

## Section 3200

### Cast-In-Place Concrete

#### **PART 1: General**

- 1.1 *General Description of Work* – Mixing, placing, finishing, and providing all related services necessary to construct all cast-in-place concrete work indicated on plans.
- 1.2 *Submittals* –
  - 1.2.1 *Manufacturer's Data* – Submit Manufacturer's product data with installation instructions for proprietary materials including reinforcement and forming accessories, admixtures, joint materials, hardeners, curing materials and others as requested by Engineer.
  - 1.2.2 *Laboratory Reports* – Submit 2 copies of laboratory test or evaluation reports for concrete materials and mix designs as requested by Engineer.
- 1.3 *Quality Assurance* –
  - 1.3.1 *General* – Comply with the latest published edition of the American Concrete Institute (ACI) and American Society of Testing and Materials (ASTM) standards and codes.
  - 1.3.2 *Mix Proportions and Design* – Proportion mixes complying with mix design procedures specified in ACI 301, Specifications for Structural Concrete for Buildings.
    - 1.3.2.1 Submit written report to Engineer for each proposed concrete mix at least 15 days prior to start of work. Do not begin concrete production until mixes have been reviewed and are acceptable to Engineer.
    - 1.3.2.2 Mix designs may be adjusted when material characteristics, job conditions, weather, test results, or other circumstances warrant. Do not use revised concrete mixes until submitted to and accepted by Engineer.
    - 1.3.2.3 Use air-entering admixture in all concrete, providing not less than 4 percent or more than 6 percent entrained air for concrete exposed to freezing and thawing, and from 2 percent to 4 percent for other concrete.
  - 1.3.3 *Concrete Testing Service* – Employ acceptable ACI certified independent testing laboratory to perform materials evaluation, testing, and design of concrete mixes. (When required by Owner).
    - 1.3.3.1 *Sampling* – Sampling procedures and frequency shall meet the requirements of ASTM C 172, Standard Practice for Sampling Freshly Mixed Concrete.
    - 1.3.3.2 *Slump* – Slump characteristics shall be tested as specified in ASTM C 143, Standard Test Method for Slump of Hydraulic-Cement Concrete. One test shall be completed for each load at point of discharge.
    - 1.3.3.3 *Air Content* – Air content testing shall meet the requirements of ASTM C 173, Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric

Method. One test shall be completed for each set of compressive strength specimens.

- 1.3.3.4 *Compressive Strength* – Concrete compressive strength tests shall meet the requirements of ASTM C 39, Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens. One set of samples shall be collected for each 50 cubic yards or fraction thereof of each class of concrete; one specimen tested at 7 days, one specimen tested at 28 days, and one retained for later testing if required.
- 1.3.3.5 *Exceptions* – When the total quantity of a given class of concrete is less than 50 cubic yards, strength tests may be waived by Engineer if field experience indicates evidence of satisfactory strength.
- 1.3.3.6 *Reporting* – Test results will be reported in writing to Engineer, Contractor, and concrete producer within 24 hours after tests are made.

## **PART 2: Products**

### **2.1 *Concrete Materials* –**

- 2.1.1 *Portland Cement* – Portland cement shall meet the requirements of ASTM C 150, Standard Specification for Portland Cement, type as required.
- 2.1.2 *Fly Ash* – Fly ash shall meet the requirements of ASTM C 618, Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete, Type C or F. Limit use of fly ash in concrete mix design to not exceed 25 percent of cement content by weight.
- 2.1.3 *Aggregates* – Aggregate shall meet the requirements of ASTM C 33; Standard Specification for Concrete Aggregates except local aggregates of proven durability may be used when acceptable to Engineer.

### **2.2 *Water* – Water for concrete shall be potable.**

### **2.3 *Admixtures* –**

- 2.3.1 *Air-Entraining Admixture* – Air entraining admixture shall meet the requirements of ASTM C 260, Standard Specification for Air-Entraining Admixtures for Concrete.
- 2.3.2 *Water-Reducing Admixture* – Water reducing admixture shall meet the requirements of ASTM C 494, Standard Specification for Chemical Admixtures for Concrete, as required to suit project conditions. Only use admixtures, which have been tested and accepted in mix designs, unless otherwise approved by the Engineer. Superplasticizers are not permitted without prior approval of Engineer.

