

SECTION 03300

CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.01 SUMMARY

- A. This Section includes cast-in-place concrete, including reinforcement, concrete materials, mix design, placement procedures, and finishes for the following:
  - 1. Footings
  - 2. Pile caps
  - 3. Foundation walls
  - 4. Interior slabs on grade
  - 5. Elevated slabs
  - 6. Concrete toppings and housekeeping pads

1.02 RELATED SECTIONS

- A. Section 01352 – LEED Requirements
- B. Section 02220 – Excavation, Backfilling and Grading
- C. Section 10270 – Access Flooring

1.03 DEFINITIONS

- A. Cementitious Materials: Portland cement alone or in combination with one or more of blended hydraulic cement, fly ash and other pozzolans, ground granulated blast-furnace slag, and silica fume.

1.04 SUBMITTALS

- A. Product Data: For each manufactured material and product indicated.
- B. Design Mixes: For each concrete mix indicated with the fly ash content given both in total weight and as a percentage of the cementitious materials.
- C. Shop Drawings: Include details of steel reinforcement placement including material, grade, bar schedules, stirrup spacing, bent bar diagrams, arrangement, and supports.
- D. Material certificates and test reports.

## 1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products complying with ASTM C 94 requirements for production facilities and equipment.
- B. Comply with ACI 301, "Specification for Structural Concrete," including the following, unless modified by the requirements of the Contract Documents.
  - 1. General requirements, including submittals, quality assurance, acceptance of structure, and protection of in-place concrete.
  - 2. Formwork and form accessories.
  - 3. Steel reinforcement and supports.
  - 4. Concrete mixtures.
  - 5. Handling, placing, and constructing concrete.
  - 6. Lightweight concrete.
  - 7. Pre-installation Conference: Conduct conference at Project site.

## PART 2 - PRODUCTS

### 2.01 MATERIALS

- A. Formwork: Furnish formwork and form accessories according to ACI 301.
- B. Steel Reinforcement:
  - 1. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.
  - 2. Plain-Steel Wire: ASTM A 82, as drawn.
  - 3. Plain-Steel Welded Wire Fabric: ASTM A 185, fabricated from as-drawn steel wire into flat sheets.
  - 4. Deformed-Steel Welded Wire Fabric: ASTM A 497, flat sheet.
- C. Concrete Materials:
  - 1. Portland Cement (**Grey or White**): ASTM C 150, Type I or II or I/II. **The content of Fe<sub>2</sub>O<sub>3</sub> for white cement shall not exceed 0.50% by weight.**
  - 2. Fly Ash: ASTM C 618, Class C or F.
  - 3. Normal-Weight Aggregate: ASTM C 33, uniformly graded, not exceeding 1½" nominal size.
  - 4. Lightweight Aggregate: ASTM C 330, uniformly graded, not exceeding ¾" nominal size.
- D. Water: Complying with ASTM C 94.
- E. Synthetic Fiber: Fibrillated or monofilament polypropylene fibers engineered and designed for use in concrete, complying with ASTM C 1116, Type III, ½" to 1½" long.

- F. Admixtures:
1. Air-Entraining Admixture: ASTM C 260.
  2. Water-Reducing Admixture: ASTM C 494, Type A.
  3. High-Range, Water-Reducing Admixture: ASTM C 494, Type F.
  4. Water-Reducing and Accelerating Admixture: ASTM C 494, Type E.
  5. Water-Reducing and Retarding Admixture: ASTM C 494, Type D.
- G. Vapor Retarder: Multi-ply reinforced polyethylene sheet, ASTM E 1745, Class C, not less than 7.8 mils thick; or polyethylene sheet, ASTM D 4397, not less than 10 mils thick. Provide a layer of fine granular material, consisting of either crushed stone, crushed gravel, or a manufactured or natural sand above and below the vapor retarder. The layer shall provide a level bedding to prevent puncture from sub-grade projections or concrete aggregates. Material shall meet ASTM D 448, Size 10, with 100% passing a No. 4 sieve and 10 to 30% passing a No. 100 sieve and shall comply with deleterious substance limits of ASTM C 33 for fine aggregates.
- H. Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber or ASTM D 1752, cork or self-expanding cork.
- I. Curing Materials:
1. Evaporation retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
  2. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf.
  3. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
  4. Water: Potable. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B.
  5. Clear, Waterborne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.
- J. Interior Liquid Floor Slab Treatments: Transparent, chemically reactive, water-based sealer to seal, harden, and dustproof concrete. Use one of the following:
1. Ashford Formula; Concrete Chemical Company
  2. Seal Hard; L & M Construction Chemicals, Inc.
  3. Euco Diamond Hard; The Euclid Chemical Company
  4. Day-Chem Sure Hard; Dayton Superior Construction

