

**EXTERIOR-INSULATED RAIN SCREEN WALL
ASSEMBLY WITH LIGHTWEIGHT NATURAL
STONE FAÇADE AND INTEGRAL THERMAL
AND AIR BARRIER SYSTEMS**

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**EXTERIOR-INSULATED RAIN SCREEN WALL ASSEMBLY WITH LIGHTWEIGHT
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SECTION 07 42 65.16
EXTERIOR-INSULATED RAIN SCREEN WALL ASSEMBLY WITH LIGHTWEIGHT
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SPEC NOTE: This guide specification is intended for use when specifying Knight Wall Systems' panelized stone cladding and support/attachment framing over the THERMAX™ Wall System by Dow to provide ASHRAE 90.1 compliant continuously insulated rain screen walls.

SPEC NOTE: Make any required selections, such as insulation thickness, board sizes, etc. Where selection is indicated with an [OR] statement, select the appropriate paragraph and delete the inappropriate statement. Delete all SPEC NOTES and [OR] statements prior to final printing.

DISCLAIMER: The manufacturer has reviewed the product information contained in this guide specification. The information is organized and presented to assist the specification writer working on a construction project to select the appropriate products and to save time in writing the project specification Section. The specification writer is responsible for product selection as well as the use and application of this information, and should contact the manufacturer to ensure that all options are available and that the associated specification information is valid and correct.

PART 1 - GENERAL

1.1 SUMMARY

- A. Provide a complete true continuous exterior-insulated rain screen wall assembly inclusive of the following:
1. Thermal and air barrier wall system
 2. Cold-formed metal support framing and attachment system
 3. Aluminum honeycomb-reinforced thin-sliced stone panel finish system

1.2 REFERENCES

SPEC NOTE: Select the applicable reference standards to suit Project requirements. Delete non-applicable standards

- A. ASTM International (ASTM):
1. A792/A792M-[05]: Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process.
 2. C97-[02]: Standard Test Methods for Absorption and Bulk Specific Gravity of Dimension Stone.
 3. C99-[08]: Standard Test Method for Modulus of Rupture of Dimension Stone.
 4. C170-[06]: Standard Test Method for Compressive Strength of Dimension Stone.

5. C203-[99]: Test Methods for Breaking Load and Flexural Properties of Block-Type Thermal Insulation.
 6. C209-[98]: Test Method for Cellulosic Fiber Insulating Board.
 7. C297/C297M-[04]: Standard Test method for Flatwise Tensile Strength of Sandwich Construction.
 8. C365/365M-[05]: Standard Test method for Flatwise Compressive Properties of Sandwich Cores.
 9. C518-[04]: Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
 10. C615-[99]: Standard Specifications for Granite Dimension Stone.
 11. C645-[07]: Standard Specification for Nonstructural Steel Framing Members.
 12. C880-[06]: Standard Test Method for Flexural Strength of Dimension Stone.
 13. C1029-[05]: Specification for Spray-Applied Rigid Cellular Polyurethane Thermal Insulation.
 14. C1289-[06]: Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board.
 15. C1513-[04]: Standard Specification for Steel Tapping Screws for Cold-Formed Steel Framing Members.
 16. D1621-[04a]: Test Method for Compressive Properties of Rigid Cellular Plastics.
 17. D1622-[03]: Test Method for Apparent Density of Rigid Cellular Plastics.
 18. D1781-[98(2004)]: Standard Test Method for Climbing Drum Peel for Adhesives.
 19. D2126-[99]: Test Method for Response of Rigid Cellular Plastics to Thermal and Humid Aging.
 20. D5229/D5229M-[92]: Standard Test Method for Moisture Absorption Properties and Equilibrium Conditioning of Polymer Matrix Composite Materials.
 21. E72-[05]: Standard Strength Tests of Panels for Building Construction.
 22. E84-[05]: Test Method for Surface Burning Characteristics of Building Materials.
 23. E96/E96M-[05]: Test Method for Water Vapor Transmission of Materials.
 24. E330-[02]: Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference.
 25. E331-[00]: Test Method for Water Penetration of Exterior Windows, Curtain Walls and Doors by Uniform Static Air Pressure Difference.
 26. E1556-[08]: Standard Specification for Epoxy Resin System for Composite Skin, Honeycomb Sandwich Panel Repair.
 27. E2357-[05]: Test Method for Determining Air Leakage of Air Barrier Assemblies.
 28. F1642-[04(2010)]: Standard Test Method for Glazing and Glazing Systems Subject to Airblast Loadings.
- B. American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)
1. 90.1-2010 Energy Standard for Buildings except Low-Rise Residential Buildings.
- C. Marble Institute of America:
1. MIA Dimensional Stone Manual.
- D. Factory Mutual (FM):
1. FM 4880: Class I Wall and Ceiling Panels Building Corner Fire Test.

- E. Underwriters Laboratories Inc. (UL):
 1. UL 723: Surface Burning Characteristics of Building Materials.
- F. National Fire Protection Association (NFPA):
 1. NFPA 286 [2006]: Standard Methods of Fire Tests for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth.
- G. American Iron and Steel Institute (AISI):
 1. Code of Standard Practice.
 2. TS-1-02 Rotational-Lateral Stiffness Test Method for Beam-to-Panel Assemblies.
 3. TS-3-02 Standard Methods for Determination of Uniform and Local Ductility.
 4. TS-4-02 Standard Test Method for Determining the Tensile and shear Strength of Screws.
 5. TS-5-02 Test Methods for mechanically Fastened Cold-Formed Steel Connections.
 6. TS-6-02 Standard Procedures for Panel and anchor Structural Tests.
- H. United Facilities Criteria (UFC)
 1. 4-010-01: Department of Defense (DOD) Minimum Antiterrorism Standards for Buildings.
- I. U.S. General Services Administration
 1. TS01-2003: Standard Test Method for Glazing and Window Systems Subject to Dynamic Overpressure Loadings.

