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DISCLAIMER

This document is written and published for the purposes of providing up-to-date guidelines consistent with generally accepted best practices for installing natural stone veneer. This document is not intended as a specific instruction for any specific project. Headwaters Stone Division and Eldorado Natural Stone do not make an express or implied warranty or guarantee of the techniques, procedures, practices, depictions, methods or materials contained in this guideline.

It should be understood that there may be alternative means and methods and materials that might be required or recommended on any specific project due to project specifications, project requirements or project conditions. Although this document has taken the International Building Code as its model, local codes may take precedence. Always check with codes in local jurisdictions or consult with local code officials. In the event local code requirements or code compliance personnel conflict with this guideline, the local code prevails.

It is the responsibility of the design professional, architect or engineer to determine applicability of any detail specific to any project.

REFERENCES

AC38 – ICC-ES Acceptance Criteria for Water Resistive Barriers

AC51 – ICC-ES Acceptance Criteria for Pre-Cast Stone Veneer

AC275 – ICC-ES Acceptance Criteria for Glass Fiber Lath used in Cementitious Exterior Wall Coating or Exterior Cement Plaster (Stucco)

ANSI – American National Standards Institute, www.ansi.org

ANSI A118.4 – American National Standards Institute Specifications for Polymer Modified Dry-Set Cement Adhesive Mortars

ANSI A118.15 – American National Standards Institute Specifications for Enhanced Polymer Modified Dry-Set Cement Adhesive Mortar.

ASTM C482 – Standard Test Method for Bond Strength of Ceramic Tile to Portland Cement Paste

ASTM C503 – Standard Specification for Marble Dimension Stone

ASTM C568 – Standard Specification for Limestone Dimension Stone

ASTM C615 – Standard Specification for Granite Dimension Stone

ASTM C616 – Standard Specification for Quartz-based Dimension Stone

ASTM C847 – Standard Specification for Metal Lath

ASTM C933 – Standard Specification for Welded Wire Lath

ASTM C979/C979M – Standard Specification for Pigments for Integrally Colored Concrete

ASTM C1032 – Standard Specification for Woven Wire Plaster Base

ASTM C1063 – Standard Specification for Installation of Lathing and Furring to Receive Interior and Exterior Portland Cement Based Plaster

ASTM C1325 – Standard Specification for Non-Asbestos Fiber-Mat Reinforced Cementitious Backer Units

ASTM C1384 – Standard Specification for Admixtures for Masonry Mortars

ASTM C1714/C1714M – Standard Specification for Pre-Blended Dry Mortar Mix for Unit Masonry

ASTM D226/D226M – Standard Specification for Asphalt Saturated Organic Felt Used in Roofing and Water Proofing

ASTM E2556/M – Standard Specification for Vapor Permeable flexible sheet water resistive barrier intended for Mechanical Attachment

ASTM International – ASTM International, formerly known as the American Society for Testing and Materials (ASTM), is a globally recognized leader in the development and delivery of international voluntary consensus standards.

REFERENCES continued

CMU – Concrete Masonry Unit, a.k.a. concrete block

Continuous Insulation or **CI** – foam or plastic insulation affixed to the exterior of a building structure such that the foam envelopes or wraps the circumference of the structure without interruption of other building elements thereby providing continuous thermal protection.

ENS – Eldorado Natural Stone

ESR-1215 – Evaluation Service Report issued to Eldorado Stone confirming the product manufactured and sold by Eldorado Stone meets the requirements of the appropriate Building Code.

HWSD – Headwaters Stone Division, comprised of Eldorado Stone, Eldorado Natural Stone, StoneCraft Industries, and Dutch Quality Stone.

International Building Code or **IBC** – Building code that provides minimum requirements for safety, health, and welfare of life and property from hazards of the built environment. The provisions of this code apply to the construction, alteration, addition, replacement, repair, use and occupancy of all buildings except one and two family dwellings, and single family townhomes not more than three stories in height. The IBC is often adopted by local jurisdictions and thus becomes a legally enforceable document.

ICC – International Code Council (see ICC-ES below)

International Code Council–Evaluation Service or **ICC-ES** – An element of the ICC which administers technical evaluations on building products, components, and construction methods for building code compliance and reports in support of the building industry. ICC-ES also develops “Acceptance Criteria” (AC) for a product or construction method which is not addressed in an existing building code.

International Residential Code (IRC) – Building code that provides minimum requirements for safety, health, and welfare of life and property from hazards of the built environment. The provisions of this code apply to the construction, alteration, addition, replacement, repair, use and occupancy of detached one and two family dwellings and single-family townhomes not more than three stories in height. The IRC is often adopted by local jurisdictions and thus becomes a legally enforceable document.

TMS 402/ACI 503/ASCE 5 – Building Code Requirements for Masonry Structures. This standard is published on behalf of the American Concrete Institute (ACI), the Structural Engineering Institute of the American Society of Civil Engineers (SEI/ASCE), and The Masonry Society (TMS).

TMS 602/ACI 530.1/ASCE6 – Specification for Masonry Structures This standard is produced through the joint efforts of the American Concrete Institute (ACI), the Structural Engineering Institute of the American Society of Civil Engineers (SEI/ASCE), and The Masonry Society (TMS).

UU-B-790A – Federal Specification–Building Paper, Vegetable Fiber: (Kraft, Waterproofed, Water Repellent and Fire Resistant)

WRB – Weather Resistive Barrier

BUILDING CODE REQUIREMENTS

Before beginning installation of Eldorado Natural Stone Veneer, check with local authorities for building code requirements for your area and application. If the local jurisdiction has adopted the International Building Code or the International Residential Code, the code is a legally binding document to which the installation must conform.

This guide is a recommendation. In the event of conflict with the local code requirements and this guide, the code is the presiding document. In the event of questions or concerns, contact the Eldorado Natural Stone Customer Service or Technical Sales personnel.

Safety Requirements

Job site safety is outside the consideration of this guideline. The specifics of each project will dictate the safety requirements. It is the responsibility of the project management to assume and assure the safety of the personnel and properties on the job site.

Structural Conditions of Wall

It must be verified that deflection under all live, dead and impact loads of substrates does not exceed industry standards of L/360 for horizontal deflections and L/480 for vertical deflections, where L = span length.

