

SECTION 03 45 00
PRECAST ARCHITECTURAL CONCRETE

PART 1 - GENERAL

1.1 DESCRIPTION

This section includes the performance criteria, materials, production, and erection of architectural precast concrete cladding and load bearing units. The work performed under this section includes all labor, material, equipment, related services, and supervision required for the manufacture and erection of the architectural precast concrete work shown on the contract drawings and includes the following:

1. Sign posts.
2. Ossuary privacy wall (CORE)

1.2 RELATED WORK

- A. Materials testing and inspection during construction: Section 01 45 29, TESTING LABORATORY SERVICES.
- B. Concrete: Section 03 30 53, SHORT FORM CAST-IN-PLACE CONCRETE.
- C. Precast Columbarium Units: Section 03 48 24 PRECAST CONCRETE COLUMBARIUM UNITS.
- D. Mortar: Section 04 05 13, MASONRY MORTARING Section 04 05 16, MASONRY GROUTING.
- E. Masonry Facing: Section 04 20 00, UNIT MASONRY.
- F. Natural Stone Veneer: Section 04 43 00 NATURAL STONE VENEER.
- G. Sealants and Caulking: Section 07 92 00, JOINT SEALANTS.

1.3 QUALITY ASSURANCE

- A. Fabricator Qualifications: A firm that complies with PCI MNL 117 and the following requirements and is experienced in producing units similar to those indicated for this Project and with a record of successful in-service performance:
 1. Assumes responsibility for engineering units to comply with performance requirements. A Comprehensive Engineering Analysis shall be performed by a qualified professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated.
 2. Participates in any nationally recognized Plant Certification program at the time of bidding.
 3. Has sufficient production capacity to produce required units without delaying the work.
- B. Erector Qualifications:

1. An erector with a minimum of 2 years of experience who has completed architectural precast concrete work similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance and who meets the following requirements:
 - a. Retains a nationally recognized Certified Field Auditor, at erector's expense, to conduct a field audit of a project in the same category as this Project prior to start of erection. Submits Erectors Post Audit Declaration.
 - b. The basis of the audit is the PCI MNL 127.
- C. Quality-Control Standard: For manufacturing procedures and testing requirements, quality-control recommendations, and dimensional tolerances for types of units required, comply with PCI MNL 117.
- D. Sample Panels: After sample approval and before fabricating units, produce a minimum of two sample panels 16 sq. ft. in size for review by COR. Incorporate full scale details of architectural features, finishes, textures, and transitions in the sample panels. Approved sample panel may be used for mockup and range sample.
 1. Locate panels where indicated or, if not indicated, as directed by COR.
 2. Damage part of an exposed-face surface for each finish, color, and texture, and demonstrate adequacy of repair techniques proposed for repair of surface blemishes.
 3. After acceptance of repair technique, maintain one sample panel at the manufacturer's plant and one at the project site in an undisturbed condition as a standard for judging the completed work.
 4. When back face of precast concrete unit is to be exposed, show samples of the workmanship, color, and texture of the backup concrete as well as the facing.
 5. Demolish and remove sample panels only when directed.
- E. Range Samples: After sample panel approval and before production of units, produce a minimum of three samples, approximately 1.5 sq. m. (16 sq. ft.) in size, representing anticipated range of color and texture on project's units. Following range sample acceptance by the COR, maintain samples at the manufacturer's plant as color and texture acceptability reference.
- F. Mockups: After sample approval but before production of units, construct full sized mockups to verify selections made under sample Submittals and to demonstrate aesthetic effects and qualities of materials and execution. Mockup to be representative of the finished work in all respects including sealants and architectural precast concrete complete with all anchors, connections, flashings, and joint fillers as accepted on the

final shop drawings. Build mockups to comply with the following requirements, using materials indicated for the completed work:

1. Build mockups in the location and of the size indicated or, if not indicated, as directed by COR.
 2. Notify COR in advance of dates and times when mockups will be constructed.
 3. Obtain COR's approval of mockups before starting fabrication.
 4. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
 5. Demolish and remove mockups when directed.
- G. Pre-installation Conference: Conduct conference at Project site to comply with requirements in Division 01, GENERAL REQUIREMENTS.

