

## **SECTION 03300**

### **CONCRETE**

#### **PART 1 GENERAL**

##### **1.01 Section Includes**

General requirements for formwork, reinforcement, accessories and cast-in-place concrete.

##### **1.02 References**

- A. American Concrete Institute (ACI) latest edition:
  - 1. ACI 301 - Structural Concrete for Buildings
  - 2. ACI 305 - Hot Weather Concreting
  - 3. ACI 306 - Cold Weather Concreting
  - 4. ACI 315 - Detailing Manual
  - 5. ACI 318 - Building Code Requirements for Structural Concrete
  - 6. ACI 347 - Formwork for Concrete
  
- B. American Association of State Highway and Transportation Officials (AASHTO) latest edition:
  - 1. AASHTO T152 - Air Content of Freshly Mixed Concrete by the Pressure Method
  
- C. American Society for Testing and Materials (ASTM) latest edition:
  - 1. ASTM A185 - Steel Welded Wire Reinforcement, Plain, for Concrete
  - 2. ASTM A615 - Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
  - 3. ASTM C31 - Making and Curing Concrete Test Specimens in the Field
  - 4. ASTM C33 - Concrete Aggregates
  - 5. ASTM C39 - Test Method for Compressive Strength of Cylindrical Concrete Specimens
  - 6. ASTM C94 - Ready-Mixed Concrete
  - 7. ASTM C138 - Test Method for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete
  - 8. ASTM C143 - Test Method for Slump of Hydraulic Cement Concrete
  - 9. ASTM C150 - Portland Cement
  - 10. ASTM C173 - Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method

11. ASTM C231 - Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
12. ASTM C260 - Air-Entraining Admixtures for Concrete
13. ASTM C309 - Liquid Membrane-Forming Compounds for Curing Concrete
14. ASTM D1751 - Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Bituminous Types)

### **1.03 Submittals**

- A. Submit reinforcement steel shop drawings prepared in accordance with ACI 315, Manual of Standard Practice for Detailing Reinforced Concrete Structures. Drawings shall indicate bending diagrams, shapes, dimensions, clearances, splicing and laps, accessories, and installation notes.
- B. Submit manufacturer's literature for all admixtures proposed for the work.
- C. Submit delivery tickets in accordance with ASTM C94 for each batch of ready-mixed concrete. Information on the ticket shall include class of concrete, water content, time of loading, truck number, admixtures, and quantity.
- D. At least 35 days prior to placing of concrete, the Contractor shall submit proposed mix proportions and samples of proposed materials.

### **1.04 Quality Control**

- A. Materials and methods of mixing and placing concrete shall conform to ACI 318, Building Code Requirements for Reinforced Concrete.
- B. Tests for slump shall be made when directed by the Engineer in accordance with ASTM C143.
- C. Air content tests shall be made, when directed by the Engineer, in accordance with ASTM C138, C173, C231, or AASHTO T-152.
- D. Sidewalks construction and/or rehabilitation shall meet FDOT ADA/Accessibility standards and FDOT Roadway and Traffic Design Standards Index No. 304.

## **PART 2 PRODUCTS**

### **2.01 Formwork**

Formwork lumber shall be straight and clean. All nails shall be withdrawn and surfaces in contact with concrete shall be thoroughly cleaned before reuse.

**2.02 Reinforcement**

- A. Reinforcement bars shall be ASTM A615, Grade 60 deformed bars, except as otherwise indicated.
- B. Welded wire fabric shall conform to ASTM A185. Where welded wire fabric is shown but not sized on Drawings, use 6" x 6" x W2.9 x W2.9 WWF.
- C. Accessories for proper installation of reinforcement shall conform to CRSI "Manual of Standard Practice for Reinforced Concrete Construction". Bar supports at exposed surfaces shall be Class C-Plastic Protected.
- D. Reinforcement fabrication shall conform to ACI 315 and ACI 318, and approved shop drawings.

