

SECTION 03 30 00

CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This Section specifies material and mixes for concrete.

1.2 RELATED WORK

- A. Materials testing and inspection during construction: Section 01 45 29, TESTING LABORATORY SERVICES.
- B. Concrete curbs and gutters and similar exterior site Work: Section 32 05 23, CEMENT AND CONCRETE FOR EXTERIOR IMPROVEMENTS.

1.3 TOLERANCES

- A. ACI 117.
- B. Slab Finishes: ACI 117, F-number method in accordance with ASTM E1155.

1.4 REGULATORY REQUIREMENTS

- A. ACI SP-66 – ACI Detailing Manual.
- B. ACI 318 – Building Code Requirements for Reinforced Concrete.

1.5 SUSTAINABILITY REQUIREMENTS

- A. Materials in this section may contribute towards Contract compliance with sustainability requirements. See Section 01 81 11, SUSTAINABLE DESIGN REQUIREMENTS, for Project local/regional materials, recycled content, and other sustainability requirements.
- B. Blended Cement: It is the intent of this Specification to reduce CO2 emissions and other environmentally detrimental effects resulting from the production of portland cement by requiring that all concrete mixes, in aggregate, utilize blended cement mixes to displace portland cement typically included in conventional construction. Provide the following submittals:
 - 1. Copies of concrete design mixes for all installed concrete.
 - 2. Copies of typical regional baseline concrete design mixes for all compressive strengths used on the Project.
 - 3. Quantities in cubic yards of each installed concrete mix.
- C. Biobased Material: For products designated by the USDA's BioPreferred® program, provide products that meet or exceed USDA recommendations for biobased content, subject to the products' compliance with performance requirements in this Section. For more information regarding the product

categories covered by the BioPreferred® program, visit
<http://www.biopreferred.gov>.

1.6 REGULATORY REQUIREMENTS FOR RECYCLED CONTENT

- A. Products and Materials with Post-Consumer Content and Recovered Materials Content:
 - 1. Contractor is obligated by Contract to satisfy Federal mandates for procurement of products and materials meeting recommendations for post-consumer content and recovered materials content; the list of designated product categories with recommendations has been compiled by the EPA - refer to <http://www.epa.gov/wastes/conserve/tools/cpg/products/>.
 - 2. Materials or products specified by this Section may be obligated to satisfy this Federal mandate and Comprehensive Procurement Guidelines program.
 - 3. The EPA website also provides tools such as a Product Supplier Directory search engine and product resource guides.
- B. Fulfillment of regulatory requirements does not relieve the Contractor of satisfying sustainability requirements stipulated by Section 01 81 11, SUSTAINABLE DESIGN REQUIREMENTS, as it relates to recycled content; additional product and material selections with recycled content may be required, as determined by Contractor's Sustainability Action Plan.

1.7 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES for all Products specified herein.
- B. Concrete Mix Design.
- C. Shop Drawings:
 - 1. Submit Steel Reinforcement Shop Drawings and Product Data to include all information necessary for fabrication and placement of reinforcement.
 - 2. Indicate grades of reinforcing steel.
 - 3. Clearly indicate the splice length for every size and type of bar used.
 - 4. Indicate the type, size and location of all accessories required for the proper assembly, placement and support of the reinforcement.
 - 5. Provide layout drawings of all pads and formed concrete indicating control and expansion joints.
- D. Manufacturer's Certificates: Air entraining admixture, chemical admixtures, aggregates, curing compounds, expansion joint materials.

1.8 APPLICABLE PUBLICATIONS

- A. Publications listed below form a part of this specification to extent referenced. Publications are referenced in text by the basic designation only. Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified. Use current edition or revision.

