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## SECTION 044256

### EXTERIOR GRANITE CLADDING

#### PART 1 - GENERAL

##### 1.1 SUMMARY

###### A. Section includes:

1. Granite set with anchors.
2. Granite anchored on prefabricated steel truss supports.
3. Granite carving and graphic surfaces.

B. Related Sections:

1. Division 03 Section "Cast-in-Place Concrete" for weld plates in concrete.
2. Division 03 Section "Faced Architectural Precast Concrete" for application of stone to precast concrete.
3. Division 04 Section "Exterior Limestone Cladding" for limestone cladding.
4. Division 05 Section "Structural Steel" for structural steel.
5. Division 07 Section "Joint Sealants" for sealing joints in stone cladding.
6. Division 08 Section "Curtain Wall and Glazed Assemblies" for glazing stone panels in curtain wall.
7. Division 09 Section "Interior Stone Facing" for stone applied on building interiors.

1.2 REFERENCES

- A. ASTM A 123-02: Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
- B. ASTM C 97-02: Test Methods for Absorption and Bulk Specific Gravity of Dimension Stone.
- C. ASTM C 119-04: Terminology Relating to Dimension Stone
- D. ASTM C 170-90 (1999): Test Method for Compressive Strength of Dimension Stone
- E. ASTM C 207-04: Specification for Hydrated Lime for Masonry Purposes
- F. ASTM C 270-03: Specification for Mortar for Unit Masonry
- G. ASTM C 615-03: Specification for Granite Dimension Stone
- H. ASTM C 880-98: Test Method for Flexural Strength of Dimensional Stone
- I. ASTM C 1201-91 (2003): Test Method for Structural Performance of Exterior Dimension Stone Cladding Systems by Uniform Static Air Pressure Difference
- J. ASTM C 1242-03: Guide for the Selection, Design, and Installation of Exterior Dimension Stone Anchors and Anchoring Systems
- K. ASTM C 1354-96: Test Method for Strength of Individual Stone Anchorages in Dimension Stone
- L. ASTM E 329-03: Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction.
- M. ASTM F 593-02: Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs
- N. ASTM F 594-02: Specification for Stainless Steel Nuts
- O. National Building Granite Quarries Association (NBGQA) Specifications for Architectural Granite.

1.3 DEFINITIONS

- A. Definitions contained in ASTM C 119 apply to this Section.
- B. Metric Conversions: The following metric conversions shall apply where English measurements are indicated in the text:
  1. 1/16 inch (1.5 mm)
  2. 1/8 inch (3 mm)

3. 3/16 inch (5 mm)
4. 1/4 inch (6 mm)
5. 5/16 inch (8 mm)
6. 3/8 inch (10 mm)
7. 1/2 inch (12 mm)
8. 5/8 inch (15 mm)
9. 13/16 inch (20 mm)
10. 1 inch (25 mm)
11. 1-3/16 inches (30 mm)
12. 1-1/4 inches (32 mm)
13. 1-1/2 inches (40 mm)
14. 1-5/8 inches (40 mm)
15. 2 inches (50 mm)
16. 3 inches (75 mm)
17. 4 inches (100 mm)
18. 6 inches (150 mm)
19. 8 inches (200 mm)
20. 12 inches (300 mm)

#### 1.4 SYSTEM DESCRIPTION

- A. Stone Cladding System: Exterior stone cladding panels anchored to backup structure with stone joints filled with mortar and sealants.

1. Backup structure: **[Prefabricated steel trusses]**

#### 1.5 PERFORMANCE REQUIREMENTS

- A. Design Requirements: Stone Anchors and Anchoring: ASTM C 1242.
- B. Structural Loading: Provide stone cladding capable of withstanding the effects of gravity loads and the following loads:
1. Wind Loads: Uniform pressure of **[Insert pressure]**, acting inward or outward.
  2. Equipment Loads: **[Allow for window cleaning and maintenance equipment loads]**.
- C. Seismic Performance: ASCE 7.
1. Seismic Design Criteria: **[Insert seismic criteria]**
- D. Thermal Movements: Allow for thermal movements resulting from the following range in temperatures: 120 deg F, ambient; 180 deg F, material surfaces.
- E. Shrinkage and Creep: 1/8 inch in 10 feet.
- F. Safety Factors: Loads indicated without exceeding allowable working stress of stone determined by dividing stone's average ultimate strength by the following factors:
1. Safety Factor: **[3 for granite]**.
  2. Safety Factor for Concentrated Stresses: **[4 for granite]**.
  3. Safety Factor for Anchors: **[4 for granite]**.
- G. Design stone anchors **[and steel backup truss structure]**: Loads indicated without exceeding allowable working stresses established by the following:

