SPECIFICATION SECTION 03 45 00

ARCHITECTURAL PRECAST CONCRETE

PART 1. GENERAL

1.1 SUMMARY

A. This section includes the performance criteria, materials, design, production, and erection of architectural precast concrete for the entire project. The work performed under this Section includes all labor, material, equipment, related services, and supervision required for the manufacture and erection of the architectural precast concrete work shown on the Contract Drawings.

B. This Section includes the following:

1. All architectural precast concrete units indicated on contract drawings as “precast”.
2. Accessories:
    a. Stainless steel pins, anchors, etc. required to support or anchor precast units in place.

C. Related Sections include the following:

1. Section 03 30 00: “Cast-in-Place Concrete”
2. Section 05 12 00: “Structural Steel”
3. Section 05 50 00: “Metal Fabrications”

1.2 DEFINITION

A. Design Reference Sample: Sample of approved architectural precast color, finish, and texture, preapproved by Architect.

1.3 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide architectural precast concrete units and connections capable of withstanding the design loads and under conditions indicated including:

1. Dead Loads
2. Live Loads
3. Wind Loads
4. Seismic Loads

1.4 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. LEED Submittals:

1. Product Data for Credit MR4.1 and Credit MR4.2: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer (postindustrial) recycled content per unit of product.
    a. Indicate recycled content; indicate percentage of preconsumer and postconsumer recycled content per unit of product.
    b. Indicate relative dollar value of recycled content product to total dollar value of product included in project.
    c. If recycled content product is part of an assembly, indicate the percentage of recycled content product in the assembly by weight.
    d. If recycled content product is part of an assembly, indicate relative dollar value of recycled content product to total dollar value of assembly.

2. Product Data for Credit MR 5.1 and Credit MR 5.2: For local and regional material extracted/harvested and manufactured within a 500 mile radius from the project site.
    a. Indicate location of extraction, harvesting, and recovery; indicate distance between extraction, harvesting, and recovery and the project site.
    b. Indicate location of manufacturing facility; indicate distance between manufacturing facility and the project site.
    c. Indicate dollar value of product containing local/regional materials; include materials cost only.
    d. Where product components are sourced or manufactured in separate locations, provide location information for each component. Indicate the percentage by weight of each component per unit of product.

C. Design Mixtures: For each precast concrete mixture. Include results of compressive strength and water-absorption tests.

D. Shop Drawings:
    1. Detail fabrication and installation of architectural precast concrete units.
    2. Indicate locations, plan views, elevations, dimensions, shapes, and cross-sections of each unit.
    3. Indicate aesthetic intent including joints, drips, chamfers, rustications or reveals, and extent and location of each surface finish.
    4. Indicate separate face and backup mixture locations and thicknesses.
    5. Indicate locations, tolerances, and details of anchorage devices to be embedded in or attached to structure or other construction.
    6. Indicate location of each architectural precast concrete unit by same identification mark placed on unit.
    7. Indicate relationship of architectural precast concrete units to adjacent materials.
    8. Design Modifications: If design modifications are proposed to meet performance requirements and field conditions, notify the Architect and submit design calculations and Shop Drawings. Do not adversely affect the appearance, durability, or strength of units when modifying details or materials and maintain the general design concept.
    9. **Comprehensive engineering design signed and sealed by qualified professional engineer** responsible for its preparation licensed in the jurisdiction in which the project is located. Show governing panel types, connections, concrete cover and reinforcement types, including special reinforcement such as epoxy coated carbon fiber grid. Indicate location, type, magnitude, and direction of loads imposed on the building structural frame by the architectural precast concrete.

E. Samples: Design reference samples for initial verification of design intent, for each type of finish indicated on exposed surfaces of architectural precast concrete units, in sets of three, representative of finish, color, and texture variations expected; approximately 12 by 12 by 2 inches.

F. 1. When other faces of precast concrete unit are exposed, include Samples illustrating workmanship, color, and texture of backup concrete as well as facing concrete.

G. Delegated-Design Submittal: For architectural precast concrete indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Show governing panel types, connections, types of reinforcement, including special reinforcement, and concrete cover on reinforcement. Indicate location, type, magnitude, and direction of loads imposed on the building structural frame from architectural precast concrete.

