

## Part III - Concrete and Concrete Structures

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## **ARTICLE 301 - CONCRETE AND CONCRETE MATERIALS**

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### **301.1 General.**

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:

501.2	Materials
501.3	Construction

All concrete used on City of Madison Public Works projects shall also comply with the following requirements, except as modified in the Special Provisions of the contract. Where the following requirements conflict with the above latest edition of the Standard Specifications for Highway and Structure Construction of the State of Wisconsin, Department of Transportation, then these following requirements apply:

1. The minimum compressive strength at twenty-eight (28) days shall be three thousand (3,000) pounds per square inch. The minimum modulus of elasticity at twenty-eight (28) days shall be three million one hundred twenty thousand (3,120,000) pounds per square inch.
2. The minimum cement content shall be six (6) bags per cubic yard, except for concrete mixes with fly ash. Each bag of cement shall contain ninety-four (94) pounds net.
3. From the master limits of the job mix, adjusted as necessary for the specific gravities of the aggregate furnished, the Contractor shall determine and submit to the City Engineer a job mix, using the lowest quantity or percentage of fine aggregate within the range shown therefor which, without exceeding the maximum quantity of water permitted, will yield a mix possessing the necessary workability. The Contractor may use concrete from a pre-approved Supplier without submitting a mix design .

Concrete suppliers shall submit a mix design for concrete annually, when a change of aggregate sources is made or as directed by the Engineer.

4. Between May 15th and September 15th, the contractor may substitute fly ash for cement in accordance with the specifications for concrete masonry in the latest edition of State of Wisconsin, Department of Transportation Standard Specifications for Road and Bridge Construction and supplements thereto. If the contractor desires to extend the above dates from April 15th through October 15th, he/she shall request permission in writing from the City Engineer. The fly ash shall be class "C" as identified in the ASTM C-618 specification. The maximum allowable fly ash used in the mix shall be twenty (20) percent.
5. All concrete shall be Air-Entrained, and shall contain seven (7) percent air by volume, plus or minus one and one-half (1.5) percent.
6. All concrete for curb and gutter, sidewalks, floors, roof slabs, and other horizontal pours shall have a slump of not less than two (2) inches and not more than four (4) inches. All concrete for walls, columns, and other vertical pours shall have a slump of not less than three (3) inches and not more than six (6) inches.

7. No water shall be added when placing concrete unless approved by the Engineer. If water is added without consent of the Engineer, this shall be considered sufficient grounds for rejecting the concrete.
8. The maximum limit of light chert (specific gravity of 2.40 or less) allowed in coarse aggregate shall be three (3) percent by weight.
9. Admixtures other than required for air entrainment shall not be used unless approved by the Engineer for a specific project.

### **301.2 Concrete Tests.**

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 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.

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.

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 work. Any concrete from the same batch from which the tests were made which has been placed shall be removed and disposed of by the Contractor at the Contractor's expense.

2. Strength tests shall be made for each of the following conditions: each day's pour; each class of concrete; each change of source of supply; or when ordered by the Engineer. A strength test shall consist of a minimum of two (2) standard six (6) inch concrete cylinders for each one hundred fifty (150) cubic yards of concrete or fraction thereof placed on any day.

The City representative shall make the cylinders following the "Method of Making and Curing Concrete Compression and Flexure Test Specimens in the Field" (ASTM C-31). The cylinders will be tested by the City at its own expense at seven (7) days or at twenty-eight (28) days, unless otherwise specified, in accordance with the "Method of Test for Compressive Strength of Molded Concrete Cylinders" (ASTM C-39). The Contractor shall furnish all materials, labor, and equipment necessary for fabricating, preparing, protecting, and transporting all required samples, including concrete, cylinder molds, and wooden boxes suitable for the protection and transportation of the samples.

In the event test cylinders show the compressive strength of the concrete to be below the specified compressive strength of concrete, the following procedure shall be followed:

- a. Three (3) cores shall be taken for each cylinder test below the specified compressive strength of concrete. Cores shall be taken in accordance with the “Standard Methods of Securing, Preparing and Testing Specimens from Hardened Concrete for Compressive and Flexural Strengths” (ASTM C-42), from the area of the pour represented by the defective cylinders. These cores shall be tested as prescribed in Section 4 of the “Method of Test for Compressive Strength of Molded Concrete Cylinders” (ASTM C-39) in order to verify the cylinder tests.
  - b. Where the cores show the compressive strength of the concrete to equal or exceed the specified compressive strength of concrete, the pour in question shall be accepted, and the costs of obtaining and testing cores shall be borne by the City.
  - c. Where the average of the cores tested show the compressive strength of the concrete to be below the specified compressive strength of concrete and equal to or greater than eighty-five (85) percent of the specified compressive strength of concrete and if no single core is less than seventy-five (75) percent of the specified compressive strength of concrete, the City shall deduct from any monies due or to become due the Contractor an amount equal to ten (10) percent of the contract price of the structure or portion thereof, in which the defective concrete is incorporated. The Contractor shall also bear the costs of obtaining and testing the cores.
  - d. Where the average of the cores tested show the compressive strength of the concrete to be below eighty-five (85) percent of the specified compressive strength of concrete, or if a single core is less than seventy-five (75) percent of the specified compressive strength of concrete, the structure or portion thereof, in which the defective concrete is incorporated shall be removed and disposed of by the Contractor at the Contractor’s expense. The Contractor shall also bear the costs of obtaining and testing the cores.
3. Tests of the concrete proposed for use on the project shall be made at the direction of the Engineer in accordance with the “Methods of Test for Compressive Strength of Molded Concrete Cylinders” (ASTM C-39) and the “Method of Making and Curing Concrete Compression and Flexure Test Specimens in the Laboratory” (ASTM 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 twenty-eight (28) days, shall be made with the proportioning and materials proposed to be used in the major part of the project.