NATURAL STONE INSTALLATION TABLES

Table 1: **Conventional Wood or Steel Stud Construction with Sheathing – 16" o.c.**

WALL SYSTEM	Wood stud or steel stud at no greater than 16" o.c. with sheathing
WATER RESISTIVE BARRIER	Minimum 2 separate layers or 1 layer WRB (60 minute or equiv.) in conjunction with a rainscreen; **For interior installations, WRB is not required.
LATH	2.5 lbs. or 3.4 lbs./sq. yd. self-furred, corrosion resistant lath per ASTM C 847
FASTENING	Corrosion resistant fasteners per ASTM C1063; for wood framing, penetration to stud at least ¾"; for steel stud, 3 threads exposed through steel or ⅜" penetration
SCRATCH COAT	Polymer modified mortar complying with the shear bond requirements of ANSI A118.4, A118.15 or Type N or S complying with ASTM C270; apply nominally ½" thick, encapsulating entire lath
BONDING	Polymer modified mortar complying with the shear bond requirements of ANSI A118.4 or A118.15; do not use Type N or S mortar

NATURAL STONE INSTALLATION TABLES continued

Table 2: **Conventional Wood or Steel Stud Construction with No Sheathing – 16" o.c.**

WALL SYSTEM	Wood stud or steel stud at no greater than 16" o.c. with no sheathing
WATER RESISTIVE BARRIER	Minimum 2 separate layers (10 minute) WRB or 1 layer (60 minute) WRB in conjunction with a rainscreen; **For interior installations, WRB is not required.
LATH	3.4 lbs./sq. yd. self-furred, corrosion resistant lath per ASTM C 847
FASTENING	Corrosion resistant fasteners per ASTM C1063; for wood framing, penetration to stud at least ¾"; for steel stud, 3 threads exposed through steel or ¾" penetration
SCRATCH COAT	Polymer modified mortar complying with the shear bond requirements of ANSI A118.4, A118.15 or Type N or S complying with ASTM C270; apply nominally ½" thick, encapsulating entire lath
BONDING	Polymer modified mortar complying with the shear bond requirements of ANSI A118.4 or A118.15; do not use Type N or S mortar

Table 3: **Conventional Wood or Steel Stud Construction with Cement Board Sheathing – 16" o.c.**

WALL SYSTEM	Wood stud or steel stud sheathed with Permabase, Durock or equivalent cement board
WATER RESISTIVE BARRIER	Liquid applied weather resistive barrier (Laticrete's® <i>MVIS™ Air & Water Barrier</i>); **For interior installations, WRB is not required.
CEMENT BOARD	Cement Board compliant with ASTM C1325
FASTENING	Fasten cement board per manufacturer's installation recommendations
SCRATCH COAT	Scratch coat not required over cement board
BONDING	Polymer modified mortar complying with the shear bond requirements of ANSI A118.4 or A118.15; do not use Type N or S mortar

NATURAL STONE INSTALLATION TABLES continued

Table 4: **Conventional Stud Construction with Continuous Insulation (thickness greater than 1/2")**

WALL SYSTEM	Wood or steel stud no greater than 16" o.c. with sheathing and continuous insulation greater than 1/2" thick
WATER RESISTIVE BARRIER	2 layers WRB or 1 Layer WRB in conjunction with continuous insulation rated as a WRB
LATH	2.5 lbs. or 3.4 lbs./sq. yd. self-furred, corrosion resistant lath per ASTM C 847
FASTENING	Contact Eldorado Natural Stone Customer Service or refer to Headwaters Stone Division Technical Report at www.drjengineering.org/products/headwaters-stone-division-adhered-masonry-veneer
SCRATCH COAT	Polymer modified mortar complying with the shear bond requirements of ANSI A118.4, A118.15 or Type N or S complying with ASTM C270; apply nominally 1/2" thick, encapsulating entire lath
BONDING	Polymer modified mortar complying with the shear bond requirements of ANSI A118.4 or A118.15 over Air & Water Barrier; do not use Type N or S mortar

Table 5: **Poured Concrete, Tilt-Up Wall or CMU (Concrete Block) Construction**

WALL SYSTEM	Concrete or CMU Wall which has been painted or coated/sealed	Fresh, clean concrete or CMU Wall with no paint, release agent or coating/sealer
WATER RESISTIVE BARRIER	One layer WRB for either interior or exterior	Liquid applied air & water barrier by <i>Laticrete®</i> over clean concrete or CMU or 1 layer, min. with lath system
LATH	2.5 lbs. or 3.4 lbs./sq. yd. self-furred, corrosion resistant lath per ASTM C 847	Bond stone directly to <i>Laticrete's® MVIS™ Air & Water Barrier</i> or 2.5 lbs. or 3.4 lbs./sq. yd. lath over single layer WRB
FASTENING	Corrosion resistant fasteners per ASTM C1063; penetration at least 3/4"	No fasteners required
SCRATCH COAT	Polymer modified mortar complying with the shear bond requirements of ANSI A118.4, A118.15 or Type N or S complying with ASTM C270; apply nominally 1/2" thick, encapsulating entire lath	No scratch coat required
BONDING	Polymer modified mortar complying with the shear bond requirements of ANSI A118.4 or A118.15 over Air & Water Barrier; do not use Type N or S mortar	

MATERIAL REQUIREMENTS

This section describes the appropriate materials and accessories needed to achieve current state-of-the-art installation process for Eldorado Natural Stone (ENS). However, not all acceptable building materials are included herein. It is recognized that other products may be acceptable and new products are introduced to the market on a regular basis.

Weather Resistive Barrier (WRB)

WRBs come in four variations: asphalt saturated kraft paper, asphalt-saturated felt, house wraps (typically polyolefin) and liquid-applied products. Where WRB is required (wood and steel framed construction), two layers are mandated. WRB are intended to be installed in a manner that creates a drainage plane between the two layers. It is acceptable to combine WRB materials to form a drainage plane.

For example, house wrap and asphalt saturated felt or paper are often used together. In this case, the house wrap is typically the inside layer against the house and the asphalt layer is over the house wrap.

The fluid-applied WRB is an excellent choice for installation of ENS over concrete or CMU wall structures. Although ENS can be installed directly over concrete or CMU walls, it is most advantageous to pre-coat the walls with a fluid applied WRB that is designed to bond with polymer modified mortar. Some fluid applied WRBs will not accept polymer modified mortars, so be sure the fluid-applied product you are choosing will offer bondability. Note that conventional mortars such as Type N or S will not bond to fluid WRB.

