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**PART 1 – GENERAL**

**1.1 DESCRIPTION**

- 34 A. Work Included: Cast-in-place concrete required for this Work is indicated on the drawings and includes, but is  
35 not necessarily limited to:  
36 1. Footings and foundations  
37 2. Formed concrete, toppings  
38 3. Slabs on grade  
39 4. Sidewalks and porches  
40 5. Exterior flatwork  
41 6. Footings for sign and exterior lighting  
42 7. Concrete curbs, equipment pads and other miscellaneous  
43 8. All other concrete work indicated on drawings  
44 B. Provide all work, materials, labor, equipment and supervision necessary.  
45 C. Related work described elsewhere:  
46 1. Earthwork - Section 31 00 00  
47 2. Concrete Formwork - Section 03 10 00  
48 3. Concrete Reinforcement - Section 03 20 00  
49 4. Concrete Hardener/Sealer - Section 03 35 00  
50 5. Structural Steel - Section 05 12 00  
51

**1.2 QUALITY ASSURANCE**

- 53 A. All work shall be in accordance with applicable manufacturer's and supplier's instructions.  
54 B. Qualifications of Workers:  
55 1. Provide at least one person who will be present at all times during execution of this portion of the work  
56 who is thoroughly trained and experienced in placing the types of concrete specified and who will direct  
57 all work performed under this Section.

- 1                    2.     For finishing of exposed surfaces of concrete, use only thoroughly trained and experienced concrete
- 2                    finishers.
- 3                    3.     Concrete field tests for water content, slump, air content, yield and strength cylinders shall be conducted
- 4                    by a certified Wisconsin Concrete Technician, or technician of equivalent certification.
- 5                    C.     Correction of Defective Work: All concrete work which does not conform to the requirements of the Contract
- 6                    Documents and ACI 301, including function, durability, appearance, strength, cracking, tolerances and finishing,
- 7                    shall be corrected as directed by Architect at Contractor's expense. Additional testing, engineering,
- 8                    reinforcement and removal and replacement of defective concrete shall be paid for by Concrete Contractor.
- 9                    Contractor shall also be responsible for the cost of corrections to any other work affected by or resulting from
- 10                    corrections to the concrete work.
- 11                    1.     Concrete repairs including, but not limited to, patching, epoxy injection, routing and sealing, shall be
- 12                    performed by a specialty repair/restoration contractor, certified by the material supplier.
- 13                    a.     Provide qualifications to Architect and Structural Engineer for review and approval.
- 14                    b.     Restoration contractor shall provide material lists, and describe means and methods to Architect
- 15                    and Structural Engineer for review, prior to commencement of work.
- 16                    c.     Acceptance of units, repaired pursuant to written approval, is contingent upon repairs being
- 17                    skillfully done so as to be sound, permanent, flush with adjacent surfaces and, when exposed, of
- 18                    color and texture matching similar adjoining surfaces and showing no apparent line of
- 19                    demarcation between original and repaired work.
- 20                    D.     Under-Slab Vapor Barrier/Retarder Inspection and Report: Material Testing Agency hired by the Owner shall
- 21                    review and approve installation prior to concrete placement. Contractor shall make necessary corrections.
- 22                    Provide written report to Architect and Structural Engineer.
- 23

### 24    1.3    SUBMITTALS

- 25                    A.     Materials List: Within 30 days after award of Contract, and before any concrete is delivered to the job site,
- 26                    submit to Architect, in accordance with General Conditions, a complete list of all materials proposed to be
- 27                    furnished and installed under this portion of the Work, showing manufacturer's name and catalog number of all
- 28                    items such as admixture and membrane, and the name and address of transit-mix concrete supplier. Prior to
- 29                    starting construction, General Contractor shall also furnish a statement to Architect giving source, sieve analysis
- 30                    and specific gravity of both fine and coarse aggregate, proportions by weight (dry) of cement, fine and coarse
- 31                    aggregates, admixtures, and water that will be used in the manufacture of each class of concrete specified. No
- 32                    change in source of materials shall be made without prior notification to Architect.
- 33                    B.     Concrete Mix Design: Submit five (5) copies of Mix Design to Architect for review. This submittal shall include the
- 34                    following:
  - 35                    1.     Required cylindrical compression strength for f'c (28 day).
  - 36                    2.     Structural element (footings, walls, beams, etc.) in which each class (strength of concrete) will be used.
  - 37                    3.     Cylinder compressive strength test results or complete standard deviation analysis in accordance with ACI
  - 38                    318 Section 5.3.
  - 39                    4.     Proportions of Materials.
  - 40                    5.     Source of materials - Cement (type and brand), gravel pit.
  - 41                    6.     Aggregate size and certification from an independent testing lab that gradation, specific gravity,
  - 42                    soundness, absorption, and impurities meet ASTM requirements.
  - 43                    7.     Admixture brand, dosage, literature.
  - 44                    8.     Air content.
  - 45                    9.     Water content and target slump.
  - 46                    10.    Range of ambient temperature and humidity for which design is valid.
  - 47                    11.    Special characteristics of mix which require precautions in mixing, placing, or finishing techniques to
  - 48                    achieve finished product specified.
  - 49                    12.    Coordination with Concrete Surface Treatment suppliers.
- 50                    C.     Product Data: Submit manufacturer's product data for review with application and installation instructions for
- 51                    proprietary materials and items including: patching compounds, epoxies, grouts, waterstops, joint systems,
- 52                    curing compounds, hardeners, sealers etc. for all items specified in materials list and used for this project.
- 53                    D.     Construction Joints: Submit drawing of proposed construction joints for review for slabs on grade, structural
- 54                    floors, roofs and walls, if different from those shown on drawings or if none shown on drawings.
  - 55                    1.     Length to width ratio of a concrete floor pour shall not exceed 2.5 to 1, including slabs on metal deck.
  - 56                    2.     Concrete on metal deck: 10,000 SF with maximum dimension of 100 ft.
  - 57                    3.     Do not provide control joints in floor slabs supported by metal deck, or precast composite toppings.

- 1 E. Transit-mix delivery slips: With each load of concrete delivered to job, there shall be furnished by ready-mixed  
2 concrete producer duplicate delivery tickets, one (1) for Contractor and one (1) for Owner's representative.  
3 Delivery tickets shall provide following information:  
4 1. Date  
5 2. Name of ready-mixed concrete plant  
6 3. Job location  
7 4. Contractor  
8 5. Type (Standard, A.E. or H.E.S.) and brand name of cement  
9 6. Class and specified cement content in pounds per cubic yard (.76 m3) of concrete  
10 7. Truck number  
11 8. Time dispatched  
12 9. Amount of concrete in load in cubic yards (.76 m3)  
13 10. Admixtures in concrete  
14 11. Maximum size of aggregate  
15 12. Water added at job, if any.  
16 13. Make the record available to Architect for inspection upon request.  
17 F. Provide copies of all quality assurance testing reports.

#### 19 1.4 PRODUCT HANDLING

- 20 A. Protection: Use all means necessary to protect cast-in-place concrete materials before, during and after  
21 installation and to protect the installed work and materials of all other trades.  
22 B. Replacements: In the event of damage, immediately make all repairs and replacements necessary to the  
23 approval of Architect at no additional cost to Owner.  
24 C. Do not use aluminum pipe if concrete is to be transported by means of pumping. Aluminum will not be allowed  
25 in concrete.  
26

#### 27 1.5 REFERENCE SPECIFICATIONS

28 A. Work under this section depends on applicable provisions from other sections and the plan set in this contract. Examples of  
29 related sections include, but are not limited to:

- 30 1. 07 05 00 – COMMON WORK RESULTS FOR THERMAL AND MOISTURE PROTECTION
- 31 2. 07 21 00 – THERMAL INSULATION
- 32 3. 07 26 00 – VAPOR RETARDERS
- 33 4. 07 84 00 - FIRESTOPPING

34 B. The following latest edition reference specifications, guides and standards shall become part of this specification  
35 as if herein written. If provisions conflict, the more stringent provisions shall apply.

- 36 – ACI 117 - Specifications for Tolerances for Concrete Construction and Materials and Commentary.
- 37 – ACI 211.1 - Recommended Practice for Selecting Proportions for Normal Mass and Heavyweight Concrete.
- 38 – ACI 212 - Chemical Admixtures for Concrete.
- 39 – ACI 214 - Recommended Practice for Evaluation of Results of Tests used to Determine the Strength of  
40 Concrete.
- 41 – ACI 301 - Specifications for Structural Concrete for Buildings.
- 42 – ACI 302.1 - Guide for Concrete Floor and Slab Construction.
- 43 – ACI 302.2 - Guide for Concrete Slabs that Receive Moisture-Sensitive Flooring Materials.
- 44 – ACI 303.1 - Standard Specification for Cast-In-Place Architectural Concrete.
- 45 – ACI 304 - Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete.
- 46 – ACI 304.2R - Placing Concrete by Pumping Method
- 47 – ACI 305.1 - Specification for Hot Weather Concreting
- 48 – ACI 306 - Cold Weather Concreting.
- 49 – ACI 306.1 - Standard Specification for Cold Weather Concreting.
- 50 – ACI 308.1 - Standard Specification for Curing Concrete.
- 51 – ACI 309 - Recommended Practice for Consolidation of Concrete.
- 52 – ACI 318 - Building Code Requirements for Reinforced Concrete.
- 53 – ACI 330.1 - Specification for Unreinforced Concrete Parking Lots.
- 54 – ASTM C 31 - Method of Making and Curing Concrete Specimens in the Field.
- 55 – ASTM C 33 - Standard Specification for Concrete Aggregate.
- 56 – ASTM C 39 - Test Method for Compressive Strength of Cylindrical Concrete Specimens.
- 57 – ASTM C 94 Standard Specification for Ready-Mixed Concrete.

- 1           – ASTM C 138 - Standard Method of Test for Weight per Cubic Foot, Yield, and Air Content (Gravimetric) of
- 2           Concrete.
- 3           – ASTM C 143 - Standard Method of Test for Slump of Portland Cement Concrete.
- 4           – ASTM C 150 - Specification for Portland Cement.
- 5           – ASTM C 171 - Sheet Materials for Curing Compound.
- 6           – ASTM C 172 - Method of Sampling Fresh Concrete.
- 7           – ASTM C 173 - Standard Method of Test for Air Content of Freshly Mixed Concrete by the Volumetric
- 8           Method.
- 9           – ASTM C 192 - Standard Method of Making and Curing Concrete Test Specimens in the Laboratory.
- 10          – ASTM C 231 - Standard Method of Test for Air Content of Freshly Mixed Concrete by the Pressure Method.
- 11          – ASTM C 260 - Specification for Air-Entraining Admixtures for Concrete.
- 12          – ASTM C 309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
- 13          – ASTM C 476 – Standard Specification for Grout for Masonry
- 14          – ASTM C 494 - Specification for Chemical Admixtures for Concrete.
- 15          – ASTM C 595 - Specification for Blended Hydraulic Cements.
- 16          – ASTM C 618 - Specification for Fly Ash and Raw or Calcinated Natural Pozzolan for Use as a Mineral
- 17          Admixture in Portland
- 18          Cement Concrete.
- 19          – ASTM C989 - Standard Specification For Slag Cement For Use in Concrete and Mortars.
- 20          – ASTM C1017 - Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete.
- 21          – ASTM D 2103 - Standard Specification for Polyethylene Film and Sheeting.
- 22          – ASTM E-1155 - Standard Test Method for Determining FF Floor Flatness and FL Floor Levelness Numbers.
- 23          – ASTM C-1611 - Standard Test Method for Slump Flow for Self-Consolidating Concrete.
- 24          – ASTM E-1643 - Standard Practice for Water Vapor Retarders used in contact with Earth on Granular Fill
- 25          under Concrete Slabs.
- 26          – ASTM E-1745 - Standard Specification for Water Vapor Retarders used in contact with Soils or Granular Fill
- 27          under Concrete Slabs.
- 28          – OSHA Standard "Safety and Health Regulations for Construction", Part 1926 Subpart Q: "Concrete and
- 29          Masonry Construction."
- 30          – ANSI A10.9 "Safety Requirements for Concrete Construction and Masonry Work."
- 31          – Standard Specification for Highway and Structure Construction, State of Wisconsin.
- 32          – City of Madison Standard Specifications for Public Works Construction
- 33          –

34   **1.6 GENERAL NOTES**

- 35   A.   Reinforcing steel will be furnished and placed under Section 03 20 00, but this Contractor shall cooperate fully.
- 36   B.   Foundations are designed for soil pressure indicated. If bearing capacity of soil varies, foundations may be
- 37       redesigned after excavation has been made.
- 38   C.   General excavation will be done under Section 31 00 00, but this Contractor shall trim and square all column and
- 39       wall footings, steps and pits.
- 40   D.   Backfill against inside of exterior walls, against pit walls and all footings to underside of floor slabs with bankrun
- 41       gravel or sand.
- 42   E.   Level off and tamp earth at proper grade over all areas where concrete floor slabs will be placed on gravel or
- 43       sand fill.
- 44   F.   Cooperate with other trades regarding installation of embedded items. Templates and instructions will be
- 45       provided for items not set in forms.

46  
47   **PART 2 - PRODUCTS**

48  
49   **2.1 CONCRETE MATERIALS**

- 50   A.   General: All concrete, unless otherwise specifically permitted by Architect, shall be transit-mixed in accordance
- 51       with ASTM C 94.
- 52       1.   Source Limitations: Obtain each type or class of cementitious material of the same brand from the same
- 53       manufacturer's plant, each aggregate from one source, and each admixture from the same manufacturer.
- 54   B.   Portland Cement:
- 55       1.   Standard Portland Cement: ASTM C 150, Type 1.
- 56       2.   High Early Strength Portland Cement: ASTM C 150, Type 3.
- 57   C.   Aggregates:



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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.
    - c. For slabs-on-grade, provide well graded aggregates without gaps, with combined aggregate gradation 8%-18% for large top size aggregates (1-1/2 in.) or 8%-22% for smaller top size aggregates (1 in. or 3/4 in.) retained on each sieve below the top size and above the No. 100. Aggregates shall be graded to try to achieve a coarseness factor close to 70, workability factors of 35, and mortar factors less than 54.
      - i. Use the largest size of specified and properly graded aggregate available, e.g. aggregate up to 1/3 the slab thickness, 2" maximum, or #2 stone.
      - ii. Coarse aggregate should comprise approximately 60% of the total aggregate in the mix.
      - iii. Crushed limestone is preferable to natural stone.
      - iv. A natural sand with a fineness modulus of 2.70 to 2.90 is preferable.
  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.
- D. 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%).
- E. Slag Cement: ASTM C 989, Grade 100 or Grade 120 ground granulated blast-furnace slag.
- F. Chemical Admixtures:
1. Admixtures shall not contain intentionally-added chlorides. The addition of calcium chloride to the concrete mix is prohibited.
  2. Water Reducing Admixtures - conform to ASTM C 494, Type A
    - a. "Eucon A+", Euclid Chemical Co.
    - b. "Pozzolith" Series, BASF
    - c. "WRDA with HYCOL" or "WRDA - 82", W.R. Grace
    - d. "Catexol 1000N", Axim
    - e. "Plastocrete 161" or "Sikament 686", Sika Corp.
    - f. Approved equal
  3. Water Reducing, Retarding Admixture - conform to ASTM C 494, Type D
    - a. "Eucon Retarder - 75" or "Eucon DS" Series, Euclid Chemical Co.
    - b. "Pozzolith" Series or "Delvo" Series, BASF
    - c. "Daratard - 17", W.R. Grace
    - d. "Catexol 1000R", Axim
    - e. "Plastiment ES", Sika Corp.
    - f. 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" Series, BASF
    - c. "Viscocrete 2100", 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" Series, BASF
    - c. "Daracem" or "Mira" Series, W.R. Grace & Co.
    - d. "Sikament 686", Sika Corp.
    - e. Approved equal

- 1 6. Non-Corrosive, Non-Chloride Accelerator - conform to ASTM C 494, Type C or E. The admixture  
2 manufacturer shall provide long-term, non-corrosive test data from an independent testing laboratory (of  
3 at least 1 year duration) using an acceptable accelerated corrosion test method such as that using  
4 electrical potential measures, within the intended dosage range. Maximum dosage of 0.2% sodium  
5 thiocyanate per mass of cement.
  - 6 a. "Accelguard 80, 90 or NCA", Euclid Chemical
  - 7 b. "Polarset", W.R. Grace
  - 8 c. "Pozzolith NC 534" or "Pozzutec 20+", BASF
  - 9 d. "Catexol 2000RHE", Axim
  - 10 e. "Sikaset NC", Sika Corp.
  - 11 f. Approved equal
- 12 7. Air Entraining Admixture - conform to ASTM C 260
  - 13 a. "Air-mix" or "Air-mix 200", Euclid Chemical Co.
  - 14 b. "Daravair" or "Darex" Series, W.R. Grace
  - 15 c. "MBAE 90", "MBVR", or "Micro-Air", BASF
  - 16 d. "Catexol AE260", Axim
  - 17 e. "Sika AEA-14" or "Multi Air", Sika Corp.
  - 18 f. Approved equal
- 19 8. Certification: Written conformance to the above mentioned requirements and the chloride ion content of  
20 the admixture is required from the admixture manufacturer.
- 21 G. Evaporation Retardant:
  - 22 1. "Confilm", BASF
  - 23 2. "Eucobar", Euclid Chemical Co.
  - 24 3. "Sealtight Evapre", W.R. Meadows, Inc.
  - 25 4. Approval equal
- 26 H. Water: ASTM C-1602, potable
- 27 I. Curing Compound:
  - 28 1. Curing compounds shall be used for interior applications which require dissipating materials that are  
29 compatible with and allow proper installation of paint, resilient tile, flooring, hardeners, or other finish  
30 surfaces.
  - 31 2. Liquid type, membrane forming curing compound complying with ASTM C 309, Type 1, Class A & B with  
32 25% solids, VOC compliant.
    - 33 a. Provide test data from an independent testing laboratory indicating a maximum moisture loss of  
34 0.55 grams per sq. cm. when applied at a coverage rate of 200 sq. ft. per gallon.
    - 35 b. Colorless, clear or with fugitive dye or pigment, non-yellowing, U.V. resistant, strippable, self-  
36 dissipating, non-penetrating, resin-based, not wax-based or chlorinated rubber.
      - 37 i. "Sealtight 1100 Series, Resin and Waterbased", W.R. Meadows, Inc.
      - 38 ii. "Kurez DR VOX", "Kurez RC" or "Kurez RC Off", Euclid Chemical
      - 39 iii. Approved equal
    - 40 c. Contractor shall verify compatibility of any curing compound with floor covering supplier.
- 41 J. Curing and Sealing Compound:
  - 42 1. Curing and sealing compounds shall be used for interior or exterior applications where concrete is left  
43 exposed with no other finish coating or hardener. Compound shall be compatible with paint or striping  
44 applications.
  - 45 2. Liquid type, membrane forming curing and sealing compound complying with ASTM 1315 Type 1, Class A  
46 with 25% solids, VOC compliant.
    - 47 a. Provide test data from an independent testing laboratory indicating a maximum moisture loss of  
48 0.04 grams per sq. cm. when applied at a coverage rate of 300 sq. ft. per gallon.
    - 49 b. Colorless, clear or with fugitive dye or pigment, non-yellowing, U.V. resistant, resin based, not wax  
50 based.
      - 51 i. "Sealtight Vocomp-25", W.R. Meadows, Inc. (Interior or exterior use - water base)
      - 52 ii. "Super Aqua Cure VOX", Euclid Chemical
      - 53 iii. "Super Diamond Clear VOX", Euclid Chemical
      - 54 iv. "Kure-N-Seal 25LV", Sonneborn, Div. of BASF
      - 55 v. Approved equal
    - 56 3. Refer to the Room Finish Schedule for liquid hardeners/sealers to be used as per Section 03 35 00.
- 57 K. For stairs, landings, platforms and where otherwise indicated in Room Finish Schedule as "non-skid" or "nonslip",  
58 provide non-slip, abrasive aggregate to be 100 percent aluminum oxides (A1203) applied at manufacturer's

recommended application rates. Use material that is factory-graded, packaged, rust-proof, and non-glazing, and is unaffected by freezing, moisture, and cleaning materials. Submit samples for Architect's approval.

1. "Alundum", Norton Co.
2. "Carborundum C"
3. "Non-slip Aggregate", Euclid Chemical Co.
4. "FRICTEX", BASF
5. Approved equal

- L. Anchorage Items: Slots and inserts for anchoring masonry and mechanical equipment to concrete of standard manufacture. Inserts for bonding glazed tile to concrete shall be "Tie-To", as manufactured by K&M Building Products Company, Milwaukee, or approved equal.

## 2.2 MISCELLANEOUS MATERIALS

- A. Expansion/Isolation Joints:

1. Premolded expansion joint strips for concrete slab-on-grade construction (also referred to as expansion felt), 3/8" thick minimum or as specified on drawings, premolded resilient, compressible, re-expanding, nonextruding, bituminous asphalt or fiber materials, conforming to ASTM D 994 or ASTM D 1751. May be used for cold or hot-applied joint sealing compounds.
  - a. "Sealtight" Asphalt or fiber expansion joints, W.R. Meadows
  - b. Masco
  - c. Approved equal
2. As a contractor option to asphalt or fiber joint strips, expansion joint filler strips shall be flexible foam premolded joint filler, thickness and width as required. Use for cold-applied joint sealing compounds.
  - a. "Sealtight Ceramar", W.R. Meadows
  - b. "Sealtight Deck-o-foam", W.R. Meadows
  - c. Approved equal
3. Joint Sealants: Polyurethane joint sealant for slab-on-grade control and construction joints required for all exposed concrete including interior vehicle parking and maintenance areas, exterior construction and parking structures. Provide backer rod when shown on plans or as required by Manufacturer.
  - a. "Sikaflex 2CSL", Sika
  - b. "THC-900", Tremco, level surfaces
  - c. "Vulkem 245SL", Tremco
  - d. "THC-901", Tremco, sloped surfaces
  - e. "Eucolastic II", Euclid Chemical
  - f. "Sonolastic SL2", BASF
  - g. Approved equal

- B. Waterstops: Provide waterstops at construction joints and other joints as shown. Waterstops to accommodate expansion movement of up to 1/2 inch.

1. Virgin Polyvinyl chloride dumbbell or centerbulb type conforming to Corp. of Engineers CRD-C572, 6" minimum width, typical unless noted otherwise.
  - a. Amico Division, Alabama Metal Industries
  - b. Meadows "Sealtight" PVC Waterstop
  - c. Vinylex
  - d. Greenstreak
  - e. Approved equal
2. Bentonite Waterproofing Compound conforming to HSF 61. Use where shown on plans. May not be used as a substitute for PVC waterstops.
  - a. "Volclay-RX", American Colloid Co., Arlington Heights, IL
  - b. "Superstop" and "Parastop II", Paramount, Division of Tremco, Cleveland, OH
  - c. "Waterstop-RX", CETCO
  - d. Approved Equal
  - e. Option to Bentonite Waterstops: "SikaSwell S", Sika Corp.
3. Option to PVC or Bentonite Waterstops:
  - a. "Adeka Ultra-seal", OCM, Inc., Vernon Hills, IL.
  - b. "Adcor ES," W.R. Grace & Co., Cambridge, MA

- C. Under-Slab Vapor Barrier:

1. Meet or exceed the requirements of ASTM E-1745 Class "A", ASTM E-154, ASTM E-96, with water vapor permeance of 0.01 perms or less after mandatory conditioning tests per ASTM E-1745.
2. Provide manufacturer product literature and samples to engineer for review.

- 1 3. Material: Minimum 15 mil polyolefin non-reinforced film with virgin resins and no recycled materials.  
2 Single ply polyethylene is prohibited.  
3 a. "Stego Wrap (15 mil)" film, Stego Industries, CA  
4 b. "Vapor Block 15 (15 mil)" film, Raven Industries, South Dakota  
5 c. "Perminator (15 mil)" film, W.R. Meadows, IL.  
6 d. "Viper VaporCheck II (15 mil)" film, Insulation Solutions, East Peoria, IL.  
7 e. Approved equal.  
8 4. Flashing Tape: Air-Shield 25mil Flashing Tape: Self-adhering, flexible membrane flashing. Minimum roll  
9 size 3" x 75'. Prime surfaces as required by manufacture. By W.R. Meadows or equal.  
10 5. Accessories: Seam tape, repair tape, mastic, detail strips and pipe boots supplied by manufacturer.  
11 ~~D. Insulation:~~  
12 1. ~~Insulation Against Walls: Extruded polystyrene (XPS) insulation board. ASTM C578, Type IV, 25 psi~~  
13 ~~minimum compressive strength, 2" thick, R=10.~~  
14 a. ~~"Styrofoam SM", Dow Chemical Company~~  
15 b. ~~"Foamular 250", Owens Corning~~  
16 c. ~~"Certifoam 25", DiversiFoam Products~~  
17 d. ~~"GreenGuard", Pactiv Building Products~~  
18 e. ~~Approved equal~~  
19 2. ~~Insulation Below Concrete Slabs:~~  
20 a. ~~Below slabs on grade, exterior plazas, or above structural slabs, where insulation is 9" thick or~~  
21 ~~less, provide extruded polystyrene insulation, 60 psi minimum compressive strength, exceed~~  
22 ~~ASTM C578 Type VII.~~  
23 i. ~~"Styrofoam Highload 60", Dow Chemical Company~~  
24 ii. ~~"Foamular 600", Owens Corning~~  
25 iii. ~~"Certifoam High Density 60", Diversifoam Products~~  
26 iv. ~~Approved equal~~  
27 b. ~~Below slabs on grade, exterior plazas, or above structural slabs, where insulation is over 9" thick,~~  
28 ~~provide extruded polystyrene insulation, 15 psi minimum compressive resistance at 10% Strain~~  
29 ~~Deformation, exceed ASTM C578 Type II. Installation per manufacturer's recommendation.~~  
30 i. ~~"Durafill Geofoam EPS22", Plymouth Foam, Plymouth, WI~~  
31 ii. ~~"Foamular 150", Owens Corning~~  
32 iii. ~~"InsulFoam GF EPS22", InsulFoam LLC~~  
33 iv. ~~"Styrofoam Square Edge", Dow Chemical Company~~  
34 v. ~~Approved equal~~  
35 c. ~~Below stair risers and stadium seating, provide extruded polystyrene, 15 psi minimum~~  
36 ~~compressive resistance at 10% Strain Deformation, exceed ASTM C578 Type II. Installation per~~  
37 ~~manufacturer's recommendation.~~  
38 i. ~~"Durafill Geofoam EPS22", Plymouth Foam, Plymouth, WI~~  
39 ii. ~~"Foamular 150", Owens Corning~~  
40 iii. ~~"InsulFoam GF EPS22", InsulFoam LLC~~  
41 iv. ~~"Styrofoam Square Edge", Dow Chemical Company~~  
42 v. ~~Approved equal~~  
43 E. Grout:  
44 1. Dry pack to plastic state, ready-to-use, non-shrink, non-metallic grouting material requiring only mixing  
45 with water at job site. Conform to ASTM C1107, Grade A or better. When placed at a fluid consistency,  
46 grout shall achieve 95% bearing under a 4' x 4' base plate. Use for base plates, setting plates, dowels and  
47 other locations noted on Drawings in accordance with manufacturer's requirements.  
48 a. "Set Grout", BASF  
49 b. "Five-Star Grout", U.S. Grout Company  
50 c. "Euco-NS", Euclid Chemical  
51 d. "Sikagrout 212", Sika Chemical Co.  
52 e. "CG-86", W.R. Meadows Sealtight  
53 f. Approved equal  
54 2. High Flow Grout: Where high fluidity and/or increase placing time is required use high flow grout. The  
55 factory pre-mixed, non-shrink grout shall conform to ASTM C1107 Grades B and C. In addition, the grout  
56 manufacturer shall furnish test data from an independent laboratory indicating that the grout when  
57 placed at a fluid consistency shall achieve 95% bearing under a 18" x 36" base plate.  
58 a. "Euco Hi-Flow Grout", Euclid Chemical Co.

- 1 b. "Masterflow 928", BASF
- 2 c. "Duragrout", L&M Construction Chemicals
- 3 d. "Five-Star Grout", U.S. Grout Company
- 4 e. "Sikagrout 328", Sika Chemical Co.
- 5 f. "CG-86", W.R. Meadows Sealtight
- 6 g. Approved equal
- 7 F. Sleeves, Anchors, Inserts and Pipe Openings:
- 8 1. Except as otherwise shown or specified, provide and install all sleeves, anchors, inserts, wood block,
- 9 grounds, bolts, nuts, washers and ties of every description to be cast into concrete and permit passage of
- 10 other work through concrete. Install dovetail slot anchors in all concrete walls where masonry walls abut.
- 11 2. Set anchor bolts and all miscellaneous items according to template and setting diagrams furnished by
- 12 other trades and Contractors for casting into concrete to accommodate their work.
- 13 3. Provide additional reinforcement for the concrete as directed due to the size of the unit being cast in the
- 14 concrete.
- 15 4. Inserts for hangers for piping, mechanical fixtures, etc. will be furnished by mechanical trades. Install as
- 16 directed.
- 17 5. Conduits, pipes and sleeves of any material not harmful to concrete and within limitations of this
- 18 paragraph and structural drawings may be embedded in concrete walls, subject to the review and
- 19 approval of Engineer. No conduits or pipes may be embedded in post-tensioned slabs for parking
- 20 structures. Conduits, pipes, sleeves, etc. placed within concrete columns, slabs, beams and joists are not
- 21 allowed. Location of the reinforcing steel shall have priority over the location of all conduit, pipes or
- 22 sleeves. In case of conflicts between the reinforcing and conduit, pipes or sleeves, this Contractor shall
- 23 notify Architect immediately. If Contractor fails to request interpretation, all required changes shall be
- 24 made without additional cost to Owner.
- 25 G. Edge Forms and Screeds: Proper wood or metal screeds, accurately leveled and securely fastened, shall be
- 26 provided to bring the floor and other slabs to the required elevation for the concrete strikeoff operation.
- 27 H. Moisture Absorptive Cover: Burlap cloth made from jute or kenaf, weighing approximately 9 oz. per sq. yd.,
- 28 complying with AASHTO M 182, Class 2.
- 29 I. Moisture Retaining Cover: One of the following, complying with ASTM C 171, for moist-curing concrete:
- 30 1. Waterproof Paper
- 31 2. Polyethylene sheet not less than 6 mills thick
- 32 3. Polyethylene-coated burlap
- 33 J. Bonding Compound: Polyvinyl acetate or acrylic base, re-wettable type, for cosmetic nonstructural repairs.
- 34 1. "Euco Weld", Euclid Chemical
- 35 2. "Weldcrete", Larsen Co.
- 36 3. "Thorobond", BASF
- 37 4. Approved equal
- 38 K. Epoxy Products: Two component material suitable for use on dry or damp surface, complying with ASTM C 881,
- 39 for use in all structural concrete repairs.
- 40 1. Products for Crack Repair:
- 41 a. "Eucopoly Injection Resin" or "Dural 50", Euclid
- 42 b. "Concresive Standard LVI", BASF
- 43 c. "Product R303", Concrete Injection Resin, "Rescon", Technology Corp.
- 44 d. "Sikadur 35 Hi Mod LV", Sika Chemical Company
- 45 e. Approved equal
- 46 2. Products for Epoxy Mortar Patches, Interior use:
- 47 a. "Concresive LPL Liquid", BASF
- 48 b. "Euco Epoxy #452" or "Duralcrete System", Euclid
- 49 c. "Product R616, Concrete Bonder" or "Product R404, Epoxy Mortar Resin", Rescon Technology
- 50 d. "Sikadur 21 Lo Mod LV", Sika Chemical Company
- 51 e. "Sikadur 23 Lo Mod Gel", (overhead, vertical)
- 52 f. Approved equal
- 53 3. Products for Epoxying Bolts or Reinforcing Steel into Concrete: See Specification 05 05 30.
- 54 L. Polymer Modified Mortars with Corrosion Inhibitor, Exterior for corrosive environments including parking
- 55 structures and pools:
- 56 1. "Thin Top Supreme, Concrete Top Supreme" horizontal repairs, Euclid Chemical
- 57 2. "Verticoat/Verticoat Supreme", vertical repairs, Euclid Chemical
- 58 3. "Sikatop 122 Plus"; horizontal repairs, Sika Chemical Company

- 1 4. "Sikatop 123 Plus"; vertical repairs, Sika Chemical Company
- 2 5. "SD2 Repair Mortar", horizontal repairs, BASF
- 3 6. "HB2 Repair Mortar", vertical/overhead repairs, BASF
- 4 7. Approved equal
- 5 M. Polymer Modified Mortars for interior or exterior concrete surface repairs including spalls and patches in
- 6 noncorrosive environments:
- 7 1. "Sika Repair 222 with Sikalatex R"; horizontal repairs Sika Chemical Corp.
- 8 2. "Sika Repair 223 with Sikalatex R"; vertical repairs, Sika Chemical Corp.
- 9 3. "Euco Verticoat Supreme" or "Speed Crete Red Line", Euclid Chemical
- 10 4. "Euco Thin Top Supreme" or "Tammspatch II", Euclid Chemical
- 11 5. "Emaco R310 CI", horizontal repairs, BASF
- 12 6. "Gel Patch", vertical/overhead repairs, BASF
- 13 7. Approved equal
- 14 N. Self-Leveling Mortars for Slab Fill Repair Products, Interior use, Structural Wear Surface:
- 15 1. "Flo-top" or "Super Flo-top", Euclid Chemical
- 16 2. "Sikatop 111", Sika Chemical Co.
- 17 3. "Mastertop Topping 112", BASF
- 18 4. Approved equal
- 19 O. Self-leveling Mortars for Slab Fill, Exterior use with corrosion inhibitors:
- 20 1. "Sikatop 111 Plus", Sika Chemical Co.
- 21 2. "Duraltop Flowable Mortar", Euclid Chemical
- 22 3. "Emaco R310 CI", BASF
- 23 4. Approved equal
- 24 P. Reglets: Where resilient or elastomeric sheet flashing or bituminous membranes are terminated in reglets,
- 25 provide reglets of not less than 26 gage galvanized sheet steel. Fill reglet or cover face opening to prevent
- 26 intrusion of concrete or debris.
- 27

**2.3 MIXES AND DELIVERY**

- 29 A. Concrete Mix:
- 30 1. Ready-mixed concrete shall be subject to the following:
- 31 a. Concrete must meet all requirements of the ASTM C 94, ACI 211, ACI 318 Chapter 4 Durability
- 32 Requirements, and those herein specified for materials, proportioning, mixing and other details of
- 33 manufacturer, quality and deliver.
- 34 b. Submit suitable evidence as to experience, equipment and capacity of plant to Architect for
- 35 approval.
- 36 B. Mix Proportioning: Furnish ready-mixed concrete in accordance with the following:
- 37

Type of Construction	Min. Comp. Strength (U.N.O.) PSI at 28 day	Max. Slump In.	Max. Agg. In.	Min. Cement Lbs/C.Y.	Air Entrained	Foot Notes
All Footings	4000	2-4	1.5	470	No	
Interior Elevated Slabs, Beams, Grade Beams, Walls, Stairs and Precast Toppings	4000	2-4	0.75	540	No	
All Exterior Walls, Piers, Grade Beams, Trench Footings	4500	2-4	0.75	646	Yes	(1)
Columns, Piers (Isolated)	4000 (INT) 4500 (EXT)	2-4	0.75	564	No	
Interior Slab on Grade	4000	2-4	---	540	No	(2)(5)
Exterior Slab on Grade	4000	2-4	---	587	Yes	(1)(2)(5)

1							
2	Masonry Grout	3000	8-10	0.375	494	No	(4)
3							
4	Floors on Metal	4000	2-4	0.75	470	No	
5	Form Deck						
6							
7	Miscell. Non-Sched.	4000	2-4	0.75	540	No	
8							
9	Interior Concrete						
10	Work						
11	Watertight	4500	0-2	0.75	646	Yes	(3)(6)
12	Construction						
13	(Pools, Tanks,						
14	Tunnels etc.)						
15							

**FOOTNOTES:**

- 18 (1) Air entrained concrete: Use for all exterior slabs, walls, walks, platforms, ramps, steps, all portions of parking ramps, and  
 19 all other concrete exposed to freezing and thawing. Maximum water/cementitious ratio = 0.45.
- 20 (2) Minimum compressive strength at 3 days: 1800 psi. Maximum aggregate size shall not exceed one third of the slab on  
 21 grade thickness. Coordinate with Contractor as to project schedule. Reduce water/cementitious ratio to 0.40, with  
 22 MRWR or HRWR, to achieve required water vapor emission rates for installation of finish materials.
- 23 (3) Use superplasticizer for all concrete with specified minimum compressive strength greater than 4500 PSI and/or w/cm  
 24 of 0.45 or less. For all other concretes, specified maximum slump may only be exceeded through the use of a MRWR or  
 25 HRWR. Maximum slump = 6" after addition of plasticizer, (at end of discharge hose if pumped).
- 26 (4) MRWR required.
- 27 (5) For slabs on grade, provide a low shrink, low curl mix with well-graded aggregates without gaps, lower sand in mix, and  
 28 a proven history of performance. Reduce water/cementitious ratio (0.40 to 0.50) as required. Use high quality  
 29 admixtures with lower shrinkage and curl properties compared to comparable alternatives. Coordinate with and receive  
 30 written approval from supplier of floor hardeners and any other finish floor material for mix design and materials. Test  
 31 performance of cements from various suppliers.
- 32 (6) Maximum water/cementitious ratio = 0.42 for Watertight Construction. Provide Crystalline Waterproofing Admixture at  
 33 a dosage of 2-1/2% by weight of Portland cement plus 2-1/2% by weight of slag, or as recommended by manufacturer,  
 34 whichever is greater. For tunnel bottom slab, rate may be reduced to 2% by weight where nominal slab thickness is 36"  
 35 or greater, or as recommended by manufacturer, whichever is greater. Air entrainment may be omitted when not  
 36 subject to freeze/thaw.
- 37
- 38 C. Additional Mix Requirements
- 39 1. Cement content specified above is minimum, except:
- 40 a. If concrete mix test results in accordance with ACI 318 Section 5.3 indicate strength greater than  
 41 that specified, reduction of specified cement content is allowed.
- 42 b. Should test results indicate strength below that specified, additional cement shall be added  
 43 without cost to Owner.
- 44 2. Fly Ash may be used as a pound for pound replacement of cement up to 20% of the total cementitious  
 45 content, 25% for footings, except for finished flatwork during winter construction, subject to Architect's  
 46 approval.
- 47 a. Mixes shall develop sufficient strength to meet contractor's schedule for flatwork finishing and  
 48 formwork removal. Adjust proportions of fly ash as required.
- 49 3. Combinations of Slag and Fly Ash, (with a minimum ratio of 1 part slag to 1 part fly ash, higher  
 50 proportions of slag are acceptable), may be used as a pound-for-pound replacement of cement as  
 51 follows:
- 52 a. Footings: 50% of the total cementitious content.
- 53 b. All other: 30% of the total cementitious content, except for finished flatwork during winter  
 54 construction.
- 55 c. Mixes shall develop sufficient strength to meet contractor's schedule for flatwork finishing and  
 56 formwork removal. Adjust proportions of fly ash and slag as required.
- 57 4. Air-Entrained Concrete:

