PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes:
1. Dimension stone panels set with individual anchors.
2. Dimension stone trim units, including bands, copings, sills and jambs.

B. Related Requirements:
1. Division 1 Section 'Sustainable Design Requirements".
2. Division 3 Section "Cast-in-Place Concrete" for installing inserts and weld plates in concrete for anchoring dimension stone cladding.
3. Division 4 Section "Unit Masonry" for installing inserts in unit masonry for anchoring dimension stone cladding and for stone trim in unit masonry walls.

1.3 DEFINITIONS

A. Definitions contained in ASTM C119 apply to this Section.

B. Dimension Stone Cladding Assembly: An exterior wall covering system consisting of dimension stone panels and trim together with anchors, backup structure, secondary weather barrier (sheathing), mortar, adhesives, fasteners, and sealants used to secure the stone to the building structure and to produce a weather-resistant covering.
1. Backup structure includes structurally reinforced concrete masonry unit wall.

C. IBC: International Building Code.

1.4 QUALITY ASSURANCE

A. The work of this section shall be performed by a company which specializes in the type of exterior stone cladding work required for this Project, with a minimum of 5 years of documented successful experience and shall be performed by skilled workmen thoroughly experienced in the necessary crafts.
1. Work shall be performed in compliance with Owner's insurance underwriters' requirements and UL approvals and testing for materials, assemblies and procedures.

B. Manufacturer shall specialize in manufacturing the type of exterior stone cladding specified in this section, with a minimum of 5 years of documented successful experience, and have the facilities capable of meeting all requirements of Contract Documents as a single-source responsibility and warranty.

C. Fabricator Qualifications: Shop that employs skilled workers who custom fabricate dimension stone cladding assemblies similar to that required for this Project and whose products have a record of successful in-service performance.

D. Installer Qualifications: An experienced installer who has completed a minimum of three (3) projects utilizing 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 of not less than 10 year.
1. Installer's responsibilities include engineering, fabricating, and installing dimension stone cladding system.
    a. Information on drawings and in Specifications establishes requirements for both aesthetic effects and performance of the dimension stone cladding system.
        1) Aesthetic effects relative to formal characteristics are indicated by dimensions, arrangement, alignment, and profiles of components and assemblies as they relate to sight lines and relationships to one another and to adjoining construction.
        2) Performance is indicated by criteria subject to verification either by preconstruction or field test, if applicable, or by in-service experience.
    b. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval and only to the extent exclusively needed to comply with performance requirements.
        1) Where modifications are proposed, submit comprehensive explanatory data to Architect for review.

2. Engineering Responsibility: Preparation of Shop Drawings and comprehensive engineering analysis by a qualified professional structural engineer.

E. 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 dimension stone cladding engineering services of the kind indicated.
1. 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.

F. Testing Agency Qualifications: Qualified according to ASTM E329 for testing indicated.

G. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code – Steel, AWS D1.2/D1.2M, "Structural Welding Code – Aluminum and AWS D1.3, "Structural Welding Code - Sheet Steel".

H. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
1. Build mockups of typical exterior wall area not less than 72 inches (1800 mm) long.
a. Include typical components, attachments to building structure, and methods of installation.
b. Include sealant-filled joint complying with requirements in Section 07 92 00 "Joint Sealants."
c. Locate mockup on site.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

I. Manufacturer's identification tags or marks are not acceptable on surfaces which will remain exposed to view after installation.
1. Evidence of "patching" after removal of tags or marks is not acceptable.

1.5 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design dimension stone cladding assembly.

B. General: Design stone anchors and anchoring systems according to ASTM C1242.
1. Stone anchors shall withstand not less than two times the weight of the stone cladding in both compression and tension.
2. Fabricate and install dimension stone cladding to withstand loads from wind, gravity, movement of building structure, and thermally induced movement as well as to resist deterioration under conditions of normal use including exposure to weather, without failure.
3. Except where specifically shown otherwise on drawings, provide all support steel and connection elements and assemblies for support of dimension stone cladding.
4. Support member shapes shown on the drawings are not necessarily the exact shapes required or best suited for the particular condition.
a. The Contractor is responsible for the design of the stone work, its anchorage to the structure (including seismic restraint) and its water and airtight integrity.
b. Method of installing and anchoring of stone work shown on drawings is diagrammatic only and shall be used for purposes of bidding.
c. Alternative methods of detailing proposed by Contractor and meeting specified criteria will be considered.
d. Design installation to meet performance requirements specified and allow for expansion, contraction and differential deflection of supporting floors.
5. All points of support for the stonework shall be properly braced in the three orthogonal directions (vertical, transverse, and longitudinal) to resist all loads from any direction including both wind pressure and suction.
6. Anchorage and supports shall be designed to accommodate variation (up/down, in/out) from theoretical location of supporting structure and adjacent construction.
7. Provide dead load support anchors for each individual stone panel.
a. Do not stack panels.
8. Capacity of stone anchors shall not be based on the use of epoxy or grout.
a. Dead load support of panels shall not depend on pull-out.

