

## SECTION 034501

### PRECAST ARCHITECTURAL THINSHELL CONCRETE

#### PART 1 – GENERAL

##### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Conditions and Supplementary Conditions and Division 01 Specification Sections, apply to this section.

##### 1.2 SUMMARY

- A. Section includes Precast Architectural Concrete Thinshell, hereinafter referred to as “precast” and/or “panels”, including:

1. Structural design and detailing of precast panels.
2. Plant fabrication of precast panels.
3. Transportation of precast panels to job site.
4. Preweld and CIP hardware for precast to be attached to the structure.
5. Installation of precast panels.

- B. Related Sections:

1. Section 018316 “Exterior Enclosure Performance Requirements”
2. Section 033200 “Concrete Reinforcement”
3. Section 033000 “Cast-in-Place Concrete”
4. Section 034500 “Precast Architectural Concrete”
5. Section 034900 “Glass Fiber Reinforced Concrete”
6. Section 051200 “Structural Steel Framing”
7. Section 055000 “Metal Fabrications”
8. Section 071900 “Water Repellents”
9. Section 072100 “Thermal Insulation”
10. Section 078453 “Building Perimeter Firestopping”
11. Section 079200 “Joint Sealants”
12. Section 085113 “Aluminum Windows”

- C. References:

1. California Building Code, Current Edition.
2. PCI MNL-117: Manual for Quality Control for Plants and Production of Architectural Precast Concrete Products, Current Edition.
3. PCI MNL-120: PCI Design Handbook, Precast and Prestressed Concrete, Current Edition.
4. PCI MNL-128: Recommended Practice for Glass Fiber Reinforced Concrete Panels, Current Edition.
5. PCI MNL-130: Manual for Quality Control for Plants and Production of Glass Fiber Reinforced Concrete Products, Current Edition.
6. AWS D1.1: Structural Welding Code – Steel, Current Edition.
7. AWS D1.4: Structural Welding Code – Steel Reinforcing Bars, Current Edition.

##### 1.3 SYSTEM DESCRIPTION

- A. Plant fabricated precast panels consisting of architectural concrete, steel reinforcement, steel support frame, and steel connections for panel attachment to structure. Panels are transported to the job site for installation.
- B. The Precast Manufacturer shall design and furnish all precast connection hardware to be attached to the precast steel support frame; shall furnish all loose connection hardware and shall furnish all connection hardware required to be embedded in the cast-in-place concrete for connection of the precast panels. The placement of the hardware in the cast-in-place concrete will be the responsibility of the General Contractor.
- C. Hardware which is to be attached to the precast panels for other trades shall be provided to the Precast Manufacturer with instructions, in a timely manner in order not to disrupt or delay production. All such hardware shall be fully defined in contract drawings.
- D. When required by the Contract Documents, the Precast Manufacturer shall design, furnish, and install steel pre-weld required (such as clip angles and drop tubes) to carry the loads from the precast panels to the structure. Any bracing or stiffening of the structure required to support the loads from the precast panels shall be by others.

#### 1.4 QUALIFICATIONS

- A. Design: Precast panels shall be designed under the supervision of a civil engineer registered in the State of California employed or retained by the Precast Manufacturer, using the accepted principles of design as stipulated in the PCI MNL-120 and PCI MNL-128. All design loads shall meet the requirements of the California Building Code.
- B. Manufacturing: The precast manufacturing plant shall be certified at the time of bid by the Precast/Prestressed Concrete Institute Plant Certification Program for Group AA. Manufacturers:
  - 1. Willis Construction Co., Inc., or approved equal.
  - 2. The GFRC Manufacturer shall have an established PCI quality control program in effect prior to bidding.
    - a. When requested, Manufacturer will provide proof of PCI Certification and/or Quality Control Procedures.
- C. Erector: Regularly engaged for at least 5 years in erection of architectural precast panels similar to those required on this project. The present erection management team shall be capable of installing the required panels without causing a delay of project schedules.
- D. Welders: All welders performing any work under this specification shall be qualified in accordance with AWS D1.1 and AWS D1.4 as necessary to perform work at panel production and erection.
- E. Testing: Precast Manufacturer shall comply with the testing provisions of PCI MNL-117, PCI MNL-130 and MNL-128 – Chapter 8 – Quality Control.