**2.03 Joint Fillers**

- A. Joint fillers shall be products of the following manufacturers, or equal:
  - 1. W. R. Meadows, Inc., Elgin, Illinois
  - 2. W. R. Grace and Co., Cambridge, Massachusetts.
- B. Preformed bituminous fiber joint filler shall be non-extruding type conforming to ASTM D1751.
- C. Control joint strips shall have a minimum depth of 25 percent of slab thickness and a minimum thickness of 1/8 inch.

**2.04 Concrete Materials**

- A. Water shall be clean and potable
- B. Portland cement shall be ASTM C150 Type I, II or III.
- C. Fine and coarse aggregate shall be clean, hard, natural, or manufactured material conforming to ASTM C33.
- D. The nominal maximum size of the aggregate shall not be larger than three-fourths of the minimum clear spacing between individual reinforcing bars. Coordinate with maximum aggregate sizes specified hereafter for classes of concrete.
- E. Admixtures shall conform to ASTM C260 (air entrainment) or C494 (water reduction) and shall be products of one of the following manufacturers, or equal.
  - 1. Dewey and Almy Chemical Div., W. R. Grace and Co.

2. Euclid Chemical Co.
3. Master Builders Co.
4. Sika Chemical Corp.

**2.05 Miscellaneous Materials**

- A. Vapor barrier shall be polyethylene film 0.006 inches thick and shall conform to Product Standard PS-17.
- B. Liquid membrane curing compound shall conform to ASTM C309, Type 1 or Type 2. Type 2 compound shall be used for P.C.C. pavement only. All permanently exposed exterior slabs shall receive clear acrylic curing and sealing compound. Moisture loss shall not be more than 0.055 gr./sq. cm when applied to 200 sq. ft./gal.
- C. Liquid membrane curing compound shall be products of one of the following manufacturers, or equal:
  1. W.R. Meadows "Curettard"
  2. Sonneborn\_Contech "Sonsil"
  3. Burke Co. "Res-Xnu"
  4. Lambert Corp. "Gardseal"
- D. Chemical hardener shall be colorless aqueous solution containing a blend of magnesium fluosilicate and zinc fluosilicate combined with a wetting agent, conforming to Federal Specifications TT-C-800A and Corps of Engineers Specification CE 204.
- E. Chemical hardener shall be products of one of the following manufacturers, or equal:
  1. Euclid Chemical Co. "Surfhard"
  2. Sonneborn-Contech "Lapidolith"
  3. Master Builders "Saniseal"
  4. Lambert Corp. "Solidus"

**2.06 Concrete Mixtures**

- A. Concrete not indicated otherwise shall be Class A concrete.
- B. The proportions of cement, aggregate, and water shall be selected by the Contractor in accordance with ACI 318 to provide a plastic and workable mix. Coarse aggregate shall be limited to prevent harshness and honeycombing. Coarse aggregate size shall not be greater than the maximum listed for the various classes of concrete and as previously specified under aggregate.

- C. Class A structural concrete shall have a 28-day strength of 4000 psi, shall contain not less than 540 pounds (5<sup>3</sup>/<sub>4</sub> bags) of cement per cubic yard of concrete, shall have a water-cement ratio of not more than 0.47 (5<sup>1</sup>/<sub>4</sub> gallons per bag of cement), and shall contain 4 percent to 6 percent entrained air, by volume, except interior slabs subject to abrasion shall not contain more than 3 percent entrained air. In addition, Class A concrete shall contain a water-reducing, densifying admixture and have a maximum slump of 4 inches. The maximum aggregate size for slabs shall be 1 inch.
- D. Class B lean concrete shall have a 28-day strength of 2500 psi, it shall contain not less than 420 pounds (4-1/2 bags) of cement per cubic yard of concrete, shall have a water-cement ratio of not more than 0.71 (8 gallons per bag of cement), and shall have a 5 inch maximum slump. The maximum aggregate size shall be 2 inches.
- E. Water-reducing densifying admixture added to Class A concrete shall reduce the water-cement ratio while maintaining slump and compressive strength. Use as manufacturer recommends.
- F. Other admixtures may be proposed by the Contractor or requested by the Engineer and shall be provided at no additional cost to the Owner. Subject to approval, admixtures may be used for the following:
  - 1. To increase slump up to 50 percent while maintaining compressive strength and water-cement ratio.
  - 2. To retard set during hot weather
- G. Calcium chloride, admixtures containing calcium chloride, or admixtures not approved, in writing by the Engineer, are prohibited.