C. Structural Performance: Dimension stone cladding assembly shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
   1. Wind Loads: As indicated.
      a. As obtained from the wind tunnel test.
      a. In accordance with the local building code.
   2. Equipment Loads: Allow for loads due to window cleaning and maintenance equipment.

D. Seismic Performance: Dimension stone cladding assembly shall withstand the effects of earthquake motions determined according to ASCE/SEI 7 and as indicated on Structural Drawings.

E. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
   1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

F. Design dimension stone cladding system to withstand loads indicated.
   1. Flexural strength shall be determined by specified tests.
   2. In the absence of specified test data, assumed allowable stress (for preliminary design only) shall not exceed 250 PSF for granite.

G. Safety Factors for Stone: Design dimension stone cladding assembly to withstand loads indicated without exceeding stone's allowable working stress determined by dividing stone's average ultimate strength, as established by testing, by the following safety factors:
   1. Safety Factor for Granite: 3.
   2. Safety Factor for Concentrated Stresses: 4 for granite and 10 for stone varieties other than granite.

H. Design Factors for Stone:
   1. Flexural Strength Design Factors: 3.0 for granite, according to ILI's "Technote on Safety Factors".
   2. Ultimate Strength (Anchorages) Design Factors: 5.0 for granite.

I. Design stone anchors and backup structure to withstand loads indicated without exceeding allowable working stresses established by the following:
   1. For Cold-Formed Stainless Steel: ASCE 8, "Specification for the Design of Cold-Formed Stainless Steel Structural Members."
   2. For Cast-in-Place and Postinstalled Fasteners in Concrete: One-fourth of tested capacity when installed in concrete with compressive strength indicated.
   3. For Postinstalled Fasteners in Masonry: One-sixth of tested capacity when installed in masonry units indicated.

J. Limit deflection in each prefabricated assembly caused by indicated loads and thermal movements, acting singly or in combination with one another, to not more than 1/720 of assembly's clear span or the following, whichever is smaller:
   1. 1/16 inch (1.5 mm), measured in plane of wall.
   2. 1/4 inch (6 mm), measured perpendicular to wall.

K. Provisions for Fabrication and Erection Tolerances: Allow for fabrication and erection tolerances of building's structural system. Concrete fabrication and erection tolerances are specified in Section 03 30 00 "Cast-in-Place Concrete".

L. Leakage Resistance, Water and Air: Provide dimension stone cladding system that complies with the following:
   1. Water Penetration: No uncontrolled water penetration beyond plane of back of dimension stone cladding system that is not contained or drained back to exterior, as measured by testing mockup per ASTM E331 at a differential pressure of 20 percent of positive design wind load, but not less than 10 lbf/sq. ft. (479 Pa).

M. Corrosion and Staining Control: Prevent galvanic and other forms of corrosion as well as staining by isolating metals and other materials from direct contact with incompatible materials. Materials shall not stain exposed surfaces of stone and joint materials.

1.6 SUBMITTALS

A. Submit the following according to Conditions of the Construction Contract and Division 1 Specification Sections.

B. Statement of Suitability: Submit statements signed by representatives of respective manufacturers that products, such as stone, mortars, admixtures, sealants and anchorage devices are proper for intended uses and that no materials soluble in water after set shall be used.

C. Preliminary Design Proposal: Submit a "preliminary design proposal" with Bid, including drawings as necessary for the basic concept of the dimension stone cladding system installation.

D. Product Data: For each variety of stone, stone accessory, and manufactured product.

E. LEED Submittals:
1. Product Certificates for Credit MR 5: For products and materials required to comply with requirements for regional materials, certificates indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating distance to Project, cost for each regional material, and fraction by weight that is considered regional.

