wall corner. Extend board end on opposite side of same corner to overlap end of first panel.
   3. Fit panel bottom ends tight to tops of spread footings.

B. Extend boards over expansion joints, unbonded to foundation on one side of joint.

C. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.

3.3 BOARD INSTALLATION AT EXTERIOR WALLS

A. Install boards horizontally on walls.

B. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.

3.4 BOARD INSTALLATION UNDER CONCRETE SLABS

A. Place insulation under slabs on grade after base for slab has been compacted.

B. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.

C. Prevent insulation from being displaced or damaged while placing vapor retarder and placing slab.

3.5 BATT INSTALLATION

A. Install insulation in accordance with manufacturer's instructions.

B. Install in exterior roof spaces without gaps or voids. Do not compress insulation.

C. Trim insulation neatly to fit spaces. Insulate miscellaneous gaps and voids.

D. Fit insulation tightly in cavities and tightly to exterior side of mechanical and electrical services within the plane of the insulation.

3.6 PROTECTION

A. Do not permit installed insulation to be damaged prior to its concealment.

3.6 BOARD INSTALLATION OVER LOW SLOPE ROOF DECK

A. Board Installation Over Roof Deck, General;
   1. See applicable roofing specification section for specific board installation requirements.
   2. Ensure vapor retarder is clean and dry, continuous, and ready for application of roofing system.
   3. Fasten insulation to deck in accordance with roofing manufacturer’s written instructions and applicable Factory Mutual requirements.
   4. Do not apply more insulation than can be covered with roofing in same day.

END OF SECTION

SECTION 07 42 13

COMPOSITE WOOD VENEER PANELS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Wood veneer composite panel system including the following:
      a. Wood veneer composite panels with mounting system. Panel mounting system including anchorages, clips, shims, offsets furring, fasteners and related flashing adapters as required for a complete system.

1.2 DEFINITION

A. Composite wood veneer panel Assembly: Composite wood veneer panels, attachment system components, miscellaneous metal framing and accessories necessary for a complete rainscreen wall system.

1.3 RELATED SECTIONS

A. Section 07 21 00 – Thermal Insulation: Insulation.

B. Section 07 25 00 – Weather Barriers.

C. Section 07 62 00 - Sheet Metal Flashing and Trim.

D. Section 07 92 00 – Joint Sealants.

1.4 SUBMITTALS

A. Product Data: Manufacturer's data sheet on each product to be used including:

B. Preparation instructions and recommendations.

C. Storage and handling requirements and recommendations.

D. Installation methods.

E. Quality Assurance: Certified test results from independent testing laboratory substantiating specified performance characteristics and physical properties.

F. Design Drawings: Include installation details and elevations showing all panel sizes, fastener locations.
   1. Provide details and calculations indicating loads of cladding system on thermal clip support assembly.
   2. Include design engineer's stamp or seal on shop drawings for panels, backup framing, attachments and anchors. Engineer shall be licensed in Iowa.

G. Samples: Submit two 6"x6" samples of specified color.

1.5 QUALITY ASSURANCE

A. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
   1. Provide installation and materials for mockups indicated on Drawings.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Delivery: Deliver Materials to site in Manufacturer's original, unopened packaging, with labels clearly identifying product name and manufacturer.

B. Storage: Store Materials in accordance with the Manufacturer's instruction in unopened packaging until ready for installation. Store materials in a covered area, away from water, on a flat, level surface with adequate support to prevent sagging.

C. Handling: Protect materials during handling to prevent damage.

1.7 ACCLIMATIZATION

A. All boxes shall be opened and all components removed from the packaging and stacked flat with spacers between the pieces in their final environment for a minimum 3-4 days prior to installation.

1.8 PROJECT CONDITIONS

A. Do not install composite wood veneer panel material under environmental conditions where it is likely to be immersed in water, or where the temperature is likely to exceed 120 degrees Fahrenheit for extended periods of time.

1.9 WARRANTY

A. Manufacturer's Warranty: Provide manufacturer's 10 year warranty.

PART 2 - PRODUCTS

2.1 PRODUCTS

A. Products: Subject to compliance with requirements, provide the following:
   1. ProdEX, Prodema North America. Website: www.prodema.com

B. System Description
   1. A complete, engineered metal aluminum or stainless steel clip girt system with metal member framing, closure pieces, trim and flashing. The system is to be composed of composite wood veneer panels fastened to metal sub-frame. System to be designed and engineered to attach to wall assembly substructure as indicated below. System shall be designed to incorporate flashing and drainage components in such a way that system will properly perform as a rear ventilated rainscreen system.
   2. System installation shall allow for all movements within structure and to support loads transferred from the adjacent construction and to fit within the space allotted without projections into the finished space as shown on the Drawings.
   3. Provide in conjunction with wall substrate and air/water barrier a weather tight wall assembly utilizing the “rain screen principle”.
      a. System design shall be single-source responsibility by the cladding supplier. All design criteria shall be project specific in accordance with the requirements of cladding supplier. Products provided must conform to the design intent shown.
      b. Panel System: Drained and Back Ventilated Rainscreen Design. System shall drain water and condensation to exterior. A complete pre-engineered system including but not limited to cladding panels, support structure, closure pieces, trim and flashing. Wall panels shall be removable. Fasteners are exposed. The panels shall be secured to a thermally broken above grade cladding support wall assembly substructure provided in this section with fastening to bracket horizontally to allow for concealed attachment of panels.
      c. Joints: Shall be dry and un-caulked.
      d. Metal Flashing: Provide metal flashing for a proper water managed assembly, to direct condensation and water infiltration within the wall to weeping points.
         1) Drainage flashing is the primary component of a water managed system which diverts water that has penetrated the exterior cladding away from the cladding compartment or condensation that occurs at the interior face of cladding surface.
         2) Provide metal drainage flashing at locations listed below prior to installation of membrane to assure proper water drainage. Membrane shall assure proper lap over flashing:
            (a) At bottom of system.
            (b) At penetrations: windows, doors, louvers, etc.
            (c) At floor line or other locations which accommodate vertical movement.
   4. System shall provide minimum 1 inch “clear” airspace behind cladding for proper ventilation.
   5. Design Modifications: Shall be provided only as necessary to satisfy as-built conditions and to meet performance requirements. Significant system and aesthetic design shall be requested in writing to architect 10 days prior to bid date.
   6. Material supplier shall be responsible for engineering system per architectural design criteria and performance requirements.
   7. Condensation: System shall accommodate positive drainage for moisture entering or condensation occurring within panel system.
   8. Flatness: System shall be flat with no noticeable warpage, buckling, deflections or other surface irregularities

C. System Description: The system shall consist of composite wood veneer panels and a system of custom aluminum extrusions in profiles indicated on drawings. The back-up framing shall utilize Cascadia fiberglass clips with aluminum extrusions in profiles indicated on the drawings. The details show the preferred profiles and performance requirements. Provide a rainscreen and structurally sound, self-draining wall panel system with minimal water penetration.

2.2 THERMAL CLIP CLADDING SUPPORT ASSEMBLY

A. Thermal Clip Cladding Support Assembly:
1. All thermal clip systems are to be designed for a fully engineered, sub-framing thermal spacer insulation clip.
2. Provide a system designed to thermally isolate the exterior cladding systems. The system shall provide the insulation retainage in addition to withstanding the loads, wind loads and dead loads imposed by the cladding systems.
   a. Approved Manufacturers:
      1) Advanced Architectural Products: SMARTci
3. Insulation clip system design: Minimum 4” wide thermal spacer designed for cladding system girt attachment.
4. Clip System and final girt attachment must be coordinated with cladding system manufacturers.
5. Final girt attachment must be designed to be perpendicular to the cladding system primary attachment system.
6. All fastener penetrations through air and vapor shall be fully sealed with compatible sealant where clip system is attached to substrate.
7. No push pin installations allowed for insulation. Insulation to be retained without fasteners.
8. Insulation to be installed in staggered layers with no gaps or voids.
9. Transition between the insulation clip system and the cladding final girt attachment will occur within the staggered layers of the insulation. Attachment of the cladding to the insulation clip may not occur at the outside face of the final layer of insulation.
10. System to be designed to accommodate the following maximum live load deflection in the plane of the exterior wall:
    a. Verify maximum live load deflection with structural requirements or 3/8 inch, whichever is greater.

2.3 MATERIALS

A. Wood Veneer Exterior Wall Panel with Resin Core
1. Panels: Grade A rotary cut, hardwood veneer from farmed forests and bonded to a bakelite core.
2. Fire Rating: Class A in accordance with ASTM E-84 criteria for flame spread 10 and smoke development 10 and Class 2 (M1) fire rating in accordance with UNE-EN 2372
3. Color: Pale
4. Panel Thickness: 8 mm.
5. Panel Dimensions: As indicated on drawings. Provide panels factory cut to required sizes. Factory finish all factory cut edges.
6. Adjacent flashings to match reveals.
7. Mounting: Exposed Fasteners to an subframe as required to suit loading.
8. Subframe Assembly: Extruded aluminum system. Provide manufacturer's standard sections as required for support and alignment of metal panel system which allows for attachment clips as necessary to accommodate continuous insulation.
9. Fasteners: Self-threading screws (SFS-SX3-L-12) with smooth heads lacquered to match panels.
10. Copings, Break Metal, Flashings and Trim: Provide as specified in Section 07 62 00 Sheet Metal Flashing and Trim.

B. MOUNTING SYSTEM
1. Manufacturer's ventilated facade mounting system.
   a. Sub-Structure: Exposed Fasteners to an Aluminum Subframe.
   b. Fasteners: Manufacturer's exposed head fasteners, color matched to color of wood veneer panel

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine supporting structure and conditions under which the work is to be erected, and notify the Contractor in writing of conditions detrimental to proper and timely completion of the work. Do not proceed with erection until unsatisfactory conditions have been corrected.

B. Prior to installation, verify water barrier has been properly installed over sheathing substrate. Notify Architect in writing of unsatisfactory conditions prior to beginning installation.

3.2 PREPARATION

A. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

B. Protect metal surfaces in contact with concrete, masonry mortar, plaster or other cementitious surface with isolation coating.

3.3 EXTERIOR WALL THERMAL CLIP SYSTEM AND INSULATION

A. Install thermal clip assembly in accordance with approved shop drawings and manufacturer's instructions. Install to depth of cladding attachment system as detailed.

B. Install exterior wall insulation in conjunction with installation of attachment system provided as part of each cladding system.

C. All fastener penetrations through air and vapor shall be fully sealed with compatible sealant where clip system is attached to substrate.

D. No push pin installations allowed for insulation. Insulation to be retained without fasteners.

E. Insulation to be installed in staggered layers with no gaps or voids.

F. Transition between the insulation clip system and the cladding final girt attachment will occur within the staggered layers of the insulation. Attachment of the cladding to the insulation clip may not occur at the outside face of the final layer of insulation.

3.4 INSTALLATION

A. Comply with panel manufacturer’s instructions for assembly, installation and erection of panels, trims, flashings and sealants.

B. Do not install component parts, which are observed to be defective, including warped, bowed, dented, abraded and/or broken members

C. Install composite wood veneer panel subframe per manufacturer’s written instructions.

D. Do not force panels into place.

E. Install structural supports required to provide a complete system. Support system shall be installed to the same tolerance as required of the panel system.

F. Attach panels with exposed fastening. Space fastener symmetrically in straight rows as approved in shop drawings.

~~3.5 FIELD QUALITY CONTROL~~ removed with Addendum 3

~~A. Field hose testing for resistance to water leakage shall be conducted and results interpreted as defined herein. Perform a minimum of three (3) field hose tests. Test areas shall include both panel and adjacent curtain wall construction. Coordinate testing of panel areas with adjacent curtain wall construction contractors as required. Area and time of tests shall be per the direction of the Architect. Initial testing shall be conducted early in the construction schedule. Schedule any out of sequence work necessary, such as out of sequence sealant work, so that selected areas can be tested as specified.~~

~~B. Size of panel test areas will be as selected by Architect and will primarily be at areas surrounding curtain wall test area openings. There shall be no unacceptable water leakage as defined in this Section.~~

~~C. Conduct test with Monarch Type B-25 #6.030 brass nozzle and 3/4 inch diameter hose. Water pressure to nozzle shall be in the range 30 to 35 psi. Working upward from bottom of test area, direct water at 5 foot long segments~~

~~of panel joints and perimeter joints, moving slowly back and forth on each segment for minimum of 5 minutes. Sustained spraying at one point while the nozzle remains stationary is acceptable. Tip of nozzle shall be 12 inches from specimen exterior surface. Nozzle shall generally be perpendicular to specimen surface, but shall be tilted to any angle that maximizes exposure of a given joint to water flow rate and kinetic energy. Continuously check for leakage on indoor side. If necessary to pinpoint leak sources, perform additional testing. Repeated testing of joints is acceptable. The use of masking to pinpoint leaks is acceptable.~~

~~D. Check completed areas below test area, and report any leaks that occur. A test that results in leakage at a completed area below a designated test area is a failure.~~

~~E. Contractor performing work of this Section shall provide powered scaffold, hose, water supply, and manpower to perform each test, plus any unsuccessful tests.~~

~~F. If failure occurs, revise and retest specimens. Modifications must be realistic in terms of project conditions, must maintain standards of quality and durability and are subject to approval.~~

~~G. If failure necessitates retesting, Contractor for Work of this Section shall pay all additional fees associated with retesting, including fees and costs incurred by the testing agency, the Architect, Owner and their representatives.~~

~~H. Submit, for information only, reports that contain dates of tests, elevation drawings of test areas with locations relative to grid lines (including any lower areas where leaks occur), and location of each leak.~~

~~I. Coordinate testing under this section with testing specified in Section 08 44 13 - Glazed Aluminum Curtain Walls.~~

~~J. Replace and/or repair components that have failed field testing and retest until performance is satisfactory.~~

3.6 MAINTENANCE

A. Remove stains and graffiti with mild ph-neutral, non-abrasive soap and damp cloth.

B. Avoid use of caustic cleaning solutions, automatic cleaners or excessive liquids.

END OF SECTION

03ADD

SECTION 07 42 13.23
ALUMINUM COMPOSITE PANELS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Exterior cladding consisting of formed aluminum composite material (ACM) sheet, secondary supports, and anchors to structure, attached to solid backup.

B. Matching flashing and trim.

C. Interior aluminum composite column covers.

1.2 RELATED REQUIREMENTS

A. Section 07 21 00 – Thermal Insulation: Insulation and thermal clip assembly.

B. Section 07 25 00 - Weather Barriers

C. Section 07 92 00 - Joint Sealants: Sealing joints between siding and adjacent construction and fixtures.

1.3 REFERENCE STANDARDS

A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2014.

B. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2015.

C. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2016a.

D. ASTM A276/A276M - Standard Specification for Stainless Steel Bars and Shapes; 2016a.

E. ASTM A480/A480M - Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip; 2016a.

F. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.

G. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2015.

H. ASTM A792/A792M - Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process; 2010 (Reapproved 2015).

I. ASTM D523 - Standard Test Method for Specular Gloss; 2014.

J. ASTM D1781 - Standard Test Method for Climbing Drum Peel for Adhesives; 1998 (Reapproved 2012).

K. ASTM D1929 - Standard Test Method for Determining Ignition Temperature of Plastics; 2016.

L. ASTM D2244 - Standard Practice for Calculation of Color Tolerances and Color Differences from Instrumentally Measured Color Coordinates; 2016.

M. ASTM D4214 - Standard Test Methods for Evaluating the Degree of Chalking of Exterior Paint Films; 2007 (Reapproved 2015).

N. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2016.

O. ASTM E283 - Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen; 2004 (Reapproved 2012).

P. ASTM E330/E330M - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference; 2014.

Q. ASTM E331 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference; 2000 (Reapproved 2016).

1.4 ADMINISTRATIVE REQUIREMENTS

A. Pre-Installation Meeting: Convene one week before starting work of this section to verify project requirements, co-ordinate with installers of other work, establish condition and completeness of building substrate, and review manufacturers' installation instructions and warranty requirements.

1. Require attendance by the installer and relevant sub-contractors.
2. Include ACM sheet manufacturer's representative and wall system manufacturer's representative to review storage and handling procedures.
3. Review in detail truck transportation, parking, vertical transportation, schedule, personnel, installation of adjacent materials and substrate.
4. Review procedures for protection of work and other construction.

1.5 SUBMITTALS

A. Product Data - MCM Sheets: Manufacturer's data sheets on each product to be used, including thickness, physical characteristics, and finish, and:
   1. Finish manufacturer's data sheet showing physical and performance characteristics.
   2. Storage and handling requirements and recommendations.
   3. Fabrication instructions and recommendations.
   4. Specimen warranty for finish, as specified herein.

B. Product Data - Wall System: Manufacturer's data sheets on each product to be used, including:
   1. Physical characteristics of components shown on shop drawings.
   2. Storage and handling requirements and recommendations.
   3. Installation instructions and recommendations.

C. Shop Drawings: Show layout and elevations, dimensions and thickness of panels, connections, details and location of joints, sealants and gaskets, method of anchorage, number of anchors, supports, reinforcement, trim, flashings, and accessories.
   1. Indicate panel numbering system.
   2. Differentiate between shop and field fabrication.
   3. Indicate substrates and adjacent work with which the wall system must be coordinated.
   4. Include large-scale details of anchorages and connecting elements.
   5. Include large-scale details or schematic, exploded or isometric diagrams to fully explain flashing at a scale of not less than 1-1/2 inches per 12 inches.
   6. Provide calculations indicating loads of cladding system on thermal clip support assembly.
   7. Include design engineer's stamp or seal on shop drawings for panels, backup framing, attachments and anchors. Engineer shall be licensed in Iowa.

D. Test Report: Submit report of full-size mock-up tests for air infiltration, water penetration, and wind performance.

E. Maintenance Data: Care of finishes and warranty requirements.

F. Executed Warranty: Submit warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

G. Compatibility:
   1. Submit letter from manufacturer stating that materials proposed for use are permanently chemically compatible and adhesively compatible with adjacent materials proposed for use.
   2. Submit letter from manufacturer stating that cleaning materials used during installation are chemically compatible with each of the adjacent materials proposed for use.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver products in manufacturer's original, unopened, undamaged containers with identification labels intact.
   1. Protect finishes by applying heavy duty removable plastic film during production.
   2. Package for protection against transportation damage.
   3. Provide markings to identify components consistently with drawings.
   4. Exercise care in unloading, storing and installing panels to prevent bending, warping, twisting and surface damage.

B. Store products protected from exposure to harmful weather conditions and at temperature conditions recommended by manufacturer.
   1. Store in well ventilated space out of direct sunlight.
   2. Protect from moisture and condensation with tarpaulins or other suitable weather tight covering installed to provide ventilation.
   3. Store at a slope to ensure positive drainage of any accumulated water.
   4. Do not store in any enclosed space where ambient temperature can exceed 120 degrees F.

5. Avoid contact with any other materials that might cause staining, denting, or other surface damage.

1.7 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal wall panel assemblies that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Structural failures, including rupturing, cracking or puncturing.
      b. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
   2. Warranty Period: Three years from date of Substantial Completion.

B. ACM Sheet Manufacturer's Finish Warranty: Provide manufacturer's written warranty stating that the finish will perform as follows for minimum of 20 years:
   1. Chalking: No more than that represented by a No. 8 rating based on ASTM D4214.
   2. Color Retention: No fading or color change in excess of 5 Hunter color difference units, calculated in accordance with ASTM D2244.
   3. Gloss Retention: Minimum of 30 percent gloss retention, when tested in accordance with ASTM D523.

PART 2 PRODUCTS

2.1 LEED REQUIREMENTS

A. Recycled Content: Minimum 30 percent recycled content value: post-consumer recycled content plus one-half of pre-consumer recycled content.

2.2 WALL PANEL SYSTEM

A. Wall Panel System: Metal panels, fasteners, and anchors designed to be supported by framing or other substrate provided by others; provide installed panel system capable of maintaining specified performance without defects, damage or failure.
   1. Provide structural design by or under direct supervision of a Structural Engineer licensed in the State in which the Project is located.
   2. Provide drained and back ventilated, reveal joint, rout and return panel system:
      a. The system shall consist of ACM panels, and a system of custom aluminum extrusions of size and shape indicated on drawing as specified herein. The system must utilize a Rout and Return configuration and a system of custom aluminum extrusions of size and shape indicated on drawings and as specified herein. The panel system shall be non-directional/non-sequential type installation and shall allow for the indiscriminate removal of any panel without disturbing adjacent panels. The system must allow for the removed panel to be replaced in the original and tested method.
   3. Basis-of-Design: Metal Design System, Series 44.

B. System Description
   1. A complete, engineered metal aluminum or stainless steel clip girt system with metal member framing, closure pieces, trim and flashing. The system is to be composed of aluminum composite panels attached to perimeter channels. System to be designed and engineered to attach to wall assembly substructure as provided under Section 07 21 00. System shall be designed to incorporate flashing and drainage components in such a way that system will properly perform as a rear ventilated rainscreen system.
   2. System installation shall allow for all movements within structure and to support loads transferred from the adjacent construction and to fit within the space allotted without projections into the finished space as shown on the Drawings.
   3. Provide in conjunction with wall substrate and air/water barrier a weather tight wall assembly utilizing the "rain screen principle".
      a. System design shall be single-source responsibility by the cladding supplier. All design criteria shall be project specific in accordance with the requirements of cladding supplier. Products provided must conform to the design intent shown.
      b. Panel System: Drained and Back Ventilated Rainscreen Design. System shall drain water and condensation to exterior. A complete pre-engineered system including but not limited to cladding panels, support structure, closure pieces, trim and flashing. Wall panels shall be removable. Fasteners are exposed.
      c. Joints: Shall be dry and un-caulked.

d. Metal Flashing: Provide metal flashing for a proper water managed assembly, to direct condensation and water infiltration within the wall to weeping points.
   1) Drainage flashing is the primary component of a water managed system which diverts water that has penetrated the exterior cladding away from the cladding compartment or condensation that occurs at the interior face of cladding surface.
   2) Provide metal drainage flashing at locations listed below prior to installation of membrane to assure proper water drainage. Membrane shall assure proper lap over flashing:
      (a) At bottom of system.
      (b) At penetrations: windows, doors, louvers, etc.
      (c) At floor line or other locations which accommodate vertical movement.

