

SECTION 03 30 53

MISCELLANEOUS CAST IN PLACE CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

- A. Section: Cast in place concrete, including reinforcement, concrete materials, mixture design, placement procedures, and finishes.

1.2 ACTION SUBMITTALS

- A. Product Data: Submit technical data including construction details, material descriptions, dimensions of individual components and profiles.
- B. Delegated Design Mixture Submittal: Submit design mixture for each class of concrete to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.3 QUALITY ASSURANCE

- A. Regulatory Requirements:
 - 1. Comply with ACI 301.
 - 2. Comply with ACI 117 Specifications for Tolerances for Concrete Construction and Materials.
- B. Ready Mix Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.
- C. Professional Engineer Qualifications: A professional engineer legally qualified to practice in jurisdiction is located and who has minimum 10 years documented experienced in determining concrete design mix. Engineering services are defined as those performed for installations of metal fabrications that are similar to those indicated in material, design, and extent.
- D. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from single source, and obtain admixtures from single source from single manufacturer.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Concrete: Comply with applicable sections of ACI 301 (ACI 301M) unless modified by requirements in the Contract Documents.
 - 1. Comply with ACI 117 (ACI 117M).
- B. Formwork: Furnish formwork and formwork accessories in accordance with ACI 301.
- C. Steel Reinforcement:
 - 1. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), deformed.
 - 2. Plain Steel Wire: ASTM A 1064/A 1064M, as drawn.
 - 3. Plain Steel Welded Wire Reinforcement: ASTM A 1064/A 1064M, plain, fabricated from as drawn steel wire into flat sheets.
 - 4. Deformed Steel Welded Wire Reinforcement: ASTM A 1064/A 1064M, flat sheet.
- D. Cementitious Materials:
 - 1. Portland Cement: ASTM C 150/C 150M, Type I or Type III.
 - 2. Fly Ash: ASTM C 618, Class C or F.
 - 3. Slag Cement: ASTM C 989/C 989M, Grade 100 or 120 without Type 1L Cement properties.
 - a. Type 1L Cement shall not be permitted in any capacity or percentage.
- E. Normal Weight Aggregate: ASTM C 33/C 33M, 1-1/2 inch (38 mm) nominal maximum aggregate size.
- F. Lightweight Aggregate: ASTM C 330/C 330M, 1 inch (25 mm) nominal maximum aggregate size.
- G. Air Entraining Admixture: ASTM C 260/C 260M.
- H. Chemical Admixtures: Certified by manufacturer as compatible with other admixtures and that do 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.
- I. Water: ASTM C 94/C 94M.

2.2 RELATED MATERIALS

- A. Vapor Retarder: Refer to Section 07 26 00 Vapor Retarders.
- B. Joint Filler Strips: ASTM D 1751, asphalt saturated cellulosic fiber, or ASTM D 1752, cork or self expanding cork.

2.3 CURING MATERIALS

- A. Evaporation Retarder: Waterborne, monomolecular film forming; manufactured for application to fresh concrete.
- B. Absorptive Cover: AASHTO M 182, Class 3, burlap cloth or cotton mats.
- C. Moisture Retaining Cover: ASTM C 171, polyethylene film or white burlap polyethylene sheet.
- D. Water: Potable.
- E. Clear, Waterborne, Membrane Forming Curing Compound: Refer to Section 03 39 00 Concrete Sealer.

2.4 CONCRETE MIXTURES

- A. Comply with ACI 301 (ACI 301M).
- B. Normal Weight Concrete:
 - 1. Minimum Compressive Strength: 4000 psi (27.6 MPa) at 28 days.
 - 2. Maximum W/C Ratio: 0.45.
 - 3. Cementitious Materials: Use fly ash, pozzolan, slag cement, and silica fume as needed to reduce the total amount of Portland cement, which would otherwise be used, by not less than 40 percent.
 - a. Type 1L Cement shall not be permitted in any capacity or percentage.
 - 4. Slump Limit: 5 inches (125 mm), plus or minus 1 inch (25 mm).
 - 5. Air Content: Maintain within range permitted by ACI 301 (ACI 301M). Do not allow air content of trowel finished floor slabs to exceed 3 percent.
- C. Structural Lightweight Concrete Mix: ASTM C 330/C 330M, proportioned to produce concrete with a minimum compressive strength of 3000 psi (20.7 MPa) at 28 days and a calculated equilibrium unit weight of 110 lb/cu. ft. (1762 kg/cu. m) plus or minus 3 lb/cu. ft. (48.1 kg/cu. m), as determined by ASTM C 567/C 567M. Concrete slump at point of placement shall be the minimum necessary for efficient mixing, placing, and finishing.
 - 1. Limit slump to 5 inches (125 mm) for troweled slabs and 4 inches (100 mm) for other slabs.