1. For Structural Steel: AISC's "Specification for Structural Steel Buildings - Allowable Stress Design and Plastic Design."
  2. For Aluminum: AA ADM-1, "The Aluminum Design Manual."
  3. For Cast-in-Place and Post installed Fasteners in Concrete: One-fourth of tested capacity when installed in concrete with compressive strength indicated.
  4. For Post-Installed Fasteners in Masonry: One-sixth of tested capacity when installed in masonry units indicated.
- H. Limit of deflection: Not more than **[1/720]** of assembly's clear span or the following, whichever is smaller:
1. 1/16 inch, measured in plane of wall.
  2. 1/4 inch, measured perpendicular to wall.
- I. Fabrication and Erection Tolerances of Building Structure: Allow for fabrication and erection tolerance of structure as specified in Division 03 Section "Cast-in-Place Concrete" and Division 05 Section "Structural Steel."
- J. Allowance for Deflection of Building Structure: Allow for the following:
1. Deflection due to Weight of Stone Cladding: Allow for 1/4-inch vertical deflection in 20-foot span of structural members supporting stone cladding.
  2. Live Load Deflection: Allow for 1/4-inch vertical deflection, in 20-foot span of structural members supporting stone cladding, due to live loads imposed on building's structural frame after stone installation.
- K. Corrosion and Staining Prevention: Isolate metals from direct contact with other materials.

## 1.6 SUBMITTALS

- A. Product Data: For each stone type and each manufactured product shown on Drawings or specified.
1. For each stone variety used on Project, include physical property data.
- B. Shop Drawings: Show fabrication and installation details for stone cladding:
1. Include dimensions and profiles of stone units.
  2. Show locations and details of joints.
  3. Show locations and details of anchors.
  4. **[Show location of steel backup truss structure].**
  5. Include elevations and details of graphics and carvings.
  6. Include structural analysis data signed and sealed by the qualified professional engineer.
- C. Samples: Submit samples for each stone type required, exhibiting the full range of color characteristics expected.
1. Submit a minimum of 2 each, 12 inches x 12 inches in size, in each color and finish specified.
  2. In the case of more variegated stones, color photos shall be submitted in addition to the number of samples to show the full range of color and markings to be expected.
  3. **[Mortar Samples]:** Full range of exposed color and texture.
  4. **[Sealant Samples]:** For each type and color of joint sealant required.

- D. Preliminary Test Reports: Submit test reports for proposed stones prior to final stone selection. Preliminary test reports shall be indicative of the stone to be proposed for the project.
    - 1. Testing of production stone may be required in addition to preliminary test reports.
  - E. Certification: Submit a letter of certification from the stone fabricator, stating the material being furnished is the specified material and there are sufficient reserves available to supply the project and furnish replacements if needed.
  - F. Quality Assurance/Control Submittals:
    - 1. Sealant Compatibility Test Report: Submit test report from sealant manufacturer, in accordance with Division 07 Section "Joint Sealants" stating that sealants will not stain stone.
    - 2. Submit welding certificates.
    - 3. Material Test Reports: From a qualified independent testing agency, as follows:
      - a. Provide reports for each stone type.
      - b. For metal components.
    - 4. Qualification Data: Submit qualification data as specified under Article, "Quality Assurance" for the following:
      - a. **[Installer]**
      - b. **[Fabricator]**
      - c. **[Professional engineer]**
      - d. **[Independent Testing agency]**.
  - G. Cold-Weather Procedures: Detailed description of methods, materials, and equipment.
- 1.7 QUALITY ASSURANCE
- A. Single Source Responsibility for Stone Cladding System: Engage a qualified installer for stone cladding system to assume complete responsibility for design, fabrication, and installation of stone cladding system to comply with specified requirements.
    - 1. Engineering Responsibility: **[Comprehensive engineering analysis of exterior stone cladding by a qualified professional engineer]**.
  - B. Qualifications:
    - 1. Installer Qualifications: Engage experienced installer that has completed stone installation similar in material, design, and extent to that indicated for the project.
    - 2. Fabricator Qualifications: Engage experienced fabricator that has completed stone fabrication similar in material, design, and extent to that indicated for the project.
    - 3. Professional Engineer Qualifications: Engage a professional engineer licensed to practice in the jurisdiction where the project is located and experienced in providing services for stone cladding systems similar in material, design, and extent to that indicated for the project.
    - 4. Independent Testing Qualifications: ASTM E 329
  - C. Preconstruction Prefabricated Stone Panel Testing: **[Owner shall engage an Independent Testing Laboratory]**.

