VERTICAL SURFACES-
EXTERIOR STONE VENEER

1.0 INTRODUCTION

1.1 Installation Methods. Exterior stone veneer may be installed by several methods:

1.1.1 Independently Supported Veneer. Each stone panel is independently supported (relieved and restrained) by mechanical anchorage.

1.1.2 “Stacked” Veneer With Relieving Supports. Restraint and relief are achieved by using a combination of lateral ties (straps, split-tail anchors, welded tees, or other positively engaged mechanical anchorage approved by the engineer of record) and relief supports.

1.1.3 Adhered Veneer. Panels of various backing materials to which thin stone tiles are affixed by epoxy, latex-portland cement, or silicone or other adhesives approved by the engineer of record or responsible governing body.

1.1.4 Other systems include a variety of prefabricated and proprietary systems commonly known as:

1.1.4.1 “Grid” systems, commonly composed of vertical and horizontal support framing of varying corrosion-resistant materials, such as aluminum, mild steel, cold-formed steel, or stainless steel. The framing is typically pre-installed in the stone setting cavity to the substrate or support wall. Stone supports are typically integrated in the system design.

1.1.4.2 “Strut” systems are commonly composed of vertical support framing of varying corrosion-resistant materials such as aluminum, mild steel, cold-formed steel or stainless steel. The framing is typically pre-installed in the stone setting cavity to the substrate or support wall. Non-integrated stone supports are typically attached in a method similar to Independently Supported Veneer or “Stacked” Veneer with Relieving Supports.

1.1.4.3 Integrated Stone Curtain Wall. Stone veneer installed in glazing channels of glazed curtain wall members, in similar manner to metal spandrel panels or stone veneer installed in structurally glazed curtain walls, in a similar manner to glass.

1.1.4.4 Panelized dimension stone cladding, which may include independently supported veneer, “stacked” veneer with relieving supports, adhered veneer, or a combination of these methods. This is also known as a truss system.

1.2 Consideration should be given to the various features of each system in making a selection for a specific installation. See detailed information about installation methods in 3.0 of this chapter and illustrations of examples at the close of this section.

2.0 DESIGN CRITERIA

2.1 Anchors. A minimum of four anchors should be provided for panels up to 12 sq ft, with two additional anchors for each additional 8 sq ft of surface area.

2.2 Exposed stone edges must be gauged to the precise thickness specified.

2.3 Physical Property Values. Final design should always be based on specific physical property values for the stone to be used. These values can be obtained from the Stone Supplier.

2.4 Insulation. Because heat is easily transmitted through stone when stone is part of a system assembly, insulation should be provided by other Contractors.
2.5 Control and Expansion Joints. In exterior stone walls, expansion joints may be provided to reduce the damaging effect of building and/or veneer movements due to thermal expansion, structural live load deflection, seismic displacement, and other applicable movements based on project conditions and material properties. Because of the many conditions and structural systems in which stone can be installed, the Specifying Authority or engineer of record shall show locations and details of expansion joints on project drawings and/or calculations.

2.6 Shims shall be stainless steel or high-impact plastic or approved equal. Shim size shall distribute the loads to ensure that point loading does not affect stones performance.

2.6.1 Where permanent setting pads are required, 90 durometer neoprene or high-impact plastic is recommended.

2.7 Metal studs and horizontal tracks placed behind stone wall installations to hold the wall should be 16 gauge or heavier or as required by the engineer of record, project specifications, or local governing officials and/or codes.

2.8 White portland cement is recommended for light-colored granite and marble. White portland cement with a low alkali content is recommended for limestone.

2.9 Precaution. Individually set thin tile (nominal ¼" thick) on vertical surfaces exceeding 15' is not recommended.

2.10 For additional information, refer to Chapter 13 Installation – General Information.

2.11 Geographic Methods. Some installation methods and materials are not recognized and may not be suitable in some geographic areas because of local trade practices, building codes, climatic conditions, or construction methods. Therefore, while every effort has been made to produce accurate guidelines, they should be used only with the independent approval of technically qualified persons.

DATA SHEET

EXTERIOR STONE VENEER

1.0 PRODUCT DESCRIPTION

1.1 Basic Use. Exterior cladding or facing for structural elements.

1.2 Thickness Limitations. Refer to ASTM C1528 for recommendations of minimum stone thickness.

1.3 Mechanical Systems. As a general rule, stone panel thickness should be a minimum of 1¼". However, panel sizes and thicknesses may also be dictated by local codes, wind load requirements, areas of usage, and material performance as determined by ASTM standard specifications.

1.4 Fabrication. Exterior veneer units are precut and prefinished to dimensions specified on shop drawings and are typically delivered to the job site ready to install.

1.5 Finishes. Most commercially available stone thicknesses are suitable for exterior veneer. Some stones, notably marbles, may not retain a polished finish in exterior environments.

1.6 Colors. Most of the commercially available varieties are suitable.

1.7 Panel Sizes. For optimum stock selection and color blending, panel sizes should generally be produced to make finished sizes 4' to 7' long and 2' to 4' wide. (Panel sizes may vary depending on the nature of selected stone.)
2.0 TECHNICAL DATA

2.1 Each stone variety used for exterior veneer should conform to the applicable ASTM standard specification and the physical requirements contained therein. The specification for each stone type follows:

2.1.1 Granite: ASTM C615 Standard Specification for Granite Dimension Stone

2.1.2 Limestone: ASTM C568 Standard Specification for Limestone Dimension Stone

2.1.3 Marble: ASTM C503 Standard Specification for Marble Dimension Stone


2.1.5 Serpentine: ASTM C1526 Standard Specification for Serpentine Dimension Stone

2.1.6 Slate: ASTM C629 Standard Specification for Slate Dimension Stone

2.1.7 Soapstone: No ASTM Standard exists at this time.

2.1.8 Travertine: ASTM C1527 Standard Specification for Travertine Dimension Stone

3.0 INSTALLATION

3.1 Independently Supported Veneer

3.1.1 Each stone panel is independently supported (relieved and restrained) by mechanical anchorage attached to the backup wall substrate (building structure, masonry backup, stud framing assembly, miscellaneous steel, and etc.). The stone panels and associated anchorage are designed to accommodate vertical loads (stone unit self weight) and lateral loads (wind and seismic forces) as required by governing codes and/or project specifications. Each of these loads is transferred directly to the backup wall substrate through the stone anchorage. Joints between each stone are designed to accommodate thermal expansion and differential movement between stone units, and therefore, must remain free of shims, mortar, or any other rigid material that would transfer load from one stone to another. The joints are typically filled with a non-staining sealant, which possesses compressive and tensile capacities adequate to meet the performance requirements for the project.