WRB must provide resistance to liquid water penetration while offering permeability to water vapor. Choose as follows:

- No. 15 felt complying with ASTM D226 for Type 1 felt
- Grade D Paper complying with ICC-ES AC38 or UU-B 790a-Type 1, Grade D, Style 2
- House Wrap complying with ICC-ES AC38
- WRB complying with ASTM E2556/M
- Liquid applied complying with ICC-ES AC212

Exceptions

In the case of continuous insulation installations, some manufacturers have certified that their foam insulation, when installed in accordance with the manufacturer's directions, will perform as an effective WRB. In this case, only one additional layer of WRB is required. Keep in mind that the purpose of two layers is to provide a drainage plane or path for water to be captured and removed from the wall cavity by exiting at the base.

The use of paper-backed lath can eliminate the need for two additional layers since the lath already bears a layer of WRB. Be sure the WRB attached to the lath meets one or more of the criteria, listed above.

If the design involves a rainscreen, then only one (1) layer of WRB is required. However, this single layer installed in concert with the rainscreen must be 60 minute paper or equivalent, not the conventional 10 minute paper noted above.

Lath

Lath is the supporting mesh upon which the stone veneer is suspended. Lath carries the entire weight of the veneer and must be selected and installed with care. The following lath selections are recommended:

- 2.5 lbs./sq. yd. (psy), self-furred expanded metal lath complying with ASTM C847
- 3.4 lbs./sq. yd. (psy), self-furred expanded metal lath complying with ASTM C847
- Welded wire lath complying with ASTM C933
- 17 gauge (minimum) woven wire lath complying with ASTM C1032

MATERIAL REQUIREMENTS continued

Note: The purpose of the self-furred lath is to prevent the lath, either self-furred or fastener furred, from laying directly against the WRB-coated sheathing surface since this will prevent or jeopardize complete encapsulation of the lath with scratch coat.

Eldorado Natural Stone also allows alternate lath materials such as fiberglass lath if the product has been granted an evaluation acceptance report from an accredited Evaluation Service. Such a report should show compliance with ICC-ES Acceptance Criteria 275.

To avoid galvanic corrosion of dissimilar metals, all fasteners must be of similar materials of construction with the lath product (with the exception of the fiberglass lath products). For galvanized lath, galvanized fasteners are required. For stainless steel lath, stainless steel fasteners are required.

Lath Fasteners

ASTM C1063 describes the means and method of installing lath over sheathing for exterior installation of stucco (and adhered concrete masonry veneer).

Note: For framed structures, lath is always fastened to wood or steel framing, never to the sheathing.

Nail heads, staple crowns and screw heads shall engage 3 strands of the diamond mesh lath.

Lath Accessories such as Weep Screed, Casing Beads & Flashings

Never use aluminum parts or flashings; select either galvanized steel or plastic.

Casing beads shall be installed in order to separate non-load-bearing elements from load-bearing members and all penetrating elements such that transfer of structural loads does not impact the adhered concrete masonry veneer. In addition, casing beads shall be used to separate dissimilar materials such as masonry surfaces and wood trim surfaces.

Mortar

Mortar is used in as many as three distinct processes for the installation of ENS: scratch coat, bonding of stone to scratch coat and grout. There are two broad classifications of mortar—conventional and polymer modified mortar.

Conventional mortar is comprised of sand, lime and cement. Polymer modified mortar is a proprietary product that is formulated with several polymer agents that act to provide a strong adhesive quality to the mortar while still retaining the cementitious properties of concrete. There are also agents that are added whose function is to retain water or to provide non-sag properties. In general, polymer modified mortars are technological advancements to conventional mortars whose basic make-up has not changed in hundreds of years. Be aware that there are basic polymer modified mortars and there are others that are premium polymer modified mortars. For Bonding Mortars, Eldorado Natural Stone recommends ONLY polymer modified mortars complying with the shear bond requirements of ANSI A118.4 or A118.15.

Natural stone typically has very low water absorption capacity. Conventional mortars, (Type S or N) require bonding surfaces to be absorptive in order for proper bonding, therefore, only polymer modified mortars are acceptable for natural stone installation.

Scratch Coat

Scratch coat is the mortar covering that is manually applied to lath. The scratch coat is intended to completely encapsulate the lath thereby providing a flat, vertical wall for supporting stone veneer. The scratch coat should be approximately 1/2" (13 mm) thick.

MATERIAL REQUIREMENTS continued

Following application of a mortar scratch coat, the surface of the coating is to be raked with a scarifier tool to impart horizontal grooves ($\frac{1}{16}$ "– $\frac{1}{8}$ " deep and $\frac{3}{4}$ "–1" on center) into the surface. The purpose of these grooves is to increase the surface area of the scratch coat to enhance to total bond when the stone is applied.

Note: *If a fluid-applied WRB is to be used on the scratch coat, do not rake or "scratch" the surface.*

Type N or S mortar can be prepared on-site in accordance with ASTM C270 and applied as a scratch coat. The use of a pre-blended Type N or S mortar (ASTM C1714) is preferred. Likewise, polymer modified mortars, specifically blended for the purpose of a scratch coat, can also be used.

Eldorado Natural Stone does not recommend the preparation of Type N or S mortars on site due to the potential for ingredient measuring error.

Bonding Mortar (Setting Bed Mortar)

Polymer modified mortars complying with the shear bond requirements of ANSI A118.4 (basic performance) and ANSI A118.15 (premium performance) are preferred and recommended for many applications. In fact, polymer modified mortar can replace conventional Type S mortar in all application. For bonding to cement board, polymer modified mortar is the only solution.

Polymer modified are sticky, thick mixes which require a lot of shear rather than shovel or tub mixing to prepare. A drill motor with mixing blade is effective.

There are two methods of installing ENS using polymer modified mortar:

1. Using a $\frac{1}{2}$ " \times $\frac{1}{2}$ " trowel, parge the wall with mortar. Work about a 10 square foot area at a time. Using the flat edge of a trowel, work a thin, skim coat of mortar onto the entire back of the stone. Press the stone on the wall in the location desired. To distribute the mortar under the stone evenly, slide the stone about 1–2" left or right, then back into place.
2. Fully back-butter the stone back (complete coverage—don't leave voids) with about $\frac{1}{2}$ " of mortar. Press the stone into place, then slide the stone left or right about 1–2", then back into place.