The slump should not be less than the greatest slump expected to be used in the structure. The tests made on the aggregate required herein may be made a part of these tests if suitably referenced on the reports which shall be issued at seven (7) days and at twenty-eight (28) days. These tests shall be repeated as necessary due to changes in materials or unsatisfactory results.

### **301.3 Reinforcing Steel.**

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

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

Such reinforcing steel will be measured by length in linear feet of the sizes ordered and installed. In the absence of applicable unit prices for the particular size(s) of reinforcing steel installed, the unit price(s) for the particular size(s) installed shall be arrived at as follows:

1. In proportion to the ratio of the cross sectional area of the size of reinforcing steel installed to the cross sectional area of the smallest size of reinforcing steel included in the contract as a bid item, or
2. In the absence of a unit price included in the contract as a bid item, in proportion to the ratio of the cross sectional area of the reinforcing steel installed to the cross sectional area of #4 (1/2 inch diameter) reinforcing steel, with a unit price of seventy-five (\$0.75) cents per linear foot for uncoated bars, and one (\$1.00) dollar for epoxy-coated bars.

### **301.4 Expansion Filler.**

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

All materials for expansion joints shall be furnished and installed by the Contractor and the costs shall be included in the unit prices bid for the various items of work.

### **301.5 Placing and Finishing.**

Retempering of mortar or concrete which has partially hardened, that is mixing with additional materials or water, shall not be permitted.

No concrete shall be deposited in water or mud. During the pouring of bottom slabs and walls, the Contractor shall furnish sufficient pumping equipment to keep the water below the bottom of the floor of the structure. After concrete has been poured the Contractor shall keep the pumping equipment in continuous operation for thirty-six (36) hours.

Concrete shall not be deposited on frozen subbase material, on or against ice or frost, or on reinforcing steel having a temperature at pouring time of less than 36°F.

Concrete when deposited shall have a temperature of not less than 55°F. and not more than 100°F.

Concrete shall be handled from the mixer to placement as rapidly as practicable and in a manner that will prevent segregation of the ingredients until the unit of operation, approved by the Engineer, is completed. It shall be deposited in the forms as nearly as practicable in its final position to avoid rehandling. Concrete as it is deposited shall be puddled with suitable tools or equipment until forms are completely filled and reinforcement and embedded fixtures thoroughly incorporated in the mass.

Concrete adjacent to the forms, joints, or structures shall be deposited and spaded or vibrated in a manner to prevent the formation of voids or rock pockets. All cavities produced by the removal of form ties and any voids or rock pockets of more than casual occurrence found after the forms are removed, shall be filled immediately with a well mixed grout, composed of one (1) part of Portland cement and three (3) parts of fine aggregate (masonry sand) and finished to the true surface of the face of structure by the following method: Defective areas shall be chipped away to a depth of not less than one (1) inch measured at right angles to the surface. The area shall be thoroughly wetted,

brushed with grout, and patched with grout. The patch shall be cured as specified for concrete structures. Defects appearing on the patch shall be repaired at the Contractor's expense.

An accumulation of water on the surface of freshly deposited concrete shall immediately be removed in a manner satisfactory to the Engineer.

Concrete shall be so deposited as to maintain, until the completion of the unit, a plastic surface, approximately horizontal. Forms for walls or other thin sections a height in excess of eight (8) feet shall be provided with openings, or other devices, that will permit the concrete to be placed in a manner that will avoid accumulation of hardened concrete on the forms or metal reinforcement. Under no circumstances shall concrete that has partially hardened be deposited in the work.

When concrete is conveyed by chuting, the mixer shall be of such size and design as to insure a practically continuous flow in the chute. The angle of the chute with the horizontal shall be such as to allow the concrete to flow without separation of the ingredients. An angle of twenty-seven (27) degrees, or one (1) vertical to two (2) horizontal, is the minimum slope which is considered permissible. Chuting through a vertical pipe is satisfactory when the lower end of the pipe is maintained four (4) feet or less above the surface of the deposit. The delivery end of the chute shall be within four (4) feet of the point of deposit. When the operation is intermittent, the spout shall discharge into a hopper. The chute shall be thoroughly flushed with water before and after each run; the water used for this purpose shall be discharged outside the forms but not into paved streets, walks, gutters or inlets.

All reinforced concrete shall be vibrated in place to the satisfaction of the Engineer with mechanical vibrators. Vibrators shall also be required for non-reinforced concrete structures when other methods of compaction or "puddling" do not give the desired results in the opinion of the Engineer.

Before depositing new concrete on or against concrete which has been set, the forms shall be retightened, the surface of the set concrete shall be roughened as required by the Engineer, thoroughly cleaned of foreign material and saturated with water.

Joints not indicated on the plans shall be so designed and located as to least impair the strength and appearance of the structure. All joints shall provide sufficient resistance to shear to which they may be subjected. Horizontal joints required to be watertight shall be constructed by forming continuous keyways in the lower portion of the concrete before the concrete has hardened. Before placing the superimposed concrete, the joint shall be thoroughly cleaned of foreign material and saturated with water. Vertical joints required to be watertight, and expansion joints shall be provided with suitable keyways subject to the approval of the Engineer.

