SUPPLEMENTAL INFORMATION
VERTICAL SURFACES / INSTALLATION NOTES

SECTION 1. VERTICAL SURFACES INSTALLATION SYSTEMS.

A) Vertical Stone Surfaces are installed with a variety of conventional and proprietary systems. Abrief discussion of the more common types is below:

1.01 Independently Supported Veneer

1. Each stone panel is independently supported (relieved and restrained) by mechanical anchorage attached to the back up wall substrate (building structure, masonry backup, stud framing assembly, miscellaneous steel and etc.).
2. 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 back up 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 that possesses compressive and tensile capacities adequate to meet the performance requirements for the project. 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.

1.02 "Stacked" Veneer With Relieving Supports

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 a qualified design professional) and gravity relief supports.
2. Each stone panel is restrained by mechanical anchorage attached to the back up wall substrate (building structure, masonry backup, stud framing assembly, miscellaneous steel, and 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 back up wall substrate through the stone anchorage. 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.
3. Consideration of weeps and flashing is recommended when continuous relief angles are utilized.

1.03 Adhered Installation

1. **Thin Stone.** Adhered installation is to be used for thin stone only (1⁄4" to 1⁄2" thickness) of heights not exceeding 15'-0" (4.5 m).
2. 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. **Thin-Set Mortar [Thin Bed (ANSI A118.1)]. See Chapter 13, section 3.1.2.**
4. **Latex-Portland Cement Mortar [Thin Bed (ANSI A118.4)]. See Chapter 13, section 3.1.3.**
5. **Epoxy Mortar (ANSI A118.3). See Chapter 13, section 3.1.4.**
6. **Setting Bed.** White portland cement with low alkali content is required for all light colored stone varieties.
7. Petroleum-based organic adhesives should be avoided because they may stain the stone.
8. Recommended substrate materials are masonry and cementitious backer board.
9. **Exterior Vertical Surfaces.** When adhesive installation methods are used for exterior vertical surfaces, the stone shall be backbutteredtoachieve,ascloseaspractic al, 100% adhesive contact between the stone and the backup. Remove freshly installed tiles periodically during installation to verify adhesion level.
10. When thin stone tiles are installed on exterior vertical surfaces, they are fully reliant upon the backup and substrate for performance. Use of unstable backup materials should be avoided.
11. Substrates to receive adhered veneer using thin-set adhesive methods shall be held to a tolerance of 1/8" variation in 10'- 0".

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

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.
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.
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.
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.

1.05 Consideration should be given to the various features of each system in making a selection for a specific installation. See detailed illustrations of examples at the close of this section.

1.06 Venting of Exterior Stone Veneers

1. **Existing Methods.** The existing methods of installing exterior thin stone veneer have evolved through the years. For the most part, the standards were developed when the joints were filled with portland cement mortar and the building interiors were not temperature- and humidity-controlled.
2. **Additional Techniques.** With today's improved construction techniques, it is possible to produce structures that are highly resistant to natural weather conditions. Joints can be sealed with resilient sealants and the building interior can be temperature and humidity controlled. Venting of the cavity is recommended to prevent moisture problems. It is recommended that a vapor barrier be installed at the exterior face of the backup wall. The back face of the stone should not be sealed.
3. **Veneer Cavities.** Solid grouting of stone veneer cavities that would permit passage of moisture through the wall from exterior to interior, and interior to exterior, is inadvisable. Windblown rain would be forced through the wall, and water vapor would move from exterior to interior and reverse, forced by the temperature and humidity differentials from outside to inside.

1.07 Relieving Supports

1. Relieving angles should be provided over all openings and at each story height (or maximum vertical spacing of 20'). Angles should have 1⁄4" weep holes every 2'. When stone liners are used, they are fastened by stainless steel dowels and epoxy to the back of the finished stone facing and are supported on these angles. Refer to local codes for variance.

