

**SECTION 03 41 33
PRECAST STRUCTURAL CONCRETE**

SPEC WRITER NOTE: Delete between //--// if not applicable to project. Also delete any other item or paragraph not applicable in the section and renumber the paragraphs.

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies precast structural concrete construction including delegated design, fabrication, erection, and other related items including bearing pads and anchorage. Precast concrete includes conventionally reinforced concrete and prestressed concrete products.
- B. Precast concrete includes // single tees // double tees // slabs // beams and spandrels // columns // I beams/box beams // tee/keystone joists // step units // ribbed wall panels //.

1.2 RELATED WORK

- A. Section 01 45 29, TESTING LABORATORY SERVICES: Materials testing and inspection during construction.
- B. Section 03 30 00, CAST-IN-PLACE CONCRETE: Concrete.
- C. Section 07 92 00, JOINT SEALANTS: Sealants and Caulking.
- D. Section 03 45 00, PRECAST ARCHITECTURAL CONCRETE: Architectural Precast Concrete Panels.
- E. Section 09 91 00, PAINTING: Repair of abraded galvanized and painted surfaces.

1.3 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Precast concrete manufacturing plant shall be certified by Precast/Prestressed Concrete Institute, Plant Certification Program, prior to start of production.
 - 1. Designated as a PCI-certified plant as follows:
 - a. Group C, [Category C1 - Precast Concrete Products (no prestressed reinforcement)] [Category C2 - Prestressed Hollowcore and Repetitively Produced Products] [Category C3 - Prestressed Straight Strand Structural Members]
- B. In lieu of above qualification, contractor shall meet and pay for following requirements:
 - 1. Retain an independent testing or consulting firm approved by the Contracting Officer's Representative (COR).

2. This firm shall inspect precast plant at two-week intervals during production and issue a report, certified by a Professional Structural Engineer registered in the state of the project, verifying that materials, methods, products and quality control meet all requirements of specifications and drawings. When report indicates to the contrary, the COR may reject any or all products produced during period of noncompliance with above requirements.
- C. Precast concrete work shall be performed by firms with a minimum of 5 years of experience that demonstrates capability, subject to approval by the COR, to produce and erect type of work specified.
- D. Precast concrete manufacturer shall have on staff or shall retain a qualified Professional Structural Engineer registered in the state of the project to certify precast concrete conforms in all aspects to requirements of ACI 318.
- E. Erector Qualifications: Regularly engaged for at least 5 years in erection of precast structural concrete similar to requirements of this project.
- F. Requirements of Regulatory Agencies: Local codes plus applicable specifications, standards and codes are a part of these specifications.

1.4 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES. All items indicated below are required submittals requiring COR review and approval.
- B. Shop Drawings:
 1. Erection Drawings:
 - a. Plans and/or elevations locating and defining material furnished by manufacturer.
 - b. Sections and details showing connections, cast-in items and their relation to structure.
 - c. Description of all loose, cast-in and field hardware.
 - d. Field installed anchor location drawings.
 - e. Erection sequences and handling requirements.
 - f. Dead, live and other applicable loads used in design.
 - g. Prepared and sealed by a Professional Structural Engineer in accordance with the section 1.4.C.2.

SPEC WRITER NOTE: Retain Production drawings submittal if required.

2. Production drawings:
 - a. Elevation view of each member.
 - b. Sections and details to indicate quantities and position of reinforcing steel, anchors, inserts, and essential embedded hardware.
 - c. Lifting and erection inserts.
 - d. Dimensions and finishes.
 - e. Prestress for strand and concrete strengths.
 - f. Estimated cambers.
 - g. Method of transportation.
- C. Product Design Criteria:
 1. Loadings for design:
 - a. Initial handling and erection stresses.
 - b. Dead and live loads as specified on contract drawings.
 - c. Other loads specified for member where they are applicable.
 - d. Deflection of precast members shall be limited as follows:
 - 1) Vertical Live Load - $\text{Span}/360$
 - 2) Wind Load - $0.0025 \times \text{Floor to Floor Height}$
 - e. Design shall provide for thermal movements of completed structure.
 2. Design calculations of Precast Structural Concrete products and connections shall be performed by a Professional Structural Engineer registered in the state of the project with a minimum of 5 years of experience in precast and prestressed concrete design.
 3. Design shall be in accordance with applicable codes, ACI 318 and the PCI Design Handbook.
 4. Details for waterproof joints between precast members.
- D. Mix Designs: Submit proposed concrete mix designs and appropriate test data as specified in Part 2 of this section.
- E. Permissible Design Deviations:
 1. Design connections according to the conceptual details shown in the contract documents.
 2. Design deviations will be permitted only after COR's written approval of manufacturer's proposed design supported by complete design calculations and drawings.
 3. Design deviations shall provide an installation equivalent to basic intent without incurring additional cost to the COR.
- F. Test Reports: Concrete and other material.

