SECTION 03 41 10 - STRUCTURAL PRECAST CONCRETE

PART 1 -- GENERAL

1.1 SUMMARY

A. The CONTRACTOR shall furnish all tools, equipment, materials, and supplies and shall perform all labor required to complete the precast concrete work in accordance with the Contract Documents.

B. This Section covers the design, fabrication, delivery and installation of all precast concrete units, including connections, complete, in place, as shown and specified.

1.2 REFERENCES. Unless noted otherwise, the latest version of each References is applicable to the WORK.

A. ANSI/ACI 315 Concrete Reinforcement

B. ANSI/ACI 318 Concrete Construction

C. AWS A5.4 Welding Rods and Electrodes

D. AWS D1.1 Welding and Cutting

E. ASTM A 184 Fabricated Deformed Steel Bar Mats for Concrete Reinforcement

F. ASTM A 185 Steel Welded Wire, Fabric, Plain, for Concrete Reinforcement

G. ASTM A 193 Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service

H. ASTM A 194 Carbon and Alloy Steel Nuts for Bolts for High-Pressure and High-Temperature Service

I. ASTM A 351 Steel Castings, Austenitic, for High-Temperature Service

J. ASTM A 497 Welded Deformed Steel Wire Fabric for Concrete Reinforcement

K. ASTM A 580 Stainless and Heat-Resisting Steel Wire

L. ASTM A 615 Deformed and Plain Billet-Steel Bars for Concrete Reinforcement

M. ASTM A 666 Austenitic Stainless Steel, Sheet, Strip, Plate, and Flat Bar for Structural Applications

N. ASTM C 33 Concrete Aggregates

O. ASTM C 67 Method for Sampling and Testing Brick and Structural Clay Tile

P. ASTM C 127 Test Method for Specific Gravity and Absorption of Coarse Aggregate

Q. ASTM C 128 Test Method for Specific Gravity and Absorption of Fine Aggregate

R. ASTM C 150 Portland Cement

S. ASTM C 173 Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method

T. ASTM C 204 Test Method for Fineness of Portland Cement by Air Permeability Apparatus

U. ASTM C 231 Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method

V. ASTM C 260 Air-Entraining Admixtures for Concrete

W. ASTM C 311 Method for Sampling and Testing Fly Ash or Natural Pozzolans for Use as a Mineral Admixture in Portland Cement Concrete

X. ASTM D 2240 Test Method for Rubber Property -- Durometer Hardness

Y. AWS D12.1 Steel Reinforcing Bars

Z. PCI MNL-116 Quality Control for Structural Precast Products

AA. PCI MNL-117 Quality Control for Architectural Precast Products

1.3 CONTRACTOR SUBMITTALS

A. Submittals shall be made in accordance with Section 01 33 00 - Contractor Submittals.

B. Shop Drawings:

1. Shop Drawings shall show details in accordance with ACI 315 and ACI 318 including installation details and design computations.

2. Shop drawings, including design computations, shall be stamped and signed by a structural engineer registered in the State and shall be approved by the ENGINEER.

3. Shop Drawings shall indicate precast unit identification marks, location of units in the WORK, elevations, fabrication details, welding details, reinforcement, connections, dimensions, interface with adjacent members, and special handling instructions in sufficient detail to cover manufacture, handling, and erection. Shop Drawings shall include erection drawings.

4. Shop Drawings shall be divided into complete separate submittals for each structure. Shop drawings shall show all elevations, dimensions, horizontal and vertical sections, openings, inserts, reinforcing, anchorage devices, details, design computations, and other requirements for each different type of element to be incorporated into the portion of the project covered by the submittal. Drawings shall be 24 inches x 36 inches maximum.

C. **Mix Proportions:** Prior to commencing operations, including fabrications of the precast for any mock-up, a statement shall be submitted giving the nominal maximum aggregate size and proportions of all ingredients that will be used in the manufacture of concrete. The statement shall include test results from an approved testing laboratory, certifying that the proportions selected will produce concrete of the properties required. No substitutions shall be made in materials used in the concrete mix without approval and additional tests to verify that the concrete properties are satisfactory. A copy shall be submitted of concrete mix with each set of samples.

D. **Test Reports:** Tests for compressive strength of concrete shall be performed by an independent commercial testing laboratory. Copies of test reports including all test data and all test results shall be submitted.

E. **Certificates of Compliance:** Certificates of compliance shall be submitted attesting that materials and products meet or exceed specified requirements.

F. **Manufacturer's Qualifications:** Prior to commencing operations, a statement shall be submitted giving the qualifications of the precast concrete manufacturer, and evidence that the manufacturer and plant are PCI certified.

