

SECTION 044200 – EXTERIOR STONE CLADDING

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 dimension stone panels [**set with individual anchors,**] [**mechanically anchored (field installed) on a metal-grid system,**] [**mechanically anchored on prefabricated steel trusses,**] [**mechanically anchored on prefabricated steel strong back frames,**] [**mechanically anchored on prefabricated steel stud frames,**] [**and**] [**for facing precast architectural concrete**].
- B. Related Sections include the following:
 - 1. Division 3 Section "Cast-in-Place Concrete" for installing inserts in concrete for anchoring dimension stone cladding.
 - 2. Division 3 Section "Plant-Precast Architectural Concrete" for additional requirements for dimension stone facings for precast concrete units.
 - 3. Division 4 Section "Unit Masonry Assemblies" for [**installing inserts in unit masonry for anchoring dimension stone cladding**] [**and**] [**for stone masonry trim in unit masonry walls**].
 - 4. Division 7 Section "Joint Sealants" for sealing joints in dimension stone cladding system with elastomeric sealants.
 - 5. Division 9 Section "Interior Stone Facing" for dimension stone applied as trim and paneling on building interiors.
 - 6. Division 9 Section "Stone Paving and Flooring" for dimension stone used as paving and flooring.
- C. Stone Types: Descriptions of stone types required for other Sections are included in Part 2 of this Section.
- D. Inspection and Testing Allowance: Furnish quality-control testing under the Inspection and Testing Allowance as specified in Division 1 Section "Allowances."

1.3 DEFINITIONS

- A. Definitions contained in ASTM C 119 apply to this Section.
- B. Dimension Stone Cladding System: An exterior wall covering system consisting of dimension stone panels together with the anchors, [**backup structure,**] [**sheathing,**] [**mortar,**] [**adhesives,**] fasteners, and sealants used to secure the stone to the building structure and to produce a weather-resistant covering.

1.4 PERFORMANCE REQUIREMENTS

- A. General: Design stone anchors and anchoring systems according to ASTM C 1242.
- B. Structural Performance: Provide dimension stone cladding system capable of withstanding the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
 - 1. Wind Loads: Determine loads based on pressures indicated on Drawings.
 - 2. Wind Loads: Determine loads based on a uniform pressure of **<Insert other design wind pressure>**, acting inward or outward.
 - 3. Wind Loads: Determine loads based on pressures indicated below:
 - a. Corner Zone: Within **<Insert distance>** of building corners, uniform pressure of **<Insert design wind pressure>** acting inward and **<Insert design wind pressure>** acting outward.
 - b. Other Than Corner Zone: Uniform pressure of **<Insert design wind pressure>** acting inward and **<Insert design wind pressure>** acting outward.
 - 4. Equipment Loads: Allow for loads due to window cleaning and maintenance equipment.
- C. Seismic Performance: Provide dimension stone cladding system capable of withstanding the effects of earthquake motions determined according to] **<Insert title of local code>**.
 - 1. Seismic Design Criteria: **<Insert criteria, such as seismic coefficient, component importance factor, etc.>**
- D. Thermal Movements: Provide dimension stone cladding system that allows for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing displacement of stone, opening of joints, overstressing of components, failure of joint sealants and connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime sky heat loss.
 - 1. Temperature Change (Range): **120 deg F**, ambient; **180 deg F**, material surfaces.
- E. Horizontal Building Movement (Interstory Drift): Allow for maximum horizontal building movement equal to quotient resulting from dividing floor-to-floor height at any floor by 400.
- F. Shrinkage and Creep: Allow for progressive vertical shortening of building frame equal to **1/8 inch in 10 feet**.
- G. Safety Factors for Stone: Design dimension stone cladding system to withstand loads indicated without exceeding allowable working stress of stone determined by dividing stone's average ultimate strength, as established by testing, by the following safety factors:
 - 1. Safety Factors for Quartz-Based Stone: 8 for uniform loads and 10 for concentrated loads.
- H. Design stone anchors [**and backup structure**] to withstand loads indicated without exceeding allowable working stresses established by the following:

1. For Structural Steel: AISC S335, "Specification for Structural Steel Buildings Allowable Stress Design and Plastic Design with Commentary."
 2. For Cold-Formed Steel: AISI SG-973, Part V, "Specification for the Design of Cold-Formed Steel Structural Members."
 3. For Cold-Formed Stainless Steel: ASCE 8, "Specification for the Design of Cold-Formed Stainless Steel Structural Members."
 4. For Aluminum: AA ADM-1, "The Aluminum Design Manual."
 5. For Cast-in-Place and Postinstalled Fasteners in Concrete: One-fourth of tested capacity when installed in concrete with compressive strength indicated.
 6. For Post-Installed Fasteners in Masonry: One-sixth of tested capacity when installed in masonry units indicated.
- I. Limit deflection in each prefabricated assembly caused by indicated loads and thermal movements, acting singly or in combination with one another, to the following maximums:
1. **1/16 inch**, measured in plane of wall.
 2. 1/720 of assembly's clear span but not more than **1/4 inch**, measured perpendicular to wall.
- J. Provisions for Fabrication and Erection Tolerances: Allow for fabrication and erection tolerances of building's structural system. [**Concrete structural fabrication and erection tolerances are specified in Division 3 Section "Cast-in-Place Concrete."**] [**Structural-steel fabrication and erection tolerances are specified in Division 5 Section "Structural Steel."**]
- K. Provision for Deflection of Building Structure: Allow for the following:
1. Deflection due to Weight of Dimension Stone Cladding System: Allow for **1/4-inch** vertical deflection in **20-foot** span of structural members supporting dimension stone cladding system.
 2. Live Load Deflection: Allow for **1/4-inch** vertical deflection, in **20-foot** span of structural members supporting dimension stone cladding system, due to live loads imposed on building's structural frame after stone installation.
- L. Leakage Resistance, Water and Air: Capable of resisting the following:
1. Air Infiltration: Not more than **0.06 cfm/sq. ft.** of wall area, as measured by testing mockup per ASTM E 283 at a differential pressure of **6.24 lbf/sq. ft.**
 2. Water Penetration: No uncontrolled water penetration beyond plane of back of stone that is not contained or drained back to exterior, as measured by testing mockup per ASTM E 331 at a differential pressure of 20 percent of design wind load, but not less than **10 lbf/sq. ft.**
- M. Control of Corrosion and Staining: Prevent galvanic and other forms of corrosion as well as staining by isolating metals and other materials from direct contact with incompatible materials. Use materials that do not stain exposed surfaces of stone and joint materials.

