

**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 combination tread and riser 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.

**1.2 RELATED WORK**

- A. Materials testing and inspection during construction: Section 01 45 29, TESTING LABORATORY SERVICES.
- B. Concrete: Section 03 30 00, CAST-IN-PLACE CONCRETE.
- C. Repair of abraded galvanized and painted surfaces: Section 09 91 00, PAINTING.

**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 PCI's Plant Certification program at the time of bidding and is designated a PCI-certified plant for Group A, Category A1- Architectural Cladding and Load Bearing Units.
  - 3. Has sufficient production capacity to produce required units without delaying the work.
- B. 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.

**CORCORGORCORGORCOR1.4 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) . Use other values, greater or smaller, whenever justified by climatic conditions at the project site.

### 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.
  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 building structural frame.

- E. Samples: Design reference samples for initial verification of design intent, approximately 300 by 300 by 50 mm (12 by 12 by 2 inches), representative of finishes, color, and textures of exposed surfaces of units.
- F. Samples for each 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.
- 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 CORs 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 and prestressing tendons.
  - 3. Admixtures.
  - 4. Bearing pads.
  - 5. Structural-steel shapes and hollow structural sections.
  - 8. 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.

#### **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-10.....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-06.....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
  - A307-10.....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-09.....Deformed and Plain Billet-Steel Bars for Concrete Reinforcement  
 A666-10.....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  
 B227-10.....Hard-Drawn Copper-Clad Steel Wire  
 B633-07.....Electrodeposited Coatings of Zinc on Iron and Steel  
 C33-11.....Concrete Aggregates  
 C40-04.....Organic Impurities in Fine Aggregate for Concrete  
 C150-09.....Portland Cement  
 C260-10.....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  
 C618-08.....Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Concrete  
 C881/C881M-10.....for Epoxy-Resin-Base Bonding Systems for Concrete  
 C979-10.....Pigments for Integrally Colored Concrete  
 C989-10.....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  
 C1240-10.....Silica Fume Used in Cementitious Mixtures  
 D412-06.....Test Methods for Vulcanized Rubber and Thermoplastic Elastomers—Tension

- D2240-05(R2010).....Test Method for Rubber Property—Durometer Hardness  
 F436/F436M-10.....Hardened Steel Washers  
 F568M-07.....Carbon and Alloy Steel Externally Threaded Metric Fasteners  
 F593-02(R2008).....Stainless Steel Bolts, Hex Cap Screws, and Studs  
 F844-07.....Washers, Steel, Plain (Flat), Unhardened for General Use
- C. American Concrete Institute (ACI):  
 ACI 211.1-91(R2009)..Selecting Proportions for Normal, Heavyweight and Mass Concrete (Reapproved 2002)  
 ACI 318-11.....Building Code Requirements for Structural Concrete
- D. American Association of State Highway and Transportation Officials  
 AASHTO LFRD-2010.....LRFD Bridge Design Specifications, U.S., 3rd Edition  
 AASHTO M251-06.....Elastomeric Bearings
- E. Precast/Prestressed 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-124-08.....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, nonabsorptive 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 that will not bond with, stain or adversely affect precast concrete surfaces and will not impair subsequent surface or joint treatments of precast concrete.

## **2.2 REINFORCING MATERIALS**

- A. Reinforcing Steel: ASTM A615/A615M, Grade 60 (Grade 420), deformed.
- B. Weldable Reinforcing Bars: ASTM A706/A706M, deformed.
  1. Galvanized Reinforcing Bars: ASTM A767/A767M, Class II zinc coated, hot-dip galvanized and chromate wash treated after fabrication and bending.
  2. Epoxy-Coated Reinforcing Bars: ASTM A775/A775M or ASTM A934/A934M.
  3. Steel Bar Mats: ASTM A184/A184M, assembled with clips.
    - a. Plain-Steel Welded Wire Reinforcement: ASTM A185, fabricated from galvanized and chromate wash treated steel wire into flat sheets.
- C. Supports: Suspend reinforcement from back of mold or use bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place according to PCI MNL 117.