1.4 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide units and connections capable of withstanding: the design criteria specified on the drawings, self weights and weights of materials supported or attached, for the conditions indicated.
1. Design Standards: Comply with ACI 318 (ACI 318M) and the design recommendations of PCI MNL 120, applicable to types of units indicated.
 2. Limit deflection of precast members as follows:
 - Vertical live load - $\text{Span} / 360$.
 - Wind load - Floor to floor height times 0.0025.
 3. Design for handling, transportation and erection stresses.
- B. Design framing system and connections to maintain clearances at openings, to allow for fabrication and construction tolerances, to accommodate live load deflection, shrinkage and creep of primary building structure, and other building movements.
- C. Thermal Movements: Provide for in-plane thermal movements resulting from annual ambient temperature changes of 27 deg C (80 deg F) Insert. Use other values, greater or smaller, whenever justified by climatic conditions at the project site.
- D. Calculated Fire-Test-Response Characteristics: Where indicated, provide units whose fire resistance has been calculated according to PCI MNL 124, and is acceptable to authorities having jurisdiction.

1.5 SUBMITTALS

- A. Product Data: For each type of product indicated. Retain quality control records and certificates of compliance for 5 years or period of warranty, whichever is greater.

- B. Design Mixes: For each concrete mix along with compressive strength and water-absorption tests.
- C. Shop (Erection) Drawings: Detail fabrication and installation of units.
 - 1. Indicate member locations with distinctive marks that match marks placed on the panels. Provide plans, elevations, dimensions, corner details, shapes, cross sections and relationships to adjacent materials including special reinforcement and lifting devices necessary for handling and erection.
 - 2. Indicate aesthetic intent including joints, reveals, and extent and location of each surface finish.
 - 3. Indicate separate face and backup mix locations, and thicknesses. Indicate locations, extent and treatment of dry joints if two-stage casting is proposed.
 - 4. Indicate welded connections by AWS standard symbols. Detail loose and cast-in hardware, and connections.
 - 5. Indicate locations, tolerances and details of anchorage devices to be embedded in or attached to structure or other construction.
 - 6. Indicate sequence of erection.
- D. Comprehensive Engineering Analysis: Provide calculations signed and sealed by the qualified professional engineer responsible for the product design. Show governing panel types, connections, and types of reinforcement, including special reinforcement. Indicate design criteria and loads. Indicate the location, type, magnitude and direction of all imposed loadings from the precast system to the cast in place foundation connection design to be by pre-cast manufacture - see also structural drawings.
- E. Samples: Design reference samples for initial verification of design intent, approximately 300 by 300 by full depth (12 by 12 by full depth representative of finishes, color, and textures of exposed surfaces of units.
- F. Samples for each facing unit required, showing the full range of color and texture expected. Supply sketch of each corner or special shape with dimensions. Supply sample showing color and texture of joint treatment.
 - 1. Precast units will be inspected at the site. Units which demonstrate lesser quality than accepted samples (outside the ranges established by the submitted and approved samples) shall not be acceptable.
 - 2. Submit non-shrink grout and sealants and caulk to be used with approved cap stones and obtain approval before manufacture of cap stones starts.
- G. Welding Certificates: Copies of certificates for welding procedure specifications (WPS) and personnel.

- H. Qualification Data for fabricator and professional engineer: List of completed projects with project names and addresses, names and addresses of COR and owners, and other information specified.
- I. Material Test Reports: From a qualified testing agency indicating and interpreting test results of the following for compliance with requirements indicated:
 - 1. Concrete strengths and mix designs.
- J. Material Certificates: Signed by manufacturers certifying that each of the following items complies with requirements.
 - 1. Concrete materials.
 - 2. Reinforcing materials.
 - 3. Admixtures.
 - 4. Bearing pads.
 - 5. Facing units.
 - 6. Anchors.

1.6 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Product handling requirements of PCI MNL 117 shall be followed at the plant and project site.
- B. Deliver all units to the project site in such quantities and at such times to assure compliance with the agreed project schedule and proper setting sequence so as to limit unloading units temporarily on the ground.
- C. Lift and support units only at designated points shown on the Shop Drawings.
- D. Furnish loose connection hardware and 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.
- E. Carefully handle, transport, and store precast members to prevent damage of any kind. Broken, chipped, stained, or damaged units will be subject to rejection unless permission to repair such defects is obtained in writing from the Owner's designated representative. Members may be shipped after attaining 90% of specified ultimate compressive strength, but not before reaching an age of 7 days.
- F. Units damaged after erection shall be either repaired or replaced as determined by the Owner's designated representative. No repairs shall be made until the damaged unit has been examined by the Owner's designated representative and a proposed repair procedure has been submitted to, and accepted by, the Owner's designated representative in writing. The Owner's designated representative may require that repairs be made by the manufacturer. Costs for repair work shall be borne by the Contractor.

