

SECTION 03 4100
PRECAST STRUCTURAL CONCRETE

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Columns.
- B. Beams.
- C. Accessories.

1.2 RELATED REQUIREMENTS

- A. Division 01 – General Requirements.
- B. Section 03 3000 – Cast-in-Place Concrete.
- C. Section 04 2000 – Unit Masonry.
- D. Section 05 1200 – Structural Steel Framing.
- E. Section 05 5000 – Metal Fabrications.

1.3 REFERENCE STANDARDS

- A. Reference the “Latest Edition” of all Standards unless noted otherwise.
- B. ACI – American Concrete Institute International.
- C. ACI 318 – Building Code Requirements for Structural Concrete.
- D. AWS – American Welding Society.
- E. ICC (IBC) – 2006 International Building Code.
- F. PCI – Precast/Prestressed Concrete Institute.
- G. PCI MNL-116 – Manual for Quality Control for Plants and Production of Precast and Prestressed Concrete Products.
- H. PCI MNL-135 – Tolerance Manual for Precast and Prestressed Concrete Construction.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination: Coordinate openings sizes and locations, attachment of related items, and other work related to the fabrication and installation of precast concrete units.
- B. Sequencing: 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.
- C. Preinstallation Meeting: Conduct a preinstallation meeting a minimum of two weeks prior to installation of precast concrete. Require attendance of related trades and the Architect. Review the following items:
 - 1. Review shop drawings and installation details.
 - 2. Anchor and weld plate locations.
 - 3. Opening locations including those cut in the field.
 - 4. Limitations on field cutting and core drilling.
 - 5. Site access requirements and obstructions including but not limited:
 - a. Access roads and maintenance thereof.

- b. Protection and repair of existing paving.
- c. Dewatering of footing trenches.
- d. Job site snow removal.
- e. Job site debris removal.
- f. Overhead obstructions including power lines.
- 6. Cold weather grouting requirements and expectations.
- 7. Cleaning responsibilities and expectations.

1.5 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide precast concrete units and connections capable of withstanding design loads within limits and under conditions indicated on Drawings.
 - 1. Loading Requirements: As indicated on the drawings.
 - 2. Fire Resistance Ratings per 2006 International Building Code: As indicated on the drawings.

1.6 SUBMITTALS

- A. See Section 01 3000 – Administrative Requirements; submittal procedures.
- B. Shop Drawings: Include layout plans with unit locations, bearing and top of unit elevations, overall dimensions, building cross sections, wall sections, details, and opening locations.
 - 1. Separately elevate and dimension each type of unit. Indicate location of each unit on overall layout by using the same identification mark placed on the actual unit.
 - 2. Indicate welded connections by AWS standard symbols and show size, length, and type of each weld.
 - 3. Indicate locations of and detail hardware and anchorage devices to be cast-in to precast units with relationship to structure.
 - 4. Indicate locations of and detail hardware and anchorage devices to be embedded into or attached to structure or other construction with relationship to structure.
 - 5. Schedule loose hardware and anchorage devices to be installed by others; include in schedule: identification marks, item descriptions, and total quantities.
 - 6. Indicate locations of and detail lifting and handling devices.
 - 7. Indicate sections and details showing quantities and position of reinforcing steel and related items including special reinforcement.
 - 8. Indicate shim sizes and grouting sequence.
 - 9. Handling procedures, sequence of erection, and bracing plan.
- C. Comprehensive Engineering: Signed and sealed by a professional engineer responsible for its preparation who is registered in the state in which the project is located. Include all dead, live, and other applicable loads used in the design. Indicate loading on shop drawings.
- D. Design Modifications: If design modifications are proposed to meet performance requirements and field conditions, notify the Architect immediately and submit design calculations and drawings. Do not adversely affect the appearance, durability or strength of units when modifying details or materials. Maintain the general design concept when altering size of units and alignment.
- E. Samples: Provide Owner/Architect with samples representing the finish color and texture of

exposed surfaces when requested. Samples to be a minimum of 12 by 12 by 2 inches in size. Owner/Architect to verify finish meets or exceeds the expectation of the design intent.