1. Tests shall be performed on full scale stone panel mockup with backup construction in accordance with ASTM C1201, "Structural Performance of Exterior Dimension Stone Cladding Systems by Uniform Static Air Pressure Difference" and tested as follows:
    - a. Air Infiltration: ASTM E283.
    - b. Water Penetration: ASTM E331.
  - D. Preconstruction Stone Testing: Engage an independent testing agency to perform the following testing for each stone variety:
    1. Furnish test specimens that are representative of materials.
    2. Physical Property Tests: ASTM standards specified for stone type.
    3. Flexural Strength Tests: ASTM C 880
    4. Anchorage Tests: ASTM C 1354
  - E. Welding: Qualify procedures and personnel according to the following:
    1. [AWS D1.1/D1.1M, "Structural Welding Code--Steel";]
    2. [AWS D1.2/D1.2M, "Structural Welding Code--Aluminum";]
    3. [AWS D1.3, "Structural Welding Code--Sheet Steel."]
  - F. Visual Mockup: **[At the Owner's Expense]** Provide full sized mock-up of the approved stone or stones in the approved finishes, erected at a site agreed to by the Architect, Contractor, and the Fabricator. The approved mock-up shall become the standard for the project.
    1. Build mockup of **[typical exterior stone]** **[areas as shown on Drawings]**.
    2. Size: **[insert size of visual mockup]**
    3. Color consistency: demonstrate color consistency with mockup; color range shall not exceed range of color established by samples.
    4. Included typical components and anchors.
    5. Include sealant joints installed as required by Division 07 Section "Joint Sealants."
    6. Mockup may become part of the completed Work if approved at time of Substantial Completion.
    7. Demolish mockup and remove from site after completion of stone cladding work.
  - G. Pre-Installation Meeting: Convene a pre-installation meeting at the site at least one week prior to commencing work of this section. The purpose of the meeting shall be to review methods and sequence of all stone work, special details and conditions, standards of workmanship, testing and quality control requirements, and other topics related to the work of this section.
- 1.8 DELIVERY, STORAGE, AND HANDLING
- A. Store and handle materials to prevent deterioration or damage.
    1. Stone shall be carefully packed and loaded for shipment using reasonable care and customary precautions against damage in transit. Material, which may cause staining or discoloration shall not be used for blocking or packing.
    2. The stone shall be stacked on timber or platforms at least 4 inches above the ground. Care shall be taken to prevent staining or discoloration during storage.
    3. If storage is to be for a prolonged period, polyethylene or other suitable plastic film shall be placed between wood and finished surfaces of completely dry stone.
  - B. Properly store cementitious materials. Do not use damp cementitious materials.

## 1.9 PROJECT CONDITIONS

### A. Protect stone as follows:

1. At the end of each day's work, cover tops of walls with nonstaining, waterproof covering. Protect partially finished work when not being worked on.
2. Prevent staining of stone from [**mortar**], grout, [**sealants**], and other sources. Immediately remove such materials without damaging stone.
3. Protect base of walls using coverings spread on ground and over wall surface.
4. Protect sills, ledges, and other projections from [**mortar**].