1.5 SUBMITTALS

- A. Product Data: For each [**variety of stone,**] stone accessory, and other manufactured products indicated.

- B. Shop Drawings: Show details of fabrication and installation of dimension stone cladding system, including dimensions and profiles of stone units.
 - 1. Show locations and details of joints both within dimension stone cladding system and between dimension stone cladding system and other construction.
 - 2. Include details of [**mortar joints,**] [**sealant joints,**] [**and**] [**mortar joints pointed with sealant**].
 - 3. Show locations and details of anchors [**and backup structure**].
 - 4. Include large-scale shaded elevations and details of decorative surfaces and inscriptions.
 - 5. For installed dimension stone cladding systems indicated to comply with certain design loads and deflection limits, include structural analysis data signed and sealed by the qualified [**professional**] [**structural**] engineer responsible for their preparation.
- C. Stone Samples for Verification: Sets for each color, grade, finish, and variety of stone required; not less than **12 inches** square. Include two or more Samples in each set showing the full range of variations in appearance characteristics expected in the completed Work.
- D. Colored Pointing Mortar Samples for Verification: For each color required, showing the full range of exposed color and texture expected in the completed Work.
- E. Sealant Samples for Verification: For each type and color of joint sealant required.
- F. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.
- G. Material Test Reports: From a qualified independent testing agency indicating and interpreting test results of the following for compliance with requirements indicated:
 - 1. Stone Test Reports: For [**each**] stone variety proposed for use on Project, provide test data indicating compliance with required physical properties including those specified by reference to ASTM standards. Include test data for flexural strength based on testing according to ASTM C 880, performed on specimens representative of minimum thickness and finish of installed stone, in both wet and dry conditions. Base reports on testing done within previous five years.
 - 2. Anchorage Test Reports: For each [**combination of**] [**stone variety,**] [**finish,**] [**and**] anchor type, based on testing according to ASTM C 1354, performed on specimens representative of minimum thickness and finish of installed stone.
 - 3. For metal components, indicate chemical and physical properties of metal.
 - 4. Sealant Compatibility and Adhesion Test Report: From sealant manufacturer complying with requirements in Division 7 Section "Joint Sealants." Include interpretation of test results and recommendations for primers and substrate preparation needed for adhesion.
 - 5. Preconstruction Sealant Field Test Report: From Installer, complying with requirements in Division 7 Section "Joint Sealants."

1.6 QUALITY ASSURANCE

- A. **Installer Qualifications:** An experienced installer who has completed dimension stone cladding systems similar in material, design, and extent to those indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.
1. Installer's responsibilities include engineering, fabricating, and installing dimension stone cladding system.
 2. **Engineering Responsibility:** Preparation of Shop Drawings and comprehensive engineering analysis by a qualified **[professional] [structural]** engineer.
- B. **[Professional] [Structural] Engineer Qualifications:** A **[professional] [structural]** engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of dimension stone cladding systems that are similar to those indicated for this Project in material, design, and extent.
- C. **Testing Agency Qualifications:** An independent testing agency, acceptable to authorities having jurisdiction, qualified according to ASTM E 329 to conduct the testing indicated, as documented according to ASTM E 548.
- D. **Source Limitations for Stone:** Obtain each variety of stone, regardless of finish, from a single quarry with resources to provide materials of consistent quality in appearance and physical properties.
1. Obtain each variety of stone from a single quarry, whether specified in this Section or in another Section of the Specifications.
- E. **Source Limitations for Mortar Materials:** Obtain mortar ingredients of uniform quality for each cementitious component from a single manufacturer and each aggregate from one source or producer.
- F. **Source Limitations for Other Materials:** Obtain each type of stone accessory, sealant, and other material from a single manufacturer for each product.
- G. **Preconstruction Stone Testing:** Owner will engage a qualified independent testing agency to perform preconstruction testing indicated below. Payment for these services will be made **[by Owner] [from the Inspection and Testing Allowance, as authorized by Change Orders]**. Retesting of materials that fail to meet specified requirements shall be done at Contractor's expense.
1. Furnish test specimens from blocks representative of actual materials proposed for incorporation into the Work.
 2. One set of test specimens will be required for each stone variety, of number and size indicated in referenced standards.
 3. Stone will be tested for compliance with physical property requirements according to referenced ASTM standards.
 4. **Flexural Strength Tests:** ASTM C 880, performed on specimens' representative of minimum thickness and finish of installed stone. One set will be tested in both wet and dry conditions.
 5. **Anchorage Tests:** ASTM C 1354, performed on specimens' representative of minimum thickness and finish of installed stone. One set will be tested for each combination of stone variety, finish, and anchor type.