3.1.2 A minimum joint width of 3/8” is recommended for exterior stone veneer. Larger joints may be required to accommodate specific project demands.

Note: This system can also be installed as a rainscreen or open-joint façade, omitting joint sealant between stone veneer units.

3.2 “Stacked” Veneer With Relieving Supports

3.2.1 Restraint and relief are achieved by using a combination of lateral ties (straps, split-tail anchors, welded tees, or other positively engaged mechanical anchorage approved by the engineer of record) and relief supports.

3.2.2 Each stone panel is restrained by mechanical anchorage attached to the backup wall substrate (building structure, masonry backup, stud framing assembly, miscellaneous steel, etc.). The stone panels and associated anchorage are designed to accommodate lateral loads only (wind and seismic forces) as required by governing codes and/or project specifications. These loads are transferred directly to the backup wall substrate through the stone anchorage.

3.2.3 Relieving supports (i.e., continuous angles or clips) are designed to accommodate the cumulative vertical load of the stone veneer units “stacked” between the relief support and expansion or control joint above,
typically a live load joint at a floor/slab line. Relief supports are typically provided over all openings and at each story height (or maximum vertical spacing of 20'). Within a “stack”, vertical loads are typically transferred from one stone to another using load-bearing shims or mortar. The joints are typically filled with a non-staining sealant or mortar adequate to meet the performance requirements for the project.

Consideration of weeps and flashing is recommended when continuous relief angles are utilized.

3.3 Standard Set System With Vented Cavity

3.3.1 Method. Panels are set firmly against mortar spots located at or near the anchors and spaced not more than 18" apart over the back of the panel or as required by the engineer of record, project specifications or local governing officials and/or codes.

3.3.2 Joints. Joint width can be maintained with non-staining, resilient cushions placed at least a joint width back from stone face.

3.3.2.1 Horizontal and vertical expansion or control joints should be provided at 20' maximum intervals or as required by the engineer of record, project specifications or local governing officials and/or codes.

3.3.3 Support angles should be composed of corrosion-resistant metals and/coatings (i.e., stainless steel, hot dipped galvanized, etc.) and should be securely attached to the support structure and to the veneer should be provided over all openings, at each story height, or as required the engineer of record, project specifications or local governing officials and/or codes.

3.3.3.1 Consideration of weeps and flashing is recommended when continuous relief angles or supports are utilized.

3.3.4 Stone Restraints. Clips, dowels, pins, cramps, and wires that contact the stone should be corrosion-resistant metals and should be securely attached to the support structure and to the veneer as required by the engineer of record, project specifications, or local governing officials and/or codes.

3.3.4.1 A minimum of four anchors should be provided for panels up to 12 sq ft, with two additional anchors for each additional 8 sq ft of surface area or as required by the engineer of record, project specifications, or local governing officials and/or codes.

3.3.5 Vents and Drainage. Cavity vents, weep holes, plastic tubing, or wicks should be provided in sealed or mortared joints at approximately 5' horizontal intervals and 20' maximum vertical intervals as required by the project specifications or local governing officials and/or codes.

3.4 “Stacked” Veneer With Relieving Supports - With Filled Cavity

(Used only if required by building code.)

3.4.1 Installation is the same as for vented cavity, except as follows:

3.4.1.1 Cavity vents are deleted.

3.4.1.2 Setting space is filled with mortar.

3.4.1.3 All joints except expansion joints are pointed with mortar in lieu of sealing.

3.5 Adhered Veneer

3.5.1 Units shall not exceed 36 inches (914 mm) in the greatest dimension nor more than 720 square inches (0.46 m²) in total area and shall not weigh more than 15 pounds per square foot (73 kg/m²) unless approved by the local governing officials and the engineer of record.
3.5.2 Exception: Adhered veneer units weighing less than three pounds per square foot (15 kg/m²) shall not be limited in dimension or area.

3.5.3 Adhesive application. When adhesive installation methods are used for exterior vertical surfaces, there must be 100% adhesive contact between the stone and the backup or as recommended by the adhesive manufacturer and/or specific project testing.

3.5.4 When thin stone tiles are installed on exterior vertical surfaces, they are only as strong as the backup. Use of unstable backup materials should be avoided.

3.5.5 Petroleum based organic adhesives should be avoided because they may stain the stone.

3.5.6 Recommended backing materials are masonry and cementitious backer board.

3.5.7 Vertical Surfaces Height. Thin-set adhesive installation is not recommended for vertical surfaces exceeding a height of 15'-0" (4.5 m).

3.5.8 Grout. When using adhesion installation methods, grout joints shall be a minimum of ¼" wide. Apply grout to full depth of stone. Avoid use of “designer grouts” on exterior or in wet areas, as these grouts tend to be soft and very absorbent. Silicone-based building sealants that remain flexible with a modulus capable of accommodating anticipated inter-panel movements are recommended for vertical work. Verify the sealant is non-staining to the specified stone material.

4.0 ENGINEERING

4.1 A knowledgeable and experienced Installer must be engaged to engineer and fabricate a system that will satisfy functional and aesthetic requirements. However, determining which performance requirements and the criteria under each must be made by the Specifying Authority in consultation with the Structural Engineer.