- F. Test Reports: At the request of the Owner/Architect provide test reports for concrete and other structural materials tested during fabrication including cement mill reports, mix reports, cylinder break reports.

1.7 QUALITY ASSURANCE

- A. Single Source Requirement: Provide precast concrete of this section and the following sections by one manufacturer:
 - 1. Section 03 4110 – Precast Double Tees.
 - 2. Section 03 4113 – Precast Hollow Core Planks.
 - 3. Section 03 4500 – Precast Architectural Wall Panels.
 - 4. Section 03 4600 – Precast Non-Architectural Wall Panels.
- B. Designer Qualifications: Precast concrete units to be designed under the direct supervision of a Professional Structural Engineer licensed in the state where the project resides and be directly employed by precast fabricator to assure that quality and structural integrity is being scrutinized on a daily basis.
- C. Fabricator Qualifications: A firm that specializes in manufacturing the types of precast concrete specified in good standing in the PCI Plant Certification Program, and that complies with the following requirements: No Exceptions. No other plant certification will be accepted.
 - 1. Assumes responsibility for engineering precast concrete units to comply with performance requirements. This responsibility includes preparation of Shop Drawings and Comprehensive Engineering analysis by a qualified Professional Engineer.
 - 2. Participates in PCI's Plant Certification program at the time of bidding and through the construction process.
 - 3. Has sufficient production capacity to produce required units without delaying the Work.
 - 4. Is registered with and approved by authorities having jurisdiction.
- D. **Erector Qualifications: PCI Certified, approved by the precast concrete manufacturer, and having a minimum of 5 years experience in the erection of precast concrete similar to the requirements of this project. Erector's workman shall be properly trained to handle and erect precast units.**
- E. Design Standards: Comply with ACI 318 (ACI 318M) and the design recommendations of PCI MNL 120, "PCI Design Handbook – Precast and Prestressed Concrete," applicable to types of structural precast concrete units indicated.
- F. Quality-Control Standard: For manufacturing procedures and testing requirements and quality control recommendations for types of units required, comply with PCI MNL 116, "Manual for Quality Control for Plants and Production of Structural Concrete Products."
 - 1. Comply with camber and dimensional tolerances of PCI MNL 135, "Tolerance Manual for Precast and Prestressed Concrete Construction."
- G. Welder Qualifications: AWS Certified, approved by the precast concrete manufacturer, and having a minimum of 5 years experience in the erection of precast concrete similar to the requirements of this project. Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code – Steel"; and AWS D1.4, "Structural Welding Code –

Reinforcing Steel.”

- H. Pollution Control Regulations: Comply with all pollution control regulations in fabricating and finishing of all products. Protection of air and ground water is the utmost importance
 - 1. Capture all water runoff and filter air as necessary in the fabrication process in compliance with all state and federal pollution control agencies.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. General Requirement: All lifting and handling, transportation and delivery, storage and support, and erection of precast panels to be performed by qualified personnel using methods and equipment approved by manufacturer.
- B. Identification: Label each unit with date of production and mark indicating unit location on the shop drawings.
- C. Lifting and Handling: Lift and handle units at all times by lifting points indicated on the shop drawings. Lift with manufacturer approved lifting devices. Lifting devices to have a minimum safety factor of 5 to 1.
- D. Transportation and Delivery: Transport units in accordance with manufacturer requirements.
- E. Storage and Support: At all times store and support units off ground with identification marks clearly visible and so lifting devices are accessible and undamaged. Separate stacked units by batten across full width of each bearing point. Do not use stacked precast units for storage of other units or equipment.

1.9 FIELD CONDITIONS

- A. General Contractor shall prepare and maintain site free of obstructions as required by precast erector for the work of this section.
- B. Cold Weather Grouting: Provide written procedures to address cold weather grouting to Owner/Architect prior to the erection process.