- 1 a. Concrete requiring air entrainment shall contain six (6) percent plus or minus one and a half (1.5)  
2 percent air by volume, (at end of discharge hose if pumped) for 3/4" dia. aggregate. Conform to  
3 ACI 318, Chapter 4. Give proper consideration to the reduction of air content when fly ash is used.  
4 Hard-troweled interior floors shall not contain more than 3% entrained or entrapped air.
- 5 5. Where synthetic or steel fibers are used in slabs, mix designer shall adjust the admixture dosage and/or  
6 water content to maintain the specified slump and adjust mix for increase in air content from fibers.
- 7 D. Admixture Usage:
- 8 1. All concrete must contain the specified water-reducing admixture or water-reducing -retarding admixture  
9 and/or the specified high-range water-reducing admixture (superplasticizer).
- 10 2. Specified cement contents shall be increased 10 percent (10%) when no water-reducing admixtures are  
11 used.
- 12 3. When temperature is at or below 40 degrees F when placing or within next 24 hours, all concrete, less  
13 than 8" in thickness, shall contain the specified non-corrosive, non-chloride accelerator.
- 14 4. All concrete required to be air entrained shall contain an approved air entraining admixture.
- 15 5. All pumped concrete, concrete for industrial slabs, synthetic fiber concrete, architectural concrete,  
16 concrete for wall pours exceeding 14 feet in height or with high rebar congestion which makes  
17 consolidation difficult (bars at 4" on center or less), concrete required to be watertight and concrete with  
18 a water/cementitious ratio below 0.41 shall =contain the specified site applied high-range water-reducing  
19 admixture (Superplasticizer). Mid-range plasticizers may be substituted for high-range when  
20 watercementitious ratios exceed 0.41. Do not use HRWR or MRWR at the batch plant.
- 21 6. When high temperatures and/or placing conditions dictate and/or when concrete temperatures exceed  
22 80 degrees F. use a water-reducing- retarding admixture (Type D) in lieu of the water-reducing admixture  
23 (Type A).
- 24 7. Admixture Certifications must be submitted with the proposed mix design for review by the Architect.
- 25 8. No other admixtures will be permitted without prior approval from the Structural Engineer.
- 26 E. Measuring Materials: Cement, aggregates, water and admixtures shall be measured and combined strictly in  
27 accordance with ASTM Specification C 94.
- 28 F. Mixing and Delivery:
- 29 1. Ready-mixed concrete shall be mixed and delivered to point designated by means and standards set forth  
30 by ASTM Specification C 94.
- 31 2. Mixers and agitators may be examined by a representative of Owner for changes in conditions due to  
32 accumulation of hardened concrete or mortar or through wear of blades.
- 33 3. When concrete is mixed in a truck mixer loaded to its maximum rated capacity, number of revolutions of  
34 drums or blades at a mixing speed shall not be less than 70 or more than 100.
- 35 4. When a truck mixer or a truck agitator is used for transporting concrete, concrete shall be delivered to  
36 site of work, and discharge shall be completed within one and one-half (1-1/2) hours or before drum has  
37 revolved a total of 300 revolutions, whichever comes first, after introduction of mixing water to the  
38 cement and aggregates, or mixing of cement and aggregates, unless a longer time is specifically  
39 authorized by Architect. In hot weather, or under conditions contributing to quick stiffening of concrete,  
40 concrete delivery and discharge shall be completed within 45 minutes.
- 41 5. Water may be added one time on the job site in the presence of a testing laboratory representative, to  
42 bring the slump to the specified level, but not to exceed 1 gallon per cubic yard and prior to any  
43 superplasticizer use. Such addition shall not increase the water-cementitious materials ratio above the  
44 maximum permitted by the specifications. For concrete with w/c less than 0.41, and for concrete  
45 exceeding 4,600 PSI strength, concrete supplier's representative and Structural Engineer shall provide  
46 approval prior to addition of any water. Mixing time shall be appropriately increased with a minimum of  
47 twenty (20) revolutions of the drum. The maximum slump shall not be exceeded with the addition of  
48 water. Concrete with higher slumps will be rejected. Contractor may exceed specified slump only if a  
49 superplasticizer is used. Amount of water added on the jobsite shall be recorded on each delivery ticket  
50 and concrete test report. All slump tests shall be taken after all water has been added. Water shall not be  
51 added to the batch at any later time.
- 52 6. Drivers may not wash concrete trucks, or discharge water at any time into pump hoppers used for  
53 concrete pumping operation.
- 54 G. The General Contractor shall include in his bid additional concrete required to provide a flat top surface, within  
55 tolerances, for metal deck slabs to account for deck, joist or steel beam deflection. Slab thickness specified on  
56 drawings is the minimum nominal thickness.
- 57



1 **PART 3 - EXECUTION**

2  
3 **3.1 FIELD QUALITY CONTROL**

- 4 A. The individuals who sample and test concrete to determine if the concrete is being produced in accordance with  
5 this specification, and that slump, air content, temperature and cylinder tests are in conformance with this  
6 Specification shall have demonstrated a knowledge and ability to perform the necessary test procedures  
7 equivalent to the ACI Minimum Guidelines for Certification of Concrete Field Testing Technicians, Grade 1. A  
8 current certificate shall be presented upon request by Architect.
- 9 B. All preparing of specimens and testing shall be performed by an independent laboratory hired by the Owner.  
10 Test reports shall be sent to Architect with copies to Contractor and ready mixed concrete producer.
- 11 1. This Contractor shall cooperate in taking of test samples and shall make adjustments in mix based on  
12 results of tests as directed by Architect.
- 13 2. Technician shall have full knowledge of required specifications prior to performance of field tests. Any  
14 non-conformance to specification shall be reported by email or fax immediately to Structural Engineer  
15 prior to field placement of concrete.
- 16 C. Samples of concrete shall be obtained in accordance with ASTM Method C 172 and shall be transported to a  
17 place on site where cylinders can be made and stored without being disturbed during first 24 hours.
- 18 D. Slump tests shall be performed in accordance with ASTM C143. Make one slump test of the first truck of each  
19 mix, each day, one test for each compression test and other tests as often as required thereafter, whenever  
20 consistency changes.
- 21 E. When air-entrained concrete is used and for industrial floors, air content tests shall be made from the first truck  
22 of each mix, each day and when-ever test cylinders are made, in accordance with ASTM C 173 or ASTM C231.  
23 Test more often when required air contents are not achieved.
- 24 1. For pumped concrete, air content tests shall be performed at point of discharge in addition to at the  
25 truck; once at the beginning of each pour and whenever the pumping orientation is significantly altered.  
26 Air contents shall be adjusted at the batching point as required.
- 27 2. Air entraining admixture may be added at the jobsite when air content tests too low.
- 28 F. Concrete Temperature: Test hourly when air temperature is 40 Degrees F (4 Degrees C) and below, and when 80  
29 Degrees F (27 Degrees C) and above; and each time a set of compression test specimens is made.
- 30 G. If measured slump, air content, or concrete temperature falls outside limits specified, a check test shall be made  
31 immediately on another portion of same sample. In event of a second failure, concrete shall be considered to  
32 have failed to meet requirements of specifications and shall not be used in structure. Notify Architect  
33 immediately.
- 34 H. Cylinders for strength tests shall be made in accordance with ASTM Method C 31. During first 24 hours all  
35 laboratory test specimens shall be covered and kept at air temperatures between 60 and 80 degrees F. (16 and  
36 27 C). At the end of 24 hours, specimens shall be carefully transported to testing laboratory where molds shall be  
37 removed and cylinders shall be cured in a moist condition of 65 to 75 degrees F. (18 to 24 C.) until time of test.  
38 Strength tests shall be made frequently at direction of Architect. In no case shall any given class of concrete be  
39 represented by less than five (5) tests for entire job.
- 40 I. A strength test for any class of concrete shall consist of standard cylinders made from a composite sample  
41 secured from a single load of concrete in accordance with ASTM C-172.
- 42 1. All concrete less than 6000 psi:
- 43 a. After 24 hours four cylinders shall be carefully transported to the testing laboratory for moist  
44 curing.
- 45 b. One laboratory cured cylinder shall be tested at 7 days and two laboratory cured cylinders to be  
46 tested at 28 days; retain one cylinder for later testing, if necessary.
- 47 J. Strength tests shall be made for each of the following conditions:
- 48 1. Each day's pour,
- 49 2. Each class of concrete,
- 50 3. Each change of supplies or source,
- 51 4. Each 150 cubic yards of concrete or fraction thereof
- 52 5. Each 5000 square feet of surface area for slabs or walls.
- 53 K. To conform to requirements of this Specification, the strength level shall be considered satisfactory so long as  
54 the average of all sets of three (3) consecutive strength test results equals or exceeds the specified f'c and no  
55 individual strength test result falls below the specified strength f'c by more than 500 psi when f'c is 5000 psi or  
56 less; or by more than 0.10f'c when f'c is more than 5000 psi. Architect shall be notified immediately of  
57 nonconformance.

- 1 L. A record shall be made by a representative of testing laboratory of delivery ticket number for particular batch of  
2 concrete tested and exact location in work at which each load represented by a strength test is deposited.  
3 M. Additional field-cured cylinder tests, in-place cylinders, non-destructive testing, and/or maturity testing may be  
4 performed, at Contractor's option and expense, to determine early strength of concrete to facilitate form or  
5 shoring removal and shorten construction schedules.  
6 N. If, in the opinion of Architect, concrete of poor quality has been placed, additional tests shall be made as  
7 directed. Concrete quality shall be based on visual inspection of the concrete and review and analysis of the  
8 cylinder strengths. Additional tests shall be at the expense of Contractor. Tests may be compression tests on  
9 cored cylinders obtained by the Testing Laboratory per ASTM C42 or load tests per ACI 318 or as recommended  
10 by the Testing Laboratory and directed by the Architect. All testing costs chargeable to Contractor will be  
11 obtained from him by means of a credit change order to the Contract.  
12

### 13 3.2 PREPARATION

- 14 A. Notification:  
15 1. Upon completion of forms and placing of reinforcing steel and before concrete is poured, notify all  
16 Contractors and Rebar Inspector allowing them Reasonable time to complete their work.  
17 2. Notify Architect at least 48 hours in advance before pouring any unit of structure.  
18 B. Protection of Adjacent Work:  
19 1. This Contractor shall be responsible to see that due care is exercised to avoid staining any adjacent  
20 finished material during concrete work. Any such damage shall be repaired in a manner subject to  
21 approval by A/E and Owner by this Contractor without expense to the Owner.  
22 2. Contractor shall be responsible for protection of footings subject to freezing temperatures by covering  
23 completed and/or existing work at footing level with sufficient temporary or permanent cover as  
24 required to Protect footings and adjacent subgrade against the possibility of freezing; maintain cover for  
25 the time period as necessary.  
26 C. Preparation:  
27 1. Before Placing Concrete:  
28 a. Clean all mixing and transporting equipment.  
29 b. Remove all ice, snow, dirt, chips and other debris from forms or place to receive concrete.  
30 c. Flush and wet down forms thoroughly to close any cracks between boards.  
31 d. Wet down subgrade with as much water as it will absorb readily. Remove standing water.  
32 e. Do not place concrete in dry forms or on dry subgrade.  
33

### 34 3.3 CONCRETE PLACEMENT

- 35 A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete  
36 and that required inspections have been performed.  
37 B. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be  
38 placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be  
39 placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.  
40 1. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner  
41 to avoid inclined construction joints.  
42 2. Place all concrete in accordance with ACI 304, ACI 304.2R and ACI 302 for slabs. Consolidate placed  
43 concrete with mechanical vibrating equipment according to ACI 301.  
44 3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at  
45 uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do  
46 not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion,  
47 limit duration of vibration to time necessary to consolidate concrete and complete embedment of  
48 reinforcement and other embedded items without causing mixture constituents to segregate.  
49 4. Crane or dump bucket may be used to transport concrete where concrete cannot be delivered to forms  
50 directly from chutes, into forms, wheelbarrows or two (2) wheeled concrete carts.  
51 5. Specified superplasticizers, or approved alternative admixtures, are required in the concrete mix if  
52 concrete pumping is used for placement.  
53 6. Delivery carts or buggies and/or pumping equipment shall be kept on temporary runways built over floor  
54 systems. Runway supports shall not bear on reinforcing steel or fresh concrete.  
55 7. Concreting operation shall not alter location of reinforcing bars. Extreme care by workmen is required.  
56 Do not drag or drop equipment, such as pumping hose on reinforcement.

- 1 8. In no case shall concrete be delivered or placed with a free fall exceeding 10 feet for concrete containing  
2 superplasticizer, or 5 feet for other concrete. Spreading of concrete with hoes and shovels for distance  
3 greater than 6'0" from delivery end of chutes, carts or buggies will not be permitted.
- 4 9. Consistency of concrete to be such that it will be:  
5 a. Uniform throughout with mortar clinging to coarse aggregate;  
6 b. Plastic enough that concrete will work readily into corners and angles of forms and around  
7 reinforcement without excessive puddling or spading and without segregation of material or  
8 collecting of free water on surface while transporting or placing;  
9 c. Of sufficient mortar content in mass to fill all voids, prevent harshness or honeycombing in the  
10 structure and uniform distribute coarse aggregate.
- 11 10. Concrete shall be deposited in such a manner as to secure most thorough consolidation. Vibration with  
12 an approved "spud" type internal vibrator with flexible shaft shall be used where possible. Vibrator shall  
13 not come in contact with reinforcing or forms. Use and type of vibrators shall conform to ACI 309.
- 14 C. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction  
15 joints, until placement of a panel or section is complete.  
16 1. Consolidate concrete during placement operations so concrete is thoroughly worked around  
17 reinforcement and other embedded items and into corners.  
18 2. Maintain reinforcement in position on chairs during concrete placement.  
19 3. Screed slab surfaces with a straightedge and strike off to correct elevations.  
20 4. Slope surfaces uniformly to drains where required.  
21 5. begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane,  
22 before excess bleedwater appears on the surface. Do not further disturb slab surfaces before starting  
23 finishing operations.
- 24 D. Concreting In Cold Weather:  
25 1. Follow ACI 306R and 306.1 for mixing, placing and protection, and as follows. Protect concrete work from  
26 physical damage or reduced strength that could be caused by frost, freezing actions, or low  
27 temperatures.  
28 a. When temperature is at or below 40 degrees F. (4 C.) when placing and for at least 72 hours  
29 afterward.  
30 b. temperature of all surfaces in contact with newly placed contact (including formwork, rebar,  
31 subgrade) shall be a minimum of 37°F and shall not be more than 10°F higher than minimum  
32 concrete placement temperatures specified in ACI 306R.  
33 c. Provide heated concrete material with temperature of concrete when placed as recommended by  
34 ACI guidelines.  
35 d. Only the specified non-corrosive non-chloride accelerator shall be used. Calcium chloride is not  
36 permitted.  
37 e. Do not place on frozen subgrades.  
38 f. Do not place concrete when the air temperature does not exceed 10°F during the day.  
39 g. Provide adequate housing covering and heating for freshly placed concrete for a minimum period  
40 of 72 hours after placing; maintain temperatures above 55oF. Do not allow carbon dioxide from  
41 heating units to contact freshly placed concrete surfaces for a minimum of 48 hours. Vent all  
42 heaters outside of any enclosure.  
43 h. All footings, walls, grade beams, piers and slabs on grade shall be protected from the penetration  
44 of frost by use of heaters, insulation, backfill, enclosures or other means. This protection shall  
45 exist throughout the entire construction period. Architect may inspect the frost penetration  
46 during construction. If frost is within 6 inches of the bottom of any construction in place, the  
47 Contractor shall take immediate steps to insulate or heat to prevent further frost penetration.  
48 i. If the protection provided by Contractor is inadequate and frost penetration extends beneath the  
49 bottom of the construction, this shall be a basis for rejecting that portion of the work. This  
50 rejected work shall be removed and properly replaced at the expense of Contractor.
- 51 2. Contractor's Responsibility: Repair or replace, in manner acceptable to Architect, all concrete work  
52 damaged due to water, snow, freezing, excessive heating and too rapid drying out.
- 53 E. Hot Weather Concreting:  
54 1. Conditions warranting hot weather concreting practices are defined as any combination of high air  
55 temperature, low relative humidity and wind velocity tending to impair the quality of fresh or hardened  
56 concrete or otherwise result in abnormal properties. Place concrete, cure and protect in compliance with  
57 ACI 305.1, Specification for Hot Weather Concreting. Do not place concrete when the air temperature is  
58 expected to reach 90o F or greater when placing or within next 24 hours.

- 1                    2.     Temperature of concrete when placed shall not be less than 50 degrees F nor exceed 85 degrees F.
- 2                        Control by:
- 3                        a.     Cooling aggregates;
- 4                        b.     Using cement with maximum temperature of 170 degrees F. (77c);
- 5                        c.     Using cold water or ice.
- 6                    3.     Sprinkle forms, subgrade and reinforcing with cool water prior to placing concrete. Keep buggies, chutes
- 7                        and other equipment shaded.
- 8                    4.     Cover reinforcing steel with water-soaked burlap if it becomes too hot, so that the steel temperature will
- 9                        not exceed the ambient air temperature immediately before embedment in concrete.
- 10                   5.     Mixing, Placing and Protection:
- 11                       a.     Keep mixing to minimum requirement which will insure adequate quality.
- 12                       b.     Do not expose mixers to hot sun.
- 13                       c.     Use concrete promptly.
- 14                       d.     Provide fog spraying operation immediately following placement and prior to final curing.
- 15                       e.     Finish promptly.
- 16                       f.     Protect and cure properly.
- 17                       g.     Do not use retarding agents unless approved by Architect.
- 18                       h.     Maintain concrete temperature not less than 50 degrees F nor more than 90 degrees F for the
- 19                                   first three days after placing. Protect from temperatures over 90 degrees F for the next five days.
- 20                   6.     When high temperatures and/or placing conditions dictate, use a water-reducing-retarding admixture
- 21                       (Type D) in lieu of the water-reducing admixture (Type A).
- 22                   F.     Evaporation Retardant: During rapid drying conditions (high concrete or ambient temperatures, low humidity,
- 23                       high winds, direct sunlight, etc.) apply a concrete evaporation retardant to minimize plastic cracking. The
- 24                       compound may be required to be applied one or more times during the finishing operation. The initial
- 25                       application is usually made after the strike-off operation.
- 26                       1.     Use is subject to approval of membrane or sealer manufacturer.
- 27

### 3.4 CONCRETE JOINTS

- 29                   A.     Use and location of expansion, contraction, control and construction joints as approved by Structural Engineer or
- 30                       as shown on drawings. Location shall be indicated on the Shop Drawings. Construct joints true to line with faces
- 31                       perpendicular to surface plane of concrete. All exposed concrete joints shall be tooled and sealed.
- 32                   B.     plumb bulkheads with keys at least 1-1/2" deep shall be used at all joints.
- 33                   C.     In no case shall pours be stopped at points that would impair strength of structure. Horizontal joints are not
- 34                       permitted within the height of a structural member, e.g. columns, footings, beams, floor systems.
- 35                       1.     Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints,
- 36                                   unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors
- 37                                   and slabs.
- 38                       2.     Locate joints for beams, slabs, joists, and girders in the middle third of spans, unless noted otherwise.
- 39                                   Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
- 40                       3.     Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the
- 41                                   top of footings or floor slabs.
- 42                   D.     Clean and roughen concrete surface to a 1/2" amplitude for wet concrete, to 1/4" amplitude for set concrete.
- 43                       Slush with neat cement grout immediately before placing additional concrete.
- 44                   E.     Install specified waterstop in all construction joints for below-grade basement walls in contact with earth.
- 45

### 3.5 EXPANSION/ISOLATION JOINTS, CONTROL JOINTS AND WATERSTOPS

- 47                   A.     At joints between slabs on earth and vertical surfaces, including columns, piers and walls, provide premolded
- 48                       joint filler strips. Before placing concrete, set isolation joint material in designated areas. Top of joint material
- 49                       shall be level to 1/4" below finished surface of concrete. Provide adequate means to maintain proper positioning
- 50                       of joint material during concrete placement. The minimum depth of isolation joint material shall be equal to the
- 51                       smaller of the concrete slab thickness with which it comes in contact.
- 52                   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
- 53                       depth of 1/4 slab thickness when using conventional saws, 1.25" for soft cut saws, as directed by Architect or as
- 54                       shown on structural drawings, whichever is more restrictive. Where joints are filled with polyurethane sealants,
- 55                       minimum 1/4" wide joints are required. Saw cutting of concrete shall be minimized. If necessary, saw cut while
- 56                       concrete is "green" to minimize dust and provide for better quality control. Provide dust barriers during cutting
- 57                       operations. Vacuum/clean surfaces following cutting operations to reduce residual concrete dust.

- 1 C. Where joint compound is indicated for control and construction joints, install premolded expansion joint filler  
2 strips topped with tapered, dressed, oiled wood strip to form groove at least 1" (2.5 cm) deep unless shown  
3 otherwise. After concrete has set, per manufacturer's exact specification, remove strip, grind or sandblast  
4 surfaces, prime, and fill groove with specified elastomeric sealant.
- 5 1. Required at exposed concrete surfaces including interior slabs, exterior driveways, warehouses, garages,  
6 plant or manufacturing areas, parking areas and parking structure slabs on grade, except for industrial  
7 building slabs on grade where semi-rigid joint filler is required.
- 8 D. Building expansion joints shall be constructed as detailed. Install specified waterstop, joint filler and compound  
9 In accordance with manufacturer's specifications.
- 10 E. Waterstops:
- 11 1. Store waterstops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.  
12 2. Install per manufacturer's requirements.  
13 3. Place in continuous lengths on top of footings where shown on plans in position shown on drawings to  
14 provide seal between wall and slab.  
15 4. Locate as detailed in all construction and expansion joint types as specified.  
16 5. Butt joints and miters shall be joined in field by heat sealing in accordance with manufacturer's  
17 instructions.  
18 6. Attach firmly to reinforcement and/or formwork to insure that waterstop will not be displaced or bent  
19 during concreting operations.  
20

### 21 3.6 CONCRETE CURING AND PROTECTION

- 22 A. General:
- 23 1. Protect freshly placed concrete from premature drying and excessive cold or hot temperatures in  
24 conformance with ACI 301 and ACI 308. After placement and prior to finishing of slabs, contractor shall  
25 use evaporation retardants, fogging, windscreens, etc. to prevent plastic shrinkage cracking caused by  
26 excessive drying of the top surface. For surfaces floated and broomed, place curing compound  
27 immediately where allowed.  
28 2. Start initial curing as soon as free water has disappeared from concrete surface after placing and  
29 finishing. Keep continuously moist for not less than 24 hours.  
30 3. Begin final curing procedures immediately following initial curing and before concrete has dried.  
31 Continue final curing for at least 7 days in accordance with ACI procedures. Avoid rapid drying at end of  
32 final curing period.
- 33 B. Curing Methods: Perform curing of concrete by curing compound, curing and sealing compound, by moist curing,  
34 by moisture-retaining cover curing and by combinations thereof, as herein specified.
- 35 1. Provide moist curing by following methods:
- 36 a. Keep concrete surface continuously wet by covering with water.  
37 b. Continuous water-fog spray.  
38 c. Cover concrete surface with specified burlap absorptive cover, thoroughly saturating cover with  
39 water and keeping continuously wet. Place absorptive cover to provide coverage of concrete  
40 surfaces and edges with 4" lap over adjacent absorptive covers.
- 41 2. Provide moisture-retaining cover curing as follows: Cover concrete surfaces with moisture-retaining  
42 cover for curing concrete, placed in widest practicable width sides and ends lapped at least 3" and sealed  
43 by waterproof tape or adhesive. Immediately repair any holes or tears during curing period using cover  
44 material and waterproof tape.
- 45 3. Provide curing compound or curing and sealing compound to slabs as follows:
- 46 a. Apply curing compound, per manufacturer's specification, to concrete slabs, including  
47 construction joints, after form removal as soon as final finishing operations are complete (within  
48 two hours). Apply uniformly in continuous operation by power-spray or roller in accordance with  
49 manufacturer's directions. Recoat areas subjected to rainfall within three (3) hours after initial  
50 application. Maintain continuity of coating and repair damage during curing period. Cover with  
51 moisture retaining cover for 48 hours.  
52 b. Exterior slabs shall have fugitive dye or pigment. Interior slabs may be clear or with pigment as  
53 required by Architect.  
54 c. Apply at dosage rates per Manufacturer's written recommendation.  
55 d. Remove by Blastrac when flooring adhesives or bonding agents are used.  
56 C. Coordinate curing methods with finish flooring contractor and manufacturer. Unless permitted in  
57 writing by finish flooring manufacturer, and approved by Architect, only moist curing is permitted  
58 during initial curing period for Multipurpose Rooms, Gymnasiums, for polished concrete, for all

- 1 floors where terrazzo, urethane, epoxy floor coatings or chemical hardener are scheduled, and for  
2 floors to receive moisture sensitive flooring materials.
- 3 D. Final cure concrete surfaces to receive liquid floor hardener by use of moisture-retaining cover,  
4 unless otherwise directed. See Room Finish Schedule and Section 03 35 00.
- 5 E. Final cure, by use of moisture-retaining cover, floors scheduled to receive moisture-sensitive  
6 Flooring materials including ceramic or quarry tile, vinyl composition tile, carpet or other "glue-  
7 down" finish flooring. Test and prepare in conformance with ACI 302.2, other sections of this  
8 specification, flooring manufacturer and industry recommendations.
- 9 F. Curing Formed Surfaces: Cure formed concrete surfaces, including undersides of beams,  
10 Supported slabs and other similar surfaces by moist curing with forms in place for full curing  
11 period or until forms are removed. If forms are removed, continue curing by methods specified  
12 above, as applicable. Vertical construction such as walls, columns, beam sides, etc. shall, if forms  
13 are removed in less than seven (7) days, be given a spray coat of liquid curing compound at rate  
14 recommended by manufacturer.
- 15 G. Curing Unformed Surfaces: Cure unformed surfaces, such as slabs, floor toppings and other flat  
16 surfaces by application of appropriate curing method.

### 17 3.7 TOLERANCES

- 18 A. The construction tolerances for cast-in-place concrete shall meet the requirements of ACI 117 and 347 and the  
19 special project tolerance requirements listed in this section. Where requirements conflict, the more stringent  
20 shall govern.
- 21 1. Tolerances are not cumulative. The most restrictive tolerance shall control.
- 22 2. Linear and Vertical Lines (When Forms are Stripped):
- 23 a. Perimeter column centerlines shall be within + or - 1" of established lines, when column edge is  
24 interior to slab edge. When column edge matches slab edge: match slab edge tolerance.
- 25 b. Perimeter slab edges shall be within + or - 1/2" of established lines.
- 26 c. Floor to floor dimension shall be within + or - 1/4" of established dimension.
- 27 d. Structural framing around elevator openings shall be within + or - 1/4" of established lines, or as  
28 required by Elevator Supplier.
- 29 3. Plumb (when forms are stripped, except where otherwise specified):
- 30 a. Lines and surfaces of columns and walls shall be within 0.3% times the clear height.
- 31 b. ACI 117 Requirements for buildings less than or equal to 83'-4" in height, shall apply to the full  
32 height of the structure. Upon completion of building, the entire height shall be plumb to the  
33 lesser of 0.3% times the height above top of foundations or +/-1", except exposed columns and  
34 walls shall be plumb to 1/2".
- 35 4. Elevations:
- 36 a. Top of slab at columns shall be within + or - 3/8" of established elevations.
- 37 b. Top of slab at perimeter edge shall be within + or - 3/8" of established elevations.
- 38 c. The top of slab at the center of a span shall be within + or - 3/8" of established elevations.
- 39 d. The top of slab at the center of a bay shall be within + or - 3/8" of established elevations.
- 40 e. For shored construction, values apply before forms and shores are stripped.
- 41 5. Formed Opening:
- 42 a. Lesser of window or door tolerances or:
- 43 b. Width or height: + or -1/2"
- 44 c. Size: +1/2" or -1/4"
- 45 d. Centerline location: + or -1/2"
- 46 6. Embed plate location: + or -1" for vertical or horizontal alignment.
- 47 7. Slab Thickness: - 1/4" maximum.
- 48 8. Construct and align formwork for elevator hoistway in accordance with ASME A17.1, not to exceed +1",  
49 and not less than the clear dimensions shown on elevator shop drawings, or as allowed by Elevator  
50 Supplier.
- 51 9. Conflicts between concrete tolerances and structural deflections, structural steel tolerances, window and  
52 curtain wall requirements, elevators and cladding shall be resolved with Architect and respective  
53 suppliers in a pre-construction meeting. Failure to do so shall negate any monetary compensation for  
54 change orders, or any schedule extensions.
- 55
- 56 B. Floor Slab Flatness and Levelness Tolerances: Finished floor slabs are required to meet the following Specified  
57 Overall Values (SOV) and Minimum Local Values (MLV).
- 58

	Floor use Category	Examples	Flatness, FF: SOV	Flatness, FF: MLV	Levelness, FL: SOV	Levelness, FL: MLV
4	Supported Floors with Improved Flatness and Levelness	Thin-set Flooring, Resilient Floor Covering	35 (Typical unless noted otherwise.)	25	25	17
10	Slabs-On-Grade with Improved Flatness and Levelness	Thin-set Flooring, Resilient Floor Covering	35 (Typical unless noted otherwise.)	25	25	17
16	Interior & Exterior Slabs-On-Grade for Vehicle Traffic	Parking and Drive Areas	20	12	15	9

1. "Supported Floors", as used in this Specification, shall mean any floor above the slab on grade; concrete, precast or steel construction; shored or unshored.
  - a. The FL values listed for supported floors only apply to shored construction.
  - b. For unshored construction:
    - i. 80% of the elevation points measured on an unshored slab shall fall within a 3/4-inch envelope centered on the mean of the data collected using ASTM E1155.
    - ii. The mean of the elevation data collected shall be within 3/8-inch of the design elevation.
2. During concreting, provide additional concrete to account for deflection of structural members under the dead load of the concrete. Set perimeter forms and check finished surface with optical or laser instruments. Do not set screeds to maintain a uniform slab thickness. For unshored, elevated surfaces, use rigid screeds instead of wet screeds. Set screeds at high points. Place slabs level as slab deflects. Use 10 foot straightedges.
3. Testing Agency, hired by the Contractor shall measure, verify and report floor flatness in accordance with ASTM E1155 within 24 hours after concreting operation. For floors with FF \_ 50, floors shall be tested immediately with an F-min. profiler or profilegraph. Provide written reports to Architect and Structural Engineer.
4. Concrete contractor is responsible for the cost of grinding and leveling after concrete has cured.
5. Conform to F-numbers specified for floor areas within 2 feet of construction and isolation joints, in lieu of ASTM E1155 requirements excluding these areas.

**3.8 UNDER-SLAB VAPOR BARRIER/RETARDER**

- A. Location: Under all interior slabs on grade, except parking garages, and industrial or manufacturing floors, unless otherwise noted.
- B. Subgrade Preparation: Installation shall not begin until a proper base has been prepared to accept the membrane lining.
  1. Subgrade drainage fill shall be installed, compacted, suitably smoothed with sand so as to prevent perforation and free of ruts, tested, and approved by Geotechnical Engineer in conformance with the Earthwork Section of this specification.
- C. Installation: In strict accordance with manufacturer's instructions and specifications and ASTM E-1643, in order to create a monolithic membrane, including:
  1. Unroll Vapor Barrier with the longest dimension parallel with the direction of the pour. Completely cover the floor area.
  2. Lap Vapor Barrier over footings, turn up edges, and seal to interior columns, foundation walls and piers with manufacturer's tape.
  3. Overlap joints a minimum of 6 inches and seal with manufacturer's tape. Repair as required.
  4. Seal all penetrations (including pipes, other utilities, and columns) with manufacturer's pipe boot or other approved methods.
  5. Where tape or other material is used, surfaces shall be clean and dry, free from dust, dirt, and moisture to allow maximum adhesion. When taping, surfaces shall be 50-60°F. At lower temperatures, external

- 1 heat may be applied to maintain such temperature for 24 hours. Do not install tape when temperatures  
2 are below 32°F.
- 3 6. No penetration of the vapor barrier is allowed. Do not drive stakes through vapor barrier. All pipe,  
4 ducting, rebar, wire penetrations and blockouts shall be sealed.
- 5 7. Use only concrete brick type reinforcing bar supports or provide 6 x 6 in. protective pads recommended  
6 by manufacturer to protect from puncture.
- 7 8. Repair damaged areas by cutting patches of vapor barrier, overlapping damaged area a minimum of 6  
8 inches in all directions and taping all four sides with tape.
- 9 9. Repair any surfaces or taped edges damaged during construction activity or concrete placement.  
10 Membrane shall be dry prior to concreting operations.
- 11 10. Workers, including concrete finishers, shall not poke holes in vapor barrier.
- 12 11. Vapor Barrier installation must be approved prior to concrete placement by Testing Agency with a report  
13 to Architect and Structural Engineer. See Section 31 00 00.

14  
15 **3.9 INSULATION**

16 A. ~~Perimeter Insulation:~~

- 17 1. ~~When backfill is being placed and before floor slabs are poured, install specified insulation of thickness~~  
18 ~~shown on drawings. Install in 1" (2.5 cm) thick layers with all joints offset.~~
- 19 2. ~~Insulation shall extend vertically on walls as shown on drawings.~~
- 20 3. ~~Apply against walls using specified adhesive if necessary to hold in place.~~
- 21 4. ~~Apply after waterproofing membrane is in place.~~

22 B. ~~Insulation Below Concrete Slabs:~~

- 23 1. ~~Install high density insulation to the thickness as shown on drawings per manufacturer's~~  
24 ~~recommendations.~~

25  
26 **3.10 SLABS**

27 A. General:

- 28 1. Obtain Architect's approval of all underslab gravel beds, formwork, reinforcement and any work that will  
29 be embedded in concrete before placing concrete.
- 30 2. Make necessary allowance so that all floor finish material can be installed within finish floor levels  
31 designated.
- 32 3. Provide recesses for urinals as directed by Plumbing Contractor, for mortar set tile, at recessed entries,  
33 etc., coordinate with architect for location.
- 34 4. Strike and level concrete. Provide additional concrete as required to account for structural deflections for  
35 slabs on metal deck systems. Slab thickness specified on the drawings is the minimum nominal thickness.  
36 Allow to set before floating. Bull float on disappearance of water sheen. Hand float areas inaccessible to  
37 bull float. Applicable to all flat work to obtain smooth, uniform, granular texture. Floors shall conform to  
38 specified tolerances including flatness and levelness except where drains occur or sloped floors are  
39 indicated, in which case the tolerance applies to the planes indicated.
- 40 5. Provide necessary pitch to drains. Coordinate with Architect for rate of pitch, unless specified. Floors shall  
41 slope as required to floor drains to eliminate ponding of water. Areas which do not drain properly shall  
42 be removed and replaced at the Contractor's expense.
- 43 6. Conform to ACI 302.2 where moisture-sensitive flooring materials are used. Moisture, Relative Humidity  
44 (RH) and Ph testing shall conform to ASTM standard test methods performed by qualified testing  
45 technicians. Test results shall not exceed flooring manufacturer's limits.

46 B. Slabs on Gravel Beds:

- 47 1. Make sure all underslab work is completed.
- 48 2. Check gravel underbed for compaction by proofrolling, proper levels and pitches to drains as required.
- 49 3. Place insulation and underslab vapor barrier/retarder.
- 50 4. Pour slabs to required levels and thickness shown in one (1) monolithic operation with joints as  
51 designated and as before specified.