### **PART 3 EXECUTION**

#### **3.01 General**

- A. Comply with ACI 305 or 306 for hot or cold weather concreting.
- B. Do not mix salt, chemicals, or other foreign materials with the concrete to prevent freezing without approval of the Engineer. Maintain the temperature of concrete above 50 degrees F for 5 days after placement. When high early strength Portland cement concrete is used, the temperature shall not be less than 70 degrees F for 2 days or 50 degrees F for 3 days.
- C. In no case shall the temperature of concrete exceed 90 degrees F at the time of placement.

**3.02 Preparation**

- A. Remove existing concrete and provide openings for installation of new work as indicated on Drawings. Repair all damage to existing work caused by concrete removal.
- B. Coordinate with other trades and properly place and locate in position all necessary dowels, bolts, anchors, anchor slots, inserts, sleeves, openings, hangers, metal ties and other fastening devices required for attachment and support of adjacent work. Securely anchor all embedded items.
- C. The subgrade and/or bedding shall be compacted and free of frost. If placement is allowed at temperatures below freezing, provide temporary heat and protection as required to remove all frost. Saturate the subgrade approximately 8 hours before placement and sprinkle ahead of the placement of concrete in areas where vapor barrier is not used. Remove all standing water, ice, mud, and foreign matter before concrete is deposited.
- D. On porous subgrade or beddings, or where indicated on the Drawings, provide vapor barrier. Lay vapor barrier sheets with 6 inch edge laps and tape or seal with mastic. Stretch and weight edges and laps to maintain their positions until concrete is placed. Coordinate with placement of reinforcement.

**3.03 Formwork Requirements**

- A. Formwork shall comply with ACI 347 and to shape, lines and dimensions as indicated on the Drawings. Forms shall be properly braced or tied to maintain position and shape under all dead and live loads and to prevent leakage. Forms shall be assembled so their removal will not damage the concrete. Tolerances for formed surfaces shall be in compliance with ACI 301.
- B. Lumber formwork may be used for surfaces which will not be exposed to view. Use plywood or metal forms for exposed surfaces.
- C. The inside surface of lumber forms shall be soaked with clean water prior to placing concrete. All other forms shall be treated with an approved form oil or lacquer. If oil is used, all excess oil shall be wiped off.

**3.04 Reinforcement**

- A. The placement of reinforcing steel shall conform to "Placing Reinforcing Bars", as published by the Concrete Reinforcing Steel Institute except as noted.
- B. Provide continuous reinforcement or dowels through construction joints. One half of reinforcement shall be discontinued across control joints unless otherwise indicated. All reinforcement shall be discontinued across expansion joints.

- C. Splice laps shall be as indicated on the Drawings.
- D. Fabric reinforcement for slabs shall be overlapped at splices not less than the spacing of the cross wires plus 2 inches. Fabric shall extend to within 4 inches of concrete edges.
- E. Unless otherwise shown, place reinforcement 2 to 3 inches below the top of the finished slab. Mesh shall either be sandwiched between two layers of fresh concrete or supported on mesh supports. Supports that may puncture the vapor barrier, if any, shall not be used.

**3.05 Joints**

- A. Provide construction joints with shear transfer keyways as indicated.
- B. Tops of edge forms and screeds shall be set to the finished elevations and to provide uniform pitch to drains as indicated on Drawings.
- C. For drives, pavements, parking areas, walks and slabs on grade, provide preformed non-extruding asphalt strip or bituminous fiber joint filler set 1/8 inch below finished surface unless otherwise indicated. Tool concrete edges on each side of joint. No sealant is required.

**3.06 Batching**

- A. Materials for concrete shall be proportioned and batched according to the approved design mix.
- B. Water shall be measured to within 1 pint of the total amount required per batch. Admixtures shall be measured by weight or volume to an accuracy of 3 percent.