Note: *Squeeze-out is not experienced with polymer modified mortars due to the nature of the product. It acts more as an adhesive than a mortar. Since this mortar does not flow well, it is important to slide the stone back and forth to evenly distribute the mortar.*

Mortar Used for Grouts (Pointing Mortars)

Mortar mixes can also be used for grout applications. Again, pre-blended mixes are appropriate and the same ASTM standards apply: ASTM C1714(M) for Type S. Since bond strength for grout is not critical, Type N is acceptable, as well.

For site-blending of grout, follow the requirements of ASTM C270 for Type N or S mortars.

It is important to recall that Type N grout (pointing mortar) will be more likely to effloresce due to the increase lime content.

Mortar Additives

Eldorado Natural Stone does not recommend the addition of "bonding agents", "bonding enhancers" or other ingredients purported to increase bond strength. These agents have not been proven to the satisfaction of Headwater Stone Division to increase bond strength of mortar mixes.

MATERIAL REQUIREMENTS continued

Pigments may be added to the mortar, but only in accordance with ASTM C979/979M.

It is strongly recommended not to add any curing agents or accelerators or anti-freeze agents or chemicals designed to perform as anti-freeze agents to the mortar mix.

Rainscreens

Rainscreens provide a gap or space between the veneer system and the wall system. This gap is typically $\frac{3}{8}$ " (10mm) and may be a requirement in certain states or jurisdictions. The rainscreen provides a drainage plane or drainage cavity that insures any water which gets past the veneer system will drop down and out of the wall cavity due to the rainscreen. Rain screens are produced as proprietary sheet material or the gap can be achieved using furring strips, typically placed at 8" o.c.

Some proprietary rainscreens can be purchased as 1-part, 2-part or 3-part products. A 1-part product is just the material used to create the gap—there is no sandwich layer over the front or back of the rain screen. A 2-part product involves the material used to create the space affixed to a WRB back-up. Finally, a 3-part rainscreen involves a WRB back-up layer as well as a mortar screen on the front of the gap material.

Mortar screens are critical when installing lath and scratch coat over the rainscreen. The mortar screen prevents the movement of mortar into the rainscreen space or gap as the scratch coat is applied to the lath.

It is recommended that rainscreen system which incorporate a mortar screen be selected. Avoid rainscreen systems that also incorporate a WRB layer. Install the required WRB layer separately and independent of the rainscreen.

Other rainscreen designs are solid sheeting of plastic which contains tiny perforations for vapor flow but not liquid flow. In this case, the product can be purchased with or without a mortar screen.

In addition to providing enhanced drainage, the rainscreen gap between the veneer and the wall structure provides ventilation. This is important since the concrete veneer system (stone, bonding mortar, scratch coat) can dry more rapidly compared to the scenario which does not include a rainscreen gap (such as 2 layers of weather resistive barrier).

When using a rainscreen, only one layer of weather resistive barrier is required. However, this WRB layer must be 60-minute paper or equivalent.

Rainscreen is an optional water management tool that is recommended by Eldorado Natural Stone.

PREPARING THE SURFACE

Flashings

All metal accessories such as weep screed and flashing shall be installed in such a manner that flanges and clips provided for their attachment are completely embedded in the plaster. Flanges of accessories shall be secured at not more than 7" (178 mm) intervals along supports.

Weep screeds and flashings over windows and doors are installed prior to installing WRB so that the WRB can overlap the flange of the flashing.

Casing beads shall be installed in order to separate non-load-bearing elements from load-bearing members. In addition, casing beads shall be used to separate dissimilar materials such as masonry surfaces and wood trim surfaces.

Refer to ASTM C1063 and the manufacturer's installation requirements for greater detail regarding flashing installation.

PREPARING THE SURFACE continued

WRB

Refer to the manufacturer's installation recommendations. Always install the dual layers of WRB separately such that a continuous plane is formed between the two layers.

The weather resistive barrier sheet material (rolled) is installed with the material oriented horizontally and plumb. Start at the bottom and layer the WRB by overlapping successive layers 2" over the lower layer. Insure the bottom layer is lapped over the flange of the weep screed or other flashings. Overlap vertical seams by at least 6". Use staples or nails (FasCap, WrapCap, or Stinger, for example) to secure WRB to the wall. If the leg of the staple or nail is longer than the width of the sheathing, the staple/nail will penetrate the sheathing and create a potential for water leakage. Locate fasteners over the studs, spacing at least 6" but not more than 12", vertically. Avoid placing staples/nails that are not over the stud. AVOID EXCESSIVE STAPLING—every unnecessary penetration is an opportunity for moisture leakage.

As a best practice, if intermixing house wrap and either asphalt-saturated paper or felt, place the house wrap against the sheathing (house wrap is the inside layer, asphalt saturate paper or felt is outside layer).

Proper integration of the WRB with window, door and other fenestrations is critical. Standard practices or WRB manufacturer's recommendations exist and should be followed. The proper sequence of wrapping, sealing, taping for penetrations and fenestrations is beyond scope of this document.

Liquid WRB is best applied in accordance with manufacturer's instructions. Typically, liquid-applied WRB is rolled, brushed or sprayed on concrete surfaces to prevent moisture absorption. Some products require two coats for proper protection.

Lath

Refer to manufacturer's installation recommendations. Always use self-furred lath or use a lath fastener that provides furring of the lath away from the WRB/sheathing. For framed structures, lath is ONLY fastened to the framing members. Never fasten lath to sheathing. Refer to ASTM C1063 for lath fastening requirements.

Lath should be oriented in the horizontally (perpendicular to the framing members). Lath can be installed from top-down, or bottom-up. However, all joints should overlap at least 1" horizontally and vertically. Although not critical, the cups should be oriented facing up. One can determine cup direction by sliding your hand across the lath. The lath should feel smooth when the hand is rubbed downward across the lath, then rough when rubbed upward. Like good whiskey: "Smooth going down, rough coming up." Although "smooth-down, rough-up" seems counter-intuitive, it is not the cups that are rough but the burr from the forming of the cups that one feels.

