

Mid-States Concrete Industries  
STRUCTURAL PRECAST CONCRETE SPECIFICATIONS- STRUCTURAL GRAY WALL PANELS,  
BEAMS, COLUMNS, AND BALCONIES

**PART 1 GENERAL**

**1.1 DESCRIPTION**

- A. This specification covers the design, manufacture, transportation and erection of plant precast structural concrete units, including the following:
  - 1. Columns
  - 2. Beams
  - 3. Load Bearing Wall Panels (insulated, non-insulated)
  - 4. Balcony slabs

**1.2 PERFORMANCE REQUIREMENTS**

- A. Design: Design precast structural concrete units, including comprehensive engineering analysis under the direct supervision of/or by a qualified engineer registered in the state where the project is located, using performance requirements and design criteria indicated by the contract documents.
- B. Structural Performance: Precast structural concrete units and connections shall withstand design loads indicated within limits and under conditions set forth by the Architectural/Structural plans.
  - 1. Design precast structural concrete units and connections to allow for fabrication and construction tolerances.
  - 2. Allow for in-plane thermal movements resulting from annual ambient temperature changes.
  - 3. Design precast structural units to resist handling, transportation and erection stresses.

**1.3 SUBMITTALS**

- A. Product Data: For each type of product indicated. Retain quality control records and certificates of compliance for 5 years after completion of structure.
- B. Design Mixtures: For each concrete mix design, compressive strength test results are available upon request.

- C. Design Submittal: Fabricator's engineer has design responsibility, and shall prepare and seal all drawings and calculations, to comply with performance requirements and design criteria, for submittal. Submit design calculations to architect/contractor.
  
- D. Fabricator's Drawings: Include unit locations, plans, elevations, dimensions, shapes and sections, openings, support conditions, and types of reinforcement.
  - 1. Indicate joints, reveals, and extent and location of each surface finish.
  - 2. Indicate separate face and backup mixture locations and thicknesses.
  - 3. Indicate welded connections by AWS standard symbols. Show size, length, and type of each weld.
  - 4. Detail loose and cast-in hardware, lifting and erection inserts, connections, and joints.
  - 5. Indicate locations and details of anchorage devices to be embedded in or attached to structure or other construction.
  - 6. Include and locate openings larger than 10 inches by 10 inches. Core drilled and/or round openings not included.
  - 7. Indicate location of each precast structural concrete unit.
  - 8. Indicate relationship of precast structural concrete units to adjacent materials.
  - 9. Indicate design loads and applicable fire ratings.
  
- E. Product Samples:
  - 1. For wall panel units, product samples showing a typical range of texture and smoothness will be provided for review and approval at the fabricator's plant location. Wall panel finish descriptions are provided in section 2.14, Finishes.
  
- F. Welding Certificates. Available upon request.
  
- G. Material Certificates: Available upon request.
  - 1. Cementitious materials
  - 2. Reinforcing materials and prestressing tendons.
  - 3. Admixtures.
  - 4. Aggregates, fine and coarse.
  - 5. Other materials
  
- H. Material Test Reports: Available upon request.

#### **1.4 QUALITY ASSURANCE**

- A. Fabricator Qualifications: A firm that assumes responsibility for engineering precast structural concrete units to comply with performance requirements.

Responsibility includes preparation of Fabricator's Drawings and comprehensive engineering analysis.

- B. Participates in PCI's Plant Certification program and is designated a PCI-certified plant as follows:
  - a. Group A1, C3A, B3, and B3-IL certified. .
- C. Erector Qualifications: A precast concrete PCI Qualified Erector to erect Category S2.
- D. Design Standards: Comply with ACI 318 and design recommendations in PCI MNL 120, "PCI Design Handbook – Precast and Prestressed Concrete," applicable to types of precast structural concrete units indicated.
- E. Quality-Control Standard: For manufacturing procedures and testing requirements, quality-control recommendations, and dimensional tolerances for types of units required, comply with PCI MNL 116 or MNL 117, "Manual for Quality Control for Plants and Production of Structural Precast Concrete Products."
- F. Welding Qualifications: Qualify procedures and personnel according to the following:
  - 1. AWS D1.1/D.1.1M, "Structural Welding Code – Steel."
  - 2. AWS D1.4, "Structural Welding Code – Reinforcing Steel."
- G. Wall Panels: Before fabricating precast structural concrete wall units, samples will be reviewed and approved by the Architect, Owner or Owner's agent. Each sample will incorporate variations of finishes and textures. All precast concrete structural elements will show variable colors.