52 C. Topping and Wearing Courses:

- 53 1. Over precast concrete construction where shown. Clean surface and install topping as per Precaster's  
54 requirements to develop necessary bond.
- 55 2. Over membrane waterproofing;
- 56 3. Topping and wearing courses shall be placed as soon as waterproofing membrane or insulation is in  
57 place.
- 58



- 1 D. Finishes: (See Room Finish Schedule)
- 2 1. All slabs where waterproofing membranes, resilient tile, epoxy terrazzo, thin set ceramic tile or cement
- 3 finish is scheduled, follow up immediately with machine float troweling and finish to a smooth uniform
- 4 level, free from depressions and tool marks.
- 5 2. Floors scheduled for urethane finish shall have a light broom finish.
- 6 3. Exposed concrete floors shall be steel troweled to a surface within slab flatness and levelness tolerances.
- 7 Check drawings for slab depression to bring floors to correct elevation. Do not hard trowel exterior,
- 8 airentrained concrete.
- 9 4. Where standard terrazzo or mortar set ceramic tile floors are scheduled, slabs shall be screed finished.
- 10 5. Broom finish exterior walks, ramps, drives and stairs, parking slabs. Broom slabs transverse to the main
- 11 direction of traffic. Finish to be approved by Architect. See architectural for special finishes, trowel edge
- 12 paving borders, patterns, etc.
- 13 6. Edge Forms and Screeds for all finish floors shall be accurately, instrument set and finish floors shall be
- 14 free of any irregularities and depressions. Any such irregularities shall be corrected by this Contractor and
- 15 depressions filled with latex cement or high spots ground down before ceramic or resilient tile work is
- 16 installed.
- 17 E. Where a trowelled finish is specified instead of broom finish, provide non-slip aggregate for entrance platforms,
- 18 stairs and landings. Wet aggregate before applying and distribute evenly over surface at minimum rate of one-
- 19 quarter (1/4) pound per square foot (1.25 kg/m<sup>2</sup>) of cement area and trowel.
- 20

### 21 3.11 STAIRS

- 22 A. Interior:
- 23 1. Of reinforced concrete as detailed, poured monolithically and finished as specified for slabs with resilient
- 24 tile finish.
- 25 2. Metal Stairs: Fill pans with concrete, same as specified for topping and reinforce with 2" x 2" (5 x 5 cm),
- 26 14/14 W.W.M. Trowel smooth for application of rubber treads.
- 27 3. Install non-slip nosings as furnished under Section 05 50 00 and non-slip aggregate.
- 28 4. Construct rough concrete stair slabs as shown on drawings making proper allowance for risers and
- 29 stringers.
- 30 B. Exterior:
- 31 1. Construct with coves at all intersections and nosings slightly rounded. Slope risers in at bottom and pitch
- 32 treads and platforms to drain.
- 33 2. Apply non-slip abrasive aggregate to all stairs, landings and platforms to be trowelled finish instead of
- 34 broom finished.
- 35 3. Set sleeves for railing.
- 36

### 37 3.12 CONCRETE SURFACE REPAIRS

- 38 A. Immediately after stripping formwork, inspect all surfaces of concrete. Face and corners of members to show
- 39 smooth and sound throughout.
- 40 B. Repair tie holes and surface defects immediately after formwork removal. Where the concrete surface will be
- 41 textured by sandblasting or bush-hammering, repair surface defects before texturing.
- 42 C. Definition - Defective Areas:
- 43 1. Formed Surfaces: Concrete surfaces requiring repairs shall include all honeycombs, rock pockets and
- 44 voids exceeding 1/4" in any dimension, holes left by tie rods or bolts, cracks in excess of 0.01" and any
- 45 other defects that affect the durability or structural integrity of the concrete.
- 46 2. Unformed Surfaces: Concrete surfaces requiring repair shall include all surface defects such as crazing,
- 47 cracks in excess of 0.0625" wide or cracks which penetrate to reinforcement or through the member,
- 48 popouts, spalling and honeycombs.
- 49 D. Classification:
- 50 1. Structural Concrete Repair: Major defective areas in concrete members that are load carrying shall
- 51 require structural repairs. Structural concrete repairs shall be made using a two part epoxy bonder
- 52 and/or epoxy mortar. Location of structural concrete repairs shall be determined by the Engineer.
- 53 Contractor is responsible for engineering costs to provide repair details and specifications.
- 54 2. Cosmetic Concrete Repair: Defective areas in concrete members that are non-load carrying and minor
- 55 defective areas in load carrying concrete members shall require cosmetic concrete repair. Cosmetic
- 56 concrete repairs may be made using a non-epoxy non-shrink patching mortar and bonding agent. Rout
- 57 and seal with approved crack-filling compound large cracks in slabs on grade and slabs on metal deck.

- 1                   The location of cosmetic concrete repair required shall be determined by the Engineer. Cosmetic  
2                   concrete repair in exposed-to-view surfaces will require Engineer's approval prior to patching operation.  
3                   3.       Slab Repairs: High areas in concrete slabs shall be repaired by grinding after concrete has cured at least  
4                   14 days. Low areas shall be filled using self-leveling mortars. Repair of slab spalls and other surface  
5                   defects shall be made using epoxy products as specified. Follow manufacturer's instructions including  
6                   minimum thickness, supplemental aggregates and curing.  
7                   E.       Outline honeycombed or otherwise defective concrete with a 1/2 to 3/4 in. deep saw cut and remove such  
8                   concrete down to sound concrete. When chipping is necessary, leave chipped edges perpendicular to the surface  
9                   or slightly undercut.  
10                  F.       Do not feather edges. Dampen the area to be patched, plus another 6 in. around the patch area perimeter.  
11                  Prepare bonding grout according to ACI 301 and thoroughly brush grout into the surface.  
12                  G.       Contractor shall repair any excessively large cracks that are unacceptable to finish flooring installer.

13  
14       **3.13 CONCRETE FINISHES OTHER THAN FLOOR FINISH**

- 15       A.       Patching:  
16               1.       Leave entire surface of concrete smooth, even and uniform in color.  
17               2.       Use specified bonding compound or epoxy adhesive.  
18               3.       Fill form tie holes.  
19       ~~B.       Rubbed Finish:~~  
20               ~~1.       For all concrete surfaces to be painted, or exposed to view not noted to receive any other finish, and all~~  
21               ~~vertical faces of walls, stairs, ramps and platforms, except interior basement walls in parking areas. This~~  
22               ~~shall also include all soffits of interior stairs.~~  
23               ~~2.       For exposed exterior concrete walls, patch holes from form ties, honeycombing, and other irregularities~~  
24               ~~in the finish. Grind joint marks, offsets and fins smooth with adjacent surfaces, to produce an~~  
25               ~~architectural finish.~~  
26               ~~3.       Provide rubbed finish on the earth side face of walls to receive membrane waterproofing. Grind all~~  
27               ~~projections flush with surface prior to rubbing.~~  
28               ~~4.       Mix one (1) part Portland Cement with 1 1/2 parts fine white silica sand.~~  
29               ~~5.       Apply grout with brush, completely filling all air bubbles and holes, and float with styrofoam, cork or~~  
30               ~~similar float.~~  
31               ~~6.       After grout had dried, rub with burlap to completely remove any dried grout.~~  
32               ~~7.       Entire cleaning operation for any area must be completed day it is started. No grout shall be left on~~  
33               ~~surface overnight.~~  
34               ~~8.       After grout has cured, remove any visible film of grout with belt sander.~~  
35       ~~C.       Sandblasting (Where indicated on Architectural Plans):~~  
36               ~~1.       Exterior architectural concrete surfaces noted on drawings to receive sandblast finish.~~  
37               ~~2.       Sandblast to a medium finish with uniform color and texture.~~  
38               ~~3.       Before proceeding, sandblast sample area for Architect's approval.~~  
39       D.       Leave entire surface of concrete smooth, even and uniform in color.  
40       E.       Tops of concrete walls and ledges on which brick or stone will be placed to be finished to a level uniform surface  
41               with darby and float.

42  
43       **3.14 MISCELLANEOUS CONCRETE AND CEMENT WORK**

- 44       A.       Openings in concrete slabs and walls for passage of ducts, etc. shall be as shown or detailed. Close entire open  
45               spaces between ducts and edges of concrete with stiff cement mortar as required. If area is too great to support  
46               mortar, install 2-1/2" (6.35 cm) concrete slab with proper forms and 3/4" (1.9 cm) rib lath or bar reinforcement.  
47       B.       In all mechanical equipment rooms, provide minimum 4" (10 cm) high concrete curb around all openings through  
48               floor slabs, monolithic with floor slab or topping.  
49       C.       Provide equipment bases where shown on drawings. (Check Mechanical, Electrical, Plumbing and other Specialty  
50               Plans.) Set anchor bolts, as may be required.  
51       D.       Non-Shrink Grouting:  
52               1.       Mixing shall be in strict conformity with manufacturer's specification.  
53                   a.       Grout shall be comprised only of ready-to-use grouting material.  
54                   b.       Use only minimum amount of water to produce flowable grout.  
55               2.       Placing:  
56                   a.       Clean underside of column base plates of grease and oil and concrete surfaces of all laitance,  
57                   debris, etc.  
58                   b.       Grout shall be placed quickly and continuously by whatever means most practical.

- 1 c. Grout shall completely fill space to be grouted, be thoroughly compacted and free of air pockets.
- 2 d. After grout has acquired initial set, all exposed edges shall be cut off vertical with base plate.
- 3 3. Cure in strict accordance with manufacturer's specification. Maintain temperature at a minimum of 40
- 4 degrees F. (4 degrees C.) until grout reaches 3000 psi.
- 5 E. Grout elevator entrance sills with Portland Cement Mortar consisting of 1 part cement and 3 parts sand.
- 6 F. Exterior and interior concrete sills and stools as detailed. Trowel finished.
- 7 G. Area walls as shown with top trowel finished.
- 8 H. Install reglets to receive waterproofing, or flashings in outer face of concrete frame at exterior walls, where
- 9 flashing is shown at lintels, relieving angles, and other conditions.

10

11 **3.15 CONSTRUCTION LOADS**

- 12 A. During the construction period, the contractor shall provide means for the adequate distribution of concentrated
- 13 loads so that the carrying capacity of any member, including metal deck, is not exceeded.
- 14 1. Review plans and consult with Architect to determine allowable uniform live loads.
- 15 2. Contractor shall hire a Professional Engineer and/or contact steel deck supplier to determine the
- 16 adequacy of concentrated loads, e.g. construction equipment point or wheel loads, in combination with
- 17 other applied loads such as wet concrete and construction personnel, stored materials, etc.

18

19 **3.16 FIELD CUTTING AND CORING**

- 20 A. For new or existing construction, all field cutting or coring of openings shall be approved by the Structural
- 21 Engineer and Testing Agency.
- 22 1. Locations of openings shall conform to structural plans where shown.
- 23 2. Contractor shall hire a Testing Laboratory to exactly locate reinforcement using X-rays or other approved
- 24 methods.
- 25 3. Do not cut through any beams or joists, or through any concrete reinforcement, unless specifically
- 26 approved by structural engineer.
- 27 4. Do not over-cut openings. Do not cut deeper than required.
- 28 5. If over-cuts occur, reinforcement or structural members are cut, or the structure is damaged, the
- 29 contractor making the saw-cuts or coring shall be responsible for all repair costs including engineering
- 30 services.
- 31 6. These requirements shall apply to all trades doing such work including mechanical, electrical and
- 32 plumbing.

33

34

**END OF SECTION**

**SECTION 07 21 00**  
**THERMAL INSULATION**

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13		

**PART 1 – GENERAL****1.1. SCOPE**

A. This section includes information common to insulation systems and applies to entire project.

**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. 07 05 00 – COMMON WORK RESULTS FOR THERMAL AND MOISTURE PROTECTION
2. 07 84 00 - FIRESTOPPING

**PART 2 - PRODUCTS****2.1. EXTERIOR WALL INSULATION**

A. ABOVE GRADE RIGID INSULATION (POST INSTALLED ANCHOR SYSTEM: Typically used on Stud walls and existing Masonry or concrete walls.

1. Glass-fiber-reinforced enhanced polyisocyanurate foam core sheathing faced with nominal 4-mil embossed acrylic-coated aluminum on one side and 1.25-mil embossed aluminum on the other side, complying with ASTM C1289:
  - a. Basis of Design: The Dow Chemical Company "THERMAX™ ci" Exterior Insulation.
  - b. Compressive Strength (ASTM D1621): 25 psi, minimum
  - c. Thermal Resistance (ASTM C518, measured at mean temperature of 75 degrees F): R-6.5 (RSI 1.14) per inch thickness
  - d. Water Absorption (ASTM C209): Maximum 0.1 percent by volume
  - e. Water Vapor Permeance (ASTM E96): <0.03 perms
  - f. Shiplap profile on two edges on thicknesses of 1.55 inches and greater.
2. FLASHING TAPE: board insulation manufacturer's compatible joint tape for sealing joints, seams and façade tie penetrations through the insulation layer and sealing window and door wall openings at head, sill and jambs.
  - a. Basis of Design: The Dow Chemical Company "WEATHERMATE™" Straight Flashing"
  - b. Adhesive: Butyl rubber (non-asphalt)
  - c. Facer: High density polyethylene
  - d. Self-sealing
  - e. Water Vapor Transmission (ASTM E96): <1 perm
3. Temporary Fasteners:
  - a. Stud construction: Rodenhouse, Inc. "Grip-Deck" screws and 1 3/4 inch diameter "Plasti-Grip CBW" plastic washers
  - b. Masonry or concrete: Rodenhouse, Inc. 1 3/4 inch diameter "Plasti-Grip III" with pre-spotting stem plastic washers and "Plasti-Grip PMF" fasteners. Alternatively adhere with DOW GREAT STUFF PRO WALL & FLOOR ADHESIVE
4. Sealing between a concrete foundation and sill plate: Dow "WEATHERMATE™ SILL SEAL Foam Gasket.
5. Install insulation/sheathing panels horizontally with blue aluminum facing to exterior. Use maximum lengths to minimize number of joints. Locate edge joints parallel to and on framing. Center end joints over supports and stagger in each course. Provide additional framing wherever panel joints do not bear against framing, plates or sill members. Abut panels tightly together and around openings and penetrations. Do not install more insulation than can be permanently fastened with vertical cold-formed steel box girts in the same day.
6. Fasten panels to each support with fasteners spaced 12 inches on center at perimeter and 16 inches on center in panel field. Set back perimeter fasteners 3/8" from edges and ends of panel units. Drive fasteners to bear tight and flush with surface of insulation. Do not countersink. Perimeter fasteners can be detailed to bridge the gap of abutting board joints due to the 1.75" diameter of the washer used to fasten the board to the studs. Maximum of two board joints may be bridged per fastener.
7. Install flashing joint tape at end and edge joints with sufficient hand pressure to ensure seal and in accordance with sheathing manufacturer's joint sealing recommendations. Install 4" flashing joint tape at end and edge joints and behind wall tie and mechanical fastening assemblies for rain screen claddings.

- 1 8. Seal sheathing joints and penetrations of sheathing in accordance with manufacturer's recommendations.
- 2 9. Install Flashing tape 6" or 9", to the exterior sheathing and lapped over the top edge of the base flashing.
- 3 B. ABOVE GRADE RIGID INSULATION (PREINSTALLED ANCHOR SYSTEM): Typically used for new Masonry walls when anchors
- 4 can be installed at time of Masonry wall erection. Use stainless steel anchors and brick ties.
- 5 1. MANUFACTURER: Dow Cavymate or approved equal
- 6 2. FLASHING: Weathermate Straight Flashing
- 7 3. GAPFILLER: Dow Greatstuff Pro
- 8 4. INSULATION properties:
- 9 a. Vapor permeance: 1.5 at 1" thickness
- 10 b. R-value: 10.8 at 1.75" thickness and 40°F mean temperature.
- 11 5. Install per manufacturers recommendations and as described as above for post-installed anchor system.
- 12 C. BELOW GRADE SPRAYFOAM:
- 13 1. FROTH-PAK™ ULTRA Premium Foam
- 14 2. Insulation R6.5 / in
- 15 3. Compressive Strength 21.7 psi
- 16 4. Water Vapor Permeance, ASTM E96, perm, max. 2.7
- 17 5. Water absorption: < 5%
- 18 D. BELOW GRADE EXTRUDED POLYSTYRENE (XPS):
- 19 1. Tape all gaps. Foam all larger gaps. Use Dow Thermax Aluminum Foil Tape
- 20 2. Dow STYROFOAM™ Brand Ultra SL Insulation
- 21 3. R5 / in
- 22 4. Compressive Strength 25 psi
- 23 5. Water Absorption, ASTM C272, % by volume, max. 0.3%
- 24 6. Water Vapor Permeance(3) , ASTM E96, perm, max. 1.5
- 25 7. Flame Spread ASTM E84 0: 0
- 26 8. Smoke Developed, ASTM E843: 155
- 27 E. BELOW GRADE POLYISOCYANURATE (POLYISO):
- 28 1. Tape all gaps. Foam all larger gaps. Use Dow Thermax Aluminum Foil Tape
- 29 2. THERMAX™ Sheathing
- 30 3. R6.5 / in
- 31 4. Compressive Strength 25 psi
- 32 5. Water Absorption, ASTM C272, % by volume: max. 0.1%
- 33 6. Water Vapor Permeance , ASTM E96, perm: max. 0.03
- 34 7. Reflective foil facers on both sides
- 35 F. FIBROUS INSULATION:
- 36 1. Thermafiber Rainbarrier HD
- 37 2. R 4.2/in
- 38 3. ASTM C 612 RainBarrier® HD Type IA, IB, II, III, IVA
- 39 4. ASTM E 96 Unfaced, 50 Perms as tested
- 40 5. ASTM E 84 Flame Spread 0, Smoke Developed 0
- 41 6. ASTM C 1104 Absorbs 0.03% water by volume
- 42 7. Friction fit batts securely. Butt ends of blankets closely together and fill all voids without excessively compressing
- 43 insulation.
- 44
- 45 **2.2. INTERIOR INSULATION**
- 46 A. EXTRUDED POLYSTYRENE (XPS): Tape all gaps. Foam all larger gaps. Use Dow Thermax Aluminum Foil Tape
- 47 1. Styrofoam SM", Dow Chemical Company
- 48 2. R5 / in
- 49 3. Compressive Strength 25 psi
- 50 4. Water Absorption, ASTM C272, % by volume, max. 0.3%
- 51 5. Water Vapor Permeance(3) , ASTM E96, perm, max. 1.5
- 52 6. Tongue and Groove.
- 53 B. POLYISOCYANURATE (POLYISO): Tape all gaps. Foam all larger gaps. Use Dow Thermax Aluminum Foil Tape
- 54 1. Dow TUFF-R
- 55 2. R6.5 / in
- 56 3. Compressive Strength 25 psi
- 57 4. Water Absorption, ASTM C272, % by volume, max. 0.1%
- 58 5. Water Vapor Permeance(3) , ASTM E96, perm, max. 0.03
- 59 6. Reflective foil facers on both sides
- 60 C. FIBROUS ACOUSTICAL INSULATION
- 61 1. Thermafiber, "ThermaTech"
- 62 2. R4/in
- 63 3. ASTM E 84 Flame spread 0 and smoke index 0

- 1 4. ASTM C 1104 Absorbs less than 1%water by volume
- 2 5. NRC of 0.95 at 2". 1.2 at 6"
- 3 6. Friction fit batts securely. Butt ends of blankets closely together and fill all voids without excessively compressing
- 4 insulation.
- 5

### 6 2.3. SPRAY FOAM INSULATION

- 7 A. CLOSED CELL SPRAY FOAM: Dow "Styrofoam" Two-component spray polyurethane cellular plastic foam:
  - 8 1. Core Density (ASTM D1622): 2.3pcf
  - 9 2. Thermal Resistance (ASTM C518): R 6.5/in.
  - 10 3. Flame Spread (ASTM E84, Class A): 25 or less
  - 11 4. Smoke Developed (ASTM E84, Class A): 450 or less
  - 12 5. Compressive Strength Minimum (ASTM D1621, 10 percent parallel to rise): 21.7 psi
  - 13 6. Closed Cell Content (ASTM D2856): minimum 90 percent
  - 14 7. Water Absorption by Volume Maximum (ASTM D2842): 5 percent
  - 15 8. Water Vapor Permeability Maximum (ASTM E96): 2.7 perm-inches
  - 16 9. Ambient and substrate Temperature for 24 hrs > 45°F: CM 2045
  - 17 10. Ambient and substrate Temperature for 24 hrs > 30°F: CM 2030
- 18 B. OPEN CELL SPRAY FOAM: Certain Teed
  - 19 1. Core Density (ASTM D1622): 0.45-0.65 pcf
  - 20 2. Thermal Resistance (ASTM C518): R 3.7/in.
  - 21 3. Flame Spread (ASTM E84, Class A): 25 or less
  - 22 4. Smoke Developed (ASTM E84, Class A): 450 or less
  - 23 5. Compressive Strength Minimum (ASTM D1621, 10 percent parallel to rise): 2.4 psi
  - 24 6. Open Cell Content (ASTM D2856): minimum 95 percent
  - 25 7. Water Absorption by Volume Maximum (ASTM D2842): 5 percent
  - 26 8. Water Vapor Permeability Maximum (ASTM E96): 33 perm-inches
- 27 C. FOAM SEALANT: For use as a foam insulating sealant to fill cavities, wall and floor penetrations, cracks and expansion joints
  - 28 1. Basis of Design: Dow Chemical Company, "FROTH-PAK 120 Kit"
  - 29 2. R4 / in.
  - 30 3. 80% closed cell content
  - 31 4. 9.3 psi compressive strength
- 32 D. WINDOW AND DOOR SEALANT: GREAT STUFF PRO™ Window & Door Insulating Foam Sealant
  - 33 1. R4 / in.
  - 34 2. 88% open cell content
  - 35 3. 5.2 psi compressive strength
- 36 E. Do not proceed with installation of spray polyurethane foam until sheathing substrate construction is complete and
- 37 openings and penetrating items have been installed and sealed. Cover wide joints with transition sheet membrane.
- 38 F. Do not proceed with installation of spray polyurethane foam until substrate surface temperatures accepting the spray
- 39 polyurethane are above the manufacturer's recommended minimum surface temperatures.
- 40 G. Provide temporary enclosures to prevent spray and noxious vapors from contaminating air beyond application area.
- 41 H. Protect adjacent surfaces and equipment from damage by overspray, fall-out, and dusting of insulation materials.
- 42 I. Verify that items required to penetrate the thermal wall system are placed and penetration gaps and cracks are properly
- 43 sealed before installation of spray foam.
- 44 J. Apply foam in accordance with ASTM C1029 and manufacturer's installation guidelines:
  - 45 1. Apply spray foam by picture framing around the interior studs at insulation/sheathing – steel stud interface. Apply
  - 46 spray foam in overlapping layers, in a manner to obtain a smooth, uniform surface.
  - 47 2. Finish applying spray polyurethane foam with one pass not exceeding 1.5 inches in thickness.
  - 48 3. Allow the layer applied first to cool to the max. substrate temperature before applying 2nd layer.
  - 49 4. Avoid formation of sub-layer air pockets.
  - 50 5. Maintain 3 in clearance around chimneys, heating vents, steam pipes, recessed lighting fixtures and other heat sources.
  - 51 6. Do not apply spray polyurethane foam to inside of exit openings or electrical junction boxes.
  - 52 7. Maintain a continuous layer of spray foam from floor to floor to roof to complete air barrier.
- 53 K. Site Tolerances: Maximum Variation in Applied Thickness - minus 1/4 inch, plus 5/8 inch
- 54

### 55 2.4. SLAB CONCRETE INSULATION

- 56 A. Below slabs on or below grade, exterior plazas, or above structural slabs, where insulation is 9" thick or less, provide
- 57 extruded polystyrene insulation, 60 psi minimum compressive strength, exceed ASTM C578 Type VII.
  - 58 1. Basis of Design: "Styrofoam Highload 60", Dow Chemical Company; "Foamular 600", Owens Corning;
  - 59 2. R5 / in
  - 60 3. Compressive Strength 60 psi (or as indicated on plans)
  - 61 4. Water Absorption, ASTM C272, % by volume, max. 0.3%
  - 62 5. Water Vapor Permeance(3) , ASTM E96, perm, max. 0.8
  - 63 6. Coefficient of Linear Thermal Expansion, ASTM D696, in/in-°F: 3.5x10<sup>-5</sup>

- 1 7. Flexural Strength, ASTM C203, psi, min.:60 (for 40 psi), 75 (for 60 psi type; 100 (for 100 psi type)
- 2 8. Comply with ASTM C578 type VI (40 pis), VII (60 psi), V (100 psi)
- 3 9. Stagger layers by at least 2'
- 4 B. R-value: R5 per inch
- 5 C. Use higher load capacity type if indicated on plans.
- 6 D. INSULATION AGAINST WALLS: Extruded polystyrene (XPS) insulation board. ASTM C578, Type IV, 25 psi minimum
- 7 compressive strength, 2" thick, R=10.
- 8 1. Basis of Design: "Styrofoam SM", Dow Chemical Company
- 9 2. R5 / in
- 10 3. Compressive Strength 25 psi
- 11 4. Water Absorption, ASTM C272, % by volume, max. 0.3%
- 12 5. Water Vapor Permeance(3) , ASTM E96, perm, max. 1.5
- 13 6. Tongue and Groove or shiplap to ensure complete isolation
- 14 7. When backfill is being placed and before floor slabs are poured, install specified insulation of thickness shown on
- 15 drawings. Install in 1" (2.5 cm) thick layers with all joints offset.
- 16 8. Insulation shall extend vertically on walls as shown on drawings.
- 17 9. Apply against walls using specified adhesive if necessary to hold in place.
- 18 10. Apply after waterproofing membrane is in place.
- 19
- 20 **2.5. INSULATION PLACED IN CAST-IN-PLACE CONCRETE**
- 21 A. MANUFACTURER: Thermomass CIP
- 22 B. Refer to Division 3 for concrete specifications
- 23 C. INSULATION:
- 24 1. Provide polyisocyanurate board insulation: rigid, cellular polyisocyanurate thermal insulation with core formed by
- 25 using hydrocarbons as blowing agents; square edged; complying with ASTM C 1289, Type I, with provisions as follows:
- 26 2. Compressive resistance: 25 psi minimum at yield or at 10 percent deformation per ASTM D 1621.
- 27 3. Water absorption: 0.02 percent maximum by weight.
- 28 4. Aged R-value: 6.5°F-ft<sup>2</sup>-h/Btu per inch at 75° F minimum per ASTM C 518/ C 236. Maximum use temperature of
- 29 190°F.
- 30 5. Polyisocyanurate insulation with an aluminum/polyester facer shall provide:
- 31 a. Water vapor permeance, ASTM E96, 1", <0.01 perm, maximum.
- 32 b. Un-exposed metallic facing that is not susceptible to corrosion or chemical reaction with the concrete.
- 33 6. Pre-installed, high-strength, polymer twist-lock retainers, designed to position the fiber composite connector within
- 34 the pre-fabricated insulation sheets. The retainers' are factory set tightly against the surface of the insulation boards
- 35 in a pre-engineered pattern to transfer lateral and gravity loads from the exterior layer to the structural layer.
- 36 7. Protect insulation from open flame and heat sources greater than 195 °F.
- 37 8. Avoid contact with petroleum-based solvents.
- 38 D. CONNECTORS: Provide fiber composite connectors having the following physical properties and attributes:
- 39 1. Non-conductive, non-corrosive, fiber-composite connectors having a minimum tensile strength of 120,000 psi,
- 40 minimum glass fiber content of 76% (by weight), in a thermoset vinyl-ester resin matrix.
- 41 2. The vinyl-ester resin matrix impregnates the fiber strands, creating a composite material that has been tested and
- 42 shown to be resistant to chemical attack.
- 43 3. Upon request, connector supplier shall provide documentation of alkali resistance of connector and long-term shear
- 44 capacity of connector.
- 45 4. Coefficient of thermal expansion: 3.9x10<sup>-6</sup> in/in/°F, nominal.
- 46 5. Central body of connector shall be provided with a flange to limit insertion depth into insulation.
- 47 6. Central body of connector shall have serrated profile to provide interference fit with pre-formed holes in the
- 48 insulation so as to prevent connector from backing out of insulation after installation.
- 49 7. Thermal Conductivity: 6.9 Btu/ (°F•ft<sup>2</sup>•h) per inch of length.
- 50 E. CORNERS: use mitered insulation
- 51 F. COCNRETE:
- 52 1. Slump of 6-7" and spread of 26"-29"
- 53 2. Aggregate size not larger than 5/8"
- 54 3. Compact by vibration
- 55 G. Set formwork in accordance with standard assembly practices, including form ties.
- 56 H. Before installation of the insulation sheets in the forms, tape the individual sheets together per the drawings supplied by
- 57 manufacturer. Install the tape on both sides of the insulation. Apply the tape only to clean, dry surfaces.
- 58 I. Install the insulation assembly in the form.
- 59 J. Install the connectors.
- 60 1. Insert the connector in the rectangular hole in the twist-lock assembly.
- 61 2. Push the connector through the thickness of the insulation until the wing comes to rest against the face of the twist-
- 62 lock assembly.

- 1           3. Using the wing for leverage, use the thumb and index finger to twist the connector in the directions indicated by the
- 2           arrows on the face of the twist-lock assembly. Note that the connectors will rotate 90 degrees until internal detent in
- 3           the retainer stops the rotation.
- 4           4. Continue this process for all of the connectors for a panel.
- 5        K. Using the notches on the fiber composite connectors, the sufficient connectors to the structural reinforcing bars to hold the
- 6        insulation in place. Alternately, the connectors can be pre-installed and the insulation system can be pre-wired to the
- 7        reinforcing cage before installation in the form.

8  
9

**END OF SECTION**



**SECTION 07 27 00****AIR BARRIERS**

1		
2		
3		
4	PART 1 – GENERAL .....	1
5	1.1. SCOPE .....	1
6	1.2. REFERENCES .....	1
7	PART 2 - PRODUCTS .....	1
8	2.1. AIR BARRIER .....	1
9		

**PART 1 – GENERAL****1.1. SCOPE**

A. This section includes information common to air barrier systems and applies to entire project.

**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. 07 05 00 – COMMON WORK RESULTS FOR THERMAL AND MOISTURE PROTECTION
2. 07 84 00 - FIRESTOPPING

**PART 2 - PRODUCTS****2.1. AIR BARRIER**

A. Approved Manufacturer: Henry or approved equal products from Tremco and Grace

**B. LIQUID APPLIED****a. NON PERMEABLE:**

i. Above 40°F ambient Temperature Product: Henry Air-Bloc 06 WB

a. **Accepted substitute: Polyguard Airlok**

ii. Below 40°F ambient Temperature Product: Henry Air-bloc 21

a. **Accepted substitute: Polyguard Airlok**

iii. Use Airbloc 06 QS for quick setting and Airbloc 32MR on fresh concrete.

iv. Use Aribloc 21 FR for fire resistant applications

**b. PERMEABLE:**

i. Henry Air-Bloc 17 MR

ii. Water Vapor Permeability 14 perm

iii. For fresh concrete Henry Air-Bloc 31MR

iv. For fire –resistant applications: Henry Air-bloc 32MR

**c. Membrane over ¼" Cracks or where different materials (i.e. CMU/steel) meet : Henry Blueskin**

i. Apply at least 3" on both sides of crack or joint.:

ii. Masonry and concrete: trowel sealant into crack, let cure, reapply until crack is filled

iii. Sheathing board: trowel fluid membrane into crack, apply 2" wide glass fiber tape Henry #183 and re-apply membrane over

**d. Apply Minimum 42 mill (20 ft<sup>2</sup> / gallon) water barrier over CMU, concrete, plywood/OSB sheathing or other substrate.****C. SHEET APPLIED****a. NON PERMEABLE :**

i. Henry Blue-Skin SA

ii. Low Temperature (under 10°F-41°F)Application : Blue-Skin SA LT

iii. Cover with Rainscreen not more than 10 days after installation. Upon approval by owner, use HE200M Metal Clad Barrier if rainscreen installation is anticipated to take longer.

**b. PERMEABLE :**

i. Henry Blueskin VP 160

ii. Water Vapor Permeability 29 perm

iii. Apply at 20°F or warmer.

**c. Prime with Henry Aquatac Primer HE 545**

d. Seal around any openings and at leading edge at the end of the days work with Henry #925 BES Sealant,

**END OF SECTION**

**SECTION 07 41 13.19  
INSULATED METAL ROOF PANELS**

1  
2  
3  
4 PART 1 – GENERAL ..... 1  
5 1.1. SCOPE ..... 1  
6 1.2. REFERENCES ..... 1  
7 1.3. SUBMITTALS ..... 1  
8 1.4. QUALITY ASSURANCE ..... 1  
9 1.5. PERFORMANCE REQUIREMENTS ..... 2  
10 1.6. WARRANTY ..... 2  
11 PART 2 - PRODUCTS ..... 2  
12 2.1. MATERIAL ..... 2  
13 PART 3 – EXECUTION ..... 3  
14 3.1. INSTALLATION ..... 3  
15

**PART 1 – GENERAL**

**1.1. SCOPE**

- A. This section includes information common to insulated standing seam metal roof panel systems.
- B. Furnish and install all steel faced factory insulated roof panels forming the exterior cladding and the related accessories and trims required for a complete weathertight roof installation.

**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 05 — METALS
  - 2. 07 05 00 – COMMON WORK RESULTS FOR THERMAL AND MOISTURE PROTECTION
  - 3. 07 42 13.19 – INSULATED METAL WALL PANELS
  - 4. 07 62 00 – SHEET METAL FLASHING AND TRIM
  - 5. 07 71 23 - MANUFACTURED GUTTERS AND DOWNSPOUTS
  - 6. 07 72 53 - SNOW GUARDS
  - 7. 07 84 00 - FIRESTOPPING
- B. ASTM - American Society for Testing and Materials
  - 1. ASTM E72 - Strength Tests of Panels for Building Construction
  - 2. ASTM E84 - Surface Burning Characteristics of Building Materials
  - 3. ASTM E 283 - Rate of Air Leakage Through Curtain Walls Under Specified Pressure Differences
  - 4. ASTM E 330 - Structural Performance of Exterior Curtain Walls by Uniform Static Air Pressure Differences
  - 5. ASTM E 331 - Water Penetration of Exterior Walls by Uniform Static Air Pressure Differences
  - 6. ASTM E1592 - Structural Performance of Metal Roof and Siding Systems by Uniform Static Air Pressure Differences
  - 7. ASTM E1646 - Water Penetration of Exterior Metal Roof Panel Systems by Static Air Pressure Differences
  - 8. ASTM C518 - Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus
  - 9. ASTM C1363 - Thermal Performance of Building Materials and Envelope Assemblies by Means of a Hot Box Apparatus
- C. FM - Factory Mutual
  - 1. FM Approval Standard 4880 - Class 1 Fire Rating of Insulated Wall, Ceiling and Roof Panels
- D. NFPA - National Fire Protection Association
  - 1. NFPA 259 - Test Method for Potential Heat of Building Materials
  - 2. NFPA 286 Fire Tests for Evaluating Contribution of Wall and Ceiling Finish to Roof Fire Growth
- E. SMACNA - Sheet Metal and Air Conditioning Contractors National Association
  - 1. SMACNA - Architectural Sheet Metal Manual
- F. UL – Underwriters Laboratory
  - 1. UL 580 - Uplift Resistance of Roof Assemblies
  - 2. UL 1897 - Uplift Tests for Roof Covering Systems

**1.3. SUBMITTALS**

- A. Detailed drawings showing location and profile of insulated panels, as well as location and shape of formed metal flashings, and the location and type of sealants and fasteners.
- B. Details for all applicable corners, transitions and locations on this project.

**1.4. QUALITY ASSURANCE**

- A. Contractor shall have been trained and certified by manufacturer.
- B. The applicable seaming tools, motorized or crimp style, shall be as specifically recommended by manufacturer.
- C. Manufacturer shall provide panel contractor with written instructions for recommended product storage and handling.