5.0 GENERAL PRECAUTION:

5.1 During construction, the General Contractor shall protect all stone from staining and damage.
1. EXTRUDED ALUMINUM OR WELDED STAINLESS STEEL "T" ON CMU BACKUP

2. EXTRUDED ALUMINUM OR WELDED ST. STEEL "T" ON CONCRETE BACKUP
1. Extruded Aluminum or Welded St. Steel "T" on Metal Stud Backup

2. Stainless Steel Split-Tail Anchor on Metal Stud Backup
STAINLESS STEEL SPLIT-TAIL ANCHOR ON MISC. METAL BACKUP

EXTRUDED ALUMINUM OR WELDED ST. STEEL "T" ON MISC. METAL BACKUP
1. Relief Angle Connection on CMU/Concrete Backup

- Grout Filled CMU
- Expansion Anchor
- S.S. Bent Plate At 1/4 Pts. of Stone
- Fill Kerf with Non-Staining Silicone Sealant Full Length of Anchor Clip
- Sealant & Backer Rod
- Full Bearing Hard Plastic Shims
- Continuous Relief Angle
BACK ANCHOR & ST. STL. CLIP FOR "BLIND" CONNECTION ON METAL STUDS

BACK ANCHOR & ST. STL. CLIP FOR "BLIND" CONNECTION ON CMU/COMCRETE
NOTE: 1. ALLOW ADEQUATE SPACE FOR ANCHOR BOLT HEADS.
2. NEVER ANCHOR THROUGH A PRESSURE RELIEVING JOINT.
3. ALL METALS IN CONTACT WITH THE STONE MUST BE CORROSION RESISTANT.
NOTE: 1. ALLOW ADEQUATE SPACE FOR ANCHOR BOLT HEADS.
   2. NEVER ANCHOR THROUGH A PRESSURE RELIEVING JOINT.
   3. ALL METALS IN CONTACT WITH THE STONE MUST BE CORROSION RESISTANT.
NOTES:
1. ALL METALS IN CONTACT WITH STONE MUST BE CORROSION RESISTANT.
3. RECOMMENDED MINIMUM THICKNESS OF STONE VENEER FOR ANCHORAGE SHOWN IN DETAILS 7, 8, 9 & 12 VARIES.
**Plan of Detail 12**

**Detail 12**

- Dovetail Strap with Dowel
- Stone Wire Anchor Sealant
- Sheetrock (Interior)
- Cement Backer Board (Exterior)
- Dovetail Strap with Dowel

**Detail 13**

- Twisted Dovetail Strap Anchors in Side of Stone Veneer
- Dovetail L-Strap
- Non-Staining Sealant

**Detail 14**

- 5/8" Washer
- Self-Drilling Self-Tapping Screw
- #10 Ga. Cont. Plate, 4" Wide Secured to Studs by G.C.
- Line of Studs or Face of Existing Wall

**Detail 15**

- Non-Ferrous Wire (Typ.)
- Mortar Spot
- Gypro Board (Interior) - Attached to Metal Studs @ 16" O.C.
- Cement Backer Board (Exterior)

**Detail 16**

- Expansion Bolt or Anchor
- Shim

**Note:**

1. Expansion bolts should only be used in brick or concrete back-up.
2. All metals in contact with stone must be corrosion resistant.
3. Allow adequate space for anchor bolt heads.
4. 3/4" (20 mm) Veneer thickness are allowed only in limited exterior applications.
NOTE: ALL METALS CONTACTING STONE SHALL BE STAINLESS STEEL TYPE 302 OR 304 OR ALUMINUM. ALL OTHER METALS SHALL BE CORROSION RESISTANT.
VERTICAL SURFACES – INTERIOR STONE WALL CLADDING

1.0 INTRODUCTION

1.1 Installation Methods. There are several methods by which interior stone wall cladding can be installed. Consideration should be given to the various features of each method in making a selection for a particular installation. See detailed information about installation methods in 5.0 and subsequent sections of this chapter section, and illustrations of examples at the close of this section.

1.2 Stone Thicknesses and Types. This section addresses the installation of vertical interior dimension stones in ¾", 1-1/8", and 1¼" thicknesses for granite, limestone, marble, quartz-based stone, and slate.

1.3 General Precautions. During construction, the General Contractor shall protect all stone from staining and damage.

2.0 DESIGN CRITERIA

2.1 Deflection. All wood frame backup to the stone veneer installation must limit deflection to L/720. All concrete surfaces backup must have a total load deflection of L/360.

2.2 Stone Size and Thickness. Most dimension stones, as defined by ASTM C119, are suitable for interior cladding. Stone panel size and thickness are closely interrelated with the type of stone being installed and its particular engineering qualities. Generally, consideration for greater stone thickness should be made for larger-sized stones (over 12 sq ft) set at higher elevations, and more fragile stones, with the exception of natural stone veneer panels with integrated reinforced backers, which have a limited availability of up to 5' x 10'.

2.3 Installation. Stone wall facing panels may be installed either by the standard set method using nonstaining anchors, dowels, pins, cramps, wire, and mortar spots; nonstaining adhesive in securing thin tile units to interior vertical surfaces; or by one of the several mechanical methods.

2.4 Stone tiles are dimension stone measuring not more than 4 sq ft and are less than 3/4" thick. Thin stone tiles are restricted in use because they cannot be mechanically anchored.

2.5 Physical Property Values. Final design should always be based on specific physical property values of the stone. These values are available from the Stone Supplier.

2.6 Joint Size. Joint width between panels or tiles should be specified. Stone tiles are normally manufactured to be installed with a 3/32" joint, stone to stone. Dimension stones other than stone tiles may be installed with a minimum 1/16" joint. Joints to materials other than stone should be a minimum of 1/8" wide, and should be caulked rather than grouted to allow for the variation in expansion of the dissimilar materials. It is not recommended to butt stone against stone.

2.7 Samples. The Dimension Stone Contractor shall furnish samples of the various dimension stones to be used. Samples shall indicate the extremes of color, veining, and marking the stone supplied to the project will have. Samples must be approved or rejected in their entirety, without stipulation.