1.10 WARRANTY

- A. Provide twelve-month guarantee for workmanship, materials, and satisfactory performance from date of Substantial Completion.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Precast Concrete:
 - 1. Wells Concrete Products: www.wellsconcrete.com.
 - 2. No Substitutions.
 - 3. Gage Brothers: www.gagebrothers.com.
 - 4. County Materials Corporation: www.countymaterials.com
 - 5. Molin Concrete Products: www.molin.com
 - 6. Substitutions: See Section 01 6000 – Product Requirements; including the following requirements:
 - a. Manufacturer and plant must be PCI Certified. No Exceptions.
 - b. Manufacturer must submit product information including typical details, proposed product construction, handling information, etc. for approval by Architect.

- c. Manufacturer must obtain written approval of project Architect prior to submitting bid.
- d. Manufacturer must obtain written approval of General Contractor prior to submitting bid.
- e. Prequalified Precaster must have in-house engineering capabilities. No others permitted without being prequalified.
- f. Precast Erector shall be PCI Certified.

2.2 PRECAST UNITS

A. Columns and Haunches:

- 1. Size/Shape/Profile: As indicated on the drawings.
- 2. Screed Side: Match Form Side.
- 3. Form Sides: Grade B (PCI), refer to description below.
- 4. Concrete Color: Gray.

B. Beams, Spandrels, Girders, and Purlins:

- 1. Size/Shape/Profile: As indicated on the drawings.
- 2. Screed Side: Match Form Side.
- 3. Form Sides: Grade B (PCI), refer to description below.
- 4. Concrete Color: Gray.

C. Form Side Finishes "By PCI":

- 1. Commercial Grade (PCI): This is essentially a "as-cast" finish. 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 (bug holes) and water marks, and there may be some minor chips and spalls. There may be patches and streaks of color variation within the surface, and the overall color tone may vary between pieces.

Large fins from joint bleeding should be removed, but small fins may remain. Only "honeycombed" and/or badly spalled areas should be repaired or finished. All faces should have true, well-defined surfaces. The maximum allowable form joint offset should be limited to 3/16 inch.

This finish should be specified only when the product will not be visible in the completed structure, or when the function of the structure does not require an enhanced surface.

- 2. Standard Grade (PCI): Small surface holes caused by air bubbles ("bug holes"), normal color variations, normal form joint marks and minor chips and spalls should be considered acceptable.

No air holes (bug holes) larger than 1/2 inch in any direction should be permitted. Air holes between 1/4 and 3/8 inch in width that occur in high concentration (more than one per 2 square feet) should be filled. Large, unsightly surface blemishes or honeycombing should be repaired. The maximum allowable form joint offset should be limited to 1/8 inch. This finish may be used where products are exposed to view but

the function of the structure does not require a special finish. The surface should be suitable for an applied textured coating but not necessarily suitable for painting. This is the typical finish grade for all structural units unless noted otherwise.

3. Grade B (PCI): All air holes over 1/4 inch in size should be filled. Air holes between 1/8 and 1/4 inch in width that occur in high concentration (more than one per 2 square inches) should be filled. Surface blemishes due to holes or dents in form should be repaired. Discoloration should be permitted at form joints.

This finish may be used on visually exposed structural members such as columns or beams unless noted otherwise.

4. Grade A (PCI): In addition to the requirements for Grade B, all exposed surfaces shall be coated with a neat cement paste. After paste coat has dried the surface shall be rubbed with burlap to remove loose particles.

D. Screed Side Finishes "By Description":

1. Food Grade: Surface acceptable to the FDA U.S. Food and Drug Administration comparable to a machine troweled finished floor.
2. Special Finish: [_____].