F. Shop Drawings: Show fabrication and installation details for dimension stone cladding assembly, including dimensions and profiles of stone units.
1. Show locations and details of joints both within dimension stone cladding assembly and between dimension stone cladding assembly 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. Show direction of veining, grain, or other directional pattern.
5. Include large-scale shaded elevations and details of decorative surfaces and inscriptions.

G. Engineering Data for Dimension Stone Cladding Systems: Submit the following items that have been signed and sealed by a qualified professional engineer registered in the state in which this Project is located who is responsible for their preparation and who certifies that they comply with requirements and recognized engineering principles and practice.
1. Drawings indicating engineering and details of system; relationships to other wall components and systems adjacent to, or penetrating, dimension stone cladding system; and method of joinery to latter components and systems that achieve compliance with indicated performance requirements.
    a. Where method for evacuating water that penetrates dimension stone cladding is through controlled gutters, indicate path of moisture travel.
2. Testing program for demonstrating compliance of system with performance requirements.
3. Evaluation of test reports for compliance with performance requirements.
4. Engineering analysis of system evidencing its compliance with performance requirements.

H. Samples for Initial Selection: For joint materials involving color selection.

I. Stone Samples for Verification: Sets for each variety, color, and finish of stone required; not less than 12 inches (300 mm) square.

J. Samples:
1. Stone: Prior to the Architect's visit to the fabricator's plant for formal stone review, submit three samples of each stone type, 30" square, showing full range of color, grain and finish of stone, including typical inclusions in finished work from the proposed material source.
    a. Architect's review and acceptance of samples is for color, texture and grain only of the material source proposed.
    b. Formal review and acceptance of the material for actual use on the Project shall occur at the fabricator's plant.
    c. Compliance with other requirements is Contractor's responsibility.
    d. Sample review and acceptance shall precede mock-up installation.
2. In addition to above, provide adjacent 12" x 12" sample panels showing sealant and grout materials for Architect's review.
3. Anchorage Devices: 3" long.

K. Colored Pointing Mortar Samples for Verification: For each color required. Make Samples using same sand and mortar ingredients to be used on Project.

L. Sealant Samples for Verification: For each type and color of joint sealant required.

M. Delegated-Design Submittal: For dimension stone cladding assembly.

N. Maintenance Data: Shall clearly indicate manufacturer's printed instructions for maintenance of installed work, including methods and frequency recommended for maintaining optimum condition under anticipated use conditions and precautions against materials and methods which may be detrimental to finishes and performances.
   1. Submit National Building Granite Quarries Association, Inc. recommended cleaning and maintenance instructions for stone materials being used.

O. Hazardous Materials Notification: In the event no product or material is available that does not contain asbestos, PCB or other hazardous materials as determined by the Owner, a "Material Safety Data Sheet" (MSDS) equivalent to OSHA Form 20 shall be submitted for that proposed product or material prior to installation.

P. Asbestos and PCB Certification: After completion of installation, but prior to Substantial Completion, Contractor shall certify in writing that products and materials installed, and processes used, do not contain asbestos or polychlorinated biphenyls (PCB), using format in Article 3 of General Conditions.

1.7 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer, fabricator, professional engineer, and testing agency.

B. Welding certificates.

C. Material Test Reports:
   1. Stone Test Reports: For each stone variety proposed for use on Project, by a qualified testing agency, indicating compliance with required physical properties, other than abrasion resistance, according to referenced ASTM standards. Base reports on testing done within previous three years.
   2. For metal components, by a qualified testing agency, indicating chemical and physical properties of metal.
   3. Sealant Compatibility and Adhesion Test Report: From sealant manufacturer complying with requirements in Section 07 92 00 "Joint Sealants" and indicating that sealants will not stain or damage stone. Include interpretation of test results and recommendations for primers and substrate preparation needed for adhesion.

D. Preconstruction test reports.

E. Source quality-control reports.

F. Cold-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with cold-weather requirements.

1.8 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Furnish quantity of full-size units for each shape and thickness equal to 2% of amount installed or 10 pieces of largest size of each type stone and finish.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Comply with General Conditions and Division 1 Section “Product Requirements”.

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 stone 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. Mark stone units, on surface that will be concealed after installation, with designations used on Shop Drawings to identify individual stone units. Orient markings on vertical panels so that they are right side up when units are installed.

D. 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.

E. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.

