

SECTION 03450

PRECAST ARCHITECTURAL CONCRETE

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Section includes specifications for precast architectural concrete items, including mini-high platforms.

1.02 REFERENCE STANDARDS

- A. American Concrete Institute (ACI):
 - 1. 318 Building Code Requirements for Reinforced Concrete
- B. American Society for Testing and Materials (ASTM International):
 - 1. A36 Specification for Carbon Structural Steel
 - 2. A82 Specification for Steel Wire, Plain, for Concrete Reinforcement
 - 3. A153 Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
 - 4. A185 Specification for Steel Welded Wire Reinforcement, Plain, for Concrete
 - 5. A283 Specification for Low and Intermediate Tensile Strength Carbon Steel Plates
 - 6. A307 Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength
 - 7. A497 Specification for Steel Welded Wire Reinforcement, Deformed, for Concrete
 - 8. A615 Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
 - 9. A706 Specification for Low-Alloy Steel Deformed Bars for Concrete Reinforcement
 - 10. A767 Specification for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement
 - 11. A775 Specification for Epoxy-Coated Steel Reinforcing Bars
 - 12. C33 Specification for Concrete Aggregates
 - 13. C39 Compressive Strength of Cylindrical Concrete Specimens

14. C150 Specification for Portland Cement
 15. C260 Specification for Air-Entraining Admixtures for Concrete
 16. C494 Specification for Chemical Admixtures for Concrete
 17. C642 Test Method for Density, Absorption, and Voids in Hardened Concrete
 18. C979 Specification for Pigments for Integrally Colored Concrete
- C. American Welding Society (AWS):
1. D1.1 Structural Welding Code - Steel
 2. D1.4 Structural Welding Code – Reinforcing Steel
 3. D1.6 Structural Welding Code – Stainless Steel
- D. Concrete Reinforcing Steel Institute (CRSI):
1. Manual of Standard Practice
- E. Precast/Prestressed Concrete Institute (PCI):
1. MNL 117 Manual for Quality Control for Plants and Production of Architectural Precast Concrete Products
 2. MNL 120 Design Handbook – Precast and Prestressed Concrete

1.03 DESIGN REQUIREMENTS

- A. Precast concrete units shall be reinforced with new billet steel reinforcing bars, as necessary for safe handling, setting and structural stress, and the size of the reinforcing shall be specified with a minimum area of steel equal to one quarter of one percent of the cross section area. If the surfaces are to be exposed to the weather, the reinforcement shall be galvanized or epoxy coated when covered with less than 2 inches of material for bars larger than 5/8 inch and 1-1/2 inches for bars 5/8 inch or smaller. The material covering in all cases shall be at least twice the diameter of the bars. Very small non-structural pieces, such as 8 x 8 x 4 inch, may be made without reinforcing if approved by the Engineer.
- B. Reinforcing shall comply with CRSI Manual of Standard Practice.

1.04 SUBMITTALS

- A. Mix designs: Submit mix designs along with laboratory test reports, less than 6 months old, performed by a qualified testing agency using the same mix design as proposed for the work showing absorption and compressive strengths

meeting the requirements of these specifications. Include names and brands of materials, proportions, slump, strength, and gradation of aggregates.

- B. Shop Drawings: Submit shop drawings prepared by an experienced professional detailer showing complete information for fabrication and installation of precast concrete units. Indicate unit dimensions and cross-section; fabrication tolerances; location, size, and type of reinforcement, including special reinforcement; and lifting devices necessary for handling and erection.
 - 1. Show layout, dimensions, and identification of each precast unit corresponding to sequence and procedure of installation.
 - 2. Indicate welded connections by AWS standard symbols. Detail inserts, connections, and joints, including accessories and construction at openings in precast units.
 - 3. Show caulked joints, including expansion joints ("soft" type) and grouted joints ("rigid" type).
 - 4. Show location and details of anchorage devices to be embedded in other construction.
 - 5. Indicate the specified protective finishes for metal items including connectors.
 - 6. Include setting diagrams and instructions as required for installation.
- C. Samples: Minimum size 6 x 6 x 2 inches to illustrate the quality, color, and specified surface finish texture.
- D. Submit samples or catalog cuts of cast-in gaskets, anchors, and other attachments and accessories.
- E. Submit qualifications of fabricator including a list of five successfully completed precast jobs at least five years old. Include a detailed description of the fabricated item, project name, location, general contractor, and architect or engineer.