H. Qualification Data: Include list of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.
    1. Include current plant certification from PCI (The Precast Concrete Institute).

I. Material Test Reports: From an accredited testing agency, indicating and interpreting test results for compliance with requirements indicated.

J. Material Certificates: For the following items, signed by manufacturers:

1. Cementitious materials.
2. Aggregates.
3. Reinforcing materials.
4. Admixtures.
5. Bearing pads.
6. Steel anchorages.

1.5 QUALITY ASSURANCE

A. Qualifications:

a. Fabricator Qualifications: A firm that assumes responsibility for engineering architectural precast concrete units to comply with performance requirements. This responsibility includes preparation of Shop Drawings and comprehensive engineering analysis by a qualified professional engineer.

1. Designated as a PCI-certified plant for Group A, Category A1 - Architectural Cladding and Load Bearing Units at time of bidding or designated as an APA-certified plant for production of architectural precast concrete products.

2. Company specializing in production of architectural precast concrete with minimum of ten (10) years documented experience.

3. Has sufficient production capacity to produce required units without delaying the Work.

D. Erector: Shall have a minimum of ten (10) years documented experience with the erection and installation of architectural precast concrete.

E. Source Quality Control: Quality control of architectural precast concrete products shall be responsibility of manufacturer.

F. Source Limitations for Architectural Precast Concrete: Obtain units through one source from a single manufacturer.

G. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color, from one manufacturer for each cementitious component and from one source or producer for each aggregate.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver architectural precast concrete units in such quantities and at such times to ensure compliance with the agreed upon project schedule and setting sequence and also to limit unloading units temporarily on the ground or other rehandling.

H. Support units during shipment on non-staining shock-absorbing material.

I. Store units with adequate dunnage and bracing, and protect units to prevent contact with soil, to prevent staining, and to prevent cracking, distortion, warping, or other physical damage.

J. Place stored units so identification marks are clearly visible, and units can be inspected.

K. Handle and transport units in a manner to avoid excessive stresses which could cause cracking or damage.

L. Lift and support units only at designated points indicated on Shop Drawings.

PART 2.

PART 3. PRODUCTS

3.1 FABRICATORS

A. Manufacturers: Subject to compliance with requirements, provide products by the following, or equal:

Nelson Precast Products (basis of design)
1501 W Patapsco Ave
Baltimore, MD 21230
www.nelsonprecast.com

3.2 MOLD MATERIALS

A. Molds: Rigid, dimensionally stable, non-absorptive material, 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 form-release agent that will not bond with, stain, or affect hardening of precast concrete surfaces and will not impair subsequent surface or joint treatments of precast concrete.
2. Surface Retarder: Chemical set retarder, capable of temporarily delaying final hardening of newly placed concrete to depth of reveal specified.

3.3 REINFORCING MATERIALS

A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), deformed.
B. Plain-Steel Welded Wire Reinforcement: ASTM A 185/A 185M, fabricated from steel wire into flat sheets.
C. Deformed Steel Welded Wire Reinforcement: ASTM A 497/A 497M, flat sheet.
D. Supports: Suspend reinforcement from back of mold or use bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place according to PCI MNL 117.

3.4 CONCRETE MATERIALS

A. Portland Cement: ASTM C150, Type I or III.
B. Supplementary Cementitious Materials.
   1. Fly Ash: ASTM C 618, Class C or F with maximum loss on ignition of 3 percent.
   2. Metakaolin: ASTM C 618, Class N.
   3. Silica Fume: ASTM C 1240 with optional chemical and physical requirements.
   4. Ground Granulated Blast Furnace Slag: ASTM C 989, Grade 100 or 120.
C. Normal-weight Aggregates: Except as modified by PCI MNL 117, ASTM C 33, with coarse aggregates complying with Class 5S. Stockpile fine and coarse aggregates for each type of exposed finish from a single source (pit or quarry) for Project.
   1. Face-Mixture Coarse Aggregates: Selected, hard, and durable; free of material that reacts with cement or causes staining; to match selected finish sample.
   2. Face-Mixture Fine Aggregates: Selected, natural, or manufactured sand of a material compatible with coarse aggregate to match selected Sample finish.
D. Coloring Admixture: ASTM C 979, synthetic or natural mineral-oxide pigments or colored water-reducing admixtures, temperature stable, and nonfading.
E. Water: Potable; free from deleterious material that may affect color stability, setting, or strength of concrete and complying with chemical limits of PCI MNL 117.
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 Accelerating Admixture: ASTM C 494/C 494M, Type E.
   4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
   5. Plasticizing Admixture for Flowable Concrete: ASTM C 1017/C 1017M.

