

**SECTION 03451 – CARBONCAST WALL PANELS****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

**1.2 SUMMARY**

- A. This Section includes CarbonCast precast concrete wall panel units, including manufacture, transportation, handling, erection, and other related items such as anchorage, bearing pads, storage and protection of the units.
  - 1. CarbonCast precast concrete wall panels are patented, insulated panels reinforced with prestressing strands, mild steel reinforcement, C-GRID® shear grid, and welded wire steel mesh or C-GRID epoxy-coated carbon fiber open strand mesh.
  - 2. CarbonCast precast wall panels can act as either bearing or non-bearing building elements, including shear walls.
- B. Related work specified elsewhere:
  - 1. Cast-in-place concrete
  - 2. Masonry
  - 3. Structural Steel
  - 4. Miscellaneous steel
  - 5. Waterproofing
  - 6. Flashing and sheet metal
  - 7. Sealant and caulking
  - 8. Painting and prep

**1.3 PERFORMANCE REQUIREMENTS**

- A. Structural Performance: Provide CarbonCast precast concrete panel units and connections capable of withstanding design loads within limits and under conditions indicated.
- B. Warranty: Manufacturer shall warrant that the CarbonCast precast concrete wall panel units will not spall or show visible cracking beyond accepted industry standards, splitting, deformation, or loosening resulting from inferior materials or workmanship by this trade for a period of one (1) year effective from the date of the substantial completion of the precast erection. Precast units showing such defects will be repaired or replaced at the precaster's option and made acceptable to the Owner or his representatives at no expense to the Owner.

**1.4 SUBMITTALS**

- A. General: Refer to and comply with Division 1 Section 01330 "Submittals", for procedures and additional submittal criteria.
- B. Product Data: For each type of product indicated. Include technical data and tested physical and performance properties.
- C. Design Mixes: For each concrete mix.
- D. Shop Drawings:
  - 1. Erection Drawings:
    - a. Member piece marks and completely dimensioned size and shape of each member.
    - b. Plans and/or elevations locating and defining all products furnished.
    - c. Sections and details showing connections, cast-in items and their relation to the supporting structures.
      - 1) Details, dimensional tolerances and related information of other trades affecting CarbonCast precast concrete work should be furnished to the AltusGroup®, Inc. precast concrete manufacturer.
    - d. Joints and openings between members and between members and structure.
    - e. Description of all loose, cast-in and field hardware.
    - f. Field installed anchor location drawings.
  - 2. Production Drawings: Typical member production drawings will be furnished only upon request.
    - a. Elevation view of each member.
    - b. Sections and details to indicated quantities, size, and position of reinforcing steel, anchors, inserts, etc.

- c. Handling devices.
  - d. Dimensions and finishes.
  - e. Tension for strand.
  - f. Concrete strengths.
  - g. Dunnage points for storage and transportation.
3. Product design criteria:
- a. Loadings for design:
    - 1) Handling stress limits.
    - 2) All dead, live loads, seismic and wind loads as specified on the contract drawings.
    - 3) All other loads specified for members, where applicable.
  - b. As directed on the contract drawings, design calculations of products shall be performed, sealed and submitted for approval by an engineer registered in the state where the project is located, who is experienced in precast, prestressed concrete design.
  - c. Design shall be in accordance with applicable codes as specified in the contract documents.

**E. Engineering Data:**

- 1. Submit complete design calculations for all precast members and connections. Indicate all design loads, including live loads, wind loads, seismic loads, and dead loads and including all handling stresses during shipment and erection and due to loads from construction procedures. Design calculations shall be performed, sealed and submitted by Precast Concrete Contractor's Professional Engineer, licensed to practice in the State where Project is located, who is experienced in precast, prestressed concrete design. Design calculations shall be based on requirements of Performance Requirements and product design criteria specified herein.