Wood Framing

When installing diamond mesh expanded metal flat ribbed galvanized lath over wood framing, corrosion-resistant staples, roofing nails or screws are acceptable. If washers are used, they must also be corrosion resistant and of the same materials of construction as the lath. Aluminum nails or washers are not acceptable.

For vertical framing members, use 6D common nails or 1" roofing nails at a vertical spacing no greater than 7" with a penetration of the fastener into the wood stud no less than 3/4". This penetration distance does not include any thickness of sheathing.

For horizontal framing members, use 1 1/2" roofing nails driven flush to the plaster base.

Wire staples can be used to fasten galvanized diamond mesh expanded metal flat ribbed lath or wire lath to wood frame members as follows: 1" (25 mm) wire staples driven flush with the plaster base. Staples shall have crowns not less than 3/4" (19.05 mm) and shall engage not less than three strands of lath and penetrate the wood framing members not less than 3/4".

PREPARING THE SURFACE continued

Screws used to attach metal plaster base to horizontal and vertical wood framing members shall penetrate not less than $\frac{5}{8}$ " (15.9 mm) into the member when the lath is installed and shall engage not less than three strands of lath.

When installing rib lath with screws, it is important that the screw shall pass through, but not deform, the rib.

Expanded $\frac{3}{8}$ " (9.5 mm) rib lath shall be attached to horizontal and vertical wood framing members with nails or staples to achieve not less than $1\frac{3}{4}$ " (44.5 mm) penetration into horizontal wood framing members and $\frac{3}{4}$ " (19.1 mm) penetration into vertical wood framing members.

Metal Framing

Screws used to fasten galvanized flat-ribbed metal lath to metal framing members shall be spaced no more than 7" vertically.

Screws used to attach metal plaster base to metal framing members shall project not less than $\frac{3}{8}$ " (9.5 mm) through the metal framing member when the lath is installed and shall engage not less than three strands of lath.

When installing rib lath, the screw shall pass through, but not deform, the rib.

Concrete or CMU Substrate

Galvanized flat-ribbed metal Lath shall be attached to concrete or CMU substrates with power or powder actuated fasteners or a combination of power or powder actuated fasteners and hardened concrete stub nails. One power or powder actuated fastener shall be located at each corner and one at the mid-point of the long dimension adjacent to the edge of the metal plaster base sheet. The balance of the lath sheet shall be fastened with power or powder actuated fasteners or hardened concrete stub nails. The fasteners shall be installed in vertical rows not more than 16" (406 mm) on center and spaced vertically along each row not more than 7" (178 mm) on center. All fasteners shall be corrosion resistant and shall be not less than $\frac{3}{4}$ " (19 mm) long, with heads not less than $\frac{3}{8}$ " (9.5 mm) wide.

Scratch Coat

When using a Type N or S scratch coat, a pre-blended mix is preferred. Site mixing of ingredients can be inaccurate or prone to errors. Type N or S mortar can be mixed using a rotary concrete mixer or by hand in a pan. Add sufficient water to obtain a stiff mix such that the mortar remains on the trowel when the trowel is tilted at about 45 degrees from horizontal. Trowel mortar onto lath using enough pressure to embed the lath in the scratch coat. The total scratch coat thickness should be approximately $\frac{1}{2}$ " but lath must be completely covered on both sides.

Once the scratch coat is sufficiently cured to the point of deformation under pressure, use a scarifier to "scratch" or rake the surface of the scratch coat. For improved bond performance the scratch coat surface is raked to the point that horizontal furrows are created that are approximately $\frac{1}{8}$ " deep and 1" apart. There is no perfect "scratch" however, do not expose the lath and do not create an excessively rough surface. The intention is to increase the total surface bond area—contrary to common belief that the grooves are there to provide a mechanical attachment, they are intended to provide added bond area.

Some polymer modified mortar scratch coats are also available on the market. They are likewise mixed and applied with a trowel. The thickness is also targeted to be $\frac{1}{2}$ " or more if needed to cover the entire lath. Unlike the bonding mortar, polymer modified scratch coats have reduced polymer additives and perform similarly to conventional mortars.

Note: *If the overall design involves liquid-applied WRB over the scratch coat, DO NOT "scratch" or rake the scratch coat!*

Since scratch coat is a monolithic coating (like stucco) it will tend to shrink and crack during the curing and drying process. Therefore, it is recommended to allow the scratch coat surface to cure and dry for at least 24 hours before applying ENS. Cracks that appear in the scratch coat are normal and acceptable.

PREPARING THE SURFACE continued

Cement Board

In lieu of lath and scratch coat, the use of cement board complying with the requirements of ASTM C1325 is acceptable for ENS installation. Install the cement board over wood or steel framing in accordance with the cement board manufacturer's installation instructions. These instructions will include taping and mortar-filling the joints.

All cement board joints are required to be taped and filled according the cement board manufacturer's instructions. The manufacturer will provide a specific mesh tape for this step.

Once the cement board is installed, ENS must be bonded using polymer modified mortar. Do not use conventional mortar (Type S) for bonding ENS to cement board. Follow the veneer installation procedure as described in this document.

Concrete

Tilt-up walls, poured-in-place walls and masonry walls must be free of release agents, paint, dirt, grease or other foreign substances that might impede bonding. Sand blasting, water blasting or a combination of both may be needed to obtain a clean, absorbent surface for mortar adhesion.

In general, it is a good sign that water sprayed on a concrete wall readily absorbs into the concrete. If the water beads upon contact, the surface is not clean. Release agents may still be present. It is recommended that a test application of stone be performed before committing to install the entire wall. If the wall surface is suspect, polymer modified mortar will offer the best chance for success.

If the concrete surface cannot be rendered bondable, WRB, lath and scratch coat or cement board are the recommended options. Note that the inclusion of a layer of WRB is a low cost level of insurance that provides a significant advantage to the long-term reliability of the wall system.

Once the wall is ready for bonding, it is recommended that a liquid WRB be applied to the wall upon which the stone can be bonded using a polymer modified mortar. The WRB prevents the absorption of water into the large concrete mass. Once this large mass of wall gets wet, it will take many days to dry out once the wall is soaked.

Stucco Surfaces

Before installing stone over existing stucco, it is important to determine the type of lath that was used during stucco installation. Most commonly, stucco requires a less rigid lath material which is not compliant with stone installation. The lath must be checked before proceeding. If it is determined that insufficient lath was used, then new lath must be installed over the stucco. It is advisable to either apply a layer of WRB or coat the stucco with liquid applied WRB before lath.

