

SECTION 07 42 47
ULTRA HIGH PERFORMANCE CONCRETE (UHPC) PANELS

SPECIFIER NOTE: The information provided below is intended to guide the Architect in developing specifications for products manufactured by Nvelope Rainscreen Systems, Ltd. and should not be viewed as a complete source of information about the product(s). The Architect should always refer to the MANUFACTURER'S Product Data for additional recommendations and for safety information.

THIS SPECIFICATION INCLUDES SOME OPTIONS AND CHOICES WITHIN THE TEXT. EDIT ACCORDINGLY.

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. This Section includes the furnishing and installation of factory-molded, ultra high performance concrete (UHPC) solid exterior wall panels [and soffit, interior, cornice, etc. parts] and pre-engineered support structure (system). The panels shall be for exterior applications. Panels shall be provided with all pre-drilled fastening holes. Exterior applications shall include pre-drilling of holes for concealed/undercut panel-fastening anchors.

1.2 RELATED DOCUMENTS

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

1.3 RELATED WORK SPECIFIED ELSEWHERE

- A. Division 05 Section "Cold-Formed Metal Framing".
- B. Division 06 Section "Sheathing".
- C. Division 07 Section "Thermal Insulation".
- D. Division 07 Section "Membrane Air Barriers".
- E. Division 08 Section "Windows".

1.4 PERFORMANCE REQUIREMENTS

- A. General Performance: Comply with performance requirements specified, as determined by testing of manufacturers' products representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.
- B. Failure also includes the following:
 - 1. Thermal stresses transferring to building structure.
 - 2. Solid exterior wall panels and support structure cracking or breakage.
 - 3. Noise or vibration created by wind and thermal and structural movements.
 - 4. Loosening or weakening of fasteners, attachments, and other components.

- C. Structural, Wind and Pressure Loads: As indicated on Structural Drawings.
- D. Structural Performance: Provide Solid Exterior Wall Panel and support system as follows:
 - 1. Will not evidence deflection exceeding specified limits.
 - 2. At 150 percent of positive and negative wind-load design pressures, assemblies, including anchorage, will not evidence material failures, structural distress, and permanent deformation of main framing members exceeding 0.2 percent of span.
 - 3. Durations: As required by design wind velocity, but not less than 10 seconds.
 - 4. Deflection of Framing Members: At design wind pressure, as follows:
 - a. Deflection Normal to Wall Plane: Limited to edge of panel in a direction perpendicular to panel plane not exceeding $L/240$ of the panel edge length for each panel or an amount that restricts edge deflection of individual panels to manufacturer's product limitations, whichever is less.
 - b. Deflection Parallel to Panel Plane: Limited to $L/360$ of clear span or 1/8 inch, manufacturer's product limitations, whichever is smaller.
 - c. Cantilever Deflection: Where framing members overhang an anchor point, limit deflection to 2 times the length of cantilevered member divided by 175, or manufacturer's product limitations, whichever is smaller.
- E. Story Drift: Accommodate design displacement of adjacent stories.
- F. Design Displacement: As indicated on Structural Drawings.
- G. Maximum Solid Exterior Wall Panels Deflection: $1/360$ of span or less when tested in accordance with positive and negative pressures.
- H. Solid exterior [and] [interior] wall panel system shall comply with 2009 International Building Code 1405.16.1 Panel Siding.}
- I. Anchorage system: Wall anchorages for exterior systems shall be designed to prevent thermal transfer through fasteners to interior side of cold-formed metal framing which could result in condensation inside the stud cavity.

1.5 SYSTEM DESCRIPTION

- A. Complete system shall include the design and installation of the solid exterior wall panels and support structure system to provide, in conjunction with wall substrate and air barrier, a weather-tight wall assembly utilizing rain screen principle.

1.6 SUBMITTALS

- A. Product Data: For each type of product indicated, including manufacturer's written handling, storage, installation and cleaning instructions and recommendations.
- B. Samples: Representative of finished exposed face of solid exterior UHPC panel. For each color and pattern specified, submit a minimum of three(3) samples, each not less than 6 by 6 inches (152 by 152 mm), and of actual thickness.
 - 1. Approved sample(s)- one each, to be returned to manufacturer
 - 2. Approved ' VECTR® Tolerances and Acceptance Criteria' documents to be returned to manufacturer.