62

**1.5. PERFORMANCE REQUIREMENTS**

- 1 A. The metal faced foam core roof panels shall be produced on a continuous process manufacturing line under strict quality  
2 control and must be independently audited quarterly by a recognized audit facility/testing lab. Panel thickness, gauges,  
3 spans between supports and overall lengths shall be as required to contribute to the combined action of the roof in  
4 resisting the specified design loads with a deflection not to exceed L/240.  
5  
6 B. The panels ability to withstand positive and negative design loads shall be verified by testing in accordance with the ASTM  
7 E 72 Vacuum Chamber Method with the standard deflection criteria to be L/240.  
8  
9 C. The panel thermal properties shall be verified by actual tested values in accordance with the ASTM C 518 steady state  
10 thermal transmission test method. Aged K Factor shall not exceed .14 @ 75° F mean temperature or .13 @ 40° F mean  
11 temperature.  
12  
13 D. The panel core shall have a flame spread maximum of 25 and smoke developed maximum of 450 as tested in accordance  
14 with the ASTM E 84 test method.  
15  
16 E. The panel shall have Factory Mutual Class 1 Approval for wall and roof/ceiling construction in accordance with the full  
17 scale FM 4880 test program with no height restriction.  
18  
19 F. The panels shall have Factory Mutual Approval for wind uplift, hailstorm, foot traffic, and spread of flame (ASTM E 108-  
20 Class A rated) in accordance with FM 4471.  
21  
22 G. The panels shall be State of Florida and Dade County Product Approvals.  
23  
24 H. The polyisocyanurate foam core shall meet or exceed the following physical properties:
1. Compressive Strength: 25 psi
  2. Density (in-place): 2.1-2.5 pcf
  3. Shear Strength: 28-32 psi
  4. Closed Cell Content: 95%
  5. Dimensional Stability: 14 day aged (ASTM D 2126) -20 °F < 1% chg, dry heat 158 °F < 1% chg, Humid Heat 158 °F

**1.6. WARRANTY**

- 25  
26 A. Contractor shall provide 5 year guarantee warranting all roofing and flashing required under contract, to be watertight and  
27 free from defects in materials or workmanship.  
28  
29 B. Manufacturer shall warrant the panels as free from defects in material and workmanship for 2 years from the date of  
30 production.  
31  
32 C. Manufacturer shall warrant that the exterior paint finish will not:
1. Chip, crack, check, or peel for a period of 30 years from date of installation (except for such crazing that may occur on  
33 tightly roll-formed edges and brake bends).
  2. Chalk in excess of a numerical rating of 8 for a period of 30 years from date of installation when measured in  
34 accordance with the standard procedures outlined in ASTM D-659.
  3. Fade or change color in excess of 5 E units for a period of 30 years from date of installation when calculated in  
35 accordance with ASTM D-2244. The color change is to be measured on exposed painted surface cleaned of surface  
36 soils and oxidation.  
37  
38

**PART 2 - PRODUCTS****2.1. MATERIAL**

- 39  
40  
41 A. BASIS OF DESIGN: AWIP All Weather Insulated Panels SR2. Nucor SR2, MetlSpan, and Kingspan Kingzip Staqnding Seam  
42 are approved equals and need to be optioned to meet all the requirements.  
43  
44 B. Thickness and R-value per schedule: 4" = R32; 5"= R41, 6"=R49  
45  
46 C. METAL GAGE: Exterior 24 ga. Interior 26 ga.  
47  
48 D. FINISH: 30 year PVDF finish with a total dry film thickness of 1.0 mil including primer.  
49  
50 E. The side joint shall be a 2" high trapezoidal standing seam rib design utilizing a continuous non-skinning butyloid sealant  
51 bead. ¼-14 hex head fasteners shall be installed through the pre-punched hidden SR series joint clip. The clip assembly  
52 shall positively lock the face and liner sheet of the panel to the structural supports and provide positive resistance to  
53 negative wind loads. An additional minimum 1/4 inch continuous bead of approved non-skinning butyloid gun grade sealant  
54 equivalent to Schnee-Morehead 5430 may be applied at the liner side grooved joint of the roof panel joint prior to  
55 engagement as shown on the panel shop/erection drawings .  
56  
57 F. The panel exterior shall be SR2. The exterior metal substrate shall be 26ga G90 Galvanized or AZ50 Galvalume Steel. The  
58 exterior color shall be selected from manufacturer's six in-stock standards. The panel interior shall have lightly planked  
59 mesa ribs on 2.22" centers. The interior metal substrate shall be minimum 26ga G60 Galvanized or AZ35 Galvalume Steel  
60 coated with a polyester finish with a dry film thickness of 1.0 mil including primer. Interior color shall be Imperial White.  
61  
62 G. The continuously foamed in-place panel core shall be Class 1 rigid polyisocyanurate (polyurethane) foam meeting the  
following:
1. Compressive Strength: 25 psi
  2. Density (in-place): 2.1-2.5 pcf
  3. Shear Strength: 28-32 psi
  4. Closed Cell Content: 95%
  5. Dimensional Stability: 14 day aged (ASTM D 2126) -20° F < 1% chg, dry heat 158 °F < 1% chg, Humid Heat 158 °F.

- 1 H. The insulated panel manufacturer shall furnish either the formed metal flashings or the flat stock in the same gauge, color  
2 and paint finish system as the panel facings.  
3

4 **PART 3 – EXECUTION**

5 **3.1. INSTALLATION**

- 6 A. Install in accordance with manufacturer's instructions and all code requirements.  
7 B. Examine the alignment of the structural steel before installing the metal wall panels. The steel shall be aligned to the  
8 tolerances established in the AISC code of standard practice, section 7, and the supplemental modification control section  
9 7.11.3, adjustable items. The maximum deviation of steel alignment shall be limited to  $-0 = 3/16''$  from the control with a  
10  $1/8''$  maximum change in deviation for any member of any  $10'-0''$  run of panel. The erector shall not proceed with  
11 installation if the structural steel is not within the specified tolerances. The face of all structural members to which the  
12 panels are attached must be in the same vertical plane, flat and free of obstructions such as weld marks, bolts or rivet  
13 heads. Roof panels shall only be mechanically attached to structural or secondary roof framing that is running  
14 perpendicular the roof panel lengths.  
15

16 **END OF SECTION**

**SECTION 07 42 13.19**  
**INSULATED METAL WALL PANELS**

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2		
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5	1.1. SCOPE .....	1
6	1.2. REFERENCES .....	1
7	1.3. SUBMITTALS .....	1
8	1.4. QUALITY ASSURANCE .....	1
9	1.5. PERFORMANCE REQUIREMENTS .....	1
10	1.6. WARRANTY .....	2
11	PART 2 - PRODUCTS .....	2
12	2.1. MATERIAL .....	2
13	PART 3 – EXECUTION .....	3
14	3.1. INSTALLATION .....	3

**PART 1 – GENERAL****1.1. SCOPE**

- A. This section includes information common to insulated standing seam metal roof panel systems and applies to entire project.
- B. Furnish and install all steel faced factory insulated wall panels forming the exterior cladding and the related accessories and trims required for a complete weathertight wall installation.

**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 05 — METALS
  2. 07 05 00 – COMMON WORK RESULTS FOR THERMAL AND MOISTURE PROTECTION
  3. 07 41 13.19 – INSULATED METAL ROOF PANELS
  4. 07 62 00 – SHEET METAL FLASHING AND TRIM
  5. 07 71 23 - MANUFACTURED GUTTERS AND DOWNSPOUTS
  6. 07 84 00 - FIRESTOPPING
- B. ASTM - American Society for Testing and Materials
1. ASTM E72 - Strength Tests of Panels for Building Construction
  2. ASTM E84 - Surface Burning Characteristics of Building Materials
  3. ASTM E 283 - Rate of Air Leakage Through Curtain Walls Under Specified Pressure Differences
  4. ASTM E 330 - Structural Performance of Exterior Curtain Walls by Uniform Static Air Pressure Differences
  5. ASTM E 331 - Water Penetration of Exterior Walls by Uniform Static Air Pressure Differences
  6. ASTM E1592 - Structural Performance of Metal Roof and Siding Systems by Uniform Static Air Pressure Differences
  7. ASTM E1646 - Water Penetration of Exterior Metal Roof Panel Systems by Static Air Pressure Differences
  8. ASTM C518 - Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus
  9. ASTM C1363 - Thermal Performance of Building Materials and Envelope Assemblies by Means of a Hot Box Apparatus
- C. FM - Factory Mutual
1. FM Approval Standard 4880 - Class 1 Fire Rating of Insulated Wall, Ceiling and Roof Panels
  2. FM Approval Standard 4881 - Class 1 Exterior Wall Structural Performance
- D. NFPA - National Fire Protection Association
1. NFPA 259 - Test Method for Potential Heat of Building Materials
  2. NFPA 285 - Evaluation of Fire Propagation Characteristics of Exterior Non-Load-Bearing Wall Assemblies
  3. NFPA 286 Fire Tests for Evaluating Contribution of Wall and Ceiling Finish to Roof Fire Growth
- E. SMACNA - Sheet Metal and Air Conditioning Contractors National Association
1. SMACNA - Architectural Sheet Metal Manual

**1.3. SUBMITTALS**

- A. Detailed drawings showing location and profile of insulated panels, as well as location and shape of formed metal flashings, and the location and type of sealants and fasteners.
- B. Details for all applicable corners, transitions and locations on this project.

**1.4. QUALITY ASSURANCE**

- A. Contractor shall have been trained and certified by manufacturer.
- B. Manufacturer shall provide panel contractor with written instructions for recommended product storage and handling.

**1.5. PERFORMANCE REQUIREMENTS**

- A. The metal faced foam core wall panels shall be produced on a continuous process manufacturing line under strict quality control and must be independently audited quarterly by a recognized audit facility/testing lab. Panel thickness, gauges,

- 1 spans between supports and overall lengths shall be as required to contribute to the combined action of the wall in  
 2 resisting the specified design loads with a deflection not to exceed L/180.
- 3 B. The panels ability to withstand positive and negative design loads shall be verified by testing in accordance with the ASTM  
 4 E 72 Vacuum Chamber Method with the standard deflection criteria to be L/180.
- 5 C. The panel thermal properties shall be verified by actual tested values in accordance with the ASTM C 518 steady state  
 6 thermal transmission test method. Aged K Factor shall not exceed .14 @ 75 °F mean temperature or .13 @ 40 °F mean  
 7 temperature.
- 8 D. The weather tightness of the installed panels system shall be tested and verified by the ASTM E 283 Air Infiltration method  
 9 and the ASTM E 331 Water Penetration method. Air leakage shall not exceed .01 CFM psf of wall area at a pressure  
 10 differential of 12.0 psf. Water leakage shall not be observed at the panel joint at a pressure differential less than 6.27 psf.
- 11 E. The panel core shall have a flame spread maximum of 25 and smoke developed maximum of 450 as tested in accordance  
 12 with the ASTM E 84 test method.
- 13 F. The panel shall have Factory Mutual Class 1 Approval for wall and roof/ceiling construction in accordance with the full  
 14 scale FM 4880 test program with no height restriction.
- 15 G. The panels shall have Factory Mutual Class 1 Exterior Wall System Approval for Windstorm in accordance with FM 4881.
- 16 H. The panels shall have Stste of Florida Product Approval.
- 17 I. The polyisocyanurate foam core shall meet or exceed the following physical properties:
- 18 1. Compressive Strength: 25 psi  
 19 2. Density (in-place): 2.1-2.5 pcf  
 20 3. Shear Strength: 28-32 psi  
 21 4. Closed Cell Content: 95%  
 22 5. Dimensional Stability: 14 day aged (ASTM D 2126) -20 °F < 1% chg, dry heat 158 °F < 1% chg, Humid Heat 158 °F  
 23

#### 24 1.6. WARRANTY

- 25 A. Manufacturer shall warrant the panels as free from defects in material and workmanship for 2 years from the date of  
 26 production.
- 27 B. Manufacturer shall warrant that the exterior paint finish will not:
- 28 1. Chip, crack, check, or peel for a period of 30 years from date of installation (except for such crazing that may occur on  
 29 tightly roll-formed edges and brake bends).
- 30 2. Chalk in excess of a numerical rating of 8 for a period of 30 years from date of installation when measured in  
 31 accordance with the standard procedures outlined in ASTM D-659.
- 32 3. Fade or change color in excess of 5 E units for a period of 30 years from date of installation when calculated in  
 33 accordance with ASTM D-2244. The color change is to be measured on exposed painted surface cleaned of surface  
 34 soils and oxidation.  
 35

### 36 PART 2 - PRODUCTS

#### 37 2.1. MATERIAL

- 38 A. Basis of Design: AWIP All Weather Insulated Panels Mesa DM40. Nucor DM40, MetlSpan, and Kingspan 300 Minor Rib are  
 39 approved equals and need to be optioned to meet all the requirements.
- 40 B. METAL GAGE: Exterior 24 ga. Interior 26 ga.
- 41 A. Thickness and R-value per schedule: 3" = R24; 4"= 32, 5"=R41
- 42 B. FINISH: 30 year 70% PVDF finish with a total dry film thickness of 1.0 mil including primer. Owner shall select color from  
 43 manufacturer's in-stock standards.
- 44 C. The side joint shall be a double tongue and groove off set design, permitting exterior side installation and fasteners  
 45 completely concealed within the side joint. The concealed fasteners shall positively lock the face sheet of the panel to the  
 46 structural supports and provide positive resistance to negative wind loads. A single minimum 3/8 inch continuous bead of  
 47 approved non-skinning butyloid gun grade sealant equivalent to Schnee-Morehead 5430 shall be applied in the female side  
 48 at the panel joint prior to engagement as shown on the panel shop/erection drawings .
- 49 D. The panel exterior profile shall be lightly planked mesa ribs on 2.22" centers. The exterior metal substrate shall be 26ga  
 50 G90 Galvanized or AZ50 Galvalume Steel. The panel interior shall have lightly planked mesa ribs on 2.22" centers. The  
 51 interior metal substrate shall be minimum 26ga G60 Galvanized or AZ35 Galvalume Steel coated with a polyester finish  
 52 with a dry film thickness of 1.0 mil including primer. Interior color shall be Imperial White.
- 53 E. The continuously foamed in-place panel core shall be Class 1 rigid polyisocyanurate (polyurethane) foam meeting the  
 54 following:
- 55 1. Compressive Strength: 25 psi  
 56 2. Density (in-place): 2.1-2.5 pcf  
 57 3. Shear Strength: 28-32 psi  
 58 4. Closed Cell Content: 95%  
 59 5. Dimensional Stability: 14 day aged (ASTM D 2126) -20° F < 1% chg, dry heat 158 °F < 1% chg, Humid Heat 158 °F.
- 60 F. The insulated panel manufacturer shall furnish either the formed metal flashings or the flat stock in the same gauge, color  
 61 and paint finish system as the panel facings.  
 62

1 **PART 3 – EXECUTION**

2 **3.1. INSTALLATION**

- 3 A. Install in accordance with manufacturer's instructions and all code requirements.
- 4 B. Examine the alignment of the structural steel before installing the metal wall panels. The steel shall be aligned to the
- 5 tolerances established in the AISC code of standard practice, section 7, and the supplemental modification control section
- 6 7.11.3, adjustable items. The maximum deviation of steel alignment shall be limited to  $-0 = 3/16''$  from the control with a
- 7  $1/8''$  maximum change in deviation for any member of any 10'-0" run of panel. The erector shall not proceed with
- 8 installation if the structural steel is not within the specified tolerances. The face of all structural members to which the
- 9 panels are attached must be in the same vertical plane, flat and free of obstructions such as weld marks, bolts or rivet
- 10 heads. In no case shall vertically installed wall panels be fastened directly to structural columns or vertical framing
- 11 members. In no case shall horizontally installed wall panels be fastened directly to structural beams or horizontal framing
- 12 members.

13

14

**END OF SECTION**

**SECTION 07 72 53  
SNOW GUARDS**

1		
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4	PART 1 – GENERAL .....	1
5	1.1. SCOPE .....	1
6	1.2. REFERENCES .....	1
7	1.3. SUBMITTALS .....	1
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9	PART 2 - PRODUCTS .....	1
10	2.1. STANDING SEAM ROOF SNOWGUARDS .....	1
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13		
14	<b><u>PART 1 – GENERAL</u></b>	
15	<b>1.1. SCOPE</b>	
16	A. This section includes information common to snowguards.	
17	B. Coordinate with the installation of the roof to assure proper placement of the snow guards.	
18	C. Provide appropriate snow guard and fasteners for the roof system	
19		
20	<b>1.2. REFERENCES</b>	
21	A. Work under this section depends on applicable provisions from other sections and the plan set in this contract. Examples of	
22	related sections include, but are not limited to:	
23	1. 07 05 00 – COMMON WORK RESULTS FOR THERMAL AND MOISTURE PROTECTION	
24	2. 07 62 00 – SHEET METAL FLASHING AND TRIM	
25		
26	<b>1.3. SUBMITTALS</b>	
27	A. Submit manufacturer's specifications, standard detail drawings, installation instructions, and recommended layout.	
28		
29	<b>1.4. QUALITY ASSURANCE</b>	
30	A. Spacing to be recommended by manufacturer or building engineer.	
31	B. Installer to be experienced in the installation of specified roofing material and snow guards for not less than 5 years in the	
32	area of the project.	
33		
34	<b><u>PART 2 - PRODUCTS</u></b>	
35	<b>2.1. STANDING SEAM ROOF SNOWGUARDS</b>	
36	A. <b>BASIS OF DESIGN: Alpine, Metal roof innovations, Ltd. Snogem is acceptable substitute when optioned to meet the</b>	
37	<b>requirements</b>	
38	B. ASG4025 Snow guard that does not penetrate the roof using clamp to seam.	
39	C. Snow Guard Bracket: 6000 Series Aluminum.	
40	D. Tubing: Aluminum – 6000 Series, 1" outside diameter and .120" wall thickness, extruded.	
41	E. Couplings: Aluminum – 6000 Series	
42	1. Internal and concealed coupling 3" long.	
43	2. External and exposed coupling which can also serve as an expansion mechanism 5" long.	
44	F. End Caps - 304 Stainless Steel.	
45	G. End Collars: 6000 Series Aluminum.	
46	H. Ice Flags: 6000 Series Aluminum 3" wide x length (as needed)	
47	I. FINISH: Mill Finish	
48	J. Install a minimum of (3) set screws per snow guard.	
49		
50	<b><u>PART 3 – EXECUTION</u></b>	
51	<b>3.1. INSTALLATION</b>	
52	A. Install in accordance with manufacturer's instructions and all code requirements.	
53	B. Inspect structure on which snow guard system is to be installed and verify that it will withstand any additional loading that	
54	it may incur.	
55	C. Verify that roofing material has been installed correctly prior to installing snow guards.	
56	D. Clean areas to receive attachments; remove loose and foreign matter that could interfere with installation or	
57	performance.	
58	E. Workers shall carry a container or apron to deposit all metal cut offs, droppings or other debris created by the work.	
59	Waste shall not be dropped to the roof and ground.	
60	F. Sections shall be uniform, accurately fitted so as to line up straight and true and rigidly secured in place, without kinks or	
61	buckles. Joints at corners and angles shall be smooth, tight and neatly mitered and seamed.	
62	G. Unless detailed otherwise, lap all vertical joints between adjacent sections a minimum of 2".	



- 1 H. Fabricate and install all material in accordance with the latest edition of SMACNA, the best-accepted practices
- 2 of the industry and these specifications.
- 3 I. Form sections true to shape, accurate in size, square and free from distortion or defects. Do not "punch" metal at brake
- 4 points.
- 5
- 6

**END OF SECTION**

## SECTION 13 34 19 METAL BUILDING SYSTEMS

**SCOPE** Applicable provisions of the General and Supplementary Conditions and Division 1 govern work under this Section.

<b>INDEX</b>	1.1 Description	1.8 Warranties
	1.2 Performance Requirements	2.1 Materials
	1.3 Reference Standards	2.2 Acceptable Manufacturers
	1.4 Submittals	2.3 Fabrication
	1.5 Delivery, Storage, & Handling	3.1 Surface Conditions
	1.6 Job Conditions	3.2 Preparation
	1.7 Alternatives	3.3 Erection

### PART 1 GENERAL

#### 1.1 Description

- A. Work Included: This Specification covers the material for and the fabrication of metal buildings as described herein and shown on the Drawings. The materials to be furnished and installed shall include the structural framing, roofing panels, wall panels, fasteners, sealants, and/or caulking, accessories, anchor bolts, connections, gutters, downspouts, roof leaders, sleeves, reinforcing at mechanical equipment, insulation, and any other component parts for the metal building. This Contractor will also obtain approvals from all regulatory agencies and provide erection of the complete building. The structural design shall include bracing and reinforcing for all crane and conveyor loads, suspended mezzanine loads, and solar panel array loads.
- B. Related Work Specified Elsewhere
- |  |                  |
|--|------------------|
| 1. Concrete  | Section 03 30 00 |
| 2. Precast Concrete                                      | Section 03 41 00 |
| 3. Masonry   | Section 04 20 00 |
| 4. Structural Steel Framing                              | Section 05 12 00 |
| 5. Metal Decking   | Section 05 30 00 |
| 6. Metal Fabrications                                    | Section 05 50 00 |
| 7. Roofing and Exterior Sheet Metal Work                 | Section 07 10 00 |
| 8. Thermal, Air and Moisture Control Layers and Sealants | Section 07 22 00 |
| 9. Plumbing  | Section 22 00 00 |
| 10. HVAC   | Section 23 00 00 |
| 11. Electrical Work                                      | Section 26 00 00 |
- C. Work Installed but Furnished by Others:
- D. Work Furnished but not Installed
- |                               |                  |
|-------------------------------|------------------|
| 1. Anchor bolts - base plates | Section 03 30 00 |
|-------------------------------|------------------|
- E. Description of System:
1. Clear span rigid frame.
  2. Primary Framing: Rigid frame of rafter beams, and columns, canopy beams, braced end frames, end wall columns, and wind bracing.
  3. Secondary Framing: Purlins, girts, eave struts, flange bracing, sill supports, clips, and other items detailed.

4. Wall and Roof System: Preformed insulated sandwich metal panels of vertical profile, with sub-girt framing/anchorage assembly, and accessory components.

F. Definitions: Refer to "Metal Building Systems Nomenclature" of the Metal Building Manufacturers Association.

## **1.2 Performance Requirements**

- A. Qualifications of Manufacturers: The Manufacturer of the building system used shall have been in the manufacture of metal buildings for at least 5 years; shall have the capabilities of supplying the specified materials in the quantities required to meet the construction schedule; shall have full engineering capabilities to meet all design requirements; and shall be able to transport the material to the job site.
- B. Qualifications of Metal Building Contractor
  1. 5 years experience in the sale and erection of metal building type specified.
  2. A licensed supplier of the Manufacturer whose system is selected for the Work.
  3. Incorporated to do work in the State of Wisconsin.
  4. Have the resources necessary to maintain the construction schedule.
- C. Qualifications of Installer
  1. A firm with a least 5 years experience in the type of work required that will be under the direct supervision of the metal building Contractor.
  2. Qualifications of Welders: Qualify procedures and personnel according to AWS A5.1/A5.1M, AWS D1.1/D1.1M, and AWS D1.3/D1.3M.
- D. Design Criteria
  1. Structural Design
    - a. Design responsibility: The entire building system shall be designed by a Registered Professional Engineer employed by the Manufacturer. Any system requiring State of Wisconsin approval shall bear the stamp of a professional engineer registered in Wisconsin.
    - b. Contract Documents: Metal Building Systems Contractor is responsible for the entire building system including Sections 05 12 00, 05 30 00, and 05 50 00. Framing shown on the contract drawings for the solar panel array, suspended main building mezzanine, and shop mezzanines can be constructed as shown incorporating all connections to the metal building system. Alternatively, the Metal Building Designer can design those components for the loads shown on the drawings.
    - c. Loading
      - (1) Initial handling and erection stresses.
      - (2) All dead and live loads as specified on the Contract Drawings and as required by the State of Wisconsin Building Code.
      - (3) All other loads specified for members where they are applicable.
      - (4) Wind load: Applied to the main frame as specified in the "Metal Building Systems Manual" of the Metal Building Manufacturers Association; ASCE 7, and the State of Wisconsin Building Code.
      - (5) Load combinations shall be as required by applicable building codes.
      - (6) Crane loads, conveyor loads, and equipment loads etc. shown on Roof Framing Plan.
      - (7) No live load reductions allowed in computing column loads for future floors.

- d. Structural Performance - Engineer assemblies to meet the following Deflection Limits:
    - (1) Purlins and Rafters: vertical deflection of 1/240 of the span
    - (2) Girts: horizontal deflection of 1/240 of the span
    - (3) Metal Roof Panels: vertical deflection of 1/240 of the span
    - (4) Metal Wall Panels; horizontal deflection of 1/240 of the span.
    - (5) Design secondary framing system to accommodate deflection of primary building structure and construction tolerances, and to maintain clearances at openings. Provide metal panel assemblies capable of withstanding the effects of loads and stresses indicated, based on testing according to ASTM E1592.
  2. Thermal Movement: Provide metal panel systems that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss on 100°C (180°F) temperature range.
  3. Thermal Performance: Provide insulated metal panel assemblies with the following maximum aged U-factors and minimum aged R-values for opaque elements. All insulation shall be continuous insulation (c.i.) and thermal values shall take into account thermal bridging.
    - a. Thermal Resistance of Wall System: U-factor per plans.
    - b. Thermal Resistance of Roof System: U-factor per plans.
  4. Air Infiltration:
    - a. Roof Panel: Air leakage through assembly must not exceed 0.3 L/s per sq. m (0.06 cfm/sq.ft.) of roof area when tested according to ASTM E168 at negative test-pressure difference of [ 75 Pa 1.57 lbf/sq.ft.
    - b. Air leakage through assembly of not more than [ 0.3 L/s per sq. m (0.06 cfm/sq.ft.) of wall area when tested according to ASTM E283 at static-air-pressure difference of [ 300 Pa 6.24 lbf/sq.ft.
  5. Water Penetration:
    - a. Roof Panels: No water penetration when tested according to ASTM E1646 at test-pressure difference of 137 Pa [2.86 lbf/sq.ft.]
    - b. Wall Panels: No water penetration when tested according to ASTM E331 at a minimum differential pressure of 20 percent of inward-acting, wind-load design pressure of not less than 300 Pa [6.24 lbf/sq.ft.]
  6. Surface-Burning Characteristics: Provide metal panels having material with the following surface-burning characteristics as determined by testing identical products according to ASTM E84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency showing:
    - a. Flame-Spread Index: 25 or less.
    - b. Smoke-Developed Index: 450 or less.
  7. Permissible Design Deviations:
    - a. Design deviations will be permitted only after the Architect's written approval of the Manufacturer's proposed design supported by complete design calculations and Drawings.
    - b. Design deviations shall provide an installation equivalent to the basic intent without incurring additional cost to the Owner.
- E. Allowable Tolerances: American Institute of Steel Construction, "Code of Standard Practice of Steel Buildings and Bridges".

- F. Source Quality Control
  - 1. Material Compliance: Manufacturer will supply on request of Architect, certificates showing mechanical, physical and strength properties of all materials supplied.
  - 2. Inspection of Welds shall be in accord with AWS Building Code.
  - 3. Inspection of Shop Painting:
    - a. Surface preparation prior to painting shall be visually evaluated for degree of cleaning by comparison with SSPC pictorial standards.
    - b. Measurement of dry film thickness of each coat of shop applied paint shall be in accord with ASTM D 1005.
  - 4. Inspection of field assembled high strength bolted construction shall be in accord with Section 6, AISC Specification for Structural Joints.

### **1.3. 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. 05 10 00 – Structural Steel Framing
  - 2. 07 21 00 – THERMAL INSULATION
  - 3. 07 41 13.19 – INSULATED METAL ROOF PANELS
  - 4. 07 42 13.19 – INSULATED METAL WALL PANELS
- B. Abbreviations of standards organizations referenced in other sections are as follows:
- C. AA - Aluminum Association
  - 1. ADM-105 (2005; Errata 2005) Aluminum Design Manual
  - 2. ASD1 (2009) Aluminum Standards and Data
- D. AMMA - American Architectural Manufacturers Association
  - 1. AAMA/WDMA/CSA 101/I.S.2/A440 (2011) Standard/Specification for Windows, Doors, and Skylights
- E. AISI – American Iron and Steel Institute
  - 1. AISC/AISI 121 (2004) Standard Definitions for Use in the Design of Steel Structures
  - 2. AISI SG03-3 (2002; Suppl 2001-2004; R 2008) Cold-Formed Steel Design Manual Set
- F. ASCE - American Society of Civil Engineers
  - 1. ASCE 7 2010 Minimum Design Loads for Buildings and Other Structures
- G. ASTM - American Society for Testing and Materials
  - 1. ASTM A1008/A1008M (2012a) Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardened
  - 2. ASTM A1011/A1011M (2012b) Specification for Steel, Sheet, and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability and Ultra-High Strength
  - 3. ASTM A123/A123M (2012) Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
  - 4. ASTM A153/A153M (2009) Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
  - 5. ASTM A193/A193M (2012a) Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service and Other Special Purpose Applications
  - 6. ASTM A307 (2012) Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength
  - 7. ASTM A325 (2010; E 2013) Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
  - 8. ASTM A325M (2013) Specification for Structural Bolts, Steel, Heat Treated, 830 MPa Minimum Tensile Strength (Metric)
  - 9. ASTM A36/A36M (2012) Specification for Carbon Structural Steel
  - 10. ASTM A463/A463M (2010) Specification for Steel Sheet, Aluminum-Coated, by the Hot-Dip Process

11. ASTM A475 (2003a; E 2009; R 2009) Specification for Zinc-Coated Steel Wire Strand
12. ASTM A500/A500M (2010a) Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing
13. ASTM A501 (2007) Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing
14. ASTM A529/A529M (2005; R 2009) Specification for High-Strength Carbon-Manganese Steel of Structural Quality
15. ASTM A53/A53M (2012) Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
16. ASTM A563 (2007a) Specification for Carbon and Alloy Steel Nuts
17. ASTM A563M (2007) Specification for Carbon and Alloy Steel Nuts (Metric)
18. ASTM A572/A572M (2012) Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel
19. ASTM A606/A606M (2009a) Specification for Steel Sheet and Strip, High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, with Improved Atmospheric Corrosion Resistance
20. ASTM A755/A755M (2011) Specification for Steel Sheet, Metallic Coated by the Hot-Dip Process and Pre-painted by the Coil-Coating Process for Exterior Exposed Building Products
21. ASTM A792/A792M (2010) Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process
22. ASTM A992/A992M (2011) Specification for Structural Steel Shapes
23. ASTM B117 (2011) Practice for Operating Salt Spray (Fog) Apparatus
24. ASTM B209 (2010) Specification for Aluminum and Aluminum-Alloy Sheet and Plate
25. ASTM B209M (2010) Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric)
26. ASTM B221 (2013) Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
27. ASTM B221M (2013) Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
28. ASTM B695 (2004; R 2009) Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel
29. ASTM C1289 (2013) Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board
30. ASTM C1363 (2011) Test Method for Thermal Performance of Building Materials and Envelope Assemblies
31. ASTM C273/C273M (2011) Shear Properties of Sandwich Core Materials
32. ASTM C518 (2010) Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus
33. ASTM C920 (2011) Standard Specification for Elastomeric Joint Sealants
34. ASTM D1056 (2007) Specification for Flexible Cellular Materials - Sponge or Expanded Rubber
35. ASTM D1308 (2013) Effect of Household Chemicals on Clear and Pigmented Organic Finishes
36. ASTM D1621 (2010) Compressive Properties of Rigid Cellular Plastics
37. ASTM D1622 (2008) Apparent Density of Rigid Cellular Plastics
38. ASTM D1667 (2005; R 2011) Flexible Cellular Materials - Poly (Vinyl Chloride) Foam (Closed-Cell)
39. ASTM D2244 (2011) Calculation of Color Tolerances and Color Differences from Measured Color Coordinates
40. ASTM D2247 (2011) Testing Water Resistance of Coatings in 100% Relative Humidity
41. ASTM D2794 (1993; R 2010) Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact)

42. ASTM D3363 (2005; E 2011; R 2011; E 2012) Film Hardness by Pencil Test
  43. ASTM D4214 (2007) Test Method for Evaluating the Degree of Chalking of Exterior Paint Films
  44. ASTM D522 (1993a; R 2008) Mandrel Bend Test of Attached Organic Coatings
  45. ASTM D523 (2008) Test Method for Specular Gloss
  46. ASTM D6226 (2010) Test Method for Open Cell Content of Rigid Cellular Plastics
  47. ASTM D714 (2002; R 2009) Evaluating Degree of Blistering of Paints
  48. ASTM D822 (2001; R 2006) Filtered Open-Flame Carbon-Arc Exposures of Paint and Related Coatings
  49. ASTM D968 (2005; R 2010) Abrasion Resistance of Organic Coatings by Falling Abrasive
  50. ASTM DEFONLINE (2008) ASTM Online Dictionary of Engineering Science and Technology
  51. ASTM E119 (2012a) Test Methods for Fire Tests of Building Construction and Materials
  52. ASTM E136 (2012) Behavior of Materials in a Vertical Tube Furnace at 750 Degrees C
  53. ASTM E1592 (2005; R 2012) Structural Performance of Sheet Metal Roof and Siding Systems
  54. ASTM E1646 (1995; R 2011) Test Method for Water Penetration of Exterior Metal Roof Panel Systems
  55. ASTM E168 (2006) General Techniques of Infrared Quantitative Analysis
  56. ASTM E283 (2004; R 2012) Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors
  57. ASTM E331 (2000; R 2009) Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls
  58. ASTM E84 (2013a) Test Method for Surface Burning Characteristics of Building Materials
  59. ASTM E96/E96M (2012) Test Methods for Water Vapor Transmission of Materials
  60. ASTM F1554 (2007a; E 2011) Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength
  61. ASTM F1852 (2011) Specification for "Twist Off" Type Tension Control Structural Bolt/Nut/Washer Assemblies, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
  62. ASTM F436 (2011) Hardened Steel Washers
  63. ASTM F436M (2011) Hardened Steel Washers (Metric)
  64. ASTM F844 (2007a) Washers, Steel, Plain (Flat), Unhardened for General Use
  65. ASTM G152 (2013) Operating Open Flame Carbon Arc Light Apparatus for Exposure of Nonmetallic Materials
  66. ASTM G153 (2013) Operating Enclosed Carbon Arc Light Apparatus for Exposure of Nonmetallic Materials
- H. MBMA - Metal Building Manufacturers Association
1. MBMA MBSM (2002) Metal Building Systems Manual
  2. NAAMM - National Association Of Architectural Metal Manufacturers
  3. NAAMM AMP 500 (2006) Metal Finishes Manual
- I. NFPA - National Fire Protection Association
1. NFPA 252 (2012) Standard Methods of Fire Tests of Door Assemblies
  2. NFPA 80 (2013) Standard for Fire Doors and Other Opening Protectives
- J. NRCA – National Roofing Contractor Association
1. NRCA RoofMan (2013) The NRCA Roofing Manual
- K. SMACNA - Sheet Metal and Air Conditioning Contractors National Association
1. SMACNA 1793 (2012) Architectural Sheet Metal Manual, 7th Edition
- L. SPC - Society of Protective Coatings (Formerly Steel Structures Painting Council)
1. SSPC Paint 15 (1999; E 2004) Steel Joist Shop Primer
  2. SSPC Painting Manual (2002) Good Painting Practice, Steel Structures Painting Manual, Volume 1
  3. SSPC SP 2 (1982; E 2000; E 2004) Hand Tool Cleaning
- M. UL – Underwriters Laboratory

## Madison Engineering Operations Addition

1. UL 580 (2006; Reprint Jul 2009) Tests for Uplift Resistance of Roof Assemblies
2. UL Bld Mat Dir (2012) Building Materials Directory

**1.4 Submittals:** Within 35 days after award of Contract, and before any of the materials of this Section are delivered to the job site, submit complete to the Architect in accord with Division 1 of these Specifications; the following:

- A. Samples: Submit color samples for approval.
- B. Shop Drawings: Before foundation work begins, submit Shop Drawings for all the Work to be performed under this Section.
  1. Structural Steel: Show all shop and erection details including cuts, copes, connections, holes, cambers, loads, threaded fasteners, rivets, and welds. All welds, both shop and field, shall be indicated by AWS "Welding Symbols" A 2.0. Separate drawing sheet showing anchor bolt locations and installation.
  2. Erection Procedure: Submit descriptive data to illustrate the structural steel erection procedure, including the sequence of erection and temporary staying and bracing.
  3. Welding procedure: Submit written description as required to illustrate each welding procedure to be performed in specified Work.
  4. Field welding equipment: Submit descriptive data for field welding equipment, including type, voltage and amperage.
- C. Calculations: The designer will submit to the Architect one set of design calculations for review. Also sets. Will be; sent to the State of Wisconsin for approval.

## **1.5 Product Delivery, Storage and Handling**

- A. Protection: Use all means necessary to protect the materials of this Section before, during and after installation and to protect the installed Work and materials of all other trades.
- B. Delivery and Handling: Handle all components in a manner consistent with their shape and design. Lift or support units only at points shown on erection drawings. Protect components from dirt and damage during transport and handling. Protect and support units during shipping.
- C. Storage at Jobsite: Deliver to job site in quantities only as needed for erection. Store in I I location set aside by General Contractor. Store components to protect from contact with soil, staining, abrasions and general physical damage. Protect finished roof and wall panels, trim, doors, frames and sash by covering with plastic sheets.
- D. Delivery of Materials to be Installed Under Other Sections: Anchor bolts and other anchorage devices which are embedded in cast-in-place concrete or masonry construction shall be delivered to the project site in time to be installed before the start of cast-in-place concrete operations or masonry work.
- E. Replacements: In the event of damage, immediately make all repairs and replacements necessary to the approval of the Architect and at no additional cost to the Owner.

## **1.6 Job Conditions**

- A. Site Conditions and Scheduling: Immediately after award of the Contract this Contractor will verify with General Contractor the requirements for site access for erection and the scheduling



for erection. The General Contractor will be responsible for providing this Contractor access to the site so that all erection equipment can be used.

### **1.7 Alternatives:**

- A. The Work of this Section is affected by alternatives (if any) as described on the Drawings and in Division 1 of these Specifications.

### **1.8 Warranties:**

- A. ~~Building System Warranty: Furnish manufacturer's no-dollar limit warranty for the metal building system. The warranty period is to be no less than 20 years from the date of acceptance of the work and be issued directly to the owner. The warranty must provide that if within the warranty period, the metal building system shows evidence of deterioration resulting from defective materials and/or workmanship, correcting of any defects is the responsibility of the metal building system manufacturer. Repairs that become necessary because of defective materials and workmanship while metal building system is under warranty are to be performed within 72 hours after notification.~~
- B. ~~Roof System Weather Tightness Warranty: Furnish manufacturer's no-dollar limit warranty for the metal panel system. The warranty period is to be no less than 20 years from the date of acceptance of the work and be issued directly to the owner. The warranty is to provide that if within the warranty period the roof panel system shows evidence of corrosion, perforation, rupture, loss of weather tightness or excess weathering due to deterioration of the panel system resulting from defective materials and correction of the defective workmanship is to be the responsibility of the metal building system manufacturer. Repairs that become necessary because of defective materials and workmanship while roof panel system is under warranty are to be performed within 48 hours after notification.~~
- C. ~~Roof and Wall Panel Finish Warranty: Furnish manufacturer's no-dollar limit warranty for the metal panel system. The warranty period is to be no less than 20 years from the date of acceptance of the work and be issued directly to the owner. The warranty is to provide that if within the warranty period the metal panel system shows evidence of checking, delaminating, cracking, peeling, chalk in excess of a numerical rating of eight, as determined by ASTM D4214 test procedures; or change colors in excess of five CIE or Hunter units in accordance with ASTM D2244 or excess weathering due to deterioration of the panel system resulting from defective materials and finish or correction of the defective workmanship is to be the responsibility of the metal building system manufacturer. Liability under this warranty is exclusively limited to replacing the defective coated materials. Repairs that become necessary because of defective materials and workmanship while roof and wall panel system is under warranty are to be performed within 72 hours after notification.~~
- D. ~~Failure to perform repairs within this time will constitute grounds for having emergency repairs performed by others at expense of contractor and will not void the warranty.~~

## **PART 2 PRODUCTS**

### **2.1 Materials**

- A. General: All materials furnished shall meet or exceed the stated design requirements.
  - 1. Erect metal building system according to manufacturer's written erection instructions, approved shop drawings and other erection documents in accordance with MBMA MBSM - "Metal Building Systems Manual".
  - 2. Do not field cut, drill, or alter structural members without written approval from metal

building system manufacturer's professional engineer and the owner.