Top surfaces of roof slabs, unless otherwise specified, shall be smoothed with a wood float. Care shall be taken to avoid an excess of water in the concrete, and to drain or otherwise promptly remove any water that comes to the surface. Dry cement or a dry mixture of cement and sand, shall not be sprinkled directly on the surface.

Top surfaces of concrete floor slabs, unless otherwise specified, shall be wood floated and then troweled with a steel hand trowel or a mechanically operated steel trowel to a smooth, dense finish. Steel troweling shall be done after the water has disappeared from the surface.

Unless otherwise specified, all edges of concrete along joints and forms shall be finished with a steel edging tool of one-fourth (1/4) inch radius.

Where concrete is to be placed in two lifts, as for cunettes, pavements, and other structures with wire mesh reinforcements, the concrete for the lower lift shall be placed, the required reinforcement positioned and secured and the upper lift of concrete placed. Any portion of the lower lift of concrete not covered with the upper lift of concrete within thirty (30) minutes after being placed, shall be removed. Concreting operations shall be discontinued due to insufficient natural light, unless an adequate and approved artificial lighting system is provided and operated.

### **301.6 Forms.**

Forms shall conform to the shape, lines and dimensions of the structure as called for on the plans.

For exposed concrete surfaces, forms shall be three-fourths (3/4) inch structural plywood or acceptable prefabricated commercial wood or steel form panels. Forms used for exposed surfaces are subject to the approval of the Engineer.

Joints in forms shall be horizontal or vertical. For unexposed surface and rough work, undressed lumber may be used. 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.

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.

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.

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.

Temporary openings shall be provided where necessary to facilitate cleaning and inspection immediately before placing concrete.

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.

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.

**301.7 Curing.**

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.

**301.8 Protection of the Concrete.****301.8(a) Cold Weather Protection.**

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:

<b>Predicted or Actual Air Temperature</b>	<b>Minimum Equivalent Level of Protection</b>
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

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.

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.

**301.8(b) Bridges, Box Culverts and Roof Slabs.**

In the determination by the Engineer, of the time for the removal of falsework, consideration shall be given to the location and character of the structure, to the weather and other conditions influencing the setting of the concrete and to the materials used in the mix.

The Engineer reserves the right to determine the time when falsework or form supports may be removed either by the use of test cylinders or by the use of the minimum requirements shown below.

Falsework supporting concrete structures shall remain in place in accordance with the following minimum requirements, which shall be exclusive of days in which concrete has been subjected to a temperature of below 40°F.

<b>Span Length - Feet</b>	<b>Air Entrained Concrete</b>	<b>High Early Strength Concrete</b>
12 or less	7 days	3 days



Over 12	14 days	6 days
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When operations are controlled by laboratory controlled cylinder tests, the removal of falsework and support forms may be begun, with the approval of the Engineer, when the test of cylinders shown a compressive strength of the concrete of not less than 2,000 lbs./sq. in. for spans twelve (12) feet or less and 2,500 lbs./sq. in. for spans over twelve (12) feet.

Backfilling of walls and over tops of box culverts shall be carried out by the Contractor only with the approval of the Engineer.

### 301.8(c) Opening Curb and Gutter, Sidewalk, Driveways, and Pavements to Traffic.

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.

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.

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.

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.

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:

For not less than seven (7) days when the atmospheric temperatures are generally 70°F. or higher during the period.

For not less than ten days when the atmospheric temperatures are generally not lower than 60°F. during the period.

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.

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.

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.

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.

### 301.8(d) Catchbasins, Access Structures, and Headwalls.

Traffic on or over these structures shall be curtailed until the concrete has reached full strength.

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.

### 301.9 Concrete Slurry.

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. The above mixes shall conform to the following one (1) cubic yard of mix of flowable slurry:

#### Type A Slurry

3000 lb.	Sand
50 lb.	Portland Cement
300 lb.	Class C Fly Ash
50 gal.	Water
1.4 oz.	Air Entraining Admixture

#### Type B Slurry

2700 lb.	Sand
100 lb.	Portland Cement
300 lb.	Class C Fly Ash
50 gal.	Water

#### NOTES:

1. All design aggregate batch weights are saturated surface dry.
2. Aggregate batch weights shall be adjusted for free moisture at time of mixing.
3. Admixture quantity may be varied within manufactures recommended dosage to provide desired results.

## **ARTICLE 302 - CONCRETE CURB AND GUTTER**

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### **302.1 General.**

#### 302.1(a) Description.

This work shall consist of constructing concrete curb and gutter, with or without reinforcement, of the dimensions and design as indicated, and placed in one course on the prepared foundation or base, at the locations and to the required lines and grades; all as shown on the plans and provided by the contract.

The Contractor shall mark the top of the curb where the sanitary sewer and water service cross the curb and gutter. The mark may be made by sawcutting. The depth shall be a minimum of one-sixteenth (1/16") inch deep. The laterals and services will be located by the City. The cost of the location marks shall be considered incidental to the cost of the concrete curb and gutter.

### **302.2 Construction Methods.**

#### 302.2(a) Preparation of Foundation.

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

#### 302.2(b) Forms.

Curb and gutter forms shall be of steel construction and conform to the design of the type of curb and gutter being installed. Wooden forms may be used only with the Engineer's approval on short radius curves and in special cases where accessibility is limited.