**F. Samples:**

- 1. Submit three samples, 12"x12", for each type of surface required showing finishes proposed for all exposed work. (Only required if the exterior is to have a finish other than as cast, paint or stain.)
- 2. Prior to product fabrication of precast concrete panel units, for projects where more than one finish is required, or where more than one type of reveal is required, prepare a (4'X 4') , partial panel mock up for final approval of the color and finish; arrange for architect's timely review of mock up at precaster's plant.
  - a. Notify architect when sample is ready for review at precaster's plant, and advise of schedule impact if review is not made in a timely way.
  - b. Do not start production fabrication of precast concrete panels with architectural finishes until sample units have received architect's written approval.

- c. The approved mock-up panels shall be a standard of quality for the color and range of required finishes.
- G. Current welder certificates for welding of reinforcements, shop and field connections.
- H. Current plant PCI certification.

## 1.5 QUALITY ASSURANCE

### A. Fabricator Qualifications:

- 1. The precast concrete manufacturer shall have 5 years of proven experience in the design and manufacture of precast concrete wall panels.
- 2. The precast concrete manufacturing plant shall belong to an AltusGroup, Inc. precaster licensed to design and manufacture lightweight CarbonCast precast concrete wall panels with C-GRID epoxy-coated carbon-fiber open strand mesh at the plant location.
- 3. The precast concrete manufacturing plant shall be certified by the Precast/Prestressed Concrete Institute Plant Certification Program. Certification shall be current at time of bidding.

### B. Erector Qualifications: PCI-certified or regularly engaged for at least 5 years in the erection of precast concrete architectural panels similar to the requirements of this project.

### C. Design Standards: Comply with governing code including, ASCE7 ACI 318 and the design recommendations in the current edition of PCI MNL 120, "PCI Design Handbook--Precast and Prestressed Concrete."

### D. Quality-Control Standards (for structural wall panels):

#### 1. For panels with a form finished gray concrete or stained or painted faces:

Comply with PCI MNL 116 through C-3 (minimum), "Manual for Quality Control; Precast and Prestressed Concrete."

#### 2. For panels with an architectural precast finish:

Comply with PCI MNL 116 C-3A, "Manual for Quality Control; Precast and Prestressed Concrete."

#### 3. For panels with an architectural precast finish and built to more stringent architectural tolerances:

Comply with PCI MNL 117 through A-2 (minimum), "Manual for Quality Control; Precast and Prestressed Concrete."

- E. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel"; and AWS D1.4, "Structural Welding Code--Reinforcing Steel."
- F. Requirements of regulatory agencies: All local codes plus the following specifications, standards and codes are a part of this specification.
  - 1. ASCE 7 – Minimum Design Loads for Buildings
  - 2. ACI 318 – Building Code Requirements for Structural Concrete.
  - 3. ACI 347 – Recommended Practice for Concrete Formworks.
  - 4. AISC – Manual of Steel Construction.
  - 5. PCI MNL 116, "Manual for Quality Control; Precast and Prestressed Concrete."
  - 6. PCI Design Handbook, Precast and Prestressed Concrete.
  - 7. AWS D1.1 – Structural Welding Code – Steel.
  - 8. AWS D1.4 – Structural Welding Code – Reinforcing Steel.
  - 9. ASTM Specifications – As referred to in Section 2 Products of this Specification.
  - 10. CRSI – Manual of Standard Practice.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Delivery and handling:
  - 1. CarbonCast precast concrete members shall be handled only at the lifting or supporting points, as shown on the shop drawings, and with suitable lifting devices. Lifting inserts shall have a minimum safety factor of 4. Rigging shall have a minimum safety factor of 5.
  - 2. Transportation, site handling and erection shall be performed by the AltusGroup, Inc. precaster, or its agents, with equipment and methods employed by qualified personnel acceptable to the precaster.
- B. Storage:
  - 1. Store all units off ground and clear of other staining influences.

2. Place stored units so that identification marks are discernible.
3. Separate stacked members by battens across full width of each bearing point. Protect all edges.
4. Protect all holes and reglets against water and ice in freezing weather.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURER

- A. Provide CarbonCast precast concrete insulating wall panels as manufactured by an AltusGroup, Inc. member precast concrete manufacturer.