G. Welding Certificates

H. Field quality-control[and special inspection] reports.

I. Sustainable Construction Submittals:

SPEC WRITER NOTE: Retain sustainable construction submittals appropriate to product.

- 1. Recycled Content: Identify post-consumer and pre-consumer recycled content percentage by weight.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Delivery and Handling:

- 1. Lift and support precast concrete members during manufacturing, stockpiling, transporting and erection operations only at lifting or supporting points, or both, as shown on contract and shop drawings, and with approved lifting devices. Lifting devices shall have a minimum safety factor of 4. Exterior lifting hardware shall have a minimum safety factor of 5.
- 2. Transportation, site handling, and erection shall be performed with acceptable equipment and methods, and by qualified personnel.

B. Storage:

- 1. Store all units off ground.
- 2. Place stored units so that identification marks are discernible.
- 3. Separate stacked members by battens across full width of each bearing point.
- 4. Stack so that lifting devices are accessible and undamaged.
- 5. Do not use upper members of stacked tier as storage area for shorter member or heavy equipment.

1.6 APPLICABLE PUBLICATIONS

A. Publications listed below form a part of this specification to extent referenced. Publications are referenced in text by basic designation only.

B. American Concrete Institute (ACI):

- 117-10(15).....Standard Specifications for Tolerances for
Concrete Construction and Materials
- 318/318R-19(22).....Building Code Requirements for Structural
Concrete and Commentary
- ITG-7-09.....Specification for Tolerances for Precast
Concrete

C. ASTM International (ASTM) :

- A36/A36M-19.....Standard Specification for Carbon Structural Steel
- A184/A184M-19... Standard Specification for Welded Deformed Steel Bar Mats for Concrete Reinforcement
- A123/A123M-17.....Standard Specifications for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
- A153/A153M-16a.....Standard Specifications for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
- A307-14e1.....Standard Specifications for Carbon Steel Bolts, Studs, and Threaded Rod 60,000 PSI Tensile Strength
- A416/A416M-18.....Standard Specification for Low-relaxation, Seven-Wire Steel Strand for Prestressed Concrete
- A615/A615M-22
.....Standard Specification for Deformed and Plain Carbon Steel Bars for Concrete Reinforcement
- A706/A706M-22.....Standard Specification for Deformed and Plain Low-Alloy Steel Bars for Concrete Reinforcement
- A767/A767M-19.....Standard Specification for Zinc Coated (Galvanized) Steel Bars for Concrete Reinforcement
- A775/A775M-22.....Standard Specification for Epoxy Coated Steel Reinforcing Bars
- A1064/A1064M-22.....Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete
- C33/C33M-18.....Standard Specification for Concrete Aggregates
- C88/C88M-18.....Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
- C150/C150M-22.....Standard Specification for Portland Cement
- C260/C260M-10a (2016)Standard Specification for Air Entraining Admixtures for Concrete
- C330/C330M-17a.....Standard Specification for Lightweight Aggregates for Structural Concrete
- C494/C494M-19e1.....Standard Specification for Chemical Admixtures for Concrete

F3125/F3125M-22.....Standard Specification for High Strength
Structural Bolts, Steel and Alloy Steel, Heat
Treated, 120ksi (830MPa) and 150ksi (1040MPa)
Minimum Tensile Strength, Inch and Meter
Dimensions

D. American Concrete Institute (ACI):

E. Precast/Prestressed Concrete Institute (PCI):

MNL-116-99.....Manual for Quality Control for Plants and
Production of Structural Precast Concrete
Products, Fourth Edition

MNL 120-17.. PCI Design Handbook - Precast and Prestressed Concrete

MNL-127-99.....Erector's Manual: Standards and Guidelines for
the Erection of Precast Concrete Products

F. American Welding Society (AWS):

D1.1/D1.1M-20.....Structural Welding Code - Steel

D1.4/D1.4M-18.....Structural Welding Code - Steel Reinforcing
Bars

PART 2 - PRODUCTS

SPEC WRITER NOTE: Make material requirements agree with applicable requirements specified in the referenced Applicable Publications. Update and specify only that which applies to the project.