All forms shall be free of hardened concrete, mud, dirt, and debris, and shall be free of bends and twists which would make their use unacceptable on the project.

All forms shall be oiled to the satisfaction of the Engineer before depositing or placing concrete in them.

When concrete curb and gutter is constructed on a curve, flexible forms shall be used for all curves having a radius of two hundred (200) linear feet or less.

#### 302.2(c) Placing and Finishing Concrete.

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

The curb and gutter over ditches shall be installed in twenty (20) foot lengths centered over the ditch. A dummy joint shall be cut at the center of the twenty (20) foot section.

Unless otherwise specified, curb and gutter shall be installed in minimum lengths of six (6) feet and maximum lengths of fifteen (15) feet.

The Contractor shall install a header at the end of each pour. At no time shall the Contractor be allowed to spread excess concrete as a base for the next or any succeeding pour.

Wherever different types of curb and gutter are employed, the Contractor shall take care that transitions from one type of curb and gutter to another type are done smoothly without loss of flow line grade or curb head shape.

The reconnection of existing drains from adjacent properties to the curb and gutter shall be incidental to concrete curb and gutter.

The slope of the curb and gutter shall not exceed 1" in 12" thru handicap accessible ramps.

Hand formed concrete curb and gutter will be paid for at the unit bid price, no distinction will be made for the various types of curb and gutter.

#### 302.2(d) Joints.

Full contraction joints shall be a minimum of three (3) inches in depth, and shall be uniformly spaced not less than six (6) feet nor more than fifteen (15) feet apart unless otherwise directed by the Engineer.

If machine methods are used for forming and finishing curb and gutter the Contractor may saw contraction joints or planes of weakness may be created by the insertion of approved partial depth separator plates having a minimum depth of three (3) inches. The depth of cut and equipment used in sawing shall meet the approval of the Engineer. The sawing shall be done as soon as practicable after the concrete has set sufficiently to preclude raveling during the sawing and before any shrinkage cracking takes place in the concrete. If this method results in random cracking the Contractor shall be required to use the partial depth separator plates.

Transverse expansion joints shall be one-half (1/2) inch in width and shall be placed across the curb and gutter perpendicular to the curb line at all radius points of curves having a radius of two hundred (200) feet or less, and on both sides of all inlets installed in curb and gutter. All expansion joints shall extend through the entire thickness of the curb and gutter and shall be perpendicular to the surface. All expansion joints shall be formed by inserting during construction, and leaving in place, the required thickness of joint filler which shall extend through the entire thickness of both curb and gutter.

Where curb and gutter and concrete sidewalk or concrete driveways join, an expansion joint one (1) inch in width must be constructed between walks and curb.

The joint filler in transverse joints shall be flush with the finished surface of the gutter. The concrete adjacent to these joints shall be finished with a wooden float which is divided through the center and which will permit finishing on both sides of the filler at the same time. Before the curb and gutter is opened to traffic, excess joint filler shall be cut off level with the finished surface.

#### 302.2(e) Reinforcement.

Where reinforcement is required it shall conform to and be placed in accordance with the details shown on the plans, as specified in the contract, or as directed by the Engineer.

Where directed by the Engineer, the Contractor shall install three (3) one-half (1/2) inch round reinforcing rods fifteen (15) feet long in concrete curbs and gutters which span ditches.

**302.2(f) Protection.**

The curb and gutter must be protected from injury by traffic or other causes, and also from the rays of the sun until completely set.

**302.2(g) Hand Formed Curb and Gutter (Tree Locations - Undisturbed).**

The work under this item shall consist of manually forming and pouring curb and gutter at tree locations or where other structures prevent the use of a curb machine, as designated by the Engineer.

Where the item Hand Formed Curb and Gutter is to be used at tree locations, the excavation cut shall be held to within six (6") inches of the proposed back of curb.

**302.3 Measurement and Payment.**

**302.3(a) Method of Measurement.**

Curb and Gutter, completed in accordance with the terms of the contract, will be measured by length in linear feet, along the flow line of the gutter and such measurement shall be continuous along such line extended across driveways, crosswalks, sidewalk ramps and special waterways.

Where a transition is made from one type of curb and gutter to another type of curb and gutter, the transition length shall be divided equally between the two types of curb and gutter.

Reinforcing steel for concrete curb and gutter installed in accordance with the terms of the contract will be measured by length in linear feet.

**302.3(b) Basis of Payment.**

The footage, measured as provided above, shall be paid for at the contract unit price per linear foot, which price shall be full compensation for all preparation of subgrade and all special construction required at driveways, crosswalks, sidewalk ramps and special waterways; for furnishing all materials, including concrete masonry and expansion joints; for placing, finishing, protecting and curing; and for all labor, tools, equipment and incidentals necessary to complete the work including disposal of surplus material from excavation and restoring the site of the work.

The contract price for reinforcing steel for concrete curb and gutter shall include furnishing the specified materials and all labor, tools, equipment and incidentals necessary to complete the work.

Where reinforcing steel for curb and gutter is not listed as an item on which to submit unit prices, it shall be understood and agreed that the Contractor shall be paid seventy-five (\$0.75) cents per linear foot of uncoated reinforcing steel, and one (\$1.00) dollar per linear foot of epoxy-coated reinforcing steel furnished and placed in accordance with these Specifications.