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- G. Cover precast units to protect from soiling or damage by subsequent building operations, using reinforced building paper or other material acceptable to the Owner's designated representative.

1.7 WARRANTY

- A. Warranty of precast concrete work, including anchorage, joint treatment and related components to be free from defects in materials and workmanship, including cracking and spalling.
- B. After erection, completed work will be weathertight, subject to terms of Article "Warranty of Construction" FAR clause 52.246-21, except warranty period is extended to five years.

1.8 APPLICABLE PUBLICATIONS

- A. Publications listed below form a part of specification to extent referenced. Publications are referenced in text by basic designation only.
- B. American Society for Testing and Materials (ASTM):
 - A27/A27M-08.....Steel Castings, Carbon, for General Application
 - A36/A36M-08.....Carbon Structural Steel
 - A47/A47M-99(R2009)...Ferritic Malleable Iron Castings
 - A82-07.....Steel Wire, Plain, for Concrete Reinforcement
 - A108-07.....Steel Bar, Carbon and Alloy, Cold-Finished
 - A123/A123M-09.....Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
 - A153/A153M-09.....Zinc Coating (Hot-Dip) on Iron and Steel Hardware
 - A167-99(R2009).....Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
 - A184/A184M-05.....Fabricated Deformed Steel Bar Mats for Concrete Reinforcement
 - A185-07.....Steel Welded Wire Fabric, Plain, for Concrete Reinforcement
 - A276-10.....Stainless Steel Bars and Shapes
 - A283/A283M-03(R2007).Low and Intermediate Tensile Strength Carbon Steel Plates
 - A307-07.....Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength
 - A325/A325M-10.....Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
 - A416/A416M-10.....Steel strand, Uncoated Seven-Wire for Prestressed Concrete

A490/A490M-10.....Structural Bolts, Alloy Steel, Heat Treated, 150
ksi Minimum Tensile Strength
A496-07.....Steel Wire, Deformed, for Concrete Reinforcement
A497-07.....Steel Welded Wire Reinforcement, Deformed, for
Concrete
A500-10.....Cold-Formed Welded and Seamless Carbon Steel
Structural Tubing in Rounds and Shapes
A563/A563M-07.....Carbon and Alloy Steel Nuts
A572/A572M-07.....High-Strength Low-Alloy Columbium-Vanadium
Structural Steel
A615/A615M-09a.....Deformed and Plain Billet-Steel Bars for Concrete
Reinforcement
A666-03.....Annealed or Cold-Worked Austenitic Stainless Steel
Sheet, Strip, Plate, and Flat Bar
A675/A675M-03 (R2009). Steel Bars, Carbon, Hot-Wrought, Special Quality,
Mechanical Properties
A706/A706M-09.....Low-Alloy Steel Deformed and Plain Bars for
Concrete Reinforcement
A767/A767M-09.....Zinc-Coated (Galvanized) Steel Bars for Concrete
Reinforcement
A775/A775M-07.....Epoxy-Coated Steel Reinforcing Bars
A780-09.....Repair of Damaged and Uncoated Areas of Hot-Dip
Galvanized Coatings
A884/A884M-06.....Epoxy-Coated Steel Wire and Welded Wire Fabric for
Reinforcement
A934/A934M-07.....Epoxy-Coated Prefabricated Steel Reinforcing Bars
B227-04.....Hard-Drawn Copper-Clad Steel Wire
B633-07.....Electrodeposited Coatings of Zinc on Iron and
Steel
C33-08.....Concrete Aggregates
C40-04.....Organic Impurities in Fine Aggregate for Concrete
C150-09.....Portland Cement
C260-06.....Air-Entraining Admixtures for Concrete
C330-09.....Lightweight Aggregates for Structural Concrete
C373-88 (R2006).....Test Method for Water Absorption, Bulk Density,
Apparent Porosity, and Apparent Specific Gravity
of Fired Whiteware Products
C494/C494M-10.....Chemical Admixtures for Concrete
C618-08a.....Coal Fly Ash and Raw or Calcined Natural Pozzolan
for Use as a Mineral Admixture in Concrete