## 2.02 CONCRETE MIXES

- A. Comply with ACI 301 requirements for concrete mixtures with fly ash.
- B. Prepare design mixes, proportioned according to ACI 301, for normal-weight concrete determined by either laboratory trial mix or field test data bases, as follows:
1. Concrete for foundations: (walls and pile caps)  
- Compressive Strength (28 Days): 4,000 psi.

- Water/cement ratio: 0.45 to 0.50
  - Slump: 4"
  - Slump Limit for Concrete Containing High-Range Water-Reducing Admixture: Not more than 8" after adding admixture to plant or site-verified, **3 to 4"** slump.
2. Concrete for interior slabs on grade:
- Compressive Strength (28 Days): 3,000 psi.
  - Water/cement ratio: 0.45 to 0.48
  - Slump: 3"
  - Slump Limit for Concrete Containing High-Range Water-Reducing Admixture: Not more than 8" after adding admixture to plant or site-verified, 2 to 3" slump.
3. Concrete for elevated (light weight) concrete slabs and toppings:
- Compressive Strength (28 Days): 3,000 psi.
  - Water/cement ratio: 0.45 to 0.48
  - Slump: 3", unmodified.
  - Slump Limit for Concrete Containing High-Range Water-Reducing Admixture: Not more than 8" after adding admixture to plant or site-verified, 2 to 3" slump.
  - Air content: No air entrainment permitted.
4. **Concrete for formed in place (light weight) concrete slabs:**
- **Mix shall use white cement and light colored aggregates without fly ash.**
  - **Compressive Strength (28 Days): 3,000 psi.**
  - **Water/cement ratio: 0.45 to 0.48**
  - **Slump: 3", unmodified.**
  - **Slump Limit for Concrete Containing High-Range Water-Reducing Admixture: Not more than 8" after adding admixture to plant or site-verified, 2 to 3" slump.**
  - **Air content: No air entrainment permitted.**
- C. Cementitious Materials: Substitute cementitious fly ash as a replacement for portland cement in concrete ranging between 20-25% by weight of total cementitious material.
- D. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having an air content of 6.0% within a tolerance of plus 1.0% or minus 1.5%. Air content of trowel-finished interior concrete floors shall not exceed 3.0%.
- E. Lightweight Structural Concrete Mix: ASTM C 330, proportioned to produce concrete with a minimum compressive strength of 3,000 psi at 28 days and a calculated equilibrium unit weight of 110 lb/cu. ft. plus or minus 3 lb/cu. ft., as determined by ASTM C 567. Concrete slump at point of placement shall be the minimum necessary for efficient mixing, placing, and finishing. Limit slump to 4" for troweled slabs and 3" for other slabs.
- F. Synthetic Fiber Reinforcing: Where specified on the drawings, uniformly disperse in concrete mix at manufacturer's recommended rate, but not less than 1.5 lb/cu. yd.

### 2.03. CONCRETE MIXING

- A. Ready-Mixed Concrete: Comply with ASTM C 94 and ASTM C 1116. When air temperature is between 85<sup>0</sup>F and 90<sup>0</sup>F, reduce mixing and delivery time from 1½ hours to 75 minutes; when air temperature is above 90<sup>0</sup>F, reduce mixing and delivery time to 60 minutes.
- B. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete according to ASTM C 94. Mix concrete materials in appropriate drum-type batch machine mixer.
  - 1. For mixer capacity of 1 cu. yd. or smaller, continue mixing at least 1½ minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released.
  - 2. For mixer capacity larger than 1 cu. yd., increase mixing time by 15 seconds for each additional 1 cu. yd.
- C. Provide batch ticket for each batch discharged and used, indicating the project identification name and number, date, mix type, mix time, quantity, and amount of water added. Record the approximate location of final placement by the structure's column line grid.