F. Store aggregates in locations where grading and other required characteristics can be maintained and where contamination can be avoided.

G. Do not exceed building design loads during delivery and storage of stone and setting materials.
1. No portions of the building or Project site are designated as storage locations for the stone.

1.10 FIELD CONDITIONS

A. Protect dimension stone cladding during erection by doing the following:
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 (600 mm) 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.

B. Cold-Weather Requirements: 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. Comply with cold-weather construction and protection requirements for masonry contained in ACI 530.1/ASCE 6/TMS 602.

C. Hot-Weather Requirements: Comply with hot-weather construction and protection requirements for masonry contained in ACI 530.1/ASCE 6/TMS 602.

D. 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 (5 deg C) or when joint substrates are wet.

1.11 COORDINATION

A. Coordinate installation of inserts that are to be embedded in concrete or masonry, flashing reglets, and similar items to be used by dimension stone cladding Installer for anchoring, supporting, and flashing of dimension stone cladding assembly. Furnish setting drawings, templates, and directions for installing such items and deliver to Project site in time for installation.

B. Time delivery and installation of dimension stone cladding to avoid extended on-site storage and to coordinate with work adjacent to dimension stone cladding.

1.12 WARRANTY

A. Comply with General Conditions and Division 1 Section “Product Requirements”.

1.13 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.14 PRECONSTRUCTION TESTING

A. Preconstruction Stone Testing: Engage a qualified independent testing agency to perform preconstruction testing.
1. Retesting of materials that fail to meet specified requirements shall be done at Contractor's expense.
2. Furnish test specimens that are representative of materials proposed for incorporation into the Work.
3. Physical Property Tests: For each stone variety proposed for use on Project, tested for compliance with physical property requirements, other than abrasion resistance, according to referenced ASTM standards.
4. Flexural Strength Tests: For stone variety, thickness, orientation of cut, and finish, proposed for use on Project, tested according to ASTM C880/C 880M, in both wet and dry conditions.
5. Anchorage Tests: For each combination of stone variety, orientation of cut, finish, and anchor type proposed for use on Project, tested according to ASTM C1354/C 1354M.

6. Cladding System Mockup Tests: For performance of dimension stone cladding system, evaluated for compliance with requirements by mockup testing per ASTM E72, with a maximum test load equal to 4 times the design load.
    a. Remove test mockups from laboratory when testing program is completed and dispose of legally; do not use materials from mockups on Project.

B. Water Porosity Testing shall be performed on each type and finish of stone proposed.
1. A minimum of three specimens each is required, of correct outdoor/indoor finishes.
    a. Minimum size is 12" by 12", of thickness as proposed for project.
2. With the stone supported in a horizontal position, install a cylindrical sleeve (at least 2" in diameter), and sealed to the exterior face of the stone specimen.
3. Fill sleeve with cold water to a depth of 10" and maintain depth for 10 days.
4. Record: When dampness is first visible on the interior surface, when water droplets are first visible on the interior surface, and when water begins to drip from the interior surface.
    a. If dripping occurs, collect and record (within any 1 hour period) the quantity of water volume collected.
    b. Formation of water droplets (with or without dripping) constitutes failure.
    c. All specimens must pass.

C. Preconstruction Sealant Compatibility Staining and Adhesion Testing: Submit to joint-sealant manufacturers, for compatibility and adhesion testing according to sealant manufacturer's standard testing methods and Section 07 92 00 "Joint Sealants" Samples of materials that will contact or affect joint sealants.
1. Submit not fewer than 9 pieces of each variety and finish of stone, setting buttons, and joint-sealant backings.
2. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
3. For materials failing tests, obtain joint sealant manufacturer's written instructions for corrective measures, including use of specially formulated primers.
4. Sealant manufacturer's representative shall pick up samples at Project site after being notified by Contractor.
5. Lab testing shall be performed by sealant manufacturer at no cost to Architect, Contractor or Owner.

D. Preconstruction Field Testing of Sealants: Before installing joint sealants, field test their adhesion to joint substrates according to Section 07 92 00 "Joint Sealants."

PART 2 PRODUCTS

2.1 UNAUTHORIZED MATERIALS

A. Materials and products required for work of this section shall not contain asbestos, polychlorinated biphenyls (PCB) or other hazardous materials identified by the Owner.

2.2 ACCEPTABLE MANUFACTURERS

A. Products of the manufacturers specified in this section establish the minimum functional, aesthetic and quality standards required for work of this section.