Install ENS as described below.

If the building construction is new or if the exterior wall cladding is new and involves separate wall sections or stucco and stone, it might be an advantage to install two layers of WRB and ENS-approved lath on all wall sections (see requirements in previous section) then switch to applying scratch coat and brown coat. The ENS can be bonded directly to the brown coat in the prescribed bonding method, described below.

If the existing stucco coating is painted, sealed or coated with a water resistant coating, do not attempt to directly bond to the stucco. WRB, lath and scratch or cement board must be installed over the existing stucco.

BONDING THE STONE TO THE SUBSTRATE

The installation of stone veneer is part science and part art. One cannot underestimate the value of each to the desired finished product.

Only polymer modified mortar complying with the shear bond requirements of ANSI A118.4 or A118.15 is recommended for bonding ENS. Do not use conventional Type N or S mortars and do not use Type N or S mortars which have added bonding agents or other additives.

In general, it is standard practice to start by installing corners before flats. Start from the bottom and work upward. Once corners are installed, flats are installed, starting in the middle of the wall and working both left and right.

Lay out approximately 25 square feet of flats and 25 linear feet of corners. During the installation process, it is important to have an array of colors, sizes and textures available for selection. Always maintain a layout of stones for selection during the installation process.

Note: Before proceeding, refer to *Special Weather-Related Installation Conditions* in this document (page 19).

Method 1 (Back Buttering)

This method is a traditional veneer installation method in which the back of each stone is fully buttered then pressed into place. Start with applying a skim coat to the back of the stone insuring that sufficient trowel pressure fully impresses the mortar onto the stone back. Then add more mortar to allow full embedment of the stone on the wall, typically, a coating of only $\frac{3}{8}$ " to $\frac{1}{2}$ " is needed. Place the stone in the position to be set, then slide the stone 1–2" away from its location and slid back to affect a good smear and displacement of mortar across the stone and substrate back.

Notes: Polymer modified mortars are much different in preparation, application and performance compared to conventional mortars. READ AND FOLLOW manufacturer's instructions carefully. When installing dry stack veneer in either method presented below, the scratch coat should not be visible following installation. Additional mortar should have covered the scratch coat, even between stone units. If a liquid applied water resistive barrier is applied over scratch coat, the methods below still apply.

- a. Mix mortar according to the manufacturer's instructions. Polymer modified mortars typically require more shear than conventional mortar. On hot or breezy days, slightly more water might be needed to affect a thick but creamy texture which is ready for use.
- b. Using the flat blade of a trowel, press a skim coat onto the back of the stone, filling all low spots with mortar and creating a level back.
- c. Then, add more mortar to the stone back and increase the thickness on the stone back to yield about $\frac{1}{4}$ – $\frac{3}{8}$ " of mortar thickness after installing stone.
- d. Using both hands, place the stone on the wall in the desired final position; then, slide the stone away from this position about 1–2" in an effort to spread the mortar, fill all gaps and displace any air bubbles. Then, slide the stone back to its original and final location. Periodically, check to see that full coverage is achieved by pulling a stone off the wall and observe that the stone back and wall have been covered with mortar. Any voids or uncoated areas would indicate additional mortar is needed on the stone back. Following evaluation, return the test stone to the wall.
- e. The mortar in the pail should NOT be tempered with the addition of water. Merely remix the mortar to "loosen" the mix and add workability. If needed for small volumes of mortar, the very top section of the mortar in the pail can be effectively worked with a trowel to regain the workability texture.

BONDING THE STONE TO THE SUBSTRATE continued

Method 2 (Wall Floating)

This method is most efficient in that the wall is floated with sufficient mortar to affect a solid bond with no need to back butter each individual stone. This method is effective with dry stack (no grout joint) installations.

- a. Mix mortar according to the manufacturer's instructions. Polymer modified mortars typically require more shear than conventional mortar. On hot or breezy days, slightly more water might be needed to affect a thick but creamy texture.
- b. The selection of the notch size of the trowel and the application to the wall will depend on the texture of the stone back. If the stone back is highly textured and very rough, a $\frac{3}{4}$ " loop trowel is recommended for an application of sufficient mortar to fill the back. If the back of the stone is only moderately textured (rough, but no large aggregate), a $\frac{1}{2}$ " \times $\frac{1}{2}$ " notched trowel is best.
- c. Always check to insure full embedment of the stone to the wall.
- d. For profiles that do not involve a grout joint (dry stack), work the trowel vertically so that the mortar troughs are also vertical. Then, place the stone on the wall and slide the stone left-to-right for about 1–2" to smear and spread the mortar evenly across the substrate and stone back.

Note: Laser levels or snapped lines might be needed for horizontally coursed stone designs such as 246Ledge, CutLedge, LedgeStone and ModernCut.

- e. Then, slide the stone to return to its original position. This left-to-right slide will prevent the mortar from squeezing out on the top or bottom of the stone and interfering with neighboring stones.
- f. In order to achieve manpower efficiency, it is recommended that an area of the wall about 10 square feet be floated before installing stone. Or, if one installer is floating and one is laying stone, allow the floater to keep ahead of the installer by about 10 square feet. Only spread as much mortar as can be covered before the mortar skims over.

Notes: In the process of stone sliding, if it is obvious that the stone is grinding on the substrate, there is insufficient mortar between the stone and the wall. A larger notched trowel may be needed to apply a thicker layer of mortar. Alternately, it is also acceptable to skim coat the stone back instead of using a large trowel. The back skim coat application reduces mortar usage; the larger trowel approach applies more mortar but eliminates the added manpower. Periodically, check to see that full coverage is achieved by pulling a stone off the wall and observe that the stone back and wall have been covered with mortar. Any voids or uncoated areas would indicate additional mortar is needed on the stone back. Following evaluation, return the test stone to the wall. In the event insufficient mortar volume is not being applied, it will be important to skim the back of the stone with mortar to achieve full embedment.

Cutting/Trimming

Natural stone veneer can be cut with a wet saw using a diamond masonry blade commonly used for concrete, tile and stone products. The use of a wet saw (instead of a dry saw) is recommended for purposes of reducing airborne dust. A hand-held diamond blade grinder is also recommended for small cuts or stone size reductions.