3.5 CONCRETE MIXTURES

A. Prepare design mixtures to match Architect's sample.
B. Design mixtures may be prepared by a qualified independent testing agency or by qualified precast concrete plant personnel at architectural precast concrete fabricator's option.
C. Limit water-soluble chloride ions to the maximum percentage by weight of cement permitted by ACI 318 (ACI 318M) or PCI MNL 117 when tested in accordance with ASTM C 1218/C 1218M.
D. Normal weight Concrete Face and Backup Mixtures: Proportion mixtures by either laboratory trial batch or field test data methods according to ACI 211.1, with materials to be used on Project, to provide normal weight concrete with the following properties:
    1. Compressive Strength (28 Days): 5000 psi (34.5 MPa) minimum.
    2. Release Strength: As required by design.
    3. Maximum Water-Cementitious Materials Ratio: 0.40.
    4. Measurable slump.
E. Water Absorption: 6 percent by weight or 14 percent by volume, tested according to ASTM C 642, except for boiling requirement.
F. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having an air content complying with PCI MNL 117.
G. When included in design mixtures, add other admixtures to concrete according to manufacturer's written instructions.

3.6 MOLD FABRICATION

A. Molds: Accurately construct molds, mortar tight, of sufficient strength to withstand pressures due to concrete placement and vibration operations and temperature changes, and for prestressing and detensioning operations. Coat contact surfaces of molds with release agent before reinforcement is placed. Avoid contamination of reinforcement and prestressing tendons by release agent.
B. Maintain molds to provide completed architectural precast concrete units of shapes, lines, and dimensions indicated in Contract Documents, within fabrication tolerances specified.
C. Form joints are not permitted on faces exposed to view in the finished work.

3.7 FABRICATION

A. Cast-in Anchors, Inserts, Plates, Angles, and Other Anchorage Hardware: Fabricate 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.
B. Cast in reglets, slots, holes, and other accessories in architectural precast concrete units as indicated on Contract Drawings.
C. Cast in openings larger than 10 in. (250 mm) in any dimension. Do not drill or cut openings or prestressing strand without Architect's approval.
D. Reinforcement: Comply with recommendations in PCI MNL 117 for fabrication, placing, and supporting reinforcement.
    1. Maintain at least 3/4 in. (19 mm) minimum concrete cover. Increase cover requirements for reinforcing steel to 1 1/2 in. (38 mm) when units are exposed to corrosive environment or severe exposure conditions.
    2. Install welded wire reinforcement in lengths as long as practicable. 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. Reinforce architectural precast concrete units to resist handling, transportation and erection stresses, and specified in-place loads, whichever governs.
F. Comply with requirements in PCI MNL 117 and requirements in this Section for measuring, mixing, transporting, and placing concrete. After concrete batching, no additional water may be added.
G. Place face mixture to a minimum thickness after consolidation of the greater of 1 in. (25 mm) or 1.5 times the nominal maximum aggregate size, but not less than the minimum reinforcing cover as indicated on Contract Drawings.
    1. Use a single design mixture for those units in which more than one major face (edge) is exposed.
    2. Where only one face of unit is exposed, at the fabricator's option, either of the following mixture

design/casting techniques may be used:

a. A single design mixture throughout the entire thickness of panel.
b. Separate mixtures for face and backup concrete; using cement and aggregates for each type as appropriate, for consecutive placement in the mold. Use cement and aggregate specified for face mixture. Use cement and aggregate for backup mixture complying with specified criteria or as selected by the fabricator.