Where directed by the Engineer, the Contractor shall construct combination curb and gutter, or curbing which varies in cross section from Madison Standard curb and gutter. Unless listed as a bid item in the proposal, for such construction, the Contractor shall be paid a unit price per linear foot

that has the same proportion to the unit price bid per linear foot of Madison Standard curb and gutter as the cross section area of the irregular curb and gutter has to the cross sectional area of the Madison Standard curb and gutter. The cross sectional area of the Madison Standard curb and gutter shall be considered as two (2) square feet.

The cost of reinstalling all pipe drains connected to the curbing shall be included in the unit price bid per foot of curb and gutter.

The price paid to the Contractor at driveways, crosswalks, sidewalk ramps, and special waterways shall be the same for regular curb and gutter, except where commercial curb cuts are specified. Commercial curb cuts shall be paid at the unit price bid for commercial curb cuts.

### 302.3(c) Damage to Inlets.

Any damage to cast-iron inlets during construction occasioned by the Contractor shall be charged to the Contractor.

Any existing cast-iron inlet found to be defective shall be hauled to the Engineering Division Service Building storage yard at 1602 Emil Street and a new inlet will be furnished by the Contractor and shall be paid for by the City to the Contractor upon the presentation of a receipted bill.

## **ARTICLE 303 - CONCRETE SIDEWALKS, CONCRETE DRIVEWAYS, CONCRETE TRAFFIC ISLANDS AND STEPS OF CONCRETE MASONRY**

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### **303.1 General.**

#### 303.1(a) Description.

This work shall consist of constructing sidewalks, sidewalk ramps, driveways, traffic islands, and steps of concrete masonry, with or without reinforcement placed on the prepared foundation or base in one course of the required dimensions and design; all as shown on the plans and provided by the contract.

Where integral curb and sidewalk is specified, such work shall consist of a sidewalk constructed with a concrete curb built integral with the same, all in accordance with the design and details shown on the plans.

The following specifications pertain equally to concrete sidewalks, concrete sidewalk ramps, concrete driveways, concrete traffic islands, and concrete steps, whether the particular item of construction is mentioned or not.

### **303.2 Construction Methods.**

#### 303.2(a) Preparation of Foundation.

The foundation shall be formed by excavating or filling to the required elevation of the bottom of the concrete. The foundation so constructed shall be thoroughly mechanically compacted to insure stability. At locations where rocks, boulders or other objects prohibit subgrading to provide a smooth foundation for slip form paving equipment the Contractor shall undercut a minimum of two (2) inches below subgrade and backfill with two (2) inches of compacted sand, screenings (limestone or sand) or crushed aggregate base course. Three (3) inches of crushed aggregate base course shall be placed under sidewalk when the centerline grade of the street exceeds 5%. The cost of excavating and compacted select backfill shall be incidental to the item of sidewalk construction.

The Contractor shall be responsible for replacement with approved materials, mechanically compacted, of any material necessary to bring the subbase to grade, where the Contractor has undercut the subbase without the direction of the Engineer.

Where tree roots are found to be in the same location of new sidewalk or sidewalk that is to be removed and replaced, the roots shall be removed to a minimum depth of five (5) inches below the subgrade.

#### 303.2(b) Forms.

Sidewalk forms shall be of steel construction and have a vertical height of at least five (5) inches. Wooden forms may be used only with the Engineer's approval on short radius curves and in special cases where accessibility is limited.

All forms shall be free of hardened concrete, mud, dirt, and debris, and shall be free of bends and twists which would make their use unacceptable on the project.

All forms shall be oiled, to the satisfaction of the Engineer, before depositing or placing concrete in them.

When concrete sidewalk is constructed on a curve, flexible forms shall be used for all curves having a radius of two hundred (200) linear feet or less.

### 303.2(c) Placing and Finishing Concrete.

All concrete driveways shall be seven (7) inches. Concrete sidewalk at commercial driveways and where otherwise designed by the Engineer shall be seven (7) inches. All driveways shall have six (6") inches of thoroughly compacted crushed stone base.

The foundation and forms, and reinforcement when required, shall be checked and approved by the Engineer before the concrete is placed.

The sidewalk shall then be given a brush or corrugated finish as the Engineer directs. Sidewalk ramps shall be given surface texturing as shown on Standard Plate for Madison Standard Sidewalk Ramps as the Engineer directs.

The Contractor shall install a header at the end of each pour. At no time shall the Contractor be allowed to spread excess concrete as a base for the next or any succeeding pour. Minimum length blocks of four (4) feet six (6) inches may be poured only at the end of a day's pour and then only with permission of the Engineer.

### 303.2(d) Joints.

Unless otherwise directed by the Engineer, the sidewalk shall be cut into blocks five (5) feet in length.

Transverse joints shall be constructed at right angles to the center line of the sidewalk, and longitudinal joints shall be constructed parallel to the center line of the walk, unless otherwise provided. The joints shall be constructed as laid out in the field by the Engineer. Whenever the entire area between the back of the curb and the right-of-way or lot line is to be covered with concrete sidewalk and when a permanent structure is located within such area or on the right-of-way or lot line, such sidewalk shall be constructed in alternate sections extending from the back of the curb to the permanent structure, and such sections shall not exceed twelve (12) linear feet of sidewalk length. When the alternate sections placed in the first operation have been cured as specified, the intervening sections shall be placed to complete the walk.

When the sidewalk is constructed in partial width slabs, transverse joints in adjacent slabs shall be placed in line with like joints in the previously constructed slabs. In the case of widening existing sidewalks, transverse joints shall be placed in line with like joints in the existing sidewalk.