4. System shall provide minimum 1 inch “clear” airspace behind cladding for proper ventilation.
5. Design Modifications: Shall be provided only as necessary to satisfy as-built conditions and to meet performance requirements. Significant system and aesthetic design shall be requested in writing to architect 10 days prior to bid date.
6. Material supplier shall be responsible for engineering system per architectural design criteria and performance requirements.
7. Condensation: System shall accommodate positive drainage for moisture entering or condensation occurring within panel system.
8. Flatness: System shall be flat with no noticeable warpage, buckling, deflections or other surface irregularities

C. Performance Requirements:
1. Thermal Movement: Provide for free and noiseless vertical and horizontal thermal movement due to expansion and contraction under material temperature range of minus 20 degrees F to 180 degrees F without buckling, opening of joints, undue stress on fasteners, or other detrimental effects; allow for ambient temperature at time of fabrication, assembly, and erection procedures.
2. Wind Performance: Provide system tested in accordance with ASTM E330/E330M without permanent deformation or failures of structural members under the following conditions:
   a. Panels shall be designed to withstand the Design Wind Load based upon the local building code, but in no case less than 20 pounds per square foot (psf) and 30 psf on parapet and corner panels.
   b. Maximum deflection of perimeter framing member of L/175 or 3/4", whichever is less, normal to plane of the wall; maximum deflection of individual panels of L/60.
   c. Maximum anchor deflection in any direction of 1/16 inch at connection points of framing members to anchors.
   d. At 1-1/2 times design pressure, permanent deflections of framing members shall not exceed L/100 of span length and components shall not experience failure or gross permanent distortion. At connection points of framing members to anchors, permanent set shall not exceed 1/16".
3. Air Infiltration: 0.06 cfm/sq ft of wall area, maximum, when tested at 1.57 psf in accordance with ASTM E283.
4. Water Penetration: No water penetration under static pressure when tested in accordance with ASTM E331 at a differential of 10 percent of inward acting design load, 6.24 psf minimum, after 15 minutes.
   a. Water penetration is defined as the appearance of uncontrolled water on the interior face of the wall.
   b. Dynamic Water Infiltration – System will show compliance with the requirements stated in the AAMA 501 Dynamic Water Infiltration test.n to drain leakage and condensation to the exterior face of the wall.

D. Panels: One inch deep pans formed of metal composite material sheet by routing back edges of sheet, removing corners, and folding edges.
1. Reinforce corners with riveted aluminum angles.
2. Provide concealed attachment to supporting structure by adhering attachment members to back of panel; attachment members may also function as stiffeners.
3. Flatness Criteria: Maximum 1/8” in 15’-0” on panel in any direction for assembled units (non-accumulative).
4. Secure members to back face of panels using structural silicone sealant approved by ACM sheet manufacturer.
5. Fabricate panels under controlled shop conditions.
6. Where final dimensions cannot be established by field measurement before commencement of manufacturing, make allowance for field adjustments without requiring field fabrication of panels.
7. Fabricate as indicated on drawings and as recommended by MCM sheet manufacturer.
   a. Make panel lines, breaks, curves and angles sharp and true.

b. Keep plane surfaces free from warp or buckle.
c. Keep panel surfaces free of scratches or marks caused during fabrication.

8. Provide joint details providing a watertight and structurally sound wall panel system that allows no uncontrolled water penetration on inside face of panel system.

E. Perimeter Channels: Extruded aluminum channels which integrate to the continuous sub-system as detailed on drawings, so as to provide the following essential features:
1. Edges of ACM shall be supported by aluminum channels on all four sides.
2. Minimum overall system is 1-7/8".
3. The ACM panel shall be held in place with stainless steel pins through the panel returns and engaged over the channel extrusion allowing the panel to free float for thermal expansion in all directions. Panel systems utilizing attachment methods which secure two edges of the panel to the structure will not be allowed.
4. Channels shall be mill finished.

F. Reveals at Panel Joints:
1. Panel joints are to be joined with manufacturer's standard clip and snap cover. Snap covers shall be painted to match aluminum composite panel color.
2. Panel joints shall be ½" wide x 3/8" deep open reveal (Nominal).

G. Flashings:
1. Fabricate flashing from aluminum sheet in matching color; where exposed to view finish to match adjacent panels. Provide lap strip under flashing at abutted conditions; with lapped surfaces sealed with a full-bed of non-hardening sealant.

2.3 MATERIALS

A. Aluminum Composite Material (ACM) Sheet: Two sheets of aluminum sandwiching a core of extruded thermoplastic material, no foamed insulation material content.
1. Overall Sheet Thickness: 4 mm, minimum.
2. Face Sheet Thickness: 0.020 inches, minimum.
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3. Bond and Peel Strength: No adhesive failure of the bond between the core and the skin nor cohesive failure of the core itself below 22.4 inch-pound/inch with no degradation in bond performance, when tested in accordance with ASTM D1781, simulating resistance to panel delamination, after 8 hours of submersion in boiling water and after 21 days of immersion in water at 70 degrees F.
4. Surface Burning Characteristics: Flame spread index of 25, maximum; smoke developed index of 450, maximum; when tested in accordance with ASTM E84.
5. Flammability: Self-ignition temperature of 650 degrees F or greater, when tested in accordance with ASTM D1929.
6. Finish: Exterior surfaces shall be coil coated with FEVE or PVDF based resin which meets or exceeds AAMA 2605-02 testing for durability In particular, the coating must have successfully passed the following or equal tests:
a. Humidity Resistance:
1) Test Method: ASTM D-2247. No formation of blisters when subjected to condensing water fog at 100% relative humidity and 100 degree Fahrenheit for 3000 hours.
b. Salt Spray Resistance
1) Test Method: ASTM B-117; expose coating system to 3000 hours, using 5% NaCl solution.
(a) Corrosion creepage from scribe line: 1/8" max.
(b) Minimum blister rating of 8 within the test specimen field.
c. Weather Exposure
1) Outdoor
(a) Ten year exposure at 45 degree angle facing south Florida exposure.
(b) Maximum color change of 5 Delta E units as calculated in accordance with ASTM D-2244.
(c) Maximum chalk rating of 8 in accordance with ASTM D-659.
(d) No checking, crazing, adhesion loss.
7. Color: As selected by Architect.
8. Products:
a. ALPOLIC material manufactured by Mitsubishi Plastics Composites America, Inc. ALPOLIC Materials Division.
b. REYNOBOND material manufactured by Reynolds Metals Company, Alcoa Architectural Products (USA).

c. ALUCOBOND material manufactured by 3A Composites USA Inc.

B. Metal Framing Members: Include sub-girts, zee-clips, base and sill angles and channels, hat-shaped and rigid channels, and furring channels required for complete installation.
1. Provide material strength, dimensions, configuration as required to meet the applied loads applied and in compliance with applicable building code.
2. Sheet Steel Components: ASTM A653/A653M galvanized to G90/Z275 or zinc-iron alloy-coated to A60/ZF180; or ASTM A792/A792M aluminum-zinc coated to AZ60/AZM180.
3. Stainless Steel Sheet Components: ASTM A480/A480M.

C. Flashing: Sheet aluminum; 0.040 inch thick, minimum; finish and color to match MCM sheet.

D. Anchors, Clips and Accessories: Use one of the following:
1. Stainless steel complying with ASTM A276/A276M, ASTM A480/A480M, or ASTM A666.
2. Steel complying with ASTM A36/A36M and hot-dipped galvanized to ASTM A153/A153M.
3. Steel complying with ASTM A36/A36M and hot-dipped galvanized to ASTM A123/A123M Coating Grade 10.

E. Fasteners:
1. Exposed Fasteners: Stainless steel; permitted only where absolutely unavoidable and subject to prior approval of the Architect.
2. Screws: Self-drilling or self-tapping Type 410 stainless steel or zinc-alloy steel hex washer head, with EPDM or PVC washer under heads of fasteners bearing on weather side of metal wall panels.
3. Bolts: Stainless steel.
4. Fasteners for Flashing and Trim: Blind fasteners of high-strength aluminum or stainless steel.

F. Provide panel system manufacturer's and installer's standard corrosion resistant accessories, including fasteners, clips, anchorage devices and attachments.

2.4 FABRICATION

A. Fabricate panel units to dimensions indicated on the drawings based on an assumed design temperature of 70 degrees F.

B. Fabricate panels in sizes shown using composite aluminum panel material and perimeter clips so that the panel thickness at the joinery is as required by design. Completed panel shall be properly fabricated and designed so that no restraints can be placed on the panel, which might result in compressive skin stresses. The installation detailing shall be such that the installed panels shall remain flat due to temperature changes and at all times remain water and wind tight. Oil canning of panel surface is not acceptable.

C. Shop fabricate units ready for erection. If not shop assembled, pre-fabricate components at the shop as required for proper and expeditious field assembly.

D. Design, fabricate, assemble, and erect wall panel units.

E. Where drawings indicate, factory curve panels to required radius.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify dimensions, tolerances, and interfaces with other work.

B. Verify substrate on-site to determine that conditions are acceptable for product installation in accordance with manufacturers written instructions.

C. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

D. Notify Architect in writing of conditions detrimental to proper and timely completion of work. Do not proceed with erection until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Do not install products that are defective, including warped, bowed, dented, and broken members, and members with damaged finishes.

B. Comply with instructions and recommendations of ACM sheet manufacturer and wall system manufacturer, as well as with approved shop drawings.

C. Do not cut, trim, weld, or braze component parts during erection, in a manner which would damage finish, decrease strength, or result in a visual imperfection or a failure in performance of wall panels. Return component parts which require alteration to shop for re-fabrication, if possible, or for replacement by new parts.

D. Install wall system securely allowing for necessary thermal and structural movement; comply with wall system manufacturer's instructions for installation of concealed fasteners.

E. Do not handle or tool products during erection in manner that damages finish, decreases strength, or results in visual imperfection or failure in performance. Return component parts that require alteration to shop for refabrication, if possible, or for replacement with new parts.

F. Do not form panels in field unless required by wall system manufacturer and approved by the Architect; comply with ACM sheet manufacturer's instructions and recommendations for field forming.

G. Separate dissimilar metals; use gasket fasteners, isolation shims, or isolation tape where needed to eliminate possibility of electrolytic action between metals.

H. Install flashings as indicated on shop drawings At flashing butt joints, provide a lap strap under flashing and seal lapped surfaces with a full bed of non-hardening sealant.

I. Install square, plumb, straight, and true, accurately fitted, with tight joints and intersections maintaining the following installation tolerances:
   1. Variation From Plane or Location: 1/2 inch in 30 feet of length and up to 3/4 inch in 300 feet, maximum.
   2. Deviation of Vertical Member From True Line: 0.1 inch in 25 feet run, maximum.
   3. Deviation of Horizontal Member From True Line: 0.1 inch in 25 feet run, maximum.
   4. Offset From True Alignment Between Two Adjacent Members Abutting End To End, In Line: 0.03 inch, maximum.

J. Replace damaged products.

~~**3.3 FIELD QUALITY CONTROL**~~ removed with Addendum 3

~~A. Field hose testing for resistance to water leakage shall be conducted and results interpreted as defined herein. Perform a minimum of one (1) field hose test. Test areas shall include both panel and adjacent curtain wall construction. Coordinate testing of panel areas with adjacent curtain wall construction contractors as required. Area and time of tests shall be per the direction of the Architect. Initial testing shall be conducted early in the construction schedule. Schedule any out of sequence work necessary, such as out of sequence sealant work, so that selected areas can be tested as specified.~~

~~B. Size of panel test areas will be as selected by Architect and will primarily be at areas surrounding curtain wall test area openings. There shall be no unacceptable water leakage as defined in this Section.~~

~~C. Conduct test with Monarch Type B-25 #6.030 brass nozzle and 3/4 inch diameter hose. Water pressure to nozzle shall be in the range 30 to 35 psi. Working upward from bottom of test area, direct water at 5 foot long segments of panel joints and perimeter joints, moving slowly back and forth on each segment for minimum of 5 minutes. Sustained spraying at one point while the nozzle remains stationary is acceptable. Tip of nozzle shall be 12 inches from specimen exterior surface. Nozzle shall generally be perpendicular to specimen surface, but shall be tilted to any angle that maximizes exposure of a given joint to water flow rate and kinetic energy. Continuously check for leakage on indoor side. If necessary to pinpoint leak sources, perform additional testing. Repeated testing of joints is acceptable. The use of masking to pinpoint leaks is acceptable.~~

~~D. Check completed areas below test area, and report any leaks that occur. A test that results in leakage at a completed area below a designated test area is a failure.~~

~~E. Contractor performing work of this Section shall provide powered scaffold, hose, water supply, and manpower to perform each test, plus any unsuccessful tests.~~

~~F. If failure occurs, revise and retest specimens. Modifications must be realistic in terms of project conditions, must maintain standards of quality and durability and are subject to approval.~~

~~G. If failure necessitates retesting, Contractor for Work of this Section shall pay all additional fees associated with retesting, including fees and costs incurred by the testing agency, the Architect, Owner and their representatives.~~

~~H. Submit, for information only, reports that contain dates of tests, elevation drawings of test areas with locations relative to grid lines (including any lower areas where leaks occur), and location of each leak.~~

~~I. Coordinate testing under this section with testing specified in Section 08 44 13 - Glazed Aluminum Curtain Walls.~~

~~J.~~ ~~Replace and/or repair components that have failed field testing and retest until performance is satisfactory.~~

3.4 CLEANING

A. Ensure weep holes and drainage channels are unobstructed and free of dirt and sealants.

B. Remove protective film after installation of joint sealers, after cleaning of adjacent materials, and immediately prior to completion of work.

C. Remove temporary coverings and protection of adjacent work areas.

D. Clean installed products in accordance with manufacturer's instructions.

3.5 PROTECTION

A. Protect installed panel system from damage until Date of Substantial Completion.

END OF SECTION

SECTION 08 43 13

ALUMINUM-FRAMED STOREFRONTS

03ADD

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Aluminum-framed storefront, with vision glass.

B. Aluminum doors and frames.

C. Weatherstripping.

1.2 RELATED REQUIREMENTS

A. Section 08 80 00 - Glazing: Glass and glazing accessories.

1.3 REFERENCE STANDARDS

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A. AAMA CW-10 - Care and Handling of Architectural Aluminum From Shop to Site; 2015.

B. AAMA 501.2 - Quality Assurance and Diagnostic Water Leakage Field Check of Installed Storefronts, Curtain Walls, and Sloped Glazing Systems; 2015.

C. AAMA 1503 - Voluntary Test Method for Thermal Transmittance and Condensation Resistance of Windows, Doors and Glazed Wall Sections; 2009.

D. AAMA 2604 - Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2013.

E. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2014.

F. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2013.

G. ASTM E283 - Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen; 2004 (Reapproved 2012).

H. ASTM E330/E330M - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference; 2014.

I. ASTM E331 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference; 2000 (Reapproved 2016).

J. ASTM E331 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference; 2000 (Reapproved 2009).

1.4 SUBMITTALS

A. Product Data: Provide component dimensions, describe components within assembly, anchorage and fasteners, glass and infill, internal drainage details.

B. Shop Drawings: Indicate system dimensions, framed opening requirements and tolerances, affected related Work, expansion and contraction joint location and details, and field welding required. Include plans, elevations, sections, details, attachements to other work, embedment type, size and layout.

1. Provide water control diagrams for condensation and infiltration evacuation.
2. Include structural analysis data signed and sealed by the professional engineer, licensed in the State of Iowa, responsible for their preparation.

C. Samples: Submit two samples 2 x 3 inches in size illustrating finished aluminum surface, color matched to existing storefront framing..

1.5 QUALITY ASSURANCE

A. Designer Qualifications: Design structural support framing components under direct supervision of a Professional Structural Engineer experienced in design of this Work and licensed in the State in which the Project is located.

B. Manufacturer Qualifications: Company specializing in performing work of type specified and with at least three years of documented experience.

C. Mockups: Provide materials and installation for mockups specified in Division 01 Section "Mock-Up Requirements and as indicated on Drawings Sheet A---- to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Handle products of this section in accordance with AAMA CW-10.

B. Protect finished aluminum surfaces with wrapping. Do not use adhesive papers or sprayed coatings that bond to aluminum when exposed to sunlight or weather.

1.7 FIELD CONDITIONS

A. Do not install sealants when ambient temperature is less than 40 degrees F. Maintain this minimum temperature during and 48 hours after installation.

1.8 WARRANTY

A. Standard Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of aluminum-framed systems that do not comply with requirements or that deteriorate as defined in this Section within spedified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Structural failures including, but not limited to, excessive deflection.
      b. Noise or vibration caused by thermal movements.
      c. Deterioration of metals and other materials beyond normal weathering.
      d. Water leakage through fixed glazing and framing areas.
      e. Failure of operating components to function property.
   2. Warranty Period: Two years from date of Substantial Completion.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Basis of Design: See below under description of products.
   1. Exterior Storefront System: Kawneer, Trifab VG 451T.

B. Other Acceptable Manufacturers:
   1. EFCO Corporation: www.efcocorp.com.
   2. Architectural Wall Systems.
   3. YKK AP America Inc
   4. Manko Window Systems, Inc.: www.mankowindows.com.
   5. United States Aluminum Corp
   6. Vistawall Architectural Products
   7. Pittco Architectural Metals Inc: www.pittcometals.com/sle.
   8. Tubelite, Inc.: www.tubeliteinc.com.

2.2 STOREFRONT

A. Aluminum-Framed Storefront: Factory fabricated, factory finished aluminum framing members with infill, and related flashings, anchorage and attachment devices.
   1. Finish: High performance organic coatings.
      a. Factory finish all surfaces that will be exposed in completed assemblies.
      b. Touch-up surfaces cut during fabrication so that no natural aluminum is visible in completed assemblies, including joint edges.
   2. Finish Color: As indicated on the drawings.

B. Performance Requirements:
   1. General: Provide aluminum-framed systems, including anchorage, capable of withstanding, without failure, the effects of the following:
      a. Structural loads.
      b. Thermal movements.

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c. Movements of supporting structure indicated on Drawings including, but not limited to, story drift and deflection from uniformly distributed and concentrated live loads.
d. Dimensional tolerances of building frame and other adjacent construction.
e. Failure includes the following:
1) Deflection exceeding specified limits.
2) Thermal stresses transferred to building structure.
3) Framing members transferring stresses, including those caused by thermal and structural movements, to glazing.
4) Noise or vibration created by wind and thermal and structural movements.
5) Loosening or weakening of fasteners, attachments, and other components.
6) Sealant failure.
7) Failure of operating units to function properly.

2. Structural Loads:
a. Wind Loads: As indicated on Structural Drawings.
b. Seismic Loads: As indicated on Structural Drawings.
3. Deflection of Framing Members Normal to Wall Plane: Limited to 1/175 of clear span for spans up to 13 feet 6 inches and to 1/240 of coear span plus 1/4 inch for spans greater than 13 feet 6 inches or an amount that restricts edge deflection of individual glazing lites to 3/4 inch, whichever is less.
4. Structural-Test Performance: Systems tested according to ASTM E 330 as follows:
a. When tested at positive and negative wind-load design pressures, systems do not evidence deflection exceeding specified limits.
b. When tested at 150 percent of positieve and negative wind-load design pressures, systems, including anchorage, do not evidence material failures, structural distress, and permanent deformation of main framing members exceeding 0.2 percent of span.
c. Test Durations: As required by design wind velocity but not less than 10 seconds.
5. Wind Loads: Design and size components to withstand the specified load requirements without damage or permanent set, when tested in accordance with ASTM E330/E330M, using loads 1.5 times the design wind loads and 10 second duration of maximum load.
a. Member Deflection: Limit member deflection to flexure limit of glass in any direction, with full recovery of glazing materials.
6. Water Penetration Resistance: No uncontrolled water on interior face, when tested in accordance with ASTM E331 at pressure differential of 8 psf.
7. Air Leakage: Maximum of 0.06 cu ft/min sq ft of wall area, when tested in accordance with ASTM E283 at 6.27 psf pressure differential across assembly.
8. Movement: Accommodate movement between storefront and perimeter framing and deflection of lintel, without damage to components or deterioration of seals.
9. Air Infiltration: Limit air infiltration through assembly to 0.06 cu ft/min/sq ft of wall area, measured at minimum static-air-pressure difference of 6.24 lbf/sq. ft. across assembly in accordance with ASTM E 283.
10. Condensation Resistance Factor: Measure in accordance with AAMA 1503 with 1 inch insulating glass installed. Fixed glazing and framing areas of systems have condensation-resistance factor (CRF) of not less than 53 when tested according to AAMA 1503.
11. Water Leakage: None, when measured in accordance with ASTM E 331 at a minimum static-air-pressure difference of 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft.
12. System Internal Drainage: Drain to the exterior by means of a weep drainage network any water entering joints, condensation occurring in glazing channel, and migrating moisture occurring within system.
13. Air and Vapor Seal: Maintain continuous water barrier membrane throughout assembly, primarily in line with pane of glass and heel bead of glazing compound.
14. Expansion/Contraction: Provide for expansion and contraction within system components caused by cycling temperature range of 170 degrees F over a 12 hour period without causing detrimental effect to system components, anchorages, and other building elements.

2.3 COMPONENTS

A. Aluminum Framing Members: Tubular aluminum sections, thermally broken with interior section insulated from exterior, drainage holes and internal weep drainage system.
1. Framing members for interior applications need not be thermally broken.
2. Cross-Section: As indicated on drawings.

B. Swing Doors: Glazed aluminum.
   1. Thickness: 1-3/4 inches.
   2. Top Rail: 3-1/2 inches wide.
   3. Vertical Stiles: 3-1/2 inches wide.
   4. Bottom Rail: 10 inches wide.
   5. Glazing Stops: Square.
   6. Finish: Same as storefront.

2.4 MATERIALS

A. Extruded Aluminum: ASTM B221 (ASTM B221M).

B. Fasteners: Stainless steel.

C. Glass: As specified in Section 08 80 00.

D. Glazing Accessories: As specified in Section 08 80 00.

2.5 FINISHES

A. Class I Natural Anodized Finish: AAMA 611 AA-M12C22A41 Clear anodic coating not less than 0.7 mils thick.

2.6 HARDWARE

A. Door Hardware: As specified in Section 08 71 00 - Door Hardware.

B. Weatherstripping: Wool pile, continuous and replaceable; provide on all doors.

C. Sill Sweep Strips: Resilient seal type, retracting, of neoprene; provide on all doors.

2.7 FABRICATION

A. Fabricate components with minimum clearances and shim spacing around perimeter of assembly, yet enabling installation and dynamic movement of perimeter seal and that have the following characteristics:
   1. Profiles that are sharp, straight and free of defects or deformations.
   2. Accurately fitted and secure joints and corners. Make joints flush, hairline, and weatherproof.
   3. Means to drain water passing joints, condensation occurring within framing members, and moisture migrating within the system to exterior.
   4. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
   5. Provisions for field replacement of glazing from exterior of building.
   6. Fasteners, anchors, and connection devices that are concealed from view to greatest extend possible.