B. Source Limitations for Stone: Obtain each variety of stone, regardless of finish, from single quarry, whether specified in this Section or in another Section of the Specifications, with resources to provide materials of consistent quality in appearance and physical properties.
1. For stone types that include same list of varieties and sources, provide same variety from same source for each.
2. Make quarried blocks available for examination by Architect and the Owner.
3. The acceptable color range and grain variation for each stone type and finish will be developed through a series of visits to each of the stone fabricators' plants.
    a. Set up a number of large uncut finished slabs (minimum of 11) of each type sufficient to demonstrate the extreme range, veining, inclusions, knots, swirls, etc., that can be expected for the production run material in a vertical position in the fabricator's yard for viewing by the Architect and Owner.
    b. The Architect will select the stones which are acceptable and conform to the requirements of the specifications, rejecting any other stones falling outside the requirements.
    c. Each approved stone panel will be cut in half, with one half being shipped to the Project site with the initial shipment of stone and the other half remaining at the fabricator's plant for quality control purposes.
4. Establish procedures for blending the range of color and grain of stone panels.
    a. Control variation from piece to piece to eliminate patchwork or "checkerboard" appearance.
    b. Provide for evenly blended appearance of finish work.

C. Source Limitations for Mortar Materials: Obtain mortar ingredients of uniform quality for each cementitious component from single manufacturer and each aggregate from single source or producer.

D. Source Limitations for Other Materials: Obtain each type of stone accessory, sealant, and other material from single manufacturer for each product.

E. Substitutions: Comply with Division 1 Section "Product Requirements" using form in Division 1 Section "Substitution Request Form".

2.3 GRANITE

A. Material Standard: Comply with ASTM C615.

B. Regional Content: For material that is extracted, harvested or recovered as well as manufactured within 500 miles of the project site – 101 First Street, San Francisco, CA, contractor shall document the cost and percentage (by weight) of each material that is regional.

C. Varieties and Sources: Subject to compliance with requirements, provide the following:
1. Refer to Stone Schedule in this section.

D. Cut: Vein.
1. Orientation of Veining: Vertical.

E. Finish: See Stone Schedule.

F. Match Architect's samples for color, finish, and other stone characteristics relating to aesthetic effects.

G. Thickness: Not less than 1-1/4 inches (32 mm) unless otherwise indicated.
1. Minimum Thickness: Provide stone units of not less than thickness indicated, and not less than the thickness required to meet the design criteria.

2.4 ANCHORS AND FASTENERS

A. Fabricate anchors from stainless steel, ASTM A240/A 240M or ASTM A666, Type 316; temper as required to support loads imposed without exceeding allowable design stresses. Fabricate dowels and pins for anchors from stainless steel, ASTM A276, Type 316.

B. Cast-in-Place Concrete Inserts: Either threaded or wedge type unless otherwise indicated; galvanized ferrous castings, either ASTM A47/A 47M malleable iron or ASTM A27/A 27M cast steel, with capability to sustain, without failure, a load equal to 4 times the loads imposed as determined by testing per ASTM E488, conducted by a qualified independent testing agency. Provide bolts, washers, and shims as needed, all hot-dip galvanized per ASTM F2329.

C. Postinstalled Anchor Bolts for Concrete and Masonry: Chemical anchors, torque-controlled expansion anchors or undercut anchors made from stainless-steel components complying with ASTM F593 and ASTM F594, Alloy Group 1 or 2 (ASTM F738M and ASTM F836M, Alloy Group A1 or A4) for bolts and nuts; ASTM A240/A 240M, ASTM A276, or ASTM A666, Type 304 or 316, for anchors, 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 E488, conducted by a qualified independent testing agency.

D. Threaded Fasteners: Heavy hexagon structural bolts, heavy hexagon nuts, and hardened washers.
1. For stainless steel, use annealed stainless-steel bolts, nuts, and washers; for bolts, ASTM F593 (ASTM F738M); and for nuts, ASTM F594 (ASTM F836M), Alloy Group 2 (A4).

E. Weld Plates for Installation in Concrete: Comply with Section 05 50 00 "Metal Fabrications."

2.5 MORTAR MATERIALS

A. Portland Cement: ASTM C150, Type I or Type II, except Type III may be used for cold-weather construction, natural color or white 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 C114.