Insofar as feasible large sidewalk slabs shall be divided into sections not less than five (5) feet nor more than twelve (12) feet in any dimension. The unit areas shall be produced by use of metal slab division forms extending to the full depth of the concrete, or, when so approved by the Engineer, by contraction joints, as defined hereinafter.



Whenever the concrete walk abuts on or is adjacent to buildings, walls, ramps, steps, castings, sidewalks, or other structures, one-half (1/2) inch expansion joint filler shall be placed. Whenever the walk abuts on or is adjacent to the curb, one (1) inch expansion joint filler shall be placed between the curb and the sidewalk. Sidewalk ramps and driveways shall have one-half (1/2) inch expansion joint filler installed between the sidewalk ramp or driveway and the City sidewalk, and one (1) inch expansion joint filler installed between the sidewalk ramp or driveway and the curb. At intervals at approximately fifty (50) feet on continuous sidewalk construction and at the ends of all radii, one-half (1/2) inch expansion joint filler shall be placed. Where the sidewalk extends from buildings to curbs, expansion joints shall be located not more than thirty (30) feet apart.

Joints shall not be sealed, unless otherwise specified.

Where the concrete walk abuts the buildings, walls, and other pavement the material shall be left 1/2" below the surface and shall extend to the bottom of the concrete. A removable plastic strip, flush with the surface of the concrete, shall be placed over the foam or sponge rubber material while the concrete is being poured and cured.

The Contractor shall place a troweled joint at standard back edge of sidewalk where sidewalk extends to meet buildings.

Expansion joint material shall be non-staining and compatible with the sealant and of resilient nature such as closed cell resilient foam or sponge rubber. Materials impregnated with oil, bitumen or similar materials shall not be used.

All joints along buildings shall be sealed. The sealants shall be the gun grade Sonolastic NPI urethane as manufactured by Sonneborn, or an approved equal. The color shall match the adjoining work and shall be approved by the Engineer. Primers shall be used only where the manufacturer recommends.

Modifications of a sealant by the addition of liquids or powders to alter the flow properties SHALL NOT be permitted.

A sealant SHALL NOT be used if the date of manufacture indicates that the sealant is more than twelve (12) months old. Where a lesser period is recommended by the manufacturer, the lesser period shall govern.

The Contractor shall submit the following:

1. Sealant manufacturer's instructions, including limitations for application and priming. Indicate on the brochure or by transmittal, which primers will be used or submit printed statements from the sealant manufacturer that no primers are required for maximum adhesion.
2. Sealant manufacturer's standard color range for selection. Color shall be selected by the Engineer.

All joint surfaces shall be dry and thoroughly clean. The Contractor shall remove all loose particles, dirt, paint, foreign matter, or curing compound by means not injurious to the materials to be sealed.

Concrete shall be cured (seven (7) days minimum) and dry before sealant application.

Unless otherwise specified herein, preparation of the surfaces, mixing and application of the sealants shall be in accordance with the written instructions of the sealant manufacturer and /or subsequent supplementary written recommendations of the manufacturer or Engineer.

No sealant shall be applied to a joint at temperatures under 40°F.

All joints shall be finished to assure proper filling of voids, elimination of air pockets and maximum contact at joint interfaces. Immediately upon completion of the joint sealing, a silica sand shall be placed over the joint material. Any sealed joint not completely filled and/or not properly finished shall be reopened and replaced as directed by the Engineer.

At the completion of the caulking work, the surface of materials adjoining such work shall be cleaned of all smears, excess compound or other dirt and left in a neat, satisfactory condition. Rough unsightly work shall not be accepted.

Sealants and expansion joints shall be incidental to installation of concrete sidewalk, driveways and integral sidewalk curb head.

No additional compensation shall be given at these locations.

#### 303.2(e) Reinforcement.

Where reinforcement is required, it shall conform to and be placed in accordance with the details shown on the plans, as specified in the contract, or as directed by the Engineer.

The Contractor shall install three (3), one-half (1/2) inch round reinforcing rods fifteen (15) feet long in concrete sidewalks which span ditches.

#### 303.2(f) Protection.

The sidewalk must be protected from injury by traffic or other causes, and also from the rays of the sun until completely set. Sidewalks may be opened to pedestrian traffic after expiration of the curing period.

#### 303.2(g) Replacement of Concrete Sidewalk.

At such places and for such distances as shall be designated by the Engineer or the Sidewalk Inspector of the City, the Contractor shall replace concrete sidewalks by breaking up and removing all old material and preparing the existing foundation for the construction of the concrete sidewalk. Upon the foundation so prepared, the Contractor shall construct a concrete sidewalk in accordance with the foregoing specifications. The cost of removal of all old concrete material shall be included in the amount bid per square foot of sidewalk replacement, unless otherwise specified in the contract.

#### 303.2(h) Contractor's Identification.

The Contractor shall stamp the Contractor's name and the year constructed on the concrete work which the Contractor constructs or reconstructs for the City of Madison. Such identification shall be stamped at the beginning and end of each section of the project. The stamp shall be approximately five (5) inches by seven (7) inches in size, and may be either oval or rectangular in shape.

**303.2(i) Concrete Sidewalks.**

Concrete sidewalks and sidewalk ramps shall be five (5) inches in thickness, five (5) feet in width, constructed of nonreinforced concrete, with a transverse slope of one-fourth (1/4) inch per foot, unless otherwise noted on the plans or in the special provisions of the contract, or unless otherwise directed by the Engineer.