3. Set structural framing accurately in locations and to elevations indicated and according to AISC 325 specifications. Maintain structural stability of frame during erection.
4. Clean and roughen concrete and masonry bearing surfaces prior to setting plates. Clean bottom surface of plates.
5. Align and adjust structural framing before permanent bolt-up and connections. Perform necessary adjustments and alignment to compensate for changes or discrepancies in elevations.
6. Maintain erection tolerances of structural framing in accordance with AISC 360.

B. Structural Framing Material :

1. W-Shapes: ASTM A992/A992M; ASTM A572/A572M or ASTM A529/A529M.
2. Channel, Angles, M-Shapes and S-Shapes: ASTM A36/A36M; ASTM A572/A572M or ASTM A529/A529M.
3. Plate and Bar: ASTM A36/A36M, ASTM A572/A572M or ASTM A529/A529M.
4. Steel Pipe: ASTM A36/A36M, ASTM A53/A53M, ASTM A572/A572M or ASTM A529/A529M.
5. Cold-Formed and Hot Formed Hollow Structural Sections: ASTM A500/A500M or ASTM B221, ASTM B221M. Hot-formed: ASTM A501.
6. Structural-Steel Sheet: Hot-rolled, ASTM A1011/A1011M or cold-rolled, ASTM A1008/A1008M.
7. Metallic-Coated Steel Sheet: ASTM A653/A653M, ASTM A606/A606M.
8. Metallic-Coated Steel Sheet Pre-painted with Coil Stock Coating:
  - a. Steel sheet metallic coated by the hot-dip process and pre-painted by the coil-coating process to comply with ASTM A755/A755M.
    - i. Zinc-Coated (Galvanized) Steel Sheet: ASTM A653/A653M, and ASTM A123/A123M.
  - b. Aluminum-Zinc Alloy-Coated Steel Sheet: ASTM A792/A792M, and ASTM A463/A463M.
9. High-Strength Bolts, Nuts, and Washers:
  - a. ASTM A325M ASTM A325, heavy hex steel structural bolts; ASTM A563M, ASTM A563 heavy hex carbon-steel nuts; and ASTM F436M ASTM F436 hardened carbon-steel washers.
    - i. Finish: Hot-dip zinc coating, ASTM A153/A153M
  - b. Tension-Control, High-Strength Bolt-Nut-Washer Assemblies:
    - i. ASTM F1852, heavy-hex-head steel structural bolts with spline
    - ii. Finish: Mechanically deposited zinc coating, ASTM B695
10. Non-High-Strength Bolts, Nuts, and Washers:
  - a. ASTM A307, ASTM A563M ASTM A563, and ASTM F844.
  - b. Finish: ASTM A153/A153M
11. Anchor Rods: ASTM F1554.
  - a. Configuration: Per Metal Building Designer
  - b. Nuts: ASTM A563M ASTM A563 heavy hex carbon steel.
  - c. Plate Washers: ASTM A36/A36M carbon steel.
  - d. Washers: ASTM F436 hardened carbon steel.
12. Finish: Hot-dip zinc coating, ASTM A153/A153M
13. Threaded Rods
  - a. ASTM A36/A36M.
  - b. Nuts: ASTM A563M ASTM A563 heavy hex carbon steel.
  - c. Washers: ASTM F436 hardened.
  - d. Finish: Hot-dip zinc coating, ASTM A153/A153M
14. Primer: SSPC-Paint 15, Type I, red oxide.

C. Primary Framing

1. Manufacturer's standard structural primary framing system includes transverse and lean-to frames; rafter, rakes, and canopy beams; sidewall, intermediate, end-wall, and corner columns; and wind bracing designed to withstand required loads and specified requirements. Provide frames with attachment plates, bearing plates, and splice members. Provide frame span and spacing AS indicated.
2. Shop fabricate framing components by welding or by using high-strength bolts to the indicated size and section with base-plates, bearing plates, stiffeners, and other items required. Cut, form, punch, drill, and weld framing for bolted field erection.
  - a. Rigid Clear-Span Frames: I-shaped frame sections fabricated from shop-welded, built-up steel plates or structural-steel shapes. Interior columns are not permitted.
  - b. Rigid Modular Frames: I-shaped frame sections fabricated from shop-welded, built-up steel plates or structural-steel shapes. Provide interior columns fabricated from steel round pipe or steel tube. shop-welded, built-up steel plates.

D. Secondary Framing :

1. Manufacturer's standard secondary framing members, including purlins, girts, eave struts, flange bracing, base members, gable angles, clips, headers, jambs, and other miscellaneous structural members. Fabricate framing from cold-formed, structural-steel sheet or roll-formed, metallic-coated steel sheet pre-painted with coil coating, unless otherwise indicated.
2. Shop fabricate framing components by roll-forming or break-forming to the indicated size and section with base-plates, bearing plates, stiffeners, and other plates required for erection. Cut, form, punch, drill, and weld secondary framing for bolted field connections to primary framing.
  - a. Purlins: C or Z-shaped sections; fabricated from steel sheet, built-up steel plates, or structural-steel shapes; minimum depth as required to comply with system performance requirements
  - b. Girts: C or Z-shaped sections; fabricated from steel sheet, built-up steel plates, or structural-steel shapes. Form ends of Z-sections with stiffening lips angled 40 to 50 degrees to flange minimum depth as indicated][ as required to comply with system performance requirements.
  - c. Eave Struts: Unequal-flange, C-shaped sections; fabricated from steel sheet, built-up steel plates, or structural-steel shapes; to provide adequate backup for metal panels.
  - d. Flange Bracing: Structural-steel angles or cold-formed structural tubing to stiffen primary frame flanges.
  - e. Sag Bracing: Structural-steel angles.
  - f. Base or Sill Angles: Zinc-coated (galvanized) steel sheet.
  - g. Purlin and Girt Clips: Steel sheet. Provide galvanized clips where clips are connected to galvanized framing members.
  - h. Secondary End-Wall Framing: Manufacturer's standard sections fabricated from zinc-coated (galvanized) steel sheet
  - i. Framing for Openings: Channel shapes; fabricated cold-formed, structural-steel sheet or structural-steel shapes. Frame head and jamb of door openings, and head, jamb, and sill of other openings.
  - j. Miscellaneous Structural Members: Manufacturer's standard sections fabricated from cold-formed, structural-steel sheet; built-up steel plates; or zinc-coated (galvanized) steel sheet; designed to withstand required loads.

E. Bracing :

1. Provide adjustable wind bracing as follows:
  - a. Rods: ASTM A36/A36M; ASTM A572/A572M; or ASTM A529/A529M threaded a minimum of 1/8 length at each end.
  - b. Cable: ASTM A475, extra-high-strength grade, zinc-coated, strand-steel with threaded end anchors
  - c. Angles: Fabricated from structural-steel shapes to match primary framing, of size required to withstand design loads.
  - d. Rigid Portal Frames: Fabricate from shop-welded, built-up steel plates or structural-steel shapes to match primary framing; of size required to withstand design loads.
  - e. Fixed-Base Columns: Fabricate from shop-welded, built-up steel plates or structural-steel shapes to match primary framing; of size required to withstand design loads.
  - f. Diaphragm Action of Metal Panels: Design metal building to resist wind forces through diaphragm action of metal panels.
  - g. Bracing: Provide wind bracing using any method specified above, at manufacturer's option.

F. Panels

1. Aluminum Sheet: Roll-form aluminum panels to the specified profile, with 0.032 in., 0.040 in. or 0.050 in. thickness and depth as indicated. Material must be plumb and true, and within the tolerances listed:
  - a. Aluminum Sheet conforming to ASTM B209M ASTM B209, AA ADM-105 and AA ASD1.
  - b. Individual panels to have continuous length to cover the entire length of any roof slope or wall area with no joints or seams and formed without warping, waviness, or ripples that are not part of the panel profile and free of damage to the finish coating system.
  - c. Provide panels with thermal expansion and contraction consistent with the type of system specified.
2. Steel Sheet: Roll-form steel panels to the specified profile, with 26, 24, 22, 20, 18 gauge and depth as indicated. Material must be plumb and true, and within the tolerances listed:
  - a. Galvanized Steel Sheet conforming to ASTM A653/A653M and AISI SG03-3.
  - b. Aluminum-Zinc Alloy-coated Steel Sheet conforming to ASTM A792/A792M and AISI SG03-3.
  - c. Individual panels to have continuous length to cover the entire length of any unbroken roof slope or wall area] with no joints or seams and formed without warping, waviness, or ripples that are not part of the panel profile and free of damage to the finish coating system.
  - d. Provide panels with thermal expansion and contraction consistent with the type of system specified;
3. Finish: All panels are to receive a factory-applied Kynar 500/Hylar 5000 finish consisting of a baked-on top-coat with a manufacturer's recommended prime coat conforming to the following:
  - a. Metal Preparation: All metal is to have the surfaces carefully prepared for painting on a continuous process coil coating line by alkali cleaning, hot water rinsing, application of chemical conversion coating, cold water rinsing, sealing with acid rinse, and thorough drying.
  - b. Prime Coating: A base coat of epoxy paint, specifically formulated to interact with the top-coat, is to be applied to the prepared surfaces by roll coating to a dry film

thickness of 0.20 plus 0.05 mils. This prime coat must be oven cured prior to application of finish coat.

- c. Exterior Finish Coating: Apply the finish coating over the primer by roll coating to dry film thickness of 0.80 plus 5 mils (3.80 plus 0.50 mils for Vinyl Plastisol) for a total dry film thickness of 1.00 plus 0.10 mils (4.00 plus 0.10 mils for Vinyl Plastisol). This finish coat must be oven-cured.
  - d. Interior Finish Coating: Apply a wash-coat on the reverse side over the primer by roll coating to a dry film thickness of 0.30 plus 0.05 mils for a total dry film thickness of 0.50 plus 0.10 mils. The wash-coat must be oven-cured.
  - e. Color: The exterior finish chosen from the manufacturer's color charts and chips.
  - f. Physical Properties: Coating must conform to the industry and manufacturer's standard performance criteria as listed by the following certified test reports:
    - i. Chalking: ASTM DEFONLINE
    - ii. Color Change and Conformity: ASTM D2244
    - iii. Weatherometer: ASTM G152, ASTM G153 and ASTM D822
    - iv. Humidity: ASTM D2247 and ASTM D714
    - v. Salt Spray: ASTM B117
    - vi. Chemical Pollution: ASTM D1308
    - vii. Gloss at 60 degrees: ASTM D523
    - viii. Pencil Hardness: ASTM D3363
    - ix. Reverse Impact: ASTM D2794
    - x. Flexibility: ASTM D522
    - xi. Abrasion: ASTM D968
    - xii. Flame Spread: ASTM E84
  - g. Repair of Finish Protection: Repair paint for color finish enameled metal panel must be compatible paint of the same formula and color as the specified finish furnished by the metal panel manufacturer, conforming to ASTM A780/A780M.
4. Metal Wall Panel:
- a. Factory-formed panel assembly fabricated from two sheets of metal with modified polyisocyanurate or polyurethane foam insulation core during fabrication with joints between panels designed to form weather-tight seals. Include accessories required for weather-tight installation.
  - b. Closed-Cell Content: 90 percent when tested according to ASTM D6226, ASTM C1289.
  - c. Density: 32 to 42 kg/cu. m 2.0 to 2.6 lb/cu. ft. when tested according to ASTM D1622.
  - d. Compressive Strength: Minimum 140 kPa 20 psi when tested according to ASTM D1621.
  - e. Shear Strength: 179 kPa 26 psi when tested according to ASTM C273/C273M.
  - f. Provide metal wall panels of full length from sill to eave as indicated, unless otherwise indicated or restricted by shipping limitations. Anchor metal wall panels and other components of the Work securely in place, in accordance with MBMA MBSM.
  - g. Erect wall panel system in accordance with the approved erection drawings, the printed instructions and safety precautions of the metal building manufacturer.
  - h. Sheets are not to be subjected to overloading, abuse, or undue impact. Do not install bent, chipped, or defective sheets.
  - i. Sheets must be erected true and plumb and in exact alignment with the horizontal and vertical edges of the building, securely anchored, and with the indicated eave, and sill.
  - j. Work is to allow for thermal movement of the wall panel, movement of the building structure, and to provide permanent freedom from noise due to wind pressure.
  - k. Field cutting metal wall panels by torch is not permitted.
5. Roof Panels:
- a. Provide metal roof panels of full length from eave to ridge or eave to wall as indicated, unless otherwise indicated or restricted by shipping limitations. Anchor metal roof panels

- and other components of the Work securely in place in accordance with NRCA RoofMan and MBMA MBSM.
- b. Erect roofing system in accordance with the approved erection drawings, the printed instructions and safety precautions of the metal building manufacturer.
  - c. Sheets are not to be subjected to overloading, abuse, or undue impact. Do not install bent, chipped, or defective sheets.
  - d. Sheets must be erected true and plumb and in exact alignment with the horizontal and vertical edges of the building, securely anchored, and with the indicated rake and eave overhang.
  - e. Work must allow for thermal movement of the roofing, movement of the building structure, and provide permanent freedom from noise due to wind pressure.
  - f. Field cutting metal roof panels by torch is not permitted.
  - g. Roofing sheets must be laid with corrugations in the direction of the roof slope. End laps of exterior roofing must not be less than 203.2 mm (8 inches); the side laps of standard exterior corrugated sheets must not be not less than 2-1/2 corrugations.
  - h. Do not permit storage, walking, wheeling, and trucking directly on applied roofing materials. Provide temporary walkways, runways, and platforms of smooth clean boards or planks as necessary to avoid damage to the installed roofing materials, and to distribute weight to conform to the indicated live load limits of roof construction.
6. Snow Retention System – Fence Type
- a. Quantity: 2 rows minimum, more as required by system design per roof size and slope. System design to be included as part of metal building engineering design.
  - b. Continuous Bar: 6000 series aluminum, mill finish. Include splice plate. Designed to support retained snow loads.
  - c. Attachment Clamp Bracket: Aluminum block to be attached to standing seam flanges in such a way as not to void roof warranty. Spacing as recommended by the roofing manufacturer. All hardware to be stainless steel or aluminum.
  - d. Assembly: Provided manufactured system components specifically designed for this purpose. Components to be compatible with each other and the roofing system.
- G. Fasteners
1. Type, material, corrosion resistance, size and sufficient length to penetrate the supporting member a minimum of 25.4 mm 1 inch with other properties required to fasten miscellaneous metal framing members to substrates in accordance with the metal panel manufacturer's and ASCE 7 requirements.
  2. Exposed Fasteners: Fasteners for metal panels to be corrosion resistant coated steel, aluminum, stainless steel, or nylon capped steel compatible with the sheet panel or flashing and of a type and size recommended by the manufacturer to
  3. Meet the performance requirements and design loads. Fasteners for accessories to be the manufacturer's standard. Provide an integral metal washer matching the color of attached material with compressible sealing EPDM gasket approximately .09 mm 3/32 inch thick.
  4. SCREWS: Screws to be corrosion resistant coated steel, aluminum and/or stainless steel being the type and size recommended by the manufacturer to meet the performance requirements.
  5. RIVETS: Rivets to be closed-end type, corrosion resistant coated steel, aluminum or stainless steel where watertight connections are required.
  6. ATTACHMENT CLIPS: Fabricate clips from steel hot-dipped galvanized in accordance with ASTM A653/A653M or Series 300 stainless steel. Size, shape, thickness and capacity as required meeting the insulation thickness and design load criteria specified.

H. Flashing, Trim, and Closure

1. Shop fabricate sheet metal flashing and trim where practicable to comply with recommendations in SMACNA 1793 that apply to design, dimensions, metal, and other characteristics of item indicated. Obtain field measurements for accurate fit before shop fabrication.
2. Fabricate sheet metal flashing and trim without excessive oil canning, buckling, and tool marks and true to line and levels indicated, with exposed edges folded back to form hems.
3. Comply with performance requirements, manufacturer's written installation instructions, and SMACNA 1793. Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.
4. Sheet metalwork is to be accomplished to form weather-tight construction without waves, warps, buckles, fastening stresses or distortion, and allow for expansion and contraction. Cutting, fitting, drilling, and other operations in connection with sheet metal required to accommodate the work of other trades is to be performed by sheet metal mechanics.

I. Finishes

1. Comply with NAAMM AMP 500 for recommendations for applying and designating finishes.
2. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

**2.2 Acceptable Manufacturers**

**A. Approved Manufacturers : Manufacturer must be AC472 accredited by MBMA (Metal Building Manufacturers Association)**

1. American Buildings Co., Eufaula, AL
2. Behlen Mfg. Co., Columbus, NE
3. Butler Manufacturing Co., Kansas City, MO
4. ~~Foremost Buildings, Inc., Jefferson, WI~~
5. Nucor Building Systems, Waterloo, IN
6. Varco Pruden Buildings, Memphis, TN

- B. Request for approval of equals must be made 2 weeks before bid due date and must be accompanied by list of reference contacts of at least three local (Dane County) installers and three local owners.

**2.3 Fabrication**

- A. General: Fabricate all Work in accord with the approved Shop Drawings and referenced standards. Be responsible for accurate fit of all Work.
1. Fabricate and finish metal panels and accessories at the factory to greatest extent possible, by manufacturer's standard procedures and processes and as necessary to fulfill indicated performance requirements.
  2. Comply with indicated profiles with dimensional and structural requirements Provide metal panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel. Aluminum and aluminum-alloy sheet and plate must conform to ASTM B209.

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3. Fabricate metal panel side laps with factory-installed captive gaskets or separator strips that provide a tight seal and prevent metal-to-metal contact, in a manner that will seal weather-tight and minimize noise from movements within panel assembly.
  4. Sheet Metal Accessories: Fabricate flashing and trim to comply with recommendations in SMACNA 1793 that apply to the design, dimensions, metal, and other characteristics of item indicated:
    - a. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
    - b. End Seams: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.
    - c. Sealed Joints: Form non-expansion but movable joints in metal to accommodate elastomeric sealant to comply with SMACNA standards.
    - d. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
    - e. Fabricate cleats and attachment devices of size and metal thickness recommended by SMACNA or by metal building system manufacturer for application, but not less than thickness of metal being secured.
- B. Connections
1. Shop Connections: Welded or bolted.
  2. Field Connections:
    - a. Provide bolted connections as follows:
      - (1) High strength threaded fasteners shall be used for bolted connections, except where standard threaded fasteners are permitted.
      - (2) High strength bolted construction assembly: tightening shall be done in accord with Section 5 of Specifications for Structural Joints.
      - (3) Fabricator is responsible for design and strength of connections unless otherwise noted on the Drawings.
  3. Holes :
    - a. Punch holes as required for connection of other Work per templates and directions of such trades.
    - b. Steel requiring accurate alignment shall be provided with slotted holes and shims for truing up steel, as required for alignment.
  4. Welded Construction:
    - a. Welding process shall be limited to one or a combination of the following:
      - (1) Manual shielded-arc
      - (2) Submerged arc
    - b. Welded assemblies shall be stress relieved by heat treatment.
    - c. Use equipment which will supply proper current in order that operator may produce satisfactory welds. Welding machine: 200 to 400 amperes, 25-40 volts capacity.
    - d. Field welding: by direct current. Remove paint within two inches of weld.
  5. Column bases shall be milled and attached to columns.
  6. Bearing plates:
    - a. Bearing plates shall be provided under beams, girders, columns and trusses resting on footings, piers and walls.
    - b. Bearing plates shall be either attached or loose.
- C. Identifying Marks: All fabricated or purchased items shall have an identifying number corresponding to marking shown on erection drawings. The marking shall be stamped, stenciled, tagged, or printed on these items after shop paint has been applied.
- D. Shipping: The size and weight of the building components as packaged and shipped shall be such that will permit transportation by common carrier.



- E. Painting
  - 1. Prior to painting, the fabricator shall clean the steel of loose rust, loose mill scale, dirt, and other foreign material. Unless otherwise specified the fabricator shall not sandblast, flame clean or pickle prior to painting. The fabricator shall then factory coat all steel with one coat of zinc chromate alkyd primer (red oxide zinc chromate may be ordered as an alternate) formulated to equal or exceed the performance requirements of Federal Specifications TT-P-636.
    - a. All purlins shall be dip tank coated by an electro-deposition method (light color only).
    - b. All other structural steel components and sub-assembly parts shall be spray painted.
  - 2. The shop coat of paint is a primer and is intended to protect the steel for a short period of exposure. Subsequent finish painting, if required, is to be performed in the field by others.

## **PART 3 EXECUTION**

### **3.1 Surface Conditions**

- A. Inspection: Before fabrication or erection examine the Site, inspect bearing surfaces, take field measurements, and carefully inspect the installed Work of all other trades and verify that all such Work is complete and that the Work of this Section can be installed in accord with the original design and approved Shop Drawings. In the event of discrepancies, notify Architect immediately for clarification. Do not proceed with the work of this Section until all such discrepancies have been fully resolved.

### **3.2 Preparation**

- A. Supply the General Contractor with all anchor bolts, setting plates, bearing pads or other built-in items required for this Work.
- B. Site Access: The General Contractor shall be responsible for providing suitable access to the building and firm level bearing for the hauling and erection equipment to operate under their own power.
- C. The General Contractor shall be responsible for providing true, level bearing surfaces on all field placed bearing walls and other field placed supporting members.

### **3.3 Erection**

- A. Column Bases and Bearing Plates:
  - 1. Attached column bases and bearing plates for beams and similar structural members shall be aligned with wedges or shims.
  - 2. Loose column bases and bearing plates which are too heavy to be placed without a derrick or crane shall be set and wedged or shimmed.
  - 3. Set column base plates with non-shrink grout to full plate bearing.
- B. Framing
  - 1. Erect framing in accord with AISC Specifications.
  - 2. Provide for erection and wind loads. Provide temporary bracing to maintain structure plumb and in alignment until completion of erection and installation of permanent

bracing. Locate braced bays to avoid fixed equipment or mechanical systems.

3. Structural steel frames shall be accurately assembled to the lines and elevations indicated, within the specified erection tolerances.
4. The various members forming parts of a complete frame or structure after being assembled shall be aligned and adjusted accurately before being fastened.
5. Fastening of splices of compression members shall be done after the abutting surfaces have been brought completely into contact.
6. Bearing surfaces and surfaces which will be in permanent contact shall be cleaned before the members are assembled.
7. Splices shall be permitted only where indicated.
8. Use drift pins only for bringing members into position, not to enlarge or distort holes.
9. Erection bolts used in welded construction may be either tightened securely and left in place or removed and the holes filled with plug welds.
10. Give special attention to steel handling during construction to avoid overloading green floor slabs; adhere to Architect's instructions when criticisms are made in this regard.
11. Gas Cutting:
  - a. Field correcting of fabrication by gas cutting shall not be permitted on any major member in the structural framing without prior approval of the Architect.
  - b. Cut out and reinforce, as indicated and/or required, holes through webs of members for mechanical Work. Verify exact locations with mechanical plans.

C. Crane Runways

1. Erect complete with all columns, beams, bracing, crane rails, crane stops, and other requirements.
2. The gage, alignment and elevation of crane rails shall be accurate to a tolerance of plus or minus 3/16 inch.
3. Crane rail joints shall be staggered on opposite sides of the runway and shall not coincide with the crane girder joints.
4. The top of crane rails shall be flush at all joints.

D. Wall and Roofing Systems

1. Install in accord with Manufacturer's instructions.
2. Exercise care when cutting prefinished material to ensure cuttings do not remain on finish surface.
3. Fasten cladding system to structural supports, aligned level and plumb.
4. Locate end laps over supports. End lap panels minimum 2 inches. Place sidelaps over bearing.
5. Provide expansion joints where indicated.
6. Use concealed fasteners.
7. Install sealant and gaskets to prevent weather penetration.
8. System: Free of rattles, noise due to thermal movement and wind whistles.

E. Accessories

1. Seal wall and roof accessories watertight and weather tight with sealant.

F. Gutter and Downspout Erection

1. Rigidly support and secure components. Join lengths with formed seams sealed watertight. Flash and seal gutters to downspouts.

- G. Touch up: At completion of erection touch-up prime coat of paint at all welds, abrasions, bolts etc. with same material used for shop coat.

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**SECTION 22 13 00  
FACILITY SANITARY SEWERAGE**

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**PART 1 – GENERAL**

**1.1. SCOPE**

A. This section contains specifications for facility sanitary waste and vent pipe and pipe fittings for this project

**1.2. RELATED WORK**

- A. All sections of Division 01.
- B. Section 22 05 00 – Common Work Results for Plumbing
- C. Section 22 05 14 – Plumbing Specialties
- D. Section 22 05 29 – Hangers and Supports for Plumbing Piping and Equipment

**1.3. DESCRIPTION**

- A. Interior sanitary waste and vent piping systems including branches, drains, cleanouts, stacks, fittings and hardware.
- B. Work under this section shall commence from 5 feet outside the building wall with connections to sanitary building sewer lateral(s).

**1.4. QUALITY ASSURANCE**

- A. Order all pipe with each length marked with the name or trademark of the manufacturer and type of pipe; with each shipping unit marked with the purchase order number, metal or alloy designation, temper, size and name of supplier.
- B. Any installed material not meeting the specification requirements must be replaced with material that meets these specifications without additional cost to the City.

**1.5. SUBMITTALS**

- A. Schedule from the contractor indicating the ASTM, or CISPI specification number of the pipe being proposed along with its type and grade and sufficient information to indicate the type and rating of fittings for each service. Include materials of construction, dimensional data, ratings/capacities/ranges, approvals, test data, and identification as referenced in this section and/or on the drawings.

**PART 2 - PRODUCTS**

**2.1. UNDERGROUND PIPE AND FITTINGS**

- A. Interior

- 
- 1                   1.     PVC plastic pipe, Schedule 40, Class 12454-B (PVC 1120), ASTM D1785; PVC plastic drain, waste and vent  
2                   pipe and fittings, ASTM D2665; socket fitting patterns, ASTM D3311; primer, ASTM F656; solvent cement,  
3                   ASTM D2564.

4  
5     **2.2    ABOVE GROUND PIPE AND FITTINGS**

- 6     A.     PVC, Schedule 40, Type I, ASTM  
7     D-1785 and PVC drain-waste-vent fittings, ASTM D-2665, with solvent weld joints, ASTM D2855.

8     **2.3    BACKWATER VALVES**

- 9     A.     \_\_\_\_\_

10  
11    **2.4    DRAINS**

- 12    A.     Drains and cleanouts manufactured by J.R. Smith, Josam, Wade, Watts, or Zurn.  
13    B.     Install trap seal barrier type on floor drains in mechanical rooms.  
14    C.     Refer to Plumbing Drain and Cleanout Schedule.

15  
16    **2.5    CLEANOUTS**

- 17    A.     Drains and cleanouts manufactured by J.R. Smith, Josam, Wade, Watts, or Zurn.  
18    B.     Refer to Plumbing Drain and Cleanout Schedule.  
19    C.     INTERIOR CONCRETE FLOOR AREAS: Enameled cast iron body with round or square adjustable scoriated polished  
20    nickel bronze cover, tapered threaded ABS closure plug. Zurn ZN 1400 / ZN 1400 T.  
21    D.     INTERIOR EXPOSED VERTICAL STACKS: Line type cleanout tee with tapered threaded ABS closure plug. Zurn Z  
22    1445.  
23    E.     INTERIOR HORIZONTAL LINES: Cast iron hub with tapped ferrule and tapered threaded ABS or PVC closure plug,  
24    or no hub coupling and blind plug.

25  
26    **2.6    SAFINGS**

- 27    A.     Manufacturers: Noble, Oatey.  
28    B.     Chlorinated polyethylene sheeting, 40 mils thick, ASTM D4068, joined with CPE solvent; or 3 lb./sq. ft. sheet lead.

29  
30    **2.7    VENT FLASHING**

- 31    A.     Manufacturers: Semco, Oatey.  
32    B.     Formed 3 lb./sq. ft. lead flashing with minimum base size of 15"x17".  
33    C.     Single Ply Membrane Roofs: Flashing boot of material compatible with roofing membrane with base flange for  
34    adhering to membrane and stainless steel drawband for securing to vent pipe.

35  
36    **PART 3 - EXECUTION**

37  
38    **3.1.    DRAIN AND VENT PIPING SYSTEM**

- 39  
40    A.     Connect all drain and vent piping to each fixture and piece of equipment and install all required piping as shown  
41    on drawings. Provide all necessary fittings and hardware to make required offsets and transitions. Changes in  
42    direction of drainage piping shall be made by the appropriate use of 45 degree wyes, long or short sweep 1/4  
43    bends, 1/6, 1/8, 1/16 bends or combination.  
44    B.     Fittings to be installed to make for the least possibility of stoppage. All horizontal drainage piping less than 3  
45    inches shall be pitched a minimum of 1/4 inch per foot of run. Pitch drainage piping 3 inch and larger a minimum  
46    of 1/8" per foot of run.  
47    C.     Connect to all drains, fixtures and equipment as required.

48  
49    **3.2.    PIPE JOINTS**

- 50    A.     Prepare PVC pipe ends as recommended by manufacturer.  
51    B.     Use a P-70 type primer (for PVC) and a PVC solvent cement appropriate to the pipe size and temperature range.

52  
53    **3.3.    DRAINS AND CLEANOUTS**

- 54    A.     Set floor drains, roof drains and cleanouts level and plumb adjusted to finished floor elevation,  
55    roof elevation or finished wall location.  
56    B.     Locate where serviceable.  
57    C.     Allow minimum of 18" clearance around cleanouts for rodding.  
58    D.     Lubricate threaded cleanout plugs with graphite and oil, teflon tape or waterproof grease.

- 
- 1 E. Install trap primer connections where indicated.  
2 F. Provide deep seal traps on floor drains and hub drains installed in mechanical rooms, penthouses or rooms with  
3 excessive positive or negative pressure.

4 **3.4 TRAPS**

- 5 A. Trap all fixtures and equipment. Trap seals shall be standard depth, except when deep seals are required by  
6 Code. Traps shall be set true and level and located within the limits of the Code requirements. A trap shall not be  
7 used as a separator, interceptor or other type of device to retain solids. All traps above grade shall be provided  
8 with approved screw-type cleanout plugs.  
9 B. Traps shall be protected during construction and sealed to prevent foreign matter from entering. Provide  
10 adjustable expansion plug, plastic cap, or approved equivalent.  
11 C. Install trap-seal protection barrier type on floor drains in mechanical rooms during trim out stage of floor drain  
12 installation.  
13

14 **3.5 TESTING**

- 15 A. Refer to Testing paragraph of Section 22 05 00.  
16 B. Hydro-statically pressure test all piping to 10 feet of water column pressure for 2 hours. No leaks allowed.  
17 Provide mint test of entire system as required by local inspector.  
18

19 **END OF SECTION**

**SECTION 22 13 19**  
**SANITARY WASTE PIPING SPECIALTIES**

1		
2		
3		
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5	1.1. SCOPE .....	1
6	1.2. REFERENCES .....	1
7	1.3. SUBMITTALS .....	1
8	1.4. QUALITY ASSURANCE .....	1
9	PART 2 - PRODUCTS .....	1
10	2.1. FLOOR CLEANOUTS .....	1
11	2.2. FLOOR DRAINS .....	1
12	2.3. TRENCH DRAINS .....	2
13	PART 3 – EXECUTION.....	2
14	3.1. INSTALLATION .....	2

**PART 1 – GENERAL****1.1. SCOPE**

A. This section includes information common to Sanitary Piping Specialties and applies to all sections in this Division.

**B. DEFINITIONS:**

1. ABS: Acrylonitrile-butadiene-styrene plastic.
2. FOG: Fats, oils, and greases.
3. FRP: Fiberglass-reinforced plastic.
4. HDPE: High-density polyethylene plastic.
5. PE: Polyethylene plastic.
6. PP: Polypropylene plastic.
7. PVC: Polyvinyl chloride plastic.

**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:

**1.3. SUBMITTALS**

A. Include rated capacities, operating characteristics, and accessories.

**1.4. QUALITY ASSURANCE**

- A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.
- B. 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.
- C. Comply with ANSI 14, "Plastics Piping Components and Related Materials," for plastic sanitary piping specialty components.

**PART 2 - PRODUCTS****2.1. FLOOR CLEANOUTS**

- A. BASIS-OF-DESIGN: Zurn (Model per schedule) or comparable product by Canplas LLC, IPS Corporation, NDS Inc., Plastic Oddities, Sioux Chief Manufacturing Company, Inc.
- B. SIZE: Size same as drainage piping up to NPS 4 (DN 100). Use NPS 4 (DN 100) for larger drainage piping unless larger cleanout is indicated.
- C. BODY: PVC.
- D. CLOSURE PLUG: PVC.
- E. RISER: Drainage pipe fitting and riser to cleanout of same material as drainage piping.
- F. Locate at each change in direction of piping greater than 45 degrees.
- G. Locate at minimum intervals of 50 feet (15 m) for piping NPS 4 (DN 100) and smaller and 100 feet (30 m) for larger piping.
- H. Locate at base of each vertical soil and waste stack.
- I. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.
- J. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.

**2.2. FLOOR DRAINS**

- A. BASIS-OF-DESIGN: Zurn (Model per schedule) or comparable product by Canplas LLC, IPS Corporation, Josam Company; Josam Div., Oatey., Plastic Oddities; a division of Diverse Corporate Technologies, Sioux Chief Manufacturing Company, Inc.
- B. STANDARD: ASME A112.6.3.
- C. MATERIAL: PVC
- D. SEEPAGE FLANGE: required where drain is not on lowest level
- E. Clamping Device: Required where waterproofing of floor is required.
- F. TOP OR STRAINER MATERIAL: Bronze unless scheduled differently

- 1 G. TOP OF BODY AND STRAINER FINISH: Nickel bronze unless scheduled differently
- 2 H. TOP SHAPE AND DIMENSION: Round or Square per plans
- 3 I. TRAP MATERIAL: same material as drainage piping.
- 4 J. TRAP PATTERN: Standard P-trap
- 5 K. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless
- 6 otherwise indicated.
- 7 1. Position floor drains for easy access and maintenance.
- 8 2. Set floor drains below elevation of surrounding finished floor to allow floor drainage. Set with grates depressed
- 9 according to the following drainage area radii:
- 10 a. Radius, 30 Inches (750 mm) or Less: Equivalent to 1 percent slope, but not less than 1/4-inch (6.35-mm) total
- 11 depression.
- 12 b. Radius, 30 to 60 Inches (750 to 1500 mm): Equivalent to 1 percent slope.
- 13 c. Radius, 60 Inches (1500 mm) or Larger: Equivalent to 1 percent slope, but not greater than 1-inch (25-mm) total
- 14 depression.
- 15 L. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of
- 16 waterproof membranes where penetrated.
- 17 M. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.
- 18 N. Install deep-seal traps on floor drains and other waste outlets, if indicated.
- 19 O. Install floor-drain, trap-seal primer fittings on inlet to floor drains that require trap-seal primer connection.
- 20 1. Exception: Fitting may be omitted if trap has trap-seal primer connection.
- 21 2. Size: Same as floor drain inlet.

### 22 **2.3. TRENCH DRAINS**

- 24 A. BASIS-OF-DESIGN: Aco S100K or comparable product by Polymor Products, ABT, J.R. Smith
- 25 B. GRATE: Heavy duty ductile iron frame and grate with Power Loc locking devices. Din 19580 Class F longitudinal ductile iron
- 26 ASTM A536-84 Grade 65-45-112. 200,000 lbs/foot., 4,182 psi.
- 27 C. The trench system bodies shall be manufactured from polymer concrete with minimum properties as follows:
- 28 1. Compressive Strength: 14,000 psi
- 29 2. Flexural Absorption: 4,000 psi
- 30 3. Water Absorption Frost Proof: 0.07%
- 31 4. Salt Proof:
- 32 D. The nominal clear opening shall be 4.00" (100 mm) with overall width of 6.3" (160mm). Precast units shall be manufactured
- 33 with either an invert slope of 0.6% invert and have a wall thickness of at least 0.67% (16mm). Each unit will feature a full
- 34 radius in the trench bottom and a male to female interconnecting end profile. Units shall have horizontal cast in anchoring
- 35 features on the outside wall to ensure maximum mechanical bond to the surrounding bedding material and pavement
- 36 surface. The ductile iron edge rail will be integrally cast in by the manufacturer to ensure maximum homogeneity between
- 37 polymer concrete body and edge rail. Each rail shall be at least 1/4" (6mm) thick.
- 38 E. Include all necessary accessories and components for a complete installation. Provide all sections to lay out per the plans
- 39 and to allow drainage. Include end caps, joint connectors and other accessories as required.
- 40 F. Install trench drains at low points of surface areas to be drained. Set grates of drains flush with finished surface, unless
- 41 otherwise indicated.

## 42 **PART 3 – EXECUTION**

### 43 **3.1. INSTALLATION**

- 45 A. Install in accordance with manufacturer's instructions and all code requirements.
- 46 B. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.
- 47 C. Install vent caps on each vent pipe passing through roof.
- 48 D. Install frost-resistant vent terminals on each vent pipe passing through roof. Maintain 1-inch (25-mm) clearance between
- 49 vent pipe and roof substrate.
- 50 E. Install expansion joints on vertical stacks and conductors. Position expansion joints for easy access and maintenance.
- 51 F. Install frost-proof vent caps on each vent pipe passing through roof. Maintain 1-inch (25-mm) clearance between vent pipe
- 52 and roof substrate.
- 53 G. Install wood-blocking reinforcement for wall-mounting-type specialties.
- 54 H. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from
- 55 traffic or construction work.
- 56 I. Place plugs in ends of uncompleted piping at end of each day or when work stops.