2.5 DESIGN MIX

- A. Comply with applicable requirements of ACI 301 requirements for concrete mixtures.

1. Prepare design mixes for each type and strength of concrete determined by either laboratory trial mix or field test data bases:
 - a. Proportion normal weight concrete according to ACI 211.1 and ACI 301.
- B. Use qualified independent testing agency for preparing and reporting proposed mix designs for laboratory trial mix basis.
 1. Design Mix Engineer: Design Mix Engineer shall stamp and seal mix designs and make determinations regarding maximum slump, additives, and water added to mix at the site.
- C. Concrete Properties: Proportion normal weight concrete mix.
 1. Compressive Strength (28 Days): Indicated on structural drawings.
 2. Maximum Slump: Determined by Design Mix Engineer.
 3. Maximum Slump for Concrete Containing High Range Water Reducing Admixture: Determined by Design Mix Engineer.
 4. Maximum Water/Cementitious Materials Ratio: 0.45 for concrete subject to severe or very severe exposure.
- D. Air Content: If permitted by Design Mix Engineer, add air entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having an air content of 2 to 4 percent, unless otherwise indicated.
 1. Do not air entrain concrete to trowel finished interior floors. Do not allow entrapped air content to exceed 3 percent.
- E. Limit water soluble, chloride ion content in hardened concrete to 0.15 percent by weight of cement.
- F. Admixtures: When permitted by Design Mix Engineer, use admixtures according to manufacturer's written instructions.
 1. Use water reducing admixture or high range water reducing admixture (superplasticizer) in concrete, as required, for placement and workability.
 2. Use water reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.

2.6 CONCRETE MIXING

- A. Ready Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M and furnish batch ticket information.
 1. When air temperature is above 90 degrees F (32 degrees C), 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/C 94M. Mix concrete materials in appropriate drum type batch machine mixer.
 1. For mixer capacity of 1 cu. yd. (0.76 cu. m) or smaller, continue mixing at least 1-1/2 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. (0.76 cu. m), increase mixing time by 15 seconds for each additional 1 cu. yd. (0.76 cu. m).
3. Provide batch ticket for each batch discharged and used in the work, indicating Project identification name and number, date, mix type, mix time, quantity, and amount of water added. Record approximate location of final deposit in structure.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Formwork: Design, construct, erect, brace, and maintain formwork according to ACI 301 (ACI 301M).
- B. Embedded Items: Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast in place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
- C. Vapor Retarder: Install, protect, and repair vapor retarders according to ASTM E 1643; place sheets in position with longest dimension parallel with direction of pour.
 1. Comply with Section 07 26 00 Vapor Retarders.
- D. Steel Reinforcement: Comply with CRSI Manual of Standard Practice for fabricating, placing, and supporting reinforcement.
 1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.
- E. Joints: Construct joints true to line with faces perpendicular to surface plane of concrete.
 1. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
 2. 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 concrete thickness:
 - a. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch (3.2 mm). 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 1/8 inch (3.2 mm) wide joints into concrete when cutting action does not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.
 3. Isolation Joints in Slabs on Grade: After removing formwork, install joint filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.
 - a. Extend joint filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated.

3.2 CONCRETE PLACEMENT

- A. Comply with ACI 301 (ACI 301M) for placing concrete.
- B. Before test sampling and placing concrete, water may be added at site, subject to limitations of ACI 301 (ACI 301M).
- C. Do not add water to concrete during delivery, at site, or during placement.
- D. Consolidate concrete with mechanical vibrating equipment according to ACI 301 (ACI 301M).
- E. Equipment Bases and Foundations:
 - 1. Coordinate sizes and locations of concrete bases with actual equipment provided.
 - 2. Construct concrete bases 6 inches (150 mm) high unless otherwise indicated; and extend base not less than 6 inches (150 mm) in each direction beyond the maximum dimensions of supported equipment unless otherwise indicated or unless required for seismic anchor support.
 - 3. Minimum Compressive Strength: 4000 psi (27.6 MPa) at 28 days.
 - 4. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18 inch (450 mm) centers around the full perimeter of concrete base.
 - 5. For supported equipment, install epoxy coated anchor bolts that extend through concrete base, and anchor them into structural concrete substrate.
 - 6. Prior to pouring concrete, place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 7. Cast anchor-bolt insert into bases. Install anchor bolts to elevations required for proper attachment to supported equipment.
- F. Tolerance: Comply with ACI 117 Specifications for Tolerances for Concrete Construction and Materials.