1.05 QUALITY ASSURANCE

- A. Qualifications of Fabricator:
 - 1. Fabricator of precast concrete products shall be an active and approved participant in the PCI Plant Certification Program.
 - 2. Precast concrete work shall be produced in a plant or production facility by a fabricator who has been regularly and continuously engaged in the manufacture of architectural precast concrete product for a minimum of five (5) years.
- B. Applicable standards for inspection and quality control shall be PCI MNL 117 and PCI MNL 120.

- C. Precast units that are suspended from the structure or carry weight over openings shall be detailed under the supervision of a qualified professional engineer registered in the State of California if the structural design of the piece is not shown on the Contract Drawings.
- D. Installer of precast work shall have a minimum of 3 years successful experience in erection of architectural precast concrete units similar to units required for the Work.
- E. Welding shall conform to the requirements in AWS D1.1, AWS D1.4, and AWS D1.6, as applicable to the work.

1.06 DELIVERY, STORAGE, AND HANDLING.

- A. Store units at project site to prevent cracking, distortion, warping, staining, or other physical damage and so that markings are visible. Lift and support units only at designated lifting or supporting points as shown on approved shop drawings.

PART 2 – PRODUCTS

2.01 REINFORCEMENT

- A. Reinforcing Bars: ASTM A615, or ASTM A706, Grade 60, deformed. Reinforcing bars conforming to ASTM A706 shall be used when welding bars.
- B. Epoxy-Coated Reinforcing Bars: ASTM A775.
- C. Galvanized Reinforcing Bars: ASTM A767, Class II (2.0 oz. zinc psf), hot-dip galvanized after fabrication and bending.
- D. Steel Wire: ASTM A82, plain, cold-drawn, steel.
- E. Welded Wire Fabric: ASTM A185.
- F. Welded Deformed Steel Wire Fabric: ASTM A497.
- G. Supports for Reinforcement: Provide supports for reinforcement including bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing.
 - 1. For exposed-to-view concrete surfaces, where legs of supports are in contact with forms, provide supports with legs that are plastic protected (CRSI, Class I) or stainless steel protected (CRSI, Class 2).

2.02 CONCRETE MATERIALS

- A. Use only one brand, type, and source of supply for each type of cement, aggregates, pigments, and other materials affecting color throughout the work.

- B. Portland Cement: ASTM C150, Type I or Type III. White cement, gray cement, or a blend of white and gray cement may be used as long as the color is achieved as approved by the Engineer.
- C. Coarse Aggregate: ASTM C33; hard, durable, selected, and graded; free of material that causes staining or reacting with cement. Color shall be white. Darker aggregates may be used as long as the color is achieved as approved by the Engineer.
- D. Fine Aggregate: ASTM C33; hard, durable, selected, and graded; free of material that causes staining or reacting with cement. Color shall be white. Darker aggregates may be used as long as the color is achieved as approved by the Engineer.
- E. Pigments: ASTM C979; Inorganic, nonfading, resistant to lime and other alkalis, and containing no carbon black. Provide ready-to-use, pure, and concentrated pigment material specially processed for mixing into concrete. Pigments shall not to exceed 10 percent of the cement weight.
- F. Water: Drinkable, clean, and free of injurious amounts of oil, acid, alkali, salts, organic material, and any other substances that may be harmful to concrete or embedded steel.
- G. Air-Entraining Admixture: ASTM C260
- H. Water-Reducing, Retarding, or Accelerating Admixtures: ASTM C494, type as selected by fabricator. Admixtures containing chlorides and sulfides are not acceptable.