### B. Cold-Weather Requirements: Comply with ACI 530.1/ASCE 6/TMS 602.

### C. Hot-Weather Requirements: Comply with ACI 530.1/ASCE 6/TMS 602.

## 1.10 SEQUENCING

### A. Coordinate installation of concrete or masonry inserts. Furnish setting drawings, templates, and directions for installing such items.

### B. Coordinate delivery and installation of dimension stone cladding.

## 1.11 MAINTENANCE

### A. Maintenance: Provide maintenance information indicating recommended cleaning and maintenance of the installed work of this section.

1. Provide product data from producers of cleaning and maintenance materials and include in the maintenance manual. The manual shall include information regarding cleaning methods, stain removal methods and sealers.
2. Comply with requirements specified in Division 01 Section, "Operation and Maintenance Data"

## PART 2 - PRODUCTS

### 2.1 STONE SOURCE

#### A. Varieties and Source: Subject to compliance with requirements, provide stone from the following source:

1. Granite Source: Coldspring

#### B. Each color of stone shall come from a single quarry, with sufficient reserves to satisfy the requirements of the project. The granite supplier shall have the capabilities to cut and finish the stone without delaying the project.

#### C. Stone Source Examination: Make quarried blocks available for examination by Architect.

### 2.2 STONE MATERIAL

#### A. Granite: ASTM C 615.

#### B. Cut stone from one block or contiguous, matched blocks in which natural markings occur.

#### C. Match Architect's samples.

#### D. Granite Type [**Insert Drawing Designation Type**]:

1. Stone Variety: [**Insert stone variety**] by Coldspring.

2. Location: Exterior Cladding.
3. Finish:
  - a. [Polish]
  - b. [Velvet]
  - c. [Diamond 8 (Honed)]
  - d. [Rub & Sand]
  - e. [Textured]
  - f. [Thermal]
  - g. [Diamond 10]
  - h. [Bush hammer]
  - i. [Rock Pitch]
  - j. [Rock Face]
  - k. [Splitface]
  - l. [Diamond 100]
  - m. [Diamond 200]
  - n. [Thermal Brush]
  - o. [Custom Finish]
4. Nominal Thickness: Not less than the following nominal thickness:
  - a. [13/16 inch (+1/8" -1/16")] [20 mm]
  - b. [1-3/16 inches (+1/8 -1/16")] [30 mm]
  - c. [1-9/16 inches (+1/8" -1/16")] [40 mm]
  - d. [1-15/16 inches (+1/8" -1/16")] [50 mm]
  - e. [3-1/16 inches (+1/8" -1/16")] [78 mm]
  - f. [4-1/16 inches (+1/8" -1/16")] [103 mm]
  - g. [6-1/8 inches (+/-1/8")] [156 mm]
  - h. [8-18 inches (+/-1/8")] [206 mm]

### 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.
  1. Provide natural color or white cement as required to produce mortar color indicated.
- B. Hydrated Lime: ASTM C 207.
- C. Portland Cement-Lime Mix: ASTM C 150, Type I or Type III, and ASTM C 207.
- D. Colored Portland Cement-Lime Mix: ASTM C 150, Type I or Type III; ASTM C 207; and mortar pigments.
- E. Aggregate: ASTM C 144.
- F. Mortar Pigments: Natural and synthetic iron oxides. Use pigments with a record of satisfactory performance in mortar. Pigments shall contain no carbon black.
- G. Water: Potable.

