

SECTION 03420

Structural Precast Concrete

PART 1 - GENERAL

1.01 GENERAL REQUIREMENTS

- A. RELATED DOCUMENTS: Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.
- B. Examine all other sections of the Specifications for requirements which affect work of this Section whether or not such work is specifically mentioned in this Section.
- C. Coordinate work with that of all trades affecting or affected by work of this Section. Cooperate with such trades to assure the steady progress of all work under the Contract.

1.02 DESCRIPTION OF WORK:

- A. Extent of structural precast concrete work is shown on drawings and in schedules.
- B. Structural precast concrete includes the following:
 - 1. 8" Hollow slab units.

1.03 RELATED WORK:

- A. Section 03300 - Cast in Place Concrete
- B. Section 05500 - Miscellaneous Metal
- C. Section 05120 - Anchor Bolts
- D. Section 07900 - Joint Sealants

1.04 QUALITY ASSURANCE:

- A. Codes and Standards: Comply with provisions of following codes, specifications and standards, except as otherwise indicated:
 - 1. ACI 301 - Latest Edition "Specifications for Structural Concrete for Buildings."
 - 2. ACI 318 - Latest Edition "Building Code Requirements for Reinforced Concrete."

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3. Concrete Reinforcing Steel Institute, "Manual of Standard Practice."
4. Prestressed Concrete Institute MNL 116, "Manual for Quality Control for Plants and Production of Precast Concrete Products."

B. Fabricator Qualifications:

1. Firms must have a minimum of 5 years successful experience in fabrication of precast concrete units similar to units required for this project.
2. Fabricator must have sufficient production capacity to produce required units without causing delay in work.
3. Fabricator must be producer member of the Prestressed Concrete Institute (PSI) and/or participate in its Plant Certification Program.

1.05 SUBMITTALS:

- A. The Engineer shall receive all submittals a minimum of two weeks prior to the start of fabrication. The Contractor shall have received and approved all submittals prior to review by the Engineer. All review by the Architect, Engineer and Contractor of submittals shall be completed prior to fabrication and installation of any material or product.
- A. Product Data: Submit manufacturer's specifications and instructions for manufactured materials and products. Include manufacturer's certifications and laboratory test reports as required.
- B. Shop Drawings:
 1. General: Submit shop drawings showing complete information for fabrication and installation of precast concrete units.
 - a. Indicate member dimensions and cross section
 - b. Indicate location, size and type of reinforcement, including special reinforcement and lifting devices necessary for handling and erection.
 - c. Indicate layout, dimensions, and identification of each precast unit corresponding to sequence and procedure of installation.

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- d. Indicate welded connections by AWS standard symbols.
- e. Detail inserts, connections, and joints, including accessories and construction at openings in precast units.
2. Anchorage: Provide location and details of anchorage devices that are to be embedded in other construction. Furnish templates if required for placement.
3. Erection Sequencing: Include erection procedure for precast units and sequence of erection.
4. Design Calculations: Provide complete design calculations prepared and stamped by a registered professional engineer licensed in the State of Maine.
5. Submittal: Submit (1) blue line print and (1) reproducible transparency (Sepia) of each shop drawing. Submit (4) copies of the design calculations.

C. Concrete Mix Design:

1. Trial Batch Method: Submit laboratory test reports for concrete materials and mix design tests.
2. Field Experience Method: Submit required records of strength tests.

1.06 DELIVERY, STORAGE AND HANDLING:

- A. Deliver precast concrete units to project site in such quantities and as such times to assure continuity of installation. Store units at project site to prevent cracking, distortion, staining, or other physical damage, and so that markings are visible. Lift and support units at designated lift points.
- B. Deliver anchorage items which are to be embedded in other construction before start of such work. Provide setting diagrams, templates, instructions and directions as required for installation.

PART 2 - PRODUCTS:

2.01 FORMWORK

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- A. Provide forms and, where required, form facing materials of metal, plastic, wood, or other acceptable material that is non-reactive with concrete and will produce required finish surfaces.
- B. Accurately construct forms, mortar-tight, of sufficient strength to withstand pressures due to concrete placing operations, temperature changes, and when prestressed, pretensioning and detensioning operations. Maintain formwork to provide completed precast concrete units of shapes, lines, and dimensions indicated, within fabrication tolerances specified in the PCI manual referenced above.
- C. Unless forms for plan manufactured prestressed concrete units are stripped prior to detensioning, design forms so that stresses are not induced in precast units due to deformation of concrete under prestress or to movement during detensioning.