B. Door Frames: Reinforce as required to support loads imposed by door operation and for installing hardware.
   1. At exterior doors, provide compression weather stripping at fixed stops. Provide continous aluminum drip above all doors, extend to outside of door frame.
   2. At interior doors, provide silencers at stops to prevent metal-to-metal contact. Install three silencers on strike jamb of single-door frames and two silencers on head of frames for pairs of doors.

C. Doors: Reinforce doors as required for installing hardware.
   1. At pairs of exterior doors, provide sliding weather stripping retained in adjustable strip mortised into door edge.
   2. At exterior doors, provide weather sweeps applied to door bottoms.

D. Prepare components to receive anchor devices. Fabricate anchors.

E. Coat concealed metal surfaces that will be in contact with cementitious materials or dissimilar metals with bituminous paint.

F. Arrange fasteners and attachments to conceal from view.

G. Reinforce components internally for door hardware .

H. Reinforce framing members for imposed loads.

I. Finishing: Apply factory finish to all surfaces that will be exposed in completed assemblies.
   1. Touch-up surfaces cut during fabrication so that no natural aluminum is visible in completed assemblies, including joint edges.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify dimensions, tolerances, and method of attachment with other work.

B. Verify that wall openings and adjoining air and vapor seal materials are ready to receive work of this section.

3.2 INSTALLATION

A. Install wall system in accordance with manufacturer's instructions.

B. Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities.

C. Provide alignment attachments and shims to permanently fasten system to building structure.

D. Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances, aligning with adjacent work.

E. Provide thermal isolation where components penetrate or disrupt building insulation.

F. Install sill flashings. Turn up ends and edges; seal to adjacent work to form water tight dam.

G. Where fasteners penetrate sill flashings, make watertight by seating and sealing fastener heads to sill flashing.

H. Install anti-walking clips in openings that are more than three frames wide per manufacturers instructions.

I. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration.

J. Coordinate attachment and seal of perimeter air and vapor barrier materials.

K. Pack fibrous insulation in shim spaces at perimeter of assembly to maintain continuity of thermal barrier.

L. Metal Protection:
   1. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape or installing nonconductive spacers as recommended by manufactuer for this purpose.
   2. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.
   3. If necessary protect the exterior framing during masonry wash down.

M. Install glass and infill panels in accordance with Section 08 80 00, using glazing method required to achieve performance criteria.

N. Entrances: Install to produce smooth operation and tight fit at contact points.
   1. Exterior Entrances: Install to produce tight fit at weather stripping and weathertight closure.
   2. Field-Installed Hardware: Install surface-mounted hardware according to hardware manufacturers' written instructions using concealed fasteners to greatest extent possible.

O. Door Hardware: Install door hardware specified in Division 8 Section "Door Hardware."

P. Touch-up minor damage to factory applied finish; replace components that cannot be satisfactorily repaired.

3.3 TOLERANCES

A. Maximum Variation from Plumb: 0.06 inches every 3 ft non-cumulative or 1/16 inches per 10 ft, whichever is less.

B. Maximum Misalignment of Two Adjoining Members Abutting in Plane: 1/32 inch.

3.4 FIELD QUALITY CONTROL

A. Water Spray Test: Before installation of interior finishes has begun, a minimum area of 25 feet by 1 story of aluminum-framed systems designated by Architect shall be tested for water leakage in accordance with AAMA 501.2 and shall not evidence water penetration.

B. Repair or remove work where test results and inspections indicate that it does not comply with specified requirements.

C. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.5 ADJUSTING

A. Adjust operating hardware and sash for smooth operation.

3.6 CLEANING

A. Remove protective material from pre-finished aluminum surfaces.

B. Remove excess sealant by method acceptable to sealant manufacturer.

3.7 PROTECTION

A. Protect installed products from damage until Date of Substantial Completion.

END OF SECTION

SECTION 08 44 13
GLAZED ALUMINUM CURTAIN WALLS

03ADD

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Aluminum-framed curtain wall, with vision glazing and glass infill panels.

B. Miscellaneous components.

1.2 RELATED REQUIREMENTS

A. Section 07 42 13 - Composite Wood Veneer Panels.

B. Section 07 42 13.23 - Aluminum Composite Panels.

1.3 REFERENCE STANDARDS

A. AAMA CW-10 - Care and Handling of Architectural Aluminum From Shop to Site; 2015.

B. AAMA 1503 - Voluntary Test Method for Thermal Transmittance and Condensation Resistance of Windows, Doors and Glazed Wall Sections; 2009.

C. AAMA 2604 - Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2013.

D. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2014.

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E. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2014.

F. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric); 2014.

G. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2014.

H. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2013.

I. ASTM E283 - Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen; 2004 (Reapproved 2012).

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordinate with installation of other components that comprise the exterior enclosure.

B. Preinstallation Meeting: Conduct a preinstallation meeting two weeks before starting work of this section; require attendance by all affected installers. Preinstallation meeting shall to establish procedures to maintain optimum working conditions, and to coordinate this work with related and adjacent work. Agenda for the meeting shall include, but not limited to, the following:
   1. Requirements for Building Envelope Commissioning.
   2. Review of submittals.
   3. Review of surface preparation, minimum curing period and installation procedures.
   4. Review of special details and flashings.
   5. Sequence of construction, responsibilities and schedule for subsequent operations.
   6. Review of mock-up requirements.
   7. Review of inspection, testing, protection and repair procedures.

C. Provide necessary compatibility information for Building Envelope Commissioning.

1.5 SUBMITTALS

A. Product Data: Provide component dimensions, describe components within assembly, anchorage and fasteners, internal drainage details, glazing, and infill.

B. Provide stamped structural calculations for curtain wall assemblies and anchorages prepared by a professional engineer licensed in the State of Iowa.

C. Shop Drawings: : Indicate configurations (including plans, elevations and section views), and construction of all parts of the work, including metal and glass thickness, methods of joining, details of all field connections and

anchorage, fastening and sealing methods, metal finishes, and all pertinent information; completed by the curtain wall manufacturer.

1. Submit full size sections when needed for clarity.
2. Clearly indicate relationship to other work.
3. Begin fabrication only after shop drawings for that work have been accepted by the Design Professional.
4. Submit manufacturer's installation instructions.

D. Verification Samples: Include representative samples of the following for approval:
1. Submit three (3) samples of finished aluminum, 6 x 6 inch in size, illustrating specified color and finish for review and approval by the Design Professional.
2. Glass, each type.
3. Frame, mullion and corner sections.
4. Fasteners and anchors.

E. Test Reports: Submit report of full-size mock-up tests for air infiltration, water penetration, and wind performance.

F. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.6 QUALITY ASSURANCE

A. Provide test reports stating the performance as specified in Article 1.05, not more than four (4) years old.

B. Manufacturer test reports shall be accompanied by the curtain wall manufacturer's letter of certification stating that the tested curtain wall meets or exceeds the referenced criteria for the appropriate curtain wall type.

C. Manufacturer: System shall be manufactured and marketed by a firm with a minimum of twenty (20) years experience in the production and sales of curtain wall systems. Manufacturers proposed for use, but not named in these specifications, shall submit evidence of ability to meet all requirements specified, and include a list of projects of similar design and complexity completed within the past five (5) years.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Handle products of this section in accordance with AAMA CW-10.

B. Protect finished aluminum surfaces with wrapping. Do not use adhesive papers or sprayed coatings that bond to aluminum when exposed to sunlight or weather.

1.8 FIELD CONDITIONS

A. Do not install sealants when ambient temperature is less than 40 degrees F. Maintain this minimum temperature during and 48 hours after installation.

1.9 WARRANTY

A. Provide ten year manufacturer warranty against excessive degradation of exterior finish. Include provision for replacement of units with excessive fading, chalking, or flaking.

B. Total Curtain Wall System:
1. Provide a total system warranty for performance of the total curtain wall installation for five years after the date of Substantial Completion. This includes the glazing (including insulated units), anchorage and setting system, sealing, flashing, etc. as it relates to air, water, and structural adequacy, and these specifications and approved shop drawings.
2. Any deficiencies due to such elements not meeting the specifications shall be corrected by the responsible contractor at his expense during the warranty period.

PART 2 PRODUCTS

2.1 LEED REQUIREMENTS

A. Recycled Content: Provide highest recycled content available, but not less than minimum postconsumer plus one half of pre-consumer content 35 percent.

B. Comply with Section 07 92 00 "Joint Sealants" for silicone sealants. Coordinate with adjacent curtain wall construction.

C. Provide sealants for use inside of the weatherproofing system that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.2 MANUFACTURERS

A. Glazed Aluminum Curtain Walls: Kawneer Company, Inc.: Product 1600 Wall System 1 / System 2.

B. Acceptable manufacturers:
   1. EFCO Corporation
   2. Oldcastle BuildingEnvelope
   3. Wausau Window and Wall Systems
   4. YKK AP
   5. Tubelite.
   6. Pittco Architectural Metals

2.3 COMPONENTS

A. Aluminum-Framed Curtain Wall: Factory fabricated, factory finished aluminum framing members with infill, and related flashings, anchorage and attachment devices.
   1. Outside dry glazed; includes exterior aluminum pressure plate and snap-on mullion cover with interior and exterior dense EPDM preset gasket.
   2. Aluminum Framing Members: Tubular aluminum sections, thermally broken with interior section insulated from exterior, drainage holes and internal weep drainage system.
      a. Cross-Sections: Sizes and shapes as indicated on the Drawings.
      b. Extrusion Wall Thickness: Minimum 1/8 inch (3 mm); all vertical and horizontal members.
   3. Finish: Superior performing organic coatings.
      a. Factory finish surfaces that will be exposed in completed assemblies.
      b. Touch-up surfaces cut during fabrication so that no natural aluminum is visible in completed assemblies, including joint edges.
      c. Coat concealed metal surfaces that will be in contact with cementitious materials or dissimilar metals with bituminous paint.
   4. Provide flush joints and corners, weathersealed, accurately fitted and secured; prepared to receive anchors; fasteners and attachments concealed from view; reinforced as required for imposed loads.
   5. Construction: Eliminate noises caused by wind and thermal movement, prevent vibration harmonics, and prevent "stack effect" in internal spaces.
   6. System Internal Drainage: Drain to the exterior by means of a weep drainage network any water entering joints, condensation occurring in glazing channel, and migrating moisture occurring within system.
   7. Air and Vapor Seal: Maintain continuous air barrier and vapor retarder throughout assembly, primarily in line with inside pane of glazing and inner sheet of infill panel and heel bead of glazing compound.

B. Entrance Doors: Glazed aluminum.
   1. Basis-of-Design Product: Kawneer Company, Inc.; 190 Standard Entrance.
   2. Acceptable manufacturers:
      a. EFCO Corporation
      b. Oldcastle BuildingEnvelope
      c. Wausau Window and Wall Systems
      d. YKK AP
      e. Tubelite Inc.
      f. Pittco Architectural Metals
   3. Major Extruded Sections: 1-3/4 inch thick; minimum 1/8 inch wall thickness.
      a. Top Rail: Minimum 2-1/4 inches wide.
      b. Vertical Stiles: Minimum 2-1/8 inches wide.
      c. Bottom Rail: Minimum 10 inches wide.
   4. Glazing Method: Dry glazed with extruded pressure-fitting aluminum glazing stops, and a gasket that complies with ASTM E 2203.
   5. Glazing Stops: Square; minimum 0.050 inch thickness. Exterior stops shall be an integral part of the door; interior stops shall be snap-in type.
   6. Finish: Same as curtain wall frames.
   7. Construction: Welded corner. Tie rod only construction is not acceptable.

8. Storefront and Vestibule Framing: Where storefront framing is indicated on drawings, provide storefront framing by same manufacturer as curtain wall in sizes as indicated on drawings.

C. Structural Performance Requirements: Design and size components to withstand the following load requirements without damage or permanent set.
   1. Design Wind Loads: Comply with the applicable code.
   2. Movement: Accommodate the following movement without damage to components or deterioration of seals:
      a. Expansion and contraction caused by 180 degrees F surface temperature.
      b. Expansion and contraction caused by cycling temperature range of 170 degrees F over a 12 hour period.
      c. Movement of curtain wall relative to perimeter framing.
      d. Deflection of structural support framing, under permanent and dynamic loads.

D. Water Penetration Resistance: No uncontrolled water on indoor face when tested as follows:
   1. Test Pressure Differential: 10 psf.

E. Air Leakage: Maximum of 0.06 cu ft/min sq ft of wall area, when tested in accordance with ASTM E283 at 6.27 psf pressure differential across assembly.

F. Thermal Performance Requirements:
   1. Condensation Resistance Factor of Framing: 50, minimum, measured in accordance with AAMA 1503.
   2. Overall U-value Including Glazing: 0.36 Btu/(hr sq ft deg F), maximum.

G. COMPONENTS

H. Glazing: As specified in Section 08 80 00.

2.4 MATERIALS

A. Extruded Aluminum: ASTM B221 (ASTM B221M).

B. Sheet Aluminum: ASTM B209 (ASTM B209M).

C. Structural Steel Sections: ASTM A36/A36M; shop primed.

D. Fasteners: Stainless steel; type as required or recommended by curtain wall manufacturer.

E. Concealed Flashings: Stainless steel, 20 gage, 0.032 inch minimum thickness.

F. Curtain Wall Break Metal: Aluminum, minimum 0.064 inch thick, finished to match curtain wall framing.

G. Glazing Gaskets: Type to suit application to achieve weather, moisture, and air infiltration requirements.

H. Glazing Accessories: As specified in Section 08 80 00.

I. Silicone Transision: Provide silicone transition strip at perimeter conditions between composite wood panels, aluminum composite panels, fiber reinforced cementitions panels, thin limestone adhered panels and the work of this section to provide an air and watertight seal. Silicone transition strip must be compatible with the air and vapor barrier being applied to the exterior sheathing withing the exterior cladding systems.
   1. Acceptable Products:
      a. Dow Corning 123 Preformed Silicone Seal
      b. Momentive UltraSpan US1100
      c. Tremco Spectrem Simple Seal

2.5 FINISHES

A. High Performance Organic Coatings: AAMA 2604; multiple coats, thermally cured fluoropolymer system.

B. Color: As indicated on drawings.

PART 3 EXECUTION

3.1 EXAMINATION

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A. Verify dimensions, tolerances, and method of attachment with other related work.

B. Verify that curtain wall openings and adjoining air and vapor seal materials are ready to receive work of this section.

C. Verify that anchorage devices have been properly installed and located.

3.2 INSTALLATION

A. Install curtain wall system in accordance with manufacturer's instructions.

B. Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities.

C. Provide alignment attachments and shims to permanently fasten system to building structure.

D. Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances, aligning with adjacent work.

E. Provide thermal isolation where components penetrate or disrupt building insulation.

F. Install sill flashings. Turn up ends and edges; seal to adjacent work to form water tight dam.

G. Structural Sealant Glazing (SSG) Adhesive: Install structural sealant glazing adhesive and weatherseal sealant in accordance with manufacturer's instructions.

H. Touch-up minor damage to factory applied finish; replace components that cannot be satisfactorily repaired.

I. Silicone Transition Installation:
   1. Coordinate installation methods and sequencing of installation with weather barrier, composite wood panels, aluminum composite panels, fiber reinforced cementitions panels, and thin limestone adhered panel contractors. Silicone transition must be installed and sealed to air/water/vapor barrier within panel walls after air/water/vapor barrier components have been installed and prior to installation of cladding panels.
   2. Clean surfaces where silicone transition is to be applied in accordance with transition boot manufacturer’s written recommendations. Set transition material in a continuous bed of sealant.
   3. Secure silicone transition on both sides of the perimeter joints and provide continuous sealant compatible with air/water/vapor barrier.

3.3 TOLERANCES

A. Maximum Variation from Plumb: 0.06 inches every 3 ft non-cumulative or 0.5 inches per 100 ft, whichever is less.

B. Maximum Misalignment of Two Adjoining Members Abutting in Plane: 1/32 inch.

C. Sealant Space Between Curtain Wall Mullions and Adjacent Construction: Maximum of 3/4 inch and minimum of 1/4 inch.

3.4 FIELD QUALITY CONTROL

A. Hose Tests
   1. Field hose testing for resistance to water leakage shall be conducted and results interpreted as defined herein. Perform a minimum of five (5) field hose tests. Test areas shall include both curtain wall system(s) and adjacent construction. Coordinate testing of curtain wall areas with adjacent construction contractors as required. Area and time of tests shall be per the direction of the Architect. Initial testing shall be conducted early in the construction schedule. Schedule any out of sequence work necessary, such as out of sequence sealant work, so that selected areas can be tested as specified.
   2. For curtain wall areas, each test area shall be three glass openings wide by two floors high, or 400 ft2, whichever is greater. There shall be no unacceptable water leakage as defined in this Section.
   3. Conduct test with Monarch Type B-25 #6.030 brass nozzle and 3/4 inch diameter hose. Water pressure to nozzle shall be in the range 30 to 35 psi. Working upward from bottom of test area, direct water at 5 foot long segments of glazing seals, frame joints and perimeter joints, moving slowly back and forth on each segment for minimum of 5 minutes. Where a framing member is between two glass units and its width does not exceed 4 inches, both lines of glazing seal may be tested as one segment by centering the spray on one glazing seal while moving in one direction, and centering the spray on the other glazing seal while moving in the opposite direction. Sustained spraying at one point while the nozzle remains stationary is acceptable. Tip of nozzle shall be 12 inches from specimen exterior surface. Nozzle shall generally be perpendicular to specimen surface, but shall be tilted to any angle that maximizes exposure of a given joint to water flow rate and kinetic energy. Continuously check for leakage on indoor side. If necessary to pinpoint leak sources, perform additional testing. Repeated testing of joints is acceptable. The use of masking to pinpoint leaks is acceptable.
   4. Check completed areas below test area, and report any leaks that occur. A test that results in leakage at a completed area below a designated test area is a failure.

5. Contractor performing work of this Section shall provide powered scaffold, hose, water supply, and manpower to perform each test, plus any unsuccessful tests.
6. If failure occurs, revise and retest specimens. Modifications must be realistic in terms of project conditions, must maintain standards of quality and durability and are subject to approval. If failure necessitates retesting, Contractor for Work of this Section shall pay all additional fees associated with retesting, including fees and costs incurred by the testing agent, the Architect, Owner and their representatives.
7. Submit, for information only, reports that contain dates of tests, elevation drawings of test areas with locations relative to grid lines (including any lower areas where leaks occur), and location of each leak.

B. Replace curtain wall components that have failed field testing and retest until performance is satisfactory.

3.5 ADJUSTING

A. Adjust operating sash for smooth operation.

3.6 CLEANING

A. Remove protective material from pre-finished aluminum surfaces.

3.7 PROTECTION

A. Protect installed products from damage until Date of Substantial Completion.

END OF SECTION

SECTION 08 71 00

DOOR HARDWARE

Check all Hardware Sets for Updates. Set 24 was added.

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PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. Mechanical door hardware for the following:

   a. Swinging doors.
   b. Sliding doors.

2. Cylinders for door hardware specified in other Sections.
3. Electrified door hardware.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Details of electrified door hardware.

C. Samples: For each exposed product and for each color and texture specified.

D. Other Action Submittals:

1. Door Hardware Schedule: Prepared by or under the supervision of Installer, detailing fabrication and assembly of door hardware, as well as installation procedures and diagrams. Coordinate final door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.

   a. Format: Use same scheduling sequence and vertical format and use same door numbers as in the Contract Documents.
   b. Content: Include the following information:

      1) Identification number, location, hand, fire rating, size, and material of each door and frame.
      2) Locations of each door hardware set, cross-referenced to Drawings on floor plans and to door and frame schedule.
      3) Complete designations, including name and manufacturer, type, style, function, size, quantity, function, and finish of each door hardware product.
      4) Description of electrified door hardware sequences of operation and interfaces with other building control systems.

2. Keying Schedule: Prepared by or under the supervision of Supplier, detailing Owner's final keying instructions for locks.

1.3 QUALITY ASSURANCE

A. Supplier Qualifications: The hardware supplier shall be a corporate member in good standing of The Door and Hardware Institute (DHI), employing at least one Architectural Hardware Consultant (AHC) who is currently participating in DHI's continuing education program (CEP).

B. Source Limitations: Provide electrified door hardware from same manufacturer as mechanical door hardware, unless otherwise indicated.

C. Items of hardware not definitely specified herein but necessary for completion of the work shall be provided. Such items shall be of type and quality suitable to the service required and comparable to the adjacent hardware. Where size and shape of members is such as to prevent the use of types specified, hardware shall be furnished of suitable types having as nearly as practicable the same operation and quality as the type specified. Sizes shall be adequate for the service required.

D. Include such nuances as strike type, strike lip length, raised barrel hinges, mounting brackets, blade stop spacers, special templates, fasteners, shims, and coordination between conflicting products. All doors shall be provided with a stop.

E. Fire-Rated Door Assemblies: Where fire-rated door assemblies are indicated, provide door hardware rated for use in assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10C, unless otherwise indicated. Provide positive latching and self-closing, regardless if specified in sets.

F. Smoke- and Draft-Control Door Assemblies: Where smoke- and draft-control door assemblies are required, provide door hardware that meet requirements of assemblies tested according to UL 1784 and installed in compliance with NFPA 105.

1. Air Leakage Rate: Maximum air leakage of0.3 cfm/sq. ft. (3 cu. m per minute/sq. m) at the tested pressure differential of 0.3-inch wg (75 Pa) of water.

G. Electrified Door Hardware: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction.

H. Means of Egress Doors: Latches do not require more than 15 lbf (67 N) to release the latch. Locks do not require use of a key, tool, or special knowledge for operation.

I. Accessibility Requirements: For door hardware on doors in an accessible route, comply with ICC/ANSI A117.1.

1. Provide operating devices that do not require tight grasping, pinching, or twisting of the wrist and that operate with a force of not more than 5 lbf (22.2 N).
2. Comply with the following maximum opening-force requirements:

    a. Interior, Non-Fire-Rated Hinged Doors: 5 lbf (22.2 N) applied perpendicular to door.
    b. Sliding or Folding Doors: 5 lbf (22.2 N) applied parallel to door at latch.
    c. Fire Doors: Minimum opening force allowable by authorities having jurisdiction.

3. Bevel raised thresholds with a slope of not more than 1:2. Provide thresholds not more than 1/2 inch (13 mm) high.
4. Adjust door closer sweep periods so that, from an open position of 90 degrees, the door will take at least 5 seconds to move to a point 12 degress from the latch, measured to the leading edge of the door.