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- C881/C881M-02.....for Epoxy-Resin-Base Bonding Systems for Concrete
- C979-05.....Pigments for Integrally Colored Concrete
- C989-09.....Ground Granulated Blast-Furnace Slag for Use in
Concrete and Mortars
- C1017/C1017M-07.....Chemical Admixtures for Use in Producing Flowing
Concrete
- C1107-08.....Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
- C1218/C1218M-99 (R2008) Test Method for Water-Soluble Chloride in Mortar
and Concrete
- C1240-05.....Silica Fume Used in Cementitious Mixtures
- D412-06ae2.....Test Methods for Vulcanized Rubber and
Thermoplastic Elastomers-Tension
- D2240-05.....Test Method for Rubber Property-Durometer Hardness
- F436/F436M-09.....Hardened Steel Washers
- F568M-07.....Carbon and Alloy Steel Externally Threaded Metric
Fasteners
- F593-02 (R2008).....Stainless Steel Bolts, Hex Cap Screws, and Studs
- F844-07a.....Washers, Steel, Plain (Flat), Unhardened for
General Use
- C. American Concrete Institute (ACI):
 - ACI 211.1-91.....Selecting Proportions for Normal, Heavyweight and
Mass Concrete (Reapproved 2002)
 - ACI 318/318M-08 (318R/318RM-08) Building Code Requirements for
Structural Concrete
- D. American Association of State Highway and Transportation Officials
 - AASHTO LRFD-2010.....LRFD Bridge Design Specifications, U.S., 5th
Edition
 - AASHTO M251-06.....Elastomeric Bearings
- E. Precast/Pre-stressed Concrete Institute (PCI):
 - MNL-117-96.....Quality Control for Plants and Production of
Architectural Precast Concrete Products
 - MNL-120-04.....Design Handbook - Precast and Prestressed Concrete
 - MNL-124-04.....Design for Fire Resistance of Precast Prestressed
Concrete.
 - MNL-127-99.....Erector's Manual - Standards and Guidelines for
the Erection of Precast Concrete Products
 - MNL-135-00.....Tolerance Manual for Precast and Prestressed
Concrete Construction
 - TR-6-03.....Interim Guidelines for the Use of Self-
Consolidating Concrete

F. Military Specifications (MIL. Spec):

MIL-C882E-89.....Cloth, Duck, Cotton or Cotton-Polyester Blend
Synthetic Rubber, Impregnated, and Laminated, Oil
Resistant.

G. Structural Steel Painting Council (SSPC):

SSPC-Paint 20 (2002).Zinc-Rich Primers (Type I, Inorganic, and Type II,
Organic).

PART 2 - PRODUCTS

2.1 MOLD MATERIALS

A. Molds: Rigid, dimensionally stable, non-absorptive material, warp and buckle free, that will provide continuous and true precast concrete surfaces within fabrication tolerances indicated; non-reactive with concrete and suitable for producing required finishes:

1. Mold-Release Agent: Commercially produced liquid-release agent.

B. Units of face design, texture, arrangement, and configuration indicated.

C. Reinforcement dowels and connections shall be securely and accurately placed as shown on the Drawings. Connection hardware shall be rigidly attached to the forms, or otherwise positively prevented from moving in any direction. Means of support shall be subject to the approval of the Owner's designated representative.

D. In general, forms may be designed with a draft of 1/8" in 12", and all forms may have 1/8" radius corners to facilitate removal and reduce breakage.

2.2 REINFORCING MATERIALS

A. Reinforcing Steel: ASTM A615/A615M, Grade 60 (Grade 420), deformed.

B. Weldable Reinforcing Bars: ASTM A706/A706M, deformed.

1. Deformed-Steel Welded Wire Reinforcement: ASTM A497, flat sheet.

C. Plain Steel Wire: ASTM A 82, as drawn

D. Plain Steel Welded Wire Fabric: ASTM A185

E. Supports: Place reinforcement according to PCI MNL 117.

2.3 CONCRETE MATERIALS

A. Portland Cement: ASTM C150, Type I or III.

B. Normal-Weight Aggregates: Except as modified by PCI MNL 117, ASTM C33, with coarse aggregates complying with Class 5S

Fine aggregate: ASTM C33; Washed, inert sand with color characteristics to produce concrete of a color which exactly matches the designated sample (silica sands required).

- C. Admixtures: Admixtures containing calcium chloride, or more than 0.15 percent chloride ions or other salts by weight of admixture are not permitted.
1. Coloring Admixture: ASTM C979, synthetic or natural mineral-oxide pigments or colored water-reducing admixtures, temperature stable and non-fading.
 2. Air Entraining Admixture: ASTM C260, certified by manufacturer to be compatible with other required admixtures.
 3. Water-Reducing Admixture: ASTM C494/C494M, Type A.
 4. Retarding Admixture: ASTM C494/C494M, Type B.
 5. Water-Reducing and Retarding Admixture: ASTM C494/C494M, Type D.
 6. High-Range, Water-Reducing Admixture: ASTM C494/C494M, Type F.
 7. High-Range, Water-Reducing and Retarding Admixture: ASTM C494/C494M, Type G.
 8. Plasticizing Admixture for Flowable Concrete: ASTM C1017/C1017M.