- B. American Concrete Institute (ACI):
 - 117 Tolerances for Concrete Construction and Materials and Commentary
 - 305R Guide to Hot Weather Concreting
 - 306R Guide to Cold Weather Concreting
 - SP-66 ACI Detailing Manual
 - 318/318M Building Code Requirements for Structural Concrete and Commentary
 - 347R Guide to Formwork for Concrete

- C. American Society for Testing and Materials (ASTM):
 - A185/A185M Steel Welded Wire Reinforcement, Plain, for Concrete
 - A615/A615M Deformed and Plain Carbon Steel Bars for Concrete Reinforcement
 - A996/A996M Rail Steel and Axle Steel Deformed Bars for Concrete Reinforcement
 - C31/C31M Making and Curing Concrete Test Specimens in the Field
 - C33/C33M Concrete Aggregates
 - C39/C39M Compressive Strength of Cylindrical Concrete Specimens
 - C94/C94M Ready Mixed Concrete
 - C143/C143M Slump of Hydraulic Cement Concrete
 - C150/C150M Portland Cement
 - C171 Sheet Materials for Curing Concrete
 - C172/C172M Sampling Freshly Mixed Concrete
 - C173/C173M Air Content of Freshly Mixed Concrete by the Volumetric Method
 - C192/C192M Making and Curing Concrete Test Specimens in the Laboratory
 - C231/C231M Air Content of Freshly Mixed Concrete by the Pressure Method
 - C260/C260M Air Entraining Admixtures for Concrete
 - C330/C330M Lightweight Aggregates for Structural Concrete
 - C494/C494M Chemical Admixtures for Concrete
 - C618 Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
 - D1751 Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
 - E1155 Determining FF Floor Flatness and FL Floor Levelness Numbers

PART 2 - PRODUCTS

2.1 FORMS

- A. Wood, plywood, metal, or other materials, approved by COR, of grade or type suitable to obtain type of finish specified.

- B. Form releasing agents to be commercial formulations that will not bond with, stain or adversely affect concrete surfaces. Agents must not impair subsequent

treatment of concrete surfaces depending upon bond or adhesion nor impede the wetting of surfaces to be cured with water or curing compounds. If special form liners are to be used, follow the recommendation of the form coating manufacturer. Submit manufacturer's recommendation on method and rate of application of form releasing agents.

2.2 MATERIALS

- A. Portland Cement: ASTM C150, Type I or II.
- B. Fly Ash: ASTM C618, Class C or F including supplementary optional requirements relating to reactive aggregates and alkalis, and loss on ignition (LOI) not to exceed 5 percent.
- C. Coarse Aggregate: ASTM C33, Size 67.
- D. Fine Aggregate: ASTM C33.
- E. Mixing Water: Fresh, clean, and potable.
- F. Air-Entraining Admixture: ASTM C260.
- G. Chemical Admixtures: ASTM C494.
- H. Reinforcing Steel: ASTM A615 or ASTM A996, deformed. See Drawings for grade.
- I. Welded Wire Fabric: ASTM A185.
- J. Expansion Joint Filler: ASTM D1751.
- K. Sheet Materials for Curing Concrete: ASTM C171.
- L. Grout, Non-Shrinking: Premixed ferrous or non-ferrous, mixed and applied in accordance with manufacturer's recommendations. Grout cannot show settlement or vertical drying shrinkage at 3 days or thereafter based on initial measurement made at time of placement. Grout must produce a compressive strength of minimum 2,500 psi at 3 days and minimum 5,000 psi at 28 days.

2.3 CONCRETE MIXES – TYPE C

- A. Design of concrete mixes using materials specified as set forth under Option C of ASTM C94.
- B. Compressive strength at 28 days: Minimum 4,000 psi.
- C. Establish strength of concrete by testing prior to beginning concreting operation. Test consists of average of three cylinders made and cured in accordance with ASTM C192 and tested in accordance with ASTM C39.
- D. Maximum slump for vibrated concrete is 4 inches tested in accordance with ASTM C143.