57 **END OF SECTION**

58



**SECTION 22 14 23  
STORM DRAINAGE PIPING SPECIALTIES**

1  
2  
3  
4 PART 1 – GENERAL ..... 1  
5 1.1. SCOPE ..... 1  
6 1.2. REFERENCES ..... 1  
7 1.3. SUBMITTALS ..... 1  
8 1.4. QUALITY ASSURANCE ..... 1  
9 PART 2 - PRODUCTS ..... 1  
10 1.1. ROOF DRAINS ..... 1  
11 PART 3 – EXECUTION..... 1  
12 3.1. INSTALLATION ..... 1  
13

**PART 1 – GENERAL**

**1.1. SCOPE**

A. This section includes information common to storm drainage specialties and applies to all sections in this Division.

**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:

**1.3. SUBMITTALS**

A. Include rated capacities, operating characteristics, and accessories.

**1.4. QUALITY ASSURANCE**

A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

**PART 2 - PRODUCTS**

**1.1. ROOF DRAINS**

A. CAST-IRON, LARGE-SUMP, GENERAL-PURPOSE ROOF DRAINS :

1. Basis-of-Desig: Zurn Z 100 or comparable product by Josam Company, MIFAB, Inc., Smith, Jay R. Mfg. Co., Tyler Pipe, Wade Div., Watts Water Technologies, Inc.
2. Standard: ASME A112.6.4, for general-purpose roof drains.
3. Body Material: dura-coated Cast iron
4. Dimension of Body: Nominal 14”(357-mm)
5. Combination Flashing Ring and Gravel Stop
6. Outlet: as required at location
7. Extension Collars: as required
8. Underdeck Clamp: as required
9. Sump Receiver Plate: as required
10. Dome Material: Stainless steel
11. Perforated Gravel Guard: on ballasted roofs only: Stainless steel

B. Install roof drains at low points of roof areas according to roof membrane manufacturer's written installation instructions.

1. Install flashing collar or flange of roof drain to prevent leakage between drain and adjoining roofing. Maintain integrity of waterproof membranes where penetrated.
2. Install expansion joints, if indicated, in roof drain outlets.
3. Position roof drains for easy access and maintenance.

**PART 3 – EXECUTION**

**3.1. INSTALLATION**

A. Install in accordance with manufacturer's instructions and all code requirements.

**END OF SECTION**

**SECTION 23 73 39  
INDOOR DIRECT GAS-FIRED HEATING AND VENTILATION UNITS**

1  
2  
3  
4 PART 1 – GENERAL ..... 1  
5 1.1. SCOPE ..... 1  
6 1.2. REFERENCES ..... 1  
7 1.3. SUBMITTALS ..... 1  
8 1.4. QUALITY ASSURANCE ..... 1  
9 PART 2 - PRODUCTS ..... 1  
10 2.1. DIRECT FIRED MAKE-UP AIR UNITS ..... 1  
11 2.2. CABINET ..... 1  
12 2.3. BURNER ..... 2  
13 2.4. FAN ..... 2  
14 2.5. CONTROLS ..... 2  
15 2.6. FILTERS ..... 2

**PART 1 – GENERAL**

**1.1. SCOPE**

A. This section includes information common to indoor direct gas-fired systems.

**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. 23 05 13 – COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT
2. 23 05 19 – METERS AND GAGES FOR HVAC
3. 23 05 29 – HANGERS AND SUPPORT FOR HVAC PIPING AND EQUIPMENT
4. 23 05 48 – VIBRATION AND SEISMIC CONTROL FOR HVAC
5. 23 07 00 – HVAC INSULATION
6. 23 09 00 – INSTRUMENTATION AND CONTROL FOR HVAC
7. 23 09 13.43 - CONTROL DAMPERS
8. 23 11 00 – FACILITY FUEL PIPING
9. 23 31 00 – HVAC DUCT AND CASINGS
10. DIVISION 26 – ELECTRICAL

B. ANSI – American National Standards Institute

C. ANSI Z83.4 - Direct Gas Fired Makeup Air Heaters

**1.3. SUBMITTALS**

- A. Complete fan performance curves for Supply Air, with system operating conditions indicated, as tested on an AMCA Certified Chamber.
- B. Sound performance data for Supply Air, as tested on an AMCA Certified chamber.
- C. Motor ratings, electrical characteristics and motor and fan accessories.
- D. Dimensioned drawings for each type of installation, showing isometric and plan views, to include location of attached ductwork and service clearance requirements.
- E. Estimated gross weight of each installed unit.

**1.4. QUALITY ASSURANCE**

- A. ASME Compliance: Units must be tested for compliance with UL 795, "Commercial-Industrial Gas Heating Equipment."
- B. Entire unit shall be ETL Certified per ANSI Z83.4 or ANSI Z83.18 and bear an ETL mark.
- C. Obtain unit with Integral Heating with all appurtenant components or accessories from a single manufacturer.
- D. Blower performance shall be factory tested for flow rate, pressure, power, air density, rotation speed and efficiency. Ratings are to be established in accordance with AMCA 210, "Laboratory Methods of Testing Fans for Rating."
- E. Engage a factory authorized service representative to perform startup service.

**PART 2 - PRODUCTS**

**2.1. DIRECT FIRED MAKE-UP AIR UNITS**

A. MANUFACTURERS: Greenheck, Modine or approved equal.

- ~~1. Provide direct drive fan unit if available from scheduled manufacturer for same unit size.~~

**2.2. CABINET**

A. MATERIALS: Formed, double wall insulated metal cabinet. Underside of unit shall have formed metal panels covering base panel insulation.

- 1 B. Outside casing: 18 gauge, galvanized (G90) steel meeting ASTM A653 for components that do not receive a painted finish.  
2 Pre-painted components as supplied by the factory shall have polyester urethane paint on 18 gauge G60 galvaneal steel.  
3 Base rail is 12 gauge, galvanized (G90) steel.
- 4 C. Internal assemblies: 24 gauge, galvanized (G90) steel except for motor supports which shall be minimum 14 gauge  
5 galvanized (G90) steel.
- 6 D. CABINET INSULATION: Comply with NFPA 90A and NFPA 90B and erosion requirements of UL 181.  
7 1. Materials: Fiberglass insulation. If insulation other than fiberglass is used, it must also meet the Fire Hazard  
8 Classification shown below.  
9 2. Thickness: 1 inch (25 mm)  
10 3. Fire Hazard Classification: Maximum flame spread of 25 and smoke developed of 50, when tested in accordance with  
11 ASTM C 411.  
12 4. Location and application: Full interior coverage of entire cabinet to include walls and roof of unit shall be semi-rigid  
13 type and installed between inner and outer shells of all cabinet exterior components Full interior coverage from  
14 Heating section all the way to air-intake.
- 15 E. ACCESS PANELS: Unit shall be equipped with [insulated] [removable/lift off] [hinged] access panels to provide easy access  
16 to all major components. Access panels shall be fabricated of 18 gauge galvanized G90 steel. Specific type of steel and  
17 finish should match "Cabinet Materials" above.  
18

### 19 2.3. BURNER

- 20 A. Unit shall be factory assembled, piped and wired. Direct gas-fired system will be 92% efficient while supplying a burner that  
21 is capable of providing 25:1 turndown. Unit will utilize a draw through design and incorporate adjustable burner baffles  
22 plates for field adjustments. Unit will have a direct spark ignition system.
- 23 B. Burner construction shall consist of a cast aluminum burner manifold and 400 series stainless steel mixing plates. No air  
24 from the inside space shall be allowed to pass across the burner at any time. Flame sensing shall be provided by ultra-violet  
25 scanner. A flame safeguard display shall be included. Burner control shall have a digital coded fault indicator capable of  
26 storing the last five faults.
- 27 C. Shall be equipped for operation on natural gas with a maximum rated inlet gas pressure that is available at location. Provide  
28 pressure regulator as required per specification elsewhere in this division.
- 29 D. Burner control options to include the following External signal for burner modulation with integral discharge temperature  
30 limits using an external 2 - 10 VDC signal.
- 31 E. Shall include the following safety controls:
- 32 F. Manual Reset, High Limit Switch: Main gas valve closes if high-limit temperature is exceeded.
- 33 G. Include high and low gas pressure switches and visual indication gas valves-when applicable.
- 34 H. Hydraulic proof of close valves(s) shall be included.
- 35 I. Visual indication: Clear visual signal demonstrating the position of the main gas safety shutoff valves.  
36

### 37 2.4. FAN

- 38 A. BLOWER ASSEMBLIES: Shall be statically and dynamically balanced and designed for continuous operation at maximum  
39 rated fan speed and horsepower and must have [neoprene vibration isolation devices, minimum of 1 – 1/8 inches thick]
- 40 B. FAN: Airfoil plenum fan statically and dynamically balanced, AMCA certified for air and sound performance. If airfoil is not  
41 available in unit size, use Backward Curved fan  
42

### 43 2.5. CONTROLS

- 44 A. Unit shall be controlled by Building Automation System (BAS) unless noted differently.  
45 B. BAS will measure DAT and modulate burner.  
46 C. BAS will control fan speed.  
47

### 48 2.6. FILTERS

- 49 A. Provide MERV 8 filters unless plans require higher MERV rating.  
50 B. Filters shall meet requirements specified elsewhere in this division.  
51

52 **END OF SECTION**

**SECTION 32 05 00**  
**COMMON WORK RESULTS FOR EXTERIOR IMPROVEMENTS**

1  
2  
3  
4 PART 1 – HEADING 1 ..... 1  
5 1.1 SCOPE ..... 1  
6 1.2 RELATED WORK ..... 1  
7 1.3 REFERENCED ORGANIZATIONS ..... 1  
8 1.4 REFERENCED DOCUMENTS ..... 2  
9 1.5 QUALITY ASSURANCE ..... 2  
10 1.6 SAFETY ..... 2  
11 1.7 PERMITS ..... 2  
12 1.8 CONSTRUCTION LIMITS ..... 2  
13 1.9 EQUIPMENT & MATERIALS FURNISHED BY OTHERS ..... 2  
14 1.10 SUBMITTALS ..... 2  
15 1.11 OFF SITE STORAGE ..... 2  
16 1.12 CODES ..... 2  
17 1.13 CERTIFICATIONS AND INSPECTIONS ..... 2  
18 2.1 BARRICADES, SIGNS, AND WARNING DEVICES ..... 3  
19 2.2 TEMPORARY PLASTIC BARRIER FENCING ..... 3  
20 PART 3 – EXECUTION ..... 3  
21 3.1 MAINTENANCE OF SITE AND BUILDING ACCESS/EGRESS ..... 3  
22 3.2 CONTINUITY OF EXISTING TRAFFIC/PARKING AND TRAFFIC CONTROL ..... 3  
23 3.3 PROTECTION AND CONTINUITY OF EXISTING UTILITIES ..... 3  
24 3.4 PROTECTION OF EXISTING WORK AND FACILITIES ..... 3  
25 3.5 CONSTRUCTION LAYOUT ..... 4  
26 3.6 STORMWATER/EXCAVATION WATER MANAGEMENT ..... 4

**PART 1 – HEADING 1**

**1.1 SCOPE**

- A. This section provides information common to two or more technical site work specification sections or items that are of a general nature, and not included in other sections. This section applies to ALL site work, as applicable.

**1.2 RELATED WORK**

- A. Applicable provisions of Division 01 govern work under this Section.  
B. Section 31 00 05 Civil General Requirements.  
C. Section 31 05 00 Common Work Results for Earthwork (Outside Building Footprint)  
D. Section 32 13 00 Cast-in-Place Concrete (Outside the Building Footprint)

**1.3 REFERENCED ORGANIZATIONS**

- A. Applicable provisions of Division 01 shall govern all work under this section.  
B. Abbreviations of organizations referenced in these specifications are as follows:  
– AASHTO American Association of State Highway and Transportation Officials  
– ACPA American Concrete Pipe Association  
– ANSI American National Standards Institute  
– ASCE American Society of Civil Engineers  
– ASME American Society of Mechanical Engineers  
– ASTM American Society for Testing and Materials  
– AWWA American Water Works Association  
– AWS American Welding Society  
– FHA Federal Highway Administration  
– EPA Environmental Protection Agency  
– NEC National Electric Code  
– NEMA National Electrical Manufacturers Association  
– NFPA National Fire Protection Association

- 1           – NSF National Sanitation Foundation
- 2           – OSHA Occupational Safety and Health Administration
- 3           – STI Steel Tank Institute
- 4           – UL Underwriters Laboratories Inc.
- 5           – WDNR State of Wisconsin Department of Natural Resources
- 6           – WisDOT State of Wisconsin Department of Transportation
- 7           –

8   **1.4 REFERENCED DOCUMENTS**

- 9    A.   Where reference is made to the "SSHSC", it shall mean the pertinent sections of the State of Wisconsin,  
10       Department of Transportation, Standard Specifications for Highway and Structure Construction, current edition,  
11       and all supplemental and interim supplemental specifications. Where reference is made to the "STANDARD  
12       SPECIFICATIONS", it shall mean pertinent sections of the City of Madison Standard Specifications for Public  
13       Works Construction, current edition. Where reference is made to the "BMPH", it shall mean the Wisconsin  
14       Construction Site Best Management Practice Handbook, current edition as published by the WDNR. Method of  
15       measurement and basis of payment sections in referenced documents shall not apply.

16  
17   **1.5 QUALITY ASSURANCE**

- 18    A.   Provide materials and products as required by individual specification sections. Refer to Division 01– General  
19       Requirements of the Contract regarding substitutions.
- 20    B.   Provide quality assurance testing and reporting as required by individual specification sections.

21  
22   **1.6 SAFETY**

- 23    A.   Contractor is solely responsible for worksite safety.
- 24    B.   Perform all work in accordance with applicable OSHA, state and local safety standards.
- 25    C.   Contact Diggers Hotline at 1-800-242-8511 in accordance with statutory requirements. Request that non-  
26       member utilities and private utilities be located by the appropriate parties.

27  
28   **1.7 PERMITS**

- 29    A.   Unless otherwise noted in the Contract Documents, Contractor shall be responsible for obtaining and paying for  
30       all permits necessary to complete the work.

31  
32   **1.8 CONSTRUCTION LIMITS**

- 33    A.   Construction Limits are indicated on the drawings. In the absence of such a designation on the drawings, confine  
34       work to the minimum area reasonably necessary to undertake the work as determined by the Construction  
35       Representative. In no case shall construction activities extend beyond property lines or construction easements.
- 36    B.   The Contractor shall restore all disturbed areas in accordance with the drawings and specifications. If plans and  
37       specifications do not address restoration of specific areas, these areas will be restored to pre-construction  
38       conditions as approved by the Construction Representative.

39  
40   **1.9 EQUIPMENT & MATERIALS FURNISHED BY OTHERS**

- 41    A.   Not Used

42  
43   **1.10 SUBMITTALS**

- 44    A.   Refer also to General Conditions of the Contract and Division 01.
- 45    B.   Submit manufacturer's shop drawings, product data, samples, substitutions and operation and maintenance  
46       (O&M) data for approval as required by individual specification sections using the format specified in Section 31  
47       00 05 Civil General Requirements.

48  
49   **1.11 OFF SITE STORAGE**

- 50    A.   Refer to Division 01.
- 51    B.   Coordinate with owner prior to bidding if required.

52  
53   **1.12 CODES**

- 54    A.   Comply with the requirements of all applicable, local, state and federal codes.

55  
56   **1.13 CERTIFICATIONS AND INSPECTIONS**

- 57    A.   Refer to General Conditions.

- 1 B. Obtain and pay for all required sampling, testing, inspections, and certifications except those expressly listed as  
2 provided by the Owner, A/E or other third party in the Contract Documents. Deliver originals of certificates and  
3 documents to the Construction Representative within 3 days; provide copies to the A/E. Include copies of the  
4 certifications and documents in the O&M Manual.  
5

6 **PART 2 – MATERIALS**  
7

8 **2.1 BARRICADES, SIGNS, AND WARNING DEVICES**  
9

- 10 A. Traffic barricades, traffic signs, and warning devices shall meet the requirements of applicable OSHA standards  
11 and the FHA Manual of Uniform Traffic Control Devices (MUTCD).  
12 B. Traffic signing materials shall meet the requirements of Sections 634, 636, and 637 of Standard Specifications for  
13 Highway Construction except that signs shall be from aluminum blanks.  
14 C. Galvanized 2" round posts shall be provided for all signs.  
15

16 **2.2 TEMPORARY PLASTIC BARRIER FENCING**

- 17 A. UV stabilized high-density polyethylene barrier fence free of holes tears and other defects. Provide 4' tall fence  
18 in diamond or rectangular pattern. Fencing shall be "safety orange" color, unless otherwise noted.  
19 B. Posts for temporary plastic barrier fencing shall be 5' tall, minimum 12 gauge, painted metal posts.  
20

21 **PART 3 – EXECUTION**  
22

23 **3.1 MAINTENANCE OF SITE AND BUILDING ACCESS/EGRESS**

- 24 A. Unless otherwise shown or directed, maintain existing access and egress to the facility throughout construction.  
25 Maintain ANSI A117 compliant access for disabled persons, delivery access, emergency vehicle access, and  
26 emergency egress. Do not interrupt access and egress without prior written approval from the Construction  
27 Representative.  
28

29 **3.2 CONTINUITY OF EXISTING TRAFFIC/PARKING AND TRAFFIC CONTROL**

- 30 A. Refer also to Division 01 - General Requirements.  
31 B. Do not interrupt or change existing traffic, delivery, or parking without prior written approval from the  
32 Construction Representative. When interruption is required, coordinate schedule with the Owner agency to  
33 minimize disruptions. When working in public right-of-way, obtain all necessary approvals and permits from  
34 applicable municipalities and WISDOT.  
35 C. When Contractor's activities impede or obstruct traffic flow, Contractor shall provide traffic control devices, signs  
36 and flaggers in accordance with other Contract Documents and the current version of the MUTCD, or as shown  
37 on the Drawings.  
38

39 **3.3 PROTECTION AND CONTINUITY OF EXISTING UTILITIES**

- 40 A. Verify the locations of any water, drainage, gas, sewer, electric, drainage, gas, sewer, electric,  
41 telephone/communication, fuel, steam lines or other utilities and site features which may be encountered in any  
42 excavations or other sitework. All lines shall be properly underpinned and supported to avoid disruption of  
43 service.  
44 B. Do not interrupt or change existing utilities without prior written approval from the Construction Representative,  
45 affected utilities and users. Notify all users impacted by outages a minimum of 48 hours in advance of outage.  
46 Notification shall be provided in writing and describe the nature and duration of outages and provide the name  
47 and number of Contractor's foreperson or other contact.  
48 C. Any service connections encountered that are to be removed shall be cut off at the limits of the excavation and  
49 capped in accordance with the requirements of applicable codes and any specifications governing such removals.  
50

51 **3.4 PROTECTION OF EXISTING WORK AND FACILITIES**

- 52 A. Verify the locations of, and protect, any signs, paved surfaces, buildings, structures, landscaping, streetlights,  
53 utilities, and all other such facilities that may be encountered or interfered with during the progress of the work.  
54 Take measures necessary to safeguard all existing work and facilities that are outside the limits of the work or  
55 items that are within the construction limits but are intended to remain. Report any damage to existing facilities  
56 to the Construction Representative immediately. Correct and pay for all damages.  
57

- 1    **3.5    CONSTRUCTION LAYOUT**
- 2    A.    Contractor shall establish all heights and grades to properly execute work from bench mark established by others
- 3        (from original survey work). It is strongly recommended that the original surveyor be contacted and used for all
- 4        construction layout as well as as-built surveys in an effort to avoid conflict between datums and horizontal
- 5        control points used. Prior to construction layout, existing and proposed finished floor elevations shall be checked
- 6        with respect to current site benchmarks to ensure elevations correspond with layout elevations.
- 7    B.    Contractor shall provide all construction layout surveys to accurately locate the construction on the site.
- 8
- 9    **3.6    STORMWATER/EXCAVATION WATER MANAGEMENT**
- 10   A.    Control grading around structures, pitch ground to prevent water running into excavated areas.
- 11   B.    Pits, trenches within building lines and other excavations shall be maintained free of water.
- 12   C.    Provide trenching, pumping, other facilities required.
- 13   D.    Notify Architect/Engineer if springs or running water are encountered in excavation; provide discharge by
- 14        trenches, drains, pumping to point outside of excavation. Provide information to Architect/Engineer of points
- 15        and areas that water will be discharged. At the Engineer's option, the Contractor shall drain the spring to the
- 16        storm sewer system by the use of field tile.
- 17   E.    Be responsible for control measures to prevent damage from flooding, erosion, and sedimentation to on-site and
- 18        off-site areas.
- 19
- 20

**END OF SECTION**

**SECTION 32 11 23.33  
DENSE GRADED BASE**

1  
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3  
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18 3.3 UNDERCUTTING/EXCAVATION BELOW SUBGRADE (EBS) ..... 4  
19

**PART 1 – GENERAL**

**1.1 SCOPE**

- A. The work under this section consists constructing a dense graded base using crushed stone or crushed gravel.

**1.2 RELATED WORK**

- A. Applicable provisions of Division 01 govern work under this Section.  
Section 03 30 05 Cast-in-place Concrete (Outside the Building Footprint)  
Section 31 05 00 Common Work Results for Earthwork (Outside Building Footprint)

**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

**1.4. RECORD DRAWINGS**

- A. 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.

**1.5 REFERENCES**

- A. 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.  
B. Applicable provisions of Division 1 shall apply to this section.

**1.6 CONTINUITY OF EXISTING TRAFFIC, PARKING, AND UTILITIES**

- A. Do not interrupt or change existing traffic, delivery, parking, or utility services without prior written approval from the Construction Representative. When traffic interruption is required, coordinate schedule with the Owner agency to minimize disruptions.



1 **1.7 PROTECTION OF EXISTING WORK AND FACILITIES**

- 2 A. The Contractor shall verify the locations of, and protect, any signs, adjacent paved surfaces, buildings, structures,  
3 landscaping, lights, utilities, and all other such facilities that may be encountered or interfered with during the  
4 progress of the work. The contractor shall take measures necessary to safeguard existing work and facilities  
5 which are outside the limits of the work or items which are within the construction limits but are intended to  
6 remain.

7  
8 **1.8 OWNER FURNISHED MATERIALS**

- 9 A. Not used.

10  
11 **1.9 PROVISIONS FOR FUTURE WORK OR WORK BY OTHERS**

- 12 A. The contractor shall coordinate his work and access to the site with the work and access requirements of all  
13 other contractors prior to the start of work -- especially when such work will connect to, or be connected to,  
14 other work.

15  
16 **PART 2 – MATERIALS**

17  
18 **2.1 GENERAL**

- 19 A. Use dense graded base. Materials shall conform to Section 301.2 of the WisDOT Standard Specifications for  
20 Highway and Structure Construction. Material gradations shall conform to Section 305.2.2 of the WisDOT  
21 Standard Specifications for Highway and Structure Construction unless specified elsewhere in the contract  
22 documents.  
23 B. Base Course Gradation: 1-1/4" Crushed Aggregate

24  
25 **2.2 BREAKER RUN AGGREGATE**

- 26 A. Crushed stone, rock or gravel meeting the requirements of either Breaker Run or Select Crushed material as  
27 defined in Section 311.2 or Section 312.2 of Standard Specifications for Highway Construction, respectively.

28  
29 **PART 3 - EXECUTION**

30  
31 **3.1 CONSTRUCTION**

- 32 A. Preparing the Pavement Foundation (sub-grade)
- 33 1. Prepare the foundation, or resurface the previously placed base layer, as specified in WisDOT Section 211  
34 before placing base. Do not place base foundations that are soft, spongy, or covered by ice or snow.  
35 Water and rework or re-compact dry foundations as necessary to ensure proper compaction, or as the  
36 representative designates.
    - 37 a. In proposed pavement areas, all organic solid shall be removed.
    - 38 b. Excavation shall be reasonably free of water prior to beginning filling. Do not place material on  
39 frozen surfaces or use frozen material.
    - 40 c. In areas of existing pavement to be modified or adjusted in grade, the existing pavement section  
41 shall be removed by an acceptable method. The new pavement section shall match the  
42 construction details.
    - 43 d. Place and compact material to minimize settlement and avoid damage to structures, pipes, utility  
44 lines and other features. Handplace and compact material as necessary.
    - 45 e. Moisture condition backfill material as necessary to achieve density required for given use.
    - 46 f. Compact fill material as required for the given use.
    - 47 g. It is the responsibility of the Contractor to provide all necessary compaction equipment and other  
48 grading equipment that may be required to obtain the specified density. Vibratory plate or  
49 tamping type walk behind compactors will be required whenever backfill is placed adjacent to  
50 structures, pipes, utility lines and other features.
    - 51 h. Where additional filling or excavation is necessary, or placement of base course will be delayed,  
52 roll surface of proposed roadway or parking lot with a smooth drum roller to provide relatively  
53 impervious surface and promote drainage.
  - 54 2. Proof-roll all subgrade areas that are to receive aggregate base or pavement. Proof-roll with a loaded  
55 dump truck prior to the placement of base courses to locate soft spots that yield under loading.  
56 Overexcavate (undercut) areas of soft subgrade that will not compact readily when proof rolled or  
57 tamped. Backfill with breaker run or select crushed material as approved by the project representative.

- 1 a. Prior to undercutting or excavating below subgrade (EBS) or placing any base course, contact the  
2 Construction Representative to schedule inspection of subgrade and proof rolling. Provide  
3 minimum of 24 hrs confirmed notice. All proof rolling shall be completed in the presence of the  
4 Construction Representative and Geotechnical Consultant.
- 5 b. To complete proof rolling, entire roadway subgrade shall be provided with a relatively smooth  
6 surface, suitable for observing soil reaction during proof rolling.
- 7 c. Contractor shall schedule and provide a fully loaded tri-axle dump truck for proof – rolling. Loaded  
8 truck shall have a minimum gross operating weight of 30 tons. Test shall be conducted with “tag”  
9 or “pusher” axles retracted from the ground.
- 10 d. Test rolling shall be accomplished in a series of traverses parallel to the centerline of the street or  
11 parking area. The truck shall traverse the length of the street or parking area once for each 12’ of  
12 width. Additional passes along the traverse shall be completed as directed by the Geotechnical  
13 Consultant, to further define unsatisfactory subgrade.
- 14 e. Soft areas, yielding areas, cracked areas or areas where rolling or wave action is observed shall be  
15 considered indicative of an unsatisfactory subgrade. Such areas shall be undercut as outlined in  
16 Section 31 05 00.
- 17 f. Once the subgrade has been proof-rolled and approved, protect the soils from becoming  
18 saturated, frozen, or adversely altered.
- 19 g. Contractor shall assume 15% of proposed paved areas may require undercutting. This work shall  
20 be included in base bid. Undercut as outlined in Section 31 05 00.
- 21 B. Stockpiling
- 22 1. If continuous compliance with material specifications is questionable, the project representative may  
23 require the contractor to supply material from a stockpile of previously tested material. Maintain a  
24 sufficiently large stockpile to preclude the use of material not previously approved.
- 25 2. Build and maintain stockpiles using methods that minimize segregation and prevent contamination. If the  
26 contract specifies location, place stockpiles where specified. Clear and prepare stockpile areas to  
27 facilitate the recovery of the maximum amount of stockpiled material.
- 28 C. Constructing Base
- 29 1. Place aggregate in a manner that minimizes hauling on the subgrade. Do not use vehicles or operations  
30 that damage the subgrade or in-place base. Deposit material in a manner that minimizes segregation.
- 31 2. Construct the base to the width and section the plans show. Shape, and compact the base surface to  
32 within 0.04 feet (12 mm) of the plan elevation.
- 33 3. Ensure there is adequate moisture in the aggregate during placing, shaping, and compacting to prevent  
34 segregation and achieve adequate compaction.
- 35 4. Maintain the base until paving over it, or until the project representative accepts the work, if paving is  
36 not part of the contract. The contractor is not responsible for maintaining material placed on detours,  
37 unless the special provisions specify otherwise.
- 38 D. Standard Compaction
- 39 1. Compact the base until there is no appreciable displacement, either laterally or longitudinally, under the  
40 compaction equipment. Route hauling equipment uniformly over previously placed base. Compact each  
41 layer before placing a subsequent layer. If the material is too dry to readily attain the required  
42 compaction, add water as necessary to achieve compaction
- 43 E. Special Compaction
- 44 1. If the contract requires special compaction, compact each layer to 95 percent of maximum density, or  
45 more, before placing the subsequent layer. The geotechnical engineer will determine the maximum  
46 density according to AASHTO T 99 method C or D and in-place density according to AASHTO T 191.
- 47 F. Controlling Dust
- 48 1. Apply water or other engineer-approved dust control materials to control dust during construction and  
49 maintenance of the base and shoulders.
- 50
- 51 **3.2 COMPACTION**
- 52 A. General
- 53 1. Compact each base layer, including shoulder foreslopes, with equipment specified in WisDOT Section  
54 301.3.1. Use standard compaction conforming to WisDOT Section 301.3.4.2, unless the special provisions  
55 specify other methods. Final shaping of shoulder foreslopes does not require compaction.
- 56 B. Compacting 1 1/4-Inch Base and 3/4-Inch Base
- 57 1. If using a pneumatic roller, do not exceed a compacted thickness of 6 inches (150 mm) per layer. For the  
58 first layer placed over a loose sandy subgrade, the contractor may, with the geotechnical engineer’s

- 1 approval, increase the compacted layer thickness to 8 inches (200 mm). If using a vibratory roller, do not  
2 exceed a compacted thickness of 8 inches (200 mm) per layer.  
3 C. Compacting 3-Inch Base  
4 1. Compact with a vibratory or pneumatic roller. Do not exceed a compacted thickness of 9 inches (225 mm)  
5 per layer.  
6

7 **3.3 UNDERCUTTING/EXCAVATION BELOW SUBGRADE (EBS)**

- 8 A. Undercutting/EBS shall be completed only when directed by the Geotechnical Consultant. The Contractor shall  
9 not be compensated for any unauthorized undercutting/EBS. Measure and document undercut areas and depths  
10 in consultation with Geotechnical Consultant. Work shall comply with Section 31 05 00. Contractor shall assume  
11 15% of proposed paved areas may require undercutting. This work shall be included in base bid.  
12

13 **3.4 CLEANUP**

- 14 A. After the project is completed, thoroughly clean up all debris which may have accumulated during the placement  
15 of dense graded base. Replace or repair as required, all surfaces and/or landscape features damaged or  
16 disturbed under this item of work.  
17

18 **END OF SECTION**

**SECTION 32 12 00  
ASPHALTIC PAVEMENT**

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**PART 1 – GENERAL**

**1.1. SUMMARY**

- A. Work under this section includes all labor, materials, equipment, and services necessary to complete the bituminous concrete paving work as shown on the drawings and herein specified.

**1.2 RELATED SECTIONS**

- A. Division 31 Earthwork  
B. Division 32 Exterior Improvements

**1.3 REFERENCES**

- A. City of Madison Standard Specifications for Public Works Construction.  
B. Part 4, "Pavements" of the latest edition of the Standard Specifications for Highway and Structure Construction of the State of Wisconsin, Department of Transportation.

**1.5 SUBMITTALS**

- A. Submittals shall be in accordance with Division 01.  
B. The Contractor shall provide to the City the 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%).  
C. 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 be PG 58-28 for E-0.3, E-1 and E-3 mixes, and PG64-22 for E-10 mixes unless otherwise specified in the Special Provisions of the contract. D.

**1.6 QUALITY ASSURANCE**

- A. Regulatory Requirements  
1. Conform to requirements of local, state, and federal rules and regulations applicable to work and project location.  
2. Conform to the applicable requirements and recommendations of the following codes, specifications, and standards except as modified by the Contract Documents and herein:  
a. Wisconsin Department of Transportation, Standard Specifications.

- 1                    3.     Where provisions of pertinent regulations, codes, and standards conflict with this specification, the more  
2                    stringent provisions shall govern.  
3

4     **1.6     PROJECT CONDITIONS**

5  
6     A.     Project Environmental Requirements

- 7                    1.     Do not apply asphalt materials if subgrade is wet or excessively damp, if rain is imminent or expected  
8                    before time required for adequate cure, or if the following conditions are not met:  
9                    a.     Tack Coat: Minimum surface temperature of 60°F.  
10                    b.     Asphalt Base Course: Minimum surface temperature of 40°F and rising at time of placement.  
11                    c.     Asphalt Surface Course: Minimum surface temperature of 60°F at time of placement.  
12                    2.     Pavement Marking Paint: Proceed with pavement marking only on clean, dry surfaces and at a minimum  
13                    ambient or surface temperature of 40°F for oil-based materials, and not exceeding 95° F.  
14

15     **PART 2 - PRODUCTS**

16  
17     **2.1     MATERIALS**

- 18     A.     The materials intended for use in base, lower, and upper layer mixtures, tack and seal coats, surface treatments,  
19                    and similar work, shall comply with the requirements of Part 4, "Pavements" of the latest edition of the Standard  
20                    Specifications for Highway and Structure Construction of the State of Wisconsin, Department of Transportation,  
21                    except as modified herein or in the Special Provisions of the contract.  
22     B.     The Contractor shall provide Asphalt Pavement mix designs in accordance with the aforementioned Part 4 of the  
23                    latest edition of the Standard Specifications for Highway and Structure Construction of the State of Wisconsin,  
24                    Department of Transportation. The asphaltic materials used shall be PG 58-28 for E-0.3, E-1 and E-3 mixes, and  
25                    PG64-22 for E-10 mixes unless otherwise specified in the Special Provisions of the contract.  
26     C.     The 2.25" binder layer shall be WisDOT Type E-0.3.  
27     D.     The 2" surface layer shall be WisDOT Type E-0.3.  
28

29     **2.2     RECYCLED ASPHALTIC MATERIALS**

- 30     A.     The contractor may use recycled asphaltic materials from FRAP, RAP, and RAS in HMA mixtures. Stockpile  
31                    recycled materials separately from virgin materials and list each as individual JMF components.  
32     B.     Control recycled materials used in HMA by evaluating the percent binder replacement, the ratio of recovered  
33                    binder to the total binder. Conform to the following:  
34

MAXIMUM ALLOWABLE PERCENT 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

- 35  
36  
37     C.     When used in combination the RAS component cannot exceed 5 percent of the total weight of the aggregate  
38                    blend.  
39

40     **2.3     ASPHALT TACK COAT**

- 41     A.     Unless otherwise specified in the contract, or directed by the Engineer, the types and grades of asphalt materials  
42                    and rates of applications in gallons per square yard shall conform to the following requirements:  
43                    1.     The tack coat material shall be type MS-2, SS-1, SS-1h, CSS-1, or an approved modified emulsified asphalt.  
44

45     **2.4     RECYCLED ASPHALT PAVEMENT**

- 46     A.     This work shall consist of the construction of a plant mixed recycled asphalt mixture furnished and placed all in  
47                    accordance with Article 460 of the latest edition of the Standard Specifications for Highway and Structure  
48                    Construction of the State of Wisconsin, Department of Transportation, except as listed below.  
49     B.     The City of Madison shall approve the sources of recycled asphalt material, including shingles.  
50

51     **PART 3 - EXECUTION**

**3.1 WORKERS**

A. The Contractor shall provide competent workers who are capable of performing the duties assigned to them in the work of placing and compacting asphalt mixtures in accordance with the specifications. 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.

**3.2 EQUIPMENT**

A. 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.

**3.3 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.

**3.4 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	92.0
Upper	91.5	92.0

**3.5 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.

- 1 B. Where reheating of joints is needed to create a “hot” joint, reheating equipment and methods shall be in
- 2 accordance with the latest edition of the Standard Specifications for Highway and Structure Construction of the
- 3 State of Wisconsin, Department of Transportation, specifically Reheating HMA Pavement Longitudinal Joints,
- 4 Item 460.4100S.
- 5 C. Where “Michigan” joints are placed to allow traffic use, the joint shall be milled, reheated and tacked in
- 6 accordance with the above stated reheating specification before continuation of paving.
- 7 D. Contractor’s operations shall not result in additional transverse joints unless approved by the Engineer.

8  
 9 **3.6 ASPHALT PAVEMENT**

- 10 A. Unless otherwise specified or directed by the Engineer, asphalt driveways and asphalt terrace paving shall be
- 11 constructed of three (3) inches of upper layer pavement installed in one (1) lift on select fill, or as directed by the
- 12 Engineer. E-0.3 mixture with 9.5mm nominal aggregate size or an approved commercial mix shall be used, unless
- 13 a substitute is approved by engineer.
- 14 B. The composition for the various asphalt mixtures shall conform to the limits specified in Part 4 of the latest
- 15 edition of the Standard Specifications for Highway and Structure Construction of the State of Wisconsin,
- 16 Department of Transportation, except as modified herein or in the Special Provisions of the contract. Warm mix
- 17 HMA is not approved.
- 18 C. The mixture shall be laid and compacted so that the average yields in pounds per square yard shall conform to
- 19 the following charts showing the various thicknesses of installation:

<b>UPPER &amp; LOWER LAYER(S) YIELD - #/S.Y.</b>		
<b>Thickness</b>	<b>Min.</b>	<b>Max.</b>
1.5”	172	180
1.75”	201	210
2”	230	240
2.5”	287	300
3”	345	360
4”	460	480
5”	575	600

- 21
- 22
- 23 D. Unless otherwise specified in the contract, or directed by the Engineer, the upper layer mixtures shall be
- 24 installed in one course of one and one -half (1-3/4) inches in depth.
- 25 E. For installations of the upper layer which are specified to be other than one and one-half (1-1/2) inches in depth,
- 26 the allowable yields for such installations shall be in proportion to the allowable yields specified above.
- 27 F. Whenever the yields fall below the minimum allowable yields specified above, the Engineer shall determine the
- 28 corrective action to be taken. The corrective action may include removal and replacement of the area of
- 29 deficient thickness, an overlay with approved material of the area of deficient thickness, or such other action as
- 30 the Engineer shall determine. The area of deficient thickness shall be determined on the basis of project area or
- 31 area overed in one day’s operation, whichever is less. The Engineer’s determination will be based on the
- 32 circumstances of the area involved, and will include a determination of the distribution of costs of the corrective
- 33 work required.