6. Mockup Tests: Performance of stone anchoring system will be evaluated for compliance with requirements by mockup testing per ASTM C 1201, Procedure B, with a maximum test load equal to 3 times the design load.
 7. Mockup Tests: Performance of dimension stone cladding system will be evaluated for compliance with requirements by mockup testing per ASTM E 72, with a maximum test load equal to 3 times the design load.
 - a. Build test mockups of representative portion of dimension stone cladding system corresponding to area indicated on Drawings.
 - b. Fabricate test mockups from same materials proposed for Project; fabricate and install mockups at testing agency's facilities using personnel who will perform the same tasks for Project.
 - c. Remove test mockups from laboratory when testing program is completed and dispose of legally; do not use materials from mockups on Project.
 8. Testing agency will report test results in writing to Architect and Contractor.
- H. Preconstruction Sealant Compatibility and Adhesion Testing: Submit to joint sealant manufacturers samples of materials that will contact or affect joint sealants, for compatibility and adhesion testing according to sealant manufacturer's standard testing methods and Division 7 Section "Joint Sealants."
- I. Preconstruction Field Testing of Sealants: Before installing joint sealants, field test their adhesion to joint substrates per requirements specified in Division 7 Section "Joint Sealants."
- J. Welding Standards: Qualify procedures and personnel according to <insert standard here>
- K. Mockups: Before installing dimension stone cladding systems, build mockups to verify selections made under sample Submittals and to demonstrate aesthetic effects and qualities of materials and execution. Build mockups to comply with the following requirements, using materials indicated for the completed Work:
1. Locate mockups where indicated or, if not indicated, as directed by Architect.
 2. Build mockup of typical wall area as shown on Drawings.
 3. Build mockups of typical exterior wall with dimension stone cladding, approximately **[72 inches long by 48 inches high] [15 feet long by 10 feet high]**.
 - a. Show typical components, attachments to building structure, and methods of installation.
 - b. Include window opening with stone **[returns] [trim]**.
 - c. Include sealant-filled joint complying with requirements in Division 7 Section "Joint Sealants."
 4. Notify Architect seven days in advance of dates and times when mockups will be constructed.
 5. Obtain Architect's approval of mockups before starting installation.
 6. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.

- a. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless such deviations are specifically approved by Architect in writing.
7. Demolish and remove mockups when directed.
8. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver sealants to Project site in original unopened containers labeled with manufacturer's name, product name and designation, color, expiration period, pot life, curing time, and mixing instructions for multicomponent materials.
- B. Store and handle stone and related materials to prevent deterioration or damage due to moisture, temperature changes, contaminants, corrosion, breaking, chipping, and other causes.
 1. Lift with wide-belt slings; do not use wire rope or ropes that might cause staining. Move stone, if required, using dollies with cushioned wood supports.
 2. Store stone on wood skids or pallets with nonstaining, waterproof covers. Arrange to distribute weight evenly and to prevent damage to stone. Ventilate under covers to prevent condensation.
- C. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.
- D. Store aggregates in locations where grading and other required characteristics can be maintained and where contamination can be avoided.

1.8 PROJECT CONDITIONS

- A. Cold-Weather Construction: Do not use frozen materials or materials mixed or coated with ice or frost. Remove and replace dimension stone cladding damaged by frost or freezing conditions. When ambient temperature is within limits indicated, use the following procedures:
 1. At 40 deg F and below, produce mortar temperatures between 40 and 120 deg F by heating mixing water and, at temperatures of 32 deg F and below, sand. In heating mortar materials, maintain mixing temperatures within 10 deg F; do not heat water to above 160 deg F. Maintain temperature of mortar on boards above freezing. Do not apply mortar to stone units or substrates below 32 deg F.
 2. At 25 to 20 deg F, heat both sides of walls under construction. Use windbreaks or enclosures when wind velocity exceeds 15 mph.
 3. At 20 deg F and below, provide enclosure and auxiliary heat to maintain air temperature above 32 deg F within enclosure. Heat stone so it is above 40 deg F at time of installation.
- B. Cold-Weather Protection: When mean daily temperature is within limits indicated, provide the following protection:

1. **40 to 25 Deg F:** Cover dimension stone cladding with a weather-resistant membrane for 48 hours after construction.
 2. **25 to 20 Deg F:** Cover dimension stone cladding with insulating blankets or provide enclosure and heat to maintain air temperature above **32 deg F** within enclosure for 48 hours after construction. Use windbreaks or enclosures when wind velocity exceeds **15 mph**.
 3. **20 Deg F** and below: Provide enclosure and heat to maintain air temperature above **32 deg F** within enclosure for 48 hours after construction.
- C. Environmental Limitations for Sealants: Do not install sealants when ambient and substrate temperatures are outside limits permitted by sealant manufacturer or below **40 deg F** or when joint substrates are wet.

