

SECTION 033000 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section specifies cast-in place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes. Concrete curbs, gutters, and walkways are included.
- B. See Division 2 Section "Earthwork" for drainage fill under slabs-on-grade.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Design Mixtures: For each concrete mixture.
- C. Shop Drawings: For steel reinforcement.
- D. Material certificates.

1.3 QUALITY ASSURANCE

- A. 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. All cement shall be provided by a single domestic manufacturer.
- B. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
  - 1. ACI 301, "Specification for Structural Concrete,"
  - 2. ACI 302.1 R "Guide for Concrete Floor and Slab Construction."
  - 3. ACI 304 "Guide for Measuring, Mixing, Transporting and Placing Concrete."
  - 4. ACI318 "Building Code Requirements for Reinforced Concrete."
  - 5. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."
  - 6. Concrete Reinforcing Steel Institute "Manual of Standard Practice."
  - 7. ASTM E 1155-96 "Standard Test Method for Determining Floor Flatness and Levelness Using the F-Number System."
  - 8. ASTM 154-99 "Standard Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs."
  - 9. ASTM E 1643-98 "Standard Practice for Installation of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under concrete slabs."
- C. Preinstallation Conference: Conduct conference at Project site.

PART 2 - PRODUCTS

2.1 FORM-FACING MATERIALS

- A. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.
- B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.
- C. Curves shall be uniform and free of form marks.
- D. Form Coatings: Use non-staining release agents approved by concrete manufacturer that will not discolor, deface, or impair finish or treatment of concrete.

2.2 STEEL REINFORCEMENT

- A. Reinforcing Bars: ASTM A 615, Grade 60, deformed.
  - 1. Weldable Rebar: ASTM A 706
- B. Plain-Steel Welded Wire Reinforcement: ASTM A 185, plain, fabricated from as-drawn steel wire into flat sheets. Rolled fabric prohibited.
- C. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice."

2.3 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 C or F, not to exceed 20% of cement content by weight. Do not use when ambient air temperatures are expected to be below 35 degrees F during the first 48 hours after placement. Do not use in mix designs where concrete will be exposed to view.
- B. Normal-Weight Aggregates: ASTM C 33.
  - 1. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
- C. Lightweight Aggregate: ASTM C 330.
- D. Water: ASTM C 94/C 94M and potable.
- E. Air-Entraining Admixture: ASTM C 260.

- F. 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.

2.4 VAPOR RETARDERS – See Section 071900 – Vapor Retarder

2.5 CURING MATERIALS

- A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
- B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.
- C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- D. Curing and Sealing Compound shall be two coat type acrylic based, non yellowing and compatible with all floor finishes and adhesives. Do not install in areas to receive quarry tile, ceramic tile or porcelain tile. Use two coat, non-slip type, guaranteed for 5 years against dusting and chalking.
- E. Chemical Hardener: Colorless solution of magnesium fluosilicate, zinc fluosilicate and wetting agent containing not less than 2lb flusilicates per gallon.
1. Acceptable products:
    - a. Sonneborn
    - b. Lapidolith
    - c. Dayton Superior
    - d. Day-Chem Hardener
- F. Water: Potable.

2.6 RELATED MATERIALS

- A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber or ASTM D 1752, cork or self-expanding cork.

## 2.7 CONCRETE MIXTURES

- 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.
- B. Proportion normal-weight concrete mixture as follows:
  - 1. Minimum Compressive Strength: 3000 psi at 28 days.
  - 2. Maximum Water-Cementitious Materials Ratio:
    - a. Subject to freezing and thawing: 0.50.
    - b. Subject to deicers/watertight: 0.45
  - 3. Slump Limits at point of placement:
    - a. Ramps and sloping surfaces: 3" max.
    - b. Reinforced foundation systems: Not less than 1" and not more than 4".
    - c. Slabs and other concrete: 4" max.
  - 4. Air Entrainment: Use air-entraining admixture resulting in concrete with air content at point of placement as follows:
    - a. Concrete exposed to freezing/thawing, deicer chemicals, or hydraulic pressure:
      - 1) 4.5% (moderate exposure); 5.5% (severe exposure) 1-1/2" max. aggregate.
      - 2) 4.5% (moderate exposure); 6.0% (severe exposure) 1" max. aggregate
      - 3) 5.0% (moderate exposure); 6.0% (severe exposure) 3/4" max. aggregate
      - 4) 5.5% (moderate exposure); 7.0% (severe exposure) 1/2" max. aggregate
    - b. Other Concrete: 2% to 4% air.
  - 5. Portland Cement Paving, Sidewalks and Curbs:
    - a. 4,000 p.s.i. at 28 days curing.
    - b. Air Entrainment: 4% to 7%
    - c. Slump: 3"
    - d. Water/Cement Ratio: per article 2.7.B.2 above.