#### **1.5 DELIVERY, STORAGE, AND HANDLING**

- A. Support units during shipment on nonstaining shock-absorbing material in same position as during storage.
- B. Store units with adequate bracing and protect units to prevent contact with soil, to prevent staining, and to prevent cracking, distortion, warping or other physical damage.
  - 1. Store units with dunnage across full width of each bearing point unless otherwise indicated.
  - 2. Place adequate dunnage of even thickness between each unit.
  - 3. Place stored units so identification marks are clearly visible, and units can be inspected.

- C. Handle and transport units in a position consistent with their shape and design in order to avoid excessive stresses that would cause cracking or damage.
- D. Lift and support units only at designated points shown on Fabricator's Drawings.

## **1.6 COORDINATION**

- A. Furnish loose connection hardware and anchorage items to be embedded in or attached to other construction before starting that work. Provide locations, setting diagrams, templates, instructions, and directions, as required, for installation.

## **PART 2 PRODUCTS**

### **2.1 FORM MATERIALS**

- A. Forms: Rigid, dimensionally stable, warp and buckle free, that will provide continuous and true precast concrete surfaces within fabrication tolerances indicated; nonreactive with concrete and suitable for producing required finishes.
  - 1. Form-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 or precast concrete.

### **2.2 REINFORCING MATERIALS**

- A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.
- B. Low-Alloy-Steel Reinforcing Bars; ASTM A 706/A 706M, deformed.
- C. Plain-Steel Welded Wire Reinforcement: ASTM A 185, fabricated from as-drawn steel wire into flat sheets.
- D. Deformed-Steel Welded Wire Reinforcement: ASTM A 497/A 497M, flat sheet.
- E. Supports: Non-staining bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement will be in place according to PCI MNL 116.

### **2.3 PRESTRESSING TENDONS**

- A. Pretensioning Strand: ASTM A 416, Grade 250/270, uncoated, 7-wire strand.

## 2.4 CONCRETE MATERIALS

- A. Portland Cement: ASTM C 150, Type III, gray.
  - 1. For exterior surfaces exposed to view in finished structure, gray cement, of same type, brand, and mill source.
- B. White Cement for Architectural panels
- C. Supplementary Cementitious Materials:
  - 1. Fly Ash: ASTM C 618, Class C.
  - 2. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.
- D. Aggregates:
  - 1. Coarse Aggregates; Selected, hard, and durable; free of material that reacts with cement.
    - a. Gradation: Uniformly graded, to meet mix design requirements.
  - 2. Fine Aggregates: Selected, natural sand.
    - a. Gradation: Uniformly graded, to meet mix design requirements.
- E. Water: Complying with chemical limits of PCI MNL 116.
- F. Air-Entraining Admixture: ASTM C 260, certified by manufacturer to be compatible with other required admixtures.
- G. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures and to not contain calcium chloride, or more than 0.15 percent chloride ions or other salts by weight of admixture.
  - 1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
  - 2. Retarding Admixture: ASTM C 494/C 494M, Type B.
  - 3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
  - 4. Water-Reducing and Accelerating Admixture: ASTM C 494/C 494M, Type E.
  - 5. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
  - 6. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
  - 7. Plasticizing and Retarding Admixture; ASTM C 1017/C 1017M.

## 2.5 STEEL CONNECTION MATERIALS

- A. Carbon-Steel Shapes and Plates: ASTM A 36.