B. Hydrated Lime: ASTM C207.

C. Portland Cement-Lime Mix: Packaged blend of portland cement and hydrated lime.

D. Colored Portland Cement-Lime Mix: Packaged blend of portland cement, hydrated lime, and mortar pigments. Mix shall produce color indicated or, if not indicated, as selected from manufacturer's standard colors. Pigments shall not exceed 10 percent of portland cement by weight.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Holcim (US) Inc.; Rainbow Mortamix Custom Color Cement/Lime.
      b. Lafarge North America Inc.; Eaglebond.
      c. Lehigh Cement Company; Lehigh Custom Color Portland/Lime Cement.

E. Aggregate: ASTM C144; except for joints narrower than 1/4 inch (6 mm) and pointing mortar, 100 percent shall pass No. 16 (1.18-mm) 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.

F. Water: Potable.

2.6 STONE ACCESSORIES

A. Setting Shims: Strips of resilient plastic or vulcanized neoprene, Type A Shore durometer hardness of 50 to 70, nonstaining to stone, of thickness needed to prevent point loading of stone on anchors and of depths to suit anchors without intruding into required depths of pointing materials.

B. Setting Buttons: Resilient plastic buttons, nonstaining to stone, sized to suit joint thicknesses and bed depths of stone units without intruding into required depths of pointing materials.

C. Concealed Sheet Metal Flashing: Fabricated from zinc-tin, alloy-coated stainless steel in thicknesses indicated, but not less than 0.0156 inch (0.4 mm) thick, and complying with Section 07 62 00 "Sheet Metal Flashing and Trim."

C. Flexible Flashing: For installation under copings, stones, at shelf angles and footings.

D. Cementitious Dampproofing for Limestone: Cementitious formulation recommended by ILI and 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 (6-mm) OD, Rectangular, cellular, polypropylene or clear butyrate extrusion, 3/8 by 1-1/2 inches (9 by 38 mm), of length required to extend from exterior face of stone to cavity behind.

F. Cellular Plastic Weep Hole/Vents: One-piece, flexible extrusion made from UV-resistant polypropylene copolymer, of length required to extend from exterior face of stone to cavity behind, in color selected from manufacturer's standard.

G. Mesh Weep/Vent: Free-draining mesh; made from polyethylene strands, of length required to extend from exterior face of stone to cavity behind, in color selected from manufacturer's standard.

H. Wicking Material: Absorbent rope, made from cotton or UV-resistant synthetic fiber, 1/4 to 3/8 inch (6 to 10 mm) in diameter, of length required to produce 2-inch (50-mm) exposure on exterior and 18 inches (450 mm) in cavity between wythes.

I. Sealants for Joints in Dimension Stone Cladding: Manufacturer's standard chemically curing, elastomeric sealants of base polymer and characteristics indicated below that comply with applicable requirements in Section 07 92 00 "Joint Sealants" and do not stain stone:
   1. Silicone Joint Sealant: Single component, nonsag, neutral curing, Class 50.
   2. Joint-Sealant Colors: As selected by Architect from manufacturer's full range of colors.

J. Sealant for Filling Kerfs: Same sealant used for joints in dimension stone.

2.7 STONE FABRICATION

A. General: Fabricate stone units in sizes and shapes required to comply with requirements indicated.
   1. For granite, comply with recommendations in NBGQA's "Specifications for Architectural Granite."

B. Control depth of stone and back check to maintain minimum clearance of 1-1/2 inches (38 mm) between backs of stone units and surfaces or projections of structural members, fireproofing (if any), backup walls, and other work behind stone.

C. Dress joints (bed and vertical) straight and at right angle to face unless otherwise indicated. Shape beds to fit supports.

D. 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.

E. Liners: Provide greater stone thickness where extent of cutouts indicated decreases effective strength of remaining material, or for proper and sufficient anchorage suitable and adequate bearing areas or surfaces.
   1. Use of liners properly sized by manufacturer and secured to stone facing permitted only where indicated.

F. Finish exposed faces and edges of stone to comply with requirements indicated for finish and to match approved samples and mockups.
   1. Exposed edges of dimension stone cladding shall have a uniform thickness.

G. Cut stone to produce uniform joints 3/8 inch (10 mm) wide and in locations indicated.

H. Contiguous Work: Provide chases, reveals, reglets, openings, and similar features as required to accommodate contiguous work.