### **2.4 *Related Materials* –**

- 2.4.1 *Waterstops* – Flat dumbbell or centerbulb type, size to suit joints, of either rubber (COE CRD C 513, Corps of Engineers Specifications for Rubber Waterstops) or PVC (COE CRD C 572, Corps of Engineers Specifications for Polyvinylchloride Waterstops)

- 2.4.2 *Moisture Barrier* – Clear 8-mils thick polyethylene; polyethylene-coated barrier paper; or 1/8-inch thick asphalt core membrane sheet.
- 2.4.3 *Membrane-Forming Curing Compound* – Membrane forming curing compounds shall meet the requirements of ASTM C 309, Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete, Type I.
- 2.4.4 *Joint Fillers* –
  - 2.4.4.1 *Joint Sealer* – Hot poured, non-extruding, elastic joint sealer shall meet the requirements of ASTM D 6690, Standard Specification for Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements.
  - 2.4.4.2 *Preformed Expansion Joint Filler* – Preformed expansion joint filler shall be Non-extruding, bituminous fiber meeting the requirements of ASTM D 1751, Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction.
- 2.4.5 *Stability* – Provide form materials with sufficient stability to withstand pressure of placed concrete without bow or deflection.
- 2.4.6 *Exposed Concrete Surfaces* – Material to suit project conditions.
- 2.5 *Reinforcing Materials* –
  - 2.5.1 *Deformed Reinforcing Bars* – Reinforcing bars shall meet the requirements of ASTM A 615, Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement, Grade 60, unless otherwise indicated.
  - 2.5.2 *Welded Wire Fabric* – Welded wire fabric shall meet all requirements of ASTM A 185, Standard Specification for Steel Welded Wire Reinforcement.

### **PART 3: Execution**

- 3.1 *Verification* – Verify anchors, seats, plates, reinforcements and other items to be cast into concrete are accurately placed, held securely, and will not cause hardship in placing concrete.
- 3.2 *Preparation* – Prepare previously placed concrete by cleaning with steel brush and applying bonding agent. Bonding agent shall be approved by the Engineer prior to use. Apply Bonding agent in accordance with Manufacturer's instructions.
- 3.3 *Forming and Placing Concrete* –
  - 3.3.1 *Job-Site Mixing* – Use drum type batch machine mixer, mixing not less than 1 minute for one cu. yd. or smaller capacity. Increase mixing time at least 15 seconds for each additional cubic yard or fraction thereof.
  - 3.3.2 *Ready-Mix Concrete* – Ready-Mix concrete shall meet all requirements of ASTM C 94, Standard Specification for Ready Mix Concrete.

- 3.3.3 *Formwork* – Construct so that concrete members and structures are of correct size, shape, alignment, elevation, and position.
  - 3.3.3.1 Provide openings in formwork to accommodate work of other trades. Accurately place and securely support items built into forms.
  - 3.3.3.2 Clean and adjust forms prior to concrete placement. Apply form release agents or wet forms, as required. Retighten forms during concrete placement if required to eliminate mortar leaks.
- 3.3.4 *Reinforcement* – Position, support, and secure reinforcement against displacement. Locate and support with metal chairs, runners, bolsters spacers and hangers, as required. Set wire ties so ends are directed into concrete, not toward exposed concrete surfaces.
- 3.3.5 *Fabric Length* – Install welded wire fabric in as long lengths as practicable, lapping at least one mesh at both ends and sides. Tie or interlace at laps.
- 3.3.6 *Joints* – Provide construction, isolation, and control joints as indicated or required. Locate construction joints so as to not impair strength and appearance of structure. Locate isolation and control joints in slabs-on-ground to accommodate differential settlement and prevent random cracking.
- 3.3.7 *Installation of Embedded Items* – Set and build into work anchorage devices and other embedded items required for other work that is attached to, or supported by cast-in-place concrete. Use setting diagrams, templates, and instructions provided by others for locating and setting.
- 3.3.8 *Concrete Placement* – Comply with ACI, placing concrete in a continuous operation within planned joints or sections. Do not begin placement until work of other trades affecting concrete is completed.
- 3.3.9 *Concrete Consolidation* – Consolidate concrete using mechanical vibrating equipment, hand rodding and tamping, so that concrete is well compacted around reinforcement and other embedded items and into forms.
- 3.3.10 *Concrete Protection* – Protect concrete from physical damage or reduced strength due to weather extremes during mixing, placement and curing.
  - 3.3.10.1 In cold weather comply with ACI 306, Specification for Cold Weather Concreting.
  - 3.3.10.2 In hot weather comply with ACI 305, Specification for Hot Weather Concreting.
- 3.4 *Concrete Finishes* –
  - 3.4.1 *Exposed-to-view Surfaces* – Provide a smooth finish for exposed concrete surfaces and surfaces that are to be covered with a coating or covering material applied directly to concrete. Remove fins and projections, patch defective areas with cement grout, and rub smooth.
  - 3.4.2 *Slab Trowel Finish* – Apply trowel finish to monolithic slab surfaces that are exposed-to-view or are to be covered with resilient flooring, paint or other thin film coating. Consolidate concrete surfaces by floating then finish troweling, free of trowel marks, and uniform in texture and appearance.

