

DIVISION 03 CONCRETE

0302.00 GENERAL

General Conditions

The General Conditions, Supplementary Conditions and the requirements of Division 01 of this Specification from a part of this Division.

Codes, Specifications and Standards

- A. Specifications for Structural Concrete for Buildings (ACI 301), by the American Concrete Institute, herein referred to as ACI 301, is included in total as specifications for this structure except as otherwise specified herein. The Contractor shall have a copy of the ACI standard on the project at all times.
- B. Comply with the provisions of the following codes, specifications and standards except where more stringent requirements are shown on the drawings or specified herein.
- 1) "Building Code Requirements for Reinforced Concrete" (ACI 318), American Concrete Institute, herein referred to as ACI 318.
 - 2) "Recommended Practice for Concrete Formwork" (ACI 347), American Concrete Institute.
 - 3) "Recommended Practice for Cold Weather Concreting" (ACI 306), American Concrete Institute.
 - 4) "Hot Weather Concreting" reported by ACI Committee, 305 (ACI 305).
 - 5) "Manual of Standard Practice" MS-2-77, Concrete Reinforcing Steel Institute.
 - 6) "Structural Welding Code – Reinforcing Steel" (AWS D1.4), American Welding Society.
 - 7) "Guide for Concrete Floor & Slab Construction" (ACI 302.1), American Concrete Institute.

0303.00 SCOPE OF WORK

0303.01 Items

The work required under this Division shall include all materials, labor, equipment and services necessary to furnish and install in accordance with the Drawings and Specifications all items listed, but not limited to: concrete work as described in this project manual and/or as detailed on the drawings and as described herein, including: reinforcement securing and cast-in-place concrete.

0304.00 WORK NOT INCLUDED

0304.01 Items

The following items of related work are specified and included in other Divisions of this Specification and in general consist of those items listed, but not limited to:

Concrete surface preparation, penetrating concrete sealer, crack filling, installation of sealants, flashing, caulking and coatings.

0305.00 SHOP DRAWINGS

0305.01 Requirements

Shop drawings shall conform to the requirements of the General Conditions, Article 16, Shop Drawings and Samples, of this Specification, and as herein specified for other sections of this Division.

0306.00 UNIFORMITY

0306.01

To minimize irregularities in appearance and/or color, the cement, aggregates, admixtures and water for each type of concrete construction exposed to view in the complete project shall be selected to match closely the existing surfaces.

0308.00 AGGREGATES

0308.01

Aggregate shall be granite.

0310.00 CONCRETE FORMWORK (ACI 301, Chapter 4)

Formwork for beams, joists, slab-on-grade edges (including dumpster pads, sidewalks & curbs), stairs, and other parts that support the weight of concrete shall remain in place until the concrete has reached 50 percent of the 28-day strength.

0320.00 CONCRETE REINFORCEMENT

Scope of Work

The work in this Section includes providing all materials, labor, equipment and supervision to fabricate and install all mild steel reinforcement as shown on the drawings.

Fabrication

A. Fabricate reinforcing bars to conform to required shapes and dimensions, with fabrication tolerances complying with CRSI "Manual of Standard Practice".

In case of fabricating errors, do not re-bend or straighten reinforcement in a manner that will injure or weaken the material.

B. Bends in reinforcing are standard 90 degrees unless noted otherwise.

C. Reinforcement with any of the following defects will be rejected:

- 1) Bar lengths, depths, and bends exceeding CRSI fabrication tolerances.
- 2) Bends or kinks not indicated on drawings or final shop drawings.
- 3) Bars with reduced cross-section due to excessive rusting or other cause.
- 4) Bars without grade marks.

D. Welded wire fabric shall be flat stock (sheets). No rolled welded wire fabric will be approved for use on the site. Damaged or deformed WWF shall be replaced before placement of concrete.

Chairs and Accessories

Provide stainless steel or epoxy coated or plastic tipped chairs and other non-corrosive accessories under all reinforcement in all concrete to be placed on this project. Maximum spacing for reinforcement chairs and accessories for slabs-on-grade shall be 2'-0" o.c. in each direction. "Pulling up" the reinforcement is not acceptable. Concrete bricks may be used to support reinforcing. Spacing requirements shall remain at 2'-0" o.c. in each direction and the reinforcing must be at the proper elevation in the slab.

Inspection

Field Inspection

Examine the conditions under which concrete reinforcement is to be placed and immediately notify the Engineer in writing of unsatisfactory conditions, as required in the General Conditions. Do not proceed with the work until unsatisfactory conditions have been corrected in an acceptable manner. All reinforcing shall be inspected and accepted by the Engineer prior to concrete placement.