Note: The use and selection of appropriate tools for installation of Eldorado Natural Stone is the responsibility of the mason or installer. In all cases, refer to the tool manufacture's safety instructions and directions when installing natural stone veneer.

BONDING THE STONE TO THE SUBSTRATE continued

Grouting/Pointing

Point (grout) installation after a minimum of 12–24 hours curing time at 70° F (21° C). Point with polymer modified pointing mortar or Type N or S mortar or grout. A pre-mixed, pre-bagged grout is preferred in lieu of site mixing which can be inaccurate.

Introduce iron oxide pigments in accordance with ASTM C979 (pigment weight must not be more than 10% of total cement weight).

CODE REQUIREMENTS TO CONSIDER

The following items relate to common code requirements that are specifically applicable when installing adhered natural stone veneer.

Clearance-to-Grade

These requirements are designed to allow water drainage from the wall cavity as well as prohibit capillary flow of water into the wall cavity from an exterior source. Finally, the clearance requirements prevent the invasion of pests and termites into the wall cavity.

- On exterior wood or steel stud walls, weep screeds and other base flashings should be held a minimum of 4" (102 mm) above grade or a minimum of 2" (51 mm) above paved surfaces such as driveways, patios, etc. This minimum can be reduced to ½" (13 mm) if the paved surface is a horizontal surface supported by the same foundation as the wall. This measurement is made from grade level to the nose of the weep screed.
- On exterior stud walls where the ENS continues down to a concrete or CMU foundation wall, and where a flashing is incorporated into the stud wall-to-foundation transition, at the bottom maintain minimum 2" (51 mm) clearance from grade, or ½" (13 mm) clearance from a paved surface. This measurement is made from grade level to the nose of the weep screed.
- On exterior stud walls where the ENS continues down a CMU foundation wall, with WRB and lath installed down to the weep screed at bottom, maintain a minimum 4" (102 mm) clearance from grade, or 2" (51 mm) clearance from a paved surface.
- Where ENS is applied over an exterior concrete or CMU wall, maintain 2" (51 mm) clearance from grade or ½" (13 mm) from a paved surface.
- Over an exterior concrete or CMU wall that is not enclosing conditioned space (e.g. landscape walls, pillars, columns, etc.) maintain a minimum 2" (51 mm) clearance from soft scrape or ½" (13 mm) clearance from a paved surface.

Maximum Weight for Adhered Natural Stone Veneer

When the units are saturated with water, the total weight of each unit cannot exceed 15 pounds per square foot of bonding area. HWSD has tested the saturated weight for each stone unit produced. This data is available upon request.

CODE REQUIREMENTS TO CONSIDER continued

Maximum Height for Adhered Natural Stone Veneer

The code specifically states that there is no limit to installed height of ENS as long as the wall is capable of structurally maintaining a maximum horizontal (out-of-plane) deflection of $L/360$ and a maximum vertical deflection of $L/600$.

Adhered Veneer vs. Anchored Veneer

As long as each saturated ENS unit weighs less than 15 pounds per square foot of bonding area, the stone can be adhered (mortar-bonded) to the wall substrate directly. If the saturated weight of the concrete unit (stone) exceeds 15 pounds per square foot, then it must be mechanically anchored or supported. The code provides guidelines regarding the methods to achieve compliance. Stone profiles sold by Eldorado Natural Stone are classified as adhered veneer (less than 15 pounds per square foot, saturated). Certain accessory items, however, require support. ENS provides recommendations for support when required; wainscot units are an example.

Bondability

The ENS must achieve 50 psi of bond strength when tested in accordance with ASTM C482. This is a lab test which is performed routinely by HWSD.

Flashings, Weep Screed & Casing Beads

Managing precipitation is critical to the performance of the ENS and the health of the structure. Wainscots are recommended when ENS is installed on a lower portion of a vertical wall surface. The wainscot diverts sheeting rainwater from the upper wall surface away from the vertical ACMV surface.

In addition to the wainscot, care must be taken to properly integrate the flashings and WRB associated with the two wall façade systems.

All retaining or ornamental walls and columns (non-structural) require walls or column caps which extend horizontally beyond the plane of the ENS such that rain water will be diverted downward away from the faces of the ENS.

Weep screed flashing is a requirement at the vertical termination of ENS wall systems. See Clearance-to-Grade requirements, above. See manufacturer's installation instructions and refer to the details as part of this document.

Casing beads are required between dissimilar surfaces, including transitions between ENS and window and door casings or trim. When installed in accordance to the manufacturer's guidelines, the casing bead provides a flexible (caulked) joint which will account for the relative movement of the dissimilar materials (typically concrete and wood).

Regardless of the veneer system, water diversion flashings are required above windows, door and other fenestrations. Properly integrate these elements with the lath, WRB and window or door openings.

Flashing shall be installed in such a manner so as to prevent moisture from entering the wall or to redirect it to the exterior. Flashing shall be installed at the perimeters of exterior door and window assemblies, penetrations and terminations of exterior wall assemblies, exterior wall intersections with roofs, chimneys, porches, decks, balconies and similar projections, and at built-in gutters/similar locations where moisture could enter the wall. Flashing with projecting flanges shall be installed on both sides and ends of copings, under sills and continuously above projecting trim.

WALL SYSTEM FOR INSTALLATION OF ENS

Wall Systems

When in doubt, the structural soundness of wall systems must be determined and evaluated by design professionals or engineers. Walls or structures upon which ENS can be effectively installed include sheathed or unsheathed wood or steel framed to 16" o.c. poured or tilt-up concrete walls/structures, and CMU walls/structures. Eldorado Natural Stone provides an engineered solution for installing ENS over wall systems encased with Continuous Insulation.

Wood or Steel Stud Walls/Structures

Walls or other vertically framed structures can be clad with ENS with the proper application of a scratch coat surface. The framing is typically clad with plywood, gypsum or other approved sheathing. Two layers of WRB are applied over the sheathing followed by lath which is then encapsulated with scratch coat.

In lieu of the lath and scratch coat, cement board can be installed in accordance with the cement board manufacture; ENS is then bonded to the cement board using polymer modified mortars (only). Conventional Type S mortar does not perform well on cement board surfaces. The cement board does not replace the use of sheathing; an exterior sheathing must be installed behind cement board. WRB is required behind the cement board. Alternately, some manufacturers or polymer modified mortars present a system in which fluid-applied WRB is brushed, rolled or sprayed on the cement board and stone is bonded directly using polymer modified mortar.