J. Keying Conference: Conduct conference at Project site to comply with requirements in Section 013100 "Project Management and Coordination."

1.4 DELIVERY, STORAGE, AND HANDLING

A. Deliver keys and permanent cores to Owner by registered mail or overnight package service.

1.5 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Manufacturers' standard warranty period.

PART 2 - PRODUCTS

2.1 SCHEDULED DOOR HARDWARE

A. Provide door hardware for each door as scheduled in Part 3 "Door Hardware Schedule" Article to comply with requirements in this Section.

1. Door Hardware Sets: Provide quantity, item, size, finish or color indicated, and named manufacturers' products.
2. Sequence of Operation: Provide electrified door hardware function, sequence of operation, and interface with other building control systems indicated.

B. Designations: Requirements for design, grade, function, finish, size, and other distinctive qualities of each type of door hardware are indicated in Part 3 "Door Hardware Schedule" Article. Products are identified by using door hardware designations, as follows:

1. Named Manufacturers' Products: Manufacturer and product designation are listed for each door hardware type required. Manufacturers' names are abbreviated in Part 3 "Door Hardware Schedule" Article.

2.2 CONTINUOUS HINGES

A. Continuous Hinges: BHMA A156.26; minimum 0.120-inch- (3.0-mm-) thick, hinge leaves with minimum overall width of 4 inches (102 mm); fabricated to full height of door and frame and to template screw locations; with components finished after milling and drilling are complete.

B. Continuous, Gear-Type Hinges: Extruded-aluminum, pinless, geared hinge leaves joined by a continuous extruded-aluminum channel cap; with concealed, self-lubricating thrust bearings.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Hager Companies.
b. Select Products Limited.
c. Stanley Commercial Hardware; Div. of The Stanley Works.

2.3 MECHANICAL LOCKS AND LATCHES

A. Strikes: Provide manufacturer's standard strike for each lock bolt or latchbolt complying with requirements indicated for applicable lock or latch and with strike box and curved lip extended to protect frame; finished to match lock or latch.

1. Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.
2. Extra-Long-Lip Strikes: For locks used on frames with applied wood casing trim.
3. Aluminum-Frame Strike Box: Manufacturer's special strike box fabricated for aluminum framing.

B. Bored Locks: BHMA A156.2; Grade 1; Series 4000.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Best Access Systems; Div. of Stanley Security Solutions, Inc.
b. Corbin Russwin Architectural Hardware; n ASSA ABLOY Group Company.
c. SARGENT Manufacturing Company; an ASSA ABLOY Group company.

C. Push-Pull Latches: Mortise, BHMA A156.13; Grade 1; with paddle handles that retract latchbolt; capable of being mounted vertically or horizontally.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Architectural Builders Hardware Mfg., Inc.
b. Corbin Russwin Architectural Hardware; an ASSA ABLOY Group company.
c. SARGENT Manufacturing Company; an ASSA ABLOY Group company.

2.4 AUXILIARY LOCKS

A. Narrow Stile Auxiliary Locks: BHMA A156.5; Grade 1; with strike that suits frame.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Adams Rite Manufacturing Co.; an ASSA ABLOY Group company.

2.5 MANUAL FLUSH BOLTS

A. Manual Flush Bolts: BHMA A156.16; minimum 3/4-inch (19-mm) throw; designed for mortising into door edge.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Hager Companies.
b. Rockwood Manufacturing Company.
c. Trimco.

2.6 AUTOMATIC AND SELF-LATCHING FLUSH BOLTS

A. Automatic and Self-Latching Flush Bolts: BHMA A156.16; minimum 3/4-inch (19-mm) throw; designed for mortising into door edge.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Hager Companies.
b. Rockwood Manufacturing Company.
c. Trimco.

2.7 EXIT DEVICES AND AUXILIARY ITEMS

A. Exit Devices and Auxiliary Items: BHMA A156.3.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Corbin Russwin Architectural Hardware; an ASSA ABLOY Group company.
b. Precision Hardware, Inc.; Division of Stanley Security Solutions, Inc.
c. SARGENT Manufacturing Company; an ASSA ABLOY Group company.

2.8 LOCK CYLINDERS

A. Lock Cylinders: Tumbler type, constructed from brass or bronze, stainless steel, or nickel silver.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. Best Access Systems; Div. of Stanley Security Solutions, Inc.

B. Construction Cores: Provide construction cores that are replaceable by permanent cores. Provide 10 construction master keys.

2.9 KEYING

A. Keying System: Factory registered, complying with guidelines in BHMA A156.28, Appendix A. Incorporate decisions made in keying conference.
1. Existing System:

a. Master key or grand master key locks to Owner's existing Best system.

B. Keys: Brass.

1. Stamping: Permanently inscribe each key with a visual key control number and include the following notation:

a. Notation: Information to be furnished by Owner.

2. Quantity: In addition to one extra key blank for each lock, provide the following:

a. Cylinder Change Keys: Three.
b. Master Keys: Five.

2.10 KEY CONTROL SYSTEM

A. Key Control Cabinet: BHMA A156.5; metal cabinet with baked-enamel finish; containing key-holding hooks, labels, 2 sets of key tags with self-locking key holders, key-gathering envelopes, and temporary and permanent markers; with key capacity of 150 percent of the number of locks.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. American Key Boxes and Cabinets.
b. GE Security, Inc.

c. HPC, Inc.
d. Lund Equipment Co., Inc.
e. MMF Industries.
f. Tri Palm International.

2. Wall-Mounted Cabinet: Cabinet with hinged-panel door equipped with key-holding panels and pin-tumbler cylinder door lock.

2.11 OPERATING TRIM

A. Operating Trim: BHMA A156.6; stainless steel, unless otherwise indicated.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Hager Companies.
b. Rockwood Manufacturing Company.
c. Trimco.

2.12 ACCESSORIES FOR PAIRS OF DOORS

A. Coordinators: BHMA A156.3; consisting of active-leaf, hold-open lever and inactive-leaf release trigger; fabricated from steel with nylon-coated strike plates; with built-in, adjustable safety release; and with internal override.

B. Carry-Open Bars: BHMA A156.3; prevent the inactive leaf from opening before the active leaf; provide polished brass or bronze carry-open bars with strike plate for inactive leaves of pairs of doors unless automatic or self-latching bolts are used.

C. Astragals: BHMA A156.22.

2.13 SURFACE CLOSERS

A. Surface Closers: BHMA A156.4; rack-and-pinion hydraulic type with adjustable sweep and latch speeds controlled by key-operated valves and forged-steel main arm. Comply with manufacturer's written recommendations for size of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Provide factory-sized closers, adjustable to meet field conditions and requirements for opening force. Provide extra duty arms at parallel arm closers.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Corbin Russwin Architectural Hardware; an ASSA ABLOY Group company. DC8000 Series.
b. SARGENT Manufacturing Company; an ASSA ABLOY Group company. 281 Series.
c. Stanley Door Closers; a Division of Stanley Security Solutions, Inc. D-4550 Series.

2.14 MECHANICAL STOPS AND HOLDERS

A. Wall- and Floor-Mounted Stops: BHMA A156.16; polished cast brass base metal.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Hager Companies.
b. Rockwood Manufacturing Company.

c. Trimco.

2.15 OVERHEAD STOPS AND HOLDERS

A. Overhead Stops and Holders: BHMA A156.8.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Architectural Builders Hardware Mfg., Inc.
b. Rockwood Manufacturing Company.
c. SARGENT Manufacturing Company; an ASSA ABLOY Group company.

2.16 DOOR GASKETING

A. Door Gasketing: BHMA A156.22; air leakage not to exceed 0.50 cfm per foot (0.000774 cu. m/s per m) of crack length for gasketing other than for smoke control, as tested according to ASTM E 283; with resilient or flexible seal strips that are easily replaceable and readily available from stocks maintained by manufacturer.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Hager Companies.
b. National Guard Products.
c. Pemko Manufacturing Co.; an ASSA ABLOY Group company.
d. Reese Enterprises, Inc.

2.17 THRESHOLDS

A. Thresholds: BHMA A156.21; fabricated to full width of opening indicated.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Hager Companies.
b. National Guard Products.
c. Pemko Manufacturing Co.; an ASSA ABLOY Group company.
d. Reese Enterprises, Inc.

2.18 METAL PROTECTIVE TRIM UNITS

A. Metal Protective Trim Units: BHMA A156.6; fabricated from 0.050-inch- (1.3-mm-) thick stainless steel; with manufacturer's standard machine or self-tapping screw fasteners.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Hager Companies.
b. Rockwood Manufacturing Company.
c. Trimco.

2.19 AUXILIARY DOOR HARDWARE

A. Auxiliary Hardware: BHMA A156.16.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Hager Companies.
    b. Rockwood Manufacturing Company.
    c. Stanley Commercial Hardware; Div. of The Stanley Works.
    d. Trimco.

2.20 AUXILIARY ELECTRIFIED DOOR HARDWARE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Securitron Magnalock Corporation; an ASSA ABLOY Group company.
2. Hanchett Entry Systems, Inc.; an ASSA ABLOY Group company.
3. Trine Access Technology.

2.21 FABRICATION

A. Fasteners: Provide door hardware manufactured to comply with published templates prepared for machine, wood, and sheet metal screws. Provide screws that comply with commercially recognized industry standards for application intended, except aluminum fasteners are not permitted. Provide Phillips flat-head screws with finished heads to match surface of door hardware, unless otherwise indicated.

1. Concealed Fasteners: For door hardware units that are exposed when door is closed, except for units already specified with concealed fasteners. Do not use through bolts for installation where bolt head or nut on opposite face is exposed unless it is the only means of securely attaching the door hardware. Where through bolts are used on hollow door and frame construction, provide sleeves for each through bolt.
2. Fire-Rated Applications:

    a. Wood or Machine Screws: For the following:

        1) Hinges mortised to doors or frames; use threaded-to-the-head wood screws for wood doors and frames.
        2) Strike plates to frames.
        3) Closers to doors and frames.

    b. Steel Through Bolts: For the following unless door blocking is provided:

        1) Surface hinges to doors.
        2) Closers to doors and frames.
        3) Surface-mounted exit devices.

3. Spacers or Sex Bolts: For through bolting of hollow-metal doors.
4. Fasteners for Wood Doors: Comply with requirements in DHI WDHS.2, "Recommended Fasteners for Wood Doors."
5. Gasketing Fasteners: Provide noncorrosive fasteners for exterior applications and elsewhere as indicated.

2.22 FINISHES

A. Provide finishes complying with BHMA A156.18 as indicated in door hardware schedule.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Steel Doors and Frames: For surface applied door hardware, drill and tap doors and frames according to ANSI/SDI A250.6.

B. Wood Doors: Comply with DHI WDHS.5 "Recommended Hardware Reinforcement Locations for Mineral Core Wood Flush Doors."

C. Mounting Heights: Mount door hardware units at heights to comply with the following unless otherwise indicated or required to comply with governing regulations.

1. Standard Steel Doors and Frames: ANSI/SDI A250.8.
2. Wood Doors: DHI WDHS.3, "Recommended Locations for Architectural Hardware for Wood Flush Doors."

D. Install each door hardware item to comply with manufacturer's written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work. Do not install surface-mounted items until finishes have been completed on substrates involved.

1. Set units level, plumb, and true to line and location. Adjust and reinforce attachment substrates as necessary for proper installation and operation.
2. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.

E. Hinges: Install types and in quantities indicated in door hardware schedule but not fewer than the number recommended by manufacturer for application indicated or one hinge for every 30 inches (750 mm) of door height, whichever is more stringent, unless other equivalent means of support for door, such as spring hinges or pivots, are provided.

F. Lock Cylinders: Install construction cores to secure building and areas during construction period.

1. Replace construction cores with permanent cores as directed by Owner.

G. Key Control System: Tag keys and place them on markers and hooks in key control system cabinet, as determined by final keying schedule.

H. Boxed Power Supplies: Locate power supplies as indicated or, if not indicated, in equipment room. Verify location with Architect.

1. Configuration: Provide least number of power supplies required to adequately serve doors with electrified door hardware.

I. Thresholds: Set thresholds for exterior doors and other doors indicated in full bed of sealant complying with requirements specified in Section 079200 "Joint Sealants."

J. Stops: Provide floor stops for doors unless wall or other type stops are indicated in door hardware schedule. Do not mount floor stops where they will impede traffic.

K. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.

L. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.

M. Door Bottoms: Apply to bottom of door, forming seal with threshold when door is closed.

N. Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

3.2 DOOR HARDWARE SCHEDULE

HARDWARE SET 1

1	EA	CONTINUOUS HINGE	780-112HD	628	HAG
1	EA	ELECTRIC STRIKE	9600	630	HES
1	EA	SMART PAC	2005M3		HES
1	EA	EXIT DEVICE	2103CD X CA-03	630	PRE
2	EA	CYLINDER	AS REQUIRED	626	BES
1	EA	PULL	BF157	630	ROC
1	EA	OVERHEAD STOP	1000	630	ABH
1	EA	AUTO OPERATOR	MAC-LL1C-R	628	MOT
1	EA	ACTUATOR	10PBS1	630	BEA
1	EA	WEATHER RING	10WRSQ475		BEA
1	EA	BOLLARD	10BOLLARDSLV	689	BEA
1	EA	THRESHOLD	8425	719	NGP
1	EA	SWEEP	200NA	628	NGP
1	SET	WEATHERSTRIPPING	BY DOOR AND FRAME MANUFACTURER		
1	EA	CARD READER	BY SECURITY CONTRACTOR		

OPERATIONAL DESCRIPTION: Door normally closed, locked and exterior actuator is deactivated. Valid credential allows entry and use of exterior actuator. Vestibule actuator always active for use. Door remains closed and locked upon loss of power. Free egress at all times.

HARDWARE SET 2

1	EA	CONTINUOUS HINGE	780-112HD	628	HAG
1	EA	DUMMY BAR	674DR	630	PRE
1	EA	PULL	BF157	630	ROC
1	EA	AUTO OPERATOR	MAC-ML1C-R	628	MOT
1	EA	ACTUATOR	10PBDGP1	630	BEA
1	EA	ACTUATOR	10PBS1	630	BEA
2	EA	MOUNTING BOX	10BOX475SQFM	BLK	BEA
1	EA	WALL STOP	403	626	ROC

HARDWARE SET 3

1	EA	CONTINUOUS HINGE	780-224HD	628	HAG
1	EA	ELECTRIC STRIKE	1500	630	HES
1	EA	STOREROOM	9K3 7D 14C S3	626	BES
1	EA	CLOSER	D-4551	689	STA
1	EA	KICK PLATE	10” X 2” LDW	630	ROC
1	EA	WALL STOP	403	626	ROC
1	EA	CARD READER	BY SECURITY CONTRACTOR		

OPERATIONAL DESCRIPTION: Door normally closed and locked. Valid credential allows entry. Door remains closed and locked upon loss of power. Free egress at all times.

HARDWARE SET 4

HARDWARE BY DOOR SUPPLIER

HARDWARE SET 5

1	EA	CONTINUOUS HINGE	780-224HD	628	HAG
1	EA	PRIVACY	9K3 0L 14C S3	626	BES
1	EA	WALL STOP	403	626	ROC

HARDWARE SET 6

1	EA	CONTINUOUS HINGE	780-224HD	628	HAG
1	EA	OFFICE	9K3 7AB 14C S3	626	BES
1	EA	WALL STOP	403	626	ROC
1	SET	SEALS	5050	BLK	NGP

HARDWARE SET 7

1	EA	CONTINUOUS HINGE	780-224HD	628	HAG
1	EA	STOREROOM	9K3 7D 14C S3	626	BES
1	EA	CLOSER	D-4551	689	STA
1	EA	KICK PLATE	10” X 2” LDW	630	ROC
1	EA	WALL STOP	403	626	ROC

HARDWARE SET 8

1	EA	CONTINUOUS HINGE	780-112HD	628	HAG
1	EA	ELECTRIC STRIKE	9600	630	HES
1	EA	SMART PAC	2005M3		HES
1	EA	EXIT DEVICE	2103CD X CA-03	630	PRE
2	EA	CYLINDER	AS REQUIRED	626	BES
1	EA	PULL	BF157	630	ROC
1	EA	OVERHEAD STOP	1000	630	ABH
1	EA	DROP PLATE	P45-180	689	STA
1	EA	CLOSER	D-4550	689	STA
1	EA	THRESHOLD	8425	719	NGP
1	EA	SWEEP	200NA	628	NGP
1	SET	WEATHERSTRIPPING	BY DOOR AND FRAME MANUFACTURER		
1	EA	CARD READER	BY SECURITY CONTRACTOR		

OPERATIONAL DESCRIPTION: Door normally closed and locked. Valid credential allows entry. Door remains closed and locked upon loss of power. Free egress at all times.

HARDWARE SET 9

1	EA	CONTINUOUS HINGE	780-224HD	628	HAG
1	EA	STOREROOM	9K3 7D 14C S3	626	BES
1	EA	CLOSER	D-4550 CS	689	STA
1	EA	KICK PLATE	10” X 2” LDW	630	ROC
1	EA	THRESHOLD	8425	719	NGP
1	EA	SWEEP	200NA	628	NGP
1	SET	WEATHERSTRIPPING	9700A	628	NGP
1	EA	DRIP CAP	16A	628	NGP

HARDWARE SET 10

1	EA	CONTINUOUS HINGE	780-224HD	628	HAG
1	EA	CLASSROOM	9K3 7R 14C S3	626	BES
1	EA	KICK PLATE	10” X 2” LDW	630	ROC
1	EA	WALL STOP	403	626	ROC

HARDWARE SET 11

1	EA	CONTINUOUS HINGE	780-224HD	628	HAG
1	EA	PASSAGE	9K3 0N 14C S3	626	BES
1	EA	CLOSER	D-4551 DA H	689	STA
1	EA	KICK PLATE	10" X 2" LDW	630	ROC
1	EA	WALL STOP	403	626	ROC

HARDWARE SET 12

1	EA	CONTINOUS HINGE	780-224HD	628	HAG
1	EA	PUSH PLATE	70F 8" X 16" LDW	630	ROC
1	EA	PULL PLATE	BF111 X 70C 4" X 16" LDW	630	ROC
1	EA	OVERHEAD STOP	4400	630	ABH
1	EA	CLOSER	D-4551	689	STA
1	EA	KICK PLATE	10" X 2" LDW	630	ROC
1	SET	SEALS	5050	BLK	NGP
1	EA	AUTO DOOR BOTTOM	423N	628	NGP

HARDWARE SET 13

1	EA	CONTINUOUS HINGE	780-224HD	628	HAG
1	EA	EXIT DEVICE	2101	630	PRE
1	EA	CLOSER	D-4550 CS	689	STA
1	EA	KICK PLATE	10" X 2" LDW	630	ROC
1	EA	THRESHOLD	8425	719	NGP
1	EA	SWEEP	200NA	628	NGP
1	SET	WEATHERSTRIPPING	9700	628	NGP
1	EA	DRIP CAP	16A	628	NGP

HARDWARE SET 14

2	EA	CONTINUOUS HINGE	780-224HD	628	HAG
1	EA	FLUSH BOLT	555	626	ROC
1	EA	CLASSROOM	9K3 7R 14C S3	626	BES
2	EA	OVERHEAD STOP	4400	630	ABH

HARDWARE SET 15

1	EA	CONTINUOUS HINGE	780-112HD	628	HAG
1	EA	DEADLATCH	2190-4-1-1-1-01	630	ADA
1	EA	CYLINDER	AS REQUIRED	626	BES
1	EA	ADA THUMBTURN CYLINDER	AS REQUIRED	626	BES
1	EA	OVERHEAD HOLDER	1000	630	ABH
1	EA	DROP PLATE	P45-180	689	STA
1	EA	CLOSER	D-4550	689	STA
1	EA	THRESHOLD	8425	719	NGP
1	EA	SWEEP	200NA	628	NGP
1	SET	WEATHERSTRIPPING	BY DOOR AND FRAME MANUFACTURER		

HARDWARE SET 16

1	EA	CONTINUOUS HINGE	780-112HD	628	HAG
1	EA	EXIT DEVICE	2108CD X 4908D	630	PRE
2	EA	CYLINDER	AS REQUIRED	626	BES
1	EA	CLOSER	D-4551	689	STA
1	EA	WALL STOP	403	626	ROC
1	EA	THRESHOLD	8425	719	NGP
1	EA	SWEEP	200NA	628	NGP
1	SET	WEATHERSTRIPPING	BY DOOR AND FRAME MANUFACTURER		

HARDWARE SET 17

1	EA	CONTINUOUS HINGE	780-224HD	628	HAG
1	EA	ELECTRIC STRIKE	1500	630	HES
1	EA	STOREROOM	9K3 7D 14C S3	626	BES
1	EA	CLOSER	D-4551	689	STA
1	EA	WALL STOP	403	626	ROC
1	EA	CARD READER	BY SECURITY CONTRACTOR		

OPERATIONAL DESCRIPTION: Door normally closed and locked. Valid credential allows entry. Door remains closed and locked upon loss of power. Free egress at all times.

HARDWARE SET 18

2	EA	CONTINUOUS HINGE	780-224HD	628	HAG
1	EA	FLUSH BOLT	555	626	ROC
1	EA	STOREROOM	9K3 7D 14C S3	626	BES
2	EA	OVERHEAD STOP	4400	630	ABH

HARDWARE SET 19

1	EA	CONTINUOUS HINGE	780-224HD	628	HAG
1	EA	PRIVACY	9K3 0L 14C S3	626	BES
1	EA	OVERHEAD STOP	4400	630	ABH

HARDWARE SET 20

1	EA	BYPASS HARDWARE	HBP200A	628	PEM
1	EA	BYPASS FASCIA	F134C	628	PEM
2	EA	FLUSH PULL	BF97L	630	ROC

HARDWARE SET 21

1	EA	CONTINUOUS HINGE	780-224HD	628	HAG
1	EA	EXIT DEVICE	2108CD X 4908D	630	PRE
2	EA	CYLINDER	AS REQUIRED	626	BES
1	EA	CLOSER	D-4550 CS	689	STA
1	EA	KICK PLATE	10” X 2” LDW	630	ROC

HARDWARE SET 22

1	EA	CONTINUOUS HINGE	780-224HD	628	HAG
1	EA	ELECTRIC STRIKE	9600	630	HES
1	EA	SMART PAC	2005M3		HES
1	EA	EXIT DEVICE	2103CD X CA-03	630	PRE
2	EA	CYLINDER	AS REQUIRED	626	BES
1	EA	PULL	BF157	630	ROC
1	EA	CLOSER	D-4550 CS	689	STA
1	EA	THRESHOLD	8425	719	NGP
1	EA	SWEEP	200NA	628	NGP
1	SET	WEATHERSTRIPPING	9700A	628	NGP
1	EA	DRIP CAP	16A	628	NGP
1	EA	CARD READER	BY SECURITY CONTRACTOR		

OPERATIONAL DESCRIPTION: Door normally closed and locked. Valid credential allows entry. Door remains closed and locked upon loss of power. Free egress at all times.