- 3.4.3 *Broom Finish* – Apply broom finish to monolithic slab surfaces that are exposed to view and subject to vehicular or pedestrian traffic. Consolidate concrete surfaces by floating and troweling prior to applying broom finish.
- 3.4.4 *Curing* – Begin initial curing as soon as free water has disappeared from exposed surfaces. Where possible, keep continuously moist for not less than 72 hours. Continue curing by use of moisture-retaining cover or membrane-forming curing compound. Cure formed surfaces by moist curing until forms are removed. Provide protections as required to prevent damage to exposed concrete surfaces.

### 3.5 *Field Quality Control* –

- 3.5.1 *Concrete Control* – The verification and control of all concrete shall be performed by and independent testing laboratory. Cost of testing shall be paid for by the Contractor. All concrete testing shall be performed by ACI certified technicians in accordance with ASTM 94, Standard Specification for Ready Mix Concrete.

#### 3.5.2 *Laboratory Services* – Laboratory services shall be as follows:

- 3.5.2.1 Make, cure, store and break test cylinders conforming to the requirements of ASTM C31, Standard Method of Making and Curing Concrete Test Specimens in the Field, ASTM C39, Standard Method of Test for Compressive Strength of Cylindrical Specimens; ASTM C143, Standard Method for Test of Slump of Portland Cement Concrete; ASTM C172 Test cylinders shall be taken at job site and under no circumstances shall they be taken at a central mixing plant.
- 3.5.2.2 Report on all tests conducted by laboratory shall be rendered promptly and distributed as follows:
  - 3.5.2.2.1 ECUA: Two (2) copies
  - 3.5.2.2.2 Engineer: One (1) copy
  - 3.5.2.2.3 Contractor: as requested
- 3.5.2.3 Reports of control cylinders for job placed concrete shall conform to ASTM C94, Standard Specification for Ready Mix Concrete.
- 3.5.2.4 Refer to the following list of functions to be performed by Contractor.
  - 3.5.2.4.1 Contractor shall comply with ACI 301, Specification for Structural Concrete for Buildings. Contractor shall provide assistance as necessary for cylinder sampling.
  - 3.5.2.4.2 Contractor shall keep a daily log, recording quantities of each class used, the area of location or each quantity of concrete relating to its controlling cylinder. The Contractor shall furnish this information to the tickets, should ECUA so request.
- 3.5.2.5 Refer to the following list of detailed requirements:
  - 3.5.2.5.1 Of the test cylinders taken, one shall be broken at 7 days; two shall be broken at 28 days and one held in reserve.

3.5.2.5.2 Acceptance of concrete shall be in accordance with ACI 301, Specification for Structural Concrete for Buildings.

3.6 *Patching* – Patch Imperfections

3.7 *Defective Concrete* –

3.7.1 *Levels and Lines* – Modify or replace concrete not conforming to the required levels and lines, details and elevations.

3.7.2 *Type* – Repair or replace concrete not properly placed of the specified type.

3.8 *Protection* –

3.8.1 *Temperature* – Immediately after placement, protect concrete from premature drying, excessive hot or cold temperatures, and mechanical damage.

3.8.2 *Moisture* – Maintain concrete with minimal moisture loss at relative constant temperature for period necessary for hydration of cement and hardening of concrete.