1.9 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Dimension Stone Units: Furnish **<Insert quantity>** finished stone panels **<Insert required dimensions>** for each finish and variety of stone specified.

PART 2 - PRODUCTS

2.1 STONE, GENERAL

- A. Varieties and Sources: Subject to compliance with requirements, provide stone varieties from sources indicated.
- B. Match Architect's samples for color, finish, and other stone characteristics relating to aesthetic effects.
- C. Quarry stone in a manner to ensure that as-quarried block orientations yield finished stone with required characteristics.
- D. Make quarried blocks available for examination by Architect for appearance characteristics.

2.2 STONE TYPES

- A. Quartz-Based Stone **<Insert stone-type designation used on Drawings>**: Provide quartz-based dimension stone complying with ASTM C 616, and as follows:
1. Classification: **II Quarzitic Sandstone**
 2. Varieties and Sources: As follows:
 - a. **[Bloom Run Sandstone] [Roaring Run Sandstone]** By Russell Stone Products
3640 Greenville Pike Grampian, PA 16838 PH: 1-814-236-2449 or 1-434-760-1229

3. Finish: **[Sandblasted]** **[Smooth]** **[Honed]** **[As indicated]** **[Match Architect's sample]**.

B.

1. Maximum Absorption per ASTM C 97: 2.2 percent.
2. Minimum Compressive Strength per ASTM C 170: 6,560 psi
3. Minimum Flexural Strength per ASTM C 880: 1,060 psi
4. Varieties and Sources: As follows:

2.3 MORTAR MATERIALS

- A. Portland Cement: ASTM C 150, Type I or Type II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.
1. Low-Alkali Cement: Portland cement for use with limestone shall contain not more than 0.60 percent total alkali when tested according to ASTM C 114.
- B. Hydrated Lime: **[ASTM C 207]** **[UBC Standard 21-13]**, Type S.
- C. Portland Cement-Lime Mix: Packaged blend of portland cement complying with ASTM C 150, Type I or Type III, and hydrated lime complying with ASTM C 207.
1. For pigmented mortar, use a colored portland cement-lime mix of formulation required to produce color indicated or, if not indicated, as selected from manufacturer's standard formulations. Pigments shall not exceed 10 percent of portland cement by weight.
- D. Aggregate: ASTM C 144; except for **[joints narrower than 1/4 inch]** **[and]** **[pointing mortar]**, use aggregate graded with 100 percent passing **No. 16** sieve.
1. White Aggregates: Natural white sand or ground white stone.
 2. Colored Aggregates: Natural-colored sand or ground marble, granite, or other durable stone; of color necessary to produce required mortar color.
- E. Mortar Pigments: Natural and synthetic iron oxides, compounded for use in mortar mixes. Use only pigments with a record of satisfactory performance in masonry mortar and containing no carbon black.
- F. Water: Potable.
- G. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
- H. Products: Subject to compliance with requirements, provide one of the following:
1. Colored Portland Cement-Lime Mix:
 - a. **<Insert product and manufacturer.>**
 2. Mortar Pigments:
 - a. **<Insert product and manufacturer.>**

2.4 ANCHORS [AND BACKUP STRUCTURE]

- A. Fabricate anchors, including shelf angles, from stainless steel, ASTM A 666, Type [304] [316], temper as required to support loads imposed without exceeding allowable design stresses.
 - 1. Fasteners for Stainless-Steel Anchors: Annealed stainless-steel bolts, nuts, and washers; **ASTM F 593** for bolts and **ASTM F 594** for nuts, Alloy Group [1] [2].
- B. Fabricate anchors, including shelf angles, from hot-dip galvanized steel, ASTM A 36/A 36M for materials and ASTM A 123/A 123M for galvanizing.
 - 1. Fasteners for Hot-Dip Galvanized Steel Anchors: **ASTM A 307, Grade A**, for bolts; **ASTM A 563**, Grade A, for nuts; and **ASTM F 436** for washers; all either hot-dip or mechanically zinc coated.
- C. Fabricate anchors, including shelf angles, from extruded aluminum, **ASTM B 221**, alloy and temper as required to support loads imposed without exceeding allowable design stresses, but not less than strength and durability properties of alloy 6063-T6.
 - 1. Fasteners for Extruded-Aluminum Anchors: Annealed stainless-steel bolts, nuts, and washers; **ASTM F 593** for bolts and **ASTM F 594** for nuts, Alloy Group 1.
- D. Backup Structure: Fabricate components not in contact with stone from hot-rolled steel shapes complying with ASTM A 36/A 36M or from steel sheet not less than **0.1046 inch** thick complying with ASTM A 570/A 570M. [**Hot-dip galvanize after fabrication to comply with ASTM A 123/A 123M.**] Fabricate components in contact with stone from same material specified for anchors.
- E. Cast-in-Place and Post installed Fasteners for Concrete and Masonry: Type indicated below, with capability to sustain, without failure, a load equal to 4 times the loads imposed, for concrete, or 6 times the load imposed, for masonry, as determined by testing per ASTM E 488, conducted by a qualified independent testing agency.
 - 1. Adjustable Inserts Embedded in Concrete: Steel, cast iron, or malleable iron, with bolts, nuts, washers, and shims; all hot-dip galvanized or mechanically zinc coated.
 - 2. Post installed Fasteners for Concrete and Masonry: [**Chemical anchors,**] [**torque-controlled expansion anchors,**] [**or**] [**undercut anchors**] made from stainless-steel components complying with **ASTM F 593 and ASTM F 594, Alloy Group 1 or 2** for bolts and nuts; ASTM A 666 or ASTM A 276, Type 304 or 316, for anchors.

