

SECTION 03450
PLANT-PRECAST ARCHITECTURAL CONCRETE

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. General Conditions, Supplementary Conditions and Division 1 – General Requirements apply to Work of this Section.

1.2 SUMMARY

- A. Section includes: Provide plant-precast architectural concrete Work shown and specified. *(Specifier may wish to describe units) (Specifier may wish to delineate structural design services; miscellaneous materials, i.e. anchorage and connection devices; testing services; and similar items required of this supplier).*
- B. Substitutions: Submit in accordance with requirements of Section 01630.

1.3 REFERENCES *(Delete references that do not apply)*

- A. American Association of State Highway and Transportation Officials (AASHTO).
- B. American Concrete Institute (ACI.)
1. ACI 318 – “Building code Requirements for Reinforced Concrete.”
 2. ACI 533 – “Guide for Precast Concrete Wall Panels.”
- C. Architectural Precast Association (APA).
- D. American Society for Testing and Materials (ASTM).
1. A-36 – “Specification for Carbon Structural Steel.”
 2. A-47 – “Specification for Ferritic Malleable Iron Castings.”
 3. A-123 – “Steel Products.”
 4. A-153 – “Specification for Zinc Coating (Hot Dip) on iron and Steel Hardware.”
 5. A-185 – “Specification for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement.”
 6. A-283 – “Specification for Low and Intermediate Tensile Strength Carbon Steel Plates.”
 7. A-307 – “Specification for Carbon Steel Bolts and Studs 60,000 PSI Tensile Strength.”
 8. A-325 – “Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.”
 9. A-416 – “Specification for Steel Strand, Uncoated Seven-Wire for Prestressed Concrete.”
 10. A-496 – “Specification for Steel Wire, Deformed, for Concrete.”
 11. A-500 – “Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.”
 12. A-563 – “Specification for Carbon and alloy Steel Nuts.”
 13. A-572 – “Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel.”
 14. A-615 – “Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.”

15. A-666 – “Specification for Austenitic Stainless Steel, Sheet, Strip, Plate, and Flat Bar.”
16. A-767 – “Specification for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement.”
17. A-934 – “Specification for Epoxy-Coated Prefabricated Steel Reinforcing Bars.”
18. C-33 – “Specification for Concrete Aggregates.”
19. C-150 – “Specification for Portland Cement.”
20. C-260 – “Specification for Air-Entraining Admixtures for Concrete.”
21. C-330 – “Specification for Lightweight Aggregates for Structural Concrete.”
22. C-404 – “Specification for Aggregates for Masonry Grout.”
23. C-494 – “Specification for Chemical Admixtures for Concrete.”
24. C-979 – “Specification for Pigments for Integrally Colored Concrete.”
25. C-1107 – “Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink).”
26. C-1240 – “Specification for Silica Fume for Use in Hydraulic-Cement Concrete and
27. D-412 – “Test Methods for Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers – Tension.”
28. F-539 – “Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.”

E. American Welding Society (AWS).

1. AWS D1.1 – “Structural Welding Code.”

F. Cement and Concrete Reference Laboratory (CCRL).

G. Concrete Reinforcing Steel Institute (CRSI).

1. “Manual of Standard Practice.”

H. Department of Defense (DOD).

I. Precast/Prestressed Concrete Institute (PCI)

1. MNL 117 – “Manual for Quality Control.”
2. MNL 120 – “Design Handbook.”

J. Steel Structures Painting Council (SSPC).

1. “Painting Manual.”

K. American Institute of Steel Construction (AISC).

1. “Manual of Steel Construction.”

1.4 SYSTEM DESCRIPTION

A. Performance Requirements: Comply with Uniform Building Code, (UBC), municipal building codes, regulations or other governing agencies having jurisdiction, and as follows: *(Some or all of the following performance requirements may apply, depending on the type and use of precast units and the nature of the structure.)*

1. Wind Loads.
2. Seismic forces.
3. Building dynamics, thermal, live, impact or concentrated loads, structural deflection, story drift.

1.5 SUBMITTALS

- A. Product Data: Submit product data for manufactured materials and products. (*May include inserts, color pigments, admixtures, manufacturers certifications, steel primer and galvanized touch up material.*)
- B. Shop Drawing
 - 1. Show in-place location, fabrication details, plans, elevations, anchorages, reinforcement, connection details and methods, dimensions, finishes, relationships to adjacent materials, and erection and placement.
 - 2. Show identification marks, coordinated to Shop Drawings, and date of manufacture on all units to facilitate hauling and erection.
 - 3. Setting diagrams, templates, instructions and directions as required for installation.
- C. Engineering Calculations (*if required*): Engineering calculations sealed by an engineer licensed to practice in (*project state*).
- D. Samples: Nominal size 12 inch by 12 inch by appropriate thickness, of each type of unit and finished facing shown and specified for approval of quality, color, and texture of surface finish. Submit prior to fabrication.
- E. Mix Design(s): Proposed concrete mix design for each type and color of concrete mix required including backup mix.
- F. Test Reports: (*May include materials, compressive strength, and water absorption*).
- G. Certifications:
 - 1. Fabricator's certification from APA, PCI, or applicable municipal certifications.
 - 2. Welder's AWS certification.