### 2.4 ANCHORS AND FASTENERS

- A. Anchor Material: Stainless steel, ASTM A 666, Type 304
- B. Dowels and Pins Material: Stainless steel, ASTM A 276, Type 304



- C. Aluminum Anchor Material: Extruded aluminum, ASTM B 221, not less than strength and durability properties of Alloy 6063-T6.
  - D. Cast-in-Place Inserts Not In Contact with Stone: Steel or malleable iron adjustable inserts, with bolts, nuts, washers, and shims and as follows:
    - 1. Finish: Hot-dip galvanized or mechanically zinc coated
    - 2. Capacity: Sustain load equal to 4 times the required loads
    - 3. Testing: ASTM E 488.
  - E. Post installed Anchor Bolts: Provide the following for installation into concrete and masonry:
    - 1. Expansion anchors
    - 2. Stainless Steel Bolts: ASTM F 593, Alloy Group 1 or 2.
    - 3. Stainless Steel Nuts: ASTM F 594, Alloy Group 1 or 2.
    - 4. Anchor Material: ASTM A 666 or ASTM A 276, Type 304 or 316.
    - 5. Capacity:
      - a. Concrete: Sustain load equal to 4 times the required loads
      - b. Masonry: Sustain load equal to 6 times the required loads
      - c. Test: ASTM E 488.
  - F. Post installed Chemical Anchor Bolts:
    - 1. Chemical anchors: <insert chemical type>
    - 2. Stainless Steel Bolts: ASTM F 593, Alloy Group 1 or 2.
    - 3. Stainless Steel Nuts: ASTM F 594, Alloy Group 1 or 2.
    - 4. Anchor Material: ASTM A 666 or ASTM A 276, Type 304 or 316.
    - 5. Capacity:
      - a. Concrete: Sustain load equal to 4 times the required loads
      - b. Masonry: Sustain load equal to 6 times the required loads
      - c. Test: ASTM E 488.
  - G. Threaded Fasteners: Heavy hexagon structural bolts, heavy hexagon nuts, and hardened washers.
    - 1. Stainless Steel Bolts: ASTM F 593, Alloy Group 1 or 2.
    - 2. Stainless Steel Nuts: ASTM F 594, Alloy Group 1 or 2.
    - 3. Threaded Fastener Anchor Material: ASTM A 666 or ASTM A 276, Type 304 or 316.
  - H. Weld Plates for Installation in Concrete: Division 05 Section "[**Structural Steel**] [**Metal Fabrications**]."
  - I. Provide stainless steel anchors including bolt, nut, flat and lock washer. Bolt designed to be inserted into routed slot in back of stone.
    - 1. Provide Type 31 Anchors manufactured by Coldspring.
    - 2. Diameter: Size anchors to comply with requirements, but not less than 3/16 inch.
- 2.5 PRIMER PAINT
- A. Shop Prime Paint: Zinc-rich primer, complying with SSPC-Paint 20 or SSPC-Paint 29.
  - B. Galvanizing Repair Paint: Zinc-content paint for repairing galvanized steel coating complying with SSPC-Paint 20.
- 2.6 PRECAST CONCRETE BACKUP FOR STONE FACED PRECAST CONCRETE

- A. Refer to Division 3 Section, "Faced Architectural Precast Concrete".

## 2.7 MATERIAL FOR PREFABRICATED BACKUP TRUSS STRUCTURE

- A. Steel framing members in contact with stone shall be stainless steel, ASTM A 666, Type: 304.
- B. Steel framing members not in contact with stone, shall be as follows:
  - 1. Steel Plates, Shapes, and Bars: ASTM A 36, minimum thickness of 3/16 inch.
  - 2. Steel Tubing: ASTM A 500 (cold formed), minimum thickness of 3/16 inch.
  - 3. Finish: **[Hot-dip galvanize] [Shop prime painted]**

## 2.8 STONE ACCESSORIES

- A. Setting Shims: Plastic or vulcanized neoprene.
- B. Setting Buttons: Resilient plastic buttons.
- C. Concealed Sheet Metal Flashing: Stainless steel; refer to Division 7 Section "Sheet Metal Flashing and Trim."
- D. Weep and Vent Tubes: Medium-density polyethylene tubing, 1/4-inch OD
  - 1. Length: Required to extend from exterior face of stone to cavity behind.
- E. Sealants for Joints in Stone Cladding: Refer to Division 07 Section "Joint Sealants".