## **2.3 CONCRETE MATERIALS**

- A. Portland Cement: ASTM C150, Type I or III.
  1. For surfaces exposed to view in finished structure, use white, same type, brand, and mill source throughout the precast concrete production.
- B. Normal-Weight Aggregates: Except as modified by PCI MNL 117, ASTM C33, with coarse aggregates complying with Class 5S. Provide and stockpile fine and coarse aggregates for each type of exposed finish from a single source (pit or quarry) for entire project.
  1. Face-Mix Coarse Aggregates: Selected, hard, and durable; free of material that reacts with cement or causes staining; to match selected finish sample.
    - a. Gradation Uniformly graded .
    - b. Hard durable granite carefully graded from coarse to fine in proportions required to match approved samples. //
  2. Face-Mix Fine Aggregates: Selected, natural or manufactured sand of the same material as coarse aggregate, unless otherwise approved by COR.
- 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.
- D. Water: Potable; free from deleterious material that may affect color stability, setting, or strength of concrete and complying with chemical limits of PCI MNL 117.

#### **2.4 STEEL CONNECTION MATERIALS**

- A. Carbon-Steel Shapes and Plates: ASTM A36/A36M except silicon (Si) content in the range of 0 to 0.03% or 0.15 to 0.25% for materials to be galvanized. Steel with chemistry conforming to the formula  $Si + 2.5P \leq 0.09$  is also acceptable.
- B. Carbon-Steel Plate: ASTM A283/A283M.
- C. 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).
- D. 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).
- E. 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.
- F. Welding Electrodes: Comply with AWS standards.

#### **2.6 BEARING PADS AND OTHER ACCESSORIES**

- A. Provide bearing pads for units as follows:
  1. Elastomeric Pads: AASHTO M251, plain, vulcanized, 100 percent polychloroprene (neoprene) elastomer, molded to size or cut from a molded sheet, 50 to 70 Shore A durometer according to ASTM D2240, minimum tensile strength 15.5 MPa (2250 psi) per ASTM D412.
  2. Random-Oriented, Fiber-Reinforced Elastomeric Pads: Preformed, randomly oriented synthetic fibers set in elastomer. Surface hardness of 70 to 90 Shore A durometer according to ASTM D2240. Capable of supporting a compressive stress of 20.7 MPa (3000 psi) with no cracking, splitting



or delaminating in the internal portions of the pad. Test one specimen for each 200 pads used in the project.

4. Frictionless Pads: Tetrafluoroethylene (teflon), glass-fiber reinforced, bonded to stainless or mild-steel plates, of type required for in-service stress.
5. High-Density Plastic: Multimonomer, nonleaching, plastic strip.
- B. Accessories: Provide clips, hangers, plastic or steel shims, and other accessories required to install units.

## **2.10 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; metakaolin and silica fume to 10 percent 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.

## **2.11 MOLD FABRICATION**

- A. Molds: Accurately construct and maintain molds, mortar tight, within fabrication tolerances and of sufficient strength to withstand pressures due to concrete-placement and vibration operations and temperature changes and for prestressing and detensioning operations.
  1. Form joints are not permitted on faces exposed to view in the finished work.
  2. Edge and Corner Treatment: Uniformly radiused.

3. Coat contact surfaces of molds with release agent before reinforcement is placed. Avoid contamination of reinforcement and prestressing tendons by release agent.

### 2.13 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.  
Weld headed studs and deformed bar anchors used for anchorage.
- 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. Do not drill or cut openings or reinforcing without approval of COR.
- 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.
- F. Mix concrete according to PCI MNL 117 and requirements in this Section. After concrete batching, no additional water may be added.
  1. A single design mix throughout the entire thickness of panel.
- G. 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.
- H. 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.
- I. 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.

## **2.15 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.

## **2.16 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 design reference sample and as follows:
  - 1. Exposed Aggregate Finish: Use chemical retarding agents applied to concrete forms and washing and brushing procedures to expose aggregate and surrounding matrix surfaces after form removal.
- B. Finish exposed bottom surfaces of units to match face-surface finish.

## **2.17 SOURCE QUALITY CONTROL**

- A. Quality-Control Testing: Test and inspect precast concrete according to Section 01 45 29, TESTING LABORATORY SERVICES and PCI MNL 117 requirements respectively. If using self-consolidating concrete also test and inspect according to PCI TR-6.
- 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. 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.
- B. 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.
- C. Do not install units until supporting steel 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.
- 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 µm (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.

### **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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