2.1 MATERIALS

- A. Portland Cement: ASTM C150, Type I or III, gray, unless otherwise indicated.
- B. Normal-Weight Aggregates: Except as modified by PCI MNL 116, ASTM C33/C33M, with coarse aggregates complying with [Class 5S] [Class 5M] [Class 4S] [Class 4M]. Stockpile fine and coarse aggregates for each type of exposed finish from a single source (pit or quarry) for project. Lightweight Coarse Aggregate: ASTM C330, maximum size 19mm (3/4 inch), maximum 15 percent loss when tested in accordance with ASTM C88.
- C. Air-entraining Admixture: ASTM C260.
- D. Chemical Admixtures: ASTM C494.
- E. Mixing Water: Fresh, clean, and potable.
- F. Reinforcing Steel: ASTM A615M, Grade 400 MPa (ASTM A615, Grade 60), deformed.

- G. Weldable Reinforcing Steel: ASTM A706M, Grade 400 MPa, (ASTM A706 Grade 60).
- H. Steel Bar Mats: ASTM A184/A184M, fabricated from [ASTM A615/A615M, Grade 60 (Grade 420)] [ASTM A706/A706M], deformed bars, assembled with clips.
- I. Galvanized Reinforcing Steel: ASTM A767M, Grade 400 MPa, (ASTM A767, Grade 60) Class II, hot-dipped galvanized after fabrication and bending.
- J. Epoxy-Coated Reinforcing Steel: ASTM A775M, Grade 400 MPa, (ASTM A775, Grade 60).
- K. Anchor Bolts: ASTM A307, low-carbon steel bolts, regular hexagon nuts and carbon steel washers, galvanized.
- L. High-Strength Threaded Fasteners: Heavy hexagon structural bolts, heavy hexagon bolts, and hardened washers complying with ASTM F3125/F3125M, galvanized.
- M. Welded Wire Fabric: ASTM A1064.
- N. Wire Reinforcement: ASTM A1064.
- O. Prestressing Steel: ASTM A416, Grade 250K or 270K, uncoated, 7-wire, stress-relieved strand.
- P. Anchors and Inserts: ASTM A36 structural steel plates and shapes, ASTM A153 or ASTM A123 hot dipped galvanized finish.
- Q. Nonmetallic, Nonshrink Grout: Packaged, nonmetallic, noncorrosive, nonstaining grout containing selected silica sands, portland cement, shrinkage-compensating agents, plasticizing and water-reducing agents, complying with ASTM C1107/C1107M, Grade A for drypack and Grades B and C for flowable grout and of consistency suitable for application within a 30-minute working time. Water-soluble chloride ion content less than 0.06 percent by weight of cement when tested according to ASTM C1218/C1218M. Bearing Pads:

SPEC WRITER NOTE: Coordinate selection of bearing pad with fabricator.

1. Provide one of the following bearing pads for precast structural concrete units // as recommended by precast fabricator for application //:
 - a. 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 D2240; minimum tensile strength 2250 psi (15.5 MPa), ASTM D412.

- b. Random-Oriented-Fiber-Reinforced Elastomeric Pads: Preformed, randomly oriented synthetic fibers set in elastomer. 70 to 90 Shore, Type A durometer hardness, ASTM D2240; capable of supporting a compressive stress of 3000 psi (20.7 MPa) with no cracking, splitting, or delaminating in the internal portions of pad. Test one specimen for every 200 pads used in Project.
 - c. Cotton-Duck-Fabric-Reinforced Elastomeric Pads: Preformed, horizontally layered cotton-duck fabric bonded to an elastomer; 80 to 100 Shore, Type A durometer hardness, ASTM D2240; complying with AASHTO's "AASHTO LRFD Bridge Design Specifications," Division II, Section 18.10.2; or with MIL-C-882E.
 - d. Frictionless Pads: PTFE, glass-fiber reinforced, bonded to stainless or mild-steel plate, or random-oriented-fiber-reinforced elastomeric pads; of type required for in-service stress.
 - e. High-Density Plastic: Multimonomer, nonleaching, plastic strip.
- 2.
- R. Welded Studs: AWS D1.1.
 - S. Welded Rebar: AWS D1.4.
 - T. Caulking and Sealants: Specified under Section 07 92 00, JOINT SEALANTS.
 - U. Accessories: Provide clips, hangers, and other accessories required for installation of project units and for support of subsequent construction or finishes.

2.2 CONCRETE MIXES

- A. Normal-Weight Concrete:
 - 1. Compressive Strength: 35 MPa (5000 psi) minimum at 28 days.
 - 2. Release Strength: 25 MPa (3500 psi) minimum at transfer of prestress.
- B. Lightweight Concrete:
 - 1. Compressive Strength: 35 MPa (5000 psi) minimum at 28 days.
 - 2. Release Strength: 25 MPa (3500 psi) minimum at transfer of prestress.
 - 3. Air-Dry Density: Not less than 1440 kg per cubic meter (90 pounds per cubic foot) nor more than 1840 kg per cubic meter (115 pounds per cubic foot).