2.5 METAL-GRID SYSTEM

- A. Provide manufacturer's standard integrated system that combines metal struts, fittings, fasteners, and stone anchors and that is engineered expressly for mechanically installing dimension stone cladding and that complies with the following requirements:
 - 1. Struts: Roll-formed steel channels, of size and shape required for application indicated, formed from steel sheet not less than **0.1046 inch** thick and complying with ASTM A 570/A 570M, hot-dip galvanized after fabrication to comply with ASTM A 123/A 123M.

2. Fittings and Fasteners: System manufacturer's standard components of design, size, and material required to securely attach struts to building structure, by method indicated or selected, and stone anchors to struts, as well as to prevent galvanic corrosion. Fabricate components in contact with stone from same material specified for anchors.
3. Stone Anchors: Shapes and sizes standard with system manufacturer.
4. Available Products: Subject to compliance with requirements, metal-grid systems that may be incorporated into the Work include, but are not limited to, the following:
5. Products: Subject to compliance with requirements, provide one of the following:
 - a. A-Metal System; Canaren, Inc.
 - b. Zibell Anchoring System; Georgia Marble Co.
 - c. HB Stone Support System; Hohmann & Barnard, Inc.
 - d. Halfen Anchoring System; Meadow-Burke Products.

2.6 FRAMING FOR PREFABRICATED ASSEMBLIES

- A. Backup Structure: For steel framing members of dimension stone cladding system not in contact with stone, comply with requirements indicated below:
 1. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M, minimum thickness of **3/16 inch**.
 2. Steel Tubing: Cold formed, ASTM A 500, minimum thickness of **3/16 inch**.
 3. Cold-Formed Metal Framing: [**Galvanized**] steel wall framing complying with Division 5 Section "Cold-Formed Metal Framing."
- B. Sheathing: Galvanized steel sheet complying with ASTM A 653/A 653M, commercial steel, coating designation **G90**.
- C. Components in Contact with Stone: Fabricate from same material specified for anchors.
- D. Threaded Fasteners: Heavy hexagon structural bolts, heavy hexagon nuts, and hardened washers. **ASTM A 307, Grade A**, for bolts; **ASTM A 563, Grade A**, for nuts; and **ASTM F 436** for washers; all hot-dip or mechanically zinc coated.

2.7 STONE ACCESSORIES

- A. Setting Buttons: Lead or resilient plastic buttons, nonstaining to stone, sized to suit joint thicknesses and bed depths of stone units without intruding into required depths of joint sealants or causing third-side adhesion between sealant and setting button.
- B. Setting Shims: Strips of [**resilient plastic**] [**or**] [**vulcanized neoprene, 50 to 70 Shore A durometer**], nonstaining to stone, sized to suit joint thicknesses and depths of stone supports without intruding into required depths of joint sealants or causing third-side adhesion between sealant and setting shims.
- C. Concealed Sheet Metal Flashing: Fabricate from stainless steel complying with requirements specified in Division 7 Section "Sheet Metal Flashing and Trim" in thicknesses indicated, but not less than **0.0156 inch** thick.

1. At Contractor's option, fabricate flashing from lead for installation in locations where flashing rests on continuous members.
- D. Dampproofing for Limestone: Provide cementitious formulations that are recommended by ILI and that are nonstaining to stone, compatible with joint sealants, and noncorrosive to anchors and attachments.
- E. Weep and Vent Tubes: [**Medium-density polyethylene tubing, 1/4-inch OD**] [**Rectangular, cellular, polypropylene or clear butyrate extrusion, 3/8 by 1-1/2 inches**] and of length required to extend from exterior face of stone to cavity behind.
- F. Plastic Weep Hole/Vent: One-piece, flexible extrusion manufactured from ultraviolet-resistant polypropylene copolymer, designed to weep moisture in masonry cavity to exterior, in color selected from manufacturer's standard.
- G. Sealant Products: Provide manufacturer's standard chemically curing, elastomeric sealants that are compatible with joint fillers, joint substrates, and other related materials and that comply with requirements in Division 7 Section "Joint Sealants" for products corresponding to those indicated below:
1. Sealant for Joints in Dimension Stone Cladding: As follows:
 - a. Multicomponent, nonsag, polysulfide sealant.
 - b. Single-component, nonsag, polysulfide sealant.
 - c. Multicomponent, nonsag, urethane sealant.
 - d. Single-component, nonsag, urethane sealant.
 - e. Multicomponent, nonsag, low-modulus, urethane sealant.
 - f. Single-component, nonsag, low-modulus, urethane sealant.
 - g. Low-modulus, neutral-curing silicone sealant.
 2. Sealant for Filling Kerfs: As follows:
 - a. Single-component, nonsag, urethane sealant for Use T.
 - b. High-modulus, neutral-curing silicone sealant.
 3. Colors: Provide colors of exposed sealants to comply with the following requirement:
 - a. [**Match color of Architect's sample**] [**Match color of stone**] [**Provide color as indicated by manufacturer's designations**] [**Provide color as selected by Architect from manufacturer's full range**].