Where directed by the Engineer, all existing sidewalk in the terrace between the curb and public sidewalk that is removed during the construction of new curb and gutter, shall be replaced in the same location and to the same dimensions as was true of original terrace walks.

**303.2(j) Concrete Aprons.**

Concrete aprons shall be seven (7) inches in thickness and constructed of nonreinforced concrete unless otherwise noted on the plans or in the Special Provisions of the contract. Expansion joints shall conform to the requirements of Subsection 303.2(d). Contraction joint shall conform to the requirements of Subsection 303.2(d), except that the Contractor may cut diagonal joints in order to control the cracking of the concrete in the curved areas of commercial drives.

**303.2(k) Concrete Traffic Islands.**

Traffic islands shall be constructed at the locations and in accordance with the design, dimensions and details shown on the plans.

**303.2(l) Steps of Concrete Masonry.**

When construction of steps is included in the contract, they shall be built at the locations and in accordance with the design, dimensions and details shown on the plans. The work shall include reinforcement and necessary excavation, backfilling, and disposal of excess material from excavation.

**303.2(m) Profile Sawcuts.**

Where directed by the Engineer, the Contractor shall construct curb cuts in existing curb and gutter, using a "profile curb cut" with the curb head removed by using a machine type concrete saw specifically designed for this type of work.

**303.3 Measurement and Payment.****303.3(a) Method of Measurement.**

Sidewalks, sidewalk ramps, traffic islands, driveways and steps shall be measured by area in square feet. The measured areas of crosswalks shall be included with the measured areas of sidewalks.

When required, the "Profile Sawcut" shall be measured by length in linear along the flow line of the curb.

In the case of integral curb and walk, the width of the walk shall extend to a point six (6) inches behind the face of curb. The curb shall be paid for separately as Curb and Gutter.

In the case of steps, the area measured for payment shall be the summation of the areas of the treads, computed by multiplying the width of the tread by the length of the tread out to out of integral wall, if any.

Reinforcing steel for concrete sidewalk installed in accordance with the terms of the contract will be measured by length in linear feet.

### 303.3(b) Basis of Payment.

The area, measured as provided above, shall be paid for at the contract unit price per square foot for the items of concrete sidewalk, concrete driveways, concrete traffic islands, and concrete steps, which price shall be full compensation for furnishing all materials, including concrete masonry and expansion joints; for excavations and preparation of subgrade including subbase, backfilling, and disposal of surplus material; for forming; for placing, finishing, protecting and curing of the concrete; and for all labor, tools, equipment and incidentals necessary to complete the work and restore the site of the work. The price paid to the Contractor for sidewalk ramps shall be the same as for sidewalk.

The footage for profile sawcut, measured as provided above, shall be paid for at the contract unit price per linear foot, which price shall be full compensation for excavating; for all labor, tools, materials, and equipment necessary to complete the work, including crushed stone made necessary by excessive excavation behind the curb; and for disposal of the concrete.

The contract price for reinforcing steel for concrete sidewalk shall include furnishing the specified materials and all labor, tools, equipment and incidentals necessary to complete the work.

Where reinforcing steel for concrete sidewalk is not listed as an item on which to submit unit prices, it shall be understood and agreed that the Contractor shall be paid seventy-five (\$0.75) cents per linear foot of uncoated reinforcing steel, and one (\$1.00) dollar per linear foot of epoxy-coated reinforcing steel furnished and placed in accordance with these Specifications.

## **ARTICLE 304 - MISCELLANEOUS CONCRETE STRUCTURES**

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### **304.1 General.**

#### 304.1(a) Description.

This work shall consist of constructing miscellaneous concrete structures, including survey monuments, walls, footings, cunettes, apron slabs on culverts, ditch checks, headwalls, access structures, catchbasins, and box culverts, with or without reinforcement, of the required design and dimensions, placed on the prepared foundation or base, all as shown on the plans and provided by the contract.

#### 304.1(b) Concrete Requirements.

All requirements under Article 301 - Concrete, for mix design, High-Early-Strength Concrete, tests, materials, mixing, placing, forms, curing, and protection of the concrete shall apply to concrete used in the construction of miscellaneous concrete structures.

#### 304.1(c) Equipment.

Equipment and tools necessary for performing all parts of the work shall be satisfactory as to design, capacity and mechanical condition for the purposes intended, and any equipment which is not maintained in full working order, or which as used by the Contractor is inadequate to obtain the results prescribed, shall be repaired, improved, replaced or supplemented to obtain the progress and quality of work contemplated by the contract.

### **304.2 Construction Methods.**

#### 304.2(a) Preparation of the Foundation.

The foundation shall be formed by excavating or filling to the required elevation of the bottom of the compacted select fill lift. The foundation so constructed shall be thoroughly mechanically compacted to insure stability.

The foundation shall be made sufficiently wide to permit placing of forms and performing the required work of placing the concrete and finishing.

The Contractor shall be responsible for replacement with 1-1/2" crushed stone, mechanically compacted, of any material necessary to bring the subbase to grade where the Contractor has undercut the subbase without approval of the Engineer. Where expressly ordered by the Engineer, the Contractor shall additionally excavate where unsuitable foundation material exists. When this condition arises, the excavation shall be carried to such depth as directed by the Engineer. Cross sections of this additional excavation will be taken to determine the amount of material removed. The maximum width shall be the outside dimension of the structure plus two (2) feet. Mechanically compacted 1-1/2" crushed stone shall be installed to subbase grade. All costs for additional excavation, including excavation, crushed stone, and disposal of excavation, shall be included in the unit price bid for "Extra Trench Excavation".