- C. Shop Drawings: Submit shop drawings showing anchor placement, joint locations, and complete pattern layout plan.
 - 1. Shop Drawings for Mockups: Include plans, elevations, sections, full-size details, and attachments to other work.

- D. Delegated-Design Submittals:
 - 1. For Exterior Solid UHPC Wall Panel, support system, fasteners and anchors to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

- E. [LEED Submittals:
 - 1. Product Data for Credit ____: For products having extracted raw materials within 500 miles of manufacture, and within 500 miles of project site, documentation indicating percentages by weight Include statement indicating cost for each product.

- F. Quality Assurance Submittals:
 - 1. Test Reports: Submit certified test reports showing compliance with specified performance characteristics and physical properties.
 - 2. Product Listing with an accredited independent testing agency indicating the product meets the specified ASTM C-1186 Grade IV standards.
 - 3. Certification of Manufacturer's Quality Management System(QMS) by an accredited (IAS, AAMA, ANSI, ISO) independent testing, quality assurance and professional service organization. The QMS shall meet the requirements of the ICC- ES *Acceptance Criteria for Quality Documentation AC10* (2011) and address the development, production, and control of the company's products.
 - 4. Product certificates signed by manufacturers certifying materials comply with specified performance characteristics and criteria and physical requirements.
 - 5. Manufacturers' Instructions: Manufacturers' written installation instructions.

- G. Closeout Submittals:
 - 1. Operation and Maintenance Data:
 - a. Operation and maintenance data for installed products in accordance with Division 1 Closeout Submittals (Maintenance Data and Operation Data) Section.
 - b. Include methods for maintaining installed products and precautions against cleaning materials and methods detrimental to finishes and performance.

1.7 QUALITY ASSURANCE

- A. Pre-Bid Pre-Qualification Submittal:
 - 1. Contractors interested in proposing a solid exterior wall panel system produced by a manufacturer that is not the basis of design indicated in this section, must provide company and product details as a necessary pre-bid pre-qualification submittal, to demonstrate full compliance with the documents and design and quality standards, and to demonstrate capabilities and experience required by the documents and the project scope. The following also applies to this pre-bid Pre-Qualification submittal:

- a. A list of at least (3) complete projects using the solid exterior wall panel system produced by a manufacturer that is not the basis of design. All submitted projects must demonstrate the inclusion under one contract of the supply and installation of a solid exterior wall and soffit panel and pre-engineered support structure (system).
 - b. In addition to demonstrating full compliance with the documents quality standards, the submitted solid exterior wall panel system must meet the design intent, including specified colors, surface sheen, and patterns as judged solely by the Architect.
 - c. The Architect's decision shall be final. All approvals shall be made in writing and evidence shall be provided via an addenda.
- B. Fabricator/Installer Qualifications:
- 1. Installer shall be experienced in performing work with thin concrete cladding panels of similar type and scope. Supervisors and installers shall have a minimum 5 years experience of projects of similar type.
- C. Mockups:
- 1. Build mockup indicated on Drawings to verify selections made under sample submittals, and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
 - 2. Build mockup, including insulation, supports, attachments, and accessories for typical conditions/parts not to exceed one (1) window surround , cornice section and or building corner and not more than 100 square foot area.
 - 3. Approval of mockup does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
- D. Pre-installation Meetings:
- 1. Conduct pre-installation meeting to verify project requirements, substrate conditions, and manufacturers' installation instructions.
- E. Surface Preparation:
- 1. Specify applicable product preparation requirements.

1.8 DELIVERY, STORAGE AND HANDLING

- A. Deliver exterior solid UHPC wall panels and support system components packaged to comply with manufacturers' requirements and adequately protected from damage during shipment.
- B. Protect components from adverse job conditions prior to installation.
- C. Protect components from other trades after installation.
- D. Panels are to be stored and handled vertically until installed.
- E. Store exterior solid UHPC wall panels and support system components on platforms or pallets, covered with tarpaulins or other suitable weather-tight ventilated covering. Store components so that water accumulations will drain freely.
- F. Do not store exterior solid UHPC wall panels and support system components in contact with other materials that might cause staining, denting, surface damage or other deleterious effects.