#### 1.5 SUBMITTALS

- A. Samples:
  - 1. Submit lab samples, approximately 12 inch by 12 inch, representative of finished exposed

face. Prior to commencement of manufacturing panels, submit production samples, approximately 4 feet by 4 feet, for conformance with the approved 12 inch by 12 inch lab sample.

- B. Shop Drawings: Submit 1 electronic file of the Thinshell Shape and Erection Drawings showing:
  - 1. Material specifications.
  - 2. Floor plans, elevations, sections identifying dimensional location of panels.
  - 3. Floor plans and/or elevations identifying location of pre-erection attachments (i.e. cast-in-place embeds and prewelds) to support structure.
  - 4. Elevation view to identifying location of panels and respective connections.
  - 5. Detail as necessary to describe geometry and depth of panel system; and relationship of panels to adjacent material.
  - 6. Details of panel connections with descriptions of all panel connection hardware.
- C. Mix Designs: Submit all precast mix designs for approval. Mix designs shall be prepared by an independent testing facility or qualified employee of the Precast Manufacturer.
- D. Weld Procedure Specifications: Submit Welding Procedures, as requested by the Authority Having Jurisdiction, in accordance with AWS D1.1 and D1.4 requirements for all welding which will be performed under this Section.
- E. Design Calculations: Submit complete design calculations for governing panel types and connections, including loads used in design.
- F. Design Modifications:
  - 1. Submit design modifications necessary to meet performance requirements and field conditions.
  - 2. Variations in details or materials shall not adversely affect the appearance, durability or strength of panels.

## 1.6 QUALITY ASSURANCE

- A. Full-Scale Panel:
  - 1. After standard samples are accepted for color and texture, produce a full-scale panel in accordance with the design requirements. The panel shall be reviewed and approved by the Architect at the precast plant and the against any previously approved samples.
  - 2. The full-scale panel shall be representative of the standard quality of work.
  - 3. Incorporate full-scale panel into work after keeping panel in plant for checking purposes.
- B. In-Plant Quality Control
  - 1. Testing of materials and inspection of production methods shall be the responsibility of the Precast Manufacturer's Quality Control Department and performed in accordance with PCI MNL 117.
  - 2. Keep quality control records available for 2 years after final acceptance.
  - 3. Keep certificates of compliance available for 5 years after final acceptance.
- C. All other testing and inspection, including 3rd Party, to be provided by Owner.

## PART 2 – PRODUCTS

## 2.1 MATERIALS

### A. Portland Cement

1. Architectural Mixes: ASTM C150 Type I, II or III cement. For surfaces exposed to view when the building is complete use same brand, type and source of supply throughout the precast production.
2. Back-up Mixes: When used, the back-up mix shall be compatible with the architectural mix to which it is combined.

### B. Aggregates: Fine and coarse aggregate for mix shall conform to ASTM C33 except for gradation. Aggregates shall be clean, hard, strong, durable, inert, and free of staining and deleterious materials.

### C. Water: Free from deleterious matter that may interfere with the color, setting, or strength of the concrete.

### D. Admixtures: Conforming to ASTM C260 and/or ASTM C494.

### E. Coloring Agent: Conforming to ASTM C979.

1. Shall be harmless to precast concrete set and strength,
2. Shall be stable at high temperatures,
3. Shall be alkali-resistant.

### F. Plant applied one-coat water repellent sealer: Protectosil Chem-Trete BSM 350, or equal. Apply in accordance with manufacturer's recommendations.

### G. Concrete Strength: Concrete strength shall be determined by design with a minimum 28 day design strength of 5,000 psi.