Installation of Reinforcement

A. Comply with ACI 301, Chapter 5 for placing reinforcement.

B. Splices

- 1) Provide standard reinforcement splices by lapping ends, placing bars in contact, and tying tightly with wire. Comply with requirements of ACI 318 for minimum lap of spliced bars.
- 2) Welding of reinforcing steel is prohibited on this project.

0321.00 EPOXY COATED REINFORCEMENT

Scope of Work

This work consists of furnishing all labor, materials, equipment, supervision and incidentals necessary to provide and install all concrete reinforcing as epoxy- coated reinforcing.

Materials

Epoxy Coated Reinforcement

Epoxy coating shall be applied by the electrostatic spray method and shall be in strict compliance with ASTM A775 and as follows:

1. Manufacturer's certification of coating is required.
2. Patching materials as required for field touch-up shall be furnished by the manufacturer and shall conform to ASTM A775, ANNEX A1.
3. Surface preparation of reinforcing bars to be coated shall be blast cleaned to near-white metal in accordance with Steel Structures Painting Council Specification SSPC-A10.
4. Testing for thickness, adhesion, and continuity of coating shall comply with ASTM A775, Paragraph 8.2.

Installation

- A. Coating damage due to handling, shipping, and placing need not be repaired when damaged area is 0.1 square inch or smaller. Damaged areas larger than 0.1 square inch shall be repaired as herein specified.

Maximum amount of damage including repaired and unrepaired areas shall not exceed two percent of surface area.

- B. When required, repair damaged epoxy-coating with patching material conforming to ASTM A775. Repair in accordance with patching material manufacturer's recommendations.
- C. Do not field bend epoxy-coated reinforcement.
- D. Epoxy-coated reinforcement shall be fastened with nylon-epoxy, or plastic-coated wire or equivalent.
- E. Bar supports for use with epoxy-coated reinforcement shall be epoxy coated.
- F. Epoxy-coated reinforcement cut in field shall have ends of reinforcement coated and shall be made of corrosion resistant material.
- G. Fading of color or coating shall not be cause for rejection.
- H. When required, mechanical connections shall be installed in accordance with the splice device manufacturer's recommendations. After installing mechanical connections on epoxy-coated reinforcement, coating damage shall be repaired as herein specified. All parts of mechanical connections used on coated bars, including steel splice sleeves, bolts and nuts shall be coated with the same material used for repair of coating damage.
- I. Do not weld epoxy-coated reinforcing.
- J. All reinforcing shall be inspected and accepted by the Engineer prior to concrete placement.

Application

- A. Concrete shall be used for sidewalks (including A.D.A. ramps), curbs, concrete stairs and dumpster pads. All concrete proportioning, production and placement shall be performed in accordance with this specification. Work shall not proceed until the Engineer has approved the mix design.

Cements

Portland cement shall be Type I, Type II, Type I/II or Type III, ASTM C150.

Admixtures

Except for air entraining agent and super plasticizer, admixtures shall not be used unless authorized by the Engineer in writing. Fly ash (ASTM C618) shall not exceed 20% of the combined total cementitious weight.

Aggregates

- 1. Coarse Aggregate – Clean, hard, durable, uncoated, crushed granite conforming to the quality and gradation requirements of ASTM Specification C-33. Maximum size aggregate allowed shall be ¾”.

Coarse aggregate shall be graded as follows:

<u>Sieve Size</u>	<u>% Retained</u>
¾”	0 to 10
⅜”	45 to 80
No. 4	90 to 100
No. 8	95 to 100

- 2. Fine Aggregate shall conform to ASTM C33.

<u>Sieve Size</u>	<u>% Retained</u>
¾”	0
No. 4	0 to 5
No. 8	0 to 20

Concrete shall be produced using an approximately 1:1 ratio by volume of sand and concrete aggregate listed above.

- 3. The amount of shale contained in the aggregates shall be limited to 1%.

Selection of Proportions

The selection of concrete proportions shall be in accordance with ACI 301, Article 3.8. Before any concrete is placed for the project, the Contractor shall submit to the Engineer data showing the method used for determining the proposed concrete mix design, including fine and coarse aggregate graduations, proportions, proportions of all ingredients, water cement ratio, slump, air content, 28-day cylinder breaks and other required data for each different concrete type specified. The mix design shall meet the following minimum requirements.