1.9 PROJECT CONDITIONS

A. Field Measurements:

1. Verify actual measurements/openings by field measurements before material fabrication, and show recorded measurements on shop drawings.
2. Coordinate field measurements and fabrication schedule with construction progress to avoid construction delays.

PART 2 – PRODUCTS

2.1 SOLID EXTERIOR UHPC WALL PANELS

A. Manufacturers: The construction documents are based on the manufacturer and product/system noted below. As such, TAKTL® is a pre-approved Manufacturer for the scope described under this section. Other manufacturers will be considered, provided that they submit for approval according to the Part 1 “Quality Assurance” provisions of this specification section.

B. Basis of Design Product/Manufacturer: VECTR® Exterior [and] [Interior] Patterned Wall and Façade Panels, factory-formulated with TAKTL® ultra high performance concrete and reinforced with alkali-resistant (AR) glass mesh, factory-mixed and manufactured; complying with ASTM C1186. Type A, Grade IV. (Contact: TAKTL, 1120 William Flynn Highway, Glenshaw, PA 15116 Phone: (412) 412-486-1600; www.taktl-llc.com. Local Rep: Dave Sommer, CSI/CSC Phone: (206) 226-2311 Email: dave@interracorp.com.)

C. Panel Performance Characteristics:

1. Thermal Expansion (ASTM C531-00): 6.41E-06 in/in/degree F (0.01inches per meter at 40 degree temperature change).
2. Material Behavior in Vertical Tube
Furnace @ 750 degrees C (ASTM E136-09): Pass
3. Density – Thin Panel (ASTM C1185-08): 137 lbs./ft³ (2,194 kg/m³).
4. Flexural Strength (Thin Panel) – Dry (ASTM C1185-08): Pass, Mean length direction not less than 3,800 lbs./in² and width direction 3,600 lbs./in².
5. Flexural Strength (Thin Panel) – Wet (ASTM C1185-08): Pass, Mean length direction not less than 3,800 lbs./in² and width direction 3,400 lbs./in².
6. Freeze/Thaw (Cladding) (ASTM C1185-08): Pass. No visible cracks and not less than 90% post-exposure strength retention.
7. Moisture Content – Thin Panel (ASTM C1185-08): less than 1.0%
8. Moisture Movement – Thin Panel (ASTM C1185-08): 0.00%
9. Warm Water (ASTM C1185-08): Pass. No visible cracks or structural alteration. Not less than 90.0% ratio of retained post-exposure strength.
10. Water Absorption - Thin Panel (ASTM C1185-08): less than 4.0%
11. Water Tightness (ASTM C1185-08): Pass. No water droplet formation.
12. Anchor Pullout Strength (ASTM E488-96): 8.5 mm embed in 13mm thick panel
 - a. Tension (Min. Mean) Peak Load – 386 lbf or greater
 - b. Shear (Min. Mean) Peak Load – 650 lbf or greater
13. Surface Burning Characteristics (ASTM E84-09):
 - a. Flame Spread – Pass
 - b. Smoke Developed - Pass
 - c. Class A.

14. Colorfastness & Weathering (500 hours) (ASTM G155-05a & D2244-09a):
 - a. 2.07 delta E. without coating (standard, varies with pigment type, texture and coating)
15. Compressive Strength (ASTM C873): $\geq 18,332$ lbs./in² (126 MPa).
16. Tensile (splitting matrix prism) Strength (ASTM C496): 1,319 lbs./in² (9 MPa).

D. Panel Finishes:

1. Finish exposed, front-facing surface of UHPC as follows, to match approved design reference sample. Panel faces shall be free of joint marks, grain, or other obvious defects.
2. Design Reference Sample:
 - a. Pattern – [note texture, finish, color]
 - b. Pattern Direction - [as noted on drawings]

E. Panel Sizes: Vary and as indicated on approved panel/part layout. F. Panel Dimensional Tolerances

G. Panel Thickness: 1/2-inch (13-mm) nominally, thickness variation +/- 1/16

H. Panel Edges: Mitered and fully adhered at all outside panel corners, mitered (open joint) at all inside corners. Cast corners as indicated on shop drawings

I. Panel Weight: 5.7 lbs/ ft² , at 1/2" thickness

SUPPORT STRUCTURE (provided by Installing contractor) A.

