

SECTION 03 30 00 - CAST-IN-PLACE CONCRETE**PART 1 - GENERAL****1.1 SUMMARY**

- A. Section Includes Cast-in-Place Concrete for Following Items:
1. Building frame members.
 2. Beams, lintels, and columns.
 3. Retaining walls.
 4. Foundation walls.
 5. Footings.
 6. Supported slabs.
 7. Slabs on grade.
 8. Control, expansion, and contraction joint devices.
 9. Equipment pads.
 10. Thrust blocks.
 11. Equipment foundations.
- B. Related Requirements:
1. Section 03 10 00 - Concrete Forming and Accessories: Formwork and accessories, Placement of joint devices in formwork, Placement of joint device anchors in formwork.
 2. Section 03 20 00 - Concrete Reinforcing: Requirements for reinforcing steel and supports.
 3. Section 03 35 00 - Concrete Finishing: Finishing of concrete floor surfaces.
 4. Section 03 39 00 - Concrete Curing: Curing of concrete floor surfaces.
 5. Section 07 90 00 - Joint Protection: Requirements for sealants and primers.

1.2 REFERENCE STANDARDS

- A. American Concrete Institute:
1. ACI 301 - Specifications for Structural Concrete.
 2. ACI 305R - Guide to Hot Weather Concreting.
 3. ACI 306.1 - Standard Specification for Cold Weather Concreting.
 4. ACI 308.1 - Specification for Curing Concrete.
 5. ACI 318 - Building Code Requirements for Structural Concrete.
 6. ACI 350 – Code Requirements for Environmental Engineering Concrete Structures
- B. ASTM International:
1. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
 2. ASTM C31 - Standard Practice for Making and Curing Concrete Test Specimens in the Field.
 3. ASTM C33 - Standard Specification for Concrete Aggregates.

4. ASTM C39 - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
5. ASTM C94 - Standard Specification for Ready-Mixed Concrete.
6. ASTM C143 - Standard Test Method for Slump of Hydraulic-Cement Concrete.
7. ASTM C150 - Standard Specification for Portland Cement.
8. ASTM C172 - Standard Practice for Sampling Freshly Mixed Concrete.
9. ASTM C231 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
10. ASTM C260 - Standard Specification for Air-Entraining Admixtures for Concrete.
11. ASTM C494 - Standard Specification for Chemical Admixtures for Concrete.
12. ASTM C618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.
13. ASTM C685 - Standard Specification for Concrete Made by Volumetric Batching and Continuous Mixing.
14. ASTM C845 - Standard Specification for Expansive Hydraulic Cement.
15. ASTM C989 - Standard Specification for Slag Cement for Use in Concrete and Mortars.
16. ASTM C1017 - Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete.
17. ASTM C1064 - Standard Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete.
18. ASTM C1107 - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink).
19. ASTM C1157 - Standard Performance Specification for Hydraulic Cement.
20. ASTM C1240 - Standard Specification for Silica Fume Used in Cementitious Mixtures.
21. ASTM D994 - Standard Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type).
22. ASTM D1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
23. ASTM D1752 - Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction.
24. ASTM E96 - Standard Test Methods for Water Vapor Transmission of Materials.
25. ASTM E1643 - Standard Practice for Selection, Design, Installation, and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs.
26. ASTM E1745 - Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs.

1.3 COORDINATION

- A. Section 01 31 13 – Project Coordination: Requirements for coordination.
- B. Coordinate placement of joint devices with erection of concrete formwork and placement of form accessories.

- C. Concrete testing – Contractor is responsible for testing and coordination with and providing adequate notice for the testing agency to schedule personnel and equipment to conduct the required tests. Contractor will provide site access for the testing agency and is responsible for providing adequate notice of cancelation or postponement of a pour. Any expenses incurred by the testing agency caused by inadequate notice of changes in schedule are the responsibility of the Contractor.
- D. Pre-Concrete Placement Conference – The Engineer may (at his discretion) require the Contractor, the Concrete Supplier, the Testing Agency, other Contractors with work affected by the concrete pour, and any other party involved with the placement to participate in a job conference to discuss items, procedures, scheduling, etc. related to the concrete placement.