2.8 Carving. All carving called for shall be performed by skilled workmen in strict accordance with approved full-size details or models. Architectural drawings will show approximate depth and relief of carving. Carving shall be left as it comes from the tool, unless otherwise specified.
2.9 Limestone And Light-Colored Stones. Wherever limestone, or white and light-colored marble or granite are to be installed, it is important to use only white portland cement, white thin-set mortar, or white-colored adhesive to adhere the stone to the backup, or for setting anchors. It is normal for the setting spots to darken the stone at the face. The dark coloring should disappear as the setting material cures and excess moisture is ventilated from the cavity. (This process has been known to take up to 8 months). Prior to installing any stone the Setter is not experienced with, the setting material should always be applied to a test scrap stone and allowed to cure thoroughly to make sure that the stone will not be permanently stained.

3.0 ANCHORS AND JOINTS

3.1 Anchor Types. The recommended anchor is a twisted copper*, brass, bronze, or stainless steel 8 gage (1/8”) wire, except:

3.1.1 Where natural stone veneer panels (thin stone, factory set to a rigid backup material) are employed.

3.1.2 A mechanical system is employed.

3.1.3 Thin (under ¾”) stone tiles are used.

3.1.4 Height is in excess of 24'. In these higher installations, a strap anchor (or equivalent) system should be employed.

*Use of copper wire for anchors to be installed over 12' off the ground is not recommended.

3.2 Number of Anchors. The quantity of anchors and their locations should be determined by the Project Engineer, addressing the cladding weight, backup material, structural flexure, seismic, or unforeseen conditions affecting the stone installation. Under normal conditions, a minimum of 4 anchors should be used for stones up to 12 sq ft and weighing up to 240 lb. In vertical installations, longer, wider, and heavier stones will require more anchors, depending on the prevailing conditions. Add anchors in groups of 2. Stones over 12 sq ft commonly require 2 additional anchors for each 8 sq ft or portion thereof.

3.3 Shims. Plastic shims used to maintain joint width must be removed prior to pointing or caulking.

3.4 Joints. Control and expansion joints are important considerations. The Specifying Authority must show the locations and details of control and expansion joints on the drawings.

3.5 Lippage. As a general rule, the recommended maximum variation of the finished surface should be no more than 1/8” cumulative over a 10' lineal measurement, with no more than 1/32” variation between individual stones.

3.6 Thermal Expansion of Marble and Limestone. The thermal expansion of geological marble and some limestone varieties is an important consideration where those stones are used with dissimilar materials to form large units that are rigidly fixed. Laboratory tests for the coefficient of thermal expansion of marbles indicate that after several cycles of heating and cooling, a residual expansion of about 0.20% of the original increase can be expected. This should be taken into account when computing clearances. The coefficient of thermal expansion differs from one variety to another, so the actual thermal characteristics of a specific stone should be obtained from the Supplier when the final stone selection is made.

4.0 MORTARS

4.1 Portland Cement Mortar (Thick Bed). Complete installation and material specifications are contained in ANSI A108.1
for installation when bed is still plastic, and for cured float bed and thin-set applications. Portland cement mortar is a mixture of portland cement, sand, and lime, roughly in proportions from 1:5:½ to 1:7:1 for walls. Portland cement mortar is suitable for most surfaces and ordinary types of installation. The thick bed, 3/8” to 1½”, facilitates accurate planes in the finished work. Portland cement mortar can be reinforced with metal lath or mesh, backed with membranes, and applied on metal lath over open studding on walls. These applications are structurally strong, minimally affected by prolonged contact with water, and can be used to plumb and square surfaces installed by others.

4.2 Thin-Set Mortar (Thin Bed). Complete installation and material specifications are contained in ANSI A108.5 and A118.1. Thin-set mortar is suitable for use over a variety of surfaces, has excellent water and impact resistance, and is water cleanable and nonflammable. It is available as a factory-sanded mortar to which only water need be added. Cured dry-set mortar is not affected by prolonged contact with water, but does not form a water barrier. It is not suitable to bring substrates true.

4.3 Latex-Portland Cement Mortar (Thin Bed). Complete installation and material specifications are contained in ANSI A108.5 and A118.4. Latex-portland cement mortar is a mixture of portland cement, sand, and special latex additives. It is similar to dry-set mortar and less rigid than portland cement mortar.

4.4 Limestone Setting Mortar. Cement used with limestone shall be white portland cement, ASTM C150, or white masonry cement, ASTM C91. Nonstaining cement shall contain not more than 0.03% of water-soluble alkali when determined in accordance with procedure 15, calculation 16 of ASTM C91 or Federal Specification SS-C181C. However, if a large amount of normal cement has been used in the backup material, and if an effective water barrier has not been provided between the stone and the backup, the use of nonstaining cement may not prevent all discoloration. Discoloration will disappear as the stone dries. The Indiana Limestone Institute recommends a 1:1:6 or Type N mortar be used with Indiana Limestone. At the present time, there are few masonry cement mortars produced labeled “nonstaining.”

4.4.1 The addition of hydrated lime or like amounts of ground limestone may increase initial shrinkage, but the improved working qualities and water retention will enable the mixture to adjust to the shrinkage and give good bonding strength in both horizontal and vertical joints. Hydrated lime should conform to ASTM C207 Type S.

4.4.2 Mortar mix proportions should be greater than 1:1:4 and not more than 1:1:9 depending on the distance between structural joints. Greater distances should lean more toward 1:1:9 to reduce stress between the stone and setting bed that is caused by thermal expansion of the different materials.

4.5 Mortar Used With Serpentine Marble. Serpentine and some green-colored marbles may warp through absorption of water from the setting bed. Water drawn into the back face of the stone is held to the crystals by surface energy. This force tends to widen the intercrystalline space and expand the wet side of the stone. This leads to the stone warping and twisting while the setting mortar is curing, and can result in severe lippage after the mortar has set. In some cases, this can be successfully addressed by soaking the stone prior to installation, or the installation be fogged (thoroughly wetted with a fine mist of potable water) and covered with plastic sheeting for at least 72 hours after installation. This establishes a saturation equilibrium between the from and back faces of the stone. An alternative is to install the stone to a cured bed with a nonwater-soluble adhesive. In this case, back butter the stone to
achieve as close as possible to 100% contact of the stone to the bed.