2.02 REINFORCING MATERIALS

- A. Reinforcing Bars: ASTM A 615, Grade 60, unless otherwise indicated.
- B. Tendons:
 - 1. Uncoated, 7 wire stress relieved strand complying with ASTM A 416. Use 270 ksi 7 wire strand.
 - 2. Strand similar to the above, but having the size and ultimate strength of wires increased so that the ultimate strength of the strand is increased approximately 15%, or strand with increased strength but with fewer number of wires per strand, may be used at the manufacturer's option.
- C. Steel Wire: ASTM A 82, plain, cold-drawn, steel.
- D. Welded Wire Fabric: ASTM A 185.
- E. Deformed Welded Wire Fabric: ASTM A 497.
- F. Supports for Reinforcement: Provide supports for reinforcement including bolsters, chairs, spacers and other devices for spacing, supporting and fastening reinforcing, complying with CRSI recommendations.

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2.03 CONCRETE MATERIALS

- A. Portland Cement: ASTM C 150, Type I or Type III.
 - 1. Use only one brand and type of cement throughout project, unless otherwise acceptable to Architect.
- B. Aggregates: ASTM C 33, and as herein specified. Provide aggregates from a single source for exposed concrete.
 - 1. Local aggregates not complying with ASTM C 33, but which have shown by special test or actual service to produce concrete of adequate strength and durability, may be used when acceptable to Architect.
- C. Water: Potable and free from foreign materials in amounts harmful to concrete and embedded steel.
- D. Air-Entraining Admixture: ASTM C 260.
- E. Water-Reducing Admixture: ASTM C 494, Type A. Types B, C, D or E may be used, subject to the Architect's approval.
- F. Cement Grout: Portland cement, ASTM C 150, Type 1, and clean, natural sand, ASTM C 404. Mix at ratio of 1.0 part cement to 3.0 parts sand, by volume, with minimum water required for placement and hydration.

2.04 RELATED MATERIALS

- A. Steel Shapes: ASTM A 36.
- B. Bearing Pads (1/8"x3"): Provide bearing pads for precast hollow slab units in accordance with manufacturer's recommendations.
 - 1. Frictionless Pads: Tetrafluorethylene (TFE), with glass fiber reinforcing as required for service load bearing stress.
 - 2. Tempered Hardboard Pads: PS 58, smooth both sides.
 - 3. Frictionless Pads: KOROLATH as required for service load bearing stress.

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- C. Accessories: Provide clips, hangers, and other accessories required for installation of project units and for supports of subsequent construction or finishes.

2.05 PROPORTIONING AND DESIGN OF MIXES:

- A. Prepare design mixes for each type of concrete required.
- B. Design mixes may be prepared by independent testing facility or by qualified precast manufacturing plant personnel, at precast manufacturer's option.
- C. Prepare design mixes for each type and strength of concrete by either laboratory trial batch or field experience methods as specified in ACI 301. Use material, including all admixtures, proposed for use on the project.
 - 1. Produce standard-weight concrete consisting of specified portland cement, aggregates, admixtures, and water to produce the following properties:
 - a. Compressive strength: 5000 psi minimum at 28 days.
 - b. Release strength for prestressed units(f'_{ci}): 3500 psi.
 - 2. Cure compression test cylinders using same methods as used for precast concrete work.
 - 3. Submit written reports to Architect or proposed mix for each type of concrete at least 15 days prior to start of precast unit production. Do not begin concrete production until mixes and evaluations have been reviewed by Architect.
- E. Admixtures:
 - 1. Use air-entraining admixture in concrete, unless otherwise indicated.
 - 2. Use water-reducing admixtures in strict compliance with manufacturer's directions. Admixtures to increase cement dispersion, or provide increased workability for low-slump concrete, may be used subject to Architect's acceptance.
 - 3. Use amount as recommended by admixture manufacturer for climatic conditions prevailing at time of placing. Adjust quantities of admixtures as required to maintain quality control.

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2.06 FABRICATION:

A. General:

1. Fabricate precast concrete units complying with manufacturing and testing procedures, quality control recommendations, and dimensional tolerances of the PCI Manual referenced above and as specified for types of units required.

B. Ready-Mix Concrete: comply with requirements of ASTM C 94, and as modified below:

1. Delete references for allowing additional water to be added to batch for material with insufficient slump. Addition of water to batch will not be permitted.