E. Cement and water factor:

Min. 28 Day Comp. Str. (psi)	Min Cement (lbs/cu yd)	Max Water Cement Ratio
4000 ^{1,2}	570	0.45

1. If trial mixes are used, the proposed mix design must achieve a compressive strength 1200 psi in excess of f'c.
2. For concrete exposed to high sulfate content soils maximum water cement ratio is 0.44.

F. Air-entrainment is required for all exterior concrete and as required for Section 32 05 23, CEMENT AND CONCRETE FOR EXTERIOR IMPROVEMENTS. Air content must conform with ACI 318 Table 4.4.1.

2.4 BATCHING AND MIXING

- A. Store, batch, and mix materials as specified in ASTM C94.
1. Job-Mixed: Mix in a batch mixer in manner specified for stationary mixers in ASTM C94.
 2. Ready-Mixed: Comply with ASTM C94, except use of non-agitating equipment for transporting concrete to the site will not be permitted. With each load of concrete delivered to Project, ready-mixed concrete producer must furnish, in duplicate, certification as required by ASTM C94.

PART 3 - EXECUTION

3.1 FORMWORK

- A. Installation conforms to ACI 347. Sufficiently tight to hold concrete without leakage, sufficiently braced to withstand vibration of concrete, and to carry, without appreciable deflection while remaining within allowable construction tolerances, all dead and live loads to which they may be subjected.
- B. Treating and Wetting: Treat or wet contact forms as follows:
1. Coat plywood and board forms with non-staining form sealer. In hot weather cool forms by wetting with cool water just before concrete is placed.
 2. Clean and coat removable metal forms with light form oil before reinforcement is placed. In hot weather, cool metal forms by thoroughly wetting with water just before placing concrete.
 3. Use sealer on reused plywood forms as specified for new material.
- C. Inserts, sleeves, and similar items: Flashing reglets, masonry ties, anchors, inserts, wires, hangers, sleeves, boxes for floor hinges and other items specified as furnished under this and other sections of Specifications are required to be in their final position at time concrete is placed, properly located, accurately positioned, built into construction, and maintained securely in place.

- D. Construction Tolerances:
1. Set and maintain concrete formwork to assure erection of completed Work within tolerances specified to accommodate installation or other rough and finish materials.
 2. Engage a professional surveyor to survey the formwork prior to concrete being poured. If the forms are not correct, they must be corrected and resurveyed. When correct, provide a written certification from the surveyor to the COR that the forms are set according to the Drawings, within the allowable tolerances for elevation, location, orientation, and dimensions called for on the Drawings.
 3. Properly brace the forms so the set concrete is correct within the allowable construction tolerances when the forms are removed.
 4. Upon removal of the forms, the professional surveyor must survey the placed concrete and provide information to the COR where the Work is not in conformance with the Drawings, within the allowable construction tolerances. The Work cannot progress until concrete is brought into compliance.
 5. Remedial Work necessary for correcting installations that is in excess of allowable tolerances are the responsibility of the Contractor.
 6. Erected Work that exceeds specified tolerance limits must be remedied or removed and replaced, at no additional cost to the Government.
 7. Any remediation Work is subject to approval of the COR in advance of the Work.

3.2 REINFORCEMENT

- A. Details of concrete reinforcement, unless otherwise shown, are in accordance with ACI 318 and ACI SP-66. Support and securely tie reinforcing steel to prevent displacement during placing of concrete.

3.3 PLACING CONCRETE

- A. Remove water from excavations before concrete is placed. Remove hardened concrete, debris and other foreign materials from interior of forms, and from inside of mixing and conveying equipment. Obtain approval of COR before placing concrete. Provide screeds at required elevations for concrete slabs.
- B. Roughen and clean set concrete free from laitance, foreign matter, and loose particles, before placing new concrete on or against concrete which has set.
- C. Convey concrete from mixer to final place of deposit by method which will prevent segregation or loss of ingredients. Do not deposit in Work concrete that has attained its initial set or has contained its water or cement more than 1 1/2 hours. Do not allow concrete to drop freely more than 5 feet in unexposed Work nor more than 3 feet in exposed Work. Place and consolidate concrete in horizontal layers not exceeding 12 inches in thickness. Consolidate concrete by spading, rodding, and mechanical vibrator. Do not secure vibrator to forms or reinforcement. Provide vibration continuously with placing of concrete.