H. Place concrete in a continuous operation to prevent cold joints or planes of weakness from forming in precast concrete units. Place backup concrete to ensure bond with face-mixture concrete.
I. Thoroughly consolidate placed concrete by internal and/or external vibration without dislocating or damaging reinforcement and built-in items, and minimize pour lines, honeycombing, or entrapped air voids on surfaces. Use equipment and procedures complying with PCI MNL 117.
J. Place self-consolidating concrete without vibration in accordance with PCI TR-6 "Interim Guidelines for the Use of Self-Consolidating Concrete." If face and backup concrete is used, ensure adequate bond between concrete mixtures.
K. Comply with PCI MNL 117 procedures for hot- and cold-weather concrete placement.
L. Cure concrete, according to requirements in PCI 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 the compressive strength is high enough to ensure that stripping does not have an effect on the performance or appearance of final product.
M. Repair damaged architectural precast concrete units to meet acceptability requirements in PCI MNL 117 and Architect's approval.

3.8 FABRICATION TOLERANCES

A. Fabricate architectural precast concrete units of shapes, lines and dimensions indicated, so each finished unit complies with PCI MNL 117 product tolerances as well as position tolerances for cast-in items.

3.9 FINISHES

A. Exposed panel faces shall be free of joint marks, grain, and other obvious defects. Corners, including false joints shall be uniform and straight. Finish exposed-face surfaces of architectural precast concrete units to match approved mockups and as follows:
   1. Acid-Etched Finish: Use acid and hot-water solution, equipment, application techniques, and cleaning procedures to expose aggregate and surrounding matrix surfaces to match accepted sample or mockup units. Protect hardware, connections, and insulation from acid attack.
B. Finish all exposed surfaces to match face-surface finish.
C. Finish unexposed surfaces of architectural precast concrete units with as-cast finish.

3.10 SOURCE QUALITY CONTROL

A. Quality-Control Testing: Test and inspect precast concrete according to PCI MNL 117 requirements. If using self-consolidating concrete also test and inspect according to PCI TR-6 "Interim Guidelines for the Use of Self-Consolidating Concrete" and ASTM C 1611/C 1611M, ASTM C 1712, ASTM C 1610/1610M, and ASTM C 1621/C 1621M.

PART 4. EXECUTION

4.1 PREPARATION

A. Furnish anchorage devices for precast concrete units to be embedded in or attached to the building structural frame or foundation before start of such Work. Provide locations, setting diagrams, templates and instructions for the proper installation of each anchorage device.

4.2 EXAMINATION

A. Examine supporting structural frame or foundation and conditions for compliance with requirements for installation tolerances, bearing surface tolerances, and other conditions affecting precast concrete performance.
B. Proceed with precast concrete installation only after unsatisfactory conditions have been corrected.

C. Contractor shall notify precast concrete erector that supporting cast-in-place concrete foundation and building structural framing has attained minimum allowable design compressive strength or supporting steel or other structure is structurally ready to receive loads from precast concrete units prior to proceeding with installation.

4.3 ERECTION

A. Install loose clips, hangers, bearing pads, and other accessories required for connecting architectural precast concrete units to supporting members and backup materials.

B. Structural steel fabricator or erector to supply and install miscellaneous steel preweld connection hardware in the field.

C. Erect architectural precast concrete level, plumb, and square within the specified allowable erection tolerances. Provide temporary supports and bracing as required to maintain position, stability, and alignment of units until permanent connections are completed.
   1. Install temporary steel or plastic spacing shims as precast concrete units are being erected. Surface 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 sand-cement grout to fill voids within recessed lifting devices flush with surface of adjacent precast concrete surfaces when recess is exposed.
   4. Unless otherwise indicated, provide for uniform joint widths of 3/8 in. (10 mm).

D. Connect architectural precast concrete units in position by bolting, welding, grouting, or as otherwise indicated on Shop (Erection) Drawings. Remove temporary shims, wedges, and spacers as soon as practical after connecting and/or grouting are completed.
   1. Disruption of roof flashing continuity by connections is not permitted; concealment within roof insulation is acceptable.