### 4.6 Back buttering

Back buttering is the process of applying a portion of the installation material to the back face of the stone. The process requires applying one-half of the setting material (thin-set mortar, epoxy, or non-water-soluble adhesive), or a lesser quantity of very rich mortar (portland cement) to the back face of the stone. Apply the rest of the setting material to the bed. Then apply the mortar to the stone in a left-to-right direction, and to the setting bed in a top-to-bottom direction to ensure 100% contact of the stone to the installation bed.

### 4.7 Sand

Sand should comply with ASTM C144.

### 4.8 Water

Mixing water must be potable quality.

### 5.0 MECHANICAL SYSTEMS

#### 5.1 Performance Criteria

The Specifying Authority must determine the performance criteria of the mechanical system to be employed.

#### 5.2 Engineering

A knowledgeable and experienced Installer must be engaged to engineer and fabricate a system that will satisfy the functional and aesthetic requirements of the project.

#### 5.3 Anchorage systems

Anchorage systems must be securely attached and located as shown on the approved shop drawings and shall be plumb and in true plane.

#### 5.4 Assembly/Installation Systems

A number of proprietary assembly and installation systems are available.

#### 5.5 Panel Installation

Panel Installation. Stone panels must be installed to the mechanical system in the prescribed manner, with vertical lines plumb and horizontal lines level.

### 6.0 STANDARD-SET METHOD FOR PANELS (WITH CAVITY)

#### 6.1 Setting Space

The standard-set mortaring method for ¾" and 1¼" thick panels (with cavity) is the optimum setting space for molded work and standing dimension stone requiring liners of 2½". Stone liners shall be epoxied and doweled. Where no liners are required, 1½" setting space is adequate.

#### 6.2 Setting Method

Dimension stone may be set by spotting with setting wire anchors secured in the masonry wall backup, or attached to the metal or wood studs. Joints shall be fully buttered with white portland cement or a commercially prepared sandless grout, depending on the conditions. Portland cement with an accelerator should be used in all wet areas to set anchors. The use of molding plaster is to be avoided. Nonstaining mastic may be used as a grout in all areas where moisture may be a factor.

#### 6.3 Conditions

In all conditions, the substrate must be installed sufficiently true and level so that the stone panels or tiles may be installed true and level and sufficiently rigid to ensure a satisfactory backup surface to the stone installation. (Industry standard: 1/8" in 10'-0" with no more than 1/32" between individual stones.)

#### 6.4 Masonry Backup

Masonry Backup. May be poured-in-place concrete, hollow concrete block, brick, or other solid masonry surface. Normally, stone installation with this substrate will be set with a cavity.

#### 6.5 Metal Studs

Metal Studs. Must be 16 gauge or thicker. Stone panel joints should be at the centers of studs. Stone anchors should attach directly to the studs. May use plywood, cementitious backer board, or gypsum board as a non-loadbearing sheathing.

#### 6.6 Wood Studs

Wood Studs. Stone panel joints should be at the centers of studs.
anchors should attach directly to the studs. May use plywood, cementitious backer board, or gypsum board as a non-loadbearing sheathing.

6.7 Mechanical Systems. Each mechanical system is different. Follow Manufacturer’s recommendations.

6.8 Wet Areas. Avoid the use of plywood or gypsum board as substrate materials. Provide a moisture barrier. Suitable substrates are masonry backup and cementitious backer board on metal or wood studs. Apply appropriate water proofing membranes to all substrates.

6.9 Relief Angles. Provide relief angles over all doorways, larger openings, and at each 12'-0" maximum of height. In projects where the maximum height of the stone is under 36', the stone’s weight should be relieved at least 2 times.

7.0 STONE PANELS

7.1 General. Stone panels that cover a wall (wall die) or a lower portion of a wall (wainscot) are supplied in several standard as well as custom thicknesses depending on the stone, its location on the wall, and its use in the project. Normally, stone thickness of ¾" is sufficient. In some instances of very large or fragile stones, thickness of 1-1/8" or 1¼" may be necessary. In either case, the supply may or may not include the stone base.

7.2 Base. The base may be in coplanar position with the wainscot or die or be offset so that a portion or all of the top edge of the base stone remains prominent. It may be profiled or otherwise decorated to achieve architectural effect. The base must be separated from the floor with a “soft” joint appropriately sized to accommodate anticipated building movements and prevent damage to either the horizontal or vertical surface.

7.3 Installation. Stone panels may be solid set or standard set (with a space) to the substrate. Normally, standard set is the more economical method, and is most commonly employed. The solid-set method is seldom used, except for installing wainscot or in certain wet or special circumstance area conditions. In the standard-set method, space allowed between the substrate and the back face of the stone may be as little as 1". Wider spaces over 2" should have strap anchors instead of twisted-wire anchors.

7.4 Weight Relief. Stone panels should have their weight relieved when spanning openings over windows or doors, and at approximately 12' intervals in height. A common method of relieving the stone’s weight is the application of a doweled and epoxied liner to the back face of the stone to form a lip (see wall sections). An easy-to-use reference for calculating weight is 1 lb per sq ft of surface area per 1/16" of stone thickness.

7.5 Joints. Stone panels should be installed with a minimum joint of 1/16", with 1/8" preferred when panel sizes are larger. It is not recommended to set panels without a joint, as building movement can cause the stone to spall.

7.6 Serpentines. Serpentines and many green-colored marbles are known to twist and warp during the curing time for the installation bed. These stones should be installed with a nonwater-soluble adhesive or in a relatively dry mortar bed.

8.0 STONE TILE

8.1 Color Differential. Stone tiles are subject to manufacturing processes different than other dimension stones and natural stone veneer panels. There is greater latitude in the acceptability of shaded stones, and Installers should obtain approval of the stone layout prior to installation.
8.2 Installation. Stone tile may be installed in almost any location for which stone panels are considered. The exception is for elevations higher than 8’-0”, which require anchors. Thin stone tiles are not suitable for use with anchors. Stone tile may be installed in a full mortar bed, in a thin-set mortar bed, or with an adhesive.