3.3 FINISHING FORMED SURFACES

- A. Rough Formed Finish: As cast concrete texture imparted by form facing material with tie holes and defects repaired and patched. Remove fins and other projections exceeding 1/2 inch (13 mm).
 - 1. 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. Remove fins and projections exceeding 1/8 inch (3 mm).
 - 1. Apply to concrete surfaces exposed to public view,.
- C. Rubbed Finish: Apply the following rubbed finish, defined in ACI 301 (ACI 301M), to smooth formed finished as cast concrete where indicated:

1. Smooth rubbed finish.
 2. Grout cleaned finish.
- D. Slip Resistive Broom Finish:
1. Apply to concrete intended for foot traffic. Provide broomed finish perpendicular to the direction of travel.
- E. 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.

3.4 FINISHING UNFORMED SURFACES

- A. 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 bleedwater appears on surface.
1. Do not further disturb surfaces before starting finishing operations.
- C. Scratch Finish: Apply scratch finish to surfaces indicated and surfaces to receive concrete floor topping or mortar setting beds for ceramic or quarry tile, portland cement terrazzo, and other bonded cementitious floor finishes unless otherwise indicated.
- D. 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, fluid applied or direct to deck applied membrane roofing, or sand bed terrazzo.
- E. 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.
- F. 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 thinset methods. Immediately after second troweling, and when concrete is still plastic, slightly scarify surface with a fine broom.
- G. Slip Resistive Broom Finish: Apply a slip resistive 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.

3.5 CONCRETE PROTECTING AND CURING

- A. Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold weather protection and with ACI 305.1 (ACI 305.1M) for hot-weather protection during curing.
- B. Evaporation Retarder: Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h (1 kg/sq. m x h) 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. Curing Methods: Cure formed and unformed concrete for at least seven days by one or a combination of the following methods:
 - 1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
 - a. Water.
 - b. Continuous water fog spray.
 - c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12 inch (300 mm) lap over adjacent absorptive covers.
 - 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 inches (300 mm), and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period, using cover material and waterproof tape.

3.6 MISCELLANEOUS CONCRETE ITEMS

- A. Filling In: Fill in holes and openings left in concrete structures for passage of work by other trades, unless otherwise shown or directed, after work of other trades is in place. Mix, place, and cure concrete to blend with in place construction. Provide other miscellaneous concrete filling shown or required to complete work.
- B. Patching Defective Areas: Repair and patch defective areas with cement mortar immediately after removal of forms, when acceptable to Architect.
 - 1. Cut out honeycomb, rock pockets, voids over 1/4 inch in any dimension, and holes left by tie rods and bolts, down to solid concrete but in no case to a depth of less than 1 inch. Make edges of cuts perpendicular to the concrete surface. Thoroughly clean, dampen with water, and brush coat the area patched with bonding agent. Place patching mortar before bonding compound has dried.
 - 2. For exposed to view surfaces, blend white portland cement and standard portland cement so, when dry, patching mortar will match color surrounding. Provide test areas at inconspicuous location to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.

3. Apply bonding agent and patch areas as required.
- C. Remove form joint marks, rough spots, and defects by grinding or rubbing with carborundum stone until defects are removed and surfaces are free from imperfections to present a dense, smooth, uniform finish.
- D. Equipment Bases: Provide equipment pads and bases indicated at locations on drawings. Set anchor bolts for machines and equipment to templates at correct elevations complying with certified designs or equipment manufacturer's templates.
- E. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.
- F. Steel Pan Stairs: Provide concrete fill for steel pan stair treads, landings, and associated items. Cast in inserts and accessories as shown on Drawings. Screed, tamp, and trowel finish concrete surfaces.
- G. Base Plates: Grout base plates and foundations indicated using specified nonshrink grout. Use nonmetallic grout for exposed conditions.
- H. Perimeter Insulation: Install perimeter insulation at exterior foundation walls shown on drawings. Apply to vertical face of walls with recommended adhesive or otherwise secure in place until backfilling is completed.
- I. Elevator Sills: Install nonshrink grout under elevator sills. Coordinate grouting with installation and alignment of elevator sills.
- J. Connection to Existing Construction: Ensure a clean, straight, viable edge for connection has been provided before placing any concrete. Provide dowels into existing concrete for attachment of new construction. Drill holes 1/4 inch larger than bar diameter, 8 inches deep and grout solid with sealant with aggregate, at on center spacing no greater than 12 inches unless otherwise noted on the Drawings.

3.7 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Tests: Perform according to ACI 301 (ACI 301M).
 1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd. (4 cu. m), but less than 25 cu. yd. (19 cu. m), plus one set for each additional 50 cu. yd. (38 cu. m) or fraction thereof.
 2. Testing Frequency: Obtain at least one composite sample for each 100 cu. yd. (76 cu. m) or fraction thereof of each concrete mixture placed each day.

3.8 REPAIRS

- A. Remove and replace concrete that does not comply with requirements.

END OF SECTION