Poured or Tilt-Up Wall Systems

Stone can be directly applied to concrete walls and vertical structures. Polymer modified mortar provides the best bonding solution due to the relatively smooth, dense concrete wall surface. However, the optimum solution is to treat the wall with WRB to prevent the wall and ENS from becoming totally soaked with water. When the stone and wall substrate contain absorbed water, the moisture must eventually evaporate through the stone veneer. This is a slow process which results in the stone being wet for long periods. Wet concrete is negatively affected more readily compared to dry concrete. So, for geographic areas that are not warm and dry most of the year, it makes sense to separate the stone from the concrete substrate with one layer or coat of WRB.

Wall Systems with Exterior Continuous Insulation

The ENS installation guidelines presented in this document are appropriate for installation of lath, scratch coat and stone veneer if the continuous insulation is not greater than 1/2". For continuous insulation designs that exceed 1/2", lath fastening systems have been developed for Headwaters Stone Division and are available in a Technical Evaluation Report (TER) prepared by an accredited engineering source. This fastening guideline is available on line at:

www.drjengineering.org/products/headwaters-stone-division-adhered-masonry-veneer

Other Wall Systems

Eldorado Natural Stone can assist by providing technical guidance when installing ENS over non-traditional wall surfaces described in this guideline. Call our Technical Service line for assistance.

WATER MANAGEMENT PRACTICES & CONSIDERATIONS— WHERE NOT TO USE ENS

Chemical exposure and continuous contact with moisture may slowly deteriorate or change natural stone color. It is important that chemicals not be allowed to regularly or routinely contact the stone veneer. Do not use ENS around pools, Jacuzzis or other water features which contain chemically treated water (chlorine, for example) or are near constant exposure to moisture.

When installing ENS over concrete or CMU walls, it is preferred and recommended to institute a water barrier between the stone and wall system. Without a water barrier, the stone and wall may become fully saturated due to precipitation. This prolonged moisture increase can have negative effects on the building's interior environment.

Other water management systems and devices which are either required or recommended include, but are not limited to, gutters, wainscot sills with drip edges, flashings, sealants and topically applied repellents.

ENS is not intended to be used on exterior horizontal surfaces such as wall or column caps. Pooling water, snow and ice collection on the stone will advance deterioration. Eldorado Natural Stone produces a line of accessories such as wall caps that are designed to perform as wall and column caps.

SPECIAL WEATHER-RELATED INSTALLATION CONDITIONS

Cold Weather Conditions

For working environment temperatures between 25–40° F, heat all mixing water and any sand to a minimum of 68° F and a maximum of 158° F.

For working environment temperatures between 20–25° F, heat all water and sand to a minimum of 68° F and a maximum of 158° F. Source heat shall be provided on both sides of the wall under construction. Windbreaks shall be employed when the wind speed exceeds 15 mph.

For working environment temperatures below 25° F, heat all water and sand to a minimum of 68° F and a maximum of 158° F. Enclosures and supplementary heating shall be provided to maintain air temperatures above 32° F. The temperature of the stone units shall be above 45° F.

If the average daily temperature is between 32–40° F, do not allow freshly bonded stone veneer to be wetted from rainfall or snow fall for the first 48 hours following installation.

If the average daily temperature is between 25–31.9° F, cover the wall for a minimum of 48 hours following installation.

If the average daily temperature is between 20–25° F, cover the wall with insulated blankets during the first 48 hours following installation.

If the average daily temperature is below 20° F, the wall shall be covered and supplementary heat shall be applied to maintain a masonry temperature above 32° F for the first 48 hours after installation.

Grout Placement

Grout temperatures shall be a minimum of 68° F and a maximum of 120° F when installed on the wall.

SPECIAL WEATHER-RELATED INSTALLATION CONDITIONS continued

Maximum Mortar Temperatures

Do not prepare mortar such that the temperature of the mortar exceeds 120° F. Flash set may occur if the mortar is too warm/hot.

Note: *The 48 hour time periods listed above can be reduced to 24 hours if a rapid set polymer modified mortar is used.*

Hot Weather Conditions

If the ambient air temperature at any time during veneer installation exceeds 100° F, the maximum allowable area for mortar to be spread on the wall is 10 square feet.

If the ambient temperature at any time during construction exceeds 90° F and the wind speed exceeds 8 mph, the maximum allowable area for mortar to be spread on the wall is 10 square feet.

CARE & CLEANING

Eldorado Natural Stone comes from the earth. Further exposure to natural elements will not harm Eldorado Natural Stone, however it is possible to see slight variations in stone over time. Furthermore, natural stone is not prone to efflorescence staining. However, the grout may be, especially if a Type N mortar mix was selected. If efflorescence is present, it might be possible to remove it with a water hose. Note that the presence of efflorescence can indicate a significant water penetration issue and effort should be made to insure the area immediately behind the efflorescence is not incurring water damage.

During installation of the ENS, if mortar gets on the face of the stone, let it dry slightly then brush it off. Using a wet sponge or rag, wipe any residual dust away.

The best cleaning method for natural stone is a diluted powdered detergent mix with water. Once the stone is firmly bonded (3–4 days) use the detergent solution and a sponge or soft bristle brush to clean any residue. Test an inconspicuous area before attempting to clean an entire stone surface.

Notes:

1. *Never use brass or steel or metal brushes*
2. *Never use acids or alkali to attempt to clean ENS*
3. *Never use harsh or strong cleaning agents such as ammonia or chlorine (bleach)-based products*
4. *Never apply high pressure water spray to ENS installations*
5. *If questions, please call the Eldorado Natural Stone Customer Service line prior to undertaking any cleaning effort beyond the recommendations provided herein*

Maintenance

Sealers, enhancers and impregnators can be used with Eldorado Natural Stone to protect and/or brighten the color of your natural stone veneer. Sealers cannot be vapor impermeable as this may have a negative effect on the ability of the wall cavity to dry or “breathe.” Refer to the manufacturer’s directions to ensure it is safe for use on natural stone. Test an inconspicuous area before attempting to apply the product to the entire stone surface.