1.3 SYSTEM DESCRIPTION

- A. Furnish and install exterior wall system that effectively controls thermal, air and water performance and provides continuity of the building envelope enclosure. The system shall include the following:
 1. Insulated sheathing secured to exterior of metal wall framing assembly.
 2. Medium-density, closed-cell spray polyurethane foam applied to interior wall cavity.
 3. Cold-formed steel support framing / attachment system installed to exterior of insulated sheathing, consisting of vertical girts, horizontal mounting tracks, thermal isolators and associated fasteners.
 4. 6 mm solid [Granite] [Marble] [Travertine] [Onyx] [Quartzite] [Limestone] [Sandstone] stone reinforced with 20mm aluminum honeycomb panel structurally adhered and mechanically fastened onto pressed metal backing to form panels, then hung on horizontal tracks by integral clips and tied into one another with screws.
 5. Penetration and gap sealing material used to seal penetrations through the wall system and gaps between building envelope enclosure components and wall opening frames.
 - a. [single component spray polyurethane foam][two component spray polyurethane foam][single component caulk or sealant].
 6. Panel joints may be either dry-jointed or filled with backer rod and sealant to meet project aesthetic requirements.
 7. Butyl-based flashing tape to seal insulation board joints, damaged areas, and appropriate penetrations.
- B. Design Requirements:
 1. Constructed exterior wall system and component materials shall be acceptable for use under the building code in force in the jurisdiction of the project.

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2. Constructed system shall comply with ANSI/ASHRAE 90.1-2010 definition of Continuous Insulation (c.i.).
3. Products may be dimensioned in either English or Metric units. Design calculations, details and shop drawings shall take this into account.
4. Structural Design: Exterior/interior wall cladding assemblies capable of withstanding effects of load and stresses from dead loads, wind loads, snow loads and normal thermal movement without evidence of permanent defects of assemblies or components.

SPEC NOTE: Define applicable structural design requirements in accordance with applicable building code or building by-law.

- a. Dead Load: As required by (applicable building code) (_____).
 - b. Live Load: As required by (applicable building code) (_____).
 - c. Wind Load: Uniform pressure (velocity pressure) of (Insert Design Criteria) lb/sq ft. (Insert Design Criteria), acting inward or outward.
 - d. Manufacturing, installation, and sealing shall prevent deformation of exposed surfaces.
 - e. Maximum allowable deflection of span: L/175.
 - f. Accommodate substructure tolerance of +0 to -1/4 inch.
5. Support Framing / Attachment System:
 - a. Frequency and spacing of vertical box girts as shown on shop drawings.
 - b. Additional horizontal J tracks may be required where panel size, penetrations, or vibration and loading dictate.
 6. Thin Stone Panel Façade:
 - a. Recommended starting height for curtain wall must allow for unobstructed air flow.
 - b. Ventilation Gap: 1 inch; must not be obstructed by other installed products or assemblies.
 - c. Minimum width for thin brick panels after cutting is 8 inches.
 - d. Expansion joints: Provide minimum 3/8-inch joint between stone panels to allow for expansion and contraction of materials resulting from changes in temperature and weather conditions.

C. Performance Characteristics:

SPEC NOTE: Insert applicable performance criteria to suit Project requirements, including total wall R-value required and air barrier and water penetration test performance requirements.

1. Thermal Performance:
 - a. Exterior Insulation: ASTM C518, Stabilized R-value of 6.5 at 1 inch of thickness with a minimum 6-month exposure capability to outdoor elements [and 15-year thermal warranty].
 - b. Interior Closed-Cell Spray Polyurethane Foam: ASTM C518, 140 degrees F / 90-day Aged R-Value (measured at 75 degrees F mean temperature), for product with a minimum 30 degrees F ambient and substrate application temperature is R6.1/inch, and 140 degrees F / 90-day Aged R-Value (measured at 75 degrees F mean temperature), for product with a minimum 45 degrees F ambient and substrate application temperature is R6.4/inch, and 140 degrees F / 90-day Aged R-Value (measured at 75 degrees F mean temperature), for product with a minimum 60 degrees F ambient and substrate application temperature is R6.1/inch.
 - 1) Core density: ASTM D1622, Minimum 2.0 pcf.
 - 2) Acceptable adhesion to substrate based on specific minimum application temperature.
2. Stone Panel Performance:
 - a. Flexural Strength of Reinforced Backing (ASTM C880): 3,974 PSI (27.4MPa)