2.03 CONNECTION MATERIALS

- A. Steel Plates: Structural quality, hot-rolled carbon steel, ASTM A283, Grade C
- B. Steel Shapes: ASTM A36
- C. Stainless Steel Shapes: AISI Type 302/304
- D. Anchor Bolts: ASTM A307, low-carbon steel bolts, regular hexagon nuts and carbon steel washers
- E. Electrodes for Welding:
 - 1. Steel plates and shapes: E70 meeting the requirements of AWS D1.1, and as applicable to plates conforming to ASTM A283
 - 2. Reinforcing bars: E90 meeting the requirements of AWS D1.4
 - 3. Stainless steel: E70 meeting the requirements of AWS D1.6
- F. Cast-In Items: Provide reglets, slots, holes, inserts, and other accessories in units to receive dowels, reglets, flashings, anchors and other similar work as indicated.

- G. Anchorages: Provide loose steel plates, clip angles, seat angles, anchors, dowels, cramps, hangers, and other miscellaneous loose steel shapes, necessary for securing precast units to supporting and adjacent members.
- H. Finish of Steel Cast-In Items: Items exposed to weather shall be hot-dip galvanized after fabrication in accordance with ASTM A153. Items not exposed to weather shall be painted with one coat of rust-inhibitive primer. Threaded inserts cast into precast units shall be hot-dip galvanized, electrogalvanized, or cadmium plated.

2.04 MISCELLANEOUS MATERIALS

- A. Cast-In Items: Provide waterstops and similar accessories as indicated.

2.05 MIX DESIGN

- A. Prepare design mix for the type of concrete required. Unless otherwise noted, all architectural precast shall be the same color and of the same mix design.
- B. Obtain design mixes from an independent testing facility or qualified precast manufacturing plant personnel, at precast fabricator's option.
- C. Proportion mixes by either laboratory trial batch or field experience methods, using materials to be employed on the project for each type of concrete required, complying with ACI 318.
- D. Mix Properties: Standard-weight concrete consisting of specified Portland cement, aggregates, pigments, admixtures, and water to produce the following properties.
 - 1. Compressive Strength: 6000 psi minimum at 28 days. Tests shall be performed by a professional testing laboratory using 6" x 12" cylinders per ASTM C39.
 - 2. Total Air Content: Minimum 4 percent, maximum 7 percent
 - 3. Water Absorption: Not to exceed 5 percent by weight when tested per ASTM C642.
 - 4. Color: Except as otherwise indicated, integral custom colored mix to match a colored sample provided by the Engineer.
- E. Adjustment to Concrete Mixes: Mix design adjustments may be requested when characteristics of materials, job conditions, weather, test results, or other circumstances warrant. Submit laboratory test data for revised mix designs and strength results to the Engineer and obtain Engineer's acceptance before using in the work.
- F. Admixtures: Use air-entraining admixture in strict compliance with admixture manufacturer's directions. Other admixtures to increase cement dispersion or provide increased workability for low-slump concrete may be used subject to

Engineer's acceptance. Use amounts as recommended by admixture manufacturer for climatic conditions prevailing at time of casting. Adjust quantities of admixtures as required to maintain quality control.

2.06 FABRICATION

- A. General: Fabricate precast concrete units complying with manufacturing and testing procedures, quality control recommendations, and dimensional tolerances as described herein, unless otherwise indicated.
- B. Provide forms and, where required, form-facing materials of metal, plastic, wood, or other acceptable material that is nonreactive with concrete and will produce required finish surfaces per the approved sample. Accurately construct forms mortar-tight and of sufficient strength to withstand pressures due to concrete placing operations, and temperature changes. Maintain form work to provide completed precast concrete trim units of shapes, lines, and dimensions indicated, within specified fabrication tolerances.
- C. Dimensional Tolerances of Finished Units:
 - 1. Overall height and width measured at face adjacent to mold at time of casting: Plus or minus 1/8 inch.
 - 2. Angular deviation of plane of side mold: 1/32 inch per 3 inches depth or 1/16 inch total, whichever is greater.
 - 3. Out of square (difference in length of two diagonal measurements): 1/8 inch per 6 feet or 1/4 inch total, whichever is greater.
 - 4. Thickness: Minus 1/8 inch, plus 1/4 inch
 - 5. Tolerances of other dimensions not otherwise indicated: Numerically greater of plus or minus 1/16 inch per 10 feet, or plus or minus 1/8 inch.
 - 6. Other tolerances per PCI MNL-117
- D. Position Tolerance: For cast-in items measured from datum line locations as shown on approved shop drawings:
 - 1. Anchors and inserts: Within 3/8 inch of centerline location shown on shop drawings.
 - 2. Blockouts and reinforcements: Within 1/4 inch of position shown on shop drawings, where such positions have structural implications or affect concrete cover; otherwise within plus or minus 1/2 inch.
- E. Fabricate units straight, smooth, and true to size and shape, with exposed edges and corners formed or stoned to a minimum radius unless otherwise indicated.
 - 1. Precast trim units that are cracked, broken, spalled, stained, or exceeding the specified manufacturing tolerances will not be acceptable.