1.4 QUALITY CONTROL

A. **General Requirements:** Design members under direct supervision of a professional structural engineer experienced in design of precast concrete units, registered in the State and conforming to requirements of PCI MNL-121 and to ACI 318.

1. Precast manufacturer and erectors shall be qualified in accordance with PCI MNL-117.

2. Welding shall be in accordance with AWS D1.1, AWS D12.1, AWS B2.1, and AWS A5.4.

3. Manufacture, Transportation and Installation: The manufacturer shall specialize in providing architectural precast products and services normally associated with precast concrete construction with high quality architectural finishes similar to that indicated on drawings, using procedures complying with PCI MNL-116 and PCI plant certified for at least 2 years.

1.5 DESIGN REQUIREMENTS

A. **General:** The precast concrete unit and connection designs shown represent minimum precast construction requirements. The manufacturer shall verify the precast unit and connection designs for all handling, erection, and service conditions, and shall provide any additional materials necessary to meet the design conditions.

B. **Standards and Loads:** The precast unit and connection design and construction shall conform to all applicable codes and AISC Specification for the Design, Fabrication and Erection of Structural Steel for Buildings.

C. **Concrete Mix:** The concrete mix shall be designed by the manufacturer and approved by the ENGINEER, using the materials and quantities specified to meet all of the requirements of this specification.

1. Proportioning of Concrete Mixes: Mixes shall be proportioned by weight except water and admixtures may be batched by volume if desired. Trial mixes and testing to meet requirements of the strengths of concrete specified is the CONTRACTOR's responsibility. Design mix shall contain similar materials as those proposed for use in the WORK.

2. Admixtures: Concrete shall contain an air entraining admixture in proportion so as to provide 4 percent plus or minus 1 percent total air in the concrete as determined by ASTM C 173 or C 231. Set retarding admixtures may be used provided cement content is not reduced. Water reducing admixtures may be used provided they are used in the mix design studies. High-range water reducers (superplasticizers) shall be used only where specifically called for in this Section, otherwise superplasticizers shall not be used without written approval from the ENGINEER. No admixture may contain chlorides, bromides, or fluorides.

3. Water: Clean, potable water. The CONTRACTOR shall provide tests to assure that no more than 200 parts per million total aggregated content of chlorides, bromides, and fluorides are present.

D. **Formwork:** Formwork shall be designed to withstand high-frequency vibration and to ensure finished units.

1.6 DELIVERY, STORAGE AND HANDLING

A. **General:** Precast members shall be handled to position consistent with their shape and design; they shall be lifted and supported from design incorporated support points and provided with strong backs and other devices as required. Lifting or handling equipment shall be capable of maintaining units during manufacture, storage, transportation, erection, and in position for fastening.

B. Blocking and supports, lateral restraints and protective materials during transport and storage shall be clean, nonstaining, without causing harm to exposed surfaces, including temporary support to prevent bowing and warping. Lateral restraints shall be provided to prevent undesirable horizontal movement. Edges and exposed faces of members shall be protected to prevent straining, chipping, or spalling of concrete.

C. Units shall be marked with date of production and final position in structure in location not visible after erection.

D. Precast units shall be stored off the ground in a manner to prevent warpage and they shall be protected from weather, marring, and overload.

E. **Stainless Steel Hardware:** Stainless steel hardware shall be transported, handled, stored, and protected in wood crates.

PART 2 -- PRODUCTS

2.1 CONCRETE MATERIALS

Cement	ASTM C 150, Type II, "low alkali," white color. "Low alkali" requirement may be waived if not reactive as defined in Appendix to ASTM C 33. Submit laboratory test reports.
Aggregate	ASTM C 33, 1/2-inch max coarse aggregate size fine aggregate ratio to total aggregate volume = 0.35 min, 0.55 max.
Water Absorption, Coarse Water Absorption, Fine	ASTM C 127 ASTM C 128
Reinforcing Steel	ASTM A 615, Grade 60, deformed. It is allowed to provide the aforementioned rebar as epoxy coated in accordance with ASTM A 775.
Welded Wire Fabric	
Plain	ASTM A 185.
Deformed Steel	ASTM A 497.
Fabricated Steel Bar or Rod Mats	ASTM A 184. It is allowed to provide the aforementioned rebar as epoxy coated.
Tie Wire	ASTM A 580, Type 316L, cold finished annealed, **Huntington Alloy Co. "Monel"** or **"Inconel."**
Air Entrainment Admixture	ASTM C 260
Water Reducing or Retarding Admixtures	ASTM C 494, Type C, D, or F/G, with no chloride, bromide, and fluoride ingredients
Silica Fume Slurry Admixture	45 to 50 percent silica fume, water, and superplasticizer as dispersant. Silica Fume: 85 percent amorphous silicon dioxide in accordance with ASTM C 311; loss on ignition shall not exceed 6 percent and moisture shall not exceed 3 percent in accordance with ASTM C 311. Surface area not less than 10,000 square meters per kilogram at bed porosity of 0.50 in accordance with ASTM C

	204 Reduce water in mix by 5.6 to 9.5 lbs for each gallon of slurry added to mix, as recommended by slurry manufacturer used.