- b. Flatwise Tension Strength (ASTM C297): 87 PSI (0.60 MPa)
 - c. Climbing Drum Peel Strength (ASTM 01781): 65.2 Nmm/mm
 - d. Shear Strength (ASTM C273): 74 PSI (0.51 MPa)
 - e. Temperature Cycle Resistance -22 F -158 F (-30 C - 70 C); 50 Cycles: No Damage
3. Air Barrier Performance: When tested in accordance with ASTM E2357-[05], at a test pressure of not less than 6.24 psf, air infiltration shall not exceed 0.04 cfm per square foot (0.2 L/s*m²) of fixed wall area. Testing should be conducted at positive and negative sustained wind loading of 12.5 psf (600 Pa) for 1-hour duration in each direction, pressure cycling of the wall at 2000 cycles in both the positive and negative direction, ending with wind gust loading at 25 psf.
 4. Water Penetration: When tested in accordance with ASTM E331, no uncontrolled water penetration shall occur at a minimum differential pressure of not less than 6.24 psf and not more than 12.0 psf for minimum test duration of 2 hours.
 5. Mold Resistance: Thermal wall [and air barrier] system components shall not provide food source for fungal growth.
 6. Make all joints, penetrations and gaps of the thermal [and air barrier] wall system watertight [and air tight].
- D. Fire Resistance:
1. Include fire-stopping measures at floor line in stud cavity, per code, when wall assembly extends beyond edge of floor line.
 2. Exterior Insulation:
 - a. Class 1 (<and/or= 25 Flame Spread Index and < 450 Smoke Developed Index) classified at maximum thickness per UL 723 criteria or ASTM E84 criteria.
 - b. Minimum density 2.0 pcf and closed-cell polyurethane foam.
 3. Spray Polyurethane Foam:
 - a. Class 1 (<and/or= 25 Flame Spread Index and < 450 Smoke Developed Index) classified at maximum thickness per UL 723 criteria or ASTM E84 criteria.
 4. Aluminum Honeycomb-Reinforced Thin Natural Stone Panel Façade:
 - a. Surface Burning Characteristics (ASTM E84):
 - b. Flame Spread: 15
 - c. Maximum Smoke Development: 15
 - d. Maximum Fuel Contribution: 0
- E. Blast Resistance:
1. Provide cladding assemblies that meet the following requirements for air blast resistance:
 - a. ASTM F1642-[04]: No Break
 - b. UFC 4-010-01: High Level of Protection
 - c. GSA-TS01-2003: Performance Condition 1 (High)

1.4 SUBMITTALS

- A. Product Data: Submit manufacturer's product data, installation instructions and Submit Material Safety Data Sheets (MSDS) for each component product required for complete wall system. Submit manufacturer's product literature and descriptions of testing performed on system components to indicate that they will meet or exceed performance specified herein.

- B. With submission of bid, provide the following to the Architect [Engineer]:
 - 1. Spray Polyurethane Foam Manufacturer Contractor Accreditation
 - a. Acceptable Accreditation Methods:
 - 1) DOW THERMAX™ Wall System Accreditation Program
 - 2) Or approved equivalent
 - 2. Stone panel manufacturer's charts showing full range of available stone types, colors and finishes.
- C. Shop Drawings: Submit shop drawings from Stone Panel manufacturer, signed and sealed by engineer licensed to practice in authority having jurisdiction, detailing system installation and attachment. Indicate the following:
 - 1. Layout of sheet sizes, including custom fabrication details which may be outside the standard scope of products.
 - 2. Profiles, stone type, backing type, thickness of stone, thickness of backing, finishes, and textures.
 - 3. Special alignment concerns, trim and other recommendations.
 - 4. Placement of anchors or holes necessary for installation hardware.
- D. Structural Calculations: Submit Stone Panel manufacturer's comprehensive analysis of design loads, including: dead loads, live loads, wind loads, and thermal movement.
- E. Certificate of Conformance: Manufacturer's certification that materials are physically and chemically compatible with each other, that materials are in compliance with performance requirements of this specification, and that materials and equipment are suitable for their intended purposes.
- F. Samples: Submit materials samples as follows:
 - 1. Rigid Insulation Board: 8-inch square.
 - 2. Insulation fasteners/washers, thermal isolating washers and 8-inch sample of joint flashing tape: one of each.
 - 3. Vertical Box Girts and Horizontal J tracks: Two 12-inch long samples of each.
 - 4. Stone Panel: 12-inch square for each selected stone type, color and finish.

1.5 QUALITY ASSURANCE

- A. Spray Polyurethane Foam (SPF)
 - 1. Contractor Qualifications: SPF installation contractor shall be accredited by the Thermal and Air Barrier Wall System manufacturer (Accredited Contractor).
 - 2. Installer Qualifications:
 - a. During award period and for duration of installation, SPF installer shall be an officially recognized Certified Installer certified by Thermal and Air Barrier Wall System Manufacturer (Certified Installer). Certified Installer shall carry liability insurance and bonding.
 - b. Each worker installing SPF must be, or be accompanied by, a Certified Installer.
 - c. Each Certified Installer can supervise a maximum of 5 workers. The Certified Installer shall be thoroughly trained and experienced in the installation of SPF thermal and air barriers of the types being applied. Certified Installers shall perform or directly supervise all SPF installation work on the project.
 - d. Certified Installers shall have their Thermal and Air Barrier Wall System Manufacturer Certificate in their possession on project site, available for inspection upon request.

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- e. Certified Installer shall ensure that all workers have been trained on and are practicing proper health and safety precautions required when applying SPF.
3. Follow manufacturer's guidelines for proper temperature settings regarding spray equipment as stated on manufacturer's product information sheets.
 4. Follow manufacturer's guidelines for proper spray polyurethane foam formulation based on substrate and ambient temperatures to which product will be applied.
- B. Support Framing / Attachment System
1. Installer Qualifications
 - a. In good standing with manufacturer as qualified installer for work of this Section.
 - b. Superintendent or foreman overseeing installation on site during work of this Section.
 - c. [Able to document completed projects of equivalent scope and quality upon request by [Architect] [Engineer]].
 2. Manufacturer Qualifications
 - a. Minimum 5 years' experience manufacturing wall support framing and panel systems similar to those specified. Demonstrate conformance to testing requirements.
 - b. Design provided by a professional engineer experienced in the design of curtain wall systems and licensed in the applicable State.
 - c. Design of anchors and fasteners for attachment to substrate provided by professional engineer licensed to practice in the applicable State.
- C. Pre-installation Meeting:
1. Participants: Authorized representatives of the General Contractor, installation subcontractor, [Construction Manager,] [Owner,] Architect, [Engineer,] SPF applicator, independent inspector, and [Manufacturer's engineer or technical representative].
 2. Meeting Timing: Minimum [2] [3] [4] weeks prior to beginning work of this Section and related work that may affect work of this Section.
 3. Review metal wall framing assemblies for potential interference and conflicts and coordinate layout and support provisions for interfacing work.
 4. Review and document methods, procedures and manufacturer's installation guidelines and safety procedures for insulated sheathing, flashings, spray polyurethane foam, support framing / attachment system, finish panels, and penetration and gap sealant.
 5. Review construction schedule and confirm availability of products, applicator personnel, equipment and facilities.
 6. Review governing regulatory requirements and requirements for insurance and certificates.
 7. Review field quality control procedures.
- D. Mock-Ups:
1. Mock up complete system at location as directed by Architect [Engineer].
 2. Mock-up shall demonstrate prepared substrate, support/attachment framing, insulation, panel façade, corner return, penetrations, exterior finishes and aesthetic appearance.
 3. Verify mock-up as conforming to manufacturer's instructions and provisions of Contract Documents.
 4. Do not begin work of this Section until after inspection by façade manufacturer's representative is complete and mock-up has been accepted in writing by Architect [Engineer].
 5. Protect and maintain accepted mock-up as standard of quality for work of this Section.

