SECTION 03 30 00
CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 DESCRIPTION

A. Provide labor, material, equipment and services to furnish and install cast-in-place concrete as shown on the drawings, as specified herein and as required for a complete and proper installation, including, but not limited to, the following:

1. Concrete curbs and gutters
2. Concrete walks and ramps
3. Concrete retaining walls and foundations
4. Site Foundations

1.2 RELATED WORK

A. All Sections listed in the Table of Contents are a Condition of this Section.

1.3 TOLERANCES

A. Slab Finishes: ACI 117, 10 foot (3000 mm) straightedge method.

1.4 REGULATORY REQUIREMENTS

A. ACI 315 – Manual of Standard Practice for Detailing Reinforced Concrete Structures.

B. ACI 318 - Building Code Requirements for Reinforced Concrete.

1.5 SUBMITTALS

A. In accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, furnish the following:

B. Concrete Mix Design.

C. Shop Drawings: Reinforcing steel: Complete shop drawings.

D. Manufacturer's Certificates: Air-entraining admixture, chemical admixtures, curing compounds.

1.6 APPLICABLE STANDARDS

A. Publications listed below form a part of this specification to extent referenced. Publications are referenced in text by basic designation only.

B. American Concrete Institute (ACI):

117R-90.....Standard Tolerances for Concrete Construction and Materials

301-89.....Specification for Structural Concrete for Buildings

305R-91.....Hot Weather Concreting

306R-88.....Cold Weather Concreting

315-80(92).....Details and Detailing of Concrete Reinforcement

318/318R-95.....Building Code Requirements for Reinforced Concrete

347R-94.....Guide to Formwork for Concrete

C. American Society for Testing and Materials (ASTM):

A185-94.....Steel Welded Wire, Fabric, Plain for Concrete Reinforcement

A615/A615M-95.....Deformed and Plain Billet-Steel Bars for Concrete Reinforcement

A616/A6166M-95....Rail-Steel Deformed and Plain Bars for Concrete Reinforcement

C31-91.....Making and Curing Concrete Test Specimens in the Field

C33-93.....Concrete Aggregates

C39-94.....Compressive Strength of Cylindrical Concrete Specimens

C94-94.....Ready-Mixed Concrete

C143-90,Rev A.....Slump of Portland Cement Concrete

C150-95.....Portland Cement

C171-95.....Sheet Material for Curing Concrete

C172-90.....Sampling Freshly Mixed Concrete

C173-94(E1-95).Air Content of Freshly Mixed Concrete by the Volumetric Method

C192-90.....Making and Curing Concrete Test Specimens in the Laboratory

C231-91.....Air Content of Freshly Mixed Concrete by the Pressure Method

C260-95.....Air-Entraining Admixtures for Concrete

C494-92.....Chemical Admixtures for Concrete

D1751-83 (R-1)....Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)

D4397-91.....Polyethylene Sheeting for Construction, Industrial and Agricultural Applications

1.7 TESTING AGENCY FOR CONCRETE MIX DESIGN:

A. Testing agency retained and reimbursed by the Contractor and approved by Contracting Officer’s Representative.

B. Testing agency maintaining active participation in Program of Cement and Concrete Reference Laboratory (CCRL) of National Institute of Standards and Technology.

C. Testing agency shall furnish equipment and qualified technicians to establish proportions of ingredients for concrete mixes.

PART 2 - PRODUCTS

2.1 FORMS

A. Wood, plywood, metal, or other materials, approved by the Contracting Officer’s Representative, of grade or type suitable to obtain type of finish specified.

2.2 MATERIALS

A. Portland Cement: ASTM C150, Type II, same brand throughout.

B. Coarse Aggregate: ASTM C33 Size 67. Size 467 may be used for footings and walls over 2 inches (1300 mm) thick. Coarse aggregate for applied topping and metal pan stair fill shall be Size 7.

C. Fine Aggregate: ASTM C33.

D. Mixing Water: Fresh, clean, and potable.

E. Air-Entraining Admixture: ASTM C260.

F. Chemical Admixtures: ASTM C494.

G. Reinforcing Steel: ASTM A615 or ASTM A616, deformed, Grade 60.

H. Welded Wire Fabric: ASTM A185.

I. Expansion Joint Filler: ASTM D1751.

J. Sheet Materials for Curing Concrete: ASTM C171.

K. Liquid Hardener and Dustproofer: Fluosilicate solution or magnesium fluosilicate or zinc fluosilicate. Magnesium and zinc may be used separately or in combination as recommended by manufacturer.

L. Grout, Non-Shrinking: Premixed ferrous or non-ferrous, mixed and applied in accordance with manufacturer's recommendations. Grout shall show no settlement or vertical drying shrinkage at 3 days or thereafter based on initial measurement made at time of placement, and produce a compressive strength of at least 5,000 psi (35mpa) at 3 days.

2.3 CONCRETE MIXES

A. Mix Designs: Proportioned in accordance with Section 5.3, "Proportioning on the Basis of Field Experience and/or Trial Mixtures" of ACI 318.