### 2.2 MATERIALS

#### A. Concrete:

1. Portland Cement: ASTM C 150, Type I or Type III.
2. Other cementitious materials:
  - a. Fly ash or natural pozzolans: ASTM C618.
  - b. Ground granulated blast furnace slag: ASTM C989.
  - c. Silica fume: ASTM C1240.
3. Normal-Weight Aggregates for face and back wythes: Except as modified by PCI MNL 116 or ASTM C 33.
4. Light-Weight Aggregates for back wythes (optional – use if needed to increase panel R-value or reduce superstructure or transportation cost): Except as modified by PCI MNL 116 or ASTM C 33 with absorption less than 11 percent.
5. NOTE: If using light-weight back wythe aggregates, similar water-cement and cement-aggregate ratios are recommended for both wythes to limit bowing or warping.
6. Admixtures:
  - a. Air-entraining admixtures: ASTM C260.
  - b. Water reducing, retarding, accelerating, high range water reducing admixtures: ASTM C494 or C1017.
  - c. Viscosity-Modifying Admixture.
  - d. Coloring Admixture: ASTM C 979, synthetic mineral-oxide pigments or colored water-reducing admixtures, temperature stable, non-fading, and alkali resistant.
  - e. Metakaolin Admixture: ASTM C 618, Class N.

- f. Calcium chloride or admixtures containing chlorides shall not be used.
- 7. Water: Potable.
- B. Steel Reinforcing:
  - 1. Reinforcing Bars: ASTM A 615/A 615M, deformed.
  - 2. Low-Alloy-Steel Reinforcing Bars: ASTM A 706/A 706M, deformed.
  - 3. Galvanized reinforcing bars: ASTM A767.
  - 4. Epoxy-coated reinforcing bars: ASTM A775.
  - 5. Plain-Steel Wire: ASTM A82, as drawn.
  - 6. Deformed-Steel Wire: ASTM A 496.
  - 7. Plain-Steel Welded Wire Fabric: ASTM A 185, fabricated from as-drawn steel wire into flat sheets.
  - 8. Deformed-Steel Welded Wire Fabric: ASTM A 497, flat sheet.
  - 9. Supports: Manufacturer's bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire fabric in place according to PCI MNL 116 section specified in 1.5.D (QUALITY ASSURANCE).
  - 10. Prestressing Strand: ASTM A 416/A 416M, Grade 250 or 270, uncoated, 7-wire, low-relaxation strand.
- C. C-GRID Epoxy Coated Interlaid Carbon Fiber Mesh:
  - 1. Product construction and architecture supplied in accordance with minimum MARV tensile strength tow values (reported in pounds force per single end) and approved for CarbonCast product use by the AltusGroup Technical Committee.
  - 2. Yarn Type: Industrial Grade PAN based carbon fiber with suitable epoxy sizing as approved by the manufacturer (24K - 50K carbon fiber tows).
  - 3. Binder Chemistry: Chomarad Formulation: Epoxy D1156 (standard Tg) and/or Epoxy D2047 (High Tg ).
  - 4. Yarn/Strand Direction: Warp and Weft Strands to be laid perpendicular to each other; warp yarns to be superimposed.

5. Cross over bond: Fully bonded to ensure proper tow integrity.
6. Strands: No missing, broken, or degraded strands.

**D. Anchors and Inserts:**

1. Carbon-Steel Shapes and Plates: ASTM A 36/A 36M.
2. Carbon-Steel Headed Studs: ASTM A 108, AISI 1018 through AISI 1020, cold finished; AWS D1.1, Type A or B, with arc shields.
3. High-Strength, Low-Alloy Structural Steel: ASTM A 572/A 572M.
4. Carbon-Steel Structural Tubing: ASTM A 500, Grade B.
5. Stainless steel: ASTM A666, Type 304.
6. Bolts: ASTM A307 or A325.
7. a. Threaded Rods: ASTM A36, A193 or A307.
8. Deformed bar anchors: ASTM A496 or A706.
9. Finish: For exterior steel items, and items indicated for galvanizing, apply zinc coating by hot-dip process according to ASTM A 123/A 123M, after fabrication, and ASTM A 153/A 153M, or equivalent as applicable.
  - a. Galvanizing Repair Paint: DOD-P-21035A or SSPC-Paint 20.
10. Shop-Primed Finish: Prepare surfaces of non-galvanized steel items, except those surfaces to be embedded in concrete, according to requirements in SSPC-SP 3 and shop-apply lead- and chromate-free, rust-inhibiting primer, complying with performance requirements in FS TT-P-664 according to SSPC-PA 1.