2.8 STONE FABRICATION

- A. General: Fabricate stone units in sizes and shapes required to comply with requirements indicated, including details on Drawings and Shop Drawings.
- B. Cut and drill sinkages and holes in stone for anchors, fasteners, supports, and lifting devices as indicated or needed to set stone securely in place; shape beds to fit supports.

- C. Cut stone to produce pieces of thickness, size, and shape indicated and to comply with fabrication and construction tolerances recommended by applicable stone association or, if none, by stone source, for faces, edges, beds, and backs.
1. Minimum Thickness: Provide stone units of not less than the following thickness, unless otherwise indicated:
 - a. Quartz-Based Stone (Bluestone): **2 inches**.
 2. Control depth of stone and back check to maintain minimum clearances indicated between backs of stone units and surfaces or projections of structural members, fireproofing (if any), backup walls, and other work behind stone.
 - a. Minimum Clearance: [**1 inch**] [**1-1/2 inches**].
 3. Dress joints (bed and vertical) straight and at right angle to face, unless otherwise indicated.
 4. Quirk-miter corners, unless otherwise indicated; provide for cramp anchorage in top and bottom bed joints of corner pieces.
 5. Cut stone to produce joints of uniform width and in locations indicated.
 - a. Joint Width: **3/8 inch**.
 6. Clean backs of stone to remove rust stains, iron particles, and stone dust.
- D. Contiguous Work: Provide chases, reveals, reglets, openings, and similar features as required to accommodate contiguous work.
- E. Fabricate molded work, including washes and drips, to produce stone shapes with a uniform profile throughout entire unit length, with precisely formed arris slightly eased to prevent snipping, and with matching profile at joints between units.
1. Produce moldings with machines having abrasive shaping wheels made to reverse contour of molding shape; do not sculpt moldings.
- F. Carve and cut inscriptions [**and decorative surfaces**] according to shaded drawings approved by Architect. Use skilled stone carvers experienced in the successful performance of work similar to that indicated.
- G. Abrasively etch inscriptions [**and decorative surfaces**] according to drawings approved by Architect.
- H. Finish exposed faces and edges of stone[, **except sawed reveals,**] to comply with requirements indicated for finish and to match approved samples [**and mockups**].
- I. Pattern Arrangement: Fabricate and arrange panels with veining and other natural markings to comply with the following requirements:
1. Cut stone from one block or contiguous, matched blocks in which natural markings occur.
 2. Arrange panels in blend pattern.

- J. Carefully inspect finished stone units at fabrication plant for compliance with requirements for appearance, material, and fabrication. Replace defective units.
 - 1. Grade and mark stone for overall uniform appearance when assembled in place. Natural variations in appearance are acceptable if installed stone units match range of colors and other appearance characteristics represented in approved samples and mockups.

2.9 FABRICATION OF BACKUP STRUCTURE

- A. General: Fabricate backup structure in shop to comply with AISC S335, "Specification for Structural Steel Buildings Allowable Stress Design and Plastic Design with Commentary," and supplements as issued, to accommodate construction tolerances specified, and as indicated on Shop Drawings.
- B. General: Fabricate and assemble cold-formed metal framing to comply with requirements in Division 5 Section "Cold-Formed Metal Framing."
- C. Weld shop connections to comply with applicable provisions of **<insert standard >**
- D. Fabricate joints to exclude water or to permit its escape to building exterior, at locations where water could accumulate because of condensation or other causes.
- E. For galvanized framing, clean welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

2.10 SHOP-PAINTED STEEL FINISHES

- A. General: Comply with SSPC-PA 1, "Paint Application Specification No. 1," for shop painting [**backup structure**] [**assembled framing for prefabricated assemblies**].
- B. Surface Preparation: After completing fabrication of steel items, prepare surfaces to comply with SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
- C. Apply 1 coat of lead- and chromate-free, universal, modified-alkyd primer complying with performance requirements in FS TT-P-664 immediately after surface preparation. [**After primer has dried, apply 1 coat of alkyd gloss enamel complying with FS TT-E-489 of a different color than primer.**]
- D. Apply 2-coat high-performance coating system consisting of organic zinc-rich primer, complying with SSPC-Paint 20, at **2.5-mil** dry film thickness and topcoat of high-build, 2-component, epoxy-polyamide, high-performance coating at **6-mil** dry film thickness.
- E. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
- F. Products: Subject to compliance with requirements, provide one of the following:
 - 1. High-Performance Coating Systems:
 - a. Carboline 621 and 190 HB; Carboline Company.

- b. Aquapon Zinc-Rich Primer 97-670 and High-Build Polyamide-Epoxy 97-131; PPG Industries, Inc.
- c. Tneme-Zinc 90-97 and Series 69 Hi-Build Epoxoline II; Tnemec Company, Inc.