## PART 3 - EXECUTION

### 3.01 INSTALLATION, GENERAL

- A. Formwork: Design, construct, erect, shore, brace, and maintain formwork according to ACI 301.
- B. Vapor Retarder: Install, protect, and repair vapor-retarder sheets according to ASTM E 1643; place sheets in position with longest dimension parallel with direction of pour.
  - 1. Lap joints 6" and seal with manufacturer's recommended tape.
  - 2. Cover vapor retarder with fine-graded granular material, moisten, and compact with mechanical equipment to elevation tolerances of plus 0" or minus 1/8".
- C. Steel Reinforcement: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.
- D. Joints: Construct joints true to line with faces perpendicular to surface plane of concrete.
  - 1. Construction Joints: Locate and install so as not to impair strength or appearance of concrete, at locations indicated or as approved by the COR.
  - 2. Isolation Joints: Install joint-filler strips at junctions with slabs-on-grade and vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated. Extend joint fillers full width and depth of joint, terminating flush with finished concrete surface, unless otherwise indicated.

3. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of the concrete thickness, as follows:
  - a. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint with groover tool to a radius of ¼ ". Repeat grooving of contraction joints after applying surface finishes. Eliminate groover marks on concrete surfaces.
  - b. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut ¼" wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.
- E. Tolerances: Comply with ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."

### 3.02 CONCRETE PLACEMENT

- A. Comply with recommendations in ACI 304R for measuring, mixing, transporting, and placing of concrete.
- B. Do not add water to concrete during delivery, at Project site, or during placement.
- C. Consolidate concrete with mechanical vibrating equipment.

### 3.03 FINISHING FORMED SURFACES

- A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defective areas repaired and patched, and fins and other projections exceeding ½" in height rubbed down or chipped off. Apply to concrete surfaces not exposed to public view.
- B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defective areas. Completely remove fins and other projections.
  1. Applies to concrete surfaces exposed to public view or to be covered with a coating or covering material applied directly to concrete, such as waterproofing, damp-proofing, veneer plaster, or painting.
- C. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise indicated.

### 3.04 FINISHING UNFORMED SURFACES

- A. General: Comply with ACI 302.1R for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

- B. Screed surfaces with a straightedge and strike off. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane before excess moisture or bleed-water appears on the surface.
1. Do not further disturb surfaces before starting finishing operations.
  2. Scratch Finish: Apply scratch finish to surfaces to receive concrete floor topping or mortar setting beds for ceramic or quarry tile, portland cement terrazzo, and other bonded cementitious floor finish, unless otherwise indicated.
  3. Float Finish: Apply float finish to surfaces indicated, to surfaces to receive trowel finish, and to floor and slab surfaces to be covered with fluid-applied or sheet waterproofing, built-up or membrane roofing, or sand-bed terrazzo.
  4. Trowel Finish: Apply a hard trowel finish to surfaces indicated and to floor and slab 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.
  5. Trowel and Fine-Broom Finish: Apply a partial trowel finish, stopping after second troweling, to surfaces indicated and to surfaces where ceramic or quarry tile is to be installed by either thickset or thin-set methods. Immediately after second troweling, and when concrete is still plastic, slightly scarify surface with a fine broom.
  6. Nonslip Broom Finish: Apply a nonslip broom finish to surfaces indicated and to exterior concrete platforms, steps, and ramps. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route.

### 3.05 CONCRETE PROTECTION AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection, and follow recommendations in ACI 305R for hot-weather protection during curing.
- B. Evaporation Retarder: Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions occur before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.
- C. Begin curing after finishing concrete, but not before free water has disappeared from concrete surface.
- D. Cure formed and unformed concrete for at least seven days as follows:
1. Moisture Curing: Keep surfaces continuously moist with water, continuous water-fog spray, or absorptive cover, water saturated and kept continuously wet.
  2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12", and sealed by waterproof tape or adhesive. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
  3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to

heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

4. Apply interior liquid floor slab treatment to all permanently exposed slabs including floor slabs beneath access flooring in full conformance with manufacturer's recommendations.

### 3.06 FIELD QUALITY CONTROL

- A. Testing Agency: Contractor shall engage a qualified, independent testing and inspecting agency to sample materials, perform tests, and submit test reports during concrete placement. Tests will be performed according to ACI 301.
- B. Testing Frequency: One composite sample for each day's pour of each concrete mix exceeding 5 cu. yd. but less than 25 cu. yd., plus one set for each additional 50 cu. yd. or fraction thereof or at least one composite sample for each 100 cu. yd. or fraction thereof of each concrete mix placed each day.
- C. All field and laboratory reports shall be collected daily by the Construction Manager and shall be submitted to the COR for record at the end of the project.

END OF SECTION 03300