## 2.8 MISCELLANEOUS MATERIALS

- A. Accessible Ramps: Impart color with integrally colored concrete.
  - 1. Red Color (for accessible ramps): Natural or synthetic mineral oxides complying with ASTM C-979 blended at batch plant.
    - a. Acceptable Products:
      - 1) Bayferrox iron oxide pigment by Bayer Corp, color#110 (4 lbs)
      - 2) Davis Colors, Mix-Ready, Color Baja Red #160 (2 lbs)
      - 3) Chromix by L.M. Scofield CO., color C-22 Coral Red.
- B. Precast Concrete shall be minimum 5000 psi 28 day strength. Precast splash blocks to be minimum 4000 psi 28 day strength. All precast to have hot dipped galvanized reinforcing.
- C. Non-slip Aggregate shall be "Alumogrit" aluminum filings.

2.9 FABRICATING REINFORCEMENT

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

2.10 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 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. Design, erect, shore, brace, and maintain formwork according to ACI 301 to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.
- B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117. Install clean, straight, solid surface and true to plane.
- C. Chamfer exterior corners and edges of permanently exposed concrete.
- D. Use earth forms only where earth is dry, stable and hidden from view.

3.2 EMBEDDED ITEMS

- A. 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. Locate items as per approved submittals.

3.3 VAPOR RETARDERS

- A. Plastic Vapor Retarders: Place, protect, and repair vapor retarders according to ASTM E 1643 and manufacturer's written instructions. Refer to Section 07190 – Vapor Retarder for installation instructions.
  - 1. Lap joints minimum 6 inches as per manufacturer's recommendations and seal with manufacturer's recommended tape.
  - 2. Protect from damage and punctures and repair all such damage.

### 3.4 STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.
  - 1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.
  - 2. For slabs on grade use reinforcing support to ensure proper clearance/cover. Do not pull reinforcing through placed concrete.
  - 3. Install materials and spacings per approved submittals, discontinuous and held back from joints as required. Set and secure to required clearances from earth and form work.

### 3.5 JOINTS

- A. General: Construct joints true to line with faces perpendicular to surface plane of concrete. Locate as per approved submittals.
- B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
- C. 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 as follows:
  - 1. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.
- D. 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, sprinkler mains, drain piping, and immovable objects.
- E. Site Concrete: at concrete pavements and curbs, provide contraction joints at 12' o.c. maximum. Joint patterns in pavements and sidewalks shall be generally square. At curbs provide full depth expansion joints at 20'o.c. maximum. At sidewalks, provide weakened plane contraction joints not more than 5'-0" max. and expansion joints at 20 feet o.c. maximum. Tool all edges. Install self-leveling sealant at all isolation/expansion joints.

### 3.6 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed. Protect adjacent finishes and materials from splatters.
- B. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.

1. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301. Contractor shall maintain spare vibrator on site during all placement.
- C. Place concrete in/on properly prepared sub-base or forms. Place concrete slabs directly on water vapor retarder. Provide not less than 6" of prepared granular sub-base between water vapor retarder and ground.
  1. Install water vapor retarder in compliance with ASTM E 1643.
  2. Lap joints 6 in. and seal with manufacturers adhesive or tape.
  3. Seal around all penetrations with manufacturers pipe boot or by wrapping with vapor retarder and taping.
  4. Repair all punctures and cuts using vapor retarder material lapped 6 inches beyond damaged area and taped.
- D. Cold-Weather Placement: Comply with ACI 306.1.
- E. Hot-Weather Placement: Comply with ACI 301.
- F. Do not place concrete on/in frozen sub-base or forms.
- G. Pumping Concrete: Concrete may be placed by pumping if first approved in writing by the Architect/Engineer of record. Pumped concrete shall only be placed in the presence of the Testing/Inspecting Agent.
  1. Equipment: Pumping equipment shall be of the size and design that ensures a continuous flow of concrete at the delivery end without separation of materials. Do not pump concrete through aluminum pipes.
  2. Concrete mix: Shall conform to the project specifications, except that mix may contain chemical admixtures to allow proper pumping. Include the specified high-range or mid-range water reducing admixture in the mix. Unless strictly controlled and anticipated in the development of the design mix, the addition of admixtures at the jobsite shall be prohibited.

