# SECTION 03200

## CONCRETE REINFORCEMENT

PART 1 GENERAL

1.01 QUALITY ASSURANCE

A. Perform concrete reinforcement work in accordance with CRSI Manual of Standard Practice, Documents 63 and 65.

B. Conform to ACI 301 and 318.

PART 2 PRODUCTS

2.01 MATERIALS

A. Reinforcing Steel: ASTM A 615, grade billet-steel deformed bars, uncoated, 60 KSI yield grade; ASTM A 706, grade 40 weld-able for bars welded to steel members.

B. Welded Steel Wire Fabric: ANSI/ASTM A 185 plain type; in flat sheets; uncoated finish.

2.02 ACCESSORY MATERIALS

A. Tie Wire: Minimum 16 gage annealed type.

B. Chairs, Bolsters, Bar Supports, Spacers: Sized and shaped for strength and support of reinforcement during installation and placement of concrete including load bearing pad on bottom to prevent vapor barrier puncture.

2.03 FABRICATION

A. Fabricate in accordance with ACI SP-66, providing concrete cover specified in Section 03300.

B. Locate reinforcing splices not indicated on Drawings at points of minimum stress. Indicate location of splices on shop drawings.

C. Weld reinforcing bars in accordance with ANSI/AWS D1.4.

D. Provide sufficient lap of splicing of reinforcement, where required, to permit transfer of stress in accordance with requirements of this specification. Splice wall vertical reinforcement at location of horizontal construction joints.

E. Unless otherwise noted on the drawings to be more, lap reinforcement 36 bar diameters (class “A” lap) at splices or have dowels of same bar section and spacing as the bars to be spliced. Lap bars at least 36 diameters (class “A” lap) at corners and at abrupt changes in direction of walls. Stagger splices in adjacent bars.

2.04 EXECUTION

A. PREPARATION

B. Before placing concrete, clean reinforcement of foreign particles or coatings.

2.05 PLACING

A. Place reinforcement in accordance with CRSI "Placing Reinforcing Bars" and ACI 318, with provisions of ACI 318 governing.

B. Move bars as necessary to avoid interference with other reinforcing steel, conduits, or embedded items.

C. If bars are moved more than one bar diameter or enough to exceed tolerances, submit resulting arrangement of bars to Owner’s Representative for review.

D. Place, support, and secure reinforcement against displacement. Do not deviate from alignment or measurement. Place in accordance with approved shop drawings and CRSI recommendations. Do not heat, cut or bend bars without Owner’s Representative's approval.

E. Do not displace or damage vapor barrier required by Section 03300.

F. Refer to Section 03300 for minimum coverage of concrete unless noted otherwise on the Drawings.

G. Place reinforcement, at time of concrete placing, free of mud, oil, or other materials that adversely affect or reduce bond.

H. Reinforcement with Rust, Mill Scale, or Both: Considered satisfactory, provided minimum dimensions, including height of deformation, requirements.

I. Support reinforcement and fasten together to prevent displacement by construction loads of placing concrete. Use No. 16 gage black annealed wire at joints and crosses to accurately position reinforcing in place.

J. Over formwork, use metal or plastic bar chairs and spacers to support reinforcement.

K. Where concrete surface will be exposed to weather in finished structure, use non-corrosive or corrosion protected accessories within 1/2 inch of concrete surface.

L. Bars having splices not shown on shop drawings will be subject to rejection.

M. Do not bend reinforcement after being embedded in hardened concrete.

N. Do not allow bars to be in contact with dissimilar materials.

END OF SECTION

# SECTION 03300

## CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.01 WORK INCLUDED:

A. Furnishing, forming, placing, finishing, curing and other related work of cast-in-place concrete for water line thrust blocking and other structures as required.

1.02 REFERENCES

A. ACI 305 - Hot Weather Concreting.

B. ACI 306 - Cold Weather Concreting.

C. ACI 308 - Standard Practice for Curing Concrete.

D. ACI 347 - Recommended Practice for Concrete Formwork.

E. ASTM C33 - Concrete Aggregates.

F. ASTM C94 - Ready-Mixed Concrete.

G. ASTM C150 - Portland Cement.

H. ASTM C260 - Air-Entraining Admixtures for Concrete.

I. ASTM C494 - Chemical Admixtures for Concrete.

J. ASTM C618 - Fly ash and raw or calcinated natural pozzolan for use as a mineral admixture in Portland cement concrete.