- F. Curing: Cure units in a warm, moist, totally enclosed curing room for a minimum of 20 hours.
- G. Surface Finish: Remove all surface cement paste by means of acid etching or lightly sandblasting to provide a smooth, dense, fine-grained texture with no streaks or blotches. Texture and quality of finish shall match approved sample when viewed in direct daylight at a 10 foot distance.
- H. Color: The color shall be match approved sample when viewed in direct daylight at a 10 foot distance. Color variation between pieces shall be minimal as determined by the Engineer.

2.07 SOURCE QUALITY CONTROL

- A. Testing: Test specimens shall be prepared by an ACI certified Grade 1 Field Testing Technician. Tests shall be performed by a certified testing laboratory hired by the Contractor. Keep test results on file for at least two years and submit to the Engineer upon request.
 - 1. Perform one set of 6 inches x 12 inches cylinder tests for every 500 cubic feet of concrete placed. Perform at least one set of cylinder tests for work that requires more than 25 cubic feet of concrete but less than 500 cubic feet.
 - 2. Perform one absorption test for every 500 cubic feet of concrete placed. Perform at least one absorption test for work that requires more than 25 cubic feet of concrete but less than 500 cubic feet.

PART 3 – EXECUTION

3.01 INSTALLATION

- A. General: Deliver anchorage items to be embedded in other construction before start of such work.
- B. Do not install precast units until supporting concrete has attained minimum allowable design compressive strength.
- C. Do not install any precast units that have any defects that exceed the acceptable PCI MNL-117 tolerances for dimensions and color if installation would result in unsatisfactory performance or appearance as determined by the Engineer.
- D. Install precast concrete members plumb, level, and in alignment in accordance with PCI MNL-117 erection tolerances. Utilize fabricator provided templates. Provide temporary supports and bracing as required to maintain position, stability, and alignment as members are being permanently connected.
 - 1. Maintain horizontal and vertical joint alignment and uniform joint width as erection progresses.
- E. Accessories: Install clips, hangers, and other accessories required for erection of precast units to supporting members and backup materials.

- F. Anchor units in final position by bolting, welding, grouting, or as otherwise indicated on the Contract Documents. Remove temporary shims, wedges, and spacers as soon as possible after anchoring and grouting are completed.
 - 1. At bolted connections use lock washers or other acceptable means to prevent loosening of nuts.
 - 2. At welded connections apply rust-inhibitive coating on damaged areas, same as shop-applied material. Use galvanizing repair coating on galvanized surfaces.
- G. Before pointing and caulking, scrub face of precast with a fiber brush, using mild detergent and water and then thoroughly rinse with clean running water. Remove any mortar on the face of the precast. Do not use acids or prepared cleaners without the approval of the precast fabricator.

3.02 PROTECTION AND REPAIR

- A. Protect the precast units from discoloration and staining when washing down the surrounding masonry by covering the precast units with plastic sheeting and/or by thoroughly soaking them with clear water so they will not absorb any of the dirty washdown water that may run onto them. If dirty washdown water gets on the precast, hose it off immediately with clear water.
- B. Repair or replace chipped or damaged precast items to the satisfaction of the Engineer. Repair of chipped or damaged precast shall be done only by mechanics skilled in this class of work, with materials and instructions furnished by the fabricator.
- C. Replace chipped or damaged precast units that cannot be repaired.

END OF SECTION