4. Drying Shrinkage (ASTM C330): Maximum 0.035 percent at 28 days.

C. Do not use calcium chloride, chloride ions or other salts.

2.3 FABRICATION

A. Fabrication Procedures: PCI MNL-116.

B. Fabrication Tolerances: PC MNL-116 and ACI 117 for reinforcing steel placement.

C. Finishes:

1. Standard Underside: Resulting from casting against approved forms using good industry practice in cleaning of forms, design of concrete mix, placing and curing. Small surface holes caused by air bubbles, normal color variations, normal form joint marks, and minor chips and spalls will be tolerated, but no major or unsightly imperfections, honeycomb, or other defects will be permitted.

2. Standard Top: Result of vibrating screed and additional hand finishing at projections. Normal color variations, minor indentations, minor chips and spalls will be permitted. No major imperfections, honeycomb, or defects will be permitted.

3. Exposed Vertical Ends: Strands shall be recessed and the ends of member will receive sacked finish.

D. Supports for Reinforcement: Provide supports for reinforcement including bolsters, chairs, spacers and other devices for spacing, supporting and fastening reinforcing, complying with CRSI recommendations. For exposed-to-view concrete surfaces, shear legs of supports are in contact with forms, provide supports with legs that are plastic protected or stainless steel protected.

E. Use epoxy coated reinforcing whenever concrete cover is less than 50 mm (2 inches) for top surfaces exposed to deicing salts, brackish water or salt spray, such as in parking garage decks.

F. Openings: Primarily on thin sections, factory fabricate those openings 250 mm (10 inches) round or square or larger as shown on drawings. Locate and field drill or cut other openings where no contact is made with prestressing or reinforcing steel after precast products have been erected. Opening shall be approved by COR before drilling or cutting.

G. Patching: Patching will be acceptable providing structural adequacy of product and appearance are not impaired.

H. Defective Work: Precast concrete units which do not conform to specified requirements, including strength, tolerances, and finishes, shall be removed and replaced with precast concrete units that meet the

requirements of this section. Contractor is also responsible for cost of corrections to other work affected by or resulting from corrections to precast concrete work.

- I. Fasteners: Cast in galvanized hardware such structural inserts, bolts and plates as required by drawings.

PART 3 - EXECUTION

3.1 ERECTION

- A. Site Access: Provide suitable access to building, proper drainage, and firm, level bearing for hauling and erection equipment to operate under their own power.
- B. Examine supporting structural frame or foundation and conditions for compliance with requirements for installation tolerances, bearing surface tolerances, and other conditions affecting performance of the work.
 - 1. Proceed with installation only after unsatisfactory conditions have been corrected.
 - 2. Do not install precast concrete units until supporting, cast-in-place concrete has attained minimum allowable design compressive strength and until supporting steel or other structure is structurally ready to receive loads from precast concrete units.
- C. Installation: Installation of precast concrete shall be performed by the fabricator or a competent erector in accordance with PCI MNL-127. Lift members with suitable lifting devices at points provided by manufacturer. Temporary shoring and bracing, when necessary, shall comply with manufacturer's recommendations.
- D. Erect precast structural concrete level, plumb, and square within specified allowable tolerances. Provide temporary structural framing, shoring, and bracing as required to maintain position, stability, and alignment of units until permanent connections are complete.
 - 1. Install temporary steel or plastic spacing shims or bearing pads as precast structural 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 plastic patch caps or sand-cement grout to fill voids within recessed lifting devices flush with surface of adjacent precast surfaces when recess is exposed.

- E. Alignment: Align and level precast members as required by the approved shop drawings. Level out variations between adjacent members by jacking, loading, or any other feasible method as recommended by the manufacturer and acceptable to COR.

3.2 FIELD WELDING

- A. Field welding is to be done by qualified welders using equipment and materials compatible to base material in accordance with AWS D1.1 and AWS D1.4.
- B. Field coat with galvanized paint specified under Section 09 91 00, PAINTING all welded connections.

3.3 ATTACHMENTS

- A. Do not use powder-actuated or air-driven fasteners or drill the precast units for surface attachment of accessory items unless otherwise accepted by the precast manufacturer.

3.4 INSPECTION AND ACCEPTANCE

- A. Final inspection and acceptance of erected precast concrete shall be made by COR to verify conformance with drawings and specifications.

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