1.4 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Product Data: Submit data on joint devices, attachment accessories, admixtures.
- C. Design Data:
 - 1. Submit concrete mix design for each concrete strength.
 - 2. Submit separate mix designs if admixtures are required for following:
 - a. Hot and cold weather concrete Work.
 - b. Air entrained concrete Work.
 - 3. Identify mix ingredients and proportions, including admixtures.
 - 4. Identify chloride content of admixtures and whether or not chlorides were added during manufacture.
- D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- E. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

1.5 CLOSEOUT SUBMITTALS

- A. Section 01 77 00 – Closeout Procedures: Requirements for submittals.
- B. Project Record Documents: Record actual locations of embedded utilities and components concealed from view in finished construction.

1.6 QUALITY ASSURANCE

- A. Perform Work according to ACI 301.
- B. Comply with ACI 305R when pouring concrete during hot weather.
- C. Comply with ACI 306.1 when pouring concrete during cold weather.

- D. Acquire cement and aggregate from one source for Work.

1.7 AMBIENT CONDITIONS

- A. Section 01 50 00 - Temporary Facilities and Controls: Requirements for ambient condition control facilities for product storage and installation.
- B. Maintain concrete temperature after installation at minimum 50 degrees F for minimum seven days.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Concrete:
 - 1. Cement:
 - a. Comply with ASTM C150, Type II - Moderate Sulfate Resistant.
 - b. Type: Portland.
 - 2. Normal Weight Aggregates:
 - a. Comply with ASTM C33.
 - b. Coarse Aggregate Maximum Size: 1 inches.
 - 3. Water:
 - a. Comply with ACI 318.
 - b. Potable, without deleterious amounts of chloride ions.
- B. Admixtures:
 - 1. Manufacturers:
 - a. BASF Corporation
 - b. Euclid Chemical Company
 - c. Substitutions: As specified in Section 01 61 00 - Product Requirements.
 - 2. Air Entrainment: Comply with ASTM C260.
 - 3. Chemical:
 - a. Comply with ASTM C494.
 - b. Type A - Water Reducing.
 - c. Type B - Retarding.
 - d. Type D - Water Reducing and Retarding.
 - e. Type E - Water Reducing and Accelerating.
 - f. Type F - Water Reducing, High Range.
 - g. Type G - Water Reducing, High Range, and Retarding.
 - 4. Fly Ash: Comply with ASTM C618, Class F.
 - 5. Silica Fume: Comply with ASTM C1240.
 - 6. Slag:
 - a. Description: Ground-granulated blast-furnace slag.
 - b. Comply with ASTM C989.
 - c. Grade 120.
 - 7. Plasticizing:

- a. Comply with ASTM C1017.
 - b. Type II, plasticizing and retarding.
 8. Waterproofing – Waterproofing admixture shall be “ADMIX C-1000” manufactured by Xypex Chemical Corporation, Richmond, B.C., Canada – no substitutes.
- C. Joint Devices and Filler:
1. Construction Joint Devices:
 - a. Material: Integral extruded plastic.
 - b. Profile: Tongue-and-groove with removable top strip exposing sealant trough and knockout holes spaced at 6 inches o.c.
 - c. Furnish ribbed steel spikes with tongue to fit top screed edge.

2.2 CONCRETE MIX

- A. Select proportions for normal weight concrete according to ACI 301, Method 1 or 2.
- B. Performance and Design Criteria for Structural Concrete:
1. Compressive Strength: 4,000 psi
 2. Cement Type: ASTM C150.
 3. Minimum Cement Content: 560 lb./cu. yd.
 4. Aggregate Type: Normal weight.
 5. Maximum Water-Cement Ratio: 0.45 by weight
 6. Aggregate Size:
 - a. Maximum: one inch
 - b. Minimum: comply with ASTM C33
 7. Air Content: 6 percent, plus or minus 1.5 percent.
 8. Maximum Fly Ash Content: 20 percent of cementitious materials by weight.
 9. Maximum Slag Content: 30 percent of cementitious materials by weight.
 10. Slump: 4 inches, plus or minus 1 inch
- C. Performance and Design Criteria for Lean Concrete:
1. Compressive Strength: 2,500 psi
 2. Cement Type: ASTM C150.
 3. Minimum Cement Content: 395 lb./cu. yd.
 4. Aggregate Type: Normal weight.
 5. Maximum Water-Cement Ratio: 0.66 by weight
 6. Aggregate Size:
 - a. Maximum: one inch
 - b. Minimum: comply with ASTM C33
 7. Air Content: not required.
 8. Maximum Fly Ash Content: 20 percent of cementitious materials by weight.
 9. Maximum Slag Content: 30 percent of cementitious materials by weight.
 10. Slump: 8 inches, plus or minus 1 inch
- D. Admixtures:
1. Include admixture types and quantities indicated in concrete mix designs only if approved by Engineer.