6. Accepted mock-ups may be incorporated into the work of this Section.
- E. Field Measurements: Verify actual supporting and adjoining construction before fabrication; record field measurements on project record shop drawings.
- F. Established Dimensions: Where field measurements cannot be made without delaying work, guarantee dimensions and proceed with fabrication of wall panel assemblies corresponding to established dimensions.
- G. Cure Times: Strictly adhere to applicable cure times and environmental conditions for field-grouted joints.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Ordering: Comply with manufacturers' ordering instructions and lead time requirements to avoid construction delays.
- B. Deliver materials and components in manufacturers' unopened containers or bundles, fully identified by name, brand, type and grade. Exercise care to avoid damage during unloading, storing and installation.
- C. Unloading: Use heavy equipment to unload stone panels; protect panels from damage during unloading.
- D. Store stone panel cartons open at each end to stabilize moisture content and temperature. Store stone panels finished side to finished side to prevent damage from reinforced backings coming into contact with solid stone facings. Handle corners carefully when moving to prevent damage to solid stone facing.
- E. Store, protect and handle materials and components in accordance with manufacturer recommendations to prevent damage, contamination and deterioration. Keep materials clean, dry, and free of dirt and other foreign matter.

1.7 PROJECT CONDITIONS

- A. Environmental Requirements: Undertake installation work only when weather conditions are in compliance with manufacturers' specific environmental requirements and when conditions will permit work to be performed in accordance with manufacturer recommendations and warranty requirements.
 1. Spray Polyurethane Foam (SPF):
 - a. Do not proceed with installation of SPF until sheathing substrate construction is complete and openings and penetrating items have been installed and sealed.
 - b. Do not proceed with installation of SPF until substrate surface temperatures are above the manufacturer's recommended minimum surface temperatures for application.
 - c. Verify that substrate surfaces to receive SPF are free of frost, oil, grease, oxidation, dirt, loose paint, loose scale, or other deleterious material that would impair bond.
 - d. Do not apply SPF past the 6-month expiry date printed on the label of each container.
 - e. Ventilate area to receive SPF by introducing fresh air and exhausting air continuously during and for 24 hours after application to maintain non-toxic, unpolluted, safe working conditions.
 - f. Provide temporary enclosures and ensure all air ducts and openings to other areas of the building are covered to prevent spray and noxious vapors from contaminating air beyond application area.
 - g. Protect workers as recommended by SPF manufacturer. Restrict access to the spray area to the spray applicator(s) and their helper(s) while spraying. Anyone in the spray area must be wearing full and proper personal protection equipment (PPE). Follow manufacturer's re-entry guidelines.

- h. Protect adjacent surfaces and equipment from damage by overspray, fall-out, and dusting of insulation materials.
 - i. Dispose of waste foam daily in location designated by Architect [Engineer] and empty drums in accordance with SPF manufacturer's instructions.
2. Stone Panels:
- a. Do not remove from packing until ready to install.
 - b. Locate materials onsite for at least 24 hours before beginning installation to allow materials to reach temperature and moisture content equilibrium.
 - c. Maintain the following conditions in areas where panels are to be installed for 24 hours before, during and for 24 hours after installation:
 - 1) Relative Humidity: 65 - 75%
 - 2) Uniform Temperature: 55 - 70 degrees F (13 - 21 degrees C)

1.8 SEQUENCING

- A. Coordinate construction to ensure that assemblies fit properly to supporting and adjoining construction; coordinate schedule with construction in progress to avoid delaying work.

1.9 WARRANTY

- A. Manufacturers' Warranties: Submit the following manufacturer warranties, starting from date of Owner's acceptance of the Work, to cover replacement of defective materials found within the term of the warranty:
 - 1. Exterior Insulation: 6-month exposure [and 15-year thermal warranty]
 - 2. Flashing Tape: Limited warranty
 - 3. Spray Polyurethane Foam: Limited warranty
 - 4. Metal Support Framing / Attachment System: Standard limited 20-year materials warranty covering defective materials
 - 5. Thin Stone Panel System: 20-year limited warranty
- B. Contractor's Warranties: [1-year] [2-year] labor warranty, starting from [date of Owner acceptance of completed work][Substantial Completion], to cover repair of materials found to be defective as a result of installation errors.
- C. Limitation of Warranties: Warranties are limited to replacement of defective materials, including labor as required, resulting from framing and panel system component or performance failures. Warranties exclude repairs, replacement, and corrective work to the substrate, structure, and/or property. Warranties exclude mechanical damage due to abuse, neglect, structural failure, or forces of nature greater than normal weather conditions.

1.10 MAINTENANCE

- A. Extra Materials: For use by Owner in building maintenance and repair, provide [a recommended percentage of] [3 percent] additional façade panels in new, unopened cartons, packaged with protective covering for storage and identified with appropriate labels.