2.4 STEEL CONNECTION MATERIALS

- A. Carbon-Steel Shapes and Plates: ASTM A36/A36M.
- B. Carbon-Steel Headed Studs: ASTM A108, Grades 1018 through 1020, cold finished of PCI MNL 117, Table 3.2.3.; AWS D1.1, Type A or B, with arc shields.
- C. Carbon-Steel Plate: ASTM A283/A283M.
- D. Malleable Iron Castings: ASTM A47/A47M. Grade 32510.
- E. Carbon-Steel Castings: ASTM A27/A27M, Grade U-60-30 (Grade 415-205).
- F. High-Strength, Low-Alloy Structural Steel: ASTM A572/A572M.
- G. Carbon-Steel Structural Tubing: ASTM A500, Grade B.
- H. Wrought Carbon-Steel Bars: ASTM A675/A675M, Grade 65 (Grade 450).
- I. Deformed-Steel Wire or Bar Anchors: ASTM A496 or ASTM A706/A706M.
- J. Carbon-Steel Bolts and Studs: ASTM A307, Grade A (ASTM F568M, Property Class 4.6) carbon-steel, hex-head bolts and studs; carbon-steel nuts (ASTM A563/A563M, Grade A); and flat, unhardened steel washers (ASTM F844).
- K. High-Strength Bolts and Nuts: ASTM A325/A325M or ASTM A490/A490M, Type 1, heavy hex steel structural bolts, heavy hex carbon-steel nuts, (ASTM A563/A563M) and hardened carbon-steel washers (ASTM F436/F436M).
- L. Finish: For exterior steel items and items indicated for galvanizing, apply zinc coating by hot-dip process according to ASTM A123/A123M, after fabrication, or ASTM A153/A153M, as applicable.
 1. Galvanizing Repair Paint: High-zinc-dust-content paint with dry film containing not less than 94 percent zinc dust by weight, and complying with SSPC-Paint 20.
- M. Welding Electrodes: Comply with AWS standards.

2.5 GROUT MATERIALS

- A. Non-metallic, Non-shrink Grout: Premixed, nonmetallic, noncorrosive, non-staining grout containing selected silica sands, portland cement, shrinkage-compensating agents, plasticizing and water-reducing agents, complying with ASTM C1107, Grade A for drypack and Grades B and C for flowable grout and of a consistency suitable for application within a 30-minute working time.

2.6 CONCRETE MIXES

- A. Prepare design mixes to match COR's sample for each type of concrete required.
 - 1. Limit use of fly ash and granulated blast-furnace slag to 20 percent replacement of Portland cement by weight.
- B. Design mixes shall be prepared by a qualified independent testing agency or by qualified precast plant personnel at fabricator's option.
- C. Limit water-soluble chloride ions to the maximum percentage by weight of cement permitted by ACI 318 (ACI 318M) or PCI MNL 117 when tested in accordance with ASTM C1218/C1218M.
- D. Proportion mixes by either laboratory trial batch or field test data methods according to ACI 211.1, with materials to be used on project, to provide normal-weight concrete with the following properties:
 - 1. Compressive Strength (28 Days): 34.5 MPa (5000 psi).
 - 2. Maximum Water-Cementitious Materials Ratio: 0.45.
 - 3. Release Strength at Transfer of Prestress: 24.1 MPa (3500 psi).
- E. Water Absorption: 6 percent by weight or 14 percent by volume, tested according to PCI MNL 117.
- F. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having an air content complying with PCI MNL 117.
- G. When included in design mixes, add other admixtures to concrete mixes according to manufacturer's written instructions.

2.7 MOLD FABRICATION

- A. Molds: Accurately construct and maintain molds, mortar tight, of sufficient strength to withstand pressures due to concrete-placement and temperature changes.
 - 1. Form joints are not permitted on faces exposed to view in the finished work.
 - 2. Edge and Corner Treatment: As indicated

3. Place form liners accurately to provide finished surface texture indicated. Provide solid backing and supports to maintain stability of liners during placing of concrete.
4. Coat contact surfaces of molds with release agent.