**3.07 Mixing and Transporting Concrete**

- A. Concrete shall be ready-mixed or job-mixed at the Contractor's option. Ready-mixed concrete shall be mixed and delivered to the project in accordance with ASTM C94. Job-mixed concrete shall be in accordance with the requirements of ACI 318.
- B. Concrete shall be in its final position within one hour after the water and aggregate have been added to the cement, except in cool weather (50 degrees F or less).
- C. Concrete shall be transported from the mixer to place of final deposit in such manner to prevent separation or loss of ingredients.

**3.08 General Concrete Placement Schedule**

- A. All structural concrete shall be Class A Concrete.
- B. Sidewalks shall be Class B Concrete.

**3.09 Depositing Concrete**

- A. Concrete shall be placed in accordance with the requirements of ACI 318 and within 10 feet of its final position. Place concrete only during normal working hours unless the Engineer is notified at least 24 hours in advance. Concrete shall not be placed until the Engineer has approved the formwork, reinforcement, and embedded items and debris has been removed.
- B. Whenever new concrete is to be placed against existing surfaces, roughen and clean the surface to improve bond.
- C. Provide runways and chutes to discharge concrete close to final position to minimize spreading and segregation.
- D. Place slabs-on-grade using formed construction joints. Maximum size of pour shall be 40 feet each way for slabs with wire mesh reinforcement and 75 feet each way for slabs with bar reinforcement. Allow 24 hours between pours of adjacent slabs. Provide joints as specified or shown. Set continuous joint strips between slabs and abutting vertical surfaces as indicated on the Drawings.

**3.10 Finishing Slabs and Flatwork**

- A. Unless otherwise indicated, provide the following slab finishes:

<b>Description</b>	<b>Concrete Finish</b>
Class B concrete surfaces	Float
Submerged slabs	1 Troweling
Exposed slabs	3 Trowelings
Ramps and walks	Float and broom finish

- B. Concrete shall be within ¼ inch of a 10 foot straightedge in all directions except where slabs are dished for drains. Deviations from the elevation indicated shall not exceed ¼ inch.
- C. Slabs sloped for drainage shall not have depressions that retain water.
- D. Immediately after placement, screed concrete with straightedges or power strikeoffs. Do not use roller screeds or vibrating screeds.

- E. Stakes for wet screeds shall be driven down flush with subgrade or pulled out as work progresses to avoid disturbing screeded concrete.
- F. For drains in level slabs, form a 5 foot diameter depression approximately ½ inch below the adjacent slab surface.
- G. Unless otherwise indicated on the Drawings, slabs sloped for drainage shall be uniformly pitched toward the drains at 1/8 inch per foot. Form a dished depression at drains unless otherwise indicated.
- H. Immediately after screeding, darby surface with wood or magnesium darby to eliminate ridges and to fill in voids left by screeding.

### **3.11 Float Finish**

- A. Float concrete using magnesium or aluminum hand floats or power floats after the concrete has stiffened to a point where only a ¼ inch indentation can be imparted by normal foot pressure.
- B. Float finish shall result in a uniform, smooth, granular texture. After floating, check slab tolerances with 10-foot straightedge. Fill low spots with fresh concrete; do not sprinkle with dry cement.

### **3.12 Trowel Finish**

- A. Where scheduled, or indicated, trowel with steel trowels after floating.
- B. Initial troweling shall be done either by power or by hand with the trowel blade kept as flat as possible against concrete surface to prevent washboard or chatter effect.
- C. Second troweling may be done by power if three trowelings are scheduled. If two trowelings are specified, second troweling shall be done by hand.
- D. Third troweling shall be done by hand and shall continue until the concrete is consolidated to a uniform, smooth, dense surface free of trowel marks and irregularities.
- E. Allow sufficient time between successive trowelings to allow the concrete to become harder. Each successive troweling shall be done with trowels that are progressively smaller and are tipped more to increase compaction of the concrete surface.

**3.13 Brooming**

Broom at right angles to direction of traffic to give a non-skid finish. Use a fine, soft-bristled broom for pedestrian ramps and walks, and a coarse, hard-bristled broom for vehicular pavement.