2.2 SUPPORT DEVICES

Connecting and Support Devices	ASTM A 666, Type 316L stainless steel
Bolts	ASTM A 193, Grade B8M (Type 316)
Nuts and Washers	ASTM A 194, Grade 8M (Type 316)
Weld Filler Metal for Stainless Steel	Stainless steel to stainless steel; AWS A5.4, Grade 316L filler metal; stainless steel to carbon steel, AWS A5.4, Grade 309 filler metal, 3/32-inch diameter
Primer	Zinc-dust, zinc oxide primer in a phenolic resin spare varnish vehicle, TT-P-641 Type III (for galvanized surfaces)

2.3 ACCESSORIES

Plates, Angles, Anchors, and Studs	ASTM A 666, Type 316L stainless steel
Austenitic Steel Castings for Embedments and Anchorage Assemblies	ASTM A 351, Type CF3M, with Type 316 stainless steel bolts, nuts, and washers
Reglets	Plastic, shaped and flanged to remain in place once cast; tape closed to prevent concrete intrusion
Bearing Pads	Neoprene, molded to size or cut from molded sheet, 70-80 Type A durometer, ASTM D 2240
Sealant	Specified in Section 07920 - Sealants and Caulking

2.4 FORMS

Forms	Manufacturer's standard with smooth, hard, dense, and rigid casting surface; without bow, warpage, oil canning, or other imperfections
Form Release Agent	Manufacturer's standard, nonstaining, nonpetroleum based; compatible with concrete surface sealer
Surface Sealer	Clear, flat, penetrating, nonyellowing, nonclouding solution; high concentration of organosilane in an aqueous alcoholic vehicle which is designed to provide water repellent concrete surfaces from which graffiti can be easily removed. Oil-type silicones, paraffins, waxes, vinyls, modified urethanes, or acrylics shall not be used. Sealant shall be tested by manufacturer and proved compatible with surface sealer

2.5 FABRICATION

A. General:

1. Precast concrete units shall be fabricated by a licensed shop in accordance with ACI 318, PCI MNL-116 (structural features), PCI MNL-117 (nonstructural features, surface treatments, patching, and tolerances). Plant records and quality control program shall be maintained during production of precast units. Records and access to plant shall be available to the ENGINEER upon request.

2. Rigid molds shall be used, constructed to maintain precast unit uniform in shape, size, and finish, free from castings and dents, gouges, oil canning, or other irregularities that will adversely affect appearance or strength of units. Consistent quality shall be maintained during manufacture.

3. Equipment for handling epoxy-coated reinforcing bars shall have protected contact areas. Bundles of coated bars shall be lifted at multiple pickup points to prevent bar-to-bar abrasion from sags in the bundles. Coated bars or bundles of coated bars shall not be dropped or dragged. Coated bars shall be stored on protective cribbing. The maximum amount of damage shall not exceed 2 percent of the surface area of each bar.

4. Reinforcing steel, anchors, inserts, plates, angles, and other cast-in-place items shall be embedded as indicated on shop drawings. Reinforcement shall be fabricated and placed in conformance with ACI 318. No tack welding of or to reinforcement permitted. Welding when allowed shall conform to AWS D1.4 requirements. No carbon steel chairs, spacers, nails or tie wire shall be used in positioning reinforcing and embedments.

5. Adequate reinforcing steel shall be provided to control cracking. Maximum permissible crack width:

    a. Surfaces exposed to weather: 0.005 inch

    b. Surfaces exposed to view but not weather: 0.01 inch

6. Connecting devices, plates, angles, items fit to steel framing members, inserts, bolts, and accessories shall be fabricated to permit initial placement and final attachment.

7. Anchors, inserts, lifting devices, and other accessories shall be placed and embedded in accordance with approved shop drawings, accurately positioned in their designed location and anchored to prevent dislocation during precast unit construction. Flashing reglets shall be placed and embedded continuous and straight, with lifting devices to permit removal after erection.

8. Units shall be moist cured with water mist to develop concrete quality and to minimize surface drying and appearance blemishes such as nonuniformity, staining, or surface cracking.