MIX DESIGN

<u>REQUIREMENTS</u>	<u>CONCRETE</u>
Compressive Strength (28-day)	5,000 psi
Water/Cement Ratio	0.41 maximum
Air Content	6.5% ± 1.5%

Cement Content	
Portland Cement Type I (ASTM C150)	600 lb/cy minimum
Or	
Portland Cement Type I (ASTM C150)	480 lb/cy
Slag (ASTM C-989, Grade 120)	120 lb/cy (20% max.)
Or	
Portland Cement Type I (ASTM C150)	480 lb/cy
Fly Ash (ASTM C618, Class F)	120 lb/cy (20% max.)
Aggregate	Granite
(Saturated surface dry)	
Fine Aggregate	1,439 lb/cy
Coarse Aggregate	
Granite (ASTM C-33)	1,439 lb/cy
Maximum Slump on	4" + <u>1</u> "
Arrival at Site	
Mid-range water reducer	6" + <u>1</u> "
added at plant to Obtain Slump	

Production of Concrete

- A. Ready mix concrete of ASTM Specification C94 subject to the requirements of this specification.

Placing Concrete

- A. Placement shall be planned well in advance so that all sections of a particular area may be poured in one continuous operation. Any bulk-heading required shall be done only with the express permission and in accordance with the requirements of the Engineer.
- B. Care shall be exercised so that when placing concrete in contact with the ground that earth does not spall off into fresh concrete. Do not place concrete on frozen ground.
- C. Before concrete is placed, all debris and foreign material shall be removed from the inner surface of the forms. All reinforcing, including dowels (as indicated herewith and/or), on the plans shall be properly and securely set into position.

Where fresh concrete is placed directly against set concrete, the work already set shall have its surface roughened and shall be drenched with water, then given a slush coat of a neat grout.

Contractor shall advise the Engineer of the approximate time he intends to place footings, foundations, structural floor slabs or any other concrete and shall not place the concrete until the Engineer has given his approval to do so. Contractor shall be responsible for the placement of construction joints, pipe sleeves, etc., and shall work with all trades to ensure work is complete before slab is placed.

- D. Transporting – Concrete shall be handled from carts, buggies or conveyors. Every possible precaution shall be taken to prevent separation or loss of the ingredients while transporting the concrete. Fresh concrete may be transported by pneumatic means (pumped) at the Contractor's option, provided the approved mix design is certified by a laboratory report as a suitable mix design.
- E. Placing – Troughs, Pipes and Chutes
1. Where it is necessary to drop concrete a distance of more than five (5) feet, troughs, pipes

and/or chutes shall be used as aids in placing the concrete and shall be arranged and used in such a manner that the ingredients of the concrete are not separated.

Where steep slopes are required, the chutes shall be equipped with baffleboards or short lengths that reverse the direction of the movement.

2. All chutes, troughs, pipes and reinforcing steel shall be kept clean and free from coating or hardened concrete. Open troughs and chutes shall be either metal or metal lines, and shall extend as nearly as possible to the point of deposit. Depositing in large quantity at any point and running or working it along the forms in a manner which will cause segregation or separation will not be permitted.
 3. Concrete shall not be dropped freely a distance of more than five (5) feet, nor be dropped through the reinforcing steel in the walls.
 4. Placing of any given section shall be done in a continuous operation.
- F. ADDITION OF "EXTRA WATER" to the concrete mix at the job site **SHALL NOT BE PERMITTED**. Withholding of water at the plant from the approved mix design shall only be acceptable if approved in writing by the Engineer in advance.
- G. Vibrating – All concrete shall be thoroughly vibrated by a suitable means during the operation of placing and shall be thoroughly worked around reinforcing embedded fixtures and into the corners of forms. Two (2) vibrators are required to be on the job at all times during the concrete construction.
- H. Placing Concrete in Cold Weather – Shall comply with ACI 306, concrete shall not be mixed or placed while the air temperature is 40°F or lower, or when the forecast by the Weather Bureau is to be lower than 40°F within 24 hours after placing, unless precautionary measures are taken, as directed by the Engineer. Such precautionary measures shall include heating the mixing water to not over 175°F at the aggregate to not over 150°F, maintaining a minimum temperature of 70°F, and not to exceed 80°F until it is placed in the forms, preventing the newly placed concrete from becoming colder than 50°F for five (5) days after placing by protecting with canvas, straw, or other material, and taking such precautionary measures as may be required by the Engineer. Regardless of what precautions are taken, the Contractor shall be considered as having elected to assume all risks; any frozen or damaged concrete shall be replaced at the Contractor's expense.
- I. Placing Concrete in Hot Weather – Shall comply with ACI 305, no concrete exposed to the elements shall be permitted when the air temperature is above 100°F. When the air temperature is above 85°F, the mix shall be cooled so that it is 70°F to 75°F when placed. Shade protect and cool the work as required to maintain the concrete temperature below 100°F for the first 24 hours and execute caution that drying is not permitted during the curing period. Admixtures may be used only with the approval of the Engineer.
- J. Placing Time – The elapsed time between proportioning of materials, including cement, and placing of concrete in its final position shall never exceed 90 minutes. Concrete shall never remain on the job site for more than 60 minutes without being placed.
- K. Install tooled control joint as directed by the Engineer to control shrinkage cracking. Basic layout shall match adjacent existing joints.
- L. Concrete shall be protected from vehicular traffic, construction machinery, and other miscellaneous heavy loads for 5 days minimum, unless directed otherwise by the Engineer.