**304.2(b) Installation of Select Fill Lift.**

The Contractor shall install a select fill lift from the foundation to the bottom of the structure of the depth shown on the plans or specified in the contract.

Except as provided by plans and specifications, the select fill lift shall consist of mechanically compacted 1-1/2" crushed stone extending one (1) foot beyond the structure on each side.

The cost of the select fill lift shall be included in the unit price bid for the respective structure.

When the local water conditions are such that the required select fill lift impedes construction, the Contractor may use an alternate material with the approval of the Engineer. The Contractor shall submit a price for the alternate material.

**304.2(c) Placing and Finishing Concrete.**

The foundation and forms, and reinforcement when required, shall be checked and approved by the Engineer before the concrete is placed. The concrete shall be placed on a moist foundation, deposited to the required depth and consolidated and spaded sufficiently to bring the mortar to the surface, after which it shall be struck off and floated with a wooden float. Before the mortar has set, the surface shall be steel troweled until a smooth surface is obtained.

The Contractor may, with prior approval of the Engineer, elect to use a machine for placing, forming and consolidating of the concrete. If a machine is used, the resulting structure shall be of such quality as to equal or exceed that produced by methods herein before described.

Unless otherwise provided, the edge of the structure along forms and edges adjacent to expansion or contraction joints shall be finished with a steel edging tool of one-fourth (1/4) inch radius.

The Contractor shall furnish an accurate straight edge ten (10) feet long to test the surface. The straight edge shall be advanced along the center of the flowline no more than one-half (1/2) of its length when the concrete is still plastic. Any depressions found shall be immediately filled with freshly mixed concrete, struck off, consolidated, and refinished. Projections shall be struck off and refinished. The straight edging shall be continued until the center of the flowline is free from any deviations and irregularities.

**304.2(d) Reinforcement.**

Where reinforcement is required, it shall conform to and be placed in accordance with the details shown on the plans, as specified in the contract, or as directed by the Engineer.

The reinforcement shall be placed at the proper depth and properly secured so that it will remain in place while the concrete is placed.

**304.2(e) Joints.**

Transverse joints shall be constructed at right angles to the center line of the structure, and longitudinal joints shall be constructed parallel to the center line, unless otherwise provided.

A contraction joint shall consist of a slot or groove at least two (2) inches deep and one-fourth (1/4) inch wide formed by inserting a metal parting strip or jointing tool in the concrete after it has been struck off and consolidated and while the concrete is still plastic. As soon as the concrete will retain its shape, the parting strip shall be removed and the joint edge finished.

Unless otherwise specified, transverse contraction joints shall be on twenty (20) foot centers.

An expansion joint shall consist of one (1) inch of expansion joint filler of the same shape and dimensions as the section.

Unless otherwise specified, transverse expansion joints shall be placed on two hundred (200) foot centers.

#### 304.2(f) Reset Monument

Reset Monument shall include hand excavation around the existing monument, removal of the existing monument, and excavation for setting the new monument. The Contractor shall contact City Surveyor, (267-1971), twenty-four (24) hours prior to excavation to allow the Surveyor to set ties to the existing monument.

### **304.3 Measurement and Payment.**

#### 304.3(a) Method of Measurement.

Reset Monument shall be measured as a completed unit.

Headwalls shall be measured as units. Cunettes, apron slabs on culverts, ditch checks and box culverts shall be measured by length in linear feet along the center line of the structure, exclusive of catchbasins.

Preparation of foundation shall be measured as Excavation Cut, or Fill as specified in Articles 201 and 202, Part 2 - Earthwork. The limit of Excavation Cut or Fill shall be the bottom of the select fill lift as shown on the plans or as specified in the contract.

#### 304.3(b) Basis of Payment.

The quantity of survey monuments, measured as provided above, shall be paid for at the contract unit price each for Reset Monument. This price shall be payment in full for all excavation around existing monument, removal of existing monument if necessary, excavating for the placement of the new monument, for placing City supplied casting; for furnishing, placing and compacting backfill material, for disposal of surplus materials; and for all labor, tools, equipment and incidentals necessary to complete this item of work.

Headwalls shall be paid for at the contract unit price per unit, which price shall be full compensation for furnishing all materials, including concrete masonry and expansion joints; for excavations and preparation of subgrade including subbase, backfilling, and disposal of surplus material; for forming; for placing, finishing, protecting and curing of the concrete; and for all labor, tools, equipment and incidentals necessary to complete the work and restore the site of the work.

The lengths of cunettes, apron slabs on culverts, ditch checks and box culverts, as provided above, shall be paid for at the contract unit price per linear foot of Concrete Cunette, Concrete Apron Slabs on Culverts, Concrete Ditch Checks and Concrete Box Culvert, which price shall be full compensation for furnishing all materials, including concrete masonry, reinforcement and expansion joint filler, for furnishing and installing the required select fill lift; for forming; for placing, finishing, protecting and curing of the concrete; and for all labor, tools, equipment and incidentals necessary to complete the work.

The volumes of Excavation Cut or Fill, as provided above shall be paid for at the contract unit price per cubic yard for Excavation Cut or Fill, which price shall be full compensation for all excavation and disposal of material specified to be excavated, for furnishing, hauling, placing and compacting the specified material in fills, for backfilling and disposal of surplus materials, for restoring the site of the work, and for all equipment, tools, labor and incidentals necessary to complete the work as specified.