2.11 MORTAR MIXES

- A. General: Comply with referenced standards and with manufacturers' written instructions for mix proportions, mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures needed to produce mortar of uniform quality and with optimum performance characteristics.
 - 1. Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures, unless otherwise indicated. Do not use calcium chloride.
 - 2. Combine and thoroughly mix cementitious materials, water, and aggregates in a mechanical batch mixer, unless otherwise indicated. Discard mortar when it has reached initial set.
- B. Portland Cement-Lime Setting Mortar: Comply with [ASTM C 270] [UBC Standard 21-15], Proportion Specification, for types of mortar indicated below:
 - 1. Set quartz-based stone with Type [S] [N] mortar.
- C. Pointing Mortar: Comply with [ASTM C 270] [UBC Standard 21-15], Proportion Specification, for types of mortar indicated. Provide pointing mortar mixed to match Architect's sample and complying with the following:
 - 1. Pigmented Pointing Mortar: Select and proportion pigments with other ingredients to produce color required. Do not exceed pigment-to-cement ratio of 1:10, by weight.
 - 2. Packaged Portland Cement-Lime Mix Mortar: Use portland cement-lime mix of selected color.
 - 3. Colored-Aggregate Pointing Mortar: Produce color required by combining colored aggregates with portland cement of selected color.
 - 4. Point quartz-based stone with Type N mortar.

2.12 SOURCE QUALITY CONTROL

- A. Source Quality-Control Testing Service: Owner will employ an independent testing agency to perform source quality-control testing. Payment for these services will be made by owner. Retesting of materials that fail to meet specified requirements shall be done at Contractor's expense.
- B. Tests for compliance with requirements will be performed as follows. Furnish test specimens randomly selected from blocks representative of actual materials proposed for incorporation into the Work.

1. Flexural Strength Tests: ASTM C 880, performed on specimens representative of minimum thickness and finish of installed stone. One set of test specimens will be required for every [5000 sq. ft.] but not fewer than 2 sets for each stone variety.
 2. Anchorage Tests: ASTM C 1354, performed on specimens representative of minimum thickness and finish of installed stone. One set of test specimens will be required for each combination of stone variety, finish, and anchor type.
- C. Testing agency will report test results promptly and in writing to Architect and Contractor.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine surfaces to receive dimension stone cladding and conditions under which dimension stone cladding will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.
1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of dimension stone cladding.
 2. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Advise installers of other work about specific requirements for placement of inserts, flashing reglets, and similar items to be used by dimension stone cladding Installer for anchoring, supporting, and flashing of dimension stone cladding system. Furnish installers of other work with Drawings or templates showing locations of these items.
- B. Protect dimension stone cladding during erection as follows:
1. Cover tops of dimension stone cladding installation with nonstaining, waterproof sheeting at end of each day's work. Cover partially completed structures when work is not in progress. Extend cover a minimum of 24 inches down both sides and hold securely in place.
 2. Prevent staining of stone from mortar, grout, sealants, and other sources. Immediately remove such materials without damaging stone.
 3. Protect base of walls from rain-splashed mud and mortar splatter by coverings spread on ground and over wall surface.
 4. Protect sills, ledges, and projections from mortar and sealant droppings.
- C. Clean stone surfaces that are dirty or stained by removing soil, stains, and foreign materials before setting. Clean stone by thoroughly scrubbing with fiber brushes and then drenching with clear water. Use only mild cleaning compounds that contain no caustic or harsh materials or abrasives.

3.3 SETTING DIMENSION STONE CLADDING, GENERAL

- A. Execute dimension stone cladding installation by skilled mechanics and employ skilled stone fitters at Project site to do necessary field cutting as stone is set.
 - 1. Use power saws with diamond blades to cut stone. Produce lines cut straight and true, with edges eased slightly to prevent snipping.
- B. Contiguous Work: Provide reveals, reglets, and openings as required to accommodate contiguous work.
- C. Set stone to comply with requirements indicated on Drawings and Shop Drawings. Install anchors, supports, fasteners, and other attachments indicated or necessary to secure dimension stone cladding in place. Shim and adjust anchors, supports, and accessories to set stone accurately in locations indicated with uniform joints of widths indicated and with edges and faces aligned according to established relationships and indicated tolerances.
- D. Provide expansion, control, and pressure-relieving joints of widths and at locations indicated.
 - 1. Sealing expansion and other joints is specified in Division 7 Section "Joint Sealants."
 - 2. Keep expansion joints free of mortar and other rigid materials.
- E. Install concealed flashing at continuous shelf angles, lintels, ledges, and similar obstructions to downward flow of water to divert water to building exterior.
- F. Keep cavities open where unfilled space is indicated between back of stone units and backup wall; do not fill cavities with mortar or grout.
 - 1. Coat sandstone cladding with dampproofing to extent indicated below:
 - a. Stone at Grade: Beds, joints, and back surfaces to at least **12 inches** above finish-grade elevations.
 - b. Stone Extending below Grade: Beds, joints, back surfaces, and face surfaces below grade.
 - c. Allow cementitious dampproofing formulations to cure before setting dampproofed stone. Do not damage or remove dampproofing while handling and setting stone.
 - 2. Place weep holes and vents in joints where moisture may accumulate, including base of cavity walls, above shelf angles, and flashing. Locate weep holes and vents at intervals not exceeding **24 inches** and for those serving as vents only, at intervals not exceeding **60 inches** horizontally and **20 feet** vertically.

3.4 INSTALLATION TOLERANCES

- A. Variation from Plumb: For vertical lines and surfaces of walls, do not exceed **1/4 inch in 10 feet**, **3/8 inch in 20 feet**, or **1/2 inch in 40 feet** or more. For external corners, corners and jambs within **20 feet** of an entrance, expansion joints, and other conspicuous lines, do not exceed **1/8 inch in 10 feet**, **1/4 inch in 20 feet**, or **3/8 inch in 40 feet** or more.