**E. Grout:**

1. Sand-Cement Grout: Portland cement, ASTM C 150, Type I, and clean, natural sand, ASTM C 144. Mix at ratio of 1 part cement to 3 parts sand, by volume, with minimum water required for placement and hydration.
2. Non-shrink grout: Premixed, packaged ferrous or non-ferrous aggregate shrink-resistant grout.
3. Epoxy-resin grout: Two component mineral-filled epoxy resin: ASTM C881 of FS MMM-A-001993.

**F. Bearing Pads:**



1. Chloroprene (Neoprene): Conform to Div II, Section 18 of ASSHTO Standard Specifications for Highway bridges.
  2. Random Oriented Fiber Reinforced: Shall support a compressive stress of 3,000 psi with no cracking, splitting or delaminating in the internal portions of the pad.
  3. Plastic: Multi-monomer plastic strips shall be non-leaching and support construction loads with no visible overall expansion.
- G. Insulation Options: (Note to Specifiers – CarbonCast Wall Panels are available in a variety of insulation types depending on the design characteristics of each individual project. Below are insulation types available for use.)
1. Expanded Polystyrene (EPS) Board Insulation (V-Rib Panel): Rigid, closed cell, expanded polystyrene, ASTM C 578, with maximum flame-spread and smoke-developed indexes of 75 and 450 respectively, Type – choose (I, 0.90 lb/cu. ft. min; 1.00 lb/cu/ ft. nominal) (VIII, 1.15 lb/cu ft. min; 1.25 lb/cu/ ft. nominal) (II, 1.35 lb/cu. ft. min; 1.50 lb/cu/ ft. nominal) (IX, 1.80 lb/cu. ft. min; 2.00 lb/cu/ ft. nominal), and with (choose options):
    - a. Unfaced both sides (typical).
    - b. Polypropylene and/or polyethylene film with one perforated face and one un-perforated face (for extreme use cases).
  2. Extruded Polystyrene (XPS) Board Insulation: Rigid, closed cell, expanded polystyrene, ASTM C 578, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, Type – choose (X, 1.20-1.30 lb/cu. ft. - typical) (IV, 1.50-1.60 lb/cu. ft.), unfaced.
  3. Polyethelene Foam Insulation: Ethafoam®.
  4. Mineral Wool Firestopping Insulation: ASTM C 136 for combustibility; ASTM E 84 for surface burning characteristics, flame spread 25 or less, smoke developed 450 or less (50 or less in plenum); install in accordance with the assembly listing by a nationally recognized testing laboratory.
- H. Cast-in Items:
1. All grouted connection tubes and lifting device covers shall use the appropriate Producer Solutions blow molded plastic accessory, as manufactured by High Concrete Accessories to produce a uniform void suitable to receive grouting or, where appropriate, to eliminate field patching of lifting devices.

## 2.3 CONCRETE MIXES

- A. Self Compacting Concrete (SCC): Proportion mixes by laboratory trial batch or field test data methods in accordance with generally accepted practice to provide SCC with the appropriate balance of filling ability, passing ability and segregation resistance characteristics to produce materials meeting the following minimum properties:
  - 1. Compressive Strength (28 Days): 5000 psi
  - 2. Compressive strength at time of release for pre-tensioned members: 3500 psi.
  - 3. Compressive strength at stripping for precast members: 2000 psi.
- B. Normal-Weight Concrete Face and Back Wythe Mixes: Proportion mixes 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.
  - 2. Maximum Water-Cementitious Materials Ratio: 0.40.
- C. Light-Weight Concrete Back Wythe Mixes (optional): Proportion mixes by either laboratory trial batch or field test data methods according to ACI 211.2, with materials to be used on Project, to provide light-weight concrete with the following properties:
  - 1. Compressive Strength (28 Days): 5000 psi.
  - 2. Maximum Water-Cementitious Materials Ratio: 0.40.
- D. Water Absorption: 12 to 14 percent by volume, tested according to PCI MNL 116.
- E. 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 116.