C. Built-in Anchorages: Accurately position built-in anchorage devices and secure to formwork. Locate anchorage where they do not affect position of main reinforcement or placing of concrete. Do not relocate bearing plates in units unless acceptable to Architect.

D. Holes: Cast holes for openings larger than 10" diameter or 10" square in accordance with final shop drawings. Smaller holes will be field cut by trades requiring them, as acceptable to Architect.

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- E. Form Coating: Coat surfaces of forms with bond breaking compound before reinforcement is placed. Provide commercial formulation form-coating compounds that will not bond with, stain nor adversely affect concrete surfaces, and will not impair subsequent treatments of concrete surfaces requiring bond or adhesion. Apply in compliance with manufacturer's instructions.
- F. Surface Preparation: Clean reinforcement of loose rust and mill scale, earth and other materials which reduce or destroy bond with concrete.
- G. Reinforcement:
 - 1. Accurately position, support and secure reinforcement against displacement by formwork, construction, or concrete placement operations.
 - 2. Locate and support reinforcing the metal chairs, runners, bolsters, spacers and hangers, as required.
 - 3. Place reinforcement to obtain the specified coverages for concrete protection.
 - 4. Arrange, space and securely tie bars and bar supports to hold reinforcement in position during concrete placement operations.
 - 5. Set wire ties so ends are directed into concrete, not toward exposed concrete surfaces.
- H. Tendon Pretensioning: Pretensioning of tendons for prestressed concrete may be accomplished either by single strand tensioning method or multiple-strand tensioning method. Comply with PCI MNL-116 requirements.
- I. Concrete Placement: Place concrete in a continuous operation to prevent formation of seams or planes of weakness in precast units, complying with requirements of ACI 304. Thoroughly consolidate placed concrete by internal and external vibration without dislocation or damage to reinforcement and built-in items.
- J. Identification: Provide permanent markings to identify pick-up points and orientation in structure, complying with markings indicated on final shop drawings. Imprint date of casting on each precast unit on a surface which will not show in finished structure.

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- K. Concrete Curing: Curing by low-pressure steam, steam vapor, radiant heat and moisture, or other similar process may be employed to accelerate concrete hardening and to reduce curing time.

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- L. Detensioning: Delay detensioning of prestressed units until concrete has attained at least 70% of design stress, as established by test cylinders.
1. If concrete has been heat-cured, perform detensioning while concrete is still warm and moist, to avoid dimensional changes which may cause cracking or undesirable stresses in concrete.
 2. Detensioning of pretensioned tendons may be accomplished either by gradual release of tensioning jacks or by heat cutting tendons, using a sequence and pattern to prevent shock or unbalanced loading.
- M. Finish of Formed Surfaces: Provide finishes for formed surfaces or precast concrete as indicated for each type of unit, and as follows:
1. Standard Finish: Normal plant run finish produced in forms that impart a smooth finish to concrete. Small surface holes caused by air bubbles, normal form joint marks, and minor chips and spalls will be tolerated, but no major or unsightly imperfections, honeycomb, or structural defects will be permitted.
- N. Finish of Unformed Surfaces: Apply trowel finish to unformed surfaces unless otherwise indicated. Consolidate concrete, bring to proper level with straightedge, float, and trowel to a smooth, uniform finish.
1. Apply scratch finish to precast units which will receive concrete topping after installation. Following initial strikeoff, transversely scarify surface to provide ridges approximately 1/4" deep.

2.07 HOLLOW SLAB UNITS:

- A. Type: Precast, prestressed concrete units with open voids running full length of slabs.
- B. Furnish units which are free of voids or honeycomb, with straight, true edges and surfaces.
- C. Provide "Standard Finish" units unless otherwise indicated.
- D. Fabrication: Manufacturer units of concrete materials which will provide a minimum 3500 psi compressive strength at time of initial prestress and a 28-day compressive strength of 5000 psi.