1.03 QUALITY ASSURANCE

A. Perform work in accordance with ACI 301 and 318.

B. Obtain materials from same source throughout the Work.

C. Conform to ACI 305 when concreting during hot weather.

D. Conform to ACI 306 when concreting during cold weather.

E. For testing purposes refer to Section 01410 Testing Laboratory Services for requirements concerning measurement and payment for this section.

1.04 PROJECT RECORD DOCUMENTS

A. Submit under Provisions of Section 01700.

B. Accurately record actual locations of all embedded utilities and components which are concealed from view.

1.05 SUBMITTALS

A. Submit under provisions of Section 01300.

B. Submit product data for specified products including all proposed admixtures.

C. Submit proposed mix design and 28 day test results for each class of concrete for review prior to commencement of work.

PART 2 PRODUCTS

2.01 CONCRETE MATERIALS

A. Cement: ASTM C150, Type I, Type II, Type III, Type IV, Type V, Portland type; or ASTM C595, Type IP, Portland Pozzolan Cement shall not exceed 25 percent by weight. Different cements shall not be used interchangeably in the same element or portion of work. No industrial slag will be allowed to be used in any concrete mix design.

B. Fine Aggregate: ASTM C33.

C. Coarse Aggregate: ASTM C33, Size 57.

D. Water: ASTM C94, Clean and not detrimental to concrete.

2.02 ADMIXTURES

A. Air Entrainment: ASTM C260.

B. Chemical Admixtures, where approved by the Engineer, shall conform to ASTM C494.

C. No Calcium Chloride shall be added to the mix.

2.03 ACCESSORIES

A. Bonding Agent: Two component modified epoxy resin as manufactured by Thermal Chem, Sika Corp., Sonneborn or equal.

B. Joint Filler: Closed cell polyvinyl chloride foam resiliency recovery of 95% if not compressed more than 50% of original thickness.

C. Sealant: Cold applied two-part liquid neoprene.

D. Non-shrink grout: Dayton Superior, Master Builders or equal. Minimum compressive strength shall be 5,000 psi at 7 days and 7,500 psi at 28 days.

2.04 CONCRETE MIX

A. Mix concrete in accordance with ASTM C94.

B. All concrete, unless otherwise specified, shall have the following characteristics:

1. Minimum Compressive Strength at 28 days
   a. Unexposed foundation work: 4000 PSI
   b. All exposed concrete work (including floors, walls, columns, walks): 4000 PSI
2. Maximum Water Cement Ratio: 0.45
3. Minimum Cement Content
   a. 4000 PSI mix: 564 LB/CY (6 sacks)
4. Slump – Minimum: 2"
5. Maximum: 4"
6. Air Entrainment: 6 ± 1 percent (all concrete exposed to weather)

C. All concrete designated as "Fill Concrete" shall have the following characteristics:

1. Minimum Compressive Strength at 28 days: 3000 PSI
2. Minimum Cement Content: 376 lb (4 sacks) per cubic yard
3. Slump – Minimum: 1"
4. Maximum: 6"

D. Add an air entraining agent to the mix for concrete exposed to the exterior or subject to freeze-thaw cycling.

E. Use set retarding admixtures during hot weather only when approved by Engineer. Use set accelerating admixtures during cold weather only when approved by Engineer. Only non-chloride accelerators will be considered.

F. No admixture shall be used unless approved in writing by the Engineer.

G. Water shall not be added to the mix at the job site without specific approval by the Engineer

H. Slump tests shall be taken prior to the addition of any approved water reducing or plasticizing agents.

2.05 FORMS

A. Conform to ACI 301.

B. Forms for exposed surfaces shall produce a smooth surface unless noted otherwise on the drawings.

PART 3 EXECUTION

3.01 CONCRETE FORMWORK

A. Construct and erect concrete formwork in accordance with ACI 301 and ACI 347.

B. Verify anchors, seats, plates, reinforcement, and other items to be cast into concrete are accurately placed, held securely, and will not cause hardship in placing concrete.

C. Minimize form joints. Symmetrically align joints and make watertight to prevent leakage of mortar.

D. Arrange and assemble formwork to permit stripping so that concrete is not damaged during its removal.

E. Arrange forms to allow stripping without removal of principal shores, where required to remain in place.

F. Provide bracing to ensure stability of formwork. Strengthen formwork liable to be overstressed by construction loads.

G. Camber slabs and beams to achieve ACI 301 tolerances.

H. Provide temporary ports in formwork to facilitate cleaning and inspection. Locate openings at bottom of forms to allow flushing water to drain. Close ports with tight fitting panels, flush with inside face of forms, neatly fitted so that joints will not be apparent in exposed concrete surfaces.

