

SECTION 033000 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this section.

1.2 SUMMARY

- A. Description:
 - 1. This section includes cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes, for the following:
 - a. Footings.
 - b. Foundation Walls.
 - c. Site Retaining Walls.
 - d. Slabs-On-Grade.
 - e. Suspended Slabs.
 - f. Concrete Toppings.
- B. Related Documents and Standards:
 - 1. All referenced standards and cited publications shall be those specifically denoted within the applicable building code noted in the General Notes of the Construction Drawings.
 - 2. All cast-in-place concrete work on this project shall conform to the Construction Documents, applicable building code including referenced standards, the requirements of "Specification for Structural Concrete" ACI 301-16 (Chapters 1-5, & Chapters 6-14 as applicable) and "Specifications for Tolerances for Concrete Construction and Materials" ACI 117, in coordination with clarifications, exemptions, and additions in the Construction Documents.
- C. Related Sections:
 - 1. Division 03 Specifications – Concrete Construction.
 - 2. Division 07 Specifications – Thermal and Moisture Protection.
 - 3. Division 31 Specifications – Earthwork.

1.3 SUBMITTALS

- A. Design Mixtures:
 - 1. Indicate amounts of mixing water to be withheld for later addition at Project site.
- B. Cold-Weather Placement: Submit detailed procedures for cold weather concreting in accordance with ACI 306.1.
- C. Hot-Weather Placement: Submit detailed procedures for hot weather concreting in accordance with ACI 305.1.

- D. Steel Reinforcement Shop Drawings: Placing drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement.
- E. Formwork layout and dimension shop drawings.
- F. Material Test Reports: For the following, from a qualified testing agency, indicating compliance with requirements:
 - 1. Aggregates
- G. Material Certificates: For each of the following as applicable on the project, signed by manufacturers:
 - 1. Cementitious materials.
 - 2. Admixtures.
 - 3. Form materials and form-release agents.
 - 4. Steel reinforcement and accessories.
 - 5. Fiber reinforcement.
 - 6. Waterstops.
 - 7. Curing compounds.
 - 8. Floor and slab treatments.
 - 9. Bonding agents.
 - 10. Adhesives.
 - 11. Vapor retarders.
 - 12. Semirigid joint filler.
 - 13. Joint-filler strips.
 - 14. Repair materials.
- H. Floor surface flatness and levelness measurements to determine compliance with specified tolerances.

1.4 INFORMATION SUBMITTALS

- A. Embed and Penetration Plans: Submit placing drawings that detail locations of mechanical, electrical, plumbing, and fire protection openings, sleeves and embedded accessories not specifically located on the Structural Construction Drawings, including routing of embedded conduit.

PART 2 - PRODUCTS

2.1 FORM-FACING MATERIALS

- A. Comply with ACI 301.
- B. Earth forms may be used for footing forms where sides of the excavation are cut true, in firm soil. If earth is not suitable to be used as “earth form,” no consideration will be given to any claim for additional cost of formwork. Contractor shall provide material and labor to provide formwork without additional cost to Owner.

2.2 STEEL REINFORCEMENT

- A. Reinforcing Bars: ASTM A 615 Grade 60 deformed.
- B. Low-Alloy-Steel Reinforcing Bars: ASTM A 706 Grade 60 deformed.
 - 1. For use where weldable reinforcing is called out in construction documents.
- C. Plain-Steel Welded Wire Reinforcement: ASTM A 1064, plain, fabricated from as-drawn steel wire into flat sheets.
- D. Headed Concrete Anchors: Conform to AWS D1.1 and ASTM A 108 specifications for 1010 through 1020 mild steels, type B. Minimum yield strength = 51,000 psi (0.2 % offset).

2.3 REINFORCEMENT ACCESSORIES

- A. Bar Supports: Manufacture bar supports from plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete for use in foundations and slabs-on-grade only.