2. Cold Weather:
 - a. Use accelerating admixtures in cold weather.
 - b. Use of admixtures will not relax cold-weather placement requirements.
 3. Hot Weather: Use set-retarding admixtures.
 4. Do not use calcium chloride or admixtures containing calcium chloride.
 5. Add air entrainment admixture to concrete mix for Work exposed to freezing and thawing or deicing chemicals.
 6. For concrete exposed to deicing chemicals, limit fly ash, pozzolans, silica fumes, and slag content as required by applicable code.
- E. Average Compressive Strength Reduction: Not permitted.
- F. Ready-Mixed Concrete: Mix and deliver concrete according to ASTM C94.

2.3 ACCESSORIES

- A. Vapor Retarder:
1. Description: Fabric-reinforced plastic film.
 2. Comply with ASTM E1745, Class A.
 3. Thickness: 6 mils.
 4. Type: As recommended for below-grade application.
 5. Joint Tape: As recommended by manufacturer.
- B. Non-shrink Grout:
1. Manufacturers:
 - a. Sika.
 - b. Substitutions: As specified in Section 01 60 00 - Product Requirement.
 2. Acceptable products:
 - a. SikaGrout 212, or equal.
 - b. SikaGrout 328 or equal.
- C. Bonding agent: Polyvinyl Acetate.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Section 01 73 00 - Execution Requirements: Requirements for installation examination.
- B. Verify requirements for concrete cover over reinforcement.
- C. Verify that anchors, seats, plates, reinforcement, and other items to be cast into concrete are accurately placed, positioned securely, and will not interfere with placing concrete.

3.2 PREPARATION

- A. Section 01 73 00 - Execution Requirements: Requirements for installation preparation.
- B. Previously Placed Concrete:
 - 1. Prepare previously placed concrete by cleaning with steel brush and applying bonding agent.
 - 2. Remove laitance, coatings, and unsound materials.
- C. In locations where new concrete is doweled to existing work, drill holes in existing concrete, insert steel dowels, and pack solid with non-shrink grout.
- D. Remove debris and ice from formwork, reinforcement, and concrete substrates.

3.3 INSTALLATION

- A. Placing Concrete:
 - 1. Place concrete according to ACI 301.
 - 2. Notify testing laboratory and Engineer minimum 24 hours prior to commencement of operations.
 - 3. Ensure that reinforcement, inserts, embedded parts, formed expansion and contraction joints, and pipe sleeves are not disturbed during concrete placement.
 - 4. Where indicated on Drawings, install vapor retarder under interior slabs on grade according to ASTM E1643.
 - 5. Lap joints minimum 6 inches and seal watertight by taping edges and ends.
 - 6. Repairs:
 - a. Repair vapor retarder damaged during placement of concrete reinforcement.
 - b. Using vapor retarder material, lap over damaged areas minimum 6 inches and seal watertight.
 - 7. Joint Filler:
 - a. Separate slabs on grade from vertical surfaces with 1/4-inch-thick joint filler.
 - b. Place joint filler in floor slab pattern placement sequence as shown on drawings; set top to required elevations; secure to resist movement by wet concrete.
 - c. Extend joint filler from bottom of slab to within 1/2 inch of finished slab surface.
 - d. Finish Joint Sealer Requirements: As specified in Section 079000 - Joint Protection.
 - 8. Joint Devices (Alternate is to saw cut control joints):
 - a. Coordination: Install construction joint devices in coordination with floor slab pattern placement sequence as shown on drawings; set top to required elevations; secure to resist movement by wet concrete.
 - b. Install joint device anchors, maintaining correct position to allow joint cover to be flush with floor finish.
 - c. Install joint covers in longest practical length when adjacent construction activity is complete.