I. 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 and molded edges with machines that use abrasive shaping wheels made to reverse contour of molding shape.

J. Clean backs of stone to remove rust stains, iron particles, and stone dust.

K. 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.

2.8 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 C270, Proportion Specification, for types of mortar indicated below:
   1. Set granite with Type S mortar.
   2. Set limestone with Type N mortar.

C. Pointing Mortar: Comply with ASTM C270, Proportion Specification, for types of mortar indicated. Provide pointing mortar mixed to match Architect's sample and complying with the following:
   1. Packaged Portland Cement-Lime Mix Mortar: Use portland cement-lime mix of selected color.
   2. Point granite with Type S mortar.
   3. Point limestone with Type N mortar.

2.9 SOURCE QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform source quality-control testing.
   1. Furnish test specimens selected by testing agency from same blocks as actual materials proposed for incorporation into the Work.
   2. Flexural Strength Tests: ASTM C880/C 880M, performed on specimens of same thickness, orientation of cut, and finish as installed stone. One set of test specimens is required to be tested for every 10,000 sq. ft. (1000 sq. m), but not fewer than two sets for each stone variety.

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 of dimension stone cladding.

B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of dimension stone cladding.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 SETTING DIMENSION STONE CLADDING, GENERAL

A. Before setting stone, clean surfaces that are dirty or stained by removing soil, stains, and foreign materials. 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.

B. 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.
   2. Field cutting not permitted without Architect's approval for each instance.

C. Contiguous Work: Provide reveals, reglets, and openings as required to accommodate contiguous work.

D. Set stone to comply with requirements indicated.
   1. Install anchors, supports, fasteners, and other attachments indicated or necessary to secure dimension stone cladding in place.
   2. 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.
   3. Do not use materials soluble in water after set.
   4. Provide dowels and anchors in sufficient quantity to eliminate "rattle" or loose pieces and to ensure a rigid installation.
   5. Use lock washers or other acceptable methods to prevent nuts loosening.
   6. After erection of 4 vertical courses by 4 horizontal stones, notify Architect prior to proceeding for review of final conditions including, joints, anchorage and other features of final work.
      a. Comments made shall be incorporated into stone work and used as reference for remaining work.
   7. At copings, set stone with two cushions per stone in horizontal joints.
      a. Provide complete isolation medium between stone and aluminum.
      b. Secure with anchors and dowels, required for rigid installation.
      c. Provide nylon or polystyrene separators where aluminum contacts painted steel.

E. Provide expansion, control, and pressure-relieving joints of widths and at locations indicated.
   1. Sealing expansion and other joints is specified in Section 07 92 00 "Joint Sealants."
   2. Keep expansion joints free of mortar and other rigid materials.

F. Install concealed flashing at continuous shelf angles, lintels, ledges, and similar obstructions to downward flow of water, to divert water to building exterior. Extend flashing 6 inches (150 mm) at ends and turn up not less than 2 inches (50 mm) to form end dams.
   1. Install end dams to control the flow of water to the building exterior.

G. 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. Place weep holes in joints where moisture may accumulate, including at base of cavity walls and above shelf angles and flashing. Locate weep holes at intervals not exceeding 24 inches (600 mm). Use weep and vent tubes, plastic weep hole/vents or wicking material.
   2. Place vents in cavity walls at tops of cavities, below shelf angles and flashing, and at intervals not exceeding 20 feet (6 m) vertically. Locate vents in joints at intervals not exceeding 60 inches (1500 mm) horizontally. Use weep and vent tubes or plastic weep hole/vents.
   3. Fill space between back of stone units and back-up wall solidly with grout up to 12" above finish grade.

3.3 SETTING MECHANICALLY ANCHORED DIMENSION STONE CLADDING

A. Set dimension stone cladding with mechanical anchors without mortar unless otherwise indicated.

B. Attach anchors securely to stone and to backup surfaces. Comply with recommendations in ASTM C1242.

C. 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 sealant indicated for filling kerfs.

D. Set stone supported on clips or continuous angles on resilient setting shims. Use material of thickness required to maintain uniform joint widths and to prevent point loading of stone on anchors. Hold shims back from face of stone a distance at least equal to width of joint.

3.4 SETTING DIMENSION STONE CLADDING WITH MORTAR

A. Set dimension stone cladding with mortar and mechanical anchors unless otherwise indicated.

B. Set stone in full bed of mortar with head joints filled 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, but not less than depth of pointing materials.
   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 and kerfs with mortar.