I. Construct formwork to maintain tolerances in accordance with ACI 301.

J. Apply form release agent on formwork in accordance with manufacturer's instructions. Apply prior to placing reinforcing steel, anchoring devices and embedded items.

K. Do not apply form release agent where concrete surfaces are scheduled to receive special finishes or applied coverings, which may be affected by agent. Soak contact surfaces of untreated forms with clean water. Keep surfaces wet prior to placing concrete

3.02 FORM REMOVAL

A. Do not remove forms and shoring until concrete has sufficient strength to support its own weight and construction and design loads which may be imposed upon it.

B. Reshore structural members due to design requirements or construction conditions to permit successive construction.

C. Do not damage concrete surfaces during form removal.

3.03 JOINTS

A. Provide keyways in all construction joints. The width of the keyway shall be 1/3 of the wall or slab thickness (3 ½ inch minimum) by 1½ inch deep, unless otherwise shown on the drawings.

B. Provide control joints in sidewalks spaced approximately 5 feet on center and expansion joints at approximately 20 feet on center. Expansion joints shall also occur adjacent to all construction items in place when walks are poured.

C. Control joints may be saw cut using a 3/16 inch thick blade, cutting 1/3 into the depth of the slab thickness. Saw cut control joints shall be made no sooner than 4 hours and no later than 24 hours after finishing is completed.

3.04 PREPARATION

A. Verify anchors, seats, plates, reinforcement and other items to be cast into concrete are accurately placed, held securely and will not cause hardship in placing concrete.

B. Prepare previously placed concrete by cleaning with a steel brush and removing all foreign matter and laitance.

1. Saturate surface with water.

2. Immediately before placing new concrete, place a bed of mortar over the entire surface.

C. Where called for on the Drawings, apply a bonding agent in accordance with the manufacturer's instructions.

D. At locations where new concrete is dowelled to existing work, drill holes in existing concrete, insert steel dowels and pack solid with non-shrink grout.

3.05 PLACING CONCRETE

A. Notify Engineer minimum 24 hours prior to commencement of concreting operations.

B. Place concrete in accordance with ACI 301.

C. Hot Weather Placement: ACI 301 and ACI 305.

D. Cold Weather Placement: ACI 301 and ACI 306.

E. Ensure reinforcement, inserts, embedded parts and formed joints are not disturbed during concrete placement.

F. The method of placing the concrete shall be such to insure against separation of materials.

G. Place concrete continuously between predetermined construction and control joints in layers not exceeding 18 inches in depth. Do not break or interrupt successive pours such that cold joints occur.

H. Placement of concrete shall be completed within one hour after the introduction of mixing water.

I. All concrete shall be consolidated by vibrating. A spare vibrator shall be kept on the job during all concrete placing operations.

J. Sidewalks shall be four (4) inches thick minimum and placed on four (4) inches of compacted sand fill unless noted otherwise on the Drawings.

3.06 FINISHING

A. Walkway Finishes

1. Finishes shall be as follows:
   a. Sidewalks, curbs, and ramps shall have a broom finish. The broom finish of sidewalks shall be transverse to the walk.

b. Edges of sidewalks and edges at control and expansion joints shall be neatly finished using a 3/8 inch radius tool.

## 3.07 CURING

A. Concrete curing shall be in accordance with ACI 301 and ACI 308.

B. Beginning immediately after placement, concrete shall be protected from premature drying, excessive hot or cold temperatures and mechanical injury.

C. For concrete surfaces not in contact with forms, one of the following procedures shall be applied immediately after completion of placement and finishing.

1. Ponding.
2. Application of absorptive mats or fabric kept continuously wet.
3. Application of waterproof sheet materials conforming to ASTM C171.
   a. Seal all edges and joints.
4. Application of liquid membrane-forming curing compound conforming to ASTM C309.
   a. Curing compound shall not be used on surfaces to which additional concrete or other material (hardeners, weatherproofing, paint, adhered floor coverings, etc.) is to be bonded.

D. For concrete surfaces in contact with forms the following procedures shall be followed:

1. Moisture loss from surfaces placed against forms exposed to the sun shall be minimized by keeping the forms wet.
2. After the concrete has hardened and while the forms are still in place, form ties shall be loosened and water applied to run down the inside of the form to keep the concrete wet.
3. Immediately following form removal, surfaces shall be kept wet by a water spray or water saturated fabric. Liquid membrane-forming curing compound conforming to ASTM C309 may be used with the previous restrictions still applying.
4. Curing procedures shall be continued for at least 7 days. One procedure may be replaced by another any time after the concrete is one day old.