2.3 MATERIALS

- A. All materials shall comply with the specifications, standards and codes quoted herein. The Architect/Engineer upon request shall be furnished satisfactory certification that all material incorporated in the precast concrete products comply with the requirements herein specified.
- B. Forms: Material that will provide smooth/anticipated finish that meets the expectations of the Owner/Architect.
- C. Form Release Agent: Non-staining type that will not impair anticipated finishes of the Owner/Architect and that will not inhibit field installed coatings, sealants, and adhesives.
- D. Portland Cement: ASTM C150 - Type I or III: ASTM C150.
- E. Other Cementitious Materials: Ground granulated blast furnace slag: ASTM C 989.
- F. Admixtures:
 1. Air entraining admixtures: ASTM C260.
 2. Water reducing, retarding, accelerating admixtures: ASTM C494.
- G. Aggregates: ASTM C33 except that coarse aggregates for precast concrete surfaces exposed to damp conditions shall contain zero iron oxides.
 1. Light weight aggregate for structural components: ASTM C330.
- H. Water: Potable or free from foreign materials in amounts harmful to concrete and embedded steel.
- I. Reinforcing Steel: Reinforcing steel or mesh will be selected from the following materials to conform to precaster's design unless otherwise indicated on the drawings. Reinforcing bars shall not be welded without specific approval of Architect/Engineer.
 1. Bars:
 - a. Deformed billet steel: ASTM A615.
 - b. Deformed rail steel: ASTM A616.

- c. Deformed axle steel: ASTM A617.
 - d. Deformed low-alloy steel: ASTM A706.
- 2. Wire: Cold drawn steel: ASTM A82.
- 3. Wire fabric:
 - a. Welded steel: ASTM A 185.
 - b. Welded deformed steel: ASTM A497.
- J. Strand: Uncoated, 7-wire, Stress-Relieved Strand: ASTM A416-Grade 250K or 270K.
- K. Anchors and Inserts:
 - 1. Materials:
 - a. Structural Steel: ASTM A36.
 - 1) Shop Primer: Manufacturer's standards.
 - a) Location: Items protected by sealants or finish coatings.
 - 2) Hot Dipped Galvanized: ASTM A153.
 - a) Location: Items left exposed unless otherwise indicated. Cold galvanize field welds.
 - 3) Zinc-rich Coating: MIL-P-2135, self curing, one component, sacrificial.
 - a) Location: As indicated.
 - 4) Cadmium Coating (Electroplated).
 - a) Location: As indicated.
 - b. Stainless Steel: ASTM A666, type 304.
 - 1) Location: As indicated.
- L. Other Items Cast-In to Precast Units:
 - 1. _____.
 - 2. Other Items: As indicated on the drawings.
 - 3. Locations: As indicated on the drawings.

2.4 ACCESSORIES

- A. Cement Grout: Type I (ASTM C150 / C150M), “Dry Pack”, portland cement, sand and water having a minimum of 3,000 psi compressive strength at 28 days. (Approximately 3 to 1 sand/cement ratio.) Use “Cement Grout” unless “Non-Shrink Cement Grout” is specifically indicated by precast or structural engineer.
- B. Non-Shrink Cement Grout: Per ASTM C1107/C1107M, Type III (ASTM C150 / C150M), “Dry Pack”, portland cement, sand, and water having a minimum of 10,000 psi compressive strength at 28 days.
- C. Bearing Pads: (Selection will be made by precast designer unless indicated otherwise.)
 - 1. Unless noted otherwise on the plans, Elastomeric Bearing Pads conforming to Division 2, Section 25 of AASHTO Standard Specifications for Highway Bridges shall be used.
 - 2. The PCI Design Handbook, Second Edition, Part 5.1 through Part 5.5 shall be used for the design of bearing pads.
 - 3. Teraflouroethylene (TFE) reinforced with glass fibers and applied to stainless or structural steel plates.

D. Sealants:

1. Refer to Section 07 9200 - Joint Sealants; Precast to precast products.
2. Refer to Section 07 8400 – Firestopping; Installation to be performed by a licensed contractor (Not Precast Erector) in the area in which the project is located.
3. Tremco; Dymeric 240 FC: www.tremcosealants.com.
4. BASF Sonneborn; Sonolastic NP2: www.buildingsystems.basf.com.
5. Backer Rod: Denver Foam or equivalent. www.backerrod.com.
6. Provide products compatible with adjacent work.