## 2.9 STONE FABRICATION

- A. Fabricate stone per requirements, as shown on Drawings, and as follows:
  - 1. Granite Fabrication: Comply with NBGQA's "Specifications for Architectural Granite."
- B. Arrises: Remove the sharp edge from arrises to slightly blunt edge and to reduce chipping of the finished edge.
- C. Fabricate stone to maintain minimum clearance of **1 inch** between backs of stone units and surfaces behind stone.
- D. Dress joints straight and at 90 degree angle to face. Shape beds to fit supports.
- E. Anchor Provision: Cut and drill sink provisions and holes in stone for anchors, fasteners, supports, and lifting devices as indicated or needed to set stone in place.
  - 1. Allow room for expansion of the anchoring devices where necessary.
  - 2. Where liners are required on the back of panels, secure by means of a mechanical anchors. Comply with referenced standards.
- F. Finish exposed faces and edges of stone, **[except sawed reveals]**, to comply with requirements indicated for finish and to match final samples and mockups.
- G. Joint Width: Cut stone to produce uniform joints **[3/8 inch] [as shown on Drawings]**.
- H. Provide chases, reveals, reglets, openings, and similar features as required to accommodate adjacent work.
- I. Fabricate molded work, including washes and drips, to produce uniform stone shapes, with precisely formed arrises slightly eased, and matching profile at joints between units.

J. Grade and mark stone to achieve uniform appearance when installed. Inspect finished stone units at fabrication plant. Replace defective units.

K. Stone Fabrication Tolerances:

1. Stone thickness 2 inches or less: Plus or minus 1/16 inch of the nominal thickness.
2. Stone thicknesses greater than 2 inches: Plus 1/8 inch and minus 1/16 inch of the nominal thickness.
3. Stone thicknesses greater than 6 inches: Plus or minus 1/8 inch of the nominal thickness.
4. Overall face size: Plus or minus 1/16 inch in both height and width
5. Out of square: Plus or minus 1/16 inch difference of diagonals.

## 2.10 STONE GRAPHICS AND CARVING

- A. Carve and cut graphics and carvings according to Shop Drawings. Use skilled stone carvers experienced in the successful performance of work similar to that indicated.
- B. Abrasively etch graphics and carvings according to Shop Drawings.
- C. Laser etch graphics and carvings according to Shop Drawings.

## 2.11 FABRICATION OF PREFABRICATED PANELS ON BACKUP STRUCTURE

A. Fabrication of Steel Truss Framing: Shop fabricate per AISC's "Specification for Structural Steel Buildings - Allowable Stress Design and Plastic Design" and the following:

1. Weld Shop Connections: AWS D1.1/D1.1M.
2. Fabricate joints to exclude water or to permit its escape to building exterior.

B. After fabrication, each steel unit shall be prepared for protective coating as follows:

1. Protective Coating: [Hot-dip galvanize per ASTM A 123]
2. Protective Coating: [Shop prime paint finish]
  - a. Surface Preparation: SSPC SP-6, "Commercial Blast Cleaning"
  - b. The coating shall be 2 mil minimum thickness of specified primer paint.

C. Stone Panel Fabrication:

1. Anchors that penetrate the stone shall be stainless steel or extruded aluminum.
2. Steel clip angles used in the panel assembly shall be steel. Steel shapes shall be cut and punched to required dimensions.
3. Anchors for attaching clip angles and frames to the stone shall be stainless steel embedded type anchors only. Do not use expansion or cinch type anchors. Holes in the stone for these anchors shall be diamond cored, drilled, or routed.
4. Each piece of stone shall receive clips or frames at the required locations. Each connection points shall consist of stainless steel shims separated from the stone with non-corrosive insulators, stainless steel anchors, nuts, and washer.
5. Anchors shall be inserted into diamond cored holes and torqued to the required tension. The washer and shims shall be spot welded and all welded areas shall receive a coating of repair paint after welding.

## 2.12 SHOP-PRIMED STEEL

A. Standard: SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel."

- B. Surface Preparation: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."

## 2.13 MORTAR MIXES

- A. Comply with referenced standards and with manufacturers' written instructions
  - 1. Mix colored mortars separately and thoroughly clean vessels and mixing equipment between different colored batches to avoid color contamination from each other.
  - 2. Mortar joints shall be concave profile.
- B. Mortar Type: Portland Cement-Lime Setting Mortar: ASTM C 270, Proportion Specification; Type S mortar.