### H. Steel Products

1. Structural Shapes, Bars & Plates (1/8 inch and thicker): ASTM A36
2. Pipe: ASTM A53 Grades A or B
3. Tube Steel: ASTM A500 Grades A or B
4. Reinforcing Steel: ASTM A615 Grades 40 & 60 or ASTM A706
5. Prestressing Strand: ASTM A416 Grade 270
6. Deformed Steel Bar Mats: ASTM A184
7. Deformed Bar Anchors: ASTM A496
8. Deformed Welded Wire Fabric: ASTM A497
9. Plain Welded Wire Fabric: ASTM A185
10. Welded Headed Studs: AWS D1.1 Type B
11. Standard Machine Bolts: ASTM A307 Grade A
12. Standard Studs/Threaded Round Stock (UNC): ASTM A307 Grade C
13. Nuts for Standard Machine Bolts and Threaded Studs: ASTM A563 Grade A Hex Nuts
14. High Strength Machine Bolts: ASTM A325 Type 1, ASTM A449 Type 1
15. Nuts for High-Strength Machine Bolts and Threaded Studs: ASTM A563 Grade A Heavy Hex Nuts
16. Coil Rods and Bolts: ASTM A108 - SAE 1016 to 1026,  $F_u/F_y = 70/55$  ksi minimum
17. Coil Nuts for Coil Rods and Bolts: Nuts passing a proof load stress of 80 ksi, based on the tensile stress area of the matching coil rods and bolts.
18. Malleable Iron Castings: ASTM A47 Grade 32510
19. Carbon Steel Castings: ASTM A27 Grade 60-30

## 2.2 STEEL PROTECTIVE COATINGS

- A. All connection hardware exposed to weather after completion of building shall be hot-dip galvanized. All connection hardware not exposed to weather after completion of building may be uncoated, except as otherwise explicitly required by the contract drawings. Fasteners can have either an electroplated zinc or cadmium coating.
- B. Rust Inhibitive Primer (shop prime paint such as red iron oxide) :
  - 1. Meets salt spray resistance ASTM B-117, VOC <100g/L
- C. Zinc Coatings:
  - 1. Hot-Dip Galvanizing: ASTM A123, or ASTM A153
  - 2. Electroplated Zinc for Steel Products and Steel Hardware: ASTM B633, minimum SC3.
  - 3. Zinc Rich Paints: Meets salt spray resistance ASTM B-117, zinc dust level by weight in dried film equal to or greater than 85 percent, VOC <100g/L, DOD-P-21035A.
- D. Cadmium Coatings:
  - 1. Electrodeposited Coatings of Cadmium: ASTM B766.

## 2.3 FABRICATION

- A. Precast Manufacturer shall not proceed with fabrication of panels prior to receiving the approved set of submittal drawings and the Architect's acceptance of submitted samples.
- B. Manufacturing procedures shall be in general compliance with PCI MNL-117.
- C. Batching of Concrete shall be in accordance with approved Mix Design(s).
- D. Forms:
  - 1. Forms for precast panels shall be rigid and constructed of materials that will result in finished products conforming to the profiles, dimensions and tolerances indicated by this Section, the Contract Documents and the approved submittal drawings.
  - 2. Construct forms to withstand vibration method selected.
  - 3. Release agents shall be applied and used according to the manufacturer's instructions.
- E. Cover: Minimum concrete cover for rebar, inserts and embeds shall be 3/4 inch, where applicable.
- F. Concreting:
  - 1. Convey concrete from the mixer to place of final deposit by methods which will prevent separation, segregation or loss of material.
  - 2. Consolidate all concrete in the form to minimize unintentional pour lines, honeycombing or entrapped air on vertical surfaces.
- G. Steel Support Frame and Flex anchors:
  - 1. Support frame shall be a prefabricated welded frame produced in accordance with the approved submittal drawings, calculations, and PCI MNL 128.
  - 2. Flex anchors shall be properly embedded in the concrete skin in accordance with the approved submittal drawings and calculations.

