

SECTION 03 41 33
PRECAST STRUCTURAL PRETENSIONED 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 prestressed concrete construction including design not shown, fabrication, erection, and other related items including bearing pads and anchorage.
- B. Precast prestressed concrete includes // single tees // double tees // hollow- core slabs // beams and spandrels // columns // I beams/box beams // tee/keystone joists // step units // ribbed wall panels //.

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. Sealants and Caulking: Section 07 92 00, JOINT SEALANTS.
- D. Architectural Precast Concrete Panels: Section 03 45 00, PRECAST ARCHITECTURAL CONCRETE.
- E. Repair of abraded galvanized and painted surfaces: Section 09 91 00, PAINTING.

1.3 QUALITY ASSURANCE:

- A. Manufacturer Qualifications: Precast concrete manufacturing plant shall be certified by Prestressed Concrete Institute, Plant Certification Program, prior to start of production.
- B. In lieu of above qualification, contractor shall meet and pay for following requirements:
 - 1. Retain an independent testing or consulting firm approved by Resident Engineer.
 - 2. This firm shall inspect precast plant at two-week intervals during production and issue a report, certified by a registered Professional Engineer verifying that materials, methods, products and quality control meet all requirements of specifications and drawings. When report indicates to the contrary, Resident Engineer may reject any or all products produced during period of noncompliance with above requirements.
- C. Precast concrete work shall be performed by firms that have demonstrated capability, subject to approval, to produce and erect type of work specified.

- D. Precast concrete manufacturer shall have on staff or shall retain a qualified registered Professional Structural Engineer 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.
- 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.
 - 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 products shall be performed by a registered Professional Engineer experienced in precast 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 Resident Engineer'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 Government.
- F. Test Reports: Concrete and other material.

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 Society for Testing and Materials (ASTM):

- A36/A36M-04 Standard Specifications for Carbon Structural Steel
- A82-02 Standard Specifications for Steel Wire, Plain, for Concrete Reinforcement
- A123/A123M-04 Standard Specifications for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
- A153/A153M-04 Standard Specifications for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
- A185-02 Standard Specifications for Steel Welded Wire, Fabric, Plain, for Concrete Reinforcement
- A307-04 Standard Specifications for Carbon Steel Bolts and Studs
- A325 Rev.B-04 Standard Specifications for Structural Bolts, Steel, Heat Treated
- A416/A416M-02 Standard Specifications for Steel Strand, Uncoated Seven-Wire for Prestressed Concrete
- A615/A615M Rev.B-04 Standard Specifications for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
- A706/A706M Rev.B-04 Standard Specifications for Low-Allow Steel Deformed and Plain Bars for Concrete Reinforcement
- A767/A767M-05 Standard Specifications for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement
- A775/A775M Rev.A-04 Standard Specifications for Epoxy-Coated Reinforcing Steel Bars
- C33-03 Standard Specifications for Concrete Aggregates
- C88-99 Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
- C150-04 Standard Specifications for Portland Cement
- C260-01 Standard Specifications for Air-Entraining Admixtures for Concrete
- C330-04 Standard Specifications for Lightweight Aggregates for Structural Concrete
- C494/C494M-04 Standard Specification for Chemical Admixtures for Concrete
- C. American Concrete Institute (ACI):
- 117/117R-02 Standard Specifications for Tolerances for Concrete Construction and Materials
- 318/318R-05 Building Code Requirements for Reinforced Concrete

- D. American Association of State Highway and Transportation Officials
(AASHTO):
HB-17-02 Standard Specifications for Highway Bridges
Fourteenth Edition
- E. Prestressed Concrete Institute (PCI):
MNL-120-85 PCI Design Handbook - Precast and Prestressed
Concrete
MNL-116S-99 Manual for Quality Controls for Plants and
Production of Precast and Prestressed Concrete
Products
MNL-127-85 Recommended Practice for Erection of Precast
Concrete
- F. American Welding Society (AWS):
D1.1/D1.1M-04 Structural Welding Code - Steel
D1.4.98 Structural Welding Code - Reinforcing Steel
- G. Military Specifications (MIL. SPEC.):
MIL-C882E-89 Cloth, Duck, Cotton or Cotton-Polyester Blend
Synthetic Rubber, Impregnated, and Laminated,
Oil Resistant
- H. U.S. Army Corps of Engineers:
CRD-C-621-93-97 Specifications for Non-Shrink Grout

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.
- B. Aggregates: ASTM C33, Coarse and Fine.
- C. Lightweight Coarse Aggregate: ASTM C330, maximum size 19mm (3/4 inch), maximum 15 percent loss when tested in accordance with ASTM C88.
- D. Air-entraining Admixture: ASTM C260.
- E. Chemical Admixtures: ASTM C494.
- F. Mixing Water: Fresh, clean, and potable.
- G. Reinforcing Steel: ASTM A615M, Grade 400 MPa (ASTM A615, Grade 60), deformed.
- H. Weldable Reinforcing Steel: ASTM A706M, Grade 400 MPa, (ASTM A706 Grade 60).
- 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 A325, galvanized.
- M. Welded Wire Fabric: ASTM A185.
- N. Wire Reinforcement: ASTM A82.
- 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. Non-metallic Shrinkage-Resistant Grout: Proprietary pre-mixed, non-metallic, non-corrosive, non-staining product containing selected silica sands, Portland cement, shrinkage compensating agents, plasticizing and water reducing agents, complying with CRD-C-621. Minimum cube strength of 62 MPa (9000 psi) at 28 days when placed at flowable consistency.
- R. Bearing Pads:
 - 1. Elastomeric Pads: Vulcanized, chloroprene elastomeric compound, molded to size or cut from a molded sheet, 50-60 shore A durometer.
 - 2. Laminated Fabric-Rubber Pads: Preformed, unused synthetic fibers and new, unvulcanized rubber. Surface hardness of 70-80 shore A durometer.
 - 4. Sliding Pads: Manufactured assembly with Polyetrafluoroethylene (PTFE) surface, with glass fiber reinforcing as required for service load bearing stress. Combine with elastomeric base where required for full contact bearing.
 - 5. Plastic: Multi-monomer plastic strips, non-leaching and able to support construction loads with no visible overall expansion.
- S. Welded Studs: AWS D1.1.
- T. Welded Rebar: AWS D1.4.
- U. Caulking and Sealants: Specified under Section 07 92 00, JOINT SEALANTS.
- V. 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 prestressed products have been erected. Opening shall be approved by Resident Engineer 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. Preparation:
1. Provide true, level surfaces on field placed bearing walls and other field placed supporting members.
 2. Place and accurately align anchor bolts, plates or dowels in column footings, grade beams and other field placed support members.
 3. Shoring required for composite beams and slab shall have a minimum load factor of 1.5 times (dead load plus construction loads).
- C. Installation: Installation of precast prestressed 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. 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 Resident Engineer. Individual pieces are considered plumb, level, and aligned if the error does not exceed 1:500 excluding structural deformation caused by loads.

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:

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:

Final inspection and acceptance of erected precast prestressed concrete shall be made by Resident Engineer to verify conformance with drawings and specifications.

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