2.4 CONCRETE MATERIALS

- A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:
 - 1. Portland Cement: ASTM C 150, Type I. Supplement with the following:
 - a. Fly Ash: ASTM C 618, Class F or C.
 - b. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.
 - c. Use of supplemental cementitious materials may be rejected by Architect/Structural Engineer of Record for certain applications on project.
 - 2. Blended Hydraulic Cement: ASTM C 595, Type IS portland blast-furnace slag, Type IP portland-pozzolan, Type I (PM) pozzolan-modified Portland, Type I (SM) slag-modified portland cement. Use of blended hydraulic cement may be rejected by Architect/Structural Engineer of Record for certain applications on project.
- B. Silica Fume: ASTM C 1240, amorphous silica. Use of blended hydraulic cement may be rejected by Architect/Structural Engineer of Record for certain applications on project.
- C. Normal-Weight Aggregates: ASTM C 33, coarse aggregate or better, graded. Select grading class per type of construction or location used, and in relation to specific weathering region. Provide aggregates from a single source.
 - 1. Maximum Coarse-Aggregate Size: See schedule on Construction Drawings.
- D. Water: Shall be potable.

2.5 ADMIXTURES

- A. Air-Entraining Admixture: ASTM C 260.
- B. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.
 - 1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
 - 2. Retarding Admixture: ASTM C 494/C 494M, Type B.

3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.

2.6 FIBER REINFORCEMENT

- A. Carbon-Steel Fiber: ASTM A 820, deformed.
 1. Products subject to compliance with requirements, provide the following:
 - a. Fiber: Type 1, Cold-Drawn Wire:
 - 1) Insert manufacturer's name; product name or designation.
 - b. Fiber: Type 2, cut sheet:
 - 1) Insert manufacturer's name; product name or designation.
- B. Synthetic Micro-Fiber: polypropylene micro-fibers engineered and designed for use in concrete, complying with ASTM C 1116, Type III.
 1. Products subject to compliance with requirements, provide the following:
 - a. Monofilament Fibers:
 - 1) Insert manufacturer's name; product name or designation.
 - b. Fibrillated Fibers:
 - 1) Insert manufacturer's name; product name or designation.
- C. Synthetic Macro-Fiber: Polyolefin macro-fibers engineered and designed for use in concrete, complying with ASTM C 1116, Type III.
 1. Products subject to compliance with requirements, provide the following:
 - a. Insert manufacturer's name; product name or designation.
- D. Fiber reinforcement may be requested for substitution by contractor. Architect/Structural Engineer of Record shall review for compliance any substitution requested and approve or reject as necessary.

2.7 VAPOR RETARDERS

- A. Sheet Vapor Retarder meeting ASTM E 1745, minimum 10 mil thickness. Coordinate with Division 03 and 07 specifications and Architectural Drawings for additional requirements or increased thickness. See Construction Drawings for locations required. Install per qualified geotechnical engineer's recommendation and ACI 302.1 requirements.

2.8 CONCRETE MIXTURES, GENERAL

- A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301 and ACI 318 chapter 5. Design mixtures shall meet the minimum requirements tabulated in the construction documents.
- B. Cementitious Materials: Use fly ash, pozzolan, ground granulated blast-furnace slag, and silica fume as needed. Requirements of table 4.1.2.9 of ACI 301 shall be adhered to.
- C. Admixtures: Use admixtures according to manufacturer's written instructions.
 1. Use water-reducing, high-range water-reducing, plasticizing, or retarding admixtures in concrete, as required, for placement and workability, and project specific conditions.

2.9 FABRICATING REINFORCEMENT

- A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.10 CONCRETE MIXING

- A. Ready-Mixed Concrete:
 - 1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1 FORMWORK

- A. Limit concrete surface irregularities, designated by ACI 347R as abrupt or gradual, as follows:
 - 1. Class A, 1/8 inch for exposed smooth-formed finished surfaces.
 - 2. Class B, 1/4 inch for exposed rough-formed finished surfaces.