### 3.7 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 that exceed specified limits on formed-surface irregularities.
  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 defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
  1. Apply to concrete surfaces exposed to public view, to receive a rubbed finish, or to be covered with a coating or covering material applied directly to concrete.
- C. Rubbed Finish: Apply the following to smooth-formed finished as-cast concrete where indicated:
  1. Smooth-Rubbed Finish: Not later than one day after form removal, moisten concrete surfaces and rub with carborundum brick or another abrasive until

producing a uniform color and texture. Do not apply cement grout other than that created by the rubbing process.

- D. 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.

### 3.8 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: Float slabs with a highway straight edge in lieu of a conventional bull float. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraighening until surface is left with a uniform, smooth, granular texture.
- C. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
  - 1. Apply a trowel finish to surfaces to all interior slabs, including slabs to receive VCT, rubber flooring, entry tiles, carpet, concrete sealer and similar finishes.
- D. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, and ramps, and elsewhere as indicated, perpendicular to traffic. Tool all edges to 1/2" radius unless noted otherwise.
- E. Apply concrete hardener to exposed interior floors and exterior slab at recessed entrance.
- F. Floors to receive resilient flooring shall limit moisture vapor emission to not more than 3 pounds per 1,000 square feet per 24 hours, in compliance with ASTM F-1869.
- G. Provide a floor surface which is true and level and achieves "F Numbers" of  $F_F = 30$  and  $F_L = 20$  minimum overall composite and  $F_F = 20$  and  $F_L = 15$  minimum at any individual section, when tested in accordance with ASTM E 1155. Remove surface irregularities to provide a continuous smooth finish.
- H. Repair or replace broken, defective and stained concrete, and replace non-conforming concrete, all as directed by owner.
- I. Install non-slip aluminum grit to exterior steps and ramps. Apply at 25 pounds per 100 square feet and work evenly into surface.

### 3.9 CONCRETE PROTECTING 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 ACI 301 for hot-weather protection during curing.

- B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. 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. Cure concrete according to ACI 308.1, by one or a combination of the following methods:
  - 1. Moisture Curing: Keep surfaces continuously moist for not less than seven days.
  - 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, 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. 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.
    - a. After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer.
  - 4. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a 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. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

### 3.10 CONCRETE SURFACE REPAIRS

- A. Defective Concrete: Repair and patch defective areas when approved by Architect. Remove and replace concrete that cannot be repaired and patched to Architect's approval. Accomplish immediately after form removal by working in slurry from adjacent concrete to maintain homogenous mix and uniform coloration.

### 3.11 FIELD QUALITY CONTROL

- A. Testing and Inspecting: Employ at the owner's expense, a testing laboratory, acceptable to owner, to perform concrete testing as described in paragraph 1.6 of Section 01400, Testing Laboratory Services. Any variation from Section 01400 must be approved in advance by the Architect.
- B. Testing:
  - 1. All performed by an independent testing laboratory.
  - 2. All (except retests and "false start calls") shall be paid by Owner; Contractor to pay for exceptions. Lab to invoice separately.

3. Architect will obtain proposals for testing services and make a recommendation to the Owner. Owner will approve the services of a testing laboratory and the Architect will contract for the services, within 10 days after Owner's "Notice of Award" to Contractor.
  4. Contractor Duties: Notify Lab prior to concrete placements; give Lab at least 24 hours notice.
  5. Lab Duties: Make cylinders, date, identify placement locations, store for lab pick-up. Retrieve cylinders from site, test, and provide written report to CCSD Project Manager, the A./E, the Contractor, and the concrete supplier. Immediately after testing, notify all parties of any low break, results by FAX transmittal.
  6. Lab Invoicing: Lab to send invoice with required back-up to A/E for endorsement; A/E forwards to Owner with recommendation for payment.
- C. Concrete not conforming to requirements of construction documents or which fails required Quality Assurance testing, including Flatness/Levelness requirements, shall be removed and replaced at owner's discretion.

END OF SECTION 033000