1.6 QUALITY ASSURANCE

- A. Fabricator's Qualifications: Firm shall have a minimum of five (5) years experience in producing units similar to those required for this Project, with sufficient production capacity to produce and deliver required units without causing delay in Work.
 - 1. Fabricating plant shall be certified by one of the following:
 - a) Architectural Precast Association (APA).
 - b) Precast/Prestressed Concrete Institute (PCI), Group A1.
 - c) Applicable municipal building department.
 - d) Firms not certified by APA or PCI shall submit a written Quality Assurance/Quality Control program for approval.
- B. Installer's Qualifications: Installer shall have a record of at least five (5) years of successful installation of units similar to those required for this Project.
- C. Welder's Qualifications: Provide certification that welders to be employed in the Work are certified by AWS and applicable local building officials, and have been re-certified in the last 12 months.
- D. (*Depending upon the nature of units required and type of Project, some or all Quality Assurance qualifications may apply as follows*):
 - 1. Testing Agency.
 - 2. Professional Engineer.
 - 3. Pre-Construction Testing Service.
- E. Applicable Standards: As specified under Paragraph 1.3 References.
- F. Production Samples or Mock-ups:
 - 1. Provide color and texture range samples for approval prior to production start OR

2. Obtain Architect's approval of initial production units of each type listed. (*List unit types requiring approval*).
3. Supply initial production units for job site assembly with other materials, for approval, as noted in this Section and in Division 1.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver units to the Project site in such quantities and at such times to ensure continuity of installation.
- B. Avoid job site storage. When job site storage is required store in a manner to prevent physical damage and so that markings are visible.
- C. Lift and support only at designated lifting or supporting points as shown on reviewed Shop Drawings.
- D. Provide anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, templates, instructions and directions as required for installation.

1.8 PROJECT CONDITIONS

- A. Field Dimensions: General Contractor to furnish field measurements, if required, to precast fabricator.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. Approved Fabricators:
 1. List your pre-approved fabricators.
 2. (*List others as approved*).
 3. Fabricators not listed as approved shall request approval, as specified in Section 01630.

2.2 MATERIALS

- A. Concrete Materials:
 1. Portland Cement: ASTM C 150, Type I or III, white or gray colors to achieve desired finish colors. Use only one brand, type, and color from the same mill. Gray cement may be used for non-exposed backup mixes.
 2. Aggregates: ASTM C 33, gradation may differ to achieve desired finish characteristics. Select coarse and fine aggregate colors and screen sizes to match approved sample(s). Verify that adequate supply, from one pit or quarry, for each type of aggregate is available for the entire Project. If possible obtain entire aggregate supply prior to starting Work, or have aggregate supply held in reserve by aggregate supplier.
 3. (*Lightweight aggregate: ASTM C 330*).
 4. Water: Potable. Clean, clear, and free from deleterious amounts of salts, acids, alkalis, organic materials, oils, detergents, or other matter that may interfere with color, curing, or strength of concrete.
 5. Admixtures: Select to be compatible in specified mix.
 - a) Air Entraining: ASTM C 260.
 - b) Water Reducing: ASTM C 494, Type A,B,C,F. or G.