SECTION 2. RELATED COMPONENTS

2.01 Mechanical Anchors, Exterior and Interior

1. **Anchor Size.** Anchor sizing is dependent upon materials, codes, and physical conditions of the structure. Anchors should be engineered separately for each.
2. **Anchor Placement.** Under typical conditions, standard practice provides for a minimum of 4 anchors per piece of stone up to 12 sq ft of surface area, and 2 anchors for each additional 8 sq ft. Weight, size, shape, and type of stone may dictate deviations from the foregoing. IBC currently prescribes minimum anchorage quantities for non- engineered "stone veneer" and "slab type veneer" based on the surface area of the stone panels. Due to varying loads, stone properties, and anchor capacities, this may not necessarily be adequate, particularly when public or occupant safety may be compromised. It is recommended that exterior stone cladding systems be reviewed by an experienced stone cladding engineer to verify anchor and panel capacities. In all cases, anchorage shall be compliant with the project specifications, requirements of the engineer of record, and/or applicable codes.
3. **Anchor Types.** Anchors shall be of non-staining, corrosion resistant metals. Stainless steel, aluminum, bronze, and brass wire and straps, and copper wire are preferred for their corrosion resistance. (See illustrations of typical anchors and accessories at the close of this chapter). In exterior cladding systems, stainless steel (series 304) is the most common. Copper is commonly limited to interior applications.
   a. Copper Wire Tie Anchorage is a historically effective method of anchoring stone panels, but is to be used within the following limitations:
      1) Wire anchors are not generally recommended for installations exceeding 15'- 0" vertically.
      2) Stainless steel wire is recommended in lieu of copper wire for exterior or wet area interior applications. "Spot" material used in conjunction with wire anchors in exterior or wet areas shall be of a portland cement based compound. Setting plaster, moulding plaster, or other gypsum based products are not adequate products for this purpose.
      3) When copper wire is used, it is common in some geographical regions to twist the wire to stiffen the wire via metallurgical work hardening. Excessive work hardening of the wire can lead to embitterment of the metal. Care must be taken to ensure that the physical properties of the wire have been improved and not degraded by this process.
4. **Thin Stone.** Natural stone in thicknesses of less than 3⁄4" (20 mm) are not usually capable of receiving mechanical anchors and can only be used with adhesive attachment.
5. **Technical Information.** Every construction condition requires engineering based on specific factors for each project– panel weight, wind and seismic loads, backup material, stone compressive and flexural properties, etc. The most stringent building code always takes precedence. Contact the engineer or manufacturer of each anchoring system for its particular technical information and engineering formulas.

Grout. When using adhesion installation methods, grout joints shall be a minimum of 1⁄4" 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.

2.02 Shims. 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.

1. Where permanent setting pads are required, 90 durometer neoprene or high- impact plastic is recommended.
2. Shims used in joints of "stacked" veneer systems remain in the joint permanently to transfer load from course to course. Shims may be used to temporarily maintain joint width in other joint conditions but are to be removed prior to application of joint filler material.

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2.03 Sealant: 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.

2.04 Metal Studs. Metal studs placed behind stone wall installations to hold the wall should be 16 gauge or heavier.

1. Lateral channels are frequently required to facilitate attachment locations and also to distribute loads over multiple studs.
2. Where studs exceed 8'-0" in height, it may be necessary to relieve the weight at a maximum of 8'-0" intervals.
3. Walls and partitions constructed of metal studs should be designed to maximum deflection of L/720 for conditions utilizing thick-set or thin-set mortar installation methods.

2.05 Joint Size. Typical joint widths are:

1. **Exterior Stone Cladding:** Minimum 1⁄4", preferably 3/8". Joints of 1⁄2" or larger are frequently required for large unit size installation.
2. **Interior Stone Cladding:** Minimum 1/16", preferably 1/8". Joints of 1⁄4" or larger are frequently required for large unit size installation.
3. IN NO CASE SHALL TIGHT or "HAND-BUTTED" JOINTERY BE USED.

2.06 Lippage. On smooth surface stones, lippage should be limited to ±1/16".

1. Allowable lippage is an installation tolerance, and is additive to the inherent warpage of the stone unit.
2. This lippage may not be attainable in flamed, cleft, or otherwise textured finishes. In those installations, joint width should be increased to limit perceived lippage, and in some cases joints as wide as 3⁄4" may be required.
3. This lippage may not be achievable in extremely large format stone pavers, in which case larger than typical joint widths are recommended to minimize perceived lippage.

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

2.08 Physical Property Values. Final design should always be based on specific physical property values obtained by ASTM test methods for the stone and attachment method systems to be used.