PART 2 - PRODUCTS

2.1 INSULATION

- A. Exterior Insulation: Glass-fiber-reinforced enhanced polyisocyanurate foam core sheathing faced with nominal 4-mil embossed white or blue acrylic-coated aluminum on one side and 1.25-mil embossed aluminum on the other side, complying with ASTM C1289 and meeting the following physical properties:
1. ASTM C1289 Type 1, Class 2
 2. Compressive Strength (ASTM D1621): 25 psi, minimum
 3. Aged Thermal Resistance (ASTM C518, measured at mean temperature of 75 degrees F): [R-6.5 up to 2 inches], R-6.0 above 2 inches] [RSI 1.14 up to 50 mm, RSI 1.07 above 50 mm] of thickness.
 4. Flexural Strength (ASTM C203): Minimum 40 psi
 5. Water Absorption (ASTM C209): Maximum 1 percent by volume
 6. Water Vapor Permeance (ASTM E96): <0.3 perms
 7. Maximum Use Temperature: 250 degrees F
- B. Acceptable Products:
1. The Dow Chemical Company "THERMAX™ ci" Exterior Insulation or approved equivalent:
SPEC NOTE: Select applicable panel size, thickness and R-value(s) to suit Project requirements.
 - a. Panel Size: 4'-0" wide by 8'-0" [12'-0"] long, square edge, shiplap (shiplap on thicknesses of 1.55 inches and greater on long edges) panels.
 - b. Thickness and Stabilized R-Value: Nominal 0.625-inch thickness, R-4.1 [1-inch thickness, R-6.5] [1.55-inch thickness, R-10.1] [2-inch thickness, R-13] [2.5-inch thickness, R-15] [3-inch thickness, R-18].
- C. Accessories:
1. Temporary Fasteners: Provide insulated sheathing manufacturer's recommended fasteners for temporary anchoring of sheathing to metal wall framing. Fastener size and length based on wall sheathing thickness and sufficient to provide solid attachment through rigid insulation to substructure as indicated on shop drawings.
 - a. Acceptable Products: ci-LOCK fasteners by Wind-Lock or approved equivalent.
 2. Insulation Flashing Tape: Provide insulation manufacturer's recommended board joint tape for sealing joints, seams and façade tie penetrations through the insulation layer.
 - a. Acceptable Products: The Dow Chemical Company "WEATHERMATE™" Straight Flashing" or approved equivalent, 4-inch width with butyl rubber adhesive.
 3. Wall Opening Flashing: Provide insulated sheathing manufacturer's recommended flashing sealing window and door wall openings.
 - a. Acceptable Products: The Dow Chemical Company "WEATHERMATE™" Straight Flashing or approved equivalent, 6-inch and 9-inch with butyl rubber adhesive, at straight opening heads, jambs and sills.
 - b. When greater widths are required for through-wall flashings, butyl rubber adhesive is recommended.

4. Penetration Filler: Provide insulated sheathing manufacturer's recommended polyurethane foam for sealing penetrations of insulated sheathing.
 - a. Acceptable Products:
 - 1) The Dow Chemical Company "GREAT STUFF PRO™ Gaps & Cracks" single-component polyurethane insulating foam sealant or approved equivalent.
 - 2) The Dow Chemical Company "GREAT STUFF PRO™ Window & Door" single-component polyurethane low-pressure foam sealant or approved equivalent.
5. Gap Air Infiltration Filler: Two-component quick cure polyurethane foam.
 - a. Acceptable Products: The Dow Chemical Company "FROTH-PAK™ Foam Insulation" two-component quick-cure polyurethane foam or approved equivalent.
 - 1) NFPA 286 Approval for exposed use to the interior of the building without the need for a 15-minute thermal barrier
 - 2) ASTM E-84 Class A
6. Flexible polyethylene foam gasket strip to reduce air infiltration between a concrete foundation and sill plate.
 - a. Acceptable Products: The Dow Chemical Company "STYROFOAM™ SILL SEAL Foam Gasket" or approved equivalent.

2.2 COLD FORMED METAL ATTACHMENT/SUPPORT FRAMING:

- A. Cold rolled steel framing to ASTM A792, 55 percent AL-ZN, nominal coating weight of 0.5 oz per square foot (total both sides) of gauge and spacing required to comply with metal wall panel system's structural requirements as recommended by the panel manufacturer and engineer of record and in accordance with approved shop drawings.
 1. Vertical Box Girt: Minimum 0.0475-inch thick (18 gauge) cold-formed steel.
 - a. Dimensions: 2.0 inches wide by 0.75 inches deep:
 - b. Attachment:
 - 1) Pre-drilled holes, 8 inches on center, to receive fasteners and thermally isolated washer assembly for attachment to substructure.
 - 2) Regularly spaced, threaded holes in vertical box girt indented to double thickness of metal at opening to facilitate M8 screw attachment of horizontal J track.
 - c. Recommended Product: CI-Girt™ by Knight Wall Systems or approved equivalent.
 2. Horizontal J Track: Nominal 0.0475 inch thick (18 gauge) cold-formed steel.
 - a. Dimensions: 0.75 inches at base with 1.125 and 1.875 inch legs.
 - b. Weep Drains: 0.75 inches diameter at 2 inches on center along base to allow for drainage.
 - c. Attachment Slots: 2 inches on center along 1.875 inch leg to facilitate M8 screw attachment to vertical box girt.
 - d. Recommended Product: RS-Rail™ by Knight Wall Systems or approved equivalent.
- B. Accessories:
 1. Fasteners: Stainless steel as instructed by panel manufacturer.
 - a. M8 hex socket screws to be used to attach horizontal rail to vertical box girt.
 - b. Minimum No. 12 stainless steel self-drill hex-head screw fasteners of sufficient length to provide solid attachment through rigid insulation to substructure as indicated on shop drawings.