E. Backer Rod for Sealants: Denver Foam by www.backerrod.com, open cell polyurethane, unless noted otherwise.

F. Welding Materials: Per AWS D1.1/D1.1M, “Structural Welding Code – Steel”; compatible with materials being welded.

G. Welded Studs: Per AWS D1.1/D1.1M, “Structural Welding Code – Steel”; compatible with materials being welded.

H. Column Protection:

1. Cast in a bent plate 1/4 inch x 8 inch x 4 feet at each column corner with anchors. This is required only where shown on plans.
2. Materials:
 - a. Structural Steel: ASTM A36.
 - 1) Shop Primer: Manufacturer's standards.
 - 2) Hot Dipped Galvanized: ASTM A153.
 - 3) Zinc-rich Coating: MIL-P-2135, self curing, one component, sacrificial.
 - 4) Cadmium Coating (Electroplated).
 - b. Stainless Steel: ASTM A666, type 304.
3. Material Finish:
 - a. Shop Primer: Manufacturer's standards.
 - b. Hot Dipped Galvanized: ASTM A153.
 - c. Zinc-rich Coating: MIL-P-2135, self curing, one component, sacrificial.
 - d. Cadmium Coating (Electroplated).

I. Anchor Bolts: As designed by precast manufacturer, cast-in place by others.

J. Attachment Plates: As designed by precast manufacturer, cast-in place by others.

K. Other Load Bearing Loose Steel Items: As designed by precast manufacturer.

2.5 FABRICATION

- A. Pre-stress all precast units.
- B. All reinforcing steel shall have minimum cover as required by code and shall be accurately located as indicated on the approved shop drawings. Metal chairs, with or without coatings, shall not be permitted in the finished face.

2.6 FABRICATION TOLERANCES

- A. Fabricate units in accordance with MNL-116 and MNL-135 and as follows:

1. Length: Plus or minus 1/8 inch for every 10 feet in length or 1/2 inch, whichever is greater.
2. Width: Plus or minus 1/8 inch for items 48 inch or less; 1/4 inch for items 48 to 120 inches, and 1/2 inches maximum for items over 120 inches and more.
3. Cross Sectional Dimensions: Plus or minus 1/8 inch for items 48 inch or less; 1/4 inch for items 48 to 120 inches, and 1/2 inches maximum for items over 120 inches and more.
4. Cast-in Anchors and Inserts: Plus or minus 1 inch from centerline location indicated on shop drawings.
5. Horizontal Alignment (Sweep): Plus or minus 1/3 inch for every 10 feet in length or 1/2 inch, whichever is greater.
6. Vertical Alignment (End Squareness): Plus or minus 1/8 inch for every 12 inches in height or 1/4 inch, whichever is greater.
7. Camber: Variation between units is plus or minus 1/4 inch for every 10 feet in length or 1/2 inch, whichever is greater.
8. Blockouts: Plus or minus 1 inch from centerline location indicated on shop drawings.

2.7 CONCRETE MIXES

- A. 28-day compressive strength: Minimum of 5,000 psi.
- B. Use of calcium chloride, chloride ions or other salts is not permitted.

EXECUTION

2.8 EXAMINATION

- A. Verify site is free of obstructions and ready to receive the work. Obstructions include but are not limited to dewatering of footing trenches, jobsite snow removal, site debris, overhead obstructions, including power lines.
- B. Verify access roads have been prepared to handle all weather conditions and are acceptable to precast concrete installer.
- C. Do not begin the work of this section unless preparations by the site contractor are complete and the site contractor understands and agrees to maintain acceptable conditions until precast installation is complete. Beginning the work of this section is acceptance of existing conditions.

2.9 PREPARATION

- A. Preparation: General Contractor (Buyer) shall be responsible for the following items:
 1. Removal of all obstructions including but not limited to power lines and wires that may be hazardous to precaster's personnel and other items required for precast installation.
 2. All-weather access roads for precaster's trucks and cranes. Refer to precaster's proposal/quotation for more defined access requirements.
 3. Grid locations, building corners, finish floor elevations, top of door elevations and other survey points/lines/elevations for accurate installation of precast units.
 4. True and level bearing surfaces on all field placed bearing walls and other field placed supporting units.
 5. Placement and accurate alignment of anchor bolts, plates, or dowels in column footings, grade beams, and other field placed supporting units.