9. Precast units shall be removed from formwork using procedures conforming to PCI MNL-117. Minor patching in plant acceptable, providing structural adequacy and appearance of units are not impaired. Each precast unit shall be identified with corresponding code on erection drawings, in location not visible to finished work.

10. Repair of damaged epoxy coating, when required, shall be made with patching material conforming to ASTM A 775. Repair shall be in accordance with the material Manufacturer's recommendations.

B. Fabrication and Tooling of Stainless Steel Connections and Embedments:

1. All tools used during fabrication shall be made of stainless steel. Use of carbon steel tools is prohibited.

2. Welding of stainless steel shall conform to AWS A5.4, AWS B2.1 and AWS D1.1, using tungsten inert gas procedures and 316L filler metal for stainless steel to stainless steel and 309 filler metal for stainless steel to carbon steel. Surfaces shall be sanded smooth (do not grind), and oxidized discoloration removed (blue heat tint). Threaded parts of stainless steel bolts shall be lubricated with graphite suspended in alcohol (**Neo-Lube**) every time that nut is run on or off the threads. No other lubricant is acceptable.

3. Erection slings, cables, blocking, hardware and restraints shall be nonmetallic or stainless steel. Cribbing or crating shall be wood.

2.6 FINISH OF PRECAST UNITS

A. **Backs and Sides (Unexposed Edges):** Smooth, dense, uniform surface free from blemishes. Defects in backs and sides (unexposed edges) shall be repaired as approved.

PART 3 -- EXECUTION

3.1 INSTALLATION

A. **Examination:** The CONTRACTOR shall verify that building structure, anchors, devices, and openings are ready to receive work of this Section. Beginning of installation means acceptance of existing condition.

B. **Preparation:** The CONTRACTOR shall provide for erection procedures and induced loads, during erection, maintain temporary bracing in place until final support is provided, provide necessary hoisting equipment and safety and protective devices.

C. Erection:

1. The units shall be erected in accordance with approved shop/erection drawings without damage to shape or finish or adjacent work. Damaged precast units shall be replaced or repaired. Unless otherwise shown, members shall be erected level and plumb within allowable tolerances.

2. The CONTRACTOR shall align and maintain uniform horizontal and vertical joints as erection progresses, provide approved shims and wedges as required, and when members required adjustment beyond design or tolerance criteria, discontinue affected work. Units shall be secured in place and field welds, scratches and otherwise damaged steel surfaces shall be touched up.

3. Field fabrication and erection of stainless steel shall conform to the procedures outlined in the paragraph entitled "Fabrication and Tooling of Stainless Steel Connectors and Embedments."

4. The vertical units shall be set dry, without grout, attaining joint dimension with lead or plastic shims and spacers.

5. Pickup points, boxouts, inserts and bearing surfaces shown shall be grouted with non-shrink grout in accordance with Section 03315 - Grout. The color and texture of concrete surfaces of adjacent areas shall be finished to match in the same plane.

D. **Tolerances:** In accordance with requirements of PCI MNL-117 unless otherwise indicated.

1. Variation from Plane of Location: 1/4-inch in 10 feet and 3/8-inch in 100 feet maximum, compensating not cumulative.

2. Offset from True Alignment between Two Connecting Members: 1/4-inch maximum.

3. Out of Square: 1/8-inch in 10 feet maximum, noncumulative.

4. Variation in Dimensions Indicated in Shop Drawings: Plus or minus 1/8-inch.

5. Misalignment of Anchors, Inserts, Openings: 1/8-inch, maximum.

6. Bowing or Warpage of Units: 1/700 of panel dimension.

7. Exposed Joint Dimension: 3/4-inch plus or minus 1/8-inch.

8. Location of Reglets: 1/4-inch from true position.

E. **Joint Sealing:** Specified in Section 07920 - Sealants and Caulking.

3.2 CLEANING

A. Not sooner than 72 hours after joints are sealed, faces and other exposed surfaces of precast units shall be cleaned using a cleaning detergent recommended by the sealer manufacturer and water applied with a soft bristle brush, and thoroughly rinsed using clean water or other approved procedures.

B. Units shall be cleaned when temperature and humidity conditions are such that surfaces dry rapidly (e.g., 70 degrees F and rising, 50 percent RH or less).

C. Discolorations which cannot be removed by these procedures shall be considered defective work, and repaired or replaced as directed by ENGINEER.

3.3 PROTECTION

A. Adjacent surfaces shall be protected from damage during sealing and cleaning operations and against damage, disfiguration or discoloration from subsequent operations. Noncombustible shielding shall be used during welding operations.

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