2. Thermal Isolating Washers: Polyoxymethylene copolymer (POM) washers with integral centering lip to act as a thermal break between steel fastener and box girt.
 - a. Recommended Product: ThermaStop™ Isolator by Knight Wall Systems or approved equivalent.
3. Galvanic Protection: Utilize tapes and other methods as necessary to separate and prevent contact between dissimilar metals

2.3 SPRAY POLYURETHANE FOAM AIR BARRIER

- A. Spray Polyurethane Foam: Two-component spray polyurethane cellular plastic foam, complying with the following methods and meeting the following physical properties:
 1. Core Density (ASTM D1622): [Minimum 2 pcf]
 2. Thermal Resistance (ASTM C518): 140 degrees F / 90-day Aged R-Value, measured at 75 degrees F mean temperature: Minimum R-6.1 per inch
 3. Flame Spread (ASTM E84, Class A): 25 or less
 4. Smoke Developed (ASTM E84, Class A): 450 or less
 5. Compressive Strength Minimum (ASTM D1621, 10 percent parallel to rise): [20 psi] [182 kPa]
 6. Closed Cell Content (ASTM D2856): minimum 90 percent
 7. Water Absorption by Volume Maximum (ASTM D2842): 5 percent
 8. Water Vapor Permeability Maximum (ASTM E96): [3.0 perm-inches] [4.4 ng/(Pa.s.m)]
- B. Acceptable Products: The Dow Chemical company “STYROFOAM™ Spray Polyurethane Foam Insulation [CM2030] [CM 2045] [CM2060]” or approved equivalent. Formulation required will depend upon surface temperature of substrate. Refer to manufacturers recommendations.
 1. STYROFOAM™ Spray Polyurethane Foam Insulation CM2030:
 - a. Thermal Resistance (ASTM C518): 140 degrees F / 90-day Aged R-Value, measured at 75 degrees F mean temperature: Minimum R-6.1 per inch
 - b. Maximum/Nominal 1.5-inch Thickness: Thermal Resistance (ASTM C518): 140 degrees F / 90-day Aged R-Value, measured at 75 degrees F mean temperature: R-9.2
 2. STYROFOAM™ Spray Polyurethane Foam Insulation CM2045:
 - a. Thermal Resistance (ASTM C518): 140 degrees F / 90-day Aged R-Value, measured at 75 degrees F mean temperature: Minimum R-6.4 per inch
 - b. Maximum/Nominal 1.5 inch Thickness: Thermal Resistance (ASTM C518): 140 degrees F / 90-day Aged R-Value, measured at 75 degrees F mean temperature: R-9.6
 3. STYROFOAM™ Spray Polyurethane Foam Insulation CM2060:
 - a. Thermal Resistance (ASTM C518): 140 degrees F / 90-day Aged R-Value, measured at 75 degrees F mean temperature: Minimum R-6.1 per inch
 - b. Maximum/Nominal 1.5 inch thickness: Thermal Resistance (ASTM C518): 140 degree F / 90-day Aged R-Value, measured at 75 degrees F mean temperature: R-9.2

2.4 STONE PANEL FAÇADE

- A. Thin-sliced solid natural stone panels reinforced with aluminum honeycomb backing.
 1. Stone Facing: 6 mm solid slice of [Specify Granite, Marble, Onyx, Travertine, Quartzite, or Sandstone] stone.

2. Stone Finish: [Specify One: Polished, Honed, Bush Hammered, Sandblasted, Antique, Grooved, Chiseled, or Flamed].
3. Panel Backing: 20mm aluminum honeycomb matrix sandwiched between fiber-epoxy resin sheets.
4. Panel Dimensions:
 - a. Thickness: ± 1.02 inches (26 mm)
 - b. Width: 48 inches (1220 mm) [or Specify Custom length.]
 - c. Length: 96 inches (2440 mm) [or Specify Custom length.]
5. Tolerances:
 - a. Width: ± 1.0 mm
 - b. Length: ± 2.0 mm
 - c. Thickness: ± 0.2 mm
 - d. Bow: max 1% of panel
 - e. Squareness: max 5.0mm
6. Flame Spread: Conforms to ASTM E84.
7. Panel Mounting Plate: Minimum G210 electro-galvanized steel mounting plate adhered to panel backing with structural sealant.

SPEC NOTE: Delete Mortar Joints section below if using dry-joint construction for this project.

B. Mortar Joints:

1. Polymer Modified Cementitious Joint Mortar: Portland Cement (Type I or II), Hydrated Lime (Type S), Aggregates (meeting ASTM C 144), and proprietary polymer admixtures. Mortar to be tested in accordance with ASTM C 1439 and achieve a minimum compressive strength of 2500 psi at 28 days.
2. Mortar Color: As selected by Architect [Engineer] from manufacturer's approved palette.
3. Face of mortar joints to be covered with micro-stone (stone granules), with > 90% of the aggregate passing a #20 (850 micron) sieve. Micro-stone color to match selected mortar.

C. Accessories:

1. Panel Hardware:
 - a. Stainless steel self-drill 3/16 by 3/4 inch hex-head screws to be used for attachment of adjacent panels along exposed perimeter of steel backing.
 - b. Seismic Rivets:
 - 1) W&E P/N 25-2122: FORD-OE 385323-S100/CHRYSLER-OE 6031091 Super Split "Glass Stop" Rivet 1/4-inch diameter - .257/.261 hole required, Grip range .520 - .590 or,
 - 2) W&E P/N 25-2622: 20184399, 389268-S100, Window Regulator Rivet, 1/4-inch diameter, 1/2-inch flange, .68 - .75 grip range, aluminum/steel.
2. Sealant for Expansion Joints: As approved by stone panel manufacturer.

PART 3- EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation conditions affecting performance of the work.