6. All shoring required for composite beams and slabs. Shoring shall have a minimum load factor of 1.5 x (dead load plus construction loads).
7. Repair all concrete and bituminous surfaces damaged during precast installation. Examine surfaces with precaster before and after precast installation and coordinate efforts to minimize damage.
8. Requirements For long span DTs - No shipping of long span units shall occur during road postings. Precaster's crane and trucks will erect from the interior side of the building at area's requiring long span units. Provide 50' wide access into the building and a clear erection area of 50' wide. Trucks and cranes will operate under their own power. Maximum grade on which erection will occur to be 4 percent. Haul roads to be approximately level transverse and 14 percent maximum longitudinal grade.

2.10 ERECTION

- A. **Precast installer shall be PCI Certified Erector in good standing with PCI.**
- B. Precast Unit Curing Procedures: Contact precaster for other minimum curing requirements.
- C. Erection Shall Be Defined As:
 1. Placing, aligning, and leveling the precast units in final positions in the structure on the designated supporting surfaces.
 2. Connection of precast units to each other, or to supporting structural units as indicated on the shop drawings.
 3. Removal of lifting hooks, if necessary.
 4. Cleaning and sealing of "Precast" to "Precast" joints. Joints include:
 - a. Precast to precast including joints between interior and exterior units.
 - b. Precast to bearing.
 5. Sealing of "Precast" to "Other Materials" and joints that require "Firestopping" are NOT considered part of erection unless indicated otherwise.
- D. Field Welding: Complete field welding using qualified personnel, equipment, and welding materials that are compatible to the base material.
- E. Grouting:
 1. Pack grout between bottom of precast columns and their bearing surface filling the entire area free of voids.
 2. General Contractor Responsibility: General Contractor shall be responsible for providing "shelters/tarps" and "temp heat" for grouting when temperatures are below 40 degrees for a 24 hour period.
- F. Patching:
 1. All exposed connections shall be recess and patched as per the intended use of the space these are exposed to.

2.11 TOLERANCES

- A. Erect precast units level, plumb, square, true, and in alignment without exceeding the non-cumulative erection tolerances of PCI MNL 135. Position units so that dimensional errors do not accumulate and so joints remain aligned and uniform as erection progresses. Level out variations between adjacent units by jacking, loading, or any other feasible method as recommended by the manufacturer and acceptable to the Architect/Engineer.

- B. In the event that precast units cannot be adjusted to conform to design or tolerance criteria, cease work and advise Architect. Execute modifications as directed by the Architect prior to resuming work.

2.12 SEALANT INSTALLATION

- A. General Contractor/Owner shall coordinate with the precast erector sealing of precast joints where required. The general contractor accepts responsibility if the precast joints above the roof deck and below grade are not sealed due to poor coordination/site conditions. The precast erector shall accept responsibility if precast joints are not sealed but were coordinated in a timely fashion by the General Contractor/Owner.
- B. Install backer rod and sealant according to product manufacturer's instructions.

2.13 FIELD REPAIR AND CLEANING OF PRECAST UNITS

- A. Repairs by Precast Erector: Repair chipping, spalling, cracking, and other damages to precast units after delivery to the jobsite. After installation and repairs are completed, all further damage is the responsibility of, and at the cost of, the General Contractor. Consult with precaster for repairs of structural precast units.
- B. Cleaning by General Contractor: Clean exposed surfaces that are soiled during shipping, installation, and remaining construction operations, prior to Substantial Completion. Clean in accordance with precast manufacturer's recommendations.

2.14 INSPECTION AND ACCEPTANCE

- A. Final inspection and acceptance of erected precast/prestressed concrete shall be made by Architect/Engineer to verify conformance with plans and specifications.

2.15 PROTECTION

- A. General Contractor to protect precast units from remaining construction operations.

END OF SPECIFICATION