Aluminum Support Structure:

1. Complete sub-frame assembly to support and anchor solid exterior solid UHPC wall panels. Aluminum support structure to be anchored to building structure.
 - a. [Exposed fastener OPTION] - NV1 by Nvelope USA, LLC Website: www.Nvelope.us Tel: (877) 491-3100 Email: info@nvelopeusa.com
 - b. [Concealed fastener OPTION] - NV3 by Nvelope USA, LLC Website: www.Nvelope.us Tel: (877) 491-3100 Email: info@nvelopeusa.com

B. Components:

1. Horizontal concealed aluminum clip system support bracket anchored to panels per cladding engineer.
2. Vertical girt profile, shelf shimming extrusions that fasten into support brackets and supports.
3. Horizontal support rails: Extruded Aluminum 'C' shaped rails with 'mated' 'C' clips attached to girt profile which provides means to suspend UHPC wall panels. Fasteners: Corrosion-resistant stainless steel fasteners and anchors of type, size and spacing required for type of substrate and project conditions.

2.2 AUXILIARY MATERIALS (provided by installing contractor)

A. Panel Anchors: Concealed, undercut type, for attaching UHPC panels to panel mounted extruded aluminum panel hangers and substructure support system. Panel anchor holes to be factory pre-drilled by UHPC panel manufacturer.

1. Basis-of-Design Product/Manufacturer (Concealed): KEIL Concealed Anchoring System for Façade Panels,

- B. Stainless Steel Drill Screws: Of sufficient lengths and sizes to securely fasten support structure to building wall framing members, and as follows:
 - 1. Screws complying with ASTM C 1002 for fastening to steel members less than 0.033 inches (0.84 mm) thick.
 - 2. Screws complying with ASTM C 954 for fastening to steel members from 0.033 to 0.112 inches (0.84 to 2.84 mm) thick.

2.3 FABRICATION

- A. Fabricate wall panels and accessory items in accordance with manufacturers' recommendations and approved submittals.
- B. Panels shall be fabricated to size, with all concealed/undercut anchor holes factory drilled by the UHPC panel manufacturer.
- C. Field-cut panels and drill face-fastening anchor holes in accordance with the UHPC panel manufacturer's written directions.
- D. Do not field-modify factory-drilled concealed/undercut panel anchor holes.
- E. Fabricate all panels to profiles, colors and textures per samples and approval selected by the Architect.

PART 3 - EXECUTION

3.1 MANUFACTURERS' INSTRUCTIONS

- A. Compliance: Comply with manufacturers' product data, including product technical bulletins, product catalog installation instructions and product carton instructions for installation.

3.2 EXAMINATION

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

3.2 ERECTION/INSTALLATION – DELEGATED DESIGN

- A. Install wall reinforcements, channel cleats, clips, hangers, and other accessories required for connecting UHPC wall panels to supporting members and backup materials per project/façade engineers approved design.
- B. Provide miscellaneous reinforcement of adhered panel parts and unitized panel parts per manufacturer and installation contractor's engineer.
- C. Lift UHPC wall panels and install without damage.
- D. Install UHPC panels level, plumb, square, and in alignment.
- E. Provide temporary supports and bracing as required to maintain position, stability, and alignment of panels until permanent connections are completed.
 - 1. Maintain horizontal and vertical joint alignment and uniform joint width.
 - 2. Remove temporary projecting hoisting devices.

3.3 CLEANING AND PROTECTION

- A. Perform cleaning procedures according to UHPC panel manufacturer's written instructions.

- B. Clean soiled UHPC surfaces with non-abrasive cleaners and water, using soft fiber brushes, rags and sponges, and rinse with clean water.
- C. Prevent damage to UHPC surfaces and staining of adjacent material.

END OF SECTION 07 42 47