- H. Curing: Procedures sufficient to insure specified concrete strength of all precast panels must be employed. Stripping of a panel shall not occur until concrete strength is sufficient to prevent cracking or breaking of the panel.
- I. Manufacturing Tolerances:
1. Overall height and width of panels measured at the face exposed to view:
    - a. 10 feet or less: Plus or minus 1/8 inch
    - b. 10 feet to 20 feet: Plus 1/8 inch, minus 3/16 inch
    - c. 20 feet to 40 feet: Plus or minus 1/4 inch
    - d. Each additional 10 feet: Plus or minus 1/16 inch
  2. Overall height and width of panels measured at the face not exposed to view:
    - a. 10 feet or less: Plus or minus 1/4 inch
    - b. 10 feet to 20 feet: Plus 1/4 inch, minus 3/8 inch
    - c. 20 feet to 40 feet: Plus or minus 3/8 inch
    - d. Each additional 10 feet: Plus or minus 1/8 inch
  3. Variation from square or designed skew (difference in length of two diagonal measurements): 1/8 inch per 6 feet or 1/2 inch total, whichever is greater
  4. Bowing: Bowing shall not exceed  $L/360$  unless it can be shown that the member can meet erection tolerances using connection adjustments.
  5. Length and width of blockouts and openings within one panel: Plus or minus 1/4 inch
  6. Location of window opening within panel: Plus or minus 1/4 inch
  7. Location of blockouts other than window openings: Plus or minus 3/8 inch
  8. Warpage: Maximum permissible warpage of one corner out of the plane of the other three shall be 1/16 inch per foot distance from the nearest adjacent corner.
  9. Location of bearing connections: Plus or minus 1/4 inch
  10. Location of embeds and inserts other than bearing connections: Plus or minus 1/2 inch
  11. Support frame:
    - a. Vertical and horizontal alignment: 1/4 inch per 10 feet.
    - b. Spacing of framing member: Plus or minus 3/8 inch.
    - c. Squareness of frame (difference of diagonal length): 3/8 inch.
    - d. Overall size of frame: Plus or minus 3/8 inch.
- J. Panel Identification:
1. Mark each precast panel corresponding to its identification mark on submittal drawings.
  2. Mark each precast panel with casting date.
- K. Panel Finish and Approval: Precast panels and approved samples shall be viewed side by side from a minimum distance of 20 feet when comparing texture and color. Precast panels which do not reasonably match the color and texture of the approved sample(s) or PCI MNL 117 tolerances, shall be satisfactorily corrected.

## PART 3 - EXECUTION

### 3.1 PRODUCT TRANSPORTATION AND HANDLING

- A. Handle and transport panels in a position consistent with their shape and design to avoid excessive stresses or damage.

- B. Lift or support panels only at the points shown on the panel fabrication drawings.
- C. Support panels during shipment on non-staining shock-absorbing material as needed to prevent damage.

### 3.2 PRE-INSTALLATION RESPONSIBILITY

- A. General Contractor's Responsibility:
  - 1. The General Contractor shall provide the perimeter control layout grid lines, and elevation benchmarks, at each building elevation on each floor receiving precast panels.
  - 2. The General Contractor shall provide true, level, and clean support and attachment surfaces.
  - 3. The General Contractor shall provide for the accurate (1/2 inch in all directions) placement and alignment of connection hardware on the structure.
  - 4. The General Contractor shall be responsible for patching fireproofing after precast panel installation.
  - 5. The General Contractor shall confirm that the dimensions and tolerances of the structure allow for proper installation of the precast panels.
- B. Erector's Responsibility: Prior to installation of the precast panels, notify the General Contractor of any discrepancies discovered which affect the work under this contract. Commencement of installation does not constitute acceptance of the structure.