2.8 FABRICATION

- A. Cast-in Anchors, Inserts, Plates, Angles, and Other Anchorage Hardware: Fabricate anchorage hardware with sufficient anchorage and embedment to comply with design requirements. Accurately position for attachment of loose hardware and secure in place during precasting operations. Locate anchorage hardware where it does not affect position of main reinforcement or concrete placement.
- B. Furnish loose hardware items including steel plates, clip angles, seat angles, anchors, dowels, cramps, hangers, and other hardware shapes for securing units to supporting and adjacent construction.
- C. Cast-in reglets, slots, holes, and other accessories in units as indicated.
- D. Cast-in openings larger than 250 mm (10 inches) in any dimension.
- E. Reinforcement: Comply with recommendations in PCI MNL 117 for fabrication, placing, and supporting reinforcement.
 1. Place reinforcing steel and prestressing strand to maintain at least 19 mm (3/4 inch) minimum concrete cover. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position while placing concrete.
 2. Install welded wire reinforcement in lengths as long as practicable. Lap adjoining pieces at least one full mesh spacing and wire tie laps, where required by design. Offset laps of adjoining widths to prevent continuous laps in either direction.
 3. Built-In Items: Provide slots, holes, and other accessories in units to receive dowels and other similar work as indicated.
 4. Anchorages: Provide loose dowels and other miscellaneous steel shapes not provided by other trades, necessary for securing precast units to supporting and adjacent members.
- F. Pre-stress tendons for units by pre-tensioning methods. Comply with PCI MNL 117.
- G. Mix concrete according to PCI MNL 117 and requirements in this Section. After concrete batching, no additional water may be added.
- H. Place concrete in a continuous operation to prevent seams or planes of weakness from forming in precast concrete units. Comply with requirements in PCI MNL 117 for measuring, mixing, transporting and placing concrete.

- I. Identify pickup points of units and orientation in structure with permanent markings, complying with markings indicated on Shop Drawings. Imprint or permanently mark casting date on each unit on a surface that will not show in finished structure.
- J. Cure concrete, according to requirements in PCI MNL 117, // by moisture retention without heat // or by accelerated heat curing using low-pressure live steam // or radiant heat and moisture //.
- K. Repair damaged units to meet acceptability requirements of PCI MNL 117 and the COR.

2.9 FABRICATION TOLERANCES

- A. Fabricate units straight and true to size and shape with exposed edges and corners precise and true so each finished unit complies with PCI MNL 117 product tolerances as well as position tolerances for cast-in items.
 - 1. Additional Position Tolerances: For cast-in items measured from datum line location, as indicated on Shop Drawings.
 - a. Weld Plates: Plus or Minus 25 mm (1 inch).
 - b. Inserts: Plus or Minus 13 mm (1/2 inch).
 - c. Handling Devices: Plus or Minus 75 mm (3 inch).
 - d. reinforcing Steel or Wire Fabric in a structural location: Plus or Minus 6 mm (1/4 inch).
 - e. reinforcing Steel or Wire Fabric in a non-structural location: Plus or Minus 13 mm (1/2 inch).
 - f. reinforcing Steel extending out of a member: Plus or Minus 13 mm (1/2 inch).
 - g. Rustication Joints: Plus or Minus 3 mm (1/8 inch).
 - h. Openings: Plus or Minus 6 mm (1/4 inch).
 - i. Flashing Reglets: Plus or Minus 6 mm (1/4 inch).
 - j. Flashing Reglets, Panel Edge: Plus or Minus 3 mm (1/8 inch).
 - k. Rotation of Plate, Electrical Boxes or Channel Inserts: Plus or Minus 6 mm (1/4 inch) or 2 degrees.
- B. In addition to tolerances of individual elements required by American Concrete Institute Publication 533.3R, erection tolerances shall be as follows:
 - 1. Variation of anchors and fasteners from dimensions specified.....1/8-inch
 - 2. Variation in overall dimensions of precast element (height and width).....1/8-inch
 - 3. Maximum differential between adjacent units in erected position.....1/4-inch

- 4. Variation in thickness of precast panels and elements.....1/8-inch
- 5. Maximum vertical differential between adjacent columbarium units in installed position.....1/8-inch
- C. Fabricate architectural trim units such as sills, lintels, coping, cornices, quoins, medallions, bollards, benches, planters, and pavers, with tolerances meeting PCI MNL 135.