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- E. Adequately reinforce slab units to resist transporting and handling stresses.
- F. Provide headers of structural steel shapes for openings larger than one slab width in accordance with hollow slab unit manufacturer's recommendations.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Bearing Pads: Install flexible bearing pads where indicated, as precast units are being erected. Set pads on level, uniform bearing surfaces and maintain in correct position until precast units are placed.
- B. Welding:
 - 1. Perform welding in compliance with AWS D 1.1, including qualification of welders.
 - 2. Protect units from damage by field welding or cutting operations and provide non-combustible shield as required.
- C. Damaged Metal Surfaces: Repair damaged metal surfaces by cleaning and applying a coat of liquid galvanizing repair compound to galvanized surfaces and compatible primer to painted surfaces.
- D. Powder-Actuated Fasteners: Powder-actuated fasteners are not permitted for surface attachment of accessory items in precast, prestressed unit, unless otherwise accepted by precast manufacturer.
- E. Installation Tolerances: Install precast units without exceeding following tolerance limits:
 - 1. Variations from Level or Elevation: 1/4" in any 20' run; 1/2" in any 40' run; total plus or minus 1/2" at any location.
 - 2. Variation from Position in Plan: Plus or minus 1/2" maximum at any location.
 - 3. Offsets in alignment of Adjacent Members at Any Joint: 1/16" in any 10' run; 1/4" maximum.

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- F. Grouting Connections and Joints: After precast concrete units have been placed and secured, grout open spaces at connection and joints as follows:
1. Provide forms or other acceptable method to retain grout in place until sufficiently hard to support itself.
 2. Pack spaces with stiff grout material tamping until voids are completely filled.
 3. Place grout to finish smooth, plumb, and level with adjacent concrete surfaces.
 4. Keep grouted joints damp for not less than 24 hours after initial set.
 5. Promptly remove grout material from exposed surfaces before it hardens.

3.02 PLANT QUALITY CONTROL EVALUATIONS:

- A. The Owner may employ a separate testing laboratory to evaluate precast manufacturer's quality control and testing methods.
- B. The precast manufacturer shall allow Owner's testing facility access to materials storage areas, concrete production equipment, and concrete placement and curing facilities. Cooperate with Owner's testing laboratory and provide samples of materials and concrete mixes as may be requested for additional testing and evaluation.
- C. Dimensional Tolerances: Units having dimensions smaller or greater than required, and outside specified tolerance limits will be subject to additional testing as herein specified.
1. Precast units having dimensions greater than required will be rejected if appearance or function of the structure is adversely affected, or if larger dimensions interfere with other construction. Repair or remove and replace rejected units as required to meet construction conditions.
- D. Strength of Units: The strength of precast concrete units will be considered potentially deficient if the manufacturing processes fail to comply with any of the requirements which may affect the strength of the precast units, including the following conditions:
1. Failure to meet compressive strength tests requirements.

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2. Reinforcement, and pretensioning and detensioning of tendons of prestressed concrete, not conforming to specified fabrication requirements.
 3. Concrete curing, and protection of precast units against extremes in temperature, not as specified.
 4. Precast units damaged during handling and erection.
- E. Testing Precast Units: When there is evidence that strength of precast concrete units does not meet specification requirements, the concrete testing service shall take cores drilled from hardened concrete for compressive strength determination, complying with ASTM C 42 and as follows:
1. Take at least 3 representative cores from precast units of suspect strength, from locations directed by Architect.
 2. Test cores in a saturated-surface-dry condition per ACI 318 if concrete will be wet during use of completed structure.
 3. Test cores in an air-dry condition per ACI 318 if concrete will be dry during use of completed structure.
 4. Strength of concrete for each series of cores will be considered satisfactory if their average compressive strength is at least 85% of 28-day design compressive strength.
 5. Test results will be made in writing on same day that test is made, with copies to Architect, Contractor, and precast manufacturer. Include in test reports the project identification name and number, date, name of precast concrete manufacturer, name of concrete testing service, identification letter, name, and type of member or members represented by core tests, design compressive strength compression breaking strength and type of break (corrected for length-diameter ratio), direction of applied load to core with respect to horizontal plan of concrete as placed, and moisture condition of core at time of bearing.
- F. Patching: Where core test results are satisfactory and precast units are acceptable for use in work, fill core holes solid with patching mortar, and finish to match adjacent concrete surfaces.
- G. Defective Work: Precast concrete units which do not conform to specified requirements, including strength, tolerance, and finishes, shall be replaced with precast concrete units that meet requirements

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

3.03 ENGINEERS REVIEW

- A. The Engineer of Record will conduct periodic reviews of the construction for compliance with the provisions of the Specifications and Drawings during the construction period.
- B. The General Contractor shall employ a licensed professional engineer to analyze and design modifications and repairs for construction not in conformance with the provisions of the Contract Documents. These modifications and repair details shall be stamped by an engineer licensed to practice in the State of Maine and submitted with calculations for approval by the Engineer of Record. Modifications shall not be made without express written approval.

END OF SECTION