## 2.4 FABRICATION

- A. Fabrication procedures shall be in general compliance with the PCI MNL-116 section specified in 1.5.D (QUALITY ASSURANCE).
- B. Formwork: Comply with ACI 347. Prefabricated mold shall be one-piece seamless rigid molds for exposed faces. Prevent deformation of molds and

maintain mold surfaces free of irregularities, dents, sags, or damage of any kind.

- C. Anchorage Hardware: Fabricate with sufficient anchorage and embedment to comply with design requirements. Accurately position for attachment of loose hardware, and secure in place during precasting operations.
- D. Furnish loose steel plates, clip angles, seat angles, anchors, dowels, cramps, hangers, and other hardware shapes for securing precast architectural concrete units to supporting and adjacent construction.
- E. Cast-in reglets, slots, holes, and other accessories in precast architectural concrete units to receive windows, cramps, dowels, reglets, waterstops, flashings, and other similar work as indicated.
- F. Reinforcement: Comply with recommendations in CRSI's "Manual of Standard Practice" and the PCI MNL 116 section specified in 1.5.D (QUALITY ASSURANCE) for fabricating, placing, and supporting reinforcement.
- G. Reinforce precast concrete wall units to resist handling, transportation, and erection stresses.
- H. Pre-stress tendons for precast concrete wall units by either post-tensioning or pre-tensioning method. Comply with PCI MNL 116.
- I. Mix concrete according to the PCI MNL 116 section specified in 1.5.D (QUALITY ASSURANCE) and requirements in this Section. After concrete batching, no additional water may be added.
- J. Place concrete in a continuous operation to prevent seams or planes of weakness from forming in precast concrete units. Comply with requirements in the PCI MNL 116 section specified in 1.5.D (QUALITY ASSURANCE) for measuring, mixing, transporting, and placing concrete.
  - 1. The production of SCC shall be carried out in plants in which the equipment, operation and materials are suitably controlled.
  - 2. All production staff involved in the production of SCC shall have been trained and possess experience in SCC.
- K. Identify pickup points of precast concrete wall units and orientation in structure with permanent markings, complying with markings indicated on Shop Drawings. Imprint or permanently mark casting date on each precast concrete wall unit on a surface that will not show in finished structure.
- L. Openings:

1. Manufacturer shall provide for openings 10 inch round or square or larger as shown on the contract drawings.
  2. Other openings shall be located and field drilled or cut by the trade after erection. Openings shall be approved by both architect and precaster before drilling or cutting.
- M. Cure concrete, according to requirements in PCI MNL 116, by accelerated heat curing using low-pressure live steam or radiant heat.
1. SCC can set faster than conventional concrete. Initial curing shall commence as soon as practicable after placement to minimize the risk of shrinkage cracking.
- N. Fabricate precast concrete wall panels straight and true to size and shape, with exposed edges and corners precise and true so each finished panel complies with PCI MNL 116 product tolerances as well as position tolerances for cast-in items.
- O. Patching: Shall be acceptable providing the structural adequacy of the product and the appearance are not impaired.
- P. Damaged, chipped or discolored units shall be replaced, patched or refinished as directed by the Architect and/or Engineer, and to their approval.
- 2.5 FINISH (*OPTIONS – Select only those that apply*)
- A. Finish exposed-face surfaces of CarbonCast precast concrete wall panels to match approved design reference sample and as follows:
1. Smooth-Surface Form Finish: Free of pockets, sand streaks, and honeycombs, with “as cast” color and texture.
  2. Textured-Surface Finish: Impart by form liners or inserts to produce surfaces free of pockets, streaks, and honeycombs.
  3. Retarded / Exposed Aggregate Finish: Use chemical retarding agents applied to concrete forms and washing and brushing procedures to expose aggregate and surrounding matrix surfaces after form removal.
  4. Abrasive-Blast Finish: Use abrasive grit, equipment, application techniques, and cleaning procedures to provide a uniform finished surface or to expose aggregates and surrounding matrix surfaces.
  5. Acid Wash Finish: Use light acid wash and water rinse, equipment, application techniques, and cleaning procedures to provide a uniform finished surface or to expose aggregates and surrounding matrix surfaces.