2.10 FINISHES

- A. Panel faces shall be free of joint marks, grain, and other obvious defects. Corners, including false joints shall be uniform, straight and sharp. Finish exposed-face surfaces of units to match approved sample panel mockups and as follows:
 - 1. Face-up Finishes (Interior Exposed):
 - a. All surfaces with interior exposure shall be cast face-up.
 - b. Provide face-up finish of panels on inside of a building with float finish followed with trowel finish.
 - c. Float Finish: Consolidate surface of plastic concrete with power-driven floats or by hand floating. Restraighten and cut down high spots and fill low spots. Repeat float passes and restraighten until surface is left with a uniform, smooth, granular texture.
 - d. Trowel Finish: After applying float finish, apply first trowel finish and consolidate plastic concrete by hand trowel or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and is uniform in texture and appearance.
 - 2. Face-Down Finishes (Exterior Exposed Surface)All surfaces with exterior exposure shall be cast face-down.
 - a. Smooth, As-Cast Finish: Where panel face is smooth, cast panel to produce a surface free of pockets, sand streaks, and honeycombs. Produce a surface appearance of uniform color and texture.
 - b. Form-Liner Finish: Where panel face is fluted texture, cast panel over form liners placed, secured, and sealed over casting slab to produce a textured surface free of pockets, streaks, and honeycombs. Produce a surface appearance of uniform color and texture.

2.11 SOURCE QUALITY CONTROL

- A. Quality-Control Testing:
 - 1. Test and inspect precast concrete according to Section 01 45 29, TESTING LABORATORY SERVICES and PCI MNL 117 requirements respectively.

2. If using self-consolidating concrete also test and inspect according to PCI TR-6.
 3. Strength of precast panels must meet the requirements of ACI 318.
- B. Testing: If there is evidence that the concrete strength of precast concrete units may be deficient, Precaster will employ an independent testing agency to obtain, prepare, and test cores drilled from hardened concrete to determine compressive strength according to PCI MNL 117:
1. Test results will be made in writing on the same day that tests are performed, with copies to COR, Contractor, and precast concrete fabricator. Test reports will include the information required in Section TESTING LABORATORY SERVICES and the following:
 - a. Identification mark and type of precast concrete units represented by core tests; design compressive strength; type of break; compressive strength at breaks, corrected for length-diameter ratio; and direction of applied load to core in relation to horizontal plane of concrete as placed.
- C. Defective or Damaged Work: Units that do not comply with acceptability requirements, including concrete strength, manufacturing tolerances, and color and texture range are unacceptable. Chipped, spalled or cored units may be repaired, if repaired units match the visual mock-up. The COR reserves the right to reject any unit if it does not match the accepted samples and visual mock-up. Replace unacceptable units with precast concrete units that comply with requirements.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Prior to installation of any of the work in this section, Contractor shall inspect the planned installation locations to insure that conditions are not significantly different from those indicated on the contract drawings. All materials shall be inspected prior to installation to insure compliance with the contract documents and to insure there is no damage. Should conditions be different from those indicated on the contract documents, contractor shall immediately notify the Owner's designated representative.
- B. All Material must be checked upon receipt at the job site prior to installation to check for any damage that may have occurred during transport.
- C. Deliver anchorage devices that are embedded in or attached to the building structural frame or foundation before start of such work. Provide

locations, setting diagrams, and templates for the proper installation of each anchorage device.

- D. Examine supporting structural frame or foundation and conditions for compliance with requirements for installation tolerances, true and level bearing surfaces, and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.
- E. Do not install units until supporting cast-in place concrete foundation has attained minimum allowable design strength or other structure is structurally ready to receive loads from precast.

3.2 ERECTION

- A. Erect level, plumb and square within the specified allowable tolerances. Provide temporary supports and bracing as required to maintain position, stability, and alignment of units until permanent connections are completed.
 - 1. Install temporary steel or plastic spacing shims or bearing pads as precast concrete units are being erected. Tack weld steel shims to each other to prevent shims from separating.
 - 2. Maintain horizontal and vertical joint alignment and uniform joint width as erection progresses.
 - 3. Remove projecting lifting devices and use sand-cement grout to fill voids within recessed lifting devices flush with surface of adjacent precast concrete surfaces when recess is exposed.
 - 4. Unless otherwise shown provide for uniform joint widths as shown on plan.
- B. Connect units in position by bolting, welding, grouting, or as otherwise indicated on approved Erection Drawings. Remove temporary shims, wedges, and spacers as soon as practical after connecting and/or grouting are completed.
 - 1. Disruption of roof flashing continuity by connections is not permitted; concealment within roof insulation is acceptable.
 - 2. Welding: Comply with applicable requirements for welding.
 - a. Protect units and bearing pads from damage by field welding or cutting operations and provide noncombustible shields as required.
 - b. Welds not specified shall be continuous fillet welds, using not less than the minimum fillet as specified by AWS.
 - c. Clean weld affected metal surfaces and apply a minimum 100 μ m (0.004 inch) thick coat of galvanized repair paint to galvanized surfaces in conformance with ASTM A780.