8.3 Back Buttering. Stone tile must be back buttered for all applications, with 100% contact to the substrate.

8.4 Size. No tile shall be employed that is less than ½ the width of the stone tile, except at the front of cutouts.

8.5 Substrates. Suitable substrates for stone tile are masonry, cementitious backer board, and gypsum board. Do not use gypsum-based products in wet areas.

8.6 Fire Rating. Two (2) layers of gypsum board are required in elevator shaft walls and where a fire rating is required.

8.7 Adhesives. Do not use a thin-set mortar bed and adhesives on installations exceeding 8’ in height. Petroleum-based adhesives should be avoided because they may stain the stone.

8.8 Serpentines. Serpentines and many green-colored marbles are known to twist and warp during the curing time for the installation bed. These stones should be installed with a nonwater-soluble adhesive or in a relatively dry mortar bed. (See 4.0 of this chapter section, Mortars.)

8.9 Joints. Stone tile is normally fabricated to be installed with a minimum joint of 3/32”.

8.10 Lippage. Stone tile should be installed with a maximum variation in plane (lippage) of 1/32”. Tighter joints accentuate lippage.

9.0 LIGHTWEIGHT NATURAL STONE VENEER PANELS

9.1 Definition. This product is a bi-material panel using a thin (±5 mm) stone face adhesively bonded to a lightweight aluminum backer. This system provides a natural stone face with the advantage of low weight and higher flexural strength due to the reinforcement of the aluminum backer. Natural stone veneer panels have a unique mechanical installation system and are suitable for any interior use where stone panels would be considered. Most stone varieties and finishes are available, although each manufacturer has several preferred stones available in their offerings.

10.0 LIGHTING

10.1 Reflection. Light reflection on vertical stone walls is the subject of much discussion. It is almost impossible to uniformly read light reflection on a polished or high-honed-finish wall installation due to the natural characteristics of dimension stone. Due to the heterogeneous composition of natural stones, variable mineral hardness exists within the stone, producing variable reflectivity of light energy. Most stones, and especially travertine marbles and honed-finish surfaces, will appear to reflect light unevenly. Additionally, stones that are true and flat within industry standard tolerances are not necessarily absolutely flat. Lippage, even within industry standard, is accentuated with downwashed illumination. The MIA recommends that areas of concern should be inspected under artificial light conditions, rather than natural light, and that downwashed illumination should be turned off when inspecting areas so lighted.

10.2 Lippage. When lighting is set directly above the finished wall so that the wall is downwashed with illumination, it will highlight lippage.
11.0 FIELD REPAIR

11.1 Minor Repairs. Many stone installations require some small degree of patching or repair of small corners and slight damage to the stone during transport or installation. Provided the repair does not affect the aesthetics of the stone or impact on its structural integrity, the MIA recommends that such repair work be accepted.
SECTION AT FIRE-RATED WALL
Scale: 1\(\frac{1}{2}\)" = 1'-0"

CORNER DETAIL
Scale: 3" = 1'-0"

NOTE: 1\(\frac{1}{2}\)" SETTING SPACE REQUIRED WHEN MARBLE LINERS ARE NOT EMPLOYED.
1. **POWDER ACTUATED ANCHOR**

   - Stone Facing
   - Wire Anchor Fastened by Powder Actuated Anchor
   - Joint
   - Mortar Spot
   - Concrete or Solid Masonry

2. **DOVETAIL ANCHOR IN MASONRY**

   - Stone Facing
   - Line of Dovetail Slot in Wall
   - Joint
   - Dovetail L-Strap
   - Mortar Spot
   - Masonry Back-Up

3. **WIRE LACE ANCHOR**

   (To be used only where edge condition is not available for anchoring)

   - S.S. or Copper Wire Anchor
   - 1-1/4"

4. **WIRE ANCHOR IN MASONRY**

   - Stone Facing
   - Wire Anchor into Edge of Stone Facing Panel
   - Mortar Spot
   - Masonry Back-Up

5. **WIRE ANCHORED MOLDED TRIM**

   - Stone Facing
   - Molded Stone Trim
   - Wire Anchor
   - Masonry Back-Up

6. **WIRE ANCHORED TO METAL STUDS**

   - Stone Liner Epoxyed and Dowelled to Back of Stone Facing Panel
   - Angle Fastened Thru Drywall to Metal Studs: Drywall and Metal Atuds Sized and Spaced Per Local Building Codes
   - Sealant Joint
   - Stone Facing
   - S.S. or Copper Wire Anchor Shown at Vertical Joint
   - Mortar Spot

**NOTE:** 1-1/2 INCH SETTING SPACE REQUIRED WHEN MARBLE LINERS ARE NOT EMPLOYED.
NOTE: DIMENSIONS ARE TO CENTER OF 1/8" JOINTS. TOP, BOTTOM AND SIDE TRIM PIECE WIDTH VARIES.

ELEVATION
1/4"=1'-0' (1:48)

DETAIL 1
HALF FULL SIZE

PLAN 2
3"=1'-0' (1:4)

SECTION 3
3"=1'-0' (1:4)

Interior Stone Wall Cladding
Crypt with Bracket and Rosette Detail
MIA DIMENSION STONE DESIGN MANUAL VII

© 2007 Marble Institute of America
NOTE: DIMENSIONS ARE TO CENTER OF 1/8" JOINTS.
TOP, BOTTOM AND SIDE TRIM PIECE WIDTH VARIES.

ELEVATION
1/4"=1'-0"(1:48)

DETAIL 1
HALF FULL SIZE

3/8" DIA. BOLT W/1" SQ. HEAD
HALF FULL SIZE

PLAN 2
3"=1'-0"(1:4)

SECTION 3
3"=1'-0"(1:4)

Interior Stone Wall Cladding
Crypt with Blot and Rosette Fasteners
MIA DIMENSION STONE DESIGN MANUAL VII

DRWG NO: 15-D-22
NOTE: DIMENSIONS ARE TO EDGE OF STILE OR RAIL. TOP, BOTTOM AND SIDE TRIM PIECE WIDTH VARIES.