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- c) Silica Fume: ASTM C 1240, for cement replacement for high performance concrete.
 - d) Coloring Agent: ASTM C 979, compatible with other concrete materials.
 - e) Other constituents: Integral water repellents and other chemicals for which no ASTM standard exists, shall be previously established as suitable for use in concrete or shall be shown by test or experience not to be detrimental to the concrete.
- B. Formwork:
- 1. Provide forms with acceptable form facing materials that are non-reactive with concrete or form release agents and will produce required finish surfaces.
 - 2. Construct and maintain forms to produce precast concrete units of shapes, lines, and dimensions indicated, within specified tolerances.
- C. Reinforcing Materials:
- 1. Reinforcing Bars: ASTM A 615, Grade 40 or 60, unless otherwise required to meet structural requirements. *(Use galvanized reinforcing bars; ASTM A 767, hot-dip galvanized where concrete cover is less than 1-1/2 inches). (Epoxy coated reinforcing bars, ASTM A 934, may be used in special applications; timely availability may be a problem).*
 - 2. *(Steel Welded Wire Fabric: ASTM A 185, plain, cold drawn).*
 - 3. *(Pre-Stressing Tendons: ASTM A 416, Grade 250 or 270, un-coated, 7 wire, low relaxation strand).*
- D. Connection Materials:
- 1. Steel Shapes and Plates: ASTM A 36.
 - 2. *(Malleable Iron Castings: ASTM A 47).*
 - 3. *(Carbon Steel Plates: ASTM A 283).*
 - 4. *(High Strength, Low Alloy Structural Steel: ASTM A 572).*
 - 5. *(Carbon Steel Structural Tubing: ASTM A 500, Grade B).*
 - 6. Anchor Bolts: ASTM A 307, carbon steel or ASTM A 325, high strength; bolts nuts, and washers.
 - 7. Welded Headed Studs: AWS D1.1, Type B.
 - 8. Deformed Steel Wire Bar Anchors: ASTM A 496.
 - 9. *(Stainless Steel Plate: ASTM F 593, Type 304 or Type 316; bolts and studs, nuts and washers. Note that selection of stainless steel will result in increased costs.)*
 - 10. Finish for Steel Connection Materials:
 - a) Hot-dip galvanize (ASTM A 123 or A 153) steel exposed to weather in final assembly.
 - b) Shop Prime Remaining Steel Shapes: SSPC-Paint 25.
 - c) Anchor Bolts, Nuts, Washers, Cadmium Plated: ASTM A 563, Grade C.
 - d) Hot-dip galvanize (ASTM A 153) setting bolts or projecting steel in masonry applications.
 - e) Galvanizing Repair Paint: DOD-P-21035A or SSPC-Paint 20.
 - f) Welding Electrodes: Comply with AWS Standards.
- E. *(Bearing Pads: Elastomeric pads, AASHTO M251; ASTM D 412).*
- F. Grout Materials:
- 1. Cement Grout: Cement ASTM C 150; sand ASTM C 404; proportions 1:2.5 by volume, minimum water for placement and hydration.

2. Non-Shrink Grout: ASTM C 1107.
3. Epoxy Grout: Consult Suppliers.

2.3 MIXES

- A. Design mixes for each type of concrete specified may be prepared by an independent testing agency or by architectural precast manufacturing plant personnel at precast fabricator's option.
- B. Proportion mixes by either testing agency trial batch or field test data methods in accordance with ACI 211.1, using materials to be used on the project, to provide normal weight concrete with properties as follows:
 1. Compressive Strength: 5,000 psi (*or other strength requirement*) when tested in accordance with ASTM C 39.
 2. Maximum water cement ratio 0.40 at point of placement.
 3. Add air-entrainment admixture to result in air content at point of placement complying with ACI 533 requirements.
 4. List other admixtures and recommended quantities.
 5. Water absorption maximum 6% (by weight) when tested in accordance with ASTM C 642.
 6. (*List ingredients of Architect's approved sample mix(es) when appropriate*).
- C. Follow procedures similar to paragraph 2.3.B for lightweight concrete mixes.

2.4 FABRICATION

- A. General:
 1. Fabricate precast concrete units with manufacturing and testing procedures, quality control recommendations, and dimensional tolerances as specified in ACI 533, unless more stringent requirements are shown or specified.
 2. Fabricate units straight, smooth and true to size and shape, with exposed edges and corners precise and square, unless otherwise indicated.
- B. Cast openings larger than 10 inches in any dimension according to locations shown on Shop Drawings. Smaller holes may be field cut when approved by Architect.
- C. Reinforcement: Comply with CRSI "Manual of Standard Practice" and ACI 318 recommendations. Reinforce architectural precast concrete units to resist handling, transportation, and erection stresses, and to comply with specified performance criteria.
- D. (*Pretension tendons for units in compliance with ACI-533*).
- E. Cast-in Items: Provide embedded anchors, inserts, steel shapes, and lifting devices as shown on reviewed Shop Drawings. Window connections are best made by field drilled inserts. Firmly hold cast items in place by jigs, strongbacks, or other approved means.
- F. Comply with ACI-533 requirements for measuring, mixing, transporting, and placing concrete. Place facing mix to a thickness of the greater of 1 inch or 1.5 times the maximum aggregate size. Place back-up concrete to ensure bond with face concrete.
- G. Consolidate concrete using equipment and procedures complying with ACI 533.