HARDWARE SET 23

1	EA	CONTINUOUS HINGE	780-224HD	628	HAG
1	EA	OFFICE	9K3 7AB 14C S3	626	BES
1	EA	CLOSER	D-4550	689	STA

1	EA	KICK PLATE	10" X 2" LDW	630	ROC
1	EA	WALL STOP	403	626	ROC
1	SET	SEALS	5050	BLK	NGP

HARDWARE SET 24

1	EA	EXIT DEVICE	2408CD X 4908D	630	PRE
2	EA	CYLINDER	AS REQUIRED	626	BES

REMAINING HARDWARE BY DOOR MANUFACTURER

ADD 3

END OF SECTION 087100

SECTION 08 80 00
GLAZING

03ADD

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Insulating glass units.

B. Glazing units.

C. Plastic films.

D. Glazing compounds and accessories.

1.2 RELATED REQUIREMENTS

A. Section 08 11 13 - Hollow Metal Doors and Frames: Glazed lites in doors and borrowed lites.

B. Section 08 14 16 - Flush Wood Doors: Glazed lites in doors.

C. Section 08 43 13 - Aluminum-Framed Storefronts: Glazing furnished as part of storefront assembly.

D. Section 08 44 13 - Glazed Aluminum Curtain Walls: Glazing furnished as part of wall assembly.

1.3 REFERENCE STANDARDS

A. 16 CFR 1201 - Safety Standard for Architectural Glazing Materials; current edition.

B. ANSI Z97.1 - American National Standard for Safety Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test; 2015.

C. ASTM C864 - Standard Specification for Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers; 2005 (Reapproved 2015).

D. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2014a.

E. ASTM C1036 - Standard Specification for Flat Glass; 2016.

F. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass; 2012.

G. ASTM C1193 - Standard Guide for Use of Joint Sealants; 2016.

H. ASTM C1376 - Standard Specification for Pyrolytic and Vacuum Deposition Coatings on Flat Glass; 2015.

I. ASTM E1300 - Standard Practice for Determining Load Resistance of Glass in Buildings; 2016.

J. ASTM E2190 - Standard Specification for Insulating Glass Unit Performance and Evaluation; 2010.

K. GANA (GM) - GANA Glazing Manual; 2009.

L. GANA (SM) - GANA Sealant Manual; 2008.

M. ITS (DIR) - Directory of Listed Products; current edition.

N. NFRC 100 - Procedure for Determining Fenestration Product U-factors; 2014.

O. NFRC 200 - Procedure for Determining Fenestration Product Solar Heat Gain Coefficient and Visible Transmittance at Normal Incidence; 2014.

P. NFRC 300 - Test Method for Determining the Solar Optical Properties of Glazing Materials and Systems; 2014.

Q. UL (DIR) - Online Certifications Directory; current listings at database.ul.com.

1.4 SUBMITTALS

A. Product Data on Insulating Glass Unit, Glazing Unit, and Plastic Film Glazing Types: Provide structural, physical and environmental characteristics, size limitations, special handling and installation requirements.

B. Product Data on Glazing Compounds and Accessories: Provide chemical, functional, and environmental characteristics, limitations, special application requirements. Identify available colors.

C. Samples: Submit two samples 12 by 12 inch in size of glass units.

D. Certificate: Certify that products of this section meet or exceed specified requirements.

E. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with GANA (GM) and GANA (SM) for glazing installation methods.

B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years documented experience.

1.6 PRECONSTRUCTION TESTING

A. Preconstruction Adhesion and Compatibility Testing: Test each glazing material type, tape sealant, gasket, glazing accessory, and glass-framing member for adhesion to and compatibility with elastomeric glazing sealants.
   1. Testing will not be required if data are submitted based on previous testing of current sealant products and glazing materials matching those submitted.

1.7 WARRANTY

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Float Glass Manufacturers:
   1. Cardinal Glass Industries: www.cardinalcorp.com.
   2. Guardian Industries Corp: www.sunguardglass.com.
   3. Pilkington North America Inc: www.pilkington.com/na.
   4. PPG Industries, Inc: www.ppgideascapes.com.

B. Fire-Protection-Rated Glass Manufacturers: Provide products as required to achieve indicated fire-rating period.
   1. SAFTIFIRST, a division of O'Keeffe's Inc; SuperLite I-XL: www.safti.com/sle.
   2. Technical Glass Products; FireLite Plus: www.fireglass.com.

2.2 PERFORMANCE REQUIREMENTS - EXTERIOR GLAZING ASSEMBLIES

A. Provide type and thickness of exterior glazing assemblies to support assembly dead loads, and to withstand live loads caused by positive and negative wind pressure acting normal to plane of glass.
   1. Comply with ASTM E1300 for design load resistance of glass type, thickness, dimensions, and maximum lateral deflection of supported glass.
   2. Provide glass edge support system sufficiently stiff to limit the lateral deflection of supported glass edges to less than 1/175 of their lengths under specified design load.
   3. Glass thicknesses listed are minimum.

B. Vapor Retarder and Air Barrier Seals: Provide completed assemblies that maintain continuity of building enclosure vapor retarder and air barrier.
   1. In conjunction with vapor retarder and joint sealer materials described in other sections.

C. Thermal and Optical Performance: Provide glass products with performance properties as indicated. Performance properties are in accordance with manufacturer's published data as determined with the following procedures and/or test methods:
   1. Center of Glass U-Value: Comply with NFRC 100 using Lawrence Berkeley National Laboratory (LBNL) WINDOW 6.3 computer program.
   2. Center of Glass Solar Heat Gain Coefficient (SHGC): Comply with NFRC 200 using Lawrence Berkeley National Laboratory (LBNL) WINDOW 6.3 computer program.
   3. Solar Optical Properties: Comply with NFRC 300 test method.

2.3 GLASS MATERIALS

A. Float Glass: Provide float glass based glazing unless noted otherwise.
   1. Annealed Type: ASTM C1036, Type I - Transparent Flat, Class 1 - Clear, Quality-Q3.
   2. Heat-Strengthened and Fully Tempered Types: ASTM C1048, Kind HS and FT.
   3. Fully Tempered Safety Glass: Complies with ANSI Z97.1 and 16 CFR 1201 criteria.
   4. Thicknesses: As indicated; provide greater thickness as required for exterior glazing wind load design.

2.4 INSULATING GLASS UNITS

A. Manufacturers:
1. Fabricator certified by glass manufacturer for type of glass, coating, and treatment involved and capable of providing specified warranty.
2. Cardinal Glass Industries: www.cardinalcorp.com.
3. Guardian Industries Corp: www.sunguardglass.com.
4. Pilkington North America Inc: www.pilkington.com/na.
5. PPG Industries, Inc: www.ppgideascapes.com.
6. Viracon, Apogee Enterprises, Inc: www.viracon.com.

B. Insulating Glass Units: Types as indicated.
1. Durability: Certified by an independent testing agency to comply with ASTM E2190.
2. Coated Glass: Comply with requirements of ASTM C1376 for pyrolytic (hard-coat) or magnetic sputter vapor deposition (soft-coat) type coatings on flat glass; coated vision glass, Kind CV; coated overhead glass, Kind CO; or coated spandrel glass, Kind CS.
3. Metal Edge Spacers: Aluminum, bent and soldered corners.
4. Spacer Color: Aluminum.
5. Edge Seal:
   a. Dual-Sealed System: Provide polyisobutylene sealant as primary seal applied between spacer and glass panes, and silicone, polysulfide, or polyurethane sealant as secondary seal applied around perimeter.
6. Color: Black.
7. Purge interpane space with dry air, hermetically sealed.

2.5 INSULATING GLASS UNITS

A. Insulating Glass Units: Vision glazing, with Low-E coating.
1. Applications: Exterior insulating glass glazing unless otherwise indicated.
2. Space between lites filled with air.
3. Total Thickness: 1 inch.
4. Thermal Transmittance (U-Value), Winter - Center of Glass: 0.29, nominal.
5. Visible Light Transmittance (VLT): 70 percent, nominal.
6. Solar Heat Gain Coefficient (SHGC): 0.39, nominal.
7. Glazing Method: Dry glazing method, gasket glazing.
8. Basis of Design - PPG Industries, Inc: www.ppgideascapes.com.
9. Outboard Lite: Heat-strengthened float glass, 1/4 inch thick, minimum. Provide fully tempered units where saftety glass is required.
   a. Low-E Coating: PPG Solarban 60 on #2 surface.
10. Inboard Lite: Heat-strengthened float glass, 1/4 inch thick. Provide fully tempered units where saftety glass is required.
    a. Coating: No coating on inboard lite.

B. Spandrel Insulating Glass Unit: Same as Insulating Glass Unit specified above, but with spandrel glass in lieu of clear glass on inboard lite.
1. Spandrel Glass Color: To be selected by Architect from manufacturer's full range.

2.6 GLAZING UNITS

A. Fire-Protection-Rated Glazing: Type, thickness, and configuration of glazing that contains flame, smoke, and does not block radiant heat, as required to achieve indicated fire-rating period of 45 minutes or less.
1. Applications:
   a. Glazing in fire-rated door assembly.
   b. Glazing in fire-rated window assembly.
   c. Other locations as indicated on drawings.
2. Provide products listed by ITS (DIR) or UL (DIR) and approved by authorities having jurisdiction.
3. Safety Glazing Certification: 16 CFR 1201 Category II.
4. Fire-Rating Period: As indicated on drawings.
5. Manufacturers:
   a. SAFTIFIRST, a division of O'Keeffe's Inc; SuperLite I: www.safti.com/sle.

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b. SCHOTT North America Inc; Pyran Platinum: www.us.schott.com.
c. Technical Glass Products; Firelite Plus: www.fireglass.com.

B. Monolithic Safety Glazing: Non-fire-rated.
1. Applications:
a. Glazed lites in doors, except fire doors.
b. Glazed sidelights to doors, except in fire-rated walls and partitions.
c. Other locations required by applicable federal, state, and local codes and regulations.
d. Other locations indicated on drawings.
2. Glass Type: Fully tempered safety glass as specified.
3. Tint: Clear.
4. Thicknesses:
a. For glass units with fully captured edges: 1/4" unless otherwise indicated.
b. For glass units with top and bottom captured edges, butt-glazed sides:
1) Up to 5' in height: 1/4".
2) Over 5' up to 8' in height: 3/8"
3) Over 8' up to 10' in height:1/2"
4) Over 10' up to 12' in height: 5/8"
5) Over 12' up to 14' in height: 3/4"
6) Over 14' up to 16' in height: 7/8"
7) Over 16' up to 18' in height: 1"

2.7 GLAZING COMPOUNDS

A. Silicone Sealant: Single component; neutral curing; capable of water immersion without loss of properties; non-bleeding, non-staining; ASTM C920, Type S, Grade NS, Class 25, Uses M, A, and G; with cured Shore A hardness range of 15 to 25; color as selected.

2.8 ACCESSORIES

A. Setting Blocks: Silicone, with 80 to 90 Shore A durometer hardness; ASTM C864 Option II. Length of 0.1 inch for each square foot of glazing or minimum 4 inch x width of glazing rabbet space minus 1/16 inch x height to suit glazing method and pane weight and area.

B. Spacer Shims: Neoprene, 50 to 60 Shore A durometer hardness; ASTM C864 Option II. Minimum 3 inch long x one half the height of the glazing stop x thickness to suit application, self adhesive on one face.

C. Glazing Tape: Closed cell polyvinyl chloride (PVC) foam, coiled on release paper over adhesive on two sides, maximum water absorption by volume of 2 percent, designed for compression of 25 percent to effect an air barrier and vapor retarder seal.

D. Glazing Splines: Resilient silicone extruded shape to suit glazing channel retaining slot; ASTM C864 Option II; color black.

E. Glazing Clips: Manufacturer's standard type.

PART 3 EXECUTION

3.1 PREPARATION

A. Clean contact surfaces with appropriate solvent and wipe dry within maximum of 24 hours before glazing. Remove coatings that are not tightly bonded to substrates.

B. Seal porous glazing channels or recesses with substrate compatible primer or sealer.

C. Prime surfaces scheduled to receive sealant where required for proper sealant adhesion.

3.2 INSTALLATION, GENERAL

A. Install glazing in compliance with written instructions of glass, gaskets, and other glazing material manufacturers, unless more stringent requirements are indicated, including those in glazing referenced standards.

B. Install glazing sealants in accordance with ASTM C1193, GANA (SM), and manufacturer's instructions.

C. Do not exceed edge pressures around perimeter of glass lites as stipulated by glass manufacturer.

D. Set glass lites of system with uniform pattern, draw, bow, and similar characteristics.

E. Set glass lites in proper orientation so that coatings face exterior or interior as indicated.

F. Prevent glass from contact with any contaminating substances that may be the result of construction operations such as, and not limited to the following; weld splatter, fire-safing, plastering, mortar droppings, etc.

3.3 INSTALLATION - DRY GLAZING METHOD (GASKET GLAZING)

A. Application - Exterior and/or Interior Glazed: Set glazing infills from either the exterior or the interior of the building.

B. Place setting blocks at 1/4 points with edge block no more than 6 inch from corners.

C. Rest glazing on setting blocks and push against fixed stop with sufficient pressure on gasket to attain full contact.

D. Install removable stops without displacing glazing gasket; exert pressure for full continuous contact.

3.4 INSTALLATION - PRESSURE GLAZED SYSTEMS

A. Application - Exterior Glazed: Set glazing infills from the exterior of the building.

B. Place setting blocks at 1/4 points with edge block no more than 6 inch from corners.

C. Rest glazing on setting blocks and push against fixed stop with sufficient pressure on gasket to attain full contact.

D. Install pressure plates without displacing glazing gasket; exert pressure for full continuous contact.

3.5 INSTALLATION - STRUCTURAL SILICONE GLAZING

A. Follow basic guidelines of structural silicone glazing for glazing application.
   1. Two-Sided Structural: Glass structurally adhered to vertical mullions with horizontal sides captured in glazing pockets.

B. Provide design review of the glazing system and project details, adhesion testing, proper surface preparation, training and a quality service program.

C. Provide only structural silicone sealant, tested and manufactured for structural glazing.

END OF SECTION

SECTION 10 21 23
CUBICLE CURTAINS AND TRACK

03ADD

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Surface mounted overhead metal curtain track and guides.

B. Curtains.

1.2 RELATED REQUIREMENTS

A. Section 06 10 00 - Rough Carpentry: Blocking and supports for track.

1.3 REFERENCE STANDARDS

A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2016.

B. NFPA 701 - Standard Methods of Fire Tests for Flame Propagation of Textiles and Films; 2015.

1.4 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data for curtain fabric characteristics and _____.

C. Shop Drawings: Indicate a reflected ceiling plan view of curtain track, hangers and suspension points, attachment details, schedule of curtain sizes.

D. Samples: Submit 12 by 12 inch sample patch of curtain cloth with representative top, bottom, and edge hem stitch detail, heading with reinforcement, bottom weight, and carrier attachment to curtain header.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Accept curtain materials on site and inspect for damage.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Cubicle Track and Curtains:

2.2 TRACKS AND TRACK COMPONENTS

A. Track: Extruded aluminum sections; one piece per cubicle track run; I-beam profile.
   1. Finish on Exposed Surfaces: Clear anodized finish.

2.3 CURTAINS

A. Curtain Materials:
   1. Curtain: Maharam Increment; color selected from manufacturer's standard range.

B. Curtain Fabrication:

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that surfaces and supports above ceiling are ready to receive work of this Section.

3.2 INSTALLATION

A. Install curtain track to be secure, rigid, and true to ceiling line.

B. See Section 06 10 00 for track supports above ceiling.

C. Secure track to ceiling system.

D. Install curtains on carriers ensuring smooth operation.

END OF SECTION

SECTION 10 28 00

TOILET ACCESSORIES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Toilet accessories.

B. Shower and bath accessories.

C. Utility room accessories.

1.2 RELATED REQUIREMENTS

A. Section 09 30 00 - Tiling: Ceramic washroom accessories.

B. Section 10 21 13.19 - Plastic Toilet Compartments.

1.3 REFERENCE STANDARDS

A. ASTM A269/A269M - Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service; 2015.

B. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2015.

C. ASTM C1036 - Standard Specification for Flat Glass; 2016.

D. ASTM C1503 - Standard Specification for Silvered Flat Glass Mirror; 2008 (Reapproved 2013).

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordinate the work with the placement of internal wall reinforcement to receive anchor attachments.

1.5 SUBMITTALS

A. Product Data: Provide data on accessories describing size, finish, details of function, attachment methods.

B. Manufacturer's Installation Instructions: Indicate special procedures and conditions requiring special attention.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. All items of each type to be made by the same manufacturer.

2.2 MATERIALS

A. Accessories - General: Shop assembled, free of dents and scratches and packaged complete with anchors and fittings, steel anchor plates, adapters, and anchor components for installation.

B. Keys: Provide six keys for each accessory to Owner; master key all lockable accessories.

C. Stainless Steel Sheet: ASTM A666, Type 304.

D. Stainless Steel Tubing: ASTM A269, Type 304 or 316.

E. Mirror Glass: Annealed float glass, ASTM C1036 Type I, Class 1, Quality Q2, with silvering, protective and physical characteristics complying with ASTM C1503.

F. Adhesive: Two component epoxy type, waterproof.

G. Fasteners, Screws, and Bolts: Hot dip galvanized, tamper-proof, security type.

2.3 FINISHES

A. Stainless Steel: No. 4 satin brushed finish, unless otherwise noted.

2.4 Toilet Accessories

A. Toilet Paper Dispenser:

1. Product: Owner furnished, contractor installed

B. Surface Mounted Toilet Paper Dispenser:
1. Product: Owner furnished, contractor installed

C. Waste Receptacle: Stainless steel, freestanding style with swing top.
1. Liner: Removable, heavy-duty vinyl liner, attached at a minimum of 3 points with stainless steel grommets and hooks.
2. Minimum capacity: 10 gallons.

D. Soap Dispenser: Owner Furnished, Contractor Installed.

E. Framed Mirrors: Stainless steel framed, 6 mm thick float glass mirror.
1. Size: As indicated on drawings.
2. Frame: 0.05 inchchannel shapes, with mitered corners, and tamperproof hanging system; No.4 finish.
3. Backing: Full-mirror sized, minimum 0.03 inch galvanized steel sheet and nonabsorptive filler material.

F. Grab Bars: Stainless steel, nonslip grasping surface finish.
1. Standard Duty Grab Bars:
a. Push/Pull Point Load: 250 pound-force, minimum.
b. Dimensions: 1-1/2 inch outside diameter, minimum 0.05 inch wall thickness, concealed flange mounting, 1-1/2 inch clearance between wall and inside of grab bar.
c. Length and Configuration: As indicated on drawings.
d. Product: Bobrick, B-6806.

2.5 SHOWER ACCESSORIES

A. Shower Curtain Rod: Stainless steel tube, 1-1/4 inch outside diameter, 0.04 inch wall thickness, satin-finished, with 3 inch outside diameter, minimum 0.04 inch thick satin-finished stainless steel flanges, for concealed mounting.

B. Shower Curtain: Manufacturer's standard shower curtain with stainless steel grommets for hook attachment to curtain rod
1. Material: [], 0.006 inch thick, matte finish,[] flameproof and stain-resistant.
2. Size: Minimum 12 inches wider than opening by 72 inches high.
3. Shower curtain hooks: Chrome-plated or stainless steel spring wire designed for snap closure. Provide one hook per curtain grommet.

ADD3

C. Folding Shower Seat: Wall-mounted surface; welded tubular seat frame, structural support members, hinges and mechanical fasteners of Type 304 stainless steel, rectangular seat.
1. Seat: Teakwood slats secured to supporting frame members with stainless steel screws. Ease edges of each slat.

D. Robe Hook: Heavy-duty stainless steel, double-prong, rectangular-shaped bracket and backplate for concealed attachment, satin finish.

2.6 Utility Room Accessories

A. Mop and Broom Holder: 0.05 inch thick stainless steel, Type 304, hat-shaped channel.
1. Length: Manufacturer's standard length for number of holders.

ADD 3

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify exact location of accessories for installation.

3.2 PREPARATION

A. Deliver inserts and rough-in frames to site for timely installation.

B. Provide templates and rough-in measurements as required.

3.3 INSTALLATION

A. Install accessories in accordance with manufacturers' instructions in locations indicated on the drawings.

B. Install plumb and level, securely and rigidly anchored to substrate.

C. Mounting Heights: As required by accessibility regulations, unless otherwise indicated.

END OF SECTION

SECTION 23 74 23.13
GAS FIRED MAKE-UP AIR UNITS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Direct Fired Make-Up Air Unit.

1.2 QUALITY ASSURANCE

A. Comply with applicable regulations and have local Gas Company approval.

B. Factory test to check construction, controls, and operation of unit and provide certification.

C. Test operation after installation.

D. Provide with complete one (1) year warranty. Warranty period begins at date of initial startup.

E. Conform to ASHRAE 90.1.

F. All air handling and distribution equipment mounted outdoors shall be designed to prevent rain intrusion into the airstream when tested at design airflow and with no airflow, using the rain test apparatus described in Section 58 of UL 1995.

1.3 SUBMITTALS

A. Submit shop drawings per Section 23 05 00 showing dimensions, connections, arrangement, accessories, electrical service and duct connections, and controls.

B. Submit manufacturer's installation instructions.

C. Submit operation and maintenance data including manufacturer's descriptive literature, maintenance and repair data, and parts listing.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Protect units from physical damage by storing off-site until ready for installation.

PART 2 - PRODUCTS

2.1 DIRECT FIRED MAKE-UP AIR UNIT

A. Acceptable Manufacturers:

1. Greenheck.
2. Modine

B. Manufactured Units:

1. Self-contained direct-fired make-up air unit with burner, inlet damper, gas controls, unit controls, and all accessories noted or required for complete installation.

2. Units shall bear a UL, ETL or AGA label indicating that the units have been tested and comply with Standard ANSI Z83.4.

3. Suspended mounted inside building.

ADD 3

4. Unit to consist of direct-fired gas burner, unit cabinet and frame, direct drive supply fan, and all unit and burner safety and control devices.

5. Controls shall include terminal connections for ~~setpoint adjustment and system enable/disable.~~ ...burner modulation and supply fan start/stop and vfd alarm.