ELEVATION

1/4"=1'-0"(1:48)

PLAN 2

3"=1'-0"(1:4)

SECTION 3

3"=1'-0"(1:4)

STONE STILE

WIRE ANCHOR

STONE RAIL

DOWELS

WIRE ANCHOR
INTRODUCTION

1.1 Installation Methods. There are several methods by which interior stone base can be installed. Consideration should be given to the various features of each method in making a selection for a specific installation. See information about installation methods on the following page, and illustrations of examples at the close of this section.

1.2 Delivered ready to install. Generally, stone base is cut to required lengths by the fabricator, based on job-site measurements furnished by the stone contractor, and delivered to the job site ready to install.

1.3 Exposed stone edges must be gauged to the precise thickness specified. Gauging tolerance cannot be over ±1/32".

1.4 White portland cement is recommended for light-colored granite and marble. White portland cement with a low alkali content is recommended for limestone.

1.5 For additional information, refer to Chapter 13, Installation General Information.

1.6 Geographic Methods. Some installation methods and materials are not recognized and may not be suitable in some geographic areas because of local trade practices, building codes, climatic conditions, or construction methods. Therefore, while every effort has been made to produce accurate guidelines, they should be used only with the independent approval of technically qualified persons.

PRODUCT DESCRIPTION

1.1 Basic Use. Lowest or bottom part of structural elements such as columns, piers, and walls.

1.2 Fabrication. Stone base units are fabricated to dimensions specified on shop drawings, prefinished, and delivered to the job site ready to be cut into required lengths for installation.

1.3 Finishes. Exposed surfaces and edges are to be finished with any typical stone finish, usually polished.

1.4 Colors. Most of the commercially available varieties are suitable.

1.5 Sizes. Thicknesses of 3/8", ½", ¾", 7/8", 1¼", or as specified.

TECHNICAL DATA

2.1 Each stone variety used for interior stone base should conform to the applicable ASTM standard specification and the physical requirements contained therein. The specification for each stone type follows:

2.1.1 Granite: ASTM C615 Standard Specification for Granite Dimension Stone

2.1.2 Limestone: ASTM C568 Standard Specification for Limestone Dimension Stone

2.1.3 Marble: ASTM C503 Standard Specification for Marble Dimension Stone

2.1.5 Serpentine: ASTM C1526 Standard Specification for Serpentine Dimension Stone

2.1.6 Slate: ASTM C629 Standard Specification for Slate Dimension Stone

2.1.7 Soapstone: No ASTM Standard exists at this time

2.1.8 Travertine: ASTM C1527 Standard Specification for Travertine Dimension Stone

3.0 INSTALLATION

3.1 Methods. Interior stone base can be installed either by the standard set method or the thin-set method.

3.2 Joints. Joints are pointed with white cement, grout, or nonstaining sealant. Joint width must be specified.

3.3 General Precaution. During construction, the General Contractor shall protect all stone from staining and damage.
NOTE: ALL METALS CONTACT WITH STONE MUST BE CORROSION RESISTANT.
VERTICAL SURFACES-
STONE SOFFITS

1.0 INTRODUCTION

1.1 Installation Methods. There are several methods by which stone soffits can be installed. Consideration should be given to the various features of each method in making a selection for a particular installation. See detailed information about installation methods in 3.0 of this chapter section, and illustrations of examples at the close of this section.

2.0 DESIGN CRITERIA

2.1 Anchoring and Installation. Each soffit stone should be independently anchored and installed. When designing stone soffits, allow ample space above soffit for anchoring to the structure. Anchor quantity, type, and position shall be determined by load calculation and anchor strength, allowing adequate factors of safety in the design.

2.2 Edge anchors should be positioned as close as possible to the bottom (exposed) face of the stone to maximize anchor capacity.

2.3 Caution. Wedge-type anchors in a continuous row or edge anchors at the center line of a long panel can weaken the stone.

2.4 Fascia Courses. Do not clamp soffits to vertical fascia courses.

2.5 Wall/Column Facing. If soffit must cross over the top of a wall or a column facing, a joint should be provided at the intersection, left open, raked clean, and sealed.

2.6 Panel Sizes. Soffit panel sizes should be kept to a minimum to permit an adequate number of anchors and to reduce possibility of breakage.

2.6.1 Large panels are difficult to hang uniformly. Long, narrow panels are subject to breakage.

2.7 Precautions. Only sound stone varieties, including Soundness Classification Group “A” and “B” marbles, should be used.

2.7.1 Soffit thickness should be sufficient to prevent stone failures after installation.

2.7.2 Thin setting thin stone tiles in soffit and ceiling applications is not recommended.

2.8 White portland cement is recommended for light-colored granite and marble. White portland cement with a low alkali content is recommended for limestone.

2.9 For additional information, refer to Chapter 13, Installation General Information.

2.10 Geographic Methods. Some installation methods and materials are not recognized and may not be suitable in some geographic areas because of local trade practices, building codes, climatic conditions, or construction methods. Therefore, while every effort has been made to produce accurate guidelines, they should be used only with the independent approval of technically qualified persons.

DATA SHEET

STONE SOFFITS

1.0 PRODUCT DESCRIPTION

1.1 Basic Use. Horizontal underside of structural elements such as beams, arches, and cornices.

1.2 Fabrication. Soffits are precut and prefinished to dimensions specified on shop
drawings, and delivered to the job site ready to install.

1.3 **Finishes.** Polished, honed, abrasive, thermal, and natural cleft for interior use; honed, abrasive, thermal, natural cleft, rough, and textured for exterior use. Polished marble or limestone is not recommended for exterior use.

1.4 **Colors.** Most of the commercially available varieties are suitable.

1.5 **Sizes.** Thicknesses of ¾", 1¼", 1½", and 2", or as specified.