E. Welding: Comply with applicable AWS D1.1/D1.1M, AWS D1.4/D1.4M and D1.6/D1.6M requirements for welding, welding electrodes, appearance of welds, quality of welds, and methods used in correcting welding work.
   1. Protect architectural precast concrete units and bearing pads from damage during field welding or cutting operations and provide noncombustible shields as required.
   2. Welds not specified shall be continuous fillet welds, using not less than the minimum fillet as specified by AWS D 1.1/D 1.1M, D 1.4/D 1.4M or D1.6/D1.6M.
   3. Clean weld- affected metal surfaces with chipping hammer followed by brushing or power tool cleaning and then reprime damaged painted surfaces in accordance with paint manufacturer's recommendations.
   4. Visually inspect all welds critical to precast concrete connections. Visually check all welds for completion and remove, reweld or repair all defective welds, if services of AWS-certified welding inspector are not furnished by Owner.

F. At bolted connections, use upset threads, thread locking compound or other approved means to prevent loosening of nuts after final adjustment.
   1. Where slotted connections are used, verify bolt position and tightness at installation. For sliding connections, properly secure bolt but allow bolt to move within connection slot.
   2. For slip critical connections, one of the following methods shall be used to assure proper bolt pretension:
      a. Turn-of-Nut – in accordance with AISC.
      b. Calibrated Wrench – in accordance with AISC.
      c. Twist-off Tension Control Bolt – meeting ASTM F 1852.
      d. Direct-Tension Control Bolt – meeting ASTM F 1852.
   3. For slip critical connections, the method to be used and the inspection procedure to be used shall be approved by the Architect and coordinated with the inspection agency.

G. Grouting or Dry-Packing Connections and Joints: Indicate joints to be grouted and any critical grouting sequences on Shop (Erection) Drawings. Grout connections where required or indicated on Shop (Erection) Drawings. Retain flowable grout in place until it gains sufficient strength to support itself. Alternatively pack spaces with stiff dry pack grout material, tamping until voids are completely filled. Place grout and finish smooth, level, and plumb with adjacent concrete surfaces. Promptly remove grout material from exposed surfaces before it affects finishes or hardens. Keep grouted joints damp for at least 24 hours after initial set.

4.4 ERECTION TOLERANCES

A. Erect architectural precast concrete units level, plumb, square, and in alignment without exceeding the noncumulative erection tolerances of PCI MNL 117, Appendix I.

4.5 FIELD QUALITY CONTROL

A. Contractor will inspect all precast concrete units before accepting delivery to ensure that they meet all project tolerances.

B. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections and prepare reports:
   1. Erection of loadbearing precast concrete members.

C. Testing: Owner will engage accredited independent testing and inspecting agency to perform field tests and inspections and prepare reports.
   1. Field welds will be subject to visual inspections and dye penetrant or magnetic particle testing in accordance with ASTM E165 or ASTM E 1444 and ASTM E 709. Testing agency shall be qualified in accordance with ASTM E543.
   2. Testing agency will report test results promptly and in writing to Contractor and Architect.

D. Repair or remove and replace work where tests and inspections indicate that it does not comply with specified requirements.

E. Additional testing and inspecting, at Erector's expense, will be performed to determine compliance of corrected work with specified requirements.

4.6 REPAIRS

A. Repairs will be permitted provided structural adequacy of units and appearance are not impaired.

B. Repair damaged units to meet acceptability requirements of PCI MNL 117.

C. Mix patching materials and repair units so cured patches blend with color, texture, and uniformity of adjacent exposed surfaces and show no apparent line of demarcation between original and repaired work, when viewed in typical daylight illumination from a distance of 20 ft (6 m).

4.7 CLEANING

A. Clean all surfaces of precast concrete to be exposed to view, as necessary, prior to shipping.

B. Clean mortar, plaster, fireproofing, weld slag, and any other deleterious material from concrete surfaces and adjacent materials immediately.

C. Clean exposed surfaces of precast concrete units after erection and completion of joint treatment to remove weld marks, dirt, stains and other markings.
   1. Perform cleaning procedures, if necessary, according to precast concrete fabricator’s recommendations. Protect adjacent work from staining or damage due to cleaning operations.
   2. Do not use cleaning materials or processes that could change the appearance of exposed concrete finishes or damage adjacent materials.

END OF SECTION 03 45 00