6. Furnish non-fused disconnect switch, short circuit protection of all internal electrical components, and all necessary motor starters, contactors, and over-current protection.

C. Fabrication:

1. Construct heater casing and components of 18 gauge steel panels, reinforced with angles and channels for rigidity. Provide access panels to burner and blower motor assemblies.

2. Locate port on burner section for observing main and pilot flames.

3. Insulate indoor units up to burner section with 1" thick neoprene faced glass fiber insulation.

4. Finish casing and components with heat resistant baked enamel.

D. Filters:

1. Provide filter section complete with removable 4" thick MERV 13 pleated filter. Refer to 23 40 00 for requirements.

E. Burner:

1. Provide natural gas burner with modulating turndown ratio of 30:1. Adjustable profile plate, stainless steel baffles, cast aluminum burner tube.

2. Gas Burner: Forced draft type burner with adjustable combustion air supply, pressure regulator, gas valves, manual shutoff, intermittent spark, flame sensing device, and automatic 100 percent shutoff pilot.

3. Gas Burner Safety Controls: Energize ignition, limit time for establishment of flame, prevent opening of gas valve until pilot flame is proven, stop gas flow on ignition failure, energize blower motor, and after airflow proven and slight delay, allow gas valve to open.

4. High Limit Control: Temperature sensor with fixed stop at maximum permissible setting, de-energize burner on excessive bonnet temperature and energize burner when temperature drops to lower safe value.

F. Fan:

1. Provide statically and dynamically balanced direct drive centrifugal fan. Extend any grease lines to access doors.

G. Unit Controls:

1. Pre-wire unit so connection of power supply and field wiring to unit's terminal strip makes unit operative. Wiring and control enclosures shall meet NEC and local codes. Provide pre-wired, numbered terminal strips for field wiring connections to Building Automation System.

2. Provide the following safety controls: air flow switch, electronic flame safety relay, high temperature limit switch, starter interlock, high gas pressure switch, low gas pressure switch, low discharge temperature control with bypass timer.

H. Gas Manifold:

1. Pilot line shall include: gas shutoff valve, gas regulator, pilot gas valve.

2. Main gas line shall include: gas shutoff valve, gas regulator, main gas valve (2 required), modulating gas valve, leakage test valve, low pressure gas switch, high pressure gas switch, vent valve between the two main gas valves and all required test valves.

3. Gas train shall meet FIA/IRI, local utility, and Owner's insurance company requirements.

4. Provide piping from vent valve to outside the building.

5. Provide additional regulator if the incoming gas pressure exceeds 2 psig.

6. Locate all valves and components in a unit mounted enclosure.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that area is ready to receive work and opening dimensions are as indicated on the shop drawings and illustrated by the manufacturer.

B. Verify that proper power supply is available.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. All field wiring shall be per the National Electrical Code.

3.3 MANUFACTURER'S FIELD SERVICES

A. Provide initial start-up and shutdown during first year of operation, including routine servicing and check-out.

END OF SECTION

SECTION 31 26 00
STEEL HELICAL PILES

PART 1 - GENERAL

1.1 DESCRIPTION:

A. The General and Supplementary Conditions of the Construction Contract and Division 1 - General Requirements apply to the work specified in this section.

B. The work includes all items required for executing and completing the steel helical pile work and related work shown on the drawings or specified herein.

C. Structural notes indicated on the drawings regarding steel helical piles should be considered a part of this specification.

D. No substitutions will be allowed without the Engineer of Record's approval.

1.2 QUALITY ASSURANCE

A. Codes and Standards: Comply with the provisions of the following codes, specifications, and standards except where more stringent requirements are shown or specified herein:

1. ASCE 20 - Standard Guidelines for the Design and Installation of Pile Foundations.

2. ASME B18.2.1 - Square, Hex, Heavy Hex, and Askew Head Bolts and Hex, Heavy Hex, Hex Flange, Lobed Head, and Lag Screws (Inch Series).

3. ASTM A29 - Standard Specification for General Requirements for Steel Bars, Carbon and Alloy, Hot-Wrought.

4. ASTM A36 - Standard Specification for Carbon Structural Steel.

5. ASTM A53 - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.

6. ASTM A123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

7. ASTM A153 - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.

8. ASTM A193 - Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications.

9. ASTM A252 - Standard Specification for Welded and Seamless Steel Pipe Piles.

10. ASTM A320 - Standard Specification for Alloy-Steel and Stainless Steel Bolting for Low-Temperature Service.

11. ASTM A500 - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.

12. ASTM A513 - Standard Specification for Electric-Resistance-Welded Carbon and Alloy Steel Mechanical Tubing.

13. ASTM A536 - Standard Specification for Ductile Iron Castings.

14. ASTM A572 - Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel.

15. ASTM A618 - Standard Specification for Hot-Formed Welded and Seamless High-Strength Low-Alloy Structural Tubing.

16. ASTM A656 - Standard Specification for Hot-Rolled Structural Steel, High-Strength Low-Alloy Plate with Improved Formability.

17. ASTM A958 - Standard Specification for Steel Castings, Carbon, and Alloy, with Tensile Requirements, Chemical Requirements Similar to Standard Wrought Grades.

18. ASTM A1018 - Standard Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Hot-Rolled, Carbon, Commercial, Drawing, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength.

19. ASTM D1143 - Standard Test Methods for Deep Foundations Under Static Axial Compressive Load.

20. ASTM D3689 - Standard Test Methods for Deep Foundations Under Static Axial Tensile Load.

21. ASTM D3966 - Standard Test Methods for Deep Foundations Under Lateral Load.

22. ASTM F3125 - Standard Specification for High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 120 ksi and 150 ksi Minimum Tensile Strength, Inch Dimensions.

23. AWS B2.1 - Specification for Welding Procedure and Performance Qualification.

24. AWS D1.1 - Structural Welding Code.

25. AWS D1.4 - Structural Welding Code – Reinforcing Steel.

26. ICC AC358 - Acceptance Criteria for Helical Piles Systems and Devices.

27. OSHA Excavation Safety Guidelines.

28. SAE J429 - Mechanical and Material Requirements for Externally Threaded Fasteners.

B. Comply with all local building code requirements which are more stringent than those listed above. All referenced codes or standards shall be the most currently adopted as of the date for Receipt of Proposal.

C. Where any provision of other pertinent codes and standards conflict with this specification, the more stringent provision shall govern.

D. Fabrication and Installation Qualifications:

1. All welding of structural steel shall be performed by operators who have been recently qualified as prescribed in “Qualification Procedures” of the American Welding Society (AWS).

2. The Steel Helical Pile Contractor shall be fully experienced in all aspects of helical pile design and construction, and shall furnish all necessary materials, skilled labor, and supervision to carry out the contract. The Contractor shall not have less than five (5) years of continuous experience in fabrication and installation of steel helical pile work. Job supervisor shall have a minimum of three (3) years of method specific experience.

3. Upon request of the Architect/Engineer, Helical Pile Contractor shall submit evidence of successful installation of steel helical piles under similar project scope and size.

4. The Steel Helical Pile Contractor shall not sublet the whole or any part of the contract without the express permission in writing of the Owner.

E. Inspector shall keep a record or log of each pile as installed. Records shall show location, top and bottom elevations, shaft diameters, date installed, type of strata encountered, rated load capacity, grout pressure attained and any other pertinent information. A copy of this record shall be submitted to the Architect and Engineer for their record files.

F. Helical Pile Contractor shall schedule and provide time and means for the Inspection Agency to inspect, take samples, and make tests.

1.3 TESTING AND INSPECTION

A. Inspection and Testing:

1. The Contractor shall employ an Inspection Agency to perform the duties and responsibilities specified below.

2. Refer to architectural, civil, mechanical, and electrical specifications for testing and inspection requirements of non-structural components.

3. Work performed on the premises of a fabricator approved by the building official need not be tested and inspected per the table below. The fabricator shall submit a certificate of compliance that the work has been performed in accordance with the approved plans and specification to the building official and the Architect and Engineer of Record.

4. Duties of the Inspection Agency:

   a. Perform all testing and inspection required per approved testing and inspection program.

   b. Furnish inspection reports to the building official, the Owner, the Architect, the Engineer of Record, and the General Contractor. The reports shall be completed and furnished within 48 hours of inspected work.

   c. Submit a final signed report stating whether the work requiring Inspection was, to the best of the Inspection Agency's knowledge in conformance with the approved plans and specifications.

5. Structural Component Testing and Inspection Schedule for Section 31 26 00 is as follows:

Steel Helical Piles	Continuous	Periodic
Verify element materials, sizes, and lengths comply with the requirements.	X	
Determine capacities of test elements and conduct additional load tests, as required.	X	
Observe drilling operations and maintain complete and accurate records for each element.	X	
Verify placement locations and plumbness, confirm type and size of jack, record pressure per foot of penetration, determine required penetration to achieve design capacity, record tip and butt elevations and document any damage to foundation element.	X	

1.4 DEFINITIONS

A. A partial list follows:

1. Bearing Stratum: The soil or highly weathered rock layer that provides the axial tension resistance for the installed helical pile.

2. Brackets: Cap plate, angle, thread bar, or other termination device that is bolted or welded to the end of a helical pile after completion of installation to facilitate attachment to structures or embedment in cast-in-place concrete.

3. Crowd: Axial compressive force or pressure applied to the helical pile as needed during installation to ensure the pile advances into the ground a minimum of 80% of the distance equal to the helix pitch for each revolution.

4. Deflection: The axial displacement of the pile as measured at the pile head under applied load.

5. Effective Torsional Resistance: The average installation torque typically taken over a distance equal to the last three diameters of penetration of the largest helix plate as close to or in the specified bearing stratum.

6. Extension Section: Helical pile component connecting the lead section to the load transfer device. Extension sections may be plain without helix plates or helical including one or more helix plates.

7. Factored Load: Service load times the required load factor.

8. Geotechnical Capacity: The maximum load that can be resisted through the bearing of the helix plates in the soil or highly weathered rock in which they are embedded as characterized by the available subsurface soils, rock and groundwater information, and geotechnical testing data, without exceeding the specified performance criteria.

9. Helical Pile: Consists of one or more helix plates attached to a central shaft and load transfer device for attachment to a structure. May also include surface coating or other corrosion protection means.

10. Helical Anchor: Same as a Helical Pile. Term generally used when axial tension is the primary service load.

11. Helix Plate (Helices): Generally round steel plate formed into a helical spiral and welded to the central steel shaft.

12. Installation Angle: Angle of inclination between the longitudinal axis of the helical pile and the horizontal.

13. Lead Section: The first helical pile component installed into the soil. It consists of one or more helical plates welded to the central steel shaft.

14. Limit State: A condition beyond which a helical pile component or interface becomes no longer useful for its intended function (serviceability limit state) or to be unsafe (strength limit state).

15. Loads: Forces or other actions as defined that must be resisted by the piles. Permanent loads are those loads in which variations over time are rare or of small magnitude. All other loads are variable loads. Refer also to Service Load below.

16. Load Factor: A factor that accounts for deviations of the actual load from the service load (load resistance factor design).

17. Load Test: A procedure to test the capacity and relation of load to deflection by applying a compression, tension, and/or lateral load on the helical pile.

18. Mechanical Strength: The maximum compressive, tension, and/or lateral load capable of being resisted by the structural elements of a helical pile.

19. Pile Design Professional: Individual or firm responsible for the design of helical piles, helical anchors, and brackets.

20. Reveal: The distance from ground surface to the end of the last installed extension of a pile, measured along the pile's longitudinal axis.

21. Pitch: The distance measured along the axis of the shaft between the leading and trailing edges of the helix plate.

22. Safety Factor: The ratio of the ultimate resistance to the service load used for the design of any helical pile component or interface.

23. Service Load: The total magnitude of the unfactored loads, determined by the Owner's Representative, that must be resisted by the piles.

24. Torque: The measure of the rotational force times the moment arm needed to overcome the shear strength of the soil measured in ft-lb. Torque is used as an empirical approach for predicting the ultimate capacity of a helical pile.

25. Ultimate Resistance: Limit state based on the lesser of mechanical strength or geotechnical capacity of the helical pile defined as the point at which no additional load can be applied without exceeding the specified performance criteria.

1.5 DESIGN

A. Helical pile design shall be designed to meet the specified loading as shown on the drawings and deflection criteria of 1/2" differential settlement and 1" total settlement. Calculations and drawings required from the Helical Pile Contractor shall be submitted to the Architect/Engineer.

B. Helical pile design shall include overall pile length, helix length, and helix configuration. If static load testing is performend, pile design to include a minimum factor of safety of 2.0. If static load testing is not performend, pile design to include a minimum factor of safety of 3.0.

C. Except where noted in the drawings, all pile components shall be designed to provide a minimum safety factor for mechanical strength of 2.0.

D. Except where noted in the drawings, each pile shall be designed to meet a corrosion service life of 50 years.

E. The helical pile design shall take into account pile spacing, soil stratification, long-term soil consolidation, corrosion, settlement, and strain compatibility issues as are present for the project.

F. The helical pile top attachment shall effectively distribute the design load to the concrete foundations such that the concrete bearing stress does not exceed those in the ACI Building Code and the bending stress in the steel plates does not exceed AISC allowable stresses for steel members.

G. If on-site load testing is to be performed, the piles shall be designed such that the maximum test load does not exceed 90% of the manufacturer's rated mechanical strength of any pile component or load transfer device.

1.6 BID REQUIREMENTS

A. Steel Helical Piles: Bids shall be provided for the lump sum amount based on the number of piles, estimated length, and total footage as shown in the drawings and/or specifications.

B. The Pile Contractor shall examine the construction site and conditions under which piles are to be installed, and notify the General Contractor and Architect in writing prior to bidding of any conditions detrimental to proper and timely completion of work.

C. Helical Pile Length: Base the length of the helical piles on the length listed on the drawings and in the Geotechnical Engineering Report. The elevation identifying the bottom of the shaft is an approximate length for consistent bidding purposes only. The actual length will be determined in the field from the actual elevation of the bearing stratum to be verified by the Inspection Agency.

D. Unit prices shall be issued to the Architect prior to construction as part of the submittal package.

E. ~~Adjustments in the Contract Price will be made due to changes in the number and length of piles, based on unit prices established in Section 01 21 00 Allowances~~ as follows:

ADD 3: ...provided on the proposal page,... — ADD 3

1. ~~Payment for helical piles will be made on the total length~~ of helical piles installed and accepted. Actual length and shaft diameter may change due to job conditions. Adjusted payment will be made on the basis of net variations to the total quantities, based on design dimensions.

2. Provide the following unit costs in the event that additions to, or deductions from, work, are required and authorized in writing by Architect/Engineer:

   a. Additional length of helical pile ($/per foot)
   b. Subtracted length of helical pile ($/per foot)
   c. Load test (lump sum per test)

1.7 SUBMITTALS

A. Shop Drawings:

1. Prepare and submit to the Architect/Engineer, for review and approval, working drawings and relevant structural design calculations for the helical pile system or systems intended for use. All design submittal shall be sealed by a Registered Professional Engineer currently licensed in the state where the project is located.

2. Product Data:

   a. Product designations for helix sections, extension sections, and all ancillary products to be supplied at each helical pile location.
   b. Evaluation approved by the applicable building code authority (e.g., International Code Council Evaluation Services (ICC-ES)).
   c. Corrosion protection and pile top attachment.
   d. Manufacturer's published mechanical strengths for the pile assemblies, including load transfer devices per current ICC-ES report, calculations, and/or full scale testing.

3. Design Data:

   a. Calculated geotechnical capacity of piles based on geotechnical information. The design submittal prepared by the pile designer shall indicate that the selected piles can be installed to achieve the performance requirements.
   b. Minimum effective torsional resistance criteria.
   c. Maximum allowable installation torque of pile.
   d. Proposed production quality control plan, including method and equipment to be used to measure torsional resistance during installation.

e. Procedures and acceptance criteria for any proposed performance and/or proof testing.

4. Submit a detailed description of the construction procedures proposed for use to the Architect/Engineer for review. This shall include a schedule of major equipment resources.

5. The working drawings shall include helical pile installation details giving:

a. Helical pile number, location, and pattern by assigned identification number
b. Helical pile design load
c. Type and size of central steel shaft
d. Number and diameter of helix plates
e. Minimum overall length
f. Minimum effective installation torque
g. Inclination of helical pile
h. Helical pile attachment to structure relative to grade beam, pile cap, etc.
i. Cutoff elevation

6. Submit shop drawings for all structural steel, including the helical pile components, corrosion protection system, pile top attachment, and helix details, to the Architect/Engineer for review and approval.

7. Submit for review and acceptance the proposed helical pile load testing procedure. The testing program shall be provided two (2) weeks prior to starting the load testing. This helical pile verification load testing proposal shall be in general conformance with ASTM D1143 and/or D3689, and shall indicate the minimum following information:

a. Type and accuracy of apparatus for measuring load
b. Type and accuracy of apparatus for applying load
c. Type and accuracy of apparatus for measuring the pile deformation
d. Type and capacity of reaction load system, including sealed design drawings
e. Hydraulic jack calibration report

8. Submit to the Architect/Engineer calibration reports for each test jack, pressure gauge, and master pressure gauge to be used. The calibration tests shall have been performed by an independent testing laboratory, and tests shall have been performed within one year of the date submitted. Testing shall not commence until the Architect/Engineer has approved the jack, pressure gauge, and master pressure gauge calculations.

9. Work shall not begin until the appropriate submittals have been received, reviewed, and approved in writing by the Architect/Engineer. Note that any additional time required due to incomplete or unacceptable submittals shall not be cause for delay or impact claims. All costs associated with incomplete or unacceptable submittals shall be the responsibility of the Contractor.

10. Welding certificates.

11. Unit costs: Submit as outlined in this section.

12. The Contractor shall submit to the Architect copies of calibration reports for each torque indicator or torque motor, and all load test equipment to be used on the project. The calibration tests shall have been performed within 45 working days of the date submitted. Helical pile installation and testing shall not proceed until the Architect/Engineer has received the calibration reports. These calibration reports shall include, but are not limited to, the following information:

a. Name of project and Contractor
b. Name of testing agency
c. Identification (serial number) of device calibrated
d. Description of calibrated testing equipment

e. Date of calibration
f. Calibration data

13. Installation Reports: The installing contractor shall provide the Owner, or his authorized representative, copies of individual helical pile installation records within 24 hours after each installation is completed. Formal copies shall be submitted within 48 hours after installation. These installation records shall include, but are not limited to, the following information:

a. Name of project and Contractor
b. Name of Contractor's supervisor during installation
c. Date and time of installation
d. Installation equipment type and operator name
e. Type of torque indicator used
f. Location of helical pile or helical anchor by grid location, diagram, or assigned identification number
g. Pile reveal
h. Type and configuration of lead section with length of shaft and number and size of helical bearing plates
i. Type and configuration of extension sections with length and number and size of helical bearing plates, if any
j. Final elevation of top of shaft and cutoff length, if any
k. Total length of installed pile
l. As-built installation angle of pile
m. Torque measurements at three-foot depth intervals
n. Final installation torque
o. Effective torsional resistance and calculated geotechnical capacity based on effective torsional resistance and/or as derived from the pre-production test program
p. Comments pertaining to interruptions, obstructions, or other relevant information
q. Unless specified otherwise on the drawings or by local codes, the pile design professional, or an inspection agency accepted by the Architect/Engineer, shall observe and document at least 10 percent of helical pile and helical anchor installations.

B. LEED Certification: Submit manufacturer's certification for each steel product including the following:

1. LEED Credit MRc 4.1/4.2 – Recycled content, including percentage of pre-consumer (post-industrial) and post-consumer recycled content. Also provide manufacturer's name, product cost and steel processing furnace type.

2. LEED Credit MRc 5.1/5.2 – Location of manufacturing plant, manufacturer's name, product cost and location of extraction or harvest of raw materials.

C. Post Construction:

1. The following records shall be prepared for the Owner. The records shall be completed within 24 hours after each pile installation is completed. The records shall include the following minimum information:

a. Pile drilling duration and observations
b. Information on soil and rock encountered, including description of strata, water, etc.
c. Approximate final tip elevation
d. Cutoff elevation
e. Rated load capacities
f. Description of unusual installation behavior or conditions
g. Any deviations from the intended parameters
h. Torque attained, where applicable
i. Pile materials and dimensions
j. Helical pile test records, analysis, and details

2. Submit as-built drawings showing the location of the piles, their depth and inclination, and details of their composition.

1.8 SUBSURFACE CONDITIONS

A. The Geotechnical Report, including logs of soil borings as shown on the boring location plan, shall be considered to be representative of the in-situ subsurface conditions likely to be encountered on the project site. Said Geotechnical Report shall be the used as the basis for helical pile design using generally accepted engineering judgment and methods.

B. The Geotechnical Report shall be provided for purposes of bidding. If, during helical pile installation, subsurface conditions of a type and location are encountered of a frequency that were not reported, inferred, and/or expected at the time of preparation of the bid, the additional costs required to overcome such conditions shall be considered as extras to be paid for by the Owner.

1.9 PILE LOAD TESTING

A. If pile testing is required, the Installing Contractor shall furnish all labor, equipment, and pre-production helical piles necessary to accomplish the testing as shown in the previously submitted and approved pile design submittals. The Installing Contractor shall apply the specified loads for the specified durations and record the specified data for the specified number of piles. No deviations from the test plan(s) will be allowed without explicit approval in writing from the Owner/Owner's Representative. Pile testing shall be in accordance with the load testing procedures and performance requirements deemed suitable for the application by the Owner/Owner's Representative, or pile designer.

removed Addendum 3

B. Helical Pile Compression Tests:

1. ~~Contractor shall perform the number of compression tests shown on the drawings.~~

2. Compression tests shall be performed following the "quick test" procedure described in ASTM D1143 specifications.

3. Load tests shall be observed and documented by the Inspection Agency.

4. Unless otherwise shown on the drawings, the maximum test load shall be 200% of the allowable load shown on the drawings.

5. The locations of helical piles to be tested shall be determined by the Contractor, unless noted on the drawings.

6. Installation methods, procedures, equipment, products, and final installation torque shall be identical to the production helical piles to the extent practical, except where otherwise approved by the Owner or Architect/Engineer.

7. A load test shall be deemed acceptable provided the maximum test load is applied without helical pile failure and the deflection of the pile head at the design load is less than 1-inch, unless noted otherwise on the drawings. Failure is defined when continuous jacking is required to maintain the load.