## 3.08 CONCRETE INSPECTION AND TESTING

A. Contractor shall be responsible for costs for inspecting and testing of concrete.

B. Portland cement:

1. Secure from the cement manufacturer Certificates of Compliance delivered directly to the concrete producer for further delivery directly to the testing laboratory.
2. Require the Certificates of Compliance to positively identify the cement as to production lot, bin or silo number, dating and routing of shipment, and compliance with the specified standards.
3. If so required by the Owner, promptly provide such other specific physical and chemical data as requested.

C. Aggregate:

1. Provide one test unless character of material changes, material is substituted, or additional test is requested by the Owner or Engineer.
2. Sample from conveyer belts or batching gates at the ready-mix plant:
   a. Sieve analysis to determine compliance with specified standards and grading.
   b. Specify gravity test for compliance with specified standards.
3. Laboratory design mix:
   a. After approval of aggregate, and whenever character or source of material is changed, provide mix design in accordance with ACI 613.
   b. Provide designs for all mixes prepared by a licensed Civil Engineer.
4. Molded concrete cylinders:
   a. Provide three test cylinders for each 100 cubic yard, or fraction thereof, of each class of concrete of each day's placement. Cylinders shall be poured under the observation of the Owner or Engineer.
   b. Test one cylinder at seven (7) days, one at twenty-eight (28) days, and one when so directed.
   c. Report the mix, slump, gage and location of concrete in the structure and test results.
   d. Take specimens and make tests in accordance with the applicable ASTM standard specifications.
5. Core tests:
   a. Provide only when specifically so directed by the Owner because of low cylinder test results.
   b. Cut from locations directed by the Owner, securing in accordance with ASTM C42, and prepare and test in accordance with ASTM C39.
6. Placement inspections:
   a. Throughout progress of concrete placement, make slump tests to verify conformance with specified slump.
   b. Using all required personnel and equipment throughout progress of concrete placement, verify that finished concrete surfaces will have the level or slope that is required by the Contract Documents.

## 3.09 CONCRETE REINFORCEMENT INSPECTION AND TESTING

A. Prior to use, test all reinforcement steel bars for compliance with the specified standards.

1. Material identified by mill test reports, and certified by the testing laboratory, does not require additional testing. Require the supplier to furnish mill test reports to the testing laboratory for certification.
2. Tag identified steel at the supplier's shop. When steel arrives at the job site without such tags, test it as unidentified steel.

B. Unidentified steel:

1. Have testing laboratory select samples consisting of two (2) pieces of each size, each 18" long.
2. Have the testing laboratory make one tensile test and one bend test for each 2-1/2 tons of fraction thereof of each size of unidentified steel.
3. Provide continuous inspection for all welding of reinforcement steel.

## 3.10 NON-SHRINK GROUT

A. Non-shrink, nonmetallic grout shall be used for filling recesses and pockets left for equipment installation and for setting of base plates. The material used shall be approved by the Engineer. Store, mix and place the non-shrinking compound as recommended by the manufacturer.

## 3.11 DEFECTIVE CONCRETE

A. Defective Concrete: Concrete not conforming to required lines, details, dimensions, finishes tolerances or specified strength requirements.

B. Repair or replacement of defective concrete will be determined by the Engineer.

C. Do not patch, fill, touch-up, repair, or replace exposed concrete except upon express direction of Engineer for each individual area.

D. If, according to the Engineer, the defects in the concrete cannot be patched successfully or if the patch is unsatisfactory from the standpoint of appearance or structural integrity, the entire section of concrete shall be removed and replaced at the Contractor's expense.

## 3.12 PATCHING

A. Allow Engineer to inspect concrete surfaces immediately upon removal of forms.

B. Excessive honeycomb or embedded debris in concrete is not acceptable. Notify Engineer upon discovery.

C. Patch imperfections in accordance with ACI 301.

D. The area to be patched shall be cleaned and all defective concrete removed down to sound concrete. The area and an area at least 6 inches wide surrounding it shall be saturated with water.

E. A bonding agent shall be applied prior to placing the patching mortar.

F. The patching mortar shall be made of the same materials and proportions as used for the concrete, except the coarse aggregate shall be omitted.

G. On all exposed concrete, sufficient white Portland cement shall be substituted for the regular cement to produce a color matching finish.

## 3.13 CONCRETE SEALANT

A. Exposed concrete shall be sealed with an approved concrete sealant after installation.

END OF SECTION