- d. Visually inspect all welds critical to precast connections.
Visually check all welds for completion and remove, reweld or repair all defective welds.
3. At bolted connections, use lock washers, tack welding, or other acceptable means to prevent loosening of nuts after final adjustment.
 - a. Where slotted connections are used, verify bolt position and tightness. For sliding connections, properly secure bolt but allow bolt to move within connection slot. For friction connection apply specified bolt torque and check 25 percent of bolts at random by calibrated torque wrench.
4. Grouting Connections: Grout connections where required or indicated. Retain grout in place until hard enough to support itself. Pack spaces with stiff grout material, tamping until voids are completely filled. Place grout to finish smooth, level, and plumb with adjacent concrete surfaces. Promptly remove grout material from exposed surfaces before it affects finishes or hardens.
- C. Attachments: Upon approval of COR, precast pre-stressed products may be drilled or "shot" for fasteners or small openings. Provided reinforcing or pre-stressing steel is not damaged or cut.
 1. Should spalling occur, repair according to this specification section.
- D. Setting: Where shown, fill joints with cement mortar specified in Section 04 05 13, MASONRY MORTARING Section 04 05 16, MASONRY GROUTING.
 1. Clean surfaces forming beds and other joints for precast concrete panels of dust, dirt, and other foreign matter, and wet thoroughly to prevent suction before precast concrete, elements are set.
 2. Set precast element level and true to line with uniform joints filled completely with mortar.
Rake out joints 25 mm (1-inch) deep for pointing or sealants.
Joints required to have only sealant: Kept free of mortar for full depth.
 3. Keep exposed faces of precast concrete elements free of mortar.
 4. Remove wedges, spacers, or other appliances which are likely to cause staining from joints.
 5. Where parging is shown, parge back of elements solid with mortar.
Apply parging without skips or holidays.
- E. Pointing: Wash and brush clean, leaving joints free from loose mortar, dust and other foreign material.
 1. Carefully point with a slightly concave joint.
 2. Mortar for pointing as specified in Section 04 05 13, MASONRY MORTARING Section 04 05 16, MASONRY GROUTING. Use same material and color sand

used in fabrication of precast concrete elements when specified in Section 09 06 00, SCHEDULE FOR FINISHES.

- F. Sealing of Joints: Where shown and where required to make work watertight: clean, dry and seal joints between precast concrete elements and between precast elements and adjoining materials as specified in Section 07 92 00, JOINT SEALANTS.

3.3 ERECTION TOLERANCES

- A. Erect units level, plumb, square, true, and in alignment without exceeding the erection tolerances of PCI MNL 117, Appendix I.

3.4 FIELD QUALITY CONTROL

- A. Refer to Section 01 45 29, TESTING LABORATORY SERVICES.
- B. Testing agency will report test results promptly and in writing to Contractor and COR.
- C. Repair or remove and replace work that does not comply with specified requirements.
- D. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of corrected work with specified requirements.

3.5 REPAIRS

- A. Repairs will be permitted provided structural adequacy of units and appearance are not impaired.
- B. Mix patching materials and repair units so cured patches blend with color, texture, and uniformity of adjacent exposed surfaces and show no apparent line of demarcation between original and repaired work, when viewed in typical daylight illumination from a distance of 6 m (20 feet).
- C. Prepare and repair damaged galvanized coatings with galvanizing repair paint according to ASTM A780.
- D. Remove and replace damaged units when repairs do not meet requirements.

3.6 CLEANING

- A. Clean all surfaces of precast concrete to be exposed to view, as necessary, prior to shipping.
- B. Clean mortar, plaster, fireproofing, weld slag, and any other deleterious material from concrete surfaces and adjacent materials immediately.
- C. Clean exposed surfaces of precast concrete units after erection and completion of joint treatment to remove weld marks, other markings, dirt, and stains.
1. Perform cleaning procedures, if necessary, according to precast concrete fabricator's recommendations. Clean soiled precast concrete

- surfaces with detergent and water, using stiff fiber brushes and sponges, and rinse with clean water. Protect other work from staining or damage due to cleaning operations.
2. Do not use cleaning materials or processes that could change the appearance of exposed concrete finishes or damage adjacent materials.

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