C. If a load test fails the foregoing acceptance criteria, the Contractor shall modify the helical pile or helical anchor design and/or installation methods and retest the modified pile or anchor as directed by the Owner or Architect/Engineer. These modifications include, but are not limited to, de-rating the load capacity, modifying the installation methods and equipment, increasing the minimum final installation torque, changing the helical configuration, or changing the product (e.g., duty). Modifications that require changes to the structure shall have prior review and acceptance of the Owner. Any modifications of design or construction procedures, and any retesting required, shall be at the Contractor's expense.

D. The Contractor shall provide the Owner and Architect/Engineer copies of load test reports confirming configuration and construction details within one (1) week after completion of the load tests. This written documentation will either confirm the load capacity as required on the working drawings or propose changes based on the results of the tests. At a minimum, the documentation shall include, but is not limited to, the following information:

1. Name of project and installing contractor
2. Name of installing contractor's supervisor during installation
3. Name of third party test agency, if any
4. Type of test, pre-production or production test
5. Date, time, and duration of test
6. Unique identifier and location of helical pile tested
7. Test procedure (ASTM D1143, D3689, or D3966)
8. List of any deviations from procedure
9. Test criteria, performance or proof
10. Description of calibrated testing equipment and test setup
11. Testing equipment calibration data
12. Type and configuration of helical pile or helical anchor including lead section, number and type of extension sections, and manufacturer's product identification numbers
13. Load steps and duration of each load increment
14. Incremental and cumulative pile-head movement at each load step
15. Comments pertaining to test procedure, equipment adjustments, or other relevant information
16. Reaction frame/pile installation and verification data, as required by Owner or pile designer
17. Incremental and cumulative pile-head movement at each load step
18. Signatures as required by local jurisdiction

1.10 PRODUCT DELIVERY, STORAGE AND HANDLING

A. All helical pile, helical anchor, and bracket assemblies shall be free of structural defects and protected from damage. Store helical piles, helical anchors, and bracket assemblies on wood pallets or supports to keep from contacting the ground. Damage to materials shall be cause for rejection.

PART 2 - PRODUCTS

2.1 MANUFACTURER

ADD 3
Added Techno Metal Post and Helical Anchors Inc.

A. AB Chance Company, a subsidiary of Hubbel Corp., 210 North Allen Street, Centralia, MO 65240-1395; or Aluma-Form/Dixie, 3625 Old Getwell Road, Memphis, TN 38118.

B. Foundation Supportworks®, Inc., 12330 Cary Circle, Omaha, NE 68128.

C. Pier Tech Systems, 17813 Edison Avenue, Suite 100, Chesterfield, MO 63005.

D. Magnum Piering, Inc., 6082 Schumacher Park Drive, West Chester, OH 45069.

2.2 LEED CREDIT

A. LEED Credit MRc 4.1/4.2:

1. Steel products shall be made using an electric arc furnace and shall have a minimum recycled content of 80%, including at least 65% post-consumer recycled content and 15% post-industrial recycled content.

2. Steel products made using a basic oxygen furnace shall have a minimum recycled content of 25%, including at least 20% post-consumer recycled content and 5% post-industrial recycled content.

B. LEED Credit MRc 5.1/5.2:

1. Steel products shall be manufactured within 500 miles of project site. Recycled scrap products shall be procured from within 500 miles of the project site.

PART 3 - EXECUTION

3.1 SITE CONDITIONS

A. Prior to commencing helical pile installation, the Contractor shall inspect the work of all other trades and verify that all said work is completed to the point where helical piles may commence without restriction.

B. The Contractor shall verify that all helical piles may be installed in accordance with all pertinent codes and regulations regarding such items as underground obstructions, right-of-way limitations, utilities, etc.

C. In the event of a discrepancy, the Contractor shall notify the Architect/Engineer. The Contractor shall not proceed with helical pile installation in areas of discrepancies until said discrepancies have been resolved. All costs associated with unresolved discrepancies shall be the responsibility of the Owner.

3.2 INSTALLATION

A. Installing Contractor shall furnish and install all helical piles per the project plans and approved pile design submittals. In the event of conflict between the project plans and the approved pile design documentation, the Installing Contractor shall not begin construction on any affected items until such conflict has been resolved.

B. Installation of helical piles may be observed by representatives of the Owner for quality assurance purposes. The Installing Contactor shall notify the Owner's Representative at least 24 hours prior to pile installation operations. All helical pile sections and ancillary products shall be marked as necessary to allow correlation with the pile design submittals before shipment from the manufacturer.

C. The helical pile installation technique shall be such that it is consistent with the geotechnical, logistical, environmental, and load carrying conditions of the project. The lead section shall be positioned at the location as shown on the pile design drawings. Inclined helical piles can be positioned perpendicular to the ground to assist in initial advancement into the soil before the required installation angle shall be established. After initial penetration, the required installation angle shall be established. The helical pile sections shall be engaged and advanced into the soil in a smooth, continuous manner at a rate of rotation of 5 to 25 rpm. Sufficient crowd shall be applied to uniformly advance the helical pile sections a minimum of 80% of the distance equal to the pitch of the helix plate per revolution. The rate of rotation and magnitude of crowd shall be adjusted for different soil conditions and depths. Extension sections shall be provided to obtain the required minimum overall depth/length and minimum effective torsional resistance as shown on the project plans.

3.3 TERMINATION CRITERIA

A. The specified minimum overall depth/length criteria and minimum effective torsional resistance criterion must be satisfied prior to terminating the helical pile installation. In the event any helical pile fails to meet these production quality control criteria, the following pre-qualified remedies are authorized:

1. If the installation fails to meet the minimum effective torsional resistance criterion at the minimum embedment depth/length:

a. Continue the installation to greater depth/length in the specified bearing stratum until the effective torsional resistance criterion is met, provided continued installation does not exceed any applicable maximum length. or,

b. Demonstrate acceptable pile performance through load testing. or,

c. Replace the pile with one having a different helix configuration. The replacement pile must not exceed any applicable maximum embedment length and either be embedded to a length that places its last helix at least three times its own diameter beyond the position of the first helix of the replaced pile and meet the minimum effective torsional resistance criterion, or pass load testing.

2. If the torque measured during installation reaches the helical pile's allowable torque rating prior to reaching the minimum embedment depth/length criterion, with approval from the Owner/Owner's Representative, terminate the installation, then proceed with one of the following recommended actions:

a. Replace the pile with one having a shaft with a higher torsional strength rating. This replacement pile must be installed to satisfy the minimum embedment depth/length criterion. It must also be embedded to a depth/length that places its last helix at least three times its own diameter beyond the position of the first helix of the replaced pile without exceeding any applicable maximum embedment depth/length requirements, and it must meet the minimum effective torsional resistance criterion. or,

b. Replace or modify the pile with one having a different helix configuration. This replacement or modified pile must be installed to satisfy the minimum embedment depth/length criterion. It must also be embedded to a depth/length that places its last helix at least three times its own diameter beyond the position of the first helix of the replaced pile without exceeding any applicable maximum embedment depth/length requirements, and it must meet the minimum effective torsional resistance criterion. or,

c. If allowed or approved by the Owner/Owner's Representative, remove and reinstall the pile at a position at least three times the diameter of the largest helix away from the initial location. Original minimum embedment depth/length and effective torsional resistance criteria must be met for the repositioned pile. This pile repositioning may require the installation of additional helical piles with service loads adjusted for these spacing changes.

3. If the installation reaches a specified maximum embedment depth/length without achieving the minimum effective torsional resistance criterion:

a. If approved by the Owner/Owner's Representative, remove and reinstall the pile at a position at least three times the diameter of the largest helix away from the initial location. Original minimum installation depth/length and effective torsional resistance criteria must be met for the repositioned pile. This pile repositioning may require the installation of additional helical piles with service loads adjusted for these spacing changes. or,

b. Demonstrate acceptable pile performance through load testing. or,

c. Reduce the load capacity of the helical pile and install additional pile(s) as necessary. The reduced capacity and additional pile location shall be subject to the approval of the Owner/Owner's Representative. or,

d. Replace the pile with one having a different helix configuration. This replacement pile must be embedded to a depth/length that places its last helix at least three times its own diameter beyond the position of the first helix of the replaced pile. This replacement pile must be installed to satisfy the minimum embedment depth/length criterion, and it must meet the minimum effective torsional resistance criterion.

4. If a helical pile fails to meet acceptance criteria in a load test:

a. Install the pile to a greater depth/length and installation torque and re-test, provided any maximum embedment depth/length criterion is not exceeded. or,

b. Replace the pile with one having more and/or larger helix plates. It must be embedded to a depth/length that places its last helix at least three times its own diameter beyond the position of the first helix of the replaced pile without exceeding any applicable maximum embedment depth/length requirements. This replacement pile must be re-tested. or,

c. If approved by the Owner's Representative, de-rate the load capacity of the helical pile and install additional piles. Additional piles must be installed at positions at least three times the diameter of the largest helix away from any other pile locations and approved by the Owner's Representative. Piles installed in cohesive soils shall not be spaced closer than four helix diameters.

5. Load testing to qualify a helical pile under any of the remedial actions outlined in Article 1.9 shall not be used to satisfy load testing frequency requirements shown in the project plans or the approved design submittals.

6. If a helical pile fails a production quality control criterion for any other reason, including damage during installation, any proposed remedy must be approved by the Owner/Owner's Representative prior to implementation.

3.4 TOLERANCES

A. When helical pile placement is shown on the project plans, production piles shall be placed such that the pile head is within 3 inches laterally and longitudinally and 1/2 inch vertically to plan; and the pile shaft alignment is within 1 degree of the installation angle shown on the project plans. When pile placement is not shown on the project plans, the placements, alignments, and their respective tolerances shall be included as part of the design submittal.

3.5 CLEANUP

A. The Installing Contractor shall remove any and all material, equipment, tools, building materials, concrete forms, debris, or other items belonging to the Installing Contractor or used under the Installing Contractor's direction.

END OF SECTION

SECTION 32 11 23.33
DENSE GRADED BASE

PART 1 - GENERAL

1.1 SCOPE

A. This section includes information common to dense graded base using crushed stone or crushed gravel and applies to all sections in this Division.

1.2 REFERENCE STANDARDS

A. Work under this section depends on applicable provisions from other sections and the plan set in this contract. Examples of related sections include, but are not limited to:

1. Division 31 — Earthwork

B. Wherever WisDOT or SSHSC appears in this specification it shall be construed to mean the pertinent sections of the State of Wisconsin, Department of Transportation, Standard Specifications for Highway and Structure Construction (SSHSC), current edition, and all supplemental and interim supplemental specifications, as they may pertain, except this contract shall be a lump sum contract and measurement and basis of payment methods shall not apply.

C. Dense Graded Base shall conform to City of Madison standard specification Article 401 – Crushed Aggregate Base Course.

1.3 SUBMITTALS

A. Provide copies of record drawings.

B. Provide copies of material testing reports.

C. Provide the following prior to construction:

1. Manufacturers product information (cut sheets)

2. Mix designs and specifications

3. Aggregate Gradations

D. Materials conforming to the WisDOT Standard Specifications for Highway and Structure Construction (Latest Edition, hereafter called “Standard Specifications for Highway Construction” and supplied from a WisDOT approved source need not be tested. The contractor shall furnish evidence of such WisDOT approval to the A/E and/or Construction Representative.

E. Maintain record drawings showing actual locations of utilities and other features encountered, modifications to proposed grades and site features, and other deviations from the original design.

PART 2 - PRODUCTS

2.1 GENERAL

A. Use dense graded base. Materials shall conform to Section 301.2 of the WisDOT Standard Specifications for Highway and Structure Construction. Material gradations shall conform to Section 305.2.2 of the WisDOT Standard Specifications for Highway and Structure Construction unless specified elsewhere in the contract documents.

B. Base Course Gradation: 1-1/4" Crushed Aggregate

C. Materials shall conform to Gradation No. 2 per the City of Madison specification 401.1(b).

2.2 BREAKER RUN AGGREGATE

A. Crushed stone, rock or gravel meeting the requirements of either Breaker Run or Select Crushed material as defined in Section 311.2 or Section 312.2 of Standard Specifications for Highway Construction, respectively.

PART 3 - EXECUTION

3.1 CONSTRUCTION

A. Preparing The Pavement Foundation (Sub-Grade):

1. Prepare the foundation, or resurface the previously placed base layer, as specified in WisDOT Section 211 before placing base. Do not place base foundations that are soft, spongy, or covered by ice or snow. Water and rework or re-compact dry foundations as necessary to ensure proper compaction, or as the representative designates.

    a. In proposed pavement areas, all organic solid shall be removed.

    b. Excavation shall be reasonably free of water prior to beginning filling. Do not place material on frozen surfaces or use frozen material.

    c. In areas of existing pavement to be modified or adjusted in grade, the existing pavement section shall be removed by an acceptable method. The new pavement section shall match the construction details.

    d. Place and compact material to minimize settlement and avoid damage to structures, pipes, utility lines and other features. Hand place and compact material as necessary.

    e. Moisture condition backfill material as necessary to achieve density required for given use.

    f. Compact fill material as required for the given use.

    g. It is the responsibility of the Contractor to provide all necessary compaction equipment and other grading equipment that may be required to obtain the specified density. Vibratory plate or tamping type walk behind compactors will be required whenever backfill is placed adjacent to structures, pipes, utility lines and other features.

    h. Where additional filling or excavation is necessary, or placement of base course will be delayed, roll surface of proposed roadway or parking lot with a smooth drum roller to provide relatively impervious surface and promote drainage.

2. Proof-roll all subgrade areas that are to receive aggregate base or pavement. Proof-roll with a loaded dump truck prior to the placement of base courses to locate soft spots that yield under loading. Overexcavate (undercut) areas of soft subgrade that will not compact readily when proof-rolled or tamped. Backfill with breaker run or select crushed material as approved by the project representative.

    a. Prior to undercutting or excavating below subgrade (EBS) or placing any base course, contact the Construction Representative to schedule inspection of subgrade and proof-rolling. Provide minimum of 24 hrs confirmed notice. All proof-rolling shall be completed in the presence of the Construction Representative and Geotechnical Consultant.

b. To complete proof-rolling, entire roadway subgrade shall be provided with a relatively smooth surface, suitable for observing soil reaction during proof-rolling.

c. Contractor shall schedule and provide a fully loaded tri-axle dump truck for proof-rolling. Loaded truck shall have a minimum gross operating weight of 30 tons. Test shall be conducted with “tag” or “pusher” axles retracted from the ground.

d. Test-rolling shall be accomplished in a series of traverses parallel to the centerline of the street or parking area. The truck shall traverse the length of the street or parking area once for each 12’ of width. Additional passes along the traverse shall be completed as directed by the Geotechnical Consultant, to further define unsatisfactory subgrade.

e. Soft areas, yielding areas, cracked areas or areas where rolling or wave action is observed shall be considered indicative of an unsatisfactory subgrade. Such areas shall be undercut as outlined in Section 31 05 00.

f. Once the subgrade has been proof-rolled and approved, protect the soils from becoming saturated, frozen, or adversely altered.

g. Contractor shall assume 15% of proposed paved areas may require undercutting. This work shall be included in base bid. Undercut as outlined in Section 31 05 00.

B. Stockpiling:

1. If continuous compliance with material specifications is questionable, the project representative may require the contractor to supply material from a stockpile of previously tested material. Maintain a sufficiently large stockpile to preclude the use of material not previously approved.

2. Build and maintain stockpiles using methods that minimize segregation and prevent contamination. If the contract specifies location, place stockpiles where specified. Clear and prepare stockpile areas to facilitate the recovery of the maximum amount of stockpiled material.

C. Constructing Base:

1. Place aggregate in a manner that minimizes hauling on the subgrade. Do not use vehicles or operations that damage the subgrade or in-place base. Deposit material in a manner that minimizes segregation.

2. Construct the base to the width and section the plans show. Shape and compact the base surface to within 0.04 feet (12 mm) of the plan elevation.

3. Ensure there is adequate moisture in the aggregate during placing, shaping, and compacting to prevent segregation and achieve adequate compaction.

4. Maintain the base until paving over it, or until the project representative accepts the work, if paving is not part of the contract. The contractor is not responsible for maintaining material placed on detours.

D. Standard Compaction: Compact the base until there is no appreciable displacement, either laterally or longitudinally, under the compaction equipment. Route hauling equipment uniformly over previously placed base. Compact each layer before placing a subsequent layer. If the material is too dry to readily attain the required compaction, add water as necessary to achieve compaction

E. Special Compaction: If the contract requires special compaction, compact each layer to 95 percent of maximum density, or more, before placing the subsequent layer. The geotechnical engineer will determine the maximum density according to AASHTO T 99 method C or D and in-place density according to AASHTO T 191.

F. Controlling Dust: Apply water or other engineer-approved dust control materials to control dust during construction and maintenance of the base and shoulders.

3.2 COMPACTION

A. Compact each base layer, including shoulder foreslopes, with equipment specified in WisDOT Section 301.3.1. Use standard compaction conforming to WisDOT Section 301.3.4.2. Final shaping of shoulder foreslopes does not require compaction.

B. Compacting 1 1/4-Inch Base and 3/4-Inch Base. If using a pneumatic roller, do not exceed a compacted thickness of 6 inches (150 mm) per layer. For the first layer placed over a loose sandy subgrade, the contractor may, with the geotechnical engineer's approval, increase the compacted layer thickness to 8 inches (200 mm). If using a vibratory roller, do not exceed a compacted thickness of 8 inches (200 mm) per layer.

C. Compacting 3-Inch Base: Compact with a vibratory or pneumatic roller. Do not exceed a compacted thickness of 9 inches (225 mm) per layer.

3.3 UNDERCUTTING/EXCAVATION BELOW SUBGRADE (EBS)

A. Undercutting/EBS shall be completed only when directed by the Geotechnical Consultant. The Contractor shall not be compensated for any unauthorized undercutting/EBS. Measure and document undercut areas and depths in consultation with Geotechnical Consultant. Work shall comply with Section 31 05 00. Contractor shall assume 50% of proposed driveway paved areas may require undercutting. This work shall be included in unit prices with bid item 90002.

ADD 3

3.4 CLEANUP

A. After the project is completed, thoroughly clean up all debris that may have accumulated during the placement of dense graded base. Replace or repair as required, all surfaces and/or landscape features damaged or disturbed under this item of work.

END OF SECTION

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Principal Engineer 2
Christopher J. Petykowski, P.E.
John S. Fahrney, P.E.
Principal Engineer 1
Christina M. Bachmann, P.E.
Eric L. Dundee, P.E.
Facilities & Sustainability
Jeanne E. Hoffman, Manager
Mapping Section Manager
Eric T. Pederson, P.S.
Financial Manager
Steven B. Danner-Rivers

November 22, 2017

NOTICE OF ADDENDUM
ADDENDUM NO. 2

CONTRACT NO. 8027, PROJECT NO. 17451
MADISON FIRE STATION 14

Revise and amend the contract document(s) for the above project as stated in this addendum, otherwise, the original document shall remain in effect.

This addendum consists of the following documents:

1. **GENERAL CONTRACT CONDITIONS**

Q1: Since this is a city project, will white sheet rates be in effect?

A1: No. Per State Statute 66.0903 enacted with the 2015-17 State Budget Bill we are no longer allowed to require Prevailing Wage on our local public works projects.

Q2: With the SBE requirements, I assume we can count WBE/DBE/MBE contractors as part of the SBE 8% requirement, correct?

A2: No, only certified SBE companies can count towards the 8% SBE goal.

2. **GENERAL QUESTIONS AND ANSWERS**

Q3: Can you provide the sign in sheet from the Pre Bid Site Walkthrough conducted on Wednesday November 15, 2017?

A3: The sign in sheet from the pre bid site walkthrough is attached.

Q4: Do you have a copy of the geothermal test bore for the fire station?

A4: Yes. It is summarized in the drawing set, sheet M402.

Q5: We are interested in bidding on the helical pile work for the Fire Station 14 project in Madison. Is there a geotechnical report that is available at this time? I did not see it in the bidding docs.

A5: The Helical Pier test bore starts on page 175 of Volume 1 of the Project Manual. Bore 6A was completed to get the data for the Helical Pier Design. All the bore and site work are on pages 8-204 of Volume 1. 00 31 00 summarizes the included documents.

Q6: At line 10-A there appears to be a column footing that has considerable loads listed next to it but no helical piles in the footing on sheet S002. Is this just an oversite and there

A12: Drawings have been updated to include drawings and details regarding the construction of the trash enclosure. See Sheet A221 – Trash Enclosure for additional information.

Q13: On C202, are clearing and grubbing limits the same as the grading limits? It is unclear what the expectation for clearing and grubbing is outside of the grading limits, especially along Femrite Drive. What kind of grading is occurring inside of the grading limits?

A13: Yes, the clearing and grubbing limits are the same as the grading limits. The contractor is responsible for the removal of all woody vegetation (except those trees noted as to be kept) to be removed within the clearing and grubbing limits. No clearing and grubbing will be done outside of the grading limits along Femrite Drive. The proposed grading activities that occur within the grading limits are shown on sheet C200 and include filling an old foundation area, smoothing out some rough areas, building construction, and the creation of a berm and swale along the wetland.

Q14: On C202, what kind of grading is occurring inside of the grading limits?

A14: Sheet C202 shows the berm and swale along the wetland, the grading necessary for the building construction, and the filling and smoothing out of an old foundation.

Changes, revisions and additions to the construction documents have been clouded for convenience. These updates include:

C201 – REVISED concrete hatching to be consistent with legend
C202 – REVISED fine grading around portion of building exterior per DSPS review comments
A002 – ADDED information regarding insulation COMcheck calculation and STC ratings for assembly types
A003 – REVISE the classification for Men's and Women's restrooms, 20 min ratting for assemblies and additional DSPS Code review clarifications
A101 – REVISED floor plan changes include: Revising Unisex 135 and LT shower 124 to be accessible per DSPS review, ADDED bench in Locker Room 134, CLARIFIED door swing of folding partition door and REVISED washer and dryer configuration under staircase.
A101.A – ADDED Knox Box near EXT-02
A101.B – See revisions outlined above for sheet A101
A102 – REVISED layout of chain-link fence and ADDED plywood shelving
A141 – REVISED location of secondary photovoltaic location
A201 – REVISED overhead door configuration on east elevation
A210 – See revisions outlined above for sheet A101
A211 – REVISED overhead door configuration on east elevation
A221 – ADDED sheet to provide details regarding trash enclosure
A311 – REVISED slab edge detail
A312 – REVISED slab edge detail
A313 – REVISED slab edge detail
A314 – REVISED slab edge detail
A403 – REVISED kitchen cabinet layout
A404 – REVISED bathroom interior elevations and updated bathroom fixtures
A501 – REVISED office furniture in LT office and Small Meeting Rooms
A601 – REVISED room finish schedule and ADDED schedule remarks

SECTION E: BIDDERS ACKNOWLEDGEMENT

CONTRACT TITLE MADISON FIRE STATION 14

CONTRACT NO. 8027

Bidder must state a Unit Price and Total Bid for each item. The Total Bid for each item must be the product of quantity, by Unit Price. The Grand Total must be the sum of the Total Bids for the various items. In case of multiplication errors or addition errors, the Grand Total with corrected multiplication and/or addition shall determine the Grand Total bid for each contract. The Unit Price and Total Bid must be entered numerically in the spaces provided. All words and numbers shall be written in ink.