- B. Carbon-Steel-Headed Studs: ASTM A 108, AISI 1018 through AISI 1020, cold finished, AWS D1.1/D1.1M, Type A or B, with arc shields and with minimum mechanical properties of PCI MNL 116.
- C. Malleable-Iron Castings: ASTM A 47.
- D. High-Strength, Low-Alloy Structural Steel: ASTM A 572.
- E. Carbon-Steel Structural Tubing: ASTM A 500, Grade B.
- F. Deformed-Steel Wire or Bar Anchors: ASTM A 496 or ASTM A 706.
- G. Carbon-Steel Bolts and Studs; ASTM A 307, Grade A: carbon-steel, hex-head bolts and studs; carbon-steel nuts, ASTM A 563; and flat, unhardened steel washers, ASTM F 844.
- H. Zinc-Coated Finish: For exterior steel items exposed to weather and items indicated for galvanizing, apply zinc coating by cold galvanizing or hot-dip process according to ASTM A123.
- I. Welding Electrodes: Comply with AWS standards.
- J. Precast Accessories: Provide hangers, plastic or steel shims, and other accessories required to install precast structural concrete units.

## **2.6 BEARING PADS**

- A. Provide one of the following bearing pads for precast structural concrete units as recommended by precast fabricator for application:
  1. Elastomeric Pads: AASHTO M 251, plain, vulcanized, 100 percent polychloroprene (neoprene) elastomer, molded to size or cut from a molded sheet, 50 to 70 Shore, Type A durometer hardness, ASTM D 2240; minimum tensile strength 2250 psi (15.5 MPa), ASTM D 412.
  2. High-Density Plastic: Korolath, nonleaching, plastic strip.

## **2.7 GROUT MATERIALS**

- A. Sand-Cement Grout:
  1. Wall panels: Non-shrink, nonmetallic bag mix grout.
  2. Columns: Non-shrink, nonmetallic bag mix grout
  3. Beams: For grout tube connections; Non-shrink, high strength, fast setting bag mix grout

## **2.8 CONCRETE MIXTURES**

- A. Prepare design mixtures for each type of precast concrete required.
  - 1. Tertiary or Binary mix designs including Type III Portland cement, Class C Fly Ash and Blast Furnace slag will meet compressive strength design requirements as set by fabricator's design engineer.
- B. Design mixtures are prepared by qualified precast plant personnel.
- C. Concrete Mixtures: With the following properties:
  - 1. Compressive Strength (28 Days): Per design requirements.
- D. Air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having an air content complying with PCI MNL 116 and MNL117.
- E. When included in design mixtures, add other admixtures to concrete mixtures according to manufacturer's written instructions.

## **2.9 FORM FABRICATION**

- A. Form fabrication procedures shall be in general compliance with PCI MNL-116 or MNL117.
- B. Forms: Accurately construct forms of sufficient strength to withstand pressures due to concrete-placement operations and for prestressing and detensioning operations. Coat contact surfaces of forms with release agent before reinforcement is placed. Avoid contamination of reinforcement and prestressing tendons by release agent.
- C. Maintain forms to provide complete precast structural concrete units of shapes, lines, and dimensions indicated, within fabrication tolerances specified.
  - 1. Standard Edge and Corner Treatment:  
Wetcast beams, columns, balconies and wall panels - uniform  $\frac{3}{4}$ ",  
45 degree chamfer

## **2.10 FABRICATION**

- A. Cast-in Anchors, Inserts, Plates, Angles, and Other Anchorage Hardware: Install 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.