34  
 35 **3.7 ASPHALT TACK COAT**

- 36 A. For existing concrete or asphalt pavements, the rate of application shall be between 0.05 and 0.10 gallons per
- 37 square yard.

38  
 39 **38. TESTING**

- 40 A. Asphalt mixtures intended for use on City projects will be tested by the City in order to determine aggregate
- 41 gradations, asphalt content, air voids and VMA. Asphalt mixtures shall be tested per section 460.2.8 of the latest
- 42 edition of the Standard Specifications for Highway and Structure Construction of the State of Wisconsin,
- 43 Department of Transportation

44  
 45 **END OF SECTION**

**SECTION 32 13 00**  
**CONCRETE WORK (OUTSIDE THE BUILDING ENVELOPE) AND CONCRETE STRUCTURES**

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**PART 1 – GENERAL**

**1.1. SCOPE**

**1.2. RELATED WORK**

**1.3. REFERENCED STANDARDS**

- A. All concrete used on City of Madison Public Works projects shall comply with the following Subsections of Article 501, "Concrete" of the latest edition of the Standard Specifications for Highway and Structure Construction of the State of Wisconsin, Department of Transportation, Division of Highways, except as modified herein or in the Special Provisions of the contract:
1. 501.2 Materials
  2. 501.3 Construction

**1.4. SUBMITTALS**

**1.5. QUALITY ASSURANCE**

- A. Concrete tests shall be made as directed by the Engineer to assure compliance with these Specifications. Tests shall be made in accordance with the requirements of Article 106 - Control of Materials, of these Specifications, and as specified below.
1. Slump and Air Tests
    - a. Slump tests shall be made following the "Methods of Test for Slump of Portland Cement Concrete" (ASTM C-143). Slump tests shall always be made from the same batch of concrete from which strength tests are made, and may be made when strength tests are not made.
    - b. Air content tests shall be made in accordance with the "Method of Test for Air Content of Freshly Mixed Concrete by the Pressure Method" (ASTM C-231). Air content may also be checked by the use of approved Air Content Indicators.
    - c. If the measured slump or air content falls outside the specified limits, a check test shall be made immediately on another portion of the same sample. In the event of a second failure, the concrete shall be considered to have failed to meet the Specifications and shall not be used in the



- 1 work. Any concrete from the same batch from which the tests were made which has been placed  
2 shall be removed and disposed of by the Contractor at the Contractor's expense.
- 3 2. Strength Tests
- 4 a. Strength tests shall be made for each of the following conditions:
- 5 i. each day's pour; each class of concrete;
- 6 ii. each change of source of supply; or
- 7 iii. when ordered by the Engineer.
- 8 b. A strength test shall consist of a minimum of two (2) standard six (6) inch concrete cylinders for  
9 each one hundred fifty (150) cubic yards of concrete or fraction thereof placed on any day.
- 10 c. The City representative shall make the cylinders following the "Method of Making and Curing  
11 Concrete Compression and Flexure Test Specimens in the Field" (ASTM C-31). The cylinders will be  
12 tested by the City at its own expense at seven (7) days or at twenty-eight (28) days, unless  
13 otherwise specified, in accordance with the "Method of Test for Compressive Strength of Molded  
14 Concrete Cylinders" (ASTM C-39). The Contractor shall furnish all materials, labor, and equipment  
15 necessary for fabricating, preparing, protecting, and transporting all required samples, including  
16 concrete, cylinder molds, and wooden boxes suitable for the protection and transportation of the  
17 samples.
- 18 d. In the event test cylinders show the compressive strength of the concrete to be below the  
19 specified compressive strength of concrete, the following procedure shall be followed:
- 20 i. Three (3) cores shall be taken for each cylinder test below the specified compressive  
21 strength of concrete. Cores shall be taken in accordance with the "Standard Methods of  
22 Securing, Preparing and Testing Specimens from Hardened Concrete for Compressive and  
23 Flexural Strengths" (ASTM C-42), from the area of the pour represented by the defective  
24 cylinders. These cores shall be tested as prescribed in Section 4 of the "Method of Test for  
25 Compressive Strength of Molded Concrete Cylinders" (ASTM C-39) in order to verify the  
26 cylinder tests.
- 27 ii. Where the cores show the compressive strength of the concrete to equal or exceed the  
28 specified compressive strength of concrete, the pour in question shall be accepted, and  
29 the costs of obtaining and testing cores shall be borne by the City.
- 30 iii. Where the average of the cores tested show the compressive strength of the concrete to  
31 be below the specified compressive strength of concrete and equal to or greater than  
32 eighty-five (85) percent of the specified compressive strength of concrete and if no single  
33 core is less than seventy-five (75) percent of the specified compressive strength of  
34 concrete, the City shall deduct from any monies due or to become due the Contractor an  
35 amount equal to ten (10) percent of the contract price of the structure or portion thereof,  
36 in which the defective concrete is incorporated. The Contractor shall also bear the costs of  
37 obtaining and testing the cores.
- 38 iv. Where the average of the cores tested show the compressive strength of the concrete to  
39 be below eighty-five (85) percent of the specified compressive strength of concrete, or if a  
40 single core is less than seventy-five (75) percent of the specified compressive strength of  
41 concrete, the structure or portion thereof, in which the defective concrete is incorporated  
42 shall be removed and disposed of by the Contractor at the Contractor's expense. The  
43 Contractor shall also bear the costs of obtaining and testing the cores.
- 44 B. Tests of the concrete proposed for use on the project shall be made at the direction of the Engineer in  
45 accordance with the "Methods of Test for Compressive Strength of Molded Concrete Cylinders" (ASTM C-39) and  
46 the "Method of Making and Curing Concrete Compression and Flexure Test Specimens in the Laboratory" (ASTM  
47 C-192). Six (6) standard six (6) inch cylinders, three (3) to be tested at seven (7) days and three (3) to be tested at  
48 twenty-eight (28) days, shall be made with the proportioning and materials proposed to be used in the major  
49 part of the project.
- 50 C. The slump should not be less than the greatest slump expected to be used in the structure. The tests made on  
51 the aggregate required herein may be made a part of these tests if suitably referenced on the reports which shall  
52 be issued at seven (7) days and at twenty-eight (28) days. These tests shall be repeated as necessary due to  
53 changes in materials or unsatisfactory results.
- 54
- 55 **1.6 CONCRETE WASTE MANAGEMENT**
- 56 A. This work consists of containment, collection, storage and proper disposal of concrete wastes generated by saw  
57 cutting or grinding of existing concrete pavements or waste run-off generated during construction of new  
58 concrete pavements, particularly exposed aggregate surfaces. Concrete wastes typically are strongly alkaline and

- 1                    may contain other contaminants that can harm plants and are particularly harmful if allowed to enter streams,  
2                    lakes wetlands or other water bodies through the storm sewer system.
- 3            B.        Contractor is alerted that there are local, state and federal regulations governing the handling and disposal of  
4                    hazardous materials and this Special Provision in no way relieves the Contractor of any responsibility to comply  
5                    with such regulations. The intent is to provide more specific guidelines for management of concrete wastes on  
6                    this project.

7

8        **PART 2 - PRODUCTS**

9

10       **2.1    CONCRETE**

- 11        A.        All concrete used on City of Madison Public Works projects shall also comply with the following requirements,  
12                    except as modified in the Special Provisions of the contract. Where the following requirements conflict with the  
13                    above latest edition of the Standard Specifications for Highway and Structure Construction of the State of  
14                    Wisconsin, Department of Transportation, then these following requirements apply:
- 15        B.        The minimum compressive strength at twenty-eight (28) days shall be three thousand (3,000) pounds per square  
16                    inch. The minimum modulus of elasticity at twenty-eight (28) days shall be three million one hundred twenty  
17                    thousand (3,120,000) pounds per square inch.
- 18        C.        The minimum cement content shall be six (6) bags per cubic yard, except for concrete mixes with fly ash. Each  
19                    bag of cement shall contain ninety-four (94) pounds net.
- 20        D.        From the master limits of the job mix, adjusted as necessary for the specific gravities of the aggregate furnished,  
21                    the Contractor shall determine and submit to the City Engineer a job mix, using the lowest quantity or  
22                    percentage of fine aggregate within the range shown therefor which, without exceeding the maximum quantity  
23                    of water permitted, will yield a mix possessing the necessary workability. The Contractor may use concrete from  
24                    a pre-approved Supplier without submitting a mix design. Contractor shall submit a mix design for concrete  
25                    annually, when a change of aggregate sources or mix design is made or as directed by the Engineer.
- 26        E.        All concrete shall be Air-Entrained, and shall contain seven (7) percent air by volume, plus or minus one and one-  
27                    half (1.5) percent.
- 28        F.        All concrete for curb and gutter, sidewalks, floors, roof slabs, and other horizontal pours shall have a slump of  
29                    not less than two (2) inches and not more than four (4) inches. All concrete for walls, columns, and other vertical  
30                    pours shall have a slump of not less than three (3) inches and not more than six (6) inches.
- 31        G.        No water shall be added when placing concrete unless approved by the Engineer. If water is added without  
32                    consent of the Engineer, this shall be considered sufficient grounds for rejecting the concrete.
- 33        H.        The maximum limit of light chert (specific gravity of 2.40 or less) allowed in coarse aggregate shall be three (3)  
34                    percent by weight.
- 35        I.        Admixtures other than required for air entrainment shall not be used unless approved by the Engineer for a  
36                    specific project.

37

38       **2.2    REINFORCING STEEL**

- 39        A.        All reinforcing bars shall be deformed, and the type used in the work under these Specifications shall be subject  
40                    to the approval of the Engineer.

41

42       **2.3    EPOXY/WATER PROOFING**

- 43        A.        Where epoxy coated reinforcing steel is specified by the contract, the Contractor shall have the option of using a  
44                    concrete additive in place of the epoxy coating. Specifically, the Contractor shall provide and incorporate to the  
45                    concrete mix – XYPEX ADMIX C-1000 to all concrete being used where epoxy coated steel was required by  
46                    contract

47

48       **2.4    EXPANSION FILLER**

- 49        A.        The filler shall be nonextruding and have the same shape and dimensions as the section in which it is installed.

50

51       **2.5    FORMS**

- 52        A.        Forms shall conform to the shape, lines and dimensions of the structure as called for on the plans.
- 53        B.        For exposed concrete surfaces, forms shall be three-fourths (3/4) inch structural plywood or acceptable  
54                    prefabricated commercial wood or steel form panels. Forms used for exposed surfaces are subject to the  
55                    approval of the Engineer.
- 56        C.        Joints in forms shall be horizontal or vertical. For unexposed surface and rough work, undressed lumber may be  
57                    used.
- 58

1 **2.6 CONCRETE SLURRY**

2 A. Slurry mixes shall conform to the following one cubic yard mix of flowable slurry):

3 1. Type A

Material	Amount
Sand	3,000 lbs.
Portland Cement	50 lbs.
Class C Fly Ash	300 lbs.
Water	50 gal.
Air Entraining Admixture	1.4 oz.

4  
5 2. Type B (for one cubic yard of mix of flowable fill):

6

Material	Amount
Sand	2,700 lbs.
Portland Cement	100 lbs.
Class C Fly Ash	300 lbs.
Water	50 gal.

- 7  
8 B. All design aggregate batch weights are saturated surface dry.  
9 C. Aggregate batch weights shall be adjusted for free moisture at time of mixing.  
10 D. Admixture quantity may be varied within manufactures recommended dosage to provide desired results.  
11

12 **2.7 CONCRETE WASTE MANAGEMENT MATERIALS**

- 13 A. Contractor may choose appropriate materials to suit his methods of management of wastes with the following  
14 minimum requirements. Pre-fabricated washout containers shall be in sound condition and watertight. Site  
15 fabricated containment structures shall be constructed below grade if feasible. If constructed above grade they  
16 shall be of sturdy materials and designed to provide a minimum of 6 inches of freeboard based on the volume of  
17 liquid wastes to be generated between clean-outs. Structure shall be lined with a waterproof plastic sheeting of  
18 minimum 10-mil thickness that has no holes or tears. Above grade structures shall have a double layer lining.  
19 B. Inlet liners used to convert an existing storm inlet into a containment structure shall be shop fabricated and shall  
20 consist of a heavy-duty waterproof lining fitted to the inside of a commercially manufactured geotextile  
21 sediment trap. The completed inlet containment structure shall be sound and watertight to prevent any leaching  
22 into the storm sewer system, and shall be approved by the Engineer prior to accepting any concrete waste  
23 water. NOTE: a geotextile sediment trap by itself is not acceptable as the leachate continues to be highly alkaline  
24 and contain dissolved contaminants.  
25

26 **PART 3 – EXECUTION**

27  
28 **3.1 REINFORCING STEEL**

- 29 A. Where directed by the Engineer the Contractor shall install reinforcing steel in concrete sidewalks, driveways,  
30 sidewalk ramps, curb and gutter, special waterways, footings, walls, and other structures.  
31

32 **3.2 EPOXY/WATER PROOFING**

- 33 A. The Contractor shall be aware that this is not a mix and match option for a given structure. Once a decision is  
34 made to switch from epoxy coating to an ADMIX for a given structure, the ADMIX shall be used for all pours and  
35 in all concrete for that structure. The ADMIX shall be used at rates in the concrete mix in accord with the  
36 manufacturers recommendations.  
37

38 **3.2 CONCRETE PLACING AND FINISHING**

- 39 A. Retempering of mortar or concrete which has partially hardened, that is mixing with additional materials or  
40 water, shall not be permitted.  
41 B. No concrete shall be deposited in water or mud. During the pouring of bottom slabs and walls, the Contractor  
42 shall furnish sufficient pumping equipment to keep the water below the bottom of the floor of the structure.  
43 After concrete has been poured the Contractor shall keep the pumping equipment in continuous operation for  
44 thirty-six (36) hours.  
45 C. Concrete shall not be deposited on frozen subbase material, on or against ice or frost, or on reinforcing steel  
46 having a temperature at pouring time of less than 36°F. Do not resume concreting operations until an ascending  
47 air temperature in the shade and away from artificial heat reaches 32°F.

- 1 D. Concrete when deposited shall have a temperature of not less than 55°F. and not more than 100°F.
- 2 E. Concrete shall be handled from the mixer to placement as rapidly as practicable and in a manner that will
- 3 prevent segregation of the ingredients until the unit of operation, approved by the Engineer, is completed. It
- 4 shall be deposited in the forms as nearly as practicable in its final position to avoid rehandling. Concrete as it is
- 5 deposited shall be puddled with suitable tools or equipment until forms are completely filled and reinforcement
- 6 and embedded fixtures thoroughly incorporated in the mass.
- 7 F. Concrete adjacent to the forms, joints, or structures shall be deposited and spaded or vibrated in a manner to
- 8 prevent the formation of voids or rock pockets. All cavities produced by the removal of form ties and any voids
- 9 or rock pockets of more than casual occurrence found after the forms are removed, shall be filled immediately
- 10 with a well mixed grout, composed of one (1) part of Portland cement and three (3) parts of fine aggregate
- 11 (masonry sand) and finished to the true surface of the face of structure by the following method: Defective areas
- 12 shall be chipped away to a depth of not less than one (1) inch measured at right angles to the surface. The area
- 13 shall be thoroughly wetted, brushed with grout, and patched with grout. The patch shall be cured as specified for
- 14 concrete structures. Defects appearing on the patch shall be repaired at the Contractor's expense.
- 15 G. An accumulation of water on the surface of freshly deposited concrete shall immediately be removed in a
- 16 manner satisfactory to the Engineer.
- 17 H. Concrete shall be so deposited as to maintain, until the completion of the unit, a plastic surface, approximately
- 18 horizontal. Forms for walls or other thin sections a height in excess of eight (8) feet shall be provided with
- 19 openings, or other devices, that will permit the concrete to be placed in a manner that will avoid accumulation of
- 20 hardened concrete on the forms or metal reinforcement. Under no circumstances shall concrete that has
- 21 partially hardened be deposited in the work.
- 22 I. When concrete is conveyed by chuting, the mixer shall be of such size and design as to insure a practically
- 23 continuous flow in the chute. The angle of the chute with the horizontal shall be such as to allow the concrete to
- 24 flow without separation of the ingredients. An angle of twenty-seven (27) degrees, or one (1) vertical to two (2)
- 25 horizontal, is the minimum slope which is considered permissible. Chuting through a vertical pipe is satisfactory
- 26 when the lower end of the pipe is maintained four (4) feet or less above the surface of the deposit. The delivery
- 27 end of the chute shall be within four (4) feet of the point of deposit. When the operation is intermittent, the
- 28 spout shall discharge into a hopper. The chute shall be thoroughly flushed with water before and after each run;
- 29 the water used for this purpose shall be discharged outside the forms but not into paved streets, walks, gutters
- 30 or inlets.
- 31 J. All reinforced concrete shall be vibrated in place to the satisfaction of the Engineer with mechanical vibrators.
- 32 Vibrators shall also be required for non-reinforced concrete structures when other methods of compaction or
- 33 "puddling" do not give the desired results in the opinion of the Engineer.
- 34 K. Before depositing new concrete on or against concrete which has been set, the forms shall be retightened, the
- 35 surface of the set concrete shall be roughened as required by the Engineer, thoroughly cleaned of foreign
- 36 material and saturated with water.
- 37 L. Joints not indicated on the plans shall be so designed and located as to least impair the strength and appearance
- 38 of the structure. All joints shall provide sufficient resistance to shear to which they may be subjected. Horizontal
- 39 joints required to be watertight shall be constructed by forming continuous keyways in the lower portion of the
- 40 concrete before the concrete has hardened. Before placing the superimposed concrete, the joint shall be
- 41 thoroughly cleaned of foreign material and saturated with water. Vertical joints required to be watertight, and
- 42 expansion joints shall be provided with suitable keyways subject to the approval of the Engineer.
- 43 M. Top surfaces of roof slabs, unless otherwise specified, shall be smoothed with a wood float. Care shall be taken
- 44 to avoid an excess of water in the concrete, and to drain or otherwise promptly remove any water that comes to
- 45 the surface. Dry cement or a dry mixture of cement and sand, shall not be sprinkled directly on the surface.
- 46 N. Top surfaces of concrete floor slabs, unless otherwise specified, shall be wood floated and then troweled with a
- 47 steel hand trowel or a mechanically operated steel trowel to a smooth, dense finish. Steel troweling shall be
- 48 done after the water has disappeared from the surface.
- 49 O. Unless otherwise specified, all edges of concrete along joints and forms shall be finished with a steel edging tool
- 50 of one-fourth (1/4) inch radius.
- 51 P. Where concrete is to be placed in two lifts, as for cunettes, pavements, and other structures with wire mesh
- 52 reinforcements, the concrete for the lower lift shall be placed, the required reinforcement positioned and
- 53 secured and the upper lift of concrete placed. Any portion of the lower lift of concrete not covered with the
- 54 upper lift of concrete within thirty (30) minutes after being placed, shall be removed.
- 55 Q. Concreting operations shall be discontinued due to insufficient natural light, unless an adequate and approved
- 56 artificial lighting system is provided and operated.

**3.3 FORMS**

- A. Lumber once used in forms shall have nails drawn, and surfaces to be in contact with concrete shall be thoroughly cleaned before being used again. All form work shall be checked for plumbness, alignment, and position by the Engineer before concrete placement begins.
- B. Forms shall be substantially tight to prevent leakage of mortar; they shall be properly braced or tied together so as to maintain position and shape. If adequate foundation for shores cannot be secured, trussed supports shall be provided.
- C. Unless otherwise specified or directed, suitable moulding or bevels shall be placed in the angles of forms to round or bevel the edges of the concrete.
- D. The inside of forms shall be coated with nonstaining mineral oil or other approved material before each use and thoroughly wetted (except in freezing weather). Oil shall be applied before reinforcement is placed and shall be kept from contact with concrete already placed to which fresh concrete is to be bonded.
- E. Temporary openings shall be provided where necessary to facilitate cleaning and inspection immediately before placing concrete.
- F. Forms shall not be disturbed until the concrete has hardened. Shoring shall not be removed until the member has acquired sufficient strength to safely support its weight and the load upon it. Members subject to additional loads during construction shall be shored adequately to support both the members and the construction loads in such a manner as will protect the member from damage by the loads. This shoring shall not be removed until the member has acquired sufficient strength to safely support its weight and the load upon it, and then only with the approval of the Engineer.
- G. After removal of forms, all metal devices used to tie forms together and hold them to correct alignment and location shall be removed in such a manner that no metal shall remain within less than one (1) inch of the surface of the concrete. The method of removal of such ties shall be such as not to cause injury to the surface of the concrete. The Contractor shall not burn off bolts, rods, or other metal devices. After the removal of such ties, the opening shall be roughened and all concrete containing any oil removed. The cavities produced shall be filled as specified in Section 301.5.

**3.4 CURING**

- A. Exposed surfaces shall be protected from drying for a period of at least seven (7) days as per Section 415.3.12 of the latest edition of the Standard Specifications for Highway and Structure Construction of the State of Wisconsin, Department of Transportation, except as modified herein or in the Special Provisions of the contract. Curing compound shall be white pigmented.

**3.5 PROTECTION OF THE CONCRETE**

- A. Cold Weather Protection
  - 1. All concrete used for sidewalk, curb and gutter, pavement, bridges, culverts, retaining walls, access structures, catchbasins, inlets, or any other structure consisting wholly or in part of concrete, when placed during cold weather shall be mixed, placed, and protected in accordance with the requirements prescribed in Subsection 501.3.9 "Mixing and Protection During Cold Weather" of Standard Specifications for Highway and Structure Construction of the State of Wisconsin, Department of Transportation. Section 415.3.15.2 of the Standard Specifications for Highway and Structure Construction of the State of Wisconsin, Department of Transportation shall be revised as follows:

Predicted or Actual Air Temperature	Minimum Equivalent Level of Protection
22 to 32 F (-6 to <0 C)	single layer of polyethylene
17 to 22 F (-8 to < -6 C)	double layer of polyethylene
< 17 F (< -8)	6" of loose, dry straw or hay between 2 layers of polyethylene

- 2. Regardless of the precautions taken, the Contractor shall be responsible for the protection of the concrete placed, and any concrete damaged by freezing or frost action during the first seven (7) days following its placement shall be removed and replaced by the Contractor at the Contractor's expense.
- 3. Under no circumstances shall concrete be ordered or delivered for the project, until such time as the equipment and materials for protecting and heating the concrete, as described above, are on the job site in sufficient quantity to obtain the desired results.
- B. Opening Curb and Gutter, Sidewalk, Driveways, and Pavements to Traffic.
  - 1. Traffic shall be excluded over or on newly constructed curb and gutter, sidewalk, driveways, and pavements for such periods as are hereinafter designated. Where the term "pavement" appears below, it shall be taken to refer to the particular type of construction involved.

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2. The Engineer reserves the right to determine the time when the pavement shall be opened to traffic either on the basis of test cylinders or minimum time periods related to atmospheric temperatures.
  3. When opening of the pavement to traffic is controlled by cylinder tests, the pavement may be opened, after expiration of the curing period or cold weather protection period, as the case may be, when the tests of cylinders show a compressive strength of the concrete of not less than 3,000 pounds per square inch.
  4. At least two cylinders shall be tested in determining the attained strength of concrete for the purpose of opening the pavement to traffic. The average of test results for the two cylinders shall be used to determine compliance, except that neither cylinder may be more than ten percent below the required strength. The cylinders shall be cured under conditions similar to those prevailing for the pavement which they represent.
  5. When the opening is not controlled by cylinder tests, traffic shall be excluded from the newly constructed pavement for such minimum periods as hereinafter designated:
    - a. For not less than seven (7) days when the atmospheric temperatures are generally 70°F. or higher during the period.
    - b. For not less than ten days when the atmospheric temperatures are generally not lower than 60°F. during the period.
    - c. For not less than such a length of time up to twenty-one (21) days as the Engineer may require, taking into consideration the temperatures and protective measures, if any, when the atmospheric temperatures are generally lower than 60°F.
  6. When High-Early-Strength Concrete is used in the work, the above specific periods of seven (7), ten (10) and twenty-one (21) days may be reduced to three (3), four (4) and seven (7) days, respectively, under like conditions.
  7. When Grade A-FA Concrete is used in the work, the specific periods of seven (7) and ten (10) days shall be increased to ten (10) and fourteen (14) days respectively, under like conditions.
  8. In all cases the pavement shall be cleaned, and the joints shall be cleaned and sealed as provided, before traffic of any kind is permitted to use the pavement.
- C. Catchbasins, Access Structures, and Headwalls
1. Traffic on or over these structures shall be curtailed until the concrete has reached full strength\
  2. Backfilling may proceed after seven (7) days for air entrained concrete or three (3) days for High-Early-Strength concrete. When the Contractor desires to backfill prior to the times specified then the Contractor shall do so at the Contractor's own risk.

### 3.6 CONCRETE SLURRY

- A. Type A and Type B slurry mixes as listed below shall be used as called for on the plans or as specified in the field by the Engineer on storm or sanitary sewer projects

### 3.7 CONCRETE WASTE MANAGEMENT

- A. If conditions are such that debris and slurry from sawcutting and grinding operations will remain on pavements and not run off into gutters, they may be allowed to dry in place and be cleaned from pavement by sweeping or vacuum equipment. Such wastes shall not be allowed to remain on pavements beyond the end of a day's work.
- B. Slurries from cutting or grinding or wash water from exposed aggregate construction may be directed to exposed (unpaved) areas of the grade provided: 1) such areas are below the surface drainage grade and will not run off into watercourses, gutters, inlets or storm sewers; 2) such areas are planned for pavement or other uses, such that residue following evaporation / percolation will not adversely impact vegetation; 3) disposal area is approved by the Engineer prior to use.
- C. If it is not practical to direct slurry to an appropriate unpaved disposal area it may be directed to a street gutter provided sand bags or other devices are used to contain the slurry on the pavement and minimize the distance the slurry travels. Contractor shall remove such slurry or residue from the pavement prior to the end of each work day by vacuum systems or other methods. Slurry may be pumped to an approved containment structure for on-site storage.
- D. On-site containment structures shall be emptied on a periodic basis, such that they do not exceed their design capacity, including required freeboard. Contractor shall remove contaminated liquids from the site, using trucks fitted with water-tight gaskets to prevent leakage, or other similar methods. Wastes shall be properly disposed of off-site, in accordance with applicable laws and regulations.
- E. If it is not practical to construct or direct slurry to an above-grade containment structure, the contractor may utilize a storm inlet for containment under the following conditions:

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1. There is no significant chance of precipitation, flows from upstream pipe connections or other reasons requiring the inlet to function for storm water drainage during the period it is to be used for containment
  2. The Construction Engineer provides prior written approval for each inlet proposed
  3. Contractor fabricates and properly installs a waterproof liner for each inlet used, in accordance with the requirements herein
  4. Contractor maintains inlet liners in good condition and periodically empties such structures and disposes of wastes as provided for on-site containment structures
  5. Contractor completely removes liner and all wastes and restores inlet to its prior functioning condition after its use.

**END OF SECTION**

**SECTION 32 16 13  
CONCRETE CURB AND GUTTER**

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5 1.1. SCOPE..... 1  
6 1.2 RELATED WORK..... 1  
7 1.3 REFERENCED STANDARDS..... 1  
8 PART 2 – PRODUCTS..... 1  
9 2.1 MATERIALS..... 1  
10 PART 3 – EXECUTION..... 1  
11 3.1 PREPARATION OF FOUNDATION..... 1  
12 3.2 FORMS..... 1  
13 3.3 PLACING AND FINISHING CONCRETE ..... 1  
14 3.4 JOINTS ..... 2  
15 3.5 REINFORCEMENT ..... 2  
16 3.6 PROTECTION ..... 2  
17 3.7 HAND FORMED CURB AND GUTTER (TREE LOCATIONS - UNDISTURBED)..... 2  
18

**PART 1 – GENERAL**

**1.1. SCOPE**

- 22 A. This work shall consist of constructing concrete curb and gutter, with or without reinforcement, of the  
23 dimensions and design as indicated, and placed in one course on the prepared foundation or base, at the  
24 locations and to the required lines and grades.  
25 B. The Contractor shall mark the top of the curb where the sanitary sewer and water service cross the curb and  
26 gutter. The mark may be made by sawcutting. The depth shall be a minimum of one-sixteenth (1/16") inch deep.  
27 The laterals and services will be located by the City.  
28 C. All work done in the vicinity of any tree located in the terrace shall be completed in accordance with City of  
29 Madison Standard Specifications for Public Works Construction Section 107.13 Tree Protection.  
30

**1.2 RELATED WORK**

**1.3 REFERENCED STANDARDS**

- 34 A. City of Madison Standard Specifications for Public Works Construction  
35

**PART 2 – PRODUCTS**

**2.1 MATERIALS**

- 39 A. All materials shall comply with City of Madison Standard Specifications for Public Works Construction.  
40

**PART 3 – EXECUTION**

**3.1 PREPARATION OF FOUNDATION**

- 44 A. The Contractor shall be responsible for replacement with 1-1/2" crushed stone, mechanically compacted, of any  
45 material necessary to bring the subbase to grade, where the Contractor has undercut the subbase without the  
46 direction of the Engineer.  
47

**3.2 FORMS**

- 49 A. Curb and gutter forms shall be of steel construction and conform to the design of the type of curb and gutter  
50 being installed. Wooden forms may be used only with the Engineer's approval on short radius curves and in  
51 special cases where accessibility is limited. All forms shall be free of hardened concrete, mud, dirt, and debris,  
52 and shall be free of bends and twists which would make their use unacceptable on the project.  
53 B. All forms shall be oiled to the satisfaction of the Engineer before depositing or placing concrete in them.  
54 C. When concrete curb and gutter is constructed on a curve, flexible forms shall be used for all curves having a  
55 radius of two hundred (200) linear feet or less.  
56

**3.3 PLACING AND FINISHING CONCRETE**

- 57 A. Wherever directed by the Engineer, driveway gutters shall be built instead of regular curb and gutters.  
58



- 1 B. The curb and gutter over ditches shall be installed in twenty (20) foot lengths centered over the ditch. A dummy
- 2 joint shall be cut at the center of the twenty (20) foot section.
- 3 C. Unless otherwise specified, curb and gutter shall be installed in minimum lengths of six (6) feet and maximum
- 4 lengths of fifteen (15) feet.
- 5 D. The Contractor shall install a header at the end of each pour. At no time shall the Contractor be allowed to
- 6 spread excess concrete as a base for the next or any succeeding pour.
- 7 E. Wherever different types of curb and gutter are employed, the Contractor shall take care that transitions from
- 8 one type of curb and gutter to another type are done smoothly without loss of flow line grade or curb head
- 9 shape.
- 10 F. The reconnection of existing drains from adjacent properties to the curb and gutter shall be incidental to
- 11 concrete curb and gutter.
- 12 G. The slope of the curb and gutter shall not exceed 1" in 12" thru handicap accessible ramps.

13  
14 **3.4 JOINTS**

- 15 A. Full contraction joints shall be a minimum of three (3) inches in depth, and shall be uniformly spaced not less
- 16 than six (6) feet nor more than fifteen (15) feet apart unless otherwise directed by the Engineer.
- 17 B. If machine methods are used for forming and finishing curb and gutter the Contractor may saw contraction joints
- 18 or planes of weakness may be created by the insertion of approved partial depth separator plates having a
- 19 minimum depth of three (3) inches. The depth of cut and equipment used in sawing shall meet the approval of
- 20 the Engineer. The sawing shall be done as soon as practicable after the concrete has set sufficiently to preclude
- 21 raveling during the sawing and before any shrinkage cracking takes place in the concrete. If this method results
- 22 in random cracking the Contractor shall be required to use the partial depth separator plates.
- 23 C. Transverse expansion joints shall be one-half (1/2) inch in width and shall be placed across the curb and gutter
- 24 perpendicular to the curb line at all radius points of curves having a radius of two hundred (200) feet or less, and
- 25 on both sides of all inlets installed in curb and gutter. All expansion joints shall extend through the entire
- 26 thickness of the curb and gutter and shall be perpendicular to the surface. All expansion joints shall be formed by
- 27 inserting during construction, and leaving in place, the required thickness of joint filler which shall extend
- 28 through the entire thickness of both curb and gutter.
- 29 D. Where curb and gutter and concrete sidewalk or concrete driveways join, an expansion joint one (1) inch in
- 30 width must be constructed between walks and curb.
- 31 E. The joint filler in transverse joints shall be flush with the finished surface of the gutter. The concrete adjacent to
- 32 these joints shall be finished with a wooden float which is divided through the center and which will permit
- 33 finishing on both sides of the filler at the same time. Before the curb and gutter is opened to traffic, excess joint
- 34 filler shall be cut off level with the finished surface.

35  
36 **3.5 REINFORCEMENT**

- 37 A. Where reinforcement is required it shall conform to and be placed in accordance with the Standard Detail
- 38 Drawings, details shown on the plans, as specified in the contract, or as directed by the Engineer.
- 39 B. Where directed by the Engineer, the Contractor shall install three (3) one-half (1/2) inch round reinforcing rods
- 40 fifteen (15) feet long in concrete curbs and gutters which span ditches.

41  
42 **3.6 PROTECTION**

- 43 A. The curb and gutter must be protected from injury by traffic or other causes, and also from the rays of the sun
- 44 until completely set.
- 45 B. In the event that concrete sidewalk, drives or curb and gutter are placed in cold weather, "Cold Weather
- 46 Protection" shall be applied in accordance with The City of Madison Standard Specifications, Section 301.8(a)
- 47 "Cold Weather Protection."

48  
49 **3.7 HAND FORMED CURB AND GUTTER (TREE LOCATIONS - UNDISTURBED)**

- 50 A. The work under this item shall consist of manually forming and pouring curb and gutter at tree locations or
- 51 where other structures prevent the use of a curb machine, as designated by the Engineer. Where the item Hand
- 52 Formed Curb and Gutter is to be used in the vicinity of any tree located in the terrace, work shall be completed
- 53 in accordance with section 107.13 Tree Protection Specification.

54 **END OF SECTION**

**SECTION 32 31 19**  
**METAL FENCES AND GATES**

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6 1.2 RELATED WORK..... 1  
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9 1.6 SUBMITTAL..... 1  
10 1.7 PRODUCT HANDLING AND STORAGE ..... 2  
11 1.8 PRODUCT WARRANTY ..... 2  
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17 3.1 PREPARATION ..... 4  
18 3.2 FENCE INSTALLATION..... 4  
19 3.4 GATE INSTALLATION..... 4  
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21

**PART 1 – GENERAL**

**1.1 WORK INCLUDED**

- 24 A. The contractor shall provide all labor, materials and appurtenances necessary for installation of the industrial  
25 welded steel fence and cantilever gate system defined herein.  
26  
27

**1.2 RELATED WORK**

- 28 A. Section 31 00 00 - Earthwork  
29 Section 03 00 00 - Concrete  
30  
31

**1.4 QUALITY ASSURANCE**

- 32 A. The contractor shall provide laborers and supervisors who are thoroughly familiar with the type of construction  
33 involved and materials and techniques specified.  
34  
35

**1.5 REFERENCES**

- 36 – ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated  
37 (Galvannealed) by the Hot-Dip Process.  
38 – ASTM B117 - Practice for Operating Salt-Spray (Fog) Apparatus.  
39 – ASTM B221 - Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles and Tubes.  
40 – ASTM D523 - Test Method for Specular Gloss.  
41 – ASTM D714 - Test Method for Evaluating Degree of Blistering in Paint.  
42 – ASTM D822 - Practice for Conducting Tests on Paint and Related Coatings and Materials using Filtered Open-  
43 Flame Carbon-Arc Light and Water Exposure Apparatus.  
44 – ASTM D1654 - Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive  
45 Environments.  
46 – ASTM D2244 - Test Method for Calculation of Color Differences from Instrumentally Measured Color  
47 Coordinates.  
48 – ASTM D2794 - Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact).  
49 – ASTM D3359 - Test Method for Measuring Adhesion by Tape Test.  
50 – ASTM F2408 – Ornamental Fences Employing Galvanized Steel Tubular Pickets.  
51 – ASTM F1184 – Industrial & Commercial Horizontal Slide Gates  
52  
53

**1.6 SUBMITTAL**

- 54 A. The manufacturer’s submittal package consisting of fence and gate elevations, hardware details, and installation  
55 details, shall be submitted prior to installation.  
56  
57  
58

**1.7 PRODUCT HANDLING AND STORAGE**

- A. Upon receipt at the job site, all materials shall be checked to ensure that no damage occurred during shipping or handling. Materials shall be stored in such a manner to ensure proper ventilation and drainage, and to protect against damage, weather, vandalism and theft.

**1.8 PRODUCT WARRANTY**

- A. All structural fence components (i.e. rails, pickets, and posts) shall be warranted within specified limitations, by the manufacturer for a period of 20 years from date of original purchase. Warranty shall cover any defects in material finish, including cracking, peeling, chipping, blistering or corroding.
- B. Reimbursement for labor necessary to restore or replace components that have been found to be defective under the terms of manufactures warranty shall be guaranteed for five (5) years from date of original purchase.