- d. Apply sealants in joint devices as specified in Section 07 90 00 - Joint Protection.
 9. Deposit concrete at final position, preventing segregation of mix.
 10. Place concrete in continuous operation for each panel or section as determined by predetermined joints.
 11. Consolidate concrete.
 12. Maintain records of concrete placement, including date, location, quantity, air temperature, and test samples taken.
 13. Place concrete continuously between predetermined expansion, control, and construction joints.
 14. Do not interrupt successive placement and do not permit cold joints to occur.
 15. Saw-Cut Joints:
 - a. Saw-cut joints within 12 hours after placing.
 - b. Use 3/16 inch thick blade.
 - c. Cut into 1/4 depth of slab thickness.
 16. Screeding:
 - a. Screed floors and slabs on grade level.
 - b. Surface Flatness: maximum 1/4 inch in 10 feet.
- B. Separate Slab Toppings:
1. Prior to placing floor topping, remove deleterious material and broom and vacuum clean.
 2. Place required dividers, edge strips, reinforcement, post tensioning and other items to be cast in concrete.
 3. Apply bonding agent to substrate.
- C. Concrete Finishing:
1. Provide formed concrete surfaces to be left exposed with sack-rubbed finish.
 2. Finish concrete floor surfaces as specified in Section 033500 - Concrete Finishing.
- D. Curing and Protection:
1. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.
 2. Protect concrete footings from freezing for minimum of five days.
 3. Maintain concrete with minimal moisture loss at relatively constant temperature for period as necessary for hydration of cement and hardening of concrete.
 4. Cure concrete floor surfaces as specified in Section 033900 - Concrete Curing.

3.4 FIELD QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements: Requirements for inspecting and testing.
- B. Inspection and Testing: Performed by approved (by Engineer) testing laboratory according to ACI 318.
- C. Provide unrestricted access to Work and cooperate with appointed testing and inspection firm.

- D. Submit proposed mix design of each class of concrete to inspection and testing firm for review prior to commencement of Work.
- E. Concrete Inspections:
 - 1. Continuous Placement Inspection: Inspect for proper installation procedures.
 - 2. Periodic Curing Inspection: Inspect for specified curing temperature and procedures.
- F. Strength Test Samples:
 - 1. Sampling Procedures: Comply with ASTM C172.
 - 2. Cylinder Molding and Curing Procedures:
 - a. Comply with ASTM C31.
 - b. Cylinder Specimens: Field cured.
 - 3. Sample concrete and make one set of six cylinders for every 75 cu. yd. or less of each class of concrete placed each day, and for every 5,000 sq. ft. of surface area for slabs and walls.
 - 4. If volume of concrete for a class of concrete would provide less than five sets of cylinders, take samples from five randomly selected batches, or from every batch if less than five batches are used.
 - 5. Make one additional cylinder during cold weather concreting and field cure.
- G. Field Testing:
 - 1. Slump Test Method: Comply with ASTM C143.
 - 2. Air Content Test Method: Comply with ASTM C231.
 - 3. Temperature Test Method: Comply with ASTM C1064.
 - 4. Compressive Strength Concrete:
 - a. Measure slump and temperature for each sample.
 - b. Measure air content in air-entrained concrete for each sample.
- H. Cylinder Compressive Strength Testing:
 - 1. Test Method: Comply with ASTM C39.
 - 2. Test Acceptance: According to ACI 318.
 - 3. Test two cylinder at seven days.
 - 4. Test two cylinder at 28 days.
 - 5. Retain two cylinder for 56 days for testing when requested by Engineer.
 - 6. Dispose of remaining cylinders if testing is not required.
- I. Patching:
 - 1. Allow Engineer to inspect concrete surfaces immediately upon removal of forms.
 - 2. Honeycombing or Embedded Debris in Concrete:
 - a. Not acceptable.
 - b. Notify Engineer upon discovery.
 - 3. Patch imperfections as directed by Engineer.
- J. Defective Concrete:
 - 1. Description: Concrete not conforming to required lines, details, dimensions, tolerances, or specified requirements.
 - 2. Repair or replacement of defective concrete will be determined by Engineer.

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

END OF SECTION 03 30 00