1. If trial mixes are used, make a set of at least 6 cylinders in accordance with ASTM C192 for test purposes from each trial mix; test three for compressive strength at 7 days and three at 28 days.
2. Submit a report of results of each test series, include a detailed listing of the proportions of trial mix or mixes, including cement, fly ash, admixtures, weight of fine and coarse aggregate per m^3 (cubic yard) measured dry rodded and damp loose, specific gravity, fineness modulus, percentage of moisture, air content, water to cement-fly ash ratio, and consistency of each cylinder in terms of slump. Include dry unit weight of lightweight structural concrete.
3. Prepare a curve showing relationship between water to cement-fly ash ratio at 7-day and 28-day compressive strengths. Plot each curve using at least three specimens.
4. If the field experience method is used, submit complete standard deviation analysis.

B. After approval of mixes no substitution in material or change in proportions of approval mixes may be made without additional tests and approval of Contracting Officer’s Representative or as specified. Making and testing of preliminary test cylinders may be carried on pending approval of cement and fly ash, providing Contractor and manufacturer certify that ingredients used in making test cylinders are the same. Contracting Officer’s Representative may allow Contractor to proceed with depositing concrete for certain portions of work, pending final approval of cement and fly ash and approval of design mix.

C. Design of concrete mixes using materials specified shall be the responsibility of the Contractor as set forth under Option C of ASTM C94.

D. Compressive strength:
   1. All: Compressive strength at 28 days shall be not less than 25 mpa (3000 psi).

E. Maximum slump for vibrated concrete is typically 4 inches tested in accordance with ASTM C143, except for retaining walls and grade beams maximum slump is 3 inches.

F. Cement and water factor:
   1. Non-Air-Entrained
      a. Min. Cement 280 kg/m^3 (470 lbs./c. yd.)
      b. Max. Water Cement Ratio 0.55.

2. Air-Entrained
   a. Min. Cement 290 kg/m^3 (490 lbs./c. yd.)
   b. Max. Water Cement Ratio 0.45.

E. Air-entrainment is required for all exterior concrete and as required for Section 32 05 23, SIDEWALKS AND CURBS.

2.4 BATCHING & MIXING

A. Ready-mixed concrete to 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 shall furnish, in duplicate, certification as required by ASTM C94.

PART 3 - EXECUTION

3.1 FORMWORK

A. Installation conform to ACI 347. Sufficiently tight to hold concrete without leakage, sufficiently braced to withstand vibration of concrete, and to carry, without appreciable deflection, 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 and required to be in their final position at time concrete is placed shall be properly located, accurately positioned and built into construction, and maintained securely in place.

D. Construction Tolerances: Contractor is responsible for setting and maintaining concrete formwork to assure erection of completed work within tolerances specified to accommodate installation or other rough and finish materials. Remedial work necessary for correcting excessive tolerances is the responsibility of the Contractor. Erected work that

exceeds specified tolerance limits shall be remedied or removed and replaced, at no additional cost to the Government.

3.2 REINFORCEMENT

A. General: Details of concrete reinforcement in accordance with ACI 318 and ACI 315, unless otherwise shown.

B. Placing: Place reinforcement conforming to CRSI DA4, unless otherwise shown. 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 deposited. Remove hardened concrete, debris and other foreign materials from interior of forms, and from inside of mixing and conveying equipment. Provide screeds at required elevations for concrete slabs.

B. Before depositing new concrete on or against concrete which has set, existing surfaces shall be roughened and cleaned free from all laitance, foreign matter, and loose particles.

C. Obtain approval of Contracting Officer’s Representative before placing concrete.

D. 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 1500 mm (5 feet) in unexposed work nor more than 900 mm (3 feet) in exposed work. Place and consolidate concrete in horizontal layers not exceeding 300 mm (12 inches) in thickness. Consolidate concrete by mechanical vibrator. Do not secure vibrator to forms or reinforcement. Vibration shall be carried on continuously with placing of concrete.

D. Hot weather placing of concrete: Follow recommendations of ACI 305 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 306, to prevent freezing of thin sections less than 12 inches (300 mm) and to permit concrete to gain strength properly, except that use of calcium chloride shall not be permitted without written approval from Contracting Officer’s Representative.

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 shall be subject to approval by Contracting Officer’s Representative.

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.

3.7 SURFACE PREPARATION

A. Immediately after forms have been removed and work has been examined and approved by Contracting Officer’s Representative, remove loose materials, 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.

3.8 FINISHES

A. Vertical and Overhead Surface Finishes:
   1. Unfinished Areas: Vertical and overhead concrete surfaces exposed in unfinished areas, above suspended ceilings in manholes, and other unfinished areas exposed or concealed will not require additional finishing.
   2. Interior and Exterior Exposed Areas (To Be Painted): Fins, burrs and similar projections on surface shall be knocked off flush by mechanical means approved by Contracting Officer’s Representative and rubbed lightly with a fine abrasive stone or hone. Use an ample amount of water during rubbing without working up a lather of mortar or changing texture of concrete.
   3. Interior and Exterior Exposed Areas (Finished): Finished areas, unless otherwise shown, shall be given a grout finish of uniform color and shall have a 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.

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