1. Verify that metal wall studs, opening framing, bridging, bracing and other framing support members and anchorage have been installed within thermal wall system alignment tolerances and requirements.
 2. Verify that substrate surfaces to receive spray polyurethane foam are free of frost, oil, grease, oxidation, dirt, loose paint, loose scale, or other deleterious material that would impair bond.
 3. Verify that items required to penetrate the thermal wall system are placed and penetration gaps and cracks are properly sealed before installation of spray polyurethane foam.
 4. Do not proceed with installation until unsatisfactory conditions have been corrected.
 5. Water-Resistant Barrier (WRB): Installed in conformance with WRB manufacturer's instructions. Verify discontinuities in WRB are properly flashed and sealed prior to installing rain screen thermal and air barrier wall system and finish panels.
- B. Field verify architectural details and mechanical and electrical requirements prior to commencing installation.
- C. Commencement of installation constitutes acceptance of existing conditions and acceptance of responsibility for satisfactory performance.

3.2 INSULATION BOARD INSTALLATION

- A. Do not install more insulation boards than can be permanently fastened with vertical box girts in the same day. Do not leave insulation overnight or for extended periods that is not permanently fastened to building substructure with vertical girts.
- B. Install insulation in accordance with manufacturer's recommendations.
- C. Temporary Fastening: Temporarily fasten insulation panels to exterior face of exterior metal stud wall framing. Abut panels tightly together and around openings and penetrations.
1. Install sheathing panels horizontally with blue aluminum facing to exterior. Use maximum panel lengths to minimize number of joints. Locate edge joints parallel to and on framing. Center end joints over supports and stagger in each course. Provide additional framing wherever panel joints do not bear against framing, plates or sill members.
 2. Fasten rigid insulation panels to each support with temporary fasteners, one at each corner [and one at top and bottom of panel at each stud location]. Set back corner fasteners by 3/8 inch from edges and ends of panel units. Drive fasteners to bear tight and flush with surface of insulation. Do not overdrive or tear aluminum skin of insulation. [Perimeter fasteners can be detailed to bridge gap of abutting board joints due to 1.75-inch diameter washer used to fasten board to studs. Maximum of 2 board joints may be bridged per fastener.]
 3. Install flashing joint tape at end and edge joints using sufficient hand pressure to ensure seal and in accordance with rigid insulation manufacturer's joint sealing recommendations.
 4. Install flashing tape on insulation behind wall tie and mechanical fastening assemblies for rain screen claddings.
 5. Seal sheathing joints and penetrations of sheathing in accordance with sheathing manufacturer's joint and penetration sealing recommendations.
 6. After base flashing is installed on exterior insulation sheathing, which may include a termination bar running horizontally along the top edge of the flashing, install 6-inch or 9-inch flashing with butyl rubber adhesive to the exterior sheathing, lapped over top edge of base flashing.

3.3 COLD-FORMED METAL FRAMING INSTALLATION

A. Preparation:

1. Verify vertical girt spacing and framing clearances relative to studs or other points of attachment.

B. Installation

1. Use laser or chalk line to mark starting height of vertical box girt.
2. Mount vertical box girts, fastened at 16 or 24 inches on center (as determined by the engineer of record) ovetop of installed rigid insulation, using one self-tapping screw for each attachment hole or for every second attachment hole in box girt, as indicated on shop drawings.
 - a. Check plumb of vertical girts both parallel and perpendicular to the structure. Use slots in girt to ensure parallel alignment of face of framing.
 - b. Tighten screws that attach vertical girt through insulation to substructure to 95 in. lbs. of torque. If installed using hand tools, verify for each installer at beginning of project using snug-tight criteria.
 - c. Where vertical obstructions are present and unavoidable (i.e. window openings), use laser or chalk line to restart vertical girt, ensuring horizontal alignment of screw holes for horizontal "J" track.
3. Mount lowest (first) horizontal J track to lowest holes in vertical box girt using M8 screws, with 1.875 inch leg against box girt. Install next J track 500 mm (~ 20 inches) above. Tighten to between 90 to 100 in. lbs. of torque. Verify equivalent snug tight condition for installers using hand tools.
 - a. Install successive horizontal J tracks at 600 mm (~ 23-3/8 inch) intervals.
 - b. When encountering windows and other openings, mount horizontal J track so that fastening points are as close as possible to lower and upper edges of windows and other openings.
 - c. Install horizontal J track for top and bottom edges of panels less than 20 feet wide. In regions of jarring or excessive vibration, install J track at 12-inch intervals. Where panel backing has been cut, prohibiting normal overlap conditions, install additional J track. Analyze atypical conditions and install appropriate framing components as needed.

3.4 STONE PANEL INSTALLATION:

A. Preparation

1. Visually survey vertical and horizontal framing components (box girts and J tracks), and verify readiness to receive finish panels. Spot-check torque on M8 hex socket screws and confirm plumb of framing members.
2. Verify and document procedure for bending panel backing clips prior to installation; perform spot checks during installation.

B. Installation

1. Install panels, beginning at bottom of wall (as was done with horizontal tracks).
2. Hang lowest (first) panel on 2 lowest horizontal J tracks, by lower and uppermost rows of clips on panel backing.
3. Proceed with installation, working from left to right and planning atypical situations in advance.