1. Weld-headed studs and deformed bar anchors used for anchorage according to AWS D1. 1/D1. 1M and AWS C5.4, " Recommended Practices for Stud Welding."
- B. Furnish loose hardware items including steel plates, anchors, dowels, clamps, hangers, and other hardware shapes for securing precast structural concrete units to supporting and adjacent construction.
- C. Cast-in openings:
  - a. Wall panels: No round openings. Cast-in openings larger than 10" in any dimension.
- D. Reinforcement: Comply with recommendations in PCI MNL 116 for fabricating, placing, and supporting reinforcement.
  1. Accurately position, support, and secure reinforcement against displacement during concrete-placement and consolidation operations.
  2. Place reinforcement according to engineered specifications. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position while placing concrete. Direct wire tie ends away from finished, exposed concrete surfaces.
  3. Place reinforcing steel and prestressing strand to maintain at least 3/4-inch minimum concrete cover unless otherwise specified by engineering and/or for production purposes
  4. Install welded wire fabric in lengths as long as practical. 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.
- E. Prestress tendons for precast structural concrete units by pretensioning methods. Comply with PCI MNL 116 or MNL 117.
  1. Delay detensioning of precast, prestressed structural concrete units until concrete has reached its indicated minimum design release compressive strength as established by PCI MNL 116 methods.
  2. Detension pretensioned tendons either by gradually releasing tensioning jacks or by heat cutting tendons, using a sequence and pattern to prevent shock or unbalanced loading.
- F. Comply with requirements in PCI MNL 116 or MNL 117 and in this Section for measuring, mixing, transporting, and placing concrete.



- G. Place concrete in a continuous operation to prevent seams or planes of weakness from forming in precast concrete units.
  - 1. Place backup concrete mixture to ensure bond with face- mixture concrete.
- H. Thoroughly consolidate placed concrete (when necessary using internal or external vibration) without dislocating or damaging reinforcement and built-in items, and minimize pour lines, honeycombing, or entrapped air on surfaces. Use equipment and procedures complying with PCI MNL 116 or MNL 117.
- I. Lifting points will be identified for wall panels, beams, columns and balconies. Orientation in the structure will be indicated on fabricator's drawings. The precast unit will be labeled including the casting date so that it will not show in finished structure.
- J. Cure concrete, according to requirements in PCI MNL 116 or MNL 117, by moisture retention without heat or by accelerated heat curing using low-pressure live steam or radiant heat and moisture. Cure units until compressive strength is high enough to ensure that stripping does not have an effect on performance or appearance of final product.
- K. Make necessary repairs to precast units according to PCI MNL 116 or MNL 117 to meet the structural, manufacturing tolerances, and finish requirements. If after review by the design engineer it is determined the precast concrete unit cannot be adequately repaired, discard and replace the precast structural concrete unit.

## **2.11 FABRICATION TOLERANCES**

- A. Fabricate precast structural concrete units straight and true to size and shape with exposed edges and corners precise and true so each finished unit complies with PCI MNL 116 or MNL 117 product dimension tolerances.

## **2.12 FINISHES**

- A. The following descriptions are set out in PCI MNL 116 or MNL 117 and apply to surface finishes of precast structural concrete wall panels, columns, beams and balconies. For wall panel units, product samples showing a typical range of texture and smoothness will be provided for review and approval at the fabricator's plant location.
- B. Unformed surface:
  - 1. Screed Finish: result of vibrating screed and additional hand finishing at projections. Normal color variations, minor chips and spalls shall be

- permitted. No major imperfections, honeycomb, or defects shall be permitted.
2. Standard Float Finish: result of vibrating screed and additional float finishing. Minor indentations, lines, and normal color variation shall be present.
  3. Steel Trowel Finish: in addition to the requirements for Screed Finish, a smooth hard steel trowel surface will be provided using either hand or power trowels. Normal color variations shall be present.
- C. Formed surface:
1. Commercial Grade: product will not be exposed in the completed structure. There may be some scaling and/or scouring. There may be patches and streaks of color variation within the surface, and the overall color tone may vary between pieces. Concrete may be produced in forms that impart a texture to the concrete, (e.g., plywood lumber or steel forms with offset joints, dents, or holes). The surface may contain air holes and water marks, and there may be some minor chips and spalls. Only honeycombed and/or badly spalled areas should be repaired.
  2. Standard Grade: product is exposed to view but the function of the structure does not require a special finish. This is the typical finish grade for all structural product. Small surface holes caused by air bubbles ("bug-holes"), normal color variations, normal form joint marks and minor chips and spalls are considered acceptable. Normal color variations, normal form joint marks and minor chips and spalls should be considered acceptable. No bug-holes larger than 1/2" in any direction should be permitted. Bug-holes between 1/4" and 3/8" in width that occur in high concentration (more than one per 2" squared) should be filled.
  3. Grade B Finish: product will be visually exposed. This surface is suitable for painting (especially with a textured or "sand" paint); however, some surface blemishes will be visible. All air pockets and holes over 1/4" in diameter shall be filled. All air holes between 1/8" and 1/4" in width that occur in high concentration (more than one per 2" square) should be filled. All chamfers and reveals will have a smooth, distinct edge with no deformation. Fins must be smaller than 1/8". Normal color variations may be present.