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 (12 mm). 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 (10 mm) until a uniform depth is formed.

F. Point stone joints by placing pointing mortar in layers not more than 3/8 inch (10 mm). Compact each layer thoroughly and allow to become thumbprint hard before applying next layer.

G. Tool joints with a round jointer having a diameter 1/8 inch (3 mm) larger than width of joint, when pointing mortar is thumbprint hard.

H. Rake out mortar from sealant-pointed joints to depths required for sealant and sealant backing but not less than 1/2 inch (12 mm). 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. Sills.
   4. Belt and other projecting courses.

3.5 JOINT-SEALANT INSTALLATION

A. Prepare joints and apply sealants of type and at locations indicated to comply with applicable requirements in Section 07 92 00 "Joint Sealants".

3.6 INSTALLATION TOLERANCES

A. Variation from Plumb: For vertical lines and surfaces of walls, do not exceed 1/4 inch in 10 feet (6 mm in 3 m), 3/8 inch in 20 feet (10 mm in 6 m), or 1/2 inch in 40 feet (12 mm in 12 m) or more. For external corners, corners and jambs within 20 feet (6 m) of an entrance, expansion joints, and other conspicuous lines, do not exceed 1/8 inch in 10 feet (3 mm in 3 m), 1/4 inch in 20 feet (6 mm in 6 m), or 3/8 inch in 40 feet (10 mm in 12 m) 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 (3 mm in 3 m), 1/4 inch in 20 feet (6 mm in 6 m), or 3/8 inch (10 mm) 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 (6 mm in 6 m) or 1/2 inch in 40 feet (12 mm in 12 m) or more.

D. Variation in Cross-Sectional Dimensions: For thickness of walls from dimensions indicated, do not exceed plus or minus 1/4 inch (6 mm).

E. Variation in Joint Width: Do not vary from average joint width more than plus or minus 1/8 inch (3 mm) or a quarter of nominal joint width, whichever is less. For joints within 60 inches (1500 mm) of each other, do not vary more than 1/8 inch (3 mm) or a quarter of nominal joint width, whichever is less from one to the other.

F. Variation in Plane between Adjacent Stone Units (Lipping): Do not exceed 1/16-inch (1.5-mm) difference between planes of adjacent units.

3.7 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.

A. Remove and replace dimension stone cladding of the following description:
   1. Broken, chipped, stained, or otherwise damaged stone.
      a. Stone may be repaired if methods and results are acceptable to Architect.
      b. Do not repair breaks with adhesive materials.
      c. Provide new units to match adjoining units, point mortar joints to eliminate evidence of replacement.
      d. Chips 3/8” or smaller may be repaired if they are within 10’ of walking surface.
         1) Chips larger than 3/8" that are within 10’ of walking surface shall be replaced.
         2) Chips that are smaller than 1" and not within 10’ of walking surface may be repaired.
         3) Chips 1" or larger shall be replaced.
      e. Do not install stone until Architect has accepted repair.
      f. Submit written procedure describing method and materials to be used in making the repairs.
      g. Submit sample of proposed repair.
   2. Defective joints.
   3. Dimension stone cladding and joints not matching approved samples and mockups.
      a. Stone that does not match adjoining units within accepted range.
   4. Dimension stone cladding not complying with other requirements indicated.

B. Replace damaged or defective work 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. Remove excess sealant and smears as sealant is installed.

D. Final Cleaning: 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.

3.8 STONE SCHEDULE

A. STONE TYPE **ST-1** & **ST-3**: See Section "09 63 40/Stone Flooring".

B. STONE TYPE **ST-2**: See Section "09 75 13/Interior Stone Paneling".

C. STONE TYPE **ST-4**: See Section "12 36 40/Stone Countertops".

D. STONE TYPE **ST-1X**:
1. Type: Granite; match stone at Exterior Plaza. See Section 32 14 40 "Stone Paving".
2. Color: Gray.
3. Finish: Honed.
4. Thickness: 3 cm veneer, and solid blocks as detailed on drawings.

E. STONE TYPE ST-1XA (Alternate):
1. Type: Granite.
2. Color: White Moncini to match Architect's sample.
3. Finish: High honed.
4. Thickness: 3 cm veneer, and solid blocks as detailed on drawings.
5. Location: Base at grade.

END OF SECTION