## 2.14 SOURCE QUALITY CONTROL

- A. Stone Testing: **[The Owner will engage] [Engage]** an independent testing laboratory to perform source quality control testing. Tests will be performed on each type and variety of stone for compliance with the physical properties specified. Tests will be conducted on specimens randomly selected under the direction of the testing laboratory. Tests will be representative and typical of the granite proposed for the project.
  - 1. Test results will be reported in writing by the testing laboratory to the Owner, Architect, and Contractor.
  - 2. Tests: Owner's independent testing laboratory shall perform the following testing:
    - a. ASTM C97: Absorption and Bulk Density.
    - b. ASTM C99: Modulus of Rupture of Dimension Stone.
    - c. ASTM C170: Compressive Strength of Dimension Stone.
    - d. ASTM C880: Flexural Strength of Dimension Stone.
    - e. Frequency of Flexural Strength Testing: Test specimens for every 20,000 sq. ft., but not less than 2 sets for each stone type and finish.
- B. Anchor Assembly Tests: Provide anchorage assembly manufacturer's test reports verifying required strengths of anchorage assemblies.
- C. Owner will engage an independent testing laboratory independent testing agency to perform anchor assembly engineering and testing.
  - 1. Anchorage Testing: Comply with requirements of ASTM C1242 and ASTM C1354 for testing anchors.
- D. Furnish test specimens from materials intended for incorporation into the stone work. Furnish one set of test specimens for every required test.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine surfaces and conditions with Installer present.
- B. Surfaces and Conditions: Prior to installing stone, examine the existing surfaces and conditions to receive the cut stone and verify surfaces and conditions are in accordance with the requirements and as shown on Drawings. Do not proceed until defective surfaces are brought into compliance.

### 3.2 PREPARATION

- A. Advise installers of other work about requirements relating to the placement of inserts, flashing reglets, and other items to be used by the stonework installer for anchoring, supporting, and flashing of dimensional stonework. Furnish coordination drawings to other trades for coordination.
- B. Prior to setting cut stone, clean all surfaces to remove accumulated dirt and stains. Clean thoroughly by scrubbing with non-metallic brushes followed by a drenching with clean water. Use only mild detergents that do not contain caustic fillers.

### 3.3 BACKUP STRUCTURE INSTALLATION

- A. Installing Steel Trusses, Frames, and Miscellaneous Steel Framing: Comply with AISC's "Specification for Structural Steel Buildings - Allowable Stress Design and Plastic Design." and as follows:
  - 1. Erection Tolerances: AISC's "Code of Standard Practice for Steel Buildings and Bridges."
  - 2. Maintain stone fabrication tolerances for stone which has been installed to prefabricated support structure before installation.
  - 3. Clean welds, connections, and damaged areas immediately after erection.
    - a. Repair galvanizing to comply with ASTM A 780.
    - b. Apply paint to exposed areas using same material as used for shop painting.

### 3.4 STONE CLADDING INSTALLATION

- A. Proceed with the installation of the stonework in accordance with Drawings and using skilled mechanics capable of proper handling of the setting of the stone and able to field cut where necessary with sharp and true edges.
- B. Set stone with joints uniform in appearance and stone edges and faces aligned to tolerances indicated.
- C. Clean surfaces that are dirty or stained. Scrub with fiber brushes, then rinse with clear water.
- D. Provide expansion, control, and pressure-relieving joints of widths and at locations shown on Drawings.
  - 1. Sealants: Refer to Division 07 Section, "Joint Sealants."
  - 2. Keep expansion joints free of materials.
- E. Install concealed flashing to divert water to building exterior.
- F. Keep cavities open where unfilled space occurs between back of stone units and backup wall; do not fill cavities with mortar or grout.
  - 1. Place weep holes in joints where moisture may accumulate behind stone. Locate weep holes at 24-inch intervals.