Exterior Concrete Slabs – Unless noted otherwise on drawings, sidewalks and slabs shall be 4" thick, reinforced with 6x6 – W2.9xW2.9 epoxy coated welded wire mesh or #3 epoxy coated bars at 12" on

center each way. Provide tooled grooves at maximum 6'-0" on center across width and tooled radius edges, typical all edges, expansion joints 40'-0" ± on center unless otherwise shown on the drawings. Joints to match adjacent existing similar concrete elements.

Forms – All forms shall be in good condition with not more than 1/8" variation in horizontal and vertical alignment. They shall conform to the shape and dimensions of the concrete as shown on the plans and shall be set true to line and grade. They shall be tight, properly braced of sufficient thickness and tied together to maintain the desired position and shape during and after placing of concrete. They shall be designed and constructed to permit their removal without damage to the concrete.

Finishing

A. All exposed cast-in-place concrete shall receive a form smooth finish. The best form materials shall be used to insure a smooth finish on all exposed areas. Remove fins, projections, level offsets, repair damaged areas. Form joints shall be smooth and clean, and rubbed if necessary. All walking surfaces shall also receive a "broom finish".

Round column shall be rubbed for dense, smooth uniform finish over the entire surface.

B. Flatwork Slabs shall be poured monolithic throughout, between construction joints with concrete of the driest consistency possible, leveled with a straight edge screed in a sawing motion of a strike-off board.

1. Exterior Slabs shall be floated, steel troweled and broomed finish.

Provide tooled grooves at maximum 6'-0" on center across width of sidewalks, at 8'-0" on center each way all other areas; with tooled radius on all edges. Place pre-formed expansion joint approximately 30' intervals and where sidewalks abut building, curbs, etc.

2. **DO NOT DUST SLABS WITH CEMENT TO REMOVE EXCESS WATER.**

3. Floating shall not start until water sheen has disappeared or concrete has stiffened enough to prevent excess fine material working to the surface and if used, permit operation of a power-driven type float.

4. Adding water to the surface of any concrete surface to aid or assist in finishing shall not be permitted. Concrete slabs that have water added to the surface shall be removed and replaced at the Contractor's expense.

C. Allowable Tolerance from level or grade shall be ¼" in 10 feet measured with a straight edge in any direction. Slabs not within this tolerance shall be removed and replaced.

D. Surface Non-Slip Treatment on exterior steps, hardener, etc., shall be installed and troweled into surface as recommended by the manufacturer.

E. Curbs – Construct and place concrete curbs as shown on the drawings and as required of construction operations. Place pre-formed expansion joints approximately 48' intervals and where curbs abut sidewalks, buildings, etc. Exposed face and top of curbs shall be troweled to a smooth, dense surface.

Curing

Concrete shall be cured according to the following minimum requirements.

A. Use MasterKure CC 180 WB concrete curing compound as manufactured by BASF on all new concrete work. Apply per manufacturer's specifications and recommendations.

Testing

A. Concrete

Standard 6"x12" cylinders will be fabricated, cured and tested in accordance with ACI 301, except as noted in this specification. Four (4) cylinders will be made for each 10 cubic yards of concrete batched. Cylinders shall be field cured for one (1) day minimum then transported to the testing laboratory where they shall be moist cured per ASTM C31. One (1) cylinder will be tested at 7 days and two (2) at 28 days. Compressive strength at 7 days shall be 80% of the design strength. One (1) additional cylinder shall be maintained as an extra cylinder for additional testing at the discretion of the Engineer.