4. Panel backing clips along row (or rows) used for hanging panel MUST engage front of horizontal J track.
 - a. As required, bend clips outward along rows used for hanging panels, as palletizing and shipping may have unintentionally bent clips straight, preventing positive engagement with horizontal track.
 - b. Leading edge of clip should protrude between 1/4 and 3/8 inches (~ 6 to 9.5 mm) from back of stone panel.
 - c. Do not over-bend clips outward, as this will also weaken the panel-to-framing attachment.
 - d. As panel backing engagement cannot be easily observed during installation, take particular care during installation to ensure full engagement of appropriate clips with J track.
5. With the exception of atypical conditions, panels installed above lowest row are to be hung from top row of clips only.
6. Overlap each adjacent panel; top over bottom, right over left.
7. Attach panels at overlaps using 3/16 by 3/4 inch hex-head screws (snug tight) at approximately 12 inches on center along horizontal and vertical joints.
8. Do not allow screws to engage framing. Linked panels are not meant to be mechanically attached to framing members.
9. At spacing frequency determined by engineer of record, drill a hole slightly larger than seismic rivet diameter at locations where rivet will pass through opening in front of horizontal J track. Engage rivet. Cut off rivet shank flush with rivet head so it is completely encapsulated within vertical grout.

SPEC NOTE: Delete Mortar Joint Grout section below if specifying dry-joint construction for this project.

C. Mortar Joint Grout

1. Preparation
 - a. Survey panel-to-panel screw installation prior to field grouting joints.
2. Installation
 - a. Install mortar joint grout provided by manufacturer at overlap where panel backing is exposed, except at designated expansion joints.
 - b. Mix polymer modified mortar in approved mixer using ~ 114 oz of water per bag (approximately 2.3 oz per lb).
 - c. Do not prepare quantities in excess of amount that can be installed over a period of 1.5 hours. Do not re-temper. Discard unused mortar after 1.5 hours.
 - d. Install mortar using a grout bag or other approved method.
 - e. Do not pre-wet panels.
 - f. Do not install material that is overly wet or dry.
 - g. Install micro-stone as mortar topcoat before mortar has set.
 - h. Observe manufacturer's environmental limitations for installation (e.g. less than 40 degrees or greater than 100 degrees F).

D. Expansion Joint Sealant:

1. Install approved expansion joint sealant in expansion joints.
2. Observe environmental limitations for installation.

3.5 SPRAY POLYURETHANE FOAM INSTALLATION

A. Preparation

1. Follow all safety precautions.
2. Mask and cover adjacent areas to protect from overspray.
3. Apply primers for special conditions as recommended by manufacturer.
4. Cover wide joints with transition sheet membrane as specified in Section 07 25 00.
5. Clean work area prior to applying spray insulation.
6. Verify substrate temperature meets manufacturer's requirements for specific formulations used.
7. Ensure that all stud cavity fire-stopping is installed prior to applying spray foam.

B. Application: Spray-apply polyurethane foam in accordance with ASTM C1029 and manufacturer's installation guidelines; comply with preparation methods outlined in 3.3.A.

1. Apply spray polyurethane foam by picture-framing around interior studs at insulated-sheathing-to-steel-stud interface and spraying single pass across all board joints and penetrations.
2. Finish applying spray polyurethane foam with one pass not exceeding 1.5 inches in thickness. Two passes are acceptable to reach maximum thickness of 1.5 inch.
3. If more than one layer is being applied, allow the layer applied first to cool to the maximum substrate temperature or lower as recommended by spray polyurethane foam insulation manufacturer.
4. Avoid formation of sub-layer air pockets.
5. Apply spray polyurethane foam in overlapping layers to achieve a smooth, uniform surface, total thickness as indicated.
6. Maintain [3-inch] [75 mm] clearance around chimneys, heating vents, steam pipes, recessed lighting fixtures and other heat sources.
7. Do not apply spray polyurethane foam to inside of exit openings or electrical junction boxes.
8. Maintain a continuous layer of spray foam from floor to floor to roof to complete air barrier.
9. Maximum Variation in Applied Thickness: minus [1/4 inch] [6 mm], plus [5/8 inch] [10 mm].

3.6 FIELD QUALITY CONTROL

A. Spray Polyurethane Foam

1. Certified Installer: Completion of a daily work record is recommended to record all information required, including results of testing. Keep daily work record on site and make available for routine inspection. Upon request, forward copies of daily work record to manufacturer, owner or owner's representative.
2. Costs incurred for daily testing and inspection by Certified Installer and completion of daily work record shall be borne by manufacturer's Accredited Contractor.
3. If required by Owner, arrange for site inspections by qualified third-party inspector. Frequency and cost of inspections shall be included in bid at Owner's request. If site inspection reveals defects, manufacturer's Accredited Contractor shall immediately rectify all such defects at own cost.
4. Certified Installer's daily work record shall verify conformance with thermal and air barrier wall system manufacturer's instructions.
 - a. Follow manufacturer's guidelines for proper temperature settings regarding spray equipment as stated on manufacturer's product information sheets.

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**EXTERIOR-INSULATED RAIN SCREEN WALL ASSEMBLY WITH LIGHTWEIGHT
NATURAL STONE FAÇADE AND INTEGRAL THERMAL AND AIR BARRIER SYSTEMS**

- b. Follow manufacturer's guidelines for proper spray polyurethane foam formulation based on substrate and ambient temperatures to which product will be applied.
- c. After product has properly cured, conduct tests to verify adhesion between spray polyurethane foam and substrate.

B. Stone Panels

1. Spot check engagement of clips to horizontal J track throughout installation.

SPEC NOTE: Delete Mortar Joint Grout section below if specifying dry-joint construction for this project.

C. Mortar Joint Grout

1. Periodically inspect mixing and installation of mortar joint grout. Prepare and test representative samples per ASTM C109. Make a minimum of 3 sample batches of mortar during material installation. As directed by engineer of record, sample panels to be taken for laboratory evaluation.

3.7 CLEANING:

- A. Remove overspray from non-prescribed surfaces in accordance with manufacturer's recommendations, without causing damage to surfaces. Remove protective covers from adjacent surfaces
- B. Remove any protective film from finish panels immediately following installation.
- C. Leave panel surfaces clean and free of debris and residue. Where required, clean exposed panel surfaces in accordance with manufacturer's instructions.

END OF SECTION 07 42 65.19

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