6. Brick Veneer: Accurately place thin veneer brick over form or mold prior to placement of concrete. (NOTE to Specifier: Brick veneer selections vary by region. Consult with an AltusGroup precaster regarding availability and acceptability prior to specifying a specific brick for a veneer application.)
  7. Consult your AltusGroup member precaster about the availability of the finishes described above as well as other available finishes such as stain or paint.
- B. Finish all other exterior wythe exposed surfaces of precast concrete wall units to match face-surface finish.
  - C. Finish all non-exposed surfaces with a smooth “as cast” or float finish that does not interfere with the application of other materials.
  - D. Finish all interior wythe surfaces with a smooth “as cast” or float finish that does not interfere with the application of other materials.
    1. For interior wythe surfaces that will be painted be certain to specify surface preparation in Division 9 to include patching large surface imperfections such as chips and air voids as well as a prime coat with filler to hide surface imperfections such as small bubbles and micro cracks.

## 2.6 SOURCE QUALITY CONTROL

- A. Quality Control Testing: Test and inspect precast concrete according to the PCI MNL 116 section specified in 1.5.D (QUALITY ASSURANCE) requirements.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation tolerances, true and level bearing surfaces, and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Site access: General contractor shall be responsible for providing suitable access to the building, proper drainage and firm, level bearing for the hauling and erection equipment to operate under their own power.

- B. Preparation of structures to receive precast panels: General contractor shall be responsible for:
  - 1. Providing true, level bearing surfaces on all field placed bearing surfaces.
  - 2. Placement and accurate alignment of anchor bolts, plates or dowels in column footings, grade beams and other field placed supporting members.
- C. Install precast concrete panels.
  - 1. Erection shall be carried out by erectors meeting requirements of this Section.
  - 2. Provide temporary supports and bracing as required to maintain position, stability, and alignment as units are being permanently connected.
  - 3. Maintain horizontal and vertical joint alignment and uniform joint width as erection progresses.
- D. Anchor precast concrete units in position by bolting, welding, grouting, or as otherwise indicated.
- E. Welding: Perform welding in compliance with AWS D1.1 and AWS D1.4, with qualified welders.
  - 1. Repair damaged steel surfaces by cleaning and applying a coat of galvanized repair paint to galvanized surfaces or by re-priming damaged painted surfaces.
- F. Install precast concrete wall units level, plumb, square, true, and in alignment without exceeding the non-cumulative erection tolerances of PCI MNL 125 or 127.
- G. Repair exposed exterior surfaces of precast concrete wall units to reasonably match color, texture, and uniformity of approved mock up panel(s) and surrounding precast concrete when repair is permitted by Architect and/or Engineer.
- H. Subject to approval of the Architect and precast Engineer, precast concrete wall panels may be drilled or “shot” by other trades for attachment of other building components provided no contact is made with prestressing steel. Should spalling occur, repair of the spall shall be the responsibility of the trade doing the drilling or the shooting.
- I. Clean exposed surfaces of precast concrete units after erection to remove weld marks, other markings, dirt, and stains caused by the erector. If other trades cause damage, marks, dirt, or stains they shall be liable for the costs of cleaning or repair.

- J. Inspection and Acceptance: Final inspection and acceptance of erected precast concrete units shall be made by the Architect and/or Engineer within a reasonable time after the precast units are installed and final alignment of the units is completed.

END SECTION 03451