- H. Permanently mark units with pick-up points as shown on reviewed Shop Drawings. Imprint casting date and piece mark on a surface to be concealed from view in the finished structure.
- I. Cure concrete in accordance with ACI 533 requirements.
- J. Discard units that are warped, cracked, broken, spalled, stained, or otherwise defective unless repairs are approved by the Architect and meet specified requirements. Refer to ACI-533 for product finish requirements unless otherwise shown or specified.
- K. Fabrication Tolerances: Fabricate to tolerances listed in ACI-533. *(More stringent tolerances, if required, will cause increased cost).*

2.5 FINISHES

- A. Finish exposed surfaces or units to match Architect's design reference sample. OR
- B. *(APA and PCI "Architectural Precast Concrete-Color and Texture Selection Guide" of Plate Numbers Indicated).* OR:
- C. Specify selected finish, selecting from the following:
 - 1. Smooth surface finish free from pockets, sand streaks, honeycomb, with uniform color and texture. State whether bugholes less than 5/8 inch in diameter are acceptable.
 - 2. Textured surface finish from form liners or inserts otherwise identical to paragraph 2.5.C.1. Note bughole statement. *(Eliminating bugholes on some textures may be difficult).*
 - 3. Machine textured finish, using power or hand tools to remove matrix and fracture coarse aggregate.
 - 4. Retarded finish, using chemical retarding agents applied to forms, with washing and brushing procedures to expose aggregate and surrounding matrix.
 - 5. Abrasive blast finish, using abrasive grit, equipment, application and cleaning procedures to expose aggregate and surrounding matrix.
 - 6. Acid etched finish using acid solution and application techniques to expose aggregate and surrounding matrix.
 - 7. Honed or Polished finish using mechanical abrasion, followed by filling and rubbing procedures.
 - 8. Sand embedment finish, using selected coarse aggregate placed in a sand bed in the bottom of the mold, with sand removed after removal from the mold.
 - 9. Applied material finish, using selected ceramic or natural stone materials, specified in Section 04400.
- D. Finish Exposed Back Surface of Units:
 - 1. *(To match face surface of units).*
 - 2. *(by smooth, steel trowel finish).*
- E. Finish unexposed surfaces of units by float finish or as-cast form finish.

2.6 SOURCE QUALITY CONTROL

- A. Inspect and test architectural precast concrete in accordance with ACI 533.
- B. *(Producers certified by APA or PCI may conduct their own Quality Control operations with reports to designated authorities).*

- C. *(Non-certified producers shall furnish and pay for reports by an independent Testing Laboratory, approved by the Owner as specified in paragraph 2.6D).*
- D. *(The Owner may retain an independent Testing Laboratory to evaluate fabricator's quality control and testing methods. Testing Laboratory shall be certified by CCRL or similar National authority. Fabricator shall allow Testing Laboratory access to all operations pertinent to the Project).*
- E. Defective Work: Discard units that do not conform to requirements as shown or specified. Replace with units which meet requirements.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Field Dimensions: Furnish field dimensions to fabricator as required.
- B. Examine substrates and conditions for compliance with requirements for installation, tolerances, true and level bearing surfaces, and other conditions affecting performance of architectural precast concrete units. Do not proceed with installation until unsatisfactory conditions have been corrected.
- C. Do not install units until supporting structure has been completed *(has attained minimum allowable design compressive strength)*.

3.2 ERECTION

- A. Erection shall be by persons experienced and trained in placement and securing of architectural precast concrete units.
- B. Erect level, plumb, and true to line. Do not allow cumulative dimensional errors to develop. Adjustments such as shimming which would place additional stress on units will not be permitted. Adhere to dimensional tolerances in accordance with ACI recommendations. Erect and secure in a manner to prevent damage to unit or units in place. Replace any damaged units.
- C. Lift and handle precast using lift points and embeds as shown on precast shop drawings.
- D. Erection Tolerances:
 - 1. Erect within tolerances listed in ACI-533.
 - 2. Erect to conform with structure tolerances listed in ACI-533.
 - 3. Where two stage joint seal is required, sequence with sealant applicator to ensure that sealant, gaskets, and similar items required for interior side seal are installed concurrently with installation of precast units.
- E. Joint Sealants: As specified in Section 07900.

3.3 REPAIR

- A. Repair exposed surfaces of units to match color, texture, and uniformity of surrounding units.
- B. Remove and replace damaged units when repairs do not meet requirements.

3.4 CLEANING

- A. Clean exposed surfaces of units after erection if soiled or stained.
 - 1. Wash and rinse according to architectural precast concrete fabricator's recommendations. Protect other work from damage while cleaning.
 - 2. Do not use cleaning materials or methods that change the appearance of architectural precast concrete finishes. Test clean a small area to verify adequacy and safety of materials and methods.
 - 3. Leave in condition for application of water repellents specified in Section 07190.

3.5 PROTECTION

- A. Protect finished surfaces from soiling or damage.

END OF SECTION