- B. Variation from Level: For lintels, sills, water tables, parapets, horizontal bands, horizontal grooves, and other conspicuous lines, do not exceed **1/8 inch in 10 feet, 1/4 inch in 20 feet, or 3/8 inch** maximum.
- C. Variation of Linear Building Line: For positions shown in plan and related portions of walls and partitions, do not exceed **1/4 inch in 20 feet** or **1/2 inch in 40 feet** or more.
- D. Variation in Cross-Sectional Dimensions: For thickness of walls from dimensions indicated, do not exceed plus or minus **1/4 inch**.
- E. Variation in Joint Width: Do not vary joint thickness more than **1/8 inch in 36 inches** or a quarter of nominal joint width, whichever is less.
- F. Variation in Plane between Adjacent Stone Units (Lipping): Do not exceed **1/16-inch** difference between planes of adjacent units.

3.5 SETTING MECHANICALLY ANCHORED DIMENSION STONE CLADDING

- A. Attach anchors securely to stone and to backup surfaces. Comply with recommendations in ASTM C 1242.
- B. Attach framing for stone support system to structural frame of building, at connection points indicated, by welding or bolting to comply with the following:
 - 1. Weld connections to comply with AWS D1.1, "Structural Welding Code--Steel."
 - 2. Fabricate joints to exclude water or to permit its escape to building exterior, at locations where water could accumulate because of condensation or other causes.
 - 3. For galvanized surfaces, clean welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.
 - 4. For shop-painted surfaces, clean field welds, bolted connections, and abraded areas immediately after erection. Apply paint to exposed areas using same material as used for shop painting.
- C. Fill anchor holes with sealant.
 - 1. Where dowel holes occur at pressure-relieving joints, provide compressible material at ends of dowels.
- D. Set stone supported on clip or continuous angles on resilient setting shims. Use material of thickness required to maintain uniform joint widths. Hold shims back from face of stone a distance at least equal to width of joint.

3.6 SETTING DIMENSION STONE CLADDING WITH MORTAR

- A. Set stone in full bed of mortar with head joints slushed full, unless otherwise indicated.
 - 1. Use setting buttons of adequate size, in sufficient quantity, and of thickness required to maintain uniform joint width and to prevent mortar from extruding. Hold buttons back from face of stone a distance at least equal to width of joint.

2. Do not set heavy units or projecting courses until mortar in courses below has hardened enough to resist being squeezed out of joint.
 3. Support and brace projecting stones until wall above is in place and mortar has set.
 4. Provide compressible filler in ends of dowel holes and bottoms of kerfs to prevent end bearing of dowels and anchor tabs on stone. Fill remainder of anchor holes with mortar.
- B. Fill space between back of stone units and backup wall solidly with mortar or grout.
 - C. Embed ends of sills in mortar; leave remainder of joint open until final pointing.
 - D. Rake out joints for pointing with mortar to depths of not less than **1/2 inch**. Rake joints to uniform depths with square bottoms and clean sides.
 - E. Prepare stone-joint surfaces for pointing with mortar by removing dust and mortar particles. Where setting mortar was removed to depths greater than surrounding areas, apply first layer of pointing mortar in layers not more than **3/8 inch** until a uniform depth is formed; compact each layer thoroughly and allow to become thumbprint hard before applying next layer.
 - F. Point stone joints by placing and compacting pointing mortar in layers not more than **3/8 inch**.
 - G. Tool joints with a round jointer having a diameter **1/8 inch** larger than width of joint, when pointing mortar is thumbprint hard.
 - H. Rake out mortar from sealant-pointed joints to depths of not less than **1/2 inch** nor less than that required to provide enough depth for sealant and sealant backing. Rake joints to uniform depths with square bottoms and clean sides.
 - I. Set the following dimension stone cladding with unfilled head joints for installing joint sealants:
 1. Cornices.
 2. Copings.
 3. Belt and other projecting courses.

3.7 JOINT SEALANT INSTALLATION

- A. Prepare joints and apply sealants of type and at locations indicated to comply with applicable requirements in Division 7 Section "Joint Sealants."

3.8 FIELD QUALITY CONTROL

- A. Field Quality-Control Testing Service: Owner will engage a qualified independent testing agency to perform field quality-control testing. Payment for these services will be made [**by Owner**] [**from the Inspection and Testing Allowance, as authorized by Change Orders**]. Retesting of materials that fail to meet specified requirements shall be done at Contractor's expense.
- B. Water Leakage: Dimension stone cladding system will be tested according to AAMA 501.2.
- C. Testing agency will report test results promptly and in writing to Architect and Contractor.

3.9 ADJUSTING AND CLEANING

- A. Remove and replace broken, chipped, stained, or otherwise damaged stone, defective joints, and dimension stone cladding that does not match approved samples [**and mockups**]. Damaged stone may be repaired if Architect approves methods and results.
- B. Replace in a manner that results in dimension stone cladding's matching approved samples [**and mockups**], complying with other requirements, and showing no evidence of replacement.
- C. In-Progress Cleaning: Clean dimension stone cladding as work progresses. Remove mortar fins and smears before tooling joints.
- D. Clean dimension stone cladding no fewer than six days after completion of pointing and sealing, using clean water and stiff-bristle fiber brushes. Do not use wire brushes, acid-type cleaning agents, cleaning agents containing caustic compounds or abrasives, or other materials or methods that could damage stone.

END OF SECTION 044200