1. The undersigned having familiarized himself/herself with the Contract documents, including Advertisement for Bids, Instructions to Bidders, Form of Proposal, City of Madison Standard Specifications for Public Works Construction - 2017 Edition thereto, Form of Agreement, Form of Bond, and Addenda issued and attached to the plans and specifications on file in the office of the City Engineer, hereby proposes to provide and furnish all the labor, materials, tools, and expendable equipment necessary to perform and complete in a workmanlike manner the specified construction on this project for the City of Madison; all in accordance with the plans and specifications as prepared by the City Engineer, including Addenda to the Contract Nos. 1 through 4 issued thereto, at the prices for said work as contained in this proposal. (Electronic bids submittals shall acknowledge addendum under Section E and shall not acknowledge here)
2. If awarded the Contract, we will initiate action within seven (7) days after notification or in accordance with the date specified in the contract to begin work and will proceed with diligence to bring the project to full completion within the number of work days allowed in the Contract or by the calendar date stated in the Contract.
3. The undersigned Bidder or Contractor certifies that he/she is not a party to any contract, combination in form of trust or otherwise, or conspiracy in restraint of trade or commerce or any other violation of the anti-trust laws of the State of Wisconsin or of the United States, with respect to this bid or contract or otherwise.
4. I hereby certify that I have met the Bid Bond Requirements as specified in Section 102.5. *(IF BID BOND IS USED, IT SHALL BE SUBMITTED ON THE FORMS PROVIDED BY THE CITY. FAILURE TO DO SO MAY RESULT IN REJECTION OF THE BID).*
5. I hereby certify that all statements herein are made on behalf of Miron Construction Co., Inc. (name of corporation, partnership, or person submitting bid) a corporation organized and existing under the laws of the State of Wisconsin a partnership consisting of _____; an individual trading as _____; of the City of _____ State of _____; that I have examined and carefully prepared this Proposal, from the plans and specifications and have checked the same in detail before submitting this Proposal; that I have fully authority to make such statements and submit this Proposal in (its, their) behalf; and that the said statements are true and correct.

David G. Voss

SIGNATURE

David G. Voss, Jr.

President

TITLE, IF ANY

Sworn and subscribed to before me this 15th day of December, 20 17.

Susan Schneider

(Notary Public or other officer authorized to administer oaths)

My Commission Expires 6/8/18

Bidders shall not add any conditions or qualifying statements to this Proposal.

LIST APPRENTICABLE TRADES (check all that apply to your work to be performed on this contract)

- [X] BRICKLAYER
- [X] CARPENTER
- [X] CEMENT MASON / CONCRETE FINISHER
- [ ] CEMENT MASON (HEAVY HIGHWAY)
- [X] CONSTRUCTION CRAFT LABORER
- [ ] DATA COMMUNICATION INSTALLER
- [ ] ELECTRICIAN
- [ ] ENVIRONMENTAL SYSTEMS TECHNICIAN / HVAC SERVICE TECH/HVAC INSTALL / SERVICE
- [ ] GLAZIER
- [X] HEAVY EQUIPMENT OPERATOR / OPERATING ENGINEER
- [ ] INSULATION WORKER (HEAT & FROST)
- [X] IRON WORKER
- [ ] IRON WORKER (ASSEMBLER, METAL BLDGS)
- [ ] PAINTER & DECORATOR
- [ ] PLASTERER
- [ ] PLUMBER
- [ ] RESIDENTIAL ELECTRICIAN
- [ ] ROOFER & WATER PROOFER
- [ ] SHEET METAL WORKER
- [ ] SPRINKLER FITTER
- [ ] STEAMFITTER
- [ ] STEAMFITTER (REFRIGERATION)
- [ ] STEAMFITTER (SERVICE)
- [ ] TAPER & FINISHER
- [ ] TELECOMMUNICATIONS (VOICE, DATA & VIDEO) INSTALLER-TECHNICIAN
- [ ] TILE SETTER

MADISON FIRE STATION 14
CONTRACT NO. 8027

Small Business Enterprise Compliance Report

Summary Sheet

SBE Subcontractors Who Are NOT Suppliers

Name(s) of SBEs Utilized	Type of Work	% of Total Bid Amount
STEPUP CEILINGS	ACCOUSTICAL CEIL	0,33 %
CAPITOL STEEL ERec	STEEL ERECTION	2.02 %
SANTA ROSA CLEANING	FINAL CLEANING	0.85 %
FIRE STOP PLUS	FIRE STOPPING.	.31 %
BYCO TILE + FLOOR	CERAMIC TILE	1,17 %
MOBILE GLASS	GLASS	4,92 %
		%
		%
		%
		%
		%
		%
		%
Subtotal SBE who are NOT suppliers:		8,80 %

SBE Subcontractors Who Are Suppliers

Name(s) of SBEs Utilized	Type of Work	% of Total Bid Amount
		%
		%
		%
		%
		%
		%

Subtotal Contractors who are suppliers: 0 % x 0.6 = 0 % (discounted to 60%)

Total Percentage of SBE Utilization: 8,80 %.

SECTION G: BID BOND

KNOW ALL MEN BY THESE PRESENT, THAT Principal and Surety, as identified below, are held and firmly bound unto the City of Madison, (hereinafter referred to as the "Obligee"), in the sum of five per cent (5%) of the amount of the total bid or bids of the Principal herein accepted by the Obligee, for the payment of which the Principal and the Surety bind themselves, their heirs, executors, administrators, successors and assigns, jointly and severally, firmly by these presents.

The conditions of this obligation are such that, whereas the Principal has submitted, to the City of Madison a certain bid, including the related alternate, and substitute bids attached hereto and hereby made a part hereof, to enter into a contract in writing for the construction of:

MADISON FIRE STATION 14
CONTRACT NO. 8027
Madison, Wisconsin.

1. If said bid is rejected by the Obligee, then this obligation shall be void.

2. If said bid is accepted by the Obligee and the Principal shall execute and deliver a contract in the form specified by the Obligee (properly completed in accordance with said bid) and shall furnish a bond for his/her faithful performance of said contract, and for the payment of all persons performing labor or furnishing materials in connection therewith, and shall in all other respects perform the agreement created by the acceptance of said bid, then this obligation shall be void.

   If said bid is accepted by the Obligee and the Principal shall fail to execute and deliver the contract and the performance and payment bond noted in 2. above executed by this Surety, or other Surety approved by the City of Madison, all within the time specified or any extension thereof, the Principal and Surety agree jointly and severally to forfeit to the Obligee as liquidated damages the sum mentioned above, it being understood that the liability of the Surety for any and all claims hereunder shall in no event exceed the sum of this obligation as stated, and it is further understood that the Principal and Surety reserve the right to recover from the Obligee that portion of the forfeited sum which exceed the actual liquidated damages incurred by the Obligee.

   The Surety, for value received, hereby stipulates and agrees that the obligations of said Surety and its bond shall be in no way impaired or affected by an extension of the time within which the Obligee may accept such bid, and said Surety does hereby waive notice of any such extension.

ZURICH AMERICAN INSURANCE COMPANY
COLONIAL AMERICAN CASUALTY AND SURETY COMPANY
FIDELITY AND DEPOSIT COMPANY OF MARYLAND
POWER OF ATTORNEY

KNOW ALL MEN BY THESE PRESENTS: That the ZURICH AMERICAN INSURANCE COMPANY, a corporation of the State of New York, the COLONIAL AMERICAN CASUALTY AND SURETY COMPANY, a corporation of the State of Maryland, and the FIDELITY AND DEPOSIT COMPANY OF MARYLAND a corporation of the State of Maryland (herein collectively called the "Companies"), by **MICHAEL BOND, Vice President,** in pursuance of authority granted by Article V, Section 8, of the By-Laws of said Companies, which are set forth on the reverse side hereof and are hereby certified to be in full force and effect on the date hereof, do hereby nominate, constitute, and appoint **Kelly CODY, Roxanne JENSEN, Trudy A. SZALEWSKI, Christopher H. KONDRICK, Brian KRAUSE and Christopher K. HOVDEN, all of Green Bay, Wisconsin, EACH** its true and lawful agent and Attorney-in-Fact, to make, execute, seal and deliver, for, and on its behalf as surety, and as its act and deed: **any and all bonds and undertakings,** and the execution of such bonds or undertakings in pursuance of these presents, shall be as binding upon said Companies, as fully and amply, to all intents and purposes, as if they had been duly executed and acknowledged by the regularly elected officers of the ZURICH AMERICAN INSURANCE COMPANY at its office in New York, New York., the regularly elected officers of the COLONIAL AMERICAN CASUALTY AND SURETY COMPANY at its office in Owings Mills, Maryland., and the regularly elected officers of the FIDELITY AND DEPOSIT COMPANY OF MARYLAND at its office in Owings Mills, Maryland., in their own proper persons.

The said Vice President does hereby certify that the extract set forth on the reverse side hereof is a true copy of Article V, Section 8, of the By-Laws of said Companies, and is now in force.

IN WITNESS WHEREOF, the said Vice-President has hereunto subscribed his/her names and affixed the Corporate Seals of the said **ZURICH AMERICAN INSURANCE COMPANY, COLONIAL AMERICAN CASUALTY AND SURETY COMPANY, and FIDELITY AND DEPOSIT COMPANY OF MARYLAND,** this 30th day of May, A.D. 2017.

ATTEST:

ZURICH AMERICAN INSURANCE COMPANY
COLONIAL AMERICAN CASUALTY AND SURETY COMPANY
FIDELITY AND DEPOSIT COMPANY OF MARYLAND

By: _____
Assistant Secretary
Dawn E. Brown

_____
Vice President
Michael Bond

State of Maryland
County of Baltimore

On this 30th day of May, A.D. 2017, before the subscriber, a Notary Public of the State of Maryland, duly commissioned and qualified, **MICHAEL BOND, Vice President, and DAWN E. BROWN, Assistant Secretary,** of the Companies, to me personally known to be the individuals and officers described in and who executed the preceding instrument, and acknowledged the execution of same, and being by me duly sworn, deposeth and saith, that he/she is the said officer of the Company aforesaid, and that the seals affixed to the preceding instrument are the Corporate Seals of said Companies, and that the said Corporate Seals and the signature as such officer were duly affixed and subscribed to the said instrument by the authority and direction of the said Corporations.

IN TESTIMONY WHEREOF, I have hereunto set my hand and affixed my Official Seal the day and year first above written.

_____
Constance A. Dunn, Notary Public
My Commission Expires: July 9, 2019

POA-F 184-3544

SECTION H: AGREEMENT

THIS AGREEMENT made this 17 day of JANUARY in the year Two Thousand and Eighteen between **MIRON CONSTRUCTION CO., INC.** hereinafter called the Contractor, and the City of Madison, Wisconsin, hereinafter called the City.

WHEREAS, the Common Council of the said City of Madison under the provisions of a resolution adopted **JANUARY 16, 2018**, and by virtue of authority vested in the said Council, has awarded to the Contractor the work of performing certain construction.

NOW, THEREFORE, the Contractor and the City, for the consideration hereinafter named, agree as follows:

1. **Scope of Work.** The Contractor shall, perform the construction, execution and completion of the following listed complete work or improvement in full compliance with the Plans, Specifications, Standard Specifications, Supplemental Specifications, Special Provisions and contract; perform all items of work covered or stipulated in the proposal; perform all altered or extra work; and shall furnish, unless otherwise provided in the contract, all materials, implements, machinery, equipment, tools, supplies, transportation, and labor necessary to the prosecution and completion of the work or improvements:

MADISON FIRE STATION 14
CONTRACT NO. 8027

2. **Completion Date/Contract Time.** Construction work must begin within seven (7) calendar days after the date appearing on mailed written notice to do so shall have been sent to the Contractor and shall be carried on at a rate so as to secure full completion SEE SPECIAL PROVISIONS, the rate of progress and the time of completion being essential conditions of this Agreement.

3. **Contract Price.** The City shall pay to the Contractor at the times, in the manner and on the conditions set forth in said specifications, the sum of **SIX MILLION THREE HUNDRED NINETY THOUSAND SEVEN HUNDRED EIGHTY-THREE AND NO/100** ($**6,390,783.00**) Dollars being the amount bid by such Contractor and which was awarded to him/her as provided by law.

4. **Affirmative Action.** In the performance of the services under this Agreement the Contractor agrees not to discriminate against any employee or applicant because of race, religion, marital status, age, color, sex, disability, national origin or ancestry, income level or source of income, arrest record or conviction record, less than honorable discharge, physical appearance, sexual orientation, gender identity, political beliefs, or student status. The Contractor further agrees not to discriminate against any subcontractor or person who offers to subcontract on this contract because of race, religion, color, age, disability, sex, sexual orientation, gender identity or national origin.

   The Contractor agrees that within thirty (30) days after the effective date of this agreement, the Contractor will provide to the City Affirmative Action Division certain workforce utilization statistics, using a form to be furnished by the City.

   If the contract is still in effect, or if the City enters into a new agreement with the Contractor, within one year after the date on which the form was required to be provided, the Contractor will provide updated workforce information using a second form, also to be furnished by the City. The second form will be submitted to the City Affirmative Action Division no later than one year after the date on which the first form was required to be provided.

   The Contractor further agrees that, for at least twelve (12) months after the effective date of this contract, it will notify the City Affirmative Action Division of each of its job openings at facilities in Dane County for which applicants not already employees of the Contractor are to be considered. The notice will include a job description, classification, qualifications and application procedures

2. Declare the Contractor ineligible for further City contracts until the Affirmative Action requirements are met.

3. Recover on behalf of the City from the prime Contractor 0.5 percent of the contract award price for each week that such party fails or refuses to comply, in the nature of liquidated damages, but not to exceed a total of five percent (5%) of the contract price, or five thousand dollars ($5,000), whichever is less. Under public works contracts, if a subcontractor is in noncompliance, the City may recover liquidated damages from the prime Contractor in the manner described above. The preceding sentence shall not be construed to prohibit a prime Contractor from recovering the amount of such damage from the non-complying subcontractor.

Article VIII

The Contractor shall include the above provisions of this contract in every subcontract so that such provisions will be binding upon each subcontractor. The Contractor shall take such action with respect to any subcontractor as necessary to enforce such provisions, including sanctions provided for noncompliance.

Article IX

The Contractor shall allow the maximum feasible opportunity to small business enterprises to compete for any subcontracts entered into pursuant to this contract. (In federally funded contracts the terms "DBE, MBE and WBE" shall be substituted for the term "small business" in this Article.)

5. Substance Abuse Prevention Program Required. Prior to commencing work on the Contract, the Contractor, and any Subcontractor, shall have in place a written program for the prevention of substance abuse among its employees as required under Wis. Stat. Sec. 103.503.

6. **Contractor Hiring Practices.**

Ban the Box - Arrest and Criminal Background Checks. (Sec. 39.08, MGO)

This provision applies to all prime contractors on contracts entered into on or after January 1, 2016, and all subcontractors who are required to meet prequalification requirements under MGO 33.07(7)(I), MGO as of the first time they seek or renew pre-qualification status on or after January 1, 2016. The City will monitor compliance of subcontractors through the pre-qualification process.

a. **Definitions.** For purposes of this section, "Arrest and Conviction Record" includes, but is not limited to, information indicating that a person has been questioned, apprehended, taken into custody or detention, held for investigation, arrested, charged with, indicted or tried for any felony, misdemeanor or other offense pursuant to any law enforcement or military authority.

"Conviction record" includes, but is not limited to, information indicating that a person has been convicted of a felony, misdemeanor or other offense, placed on probation, fined, imprisoned or paroled pursuant to any law enforcement or military authority.

"Background Check" means the process of checking an applicant's arrest and conviction record, through any means.

b. **Requirements.** For the duration of this Contract, the Contractor shall:

1. Remove from all job application forms any questions, check boxes, or other inquiries regarding an applicant's arrest and conviction record, as defined herein.

MADISON FIRE STATION 14
CONTRACT NO. 8027

IN WITNESS WHEREOF, the Contractor has hereunto set his/her hand and seal and the City has caused these presents to be sealed with its corporate seal and to be subscribed by its Mayor and City Clerk the day and year first above written.

Countersigned:

Witness 1/12/18 Date

Witness 1/12/18 Date

MIRON CONSTRUCTION CO., INC.
Company Name

President **David G. Voss, Jr.** 1/12/18 Date

Secretary **Dean J. Basten** 1/12/18 Date

CITY OF MADISON, WISCONSIN

Provisions have been made to pay the liability that will accrue under this contract.

Finance Director

Approved as to form:

City Attorney

Signed this 26 day of January 20 18

Witness

Witness

Mayor 1.26.18 Date

City Clerk for 1-23-18 Date

NOTARY PUBLIC JASMINE BRENN STATE OF WISCONSIN

Bond No. 9270265

SECTION I: PAYMENT AND PERFORMANCE BOND

KNOW ALL MEN BY THESE PRESENTS, that we **MIRON CONSTRUCTION CO., INC.** as principal, and Fidelity and Deposit Company of Maryland Company of MD as surety, are held and firmly bound unto the City of Madison, Wisconsin, in the sum of **SIX MILLION THREE HUNDRED NINETY THOUSAND SEVEN HUNDRED EIGHTY-THREE AND NO/100** ($6,390,783.00) Dollars, lawful money of the United States, for the payment of which sum to the City of Madison, we hereby bind ourselves and our respective executors and administrators firmly by these presents.

The condition of this Bond is such that if the above bounden shall on his/her part fully and faithfully perform all of the terms of the Contract entered into between him/herself and the City of Madison for the construction of:

MADISON FIRE STATION 14
CONTRACT NO. 8027
(Miron Project #180610)

in Madison, Wisconsin, and shall pay all claims for labor performed and material furnished in the prosecution of said work, and save the City harmless from all claims for damages because of negligence in the prosecution of said work, and shall save harmless the said City from all claims for compensation (under Chapter 102, Wisconsin Statutes) of employees and employees of subcontractor, then this Bond is to be void, otherwise of full force, virtue and effect.

Signed and sealed this 17th day of January, 2018

Countersigned:

Witness

Secretary **Dean J. Basten**

MIRON CONSTRUCTION CO., INC.
Company Name (Principal)

President **David G. Voss, Jr.** Seal

Approved as to form:

City Attorney

Fidelity and Deposit Company of Maryland
Surety Seal
☐ Salary Employee ☒ Commission

By
Attorney-in-Fact Kelly Cody

This certifies that I have been duly licensed as an agent for the above company in Wisconsin under National Producer Number 7835807 for the year 2018, and appointed as attorney-in-fact with authority to execute this payment and performance bond which power of attorney has not been revoked.

1/17/18
Date

Agent Signature Kelly Cody

ZURICH AMERICAN INSURANCE COMPANY
COLONIAL AMERICAN CASUALTY AND SURETY COMPANY
FIDELITY AND DEPOSIT COMPANY OF MARYLAND
POWER OF ATTORNEY

KNOW ALL MEN BY THESE PRESENTS: That the ZURICH AMERICAN INSURANCE COMPANY, a corporation of the State of New York, the COLONIAL AMERICAN CASUALTY AND SURETY COMPANY, a corporation of the State of Maryland, and the FIDELITY AND DEPOSIT COMPANY OF MARYLAND a corporation of the State of Maryland (herein collectively called the "Companies"), by **MICHAEL BOND, Vice President,** in pursuance of authority granted by Article V, Section 8, of the By-Laws of said Companies, which are set forth on the reverse side hereof and are hereby certified to be in full force and effect on the date hereof, do hereby nominate, constitute, and appoint **Kelly CODY, Roxanne JENSEN, Trudy A. SZALEWSKI, Christopher H. KONDRICK, Brian KRAUSE and Christopher K. HOVDEN, all of Green Bay, Wisconsin, EACH** its true and lawful agent and Attorney-in-Fact, to make, execute, seal and deliver, for, and on its behalf as surety, and as its act and deed: **any and all bonds and undertakings,** and the execution of such bonds or undertakings in pursuance of these presents, shall be as binding upon said Companies, as fully and amply, to all intents and purposes, as if they had been duly executed and acknowledged by the regularly elected officers of the ZURICH AMERICAN INSURANCE COMPANY at its office in New York, New York., the regularly elected officers of the COLONIAL AMERICAN CASUALTY AND SURETY COMPANY at its office in Owings Mills, Maryland., and the regularly elected officers of the FIDELITY AND DEPOSIT COMPANY OF MARYLAND at its office in Owings Mills, Maryland., in their own proper persons.

The said Vice President does hereby certify that the extract set forth on the reverse side hereof is a true copy of Article V, Section 8, of the By-Laws of said Companies, and is now in force.

IN WITNESS WHEREOF, the said Vice-President has hereunto subscribed his/her names and affixed the Corporate Seals of the said **ZURICH AMERICAN INSURANCE COMPANY, COLONIAL AMERICAN CASUALTY AND SURETY COMPANY, and FIDELITY AND DEPOSIT COMPANY OF MARYLAND**, this 30th day of May, A.D. 2017.

ATTEST:

ZURICH AMERICAN INSURANCE COMPANY
COLONIAL AMERICAN CASUALTY AND SURETY COMPANY
FIDELITY AND DEPOSIT COMPANY OF MARYLAND

By: _____
Assistant Secretary
Dawn E. Brown

_____
Vice President
Michael Bond

State of Maryland
County of Baltimore

On this 30th day of May, A.D. 2017, before the subscriber, a Notary Public of the State of Maryland, duly commissioned and qualified, **MICHAEL BOND, Vice President, and DAWN E. BROWN, Assistant Secretary,** of the Companies, to me personally known to be the individuals and officers described in and who executed the preceding instrument, and acknowledged the execution of same, and being by me duly sworn, deposeth and saith, that he/she is the said officer of the Company aforesaid, and that the seals affixed to the preceding instrument are the Corporate Seals of said Companies, and that the said Corporate Seals and the signature as such officer were duly affixed and subscribed to the said instrument by the authority and direction of the said Corporations.

IN TESTIMONY WHEREOF, I have hereunto set my hand and affixed my Official Seal the day and year first above written.

_____
Constance A. Dunn, Notary Public
My Commission Expires: July 9, 2019