**3.14 Control Joints**

- A. Control joints for non-structural slabs shall consist of partial depth plastic strips set flush with finished surface or 1/8 inch wide joints cut with a diamond saw. Control joints shall be one-quarter to one-third the depth of the slab unless otherwise indicated.
- B. Saw joints as soon as concrete has hardened sufficiently so aggregate will not be dislodged but before shrinkage stresses develop cracks. Sawn joints shall be filled with approved joint sealant.
- C. Unless otherwise indicated on the Drawings, spacing of control joints shall not exceed 25 feet in each direction.

**3.15 Protection and Curing**

- A. Comply with ACI 305 and 306 for protecting and curing concrete in hot and cold weather. Fresh concrete shall be protected from rain, premature drying and excessively hot or cold temperatures, and shall be maintained with minimal moisture loss for the period of time necessary for the hydration of the cement and proper hardening of the concrete. Cure all concrete for a minimum period of 7 days (3 days for high early strength concrete) after placing.
- B. Immediately after finishing, begin curing by covering with constantly saturated moisture retaining fabrics, impervious sheeting, or membrane curing compounds. Surfaces shall be thoroughly wetted with a fine spray before they are covered with sheeting.
- C. Sheeting shall provide complete surface coverage with all joints lapped at least 4 inches and shall be placed and secured in a manner that will not mar or damage the concrete surface.
- D. Apply membrane-curing compound in accordance with manufacturer's recommendations. Apply by spraying in a two coat continuous operation. Apply the coats at right angles to each other with a coverage of 200 square feet per gallon per coat. Begin application not later than 4 hours after finishing of the surface. The application shall result in an uninterrupted adherent film free of defects.

- E. On surfaces scheduled to receive sealants, paint, seamless flooring, or other adhesive bonded finishes, either the membrane curing compound shall be compatible with the bonding agent or the curing compound shall be removed with sandblasting, acid etching or grinding, to the satisfaction of the installer of the finish surfacing. Bonded surfaces that fail to adhere to the concrete shall be removed and replaced at no additional cost to the Owner.
- F. Apply hardener to floors of mechanical and electrical rooms and in other areas as required. Application shall be in strict accordance with the manufacturer's recommendations and as follows:
  - 1. Hardener shall be applied at original container consistency without dilution to dry, clean surfaces no sooner than 30 days following completion of curing. NOTE: Hardener shall not be applied over surfaces covered with membrane curing agent.
  - 2. Application shall generally be a three-coat process adjusted to accommodate extreme concrete densities only if prior review has been obtained from the Engineer. Application coverage shall be made at the approximate rate of one gallon to 100 square feet.
  - 3. Apply first and second coats generously to surface, mop or squeegee standing water to leave a uniformly wet surface, allow to dry. Apply third coat in a manner similar to first two, except that surplus must be scrubbed with stiff bristled broom and flushed from floor surface with clear water. Scrubbing and flushing shall remove all traces of effervescence. Remove excess water and allow to dry.

### **3.16 Defective Concrete**

- A. All concrete not formed as indicated on the Drawings within tolerances specified in ACI 347 shall be removed and replaced.
- B. Temperature and shrinkage cracks which develop prior to final acceptance of the work shall be repaired.

### **3.17 Miscellaneous Concrete Work**

Provide concrete equipment pads and supports as indicated and conforming to approved shop drawings. Fastening devices and accessories shall be located by templates or setting diagrams furnished by the manufacturer.

### **3.18 Clean-Up**

- A. All concrete floor construction shall have the surfaces thoroughly scrubbed and cleaned with clear water. After cleaning, the floors shall be protected until they are accepted.

- B. Clean all surfaces affected by the Concrete Work. No extraneous concrete or discoloration shall be left on any construction.

**3.19 Concrete Testing**

- A. Compressive Strength Tests: Conform to ASTM C31 and ASTM C39. One set of four cylinders for each 50 cubic yards or fraction thereof, of each strength concrete placed in any one day. Test one specimens at seven days; test two specimens at 28 days. One specimen shall be retained for 56 days and tested only at the direction of the Engineer.
- B. Slump Tests: Conform to ASTM C143. Perform one test for each load point of discharge and one for each set of compressive strength test specimens.

**END OF SECTION**