- D. Hot weather placing of concrete: Follow recommendations of ACI 305R to prevent problems in the manufacturing, placing, and curing of concrete that can adversely affect the properties and serviceability of the hardened concrete.
- E. Cold weather placing of concrete: Follow recommendations of ACI 306R, to prevent freezing of thin sections less than 12 inches and to permit concrete to gain strength properly, except that use of calcium chloride cannot be used without written approval from COR.

3.4 PROTECTION AND CURING

- A. Protect exposed surfaces of concrete from premature drying, wash by rain or running water, wind, mechanical injury, and excessively hot or cold temperature. Curing method is subject to approval by COR.

3.5 FORM REMOVAL

- A. Forms remain in place until concrete has a sufficient strength to carry its own weight and loads supported. Removal of forms at any time is the Contractor's sole responsibility.

3.6 SURFACE PREPARATION

- A. Immediately remove loose materials, after forms have been removed and Work has been examined and approved by COR, and patch all stone pockets, surface honeycomb, or similar deficiencies with cement mortar made with 1 part portland cement and 2 to 3 parts sand.

3.7 FINISHES

- A. Vertical and Overhead Surface Finishes:
 - 1. Exposed Areas (finished): Provide grout finish of uniform color and smooth finish treated as follows:
 - a. After concrete has hardened and laitance, fins and burrs have been removed, scrub concrete with wire brushes. Clean stained concrete surfaces by use of a hone or stone.
 - b. Apply grout composed of 1 part Portland cement and 1 part clean, fine sand (smaller than No. 30 sieve). Work grout into surface of concrete with cork floats or fiber brushes until all pits and honeycomb are filled.
 - c. After grout has hardened, but still plastic, remove surplus grout with a sponge rubber float and by rubbing with clean burlap.
 - d. In hot, dry weather use a fog spray to keep grout wet during setting period. Complete finish for any area in same day. Confine limits of finished areas to natural breaks in wall surface. Do not leave grout on concrete surface overnight.
- B. Slab Finishes:
 - 1. Scratch Finish: Slab surfaces to receive a bonded applied cementitious application must be thoroughly raked or wire broomed after partial setting

- (within 2 hours after placing) to roughen surface and ensure a permanent bond between base slab and applied cementitious materials.
2. Floating: Allow water brought to surface by float used for rough finishing to evaporate before surface is again floated or troweled. Do not sprinkle dry cement on surface to absorb water.
 3. Steel Trowel Finish: All monolithic concrete floor slabs exposed in finished Work and for which no other finish is shown or specified must be steel troweled. Delay final steel troweling to secure a smooth, dense surface as long as possible, generally when the surface can no longer be dented with finger. During final troweling, tilt steel trowel at a slight angle and exert heavy pressure on trowel to compact cement paste and form a dense, smooth surface. Finished surface must be free of trowel marks, uniform in texture and appearance.
 4. Broom Finish: Finish all exterior slabs with a bristle brush moistened with clear water after the surfaces have been floated.
 5. Finished slab flatness (FF) and levelness (FL) values must comply with the following minimum requirements:

	Slab On Grade
Specified overall value	FF 25
Minimum local value	FF 17

3.8 SURFACE TREATMENTS

- A. Mix and apply surface treatments in accordance with manufacturer's printed instructions.

3.9 PRECAST CONCRETE ITEMS

- A. Cast precast concrete items, not specified elsewhere, using 3,000 psi air-entrained concrete to shapes and dimensions shown. Finish surfaces to match corresponding adjacent concrete surfaces. Reinforce with steel as necessary for safe handling and erection.

END OF SECTION