### 3.3 ERECTION

- A. Unloading Areas and Access: Clear all-weather unloading areas and access roadways around the building and in the building (where appropriate) shall be provided and maintained by the General Contractor so that the hauling and erection equipment for the precast panels may operate under their own power.
- B. Safety Aspects: The General Contractor shall provide all required traffic controls, barricades, warning lights and/or signs to ensure safe installation.
- C. Setting: Precast panels shall be lifted with suitable lifting devices at points provided by the Precast Manufacturer to prevent excessive stresses or damage to the panels.
- D. Temporary Supports and Bracing: The erector shall provide temporary support and bracing as required to maintain position, stability and alignment until panels are permanently connected.
- E. Tolerances of Erected Panels: Tolerances for location of precast panels shall be as listed below;
  - 1. Plan location from building grid datum: Plus or minus 1/2 inch
  - 2. Top elevation from nominal top elevation:
    - a. Exposed individual panel: Plus or minus 1/4 inch
    - b. Nonexposed individual panel: Plus or minus 1/2 inch
    - c. Exposed relative to adjacent panel: 1/4 inch
    - d. Nonexposed relative to adjacent panel: 1/2 inch
  - 3. Maximum plumb variation over height of structure or 100 feet, whichever is less: 1 inch
  - 4. Plumb in any 10 ft. of element height: 1/4 inch
  - 5. Maximum jog in alignment of matching edges: 1/4 inch
  - 6. Joint width (governs over joint taper)

- a. Panel dimension less than 20 feet: Plus or minus 1/4 inch
  - b. Panel dimension over 20 feet: Plus or minus 3/8 inch
- 7. Joint taper maximum: 3/8 inch
  - 8. Joint taper in 10 ft: 1/4 inch
  - 9. Maximum jog in alignment of matching faces: 1/4 inch
  - 10. Differential bowing as erected between adjacent member of the same design: 1/4 inch
- F. Final Connection of Panels to Structure:
- 1. Precast panels shall be attached to the structure as shown on the approved submittal drawings.
  - 2. All modifications made to details shown on approved submittal drawings shall be submitted for approval.
  - 3. Field Welding shall be performed by certified welders using equipment and materials compatible with the base material.

### 3.4 JOB SITE STORAGE, HANDLING, AND PROTECTION

- A. The Erector shall be responsible for the repair of damage to precast panels that is caused by its own crew.
- B. After precast panels are installed in their final positions, the General Contractor shall be responsible for their protection.
- C. The General Contractor shall be responsible for the repair of any damage to the precast panels caused by someone other than the Precast Manufacturer.

### 3.5 PATCHING

- A. Repairs will be permitted provided structural adequacy of GFRC panel and appearance of the finished face surface shall have no obvious imperfections or evidence of repair other than minimal color and texture variations in accordance with PCI MNL 117 – “2.10 Acceptability of Appearance,”.
- B. Mix patching materials and patch thinshell so that cured patches blend with color, texture, and uniformity of adjacent exposed surface.
- C. The repair shall be viewed with the unaided eye at an appropriate distance of 20 feet or greater. The appearance of the surface shall not be evaluated when light is illuminating the surface from an extreme angle.

### 3.6 CLEANING

- A. Cleaning methods shall be approved by Precast Manufacturer.
- B. Precast Manufacturer is responsible for providing a clean panel to Erector.
- C. The Erector shall clean erection marks from precast panels, when exposed to view, when the building is complete.
- D. Use care to prevent damage to precast surfaces and to adjacent materials.



- E. Surface must be thoroughly rinsed with clean water immediately after using cleaner.
- F. At completion of the project, the General Contractor shall be responsible for final cleaning and wash down of building.

### 3.7 ACCEPTANCE

- A. Immediately after the erection is completed, inspection and acceptance of the erected panels shall be made by the General Contractor to verify conformance with plans and specifications.
- B. Final acceptance of the panels shall be in accordance with PCI MNL 117 – “2.10 Acceptability of Appearance,” and be obtained from the Architect and/or Owner.
- C. Panels shall be viewed with the unaided eye at an appropriate distance of 20 feet or greater. The appearance of the surface shall not be evaluated when light is illuminating the surface from an extreme angle.

### 3.8 WARRANTY

- A. All labor and materials under the Precast Manufacturer’s contract shall be warranted by the Precast Manufacturer for a period of 1 year following final approval of the GFRC panel by the Architect. Any additional labor or material warranties, i.e. caulking, shall be passed through to the General Contractor with no responsibility by the Precast Manufacturer.

END OF SECTION