### 3.5 ANCHORED STONE CLADDING

- A. Installation of Anchors: Comply with ASTM C 1242.
- B. Set stone on setting shims. Maintain uniform joint widths and prevent point loading of stone on anchors. Hold shims back from face of stone a minimum distance of width of joint.

### 3.6 MORTAR SET STONE CLADDING

- A. Set stone in full bed of mortar with head joints filled.
  - 1. Use setting buttons to maintain uniform joint width. Hold buttons back from face of stone a distance not less than the joint width.
  - 2. Do not set heavy courses until mortar in courses below has hardened 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 and kerfs with mortar.
- B. Embed ends of sills in mortar; leave remainder of joint open until final pointing.
- C. Mortar Pointing:
  - 1. Prepare stone-joint surfaces for pointing with mortar by removing dust and mortar particles.
  - 2. Point stone joints by placing pointing mortar in layers not more than 3/8 inch. Compact each layer thoroughly and apply next layer when installed layer is thumbprint hard.
  - 3. Tool joints to a concave profile.
- D. Sealant: Rake out mortar from sealant-filled joints to depths of not less than 1/2 inch. Rake joints to uniform depths with square bottoms and clean sides.
- E. Set the following stone cladding with head joints filled with sealants:
  - 1. Cornices.
  - 2. Copings.
  - 3. Belt and other projecting courses.

### 3.7 JOINT-SEALANT INSTALLATION

- A. Comply with applicable requirements in Division 07 Section "Joint Sealants."

### 3.8 INSTALLATION TOLERANCES

- A. Variation from Plumb:
  - 1. Vertical lines and surfaces of walls do not exceed:
    - a. 1/4 inch in 10 feet
    - b. 3/8 inch in a story height or 20 feet maximum
    - c. 1/2 inch in 40 feet or more.
  - 2. External corners, corners and jambs within 20 feet of an entrance, expansion joints, and other critical lines do not exceed:
    - a. 1/8 inch in 10 feet.
    - b. 1/4 inch in 20 feet.
    - c. 3/8 inch in 40 feet or more.
- B. Variation from Level:
  - 1. Horizontal stone lines including lintels, sills, copings, bands, and grooves, not to exceed:
    - a. 1/8 inch in 10 feet.
    - b. 1/4 inch in 20 feet.
    - c. 1/2 inch in any bay
    - d. 3/4 inch in 40 feet maximum

- C. Variation of Linear Building Line:
  - 1. Positions shown in plan and related portions of walls and partitions, do not exceed:
    - a. 1/4 inch in 20 feet.
    - b. 1/2 inch in 40 feet or more.
- D. For wall thicknesses and columns from dimensions shown, do not exceed minus 1/4 inch plus 1/2 inch.
- E. Variation in Joint Width: Do not exceed plus or minus 1/8 inch.
- F. Variation in Plane between Adjacent Stone Units (Lipping): Do not exceed 1/16-inch difference between planes of adjacent units.

### 3.9 FIELD QUALITY CONTROL

- A. The Owner will engage an independent testing laboratory to perform field quality control testing. Tests will be performed on stone cladding for water penetration in accordance with ASTM test procedures.
- B. Test results will be reported in writing by the testing laboratory to the Owner, Architect, and Contractor.

### 3.10 ADJUSTING

- A. Remove and replace stone not matching final samples and mockups.
- B. Remove and replace stone not complying with requirements.
- C. Replace non-complying stone to match final samples and mockups, comply with specified requirements. Replacement stone shall show no evidence of replacement.
- D. Patching: Minor patching in small areas may be acceptable if the repair does not distract from the overall appearance of the finished project.

### 3.11 PROTECTION

- A. At the end of each day's work, cover top of walls with a nonstaining waterproof covering. Protect partially finished work when not being worked on.

### 3.12 CLEANING

- A. Clean stone as work progresses. Remove mortar, sealant, and stains before tooling joints.
- B. Final Cleaning: Clean stone as recommended by fabricator or stone producer.
  - 1. Clean all finished stonework with a mild detergent using a fiber brush.
  - 2. After cleaning, rinse with clean water.
  - 3. Do not use acid or other caustic materials.
- C. When cleaning is completed, remove temporary protection.

END OF SECTION