2.0 **TECHNICAL DATA**

2.1 Each stone variety used for soffits should conform to the applicable ASTM standard specification and the physical requirements contained therein. The specification for each stone type are as follows:

2.1.1 **Granite:** ASTM C615 Standard Specification for Granite Dimension Stone

2.1.2 **Limestone:** ASTM C568 Standard Specification for Limestone Dimension Stone

2.1.3 **Marble:** ASTM C503 Standard Specification for Marble Dimension Stone

2.1.4 **Quartz-based Stone:** ASTM C616 Standard Specification for Quartz-based Dimension Stone

2.1.5 **Slate:** ASTM C629 Standard Specification for Slate Dimension Stone

2.1.6 **Serpentine:** ASTM C1526 Standard Specification for Serpentine Dimension Stone

2.1.7 **Soapstone:** No ASTM Standard exists at this time

2.1.8 **Travertine:** ASTM C1527 Standard Specification for Travertine Dimension Stone

3.0 **INSTALLATION**

3.1 **Preparatory Work.** The General Contractor must furnish concrete beam, noncorrosive metal frame, or other structure to which soffit shall be attached.

3.2 **Method.** Soffits can be installed by the standard set method. Use nonstaining and corrosion resistant wires, dowels, and pins and/or mortar spots.

3.2.1 Each soffit stone should be independently anchored and installed.

3.2.2 Joint widths should be 3/16" to ½". Caulk with nonstaining sealant.

3.3 **General Precaution.** During construction, the General Contractor shall protect all stone from staining or damage.
SECTION THROUGH FLAT STRAP ANCHORS

NOTE: 1. BOLT ANCHORS TO STEEL FRAMING, BEAMS, CLIP ANGLES OR CONCRETE INSERTS. USE EXPANSION BOLTS TO FASTEN TO VERTICAL CONCRETE SURFACES ONLY.
2. SPACER REQUIRED. 16 GA. STAINLESS STEEL OR AS SPECIFIED. NON-STAINLESS SUPPORT STEEL MUST NOT BE IN DIRECT CONTACT WITH STONE.

SECTION THROUGH T-31 BACK ANCHORS

SECTION THROUGH DISC & L-SPLINE ANCHORS

NOTE: EACH STONE SOFFIT PIECE SHOULD BE ANCHORED INDEPENDENTLY FROM OTHER SOFFIT AND VERTICAL PIECES.
VERTICAL SURFACES
STONE FIREPLACE FACINGS

1.0 INTRODUCTION

1.1 Methods. There are several methods by which stone fireplace facings may be installed. Consideration should be given to each method when making a selection for a specific installation. See information about installation methods on the following page, and illustrations of examples at the close of this section.

2.0 DESIGN CRITERIA

2.1 Fireplace headers and legs (uprights) may be thin-set if stone is no thicker than ½". Stone thicker than ½" must be mechanically fastened.

2.2 Exposed stone edges must be gauged to the precise thickness specified. Gauging tolerance cannot be over ±1/32".

2.3 Backup Materials/Temperature. Cracking of fireplace facings is primarily due to expansion and contraction of backup materials. Ensure that stone surface temperatures do not exceed ability to safely and comfortably touch the stone facing when a fire is burning in the fireplace. Setting space between stone and backup should be at least ¾".

2.4 White portland cement is recommended for light-colored granite and marble. White portland cement with a low alkali content is recommended for limestone.

2.5 For additional information, refer to Chapter 13, Installation General Information.

2.6 Geographic Methods. Some installation methods and materials are not recognized and may not be suitable in some geographic areas because of local trade practices, building codes, climatic conditions, or construction methods. Therefore, while every effort has been made to produce accurate guidelines, they should be used only with the independent approval of technically qualified persons.

DATA SHEET
STONE FIREPLACE FACINGS

1.0 PRODUCT DESCRIPTION

1.1 Basic Use. As interior stone fireplace facings for commercial, institutional, and residential use.

1.2 Finishes. Polished, honed, natural cleft.

1.3 Colors. Most of the commercially available varieties are suitable.

1.4 Sizes. Thicknesses of 3/8", ½", ¾", 7/8", 1¼", or as specified.

2.0 TECHNICAL DATA

2.1 Each stone variety used for fireplace facings should conform to the applicable ASTM standard specification and the physical requirements contained therein. The specification for each stone type are as follows:

2.1.1 Granite: ASTM C615 Standard Specification for Granite Dimension Stone

2.1.2 Limestone: ASTM C568 Standard Specification for Limestone Dimension Stone

2.1.3 Marble: ASTM C503 Standard Specification for Marble Dimension Stone

2.1.5 Slate: ASTM C629-99 Standard Specification for Slate Dimension Stone

2.1.6 Serpentine: ASTM C1526 Standard Specification for Serpentine Dimension Stone

2.1.7 Soapstone: No ASTM Standard exists at this time

2.1.8 Travertine: ASTM C1527 Standard Specification for Travertine Dimension Stone

3.0 INSTALLATION

3.1 Standard Set System. Stone facings are set firmly against mortar spots located at anchors.

3.2 Thin Set System. A nonstaining adhesive should be spread over the backup wall with a notched trowel and the stone facing positioned plumb against the adhesive. Used for stone no thicker than ½”.

100% coverage of adhesive materials between stone and backup is recommended.

3.3 General Precaution. During construction, the General Contractor shall protect all stone from staining and damage.
STONE FIREPLACE FACINGS
TYPICAL TILE DETAILS
MIA DIMENSION STONE DESIGN MANUAL VII

1. PLAN DETAIL
Scale: 1/8" = 1'-0"

2. ELEVATION
Scale: 1/8" = 1'-0"

A. SECTION
Scale: 1/8" = 1'-0"

NOTE: 1. USE A NON-STAINING ADHESIVE TO BOND STONE TILES TO BACK-UP SURFACES. 100% COVERAGE OF ADHESIVE IS RECOMMENDED.
2. ARRIS AND POLISH ALL EXPOSED EDGES.