## 2.13 SOURCE QUALITY CONTROL

- A. Testing: Test and inspect precast structural concrete according to PCI MNL 116 requirements.

- B. Strength of precast structural concrete units will be considered deficient if units fail to comply with the design engineer's and/or fabricator's compressive strength requirements for each product type.

## **PART 3 EXECUTION**

### **3.1 EXAMINATION**

- A. Review site conditions for installation readiness.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.2 INSTALLATION**

- A. Install hangers, bearing pads, dowels, anchors and other accessories required for connecting precast structural concrete units to supporting members and backup materials as shown on fabricator's drawings.
- B. Erect precast structural concrete level, plumb, and square within PCI MNL 127 tolerances. For the precast units only, provide temporary structural framing, supports, and bracing as required to maintain position, stability, and alignment of precast units until permanent connection.
  - 1. Install temporary steel or plastic spacing shims or bearing pads as precast structural concrete units are being erected.
- C. Connect precast structural concrete units in position by bolting, welding, grouting, or as otherwise indicated on fabricator's drawings.
- D. Field cutting of precast units is not permitted without approval of the precast supplier.
- E. Fasteners: Drilled fasteners may be used for attaching accessory items to precast, prestressed concrete units. Do not cut reinforcing. Powder actuated fasteners are not to be used.
- F. Welding: Comply with applicable AWS D1.1/D1.1M and AWS D1.4 for welding, welding electrodes, appearance, quality of welds, and methods used in correcting welding work.
  - 1. Protect precast structural concrete units and bearing pads from damage by field welding or cutting operations, and provide noncombustible shields as required.
  - 2. Clean weld-affected steel surfaces with chipping hammer followed by brushing.

3. Remove, reweld, or repair incomplete and defective welds.
- G. Grouting: Grout connections and joints as indicated on fabricator's drawings. Retain grout in place until hard enough to support itself. Pack spaces with stiff grout material.
1. Fill joints completely without seepage to other surfaces.
  2. Promptly remove grout material from exposed surfaces before it affects finishes or hardens.

### **3.3 ERECTION TOLERANCES**

- A. Erect precast structural concrete units level, plumb, square, true, and in alignment without exceeding the noncumulative erection tolerances of PCI MNL 127.

### **3.4 REPAIRS**

- A. Repair precast structural concrete units according to PCI MNL 116.
1. Repairs will be permitted when structural adequacy of units will not be impaired.
- B. Mix patching materials and repair the units so cured patches blend with texture and relative smoothness of adjacent exposed surfaces.
- C. Prepare and repair damaged galvanized coatings with galvanizing repair paint according to ASTM A 780.
- D. Remove and replace damaged precast structural concrete units that cannot be repaired or when repairs do not comply with structural requirements as determined by the fabricator's design engineer.

### **3.5 CLEANING**

- A. By others:
1. Perform cleaning procedures, if necessary, according to precast concrete fabricator's written 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 affect the structural integrity of the precast concrete unit or damage adjacent materials.
  3. Snow removal: do not use calcium chloride material for melting snow and ice

END OF SECTION

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**PRECAST STRUCTURAL GRAY CONCRETE-WALL PANELS, BEAMS, COLUMNS, AND  
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