**PART 2 - PRODUCTS**

**2.1 MANUFACTURER**

- A. Fence:
1. Ameristar® Montage Industrial **Welded and Rackable** (ATF – All Terrain Flexibility) Ornamental Steel, Genesis design, extended picket bottom rail treatment, 3-Rail style.
  2. Height: 8'0"
  3. Color: Black
- B. Gate:
1. Ameristar® TransPort II gate system, *Genesis* style.
  2. Height: 8'0"
  3. Width: 30'0"
  4. Color: Black

**2.2 MATERIAL**

- A. Fence
1. Steel material for fence panels and posts shall conform to the requirements of ASTM A653/A653M, with a minimum yield strength of 45,000 psi (344 MPa) and a minimum zinc (hot-dip galvanized) coating weight of 0.60 oz/ft<sup>2</sup> (184 g/m<sup>2</sup>), Coating Designation G-60. A minimum of 62% of the steel material shall be derived from recycled scrap metal.
  2. Material for pickets shall be 1" square x 16 Ga. tubing. The rails shall be steel channel, 1.75" x 1.75" x .105". Picket holes in the rail shall be spaced 4.715" o.c. For fence systems up to and including 6 feet tall, posts shall be a minimum of 2-1/2" square x 14 Ga. For fence systems 7 feet tall and 8' tall, posts shall be a minimum of 2-1/2" square x 12 Ga. Gate posts shall meet the minimum requirements of Table 1.

Fence Posts	Panel Height		
2-1/2" x 14 Ga.	Up to & Including 6' Height		
2-1/2" x 12 Ga.	Over 6' Up to & Including 8' Height		
Gate Leaf	Gate Height		
	Up to & Including 4'	Over 4' Up to & Including 6'	Over 6' Up to & Including 8'
Up to 4'	2-1/2" x 12 Ga.	3" x 12 Ga.	3" x 12 Ga.
4'1" to 6'	3" x 12Ga.	4" x 11 Ga.	4" x 11 Ga.
6'1" to 8'	3" x 12 Ga.	4" x 11 Ga.	6" x 3/16"
8'1" to 10'	4" x 11 Ga.	6" x 3/16"	6" x 3/16"
10'1" to 12'	4" x 11 Ga.	6" x 3/16"	6" x 3/16"
12'1" to 14'	4" x 11 Ga.	6" x 3/16"	6" x 3/16"
14'1" to 16'	6" x 3/16"	6" x 3/16"	6" x 3/16"

- B. Gate
1. The materials used for cantilever gate framing (i.e., uprights, diagonal braces and pickets or pales) shall be manufactured from ASTM B221 aluminum (designation 6063-T-6) with a yield strength of 25,000 PSI, a tensile strength of 30,000 PSI and a standard mill finish. The TransPort® Fast-Trak™ rails shall be manufactured from ASTM B221 aluminum (designation 6063-T-6) with minimum yield strength of 25,000 PSI, a tensile strength of 30,000 PSI and a standard mill finish.

- 1                    2.    Material for diagonal bracing and uprights shall be 2" sq. x 1/4" aluminum. The design of the top and  
 2 bottom enclosed track shall conform to the manufacturers 5" x 2" Fast-Trak system. Material for pickets  
 3 shall be 1" x 1/8" wall aluminum.  
 4                    3.    Internal roller truck assembly shall be self-aligning swivel ball-and-socket type running on four bearing  
 5 wheels. Internal roller truck assembly shall be affixed to the hanger bracket by means of a 5/8" diameter  
 6 industrial-grade rod end/center bolt, with a minimum static load rating of 10,000 pounds. Attachment of  
 7 the center bolt to the truck body shall be by means of a swivel joint to ensure equivalent and consistent  
 8 loading on all bearing wheels and internal track surfaces throughout the travel of the gate.  
 9

10 **2.3 FABRICATION**

11 A. Fence

- 12                    1.    Pickets, rails and posts shall be pre-cut to specified lengths. Rails shall be pre-punched to accept pickets.  
 13                    2.    Pickets shall be inserted into the pre-punched holes in the rails and shall be aligned to standard spacing  
 14 using a specially calibrated alignment fixture. The aligned pickets and rails shall be joined at each picket-  
 15 to-rail intersection by Ameristar's proprietary fusion welding process, thus completing the rigid panel  
 16 assembly (Note: The process produces a virtually seamless, spatter-free good-neighbor appearance,  
 17 equally attractive from either side of the panel).  
 18                    3.    The manufactured panels and posts shall be subjected to an inline electrodeposition coating (E-Coat)  
 19 process consisting of a multi-stage pretreatment/wash (with zinc phosphate), followed by a duplex  
 20 application of an epoxy primer and an acrylic topcoat. The minimum cumulative coating thickness of  
 21 epoxy and acrylic shall be 2 mils (0.058 mm). The color shall be Black. The coated panels and posts shall  
 22 be capable of meeting the performance requirements for each quality characteristic shown in Table 2  
 23 (Note: The requirements in Table 2 meet or exceed the coating performance criteria of ASTM F2408).  
 24

Table 2 – Coating Performance Requirements		
Quality Characteristics	ASTM Test Method	Performance Requirements
Adhesion	D3359 – Method B	Adhesion (Retention of Coating) over 90% of test area (Tape and knife test).
Corrosion Resistance	B117, D714 & D1654	Corrosion Resistance over 1,500 hours (Scribed per D1654; failure mode is accumulation of 1/8" coating loss from scribe or medium #8 blisters).
Impact Resistance	D2794	Impact Resistance over 60 inch lb. (Forward impact using 0.625" ball).
Weathering Resistance	D822 D2244, D523 (60" Method)	Weathering Resistance over 1,000 hours (Failure mode is 60% loss of gloss or color variance of more than 3 delta-E color units).

- 25                    4.    The manufactured fence system shall be capable of meeting the vertical load, horizontal load, and infill  
 26 performance requirements for Industrial weight fences under ASTM F2408.  
 27
- 28 B. Gate
- 29                    1.    Pickets, enclosed track, uprights and diagonal bracing shall be pre-drilled and labeled for easy assembly.  
 30 All components shall be pre-cut to specified lengths.  
 31                    2.    Top and bottom rail extrusions shall be mechanically fastened to vertical uprights and reinforced with  
 32 diagonal braces, as required by drawing.  
 33                    3.    The manufactured components shall be subjected to the Ameristar thermal stratification coating process  
 34 (high-temperature, in-line, multi-stage, and multi-layer) including, as a minimum, a six-stage  
 35 pretreatment/wash and an electrostatic spray application of a polyester finish. The topcoat shall be a  
 36 "no-mar" TGIC polyester powder coat finish with a minimum thickness of 2 mils (0.0508mm). The color  
 37 shall Black. The stratification-coated framework shall be capable of meeting the performance  
 38 requirements for each quality characteristic shown in Table 3.  
 39

Table 3 – Coating Performance Requirements		
Quality Characteristics	ASTM Test Method	Performance Requirements
Adhesion	D3359 – Method B	Adhesion (Retention of Coating) over 90% of test area (Tape and knife test).
Corrosion Resistance	B117, D714 & D1654	Corrosion Resistance over 3,500 hours (Scribed per D1654; failure mode is accumulation of 1/8" coating loss from scribe or medium #8 blisters).

Impact Resistance	D2794	Impact Resistance over 60 inch lb. (Forward impact using 0.625" ball).
Weathering Resistance	D822 D2244, D523 (60° Method)	Weathering Resistance over 1,000 hours (Failure mode is 60% loss of gloss or color variance of more than 3 delta-E color units).

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**PART 3 – EXECUTION**

**3.1 PREPARATION**

- A. Fence:
  1. All new installation shall be laid out by the contractor in accordance with the construction plans.
- B. Gate:
  1. All new gate installations shall be laid out by the contractor in accordance with the construction plans.
  2. All hardware shall be installed in accordance with the Transport installation instructions. Transport cantilever gates shall be installed so they comply with current ASTM F2200 & UL325 standards.
  3. Gate stops shall be installed on each track in a way that conforms to current ASTM F2200 standards.

**3.2 FENCE INSTALLATION**

- A. Fence post shall be spaced according to Table 4, plus or minus 1/2". For installations that must be raked to follow sloping grades, the post spacing dimension must be measured along the grade. Fence panels shall be attached to posts with brackets supplied by the manufacturer. Posts shall be set in concrete footers having a minimum depth of 36" (Note: In some cases, local restrictions of freezing weather conditions may require a greater depth). The "Earthwork" and "Concrete" sections of this specification shall govern material requirements for the concrete footer. Posts setting by other methods such as plated posts or grouted core-drilled footers are permissible only if shown by engineering analysis to be sufficient in strength for the intended application.

Table 4 – Montage Industrial – Post Spacing By Bracket Type						
Span	For CLASSIC, GENESIS, & MAJESTIC 8' Nominal (92-5/8" Rail)					
Post Size	2-1/2"	3"	2-1/2"	3"	2-1/2"	3"
Bracket Type	Industrial Universal 2.5" (BB302) 3" (BB303)		Industrial Flat Mount (BB301)		Industrial Swivel (BB304)*	
Post Settings ± 1/2" O.C.	96"	96-1/2"	96"	96-1/2"	*96"	*96-1/2"
*Note: When using BB304 swivel brackets on either or both ends of a panel installation, care must be taken to ensure the spacing between post and adjoining pickets meets applicable codes. This will require trimming one or both ends of the panel. When using the BB301 flat mount bracket for Invincible style, rail may need to be drilled to accommodate rail to bracket attachment.						

- B. When cutting/drilling rails or posts adhere to the following steps to seal the exposed steel surfaces; 1) Remove all metal shavings from cut area. 2) Apply zinc-rich primer to thoroughly cover cut edge and/or drilled hole; let dry. 3) Apply 2 coats of custom finish paint matching fence color. Failure to seal exposed surfaces per steps 1-3 above will negate warranty. Ameristar spray cans or paint pens shall be used to prime and finish exposed surfaces; it is recommended that paint pens be used to prevent overspray. Use of non-Ameristar parts or components will negate the manufactures' warranty.

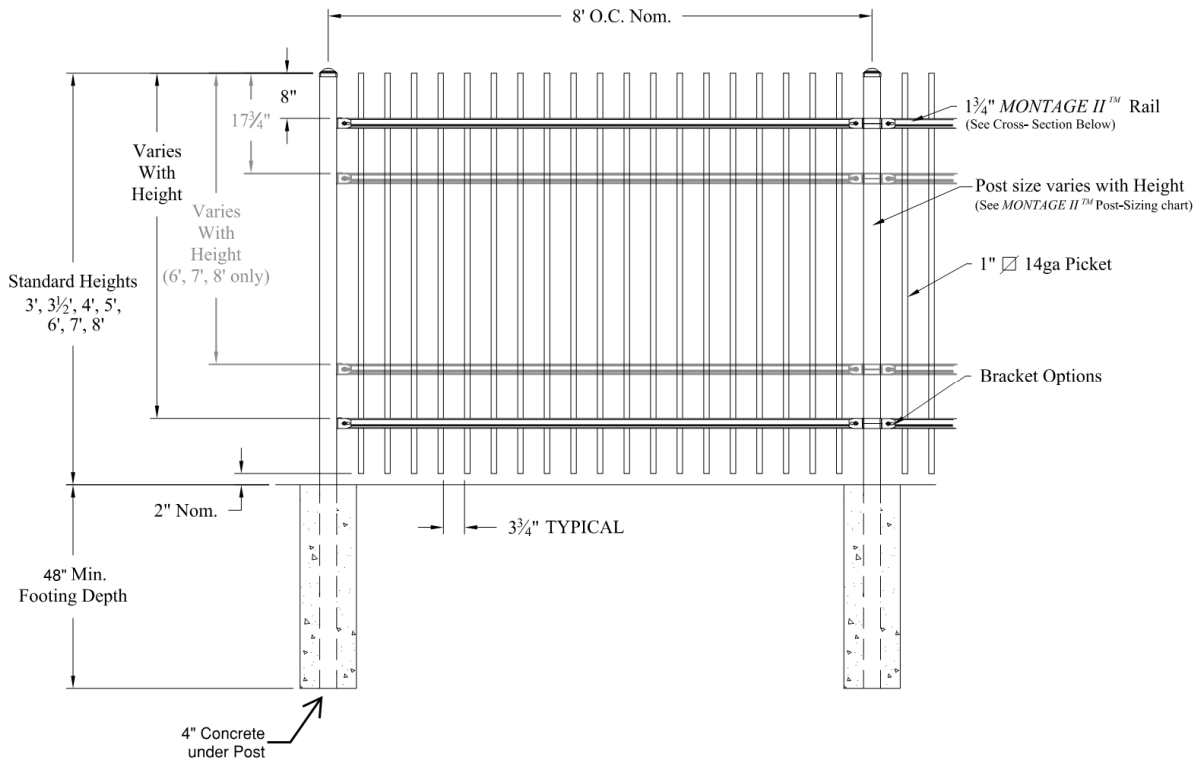
**3.4 GATE INSTALLATION**

- A. Gate post shall be spaced according to specified gate elevation. Posts shall be set in concrete footers having a minimum depth of 48" with a minimum diameter of 12" (Note: In some cases, local restrictions of freezing weather conditions may require a greater depth). The "Earthwork" and "Concrete" sections of this specification shall govern material requirements for the concrete footer. Posts setting by other methods such as plated posts or grouted core-drilled footers are permissible only if shown by engineering analysis to be sufficient in strength for the intended application.

**3.5 CLEANING**

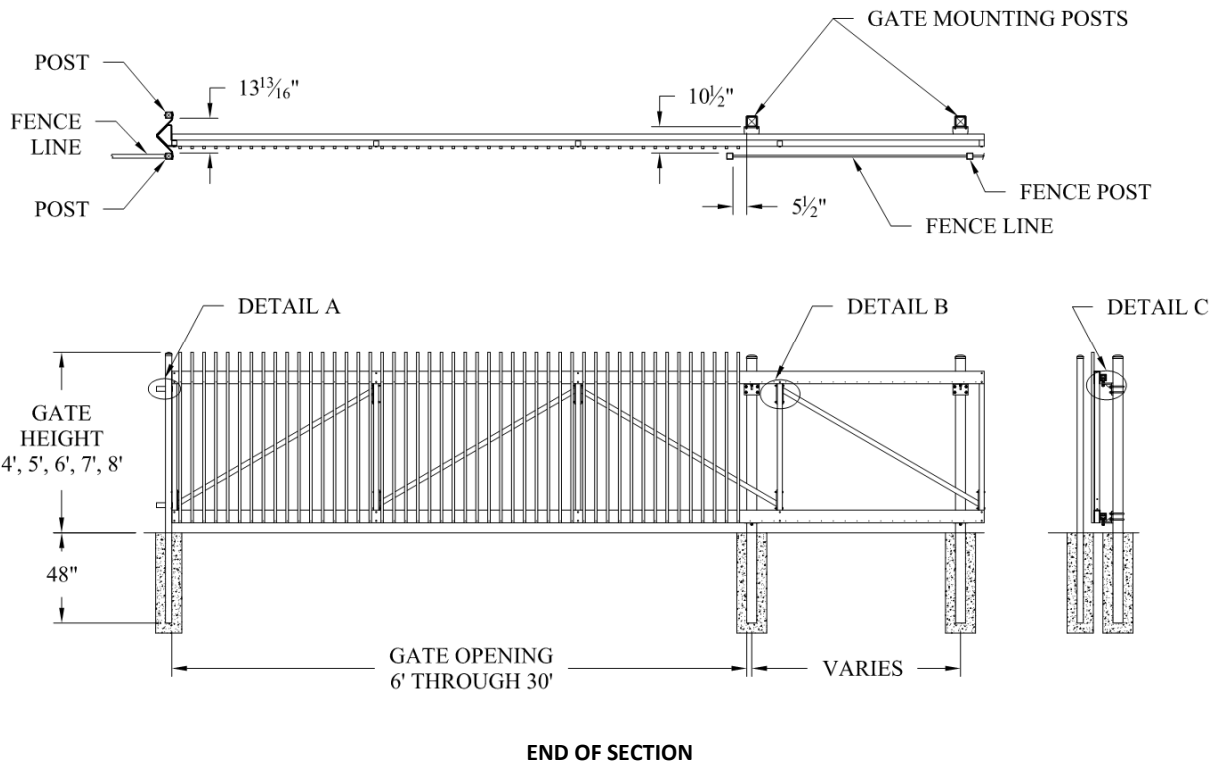
- A. The contractor shall clean the jobsite of excess materials; post-hole excavations shall be scattered uniformly away from posts.

1 **3.6. FENCE DETAIL**



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**3.7. GATE DETAIL**



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## SECTION 41 22 13.13

## BRIDGE CRANES

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8	1.4. QUALITY ASSURANCE .....	2
9	1.5. PERFORMANCE REQUIREMENTS .....	2
10	1.6. EXTRA MATERIAL .....	3
11	PART 2 - PRODUCTS .....	3
12	2.1. PRODUCTS .....	3
13	2.2. CONTROLS .....	3
14	2.3. ELECTRIFICATION CRITERIA .....	4
15	2.4. ELECTRIC WIRE ROPE HOIST .....	4
16	2.5. FINISHES .....	5
17	PART 3 – EXECUTION .....	5
18	3.1. INSTALLATION .....	5

**PART 1 – GENERAL****1.1. SCOPE**

- A. This section includes information common to bridge cranes. Work under this section includes all labor, materials, equipment, and services necessary to complete the bridge crane work as shown on the drawings and herein specified. This includes, but is not limited to Crane rails with clamps and accessories, Crane stops and their connections to the runway beams/girders, Crane controls and mainline electrical conductor
- B. The Crane Provider, and/or the manufacturer, shall design, fabricate and provide a complete system as described in these specifications. All certifications by professional engineer shall be provided by contractor.

**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 05 — METALS
  2. DIVISION 26 — ELECTRICAL
- B. AISI – American Iron and Steel Institute
1. AISI Technical Report #13 – 2003 – “Guide for the Design and Construction of Mill Buildings.”
- C. ANSI – American National Standards Institute
1. ANSI/ASME B30.2, B30.17, and B30.18 as applicable for cranes.
  2. ANSI/ASME HST 1-6, B30.7, B30.16, and B30.21 as applicable for hoists.
- D. ASME – American Society of Mechanical Engineers
1. ASME HST-4M-1996 - Performance Standard for Overhead Electric Wire Rope Hoists
- E. MHI – Material Handling Institute
1. MH27.1 - 2003 - “Specifications for Patented Track Underhung Cranes and Monorail Systems.”
  2. MH27.2 - 2003 - “Specifications for Enclosed Track Underhung Cranes and Monorail Systems.”
- F. CMAA – Crane Manufacturers Association of America
1. CMAA Specification No. 70 - 2004 - “Specification for Top Running and Gantry Type Multiple Girder Electric Traveling Cranes.”
  2. CMAA Specification No. 74 - 2004 - “Specification for Top Running and Under Running Single Girder Electric Traveling Cranes Utilizing Under Running Trolley Hoist.”
- G. OSHA – Occupational Safety and Health Administration
1. OSHA standards including, but not limited to, 29 CFR 1910.179 for Overhead and Gantry Cranes and 29 CFR 1926.550 for Cranes and Derricks.
- H. FS – Federal Specifications
1. Federal specification RR-W-410 and the Wire Rope Users Manual or ASTM A1023/A for wire rope.
- I. NEMA - National Electrical Manufacturers Association
1. NEMA Standard Publication No 250-2003, “Enclosures for Electrical Equipment (1000 Volts Maximum)
  2. NEMA MG-1 for name plates.

**1.3. SUBMITTALS**

- A. Provide at Minimum the Following submittals. Owner may request additional submittals or supporting documentation at any time:
1. MSDS
  2. Complete materials list of all items to be furnished and installed.
  3. Erection Drawings - Detail product installation including:

- 1 a. Each member's designation (identification or piece mark), shape and size shall be clearly indicated and completely
- 2 dimensioned.
- 3 b. Plans and elevations shall locate each member by designation, define all work provided under this section, and
- 4 indicate sequence of erection for stability, handling requirements, or for other special conditions.
- 5 c. Sections and details shall show member connections and relationship of members to adjacent materials, to the
- 6 structure, and other construction.
- 7 d. Indicate all loading used in the design
- 8 4. Submit structural design calculations.
- 9 a. The structural design calculations shall bear the seal, registration number, and signature of a qualified structural
- 10 engineer responsible for their preparation.
- 11 b. The structural engineer shall be registered in the state applicable to work and project location.
- 12 5. Submit electrical design information. Include motor sizes and wiring diagrams
- 13 6. Manufacturer's and Erector's qualification statements.
- 14 7. Manufacturer's recommended installation procedures.
- 15 8. Plan for testing the crane capacity. The plan shall include the name of the responsible testing agency and procedures
- 16 for performing the actual testing.
- 17 9. Product data for each crane component.
- 18 10. Recommended spare parts list and prices.
- 19

#### 20 1.4. QUALITY ASSURANCE

- 21 A. MANUFACTURER QUALIFICATIONS: The manufacturer must have produced product similar to the product being specified
- 22 for a minimum of ten years with a record of successful in-service performance.
- 23 B. ERECTOR QUALIFICATIONS: Erector must have been regularly engaged for at least five years in erection for products similar
- 24 in material, design, and extent to that required on this project with a record of successful in-service performance. The
- 25 erector shall be manufacturer-trained and authorized by the manufacturer to install their products.
- 26 C. Outdoor cranes shall be designed considering wind forces.
- 27 D. Crane girder and rail tolerances shall be per AISI Technical Report #13.
- 28 E. Materials shall be properly selected for the stresses to which they will be subjected. Load carrying parts, except girders shall
- 29 be designed so that the calculated static stress in the material, based on rated load, shall not exceed 20 percent of the
- 30 published average ultimate strength of the material. This limitation of stress provides a margin of strength to allow for
- 31 variations in the properties of materials and under no condition should imply authorization or protection for user to load
- 32 the crane beyond capacity. Girders shall be designed in accordance with CMAA No. 74 Specifications.
- 33 F. Design calculations for bridge girder stresses shall include all live and dead loads and live and dead load impacts and shall
- 34 follow the method of calculation as prescribed by the Crane Manufacturer's Association of America (CMAA).
- 35 G. A safety factor of 5:1 shall be applied to the design of all load-bearing parts of the crane bridge, hoist and trolley.
- 36 H. The rated capacity of the crane shall be the load that the crane is designed to carry as specified by the manufacturer and
- 37 shown in tons on large capacity plates located on each side of the crane bridge. The crane bridge will be designed and built
- 38 to handle this rated load plus the weight of the hoist, trolley and all handling accessories such as buckets, magnets, grabs,
- 39 etc., shall be included as part of the load to be handled.
- 40 I. Materials shall be specified herein and shall be free from all defects and imperfections that may affect the finished product.
- 41 All parts shall be new and unused.
- 42 J. Structural steel shall be of good commercial quality conforming to ASTM specification A36.
- 43 K. End trucks shall be fabricated from tubes, structural steel shapes and plates welded into an integral unit and in-line bored
- 44 to receive the wheel axles.
- 45 L. Bearings shall be anti-friction ball or roller type, oil splash lubricated or equipped with easily lubrication fittings.
- 46 M. The bridge girder shall be constructed of standard structural shapes or boxed sections, reinforced and welded as required.
- 47 Connections between the girder and end trucks can be either welded or bolted after installation and squaring.
- 48 N. The end trucks will have a minimum wheelbase of 1/8 of the crane's span. Each end truck will be carried on two (2) wheels
- 49 running on anti-friction bearings. Wheels will be of machined steel, hardened to 300 –320 BHN, double flanged and capable
- 50 of running on either ASCE or square bar runway rails. The end trucks will be provided with rubber bumpers at each end to
- 51 engage end stops on the crane runway.
- 52

#### 53 1.5. PERFORMANCE REQUIREMENTS

- 54 A. Crane to be designed and built per CMAA (Crane Manufacturer's Association of America) standards
- 55 1. Capacity: per schedule
- 56 2. Service Classifications:
- 57 a. CMAA Class C
- 58 b. HMI Class H4
- 59 3. Operating Environment:
- 60 a. Location: Indoor
- 61 b. Classification: Non-Hazardous
- 62 c. Temperature: 40°F – 100°F
- 63 4. Span: See drawings.
- 64 5. Steel: AISC Hot Rolled Steel Beams, A-992.



- 1 6. Bridge Girder Deflection:  $L/600$
- 2 7. End Trucks: Dual drive with fixed axles. Motors shall include AC magnetic disc brakes per CMAA requirements.
- 3 Wheelbase-to-span ratio shall not exceed 7:1.
- 4 8. Hoist: Low-Headroom, Electric wire rope hoist with a hook to block dimension not to exceed 16 inches.
- 5 9. Lifting Height: See the Drawings. The height shown is the minimum max height allowable, however the Owner prefers
- 6 the most height achievable within the constraints of the existing building elements: Lifting height is above the operating
- 7 floor with three wraps remaining on drum at lowest hook position.
- 8 10. Trolley: Motor driven with two drive wheels and brakes per CMAA requirements.
- 9 B. Crane Speeds - Full Load Speed(AC)
- 10 1. Bridge: VFD (variable frequency drive) – 60 FPM minimum and 150 FPM maximum
- 11 2. Trolley: VFD (variable frequency drive) – 50 FPM minimum and 80 FPM maximum
- 12 3. Hoist VFD (variable frequency drive) – 5 FPM minimum and 20 FPM maximum
- 13 C. Bumpers: Rubber bumpers on end trucks and trolley per CMAA requirements.
- 14 D. Electrical
- 15 1. Any reference to motor size or power requirements for the crane motors contained in this specification section is
- 16 preliminary and shall not be relied on by the Crane Provider. The Crane Provider shall be responsible for any changes to
- 17 the electrical system that may result from final sizing and selection of the crane motors by the crane manufacturer at
- 18 no additional cost to the Owner.
- 19 2. All motors shall be furnished and installed under this section. All motors shall be of NEMA premium efficiency. All
- 20 motors shall be of ample size and construction to carry continuously all loads, which may be imposed through their full
- 21 range of operation. The maximum motor loading shall not exceed the nameplate horsepower rating, exclusive of
- 22 service factor. Motor horsepower is to be determined by the Crane Provider. All motors shall operate at speeds not
- 23 greater than nominal Speed.
- 24 3. Enclosures: NEMA 4, Minimum.
- 25 4. Voltage: per plan
- 26
- 27 **1.6. EXTRA MATERIAL**
- 28 A. Provide any special tools required for the equipment.
- 29

## 30 **PART 2 - PRODUCTS**

### 31 **2.1. PRODUCTS**

- 32 A. MANUFACTURERS : Abell-Howe, Engineered Material Handling, DeMag Cranes & Components, KCI Konecranes America,
- 33 Inc., Overhead Material Handling, Morris Material Handling, Zenar Corporation, Superior Crane Corporation, North
- 34 American Industries, Inc., Sievert Electric Service and Sales Company, TC/American,
- 35 B. RAILS AND RAIL ACCESSORIES:
- 36 1. Rails shall be Control Cooled with Ends Hardened / Heat Treated
- 37 2. Rail joints shall be "Tight Fit"
- 38 3. Rails and splice bars shall be provided by a single source and shall have holes drilled for splice bars prior to arrival on
- 39 site.
- 40 4. Bolted / Welded Splices
- 41 5. Rail splices shall be staggered on each side of runway a minimum of 1 foot and shall not equal the wheel spacing.
- 42 6. Rail splices shall not occur at crane beam splices
- 43 7. Rail lengths shall be a minimum of 10 feet.
- 44 8. Rail clamps shall provide "fixed" rails for CMAA Class A, B, or C cranes except for when expansion joints are used in the
- 45 crane runway beam. In that case "floating" rails shall be provided.
- 46 9. Rail clamps shall provided "floating" rails for CMAA Class D, E, or F cranes.
- 47 C. Crane stops: Align longitudinally along the crane runway
- 48 D. Vertical Lift: Main hook
- 49 E. Provide oil and grease tight gear cases
- 50

### 51 **2.2. CONTROLS**

- 52 A. The bridge motion's control shall be located in a bridge-mounted NEMA4/12 enclosure. The bridge control is to be provided
- 53 with a mainline contactor controlled from the bridge control station and a door-mounted disconnect that turns off power
- 54 to the bridge panel and drives and the hoist and trolley panel and drives before the panel door can be opened.
- 55 B. The control shall be designed and built per the National Electric Code (NEC) standards with color-coded and match-marked
- 56 wires. The panel shall also meet the standards of an independent certification agency.
- 57 C. All motions of the crane (hoist, trolley and bridge) shall be operated through a single cable suspended pendant pushbutton
- 58 type control. The pendant shall have two buttons for the control of each motion plus power on/off buttons:
- 59 1. Hoist: Up/Down
- 60 2. Trolley: Left/Right
- 61 3. Bridge: Forward/Reverse
- 62 4. Power: On/Off
- 63 D. The pendant shall be suspended from:
- 64 1. A separate "C" Track roving pendant.

- 1 E. Pushbutton station shall be of molded contour grip type and supported from hoist by strain relief cable to avoid damage  
 2 from pull on the control wires. The enclosure is to be NEMA 4X watertight. Controls pendant shall be 115 volt AC,  
 3 supported by a strain cable. Pendant shall hang to a point 3" - 6" above the operating floor elevation as shown on the  
 4 drawings. The pushbuttons shall return to the off position when the operator releases the pressure. The magnetic  
 5 contactors for all motions shall be mechanically or electrically interlocked. Control voltage at the pushbutton stations shall  
 6 be grounded to the hoists. A strain reliever cable shall support the control pendant.
- 7 F. Provide a remote push button station/operator/controls at location in same space (designated by owner)
- 8 G. Primary Method: Festooned Pendant
- 9 H. Secondary Method: None
- 10 I. Lockable
- 11 J. Control Criteria:
- 12 1. Start and Stop Buttons
  - 13 2. Directional Buttons labeled based on compass directions
  - 14 3. Detachable
  - 15 4. Indicator Lights on Pendant
  - 16 5. Festooned / Suspended from Trolley

### 17 2.3. ELECTRIFICATION CRITERIA

- 19 A. Mainline conductors per manufacturers recommendations with mounting hardware throughout for a complete and proper  
 20 installation - coordinate location with electrical power supply
- 21 B. Fused disconnect between crane and mainline conductor.
- 22 C. Motor overload protection for each motion
- 23 D. Cross conductors shall be festooned cables.
- 24 E. NEMA 12, Front Wired, Rear Mounted Enclosures
- 25 F. Indicator lights on bridge
- 26 G. CRANE BRIDGE ELECTRIFICATION:
- 27 1. Power and control voltage will be provided to the moving trolley and hoist through means of a festoon flat cable  
 28 system. There will be separate cables for the motor power supply (line voltage) and control and these cables will be  
 29 provided with separate connecting fittings and plugs. The cable connecting fittings and plugs shall be metal, not plastic,  
 30 and will be of the type easily repairable or modified in the field without special tools. The power and control cables will  
 31 be carried from trolleys with four (4) steel wheels running in a track suspended off of the bridge girder running the full  
 32 length of the crane span.
  - 33 2. The bridge will be provided with a main power pick-up (collector pole) and sliding shoe collectors that will contact and  
 34 run in the shielded bar runway conductor system.
- 35 H. CRANE RUNWAY SYSTEM:
- 36 1. a. Runway Beams: Runway beams will be provided by the Crane Provider, supported on stools welded to the building  
 37 columns. The beams will be capped or uncapped as required to achieve maximum hook lift and to handle the crane's  
 38 loading (Equivalent center loading, E.C.L.) at full capacity load and closest hook approach possible. The ends of the  
 39 runway beams are to be joined together by means of bolted splices.
  - 40 2. Runway Rails: ASCE runway rails will be provided and installed on the runway beams. The rails will be properly sized for  
 41 the crane's intended service class, wheel diameter and loading and are to be secured to the top of the runway beams  
 42 with J-bolts to permit future adjustments as needed. Bolted rail splices will be used to join the ends of the rail together  
 43 and end stops will be provided at each end of the rails to engage with the bridge end truck bumpers.
  - 44 3. Runway Electrification:
    - 45 a. Runway power electrification will be provided running the full length on one side of the runway. The electrification  
 46 will be of the shielded bar type supported at proper intervals to prevent sag or excessive vibration and with power  
 47 feeds located to minimize voltage drop so as to provide adequate power to operate at least the hoist and one  
 48 traverse motion at the extreme ends of the runway.
    - 49 b. Provide four bar runway electrification system, Duct-O-Bar or approved. 3 line conductors are to be connected to  
 50 the bridge via collectors. 1 line conductor for ground is to be connected to the bridge via similar collectors for a  
 51 complete code approved installation.
  - 52 I. Capacity Overload Protection: Overload Lockout. Overload protection set at 100% rated capacity. Limit Switch: An upper  
 53 block operated control circuit limit switch shall be provided that shuts off the hoist motor when the load hook reaches its  
 54 highest position. n. Controls to be centralized and designed per NEC (National Electric Code) standards housed in a panel  
 55 with a hinged door. The controls are to be provided with a step-down transformer within the panel that provides 120 volts  
 56 power to the control circuits. Control circuit voltage to the push button station shall not exceed 120 volts. In addition, the  
 57 panel will meet the standards of an independent certification organization.

### 59 2.4. HOISTS

- 60 A. MANUFACTURER: ACCO-Wright, Ace World Companies, David Round, Detroit Hoist, Shepard Niles, Shaw Box, Yale, Coffing  
 61 WR series,
- 62 B. Headroom required shall not exceed 30 inches from the bottom of the bridge beam to the throat of the load hook.

- 1 C. Wire rope hoist shall meet the requirements of ASME B30.16 "Overhead Hoists". Hoist shall be heavy duty meeting H4  
2 Service classification as defined in ANSI/ASME HST-4M "Performance Standard for Overhead Electric Wire Rope Hoists".  
3 Electric wire rope hoists shall meet the following requirements:
- 4 1. Frame shall be fabricated from rolled steel to form a one-piece weldment.
  - 5 2. Gear case is to be machined aluminum alloy casting with sealed construction allowing the gears and load brake to  
6 operate in a bath of oil.
  - 7 3. Bearings shall be high quality anti-friction type of either needle or ball design and used throughout the hoist. Bearings,  
8 not considered lifetime lubricated by the manufacturer, should be provided with a means for lubrication.
- 9 D. Brakes: Hoist shall have 2 types of brakes: One DC electrical multiple disc motor brake spring set electrically released, and  
10 one self-adjusting Weston type mechanical load brake located in the gear case. Either brake shall have the capability of  
11 holding rated load in the event of failure of either brake system.
- 12 E. Overload device shall be provided to prevent lifting excessive overloads. This load-limiting device shall be preset at the  
13 factory to disengage the hoist motor from the gearing in event of excessive overload condition. Overload device is to be  
14 located between the motor and load brake, so that the load brake will hold the load in event of overload device failure.
- 15 F. Motors shall be of high starting torque type designed specifically for hoist duty service with permanently lubricated ball  
16 bearings, rated for 30-minute duty cycle. The motor enclosure is to be totally enclosed non-ventilated, TENV. Motor  
17 insulation shall be class F Minimum. If hoist is to be two-speed it shall have a high speed to low speed ratio of 3:1. Motor is  
18 to have automatic reset temperature actuated switch (TAS) in motor windings to provide motor running over current  
19 protection.
- 20 G. Gearing shall be a combination of spur and/or helical, precision cut and heat treated to ensure quiet, efficient operation.  
21 Gears shall be totally enclosed and run in a bath of oil to provide maximum lubrication. Gears are either splined or keyed to  
22 shafts.
- 23 H. Deep grooved, large diameter rope drum that helps prevent over wrap of cable for longer rope life.
- 24 I. The diameter of the rope drum shall not be less than 18 times the diameter of hoisting cable, running sheaves not be less  
25 than 16 times and idler sheave not less than 12 times the diameter. Hoisting cable shall be 6 x 37 improved plow steel.
- 26 J. Motor driven trolleys are to have heavy section rolled steel side frames. The wheels are steel with heat-treated  
27 (universal/patented track) tread. Motor driven trolleys have totally enclosed non-ventilated (TENV) motors with right angle  
28 gear reducers. Trolley wheel gears and pinions have machined cut gear teeth. Spacer washers are provided for trolley  
29 adjustments to various beam sizes.

## 30 **2.5. FINISHES**

- 31 A. Surface Preparation:
- 32 B. SSPC-SP1: The Society for Protective Coatings "Surface Preparation Specification No. 1 – Solvent Cleaning", September 1,  
33 2000 Edition and SSPC-SP2: "Surface Preparation Specification No. 6 – Commercial Blast Cleaning", September 1, 2000  
34 Edition.  
35
- 36 C. The crane shall be given a minimum of one prime coat and a minimum of two finish coats of standard safety yellow paint.
- 37 D. Paint compass directions legend in a visible location on the underside of the crane.

## 38 **PART 3 – EXECUTION**

### 39 **3.1. INSTALLATION**

- 40 A. Install in accordance with manufacturer's instructions and all code requirements.
- 41 B. Install in accordance with manufacturer's instructions and all code requirements.
- 42 C. TESTING:
- 43 D. An independent testing agency will perform special inspection for structural welding in accordance with OSSC 1701.5.5.1.  
44 The owner will retain the services of the testing agency. The structural engineer retained by the Crane Provider to  
45 engineer the Crane Support System to identify the elements that require special inspection.
- 46 E. Testing shall comply with rules and coordination with inspectors of OSHA, City of Corvallis, OSU Environmental Health and  
47 Safety, and other applicable agencies.
- 48 F. Field Testing: After approved equipment is installed, it shall be given a running test where it shall demonstrate the ability  
49 to lift and continuously transport the rated capacity throughout the entire length and width of the specified ranges.
- 50 G. Use of system is not permitted during construction.
- 51

52 **END OF SECTION**

53