3.2 STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.
- B. Field bending or straightening of reinforcing bars partially embedded in concrete is prohibited unless specifically permitted by Structural Engineer of Record. Comply with ACI 301 procedures for field bending and straightening.
- C. Install welded wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least two full panels. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.

3.3 CONCRETE PLACEMENT

- A. Do not add water to concrete during delivery or at Project site. Add water at project site only as noted on delivery ticket, and prior to beginning placement.
- B. Cold-Weather Placement: Comply additionally with ACI 306.1 and as follows:
 - 1. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.
- C. Hot-Weather Placement: Comply additionally with ACI 305.1 and as follows:
 - 1. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water.

3.4 FINISHING FLOORS AND SLABS

- A. General: Comply with ACI 302.1R recommendations for screeding, restraighening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.
- B. Float Finish:

1. Apply float finish to surfaces to receive trowel finish and to be covered with fluid-applied or sheet waterproofing, built-up or membrane roofing, or sand-bed terrazzo.
- C. Trowel Finish (after applying float finish):
 1. Apply a trowel finish to surfaces exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system.
 2. Finish surfaces to the following tolerances, according to ASTM E 1155, for a randomly trafficked floor surface:
 - a. Specified overall values of flatness, F(F) 35; and of levelness, F(L) 25; with minimum local values of flatness, F(F) 24; and of levelness, F(L) 17; for slabs-on-grade.
- D. Trowel and Fine-Broom Finish:
 1. Apply a trowel finish to surfaces where ceramic or quarry tile is to be installed by either thickset or thin-set method.
 2. Comply with flatness and levelness tolerances for trowel-finished floor surfaces.
- E. Broom Finish: Apply a broom finish to exterior concrete platforms, steps and ramps, and elsewhere as indicated.
 1. Coordinate required final finish with Architect before application.

3.5 CONCRETE PROTECTING AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 301, ACI 305, ACI 306, and ACI 306.1 as applicable.
- B. Cure concrete according to ACI 308.1, by one or a combination of the methods allowed in ACI 301.

3.6 CONCRETE SURFACE REPAIRS

- A. Defective Concrete: Repair and patch defective areas when approved by Architect/Structural Engineer of Record. Remove and replace concrete that cannot be repaired and patched to Architect/Structural Engineer of Record approval.
- B. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning per ACI 301, to the satisfaction of the Architect/Structural Engineer of Record.
- C. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. For areas out of tolerance or specification, Contractor shall propose correction method to Architect/Structural Engineer of Record for approval.

3.7 FIELD QUALITY CONTROL

- A. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:

1. Testing Frequency: Obtain at least one composite sample set for each 75 cu. yd. or fraction thereof of each concrete mixture placed each day.
 - a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
 2. Slump: ASTM C 143; one test at point of delivery for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
 3. Concrete Temperature: ASTM C 1064; one test hourly when air temperature is 40 deg F and below and when 80 deg F and above, and one test for each composite sample.
 4. Air Content: ASTM C231 or ASTM C173 as applicable, one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
 5. Compression Test Specimens: ASTM C 31.
 - a. Cast and cure a minimum of four 6"x12" or five 4"x8" cylinder specimens for each composite sample.
 - b. Additional cylinders to be cast for high-early strength concrete and as required for contractor's means and methods.
 6. Compressive-Strength Tests: ASTM C 39; test one specimen at 7 days and one set of two (6"x12")/three (4"x8") specimens at 28 days. Should 28 day strength not be met, test remaining cylinder at 56 days. Should 28 day strength be met, remaining cylinder may be discarded. Additional tests for high-early strength concrete and as required for contractor's means and methods.
- B. Measure floor and slab flatness and levelness according to ASTM E 1155 as soon as possible but within 24 hours of finishing. Elevated framing shall be measured in its shored condition (where applicable).

END OF SECTION 033000