THE STATE OF SOUTH CAROLINA

In the Court of Appeals

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SC Court of Appeals

APPEAL FROM OCONEE COUNTY

Court of Common Pleas

The Honorable Alexander S. Macaulay, Circuit Court Judge

Lower Court Case No. 2009-CP-37-00652

Court of Appeals Case No. 2015-000417

Volume VI of VI

Stoneledge at Lake Keowee Owners' Association, Inc., C. Dan Carson, Jeffrey J. Dauler, Joan W. Davenport, Michael Furnari, Donna Furnari, Jessy B. Grasso, Nancy E. Grasso, Robert P. Hayes, Lucy H. Hayes, Ty Hix, Jennifer D. Hix, Paul W. Hund, III, Ruth E. Isaac, Michael D. Plourde, Mary Lou Plourde, Carol C. Pope, Steven B. Taylor, Bette J. Taylor, and Robert White, Individually, and on Behalf of All others similarly situated, Respondents,

v.

IMK Development Co., LLC, Larry D. Lollis, William C. Cox, Integrys Keowee Development, LLC, Marick Home Builders, LLC, Bostic Brothers Construction, Inc., Rick Thoennes, Defendants.

(Of Whom Bostic Brothers Construction, Inc., is the Appellant)

RECORD ON APPEAL

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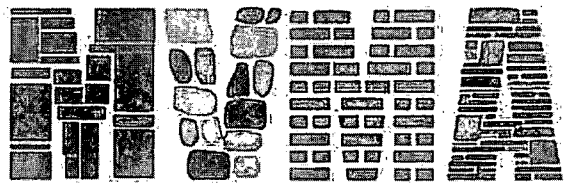
Installation Guidelines for Adhered Concrete Masonry Veneer



Masonry Veneer Manufacturers Association

03/09/09

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Masonry Veneer Manufacturers Association (MVMA) represents the adhered concrete masonry veneer industry's manufacturing companies and their suppliers. The mission of the organization is: To advance the growth of the manufactured masonry veneer products industry through proactive technical, advocacy, and awareness efforts.

This guide is for builders, architects, designers, masons, installers and other construction professionals to illustrate typical applications of Adhered Concrete Masonry Veneer.

It is the sole responsibility of any architectural or construction professional to apply any detail to any specific project.

Disclaimer

This guide addresses acceptable methods and details for installation of Adhered Concrete Masonry Veneer. The purpose is to serve as a guideline, and is not intended for any specific construction project. The MVMA makes no express or implied warranty or guarantee of the techniques, construction methods or materials identified herein.

This guide addresses acceptable methods and details for installation of Adhered Concrete Masonry Veneer. It is understood there are alternative ways that might be required and/or recommended based on project conditions.

Details in this guide that address the Adhered Concrete Masonry Veneer and its interface with the building components are not intended as a specific resource for the construction of the interfacing building components.

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To the best of our knowledge, the information in this Adhered Concrete Masonry Veneer Guide is correct and up to date.

Definitions

Wall System- The constructed exterior or interior framework and substrate of the building.
Water Resistive Barrier- A material used to restrict the transmission of moisture to the surface behind.
Flashing- Material used to restrict the seepage of moisture around any intersection or projection of materials in an assembly.
Lath- Corrosion resistant mesh building material fastened to the substrate to act as base for adhering plaster or mortar.
Fasteners- Corrosion resistant hardware used to secure lath and flashing material to wall system.
Mortar- A workable paste mixture of cementitious material, water, and aggregate used to bond masonry construction materials together, and fill spaces between.
Mortar Scratch Coat - Base coat of mortar used in installation. Cross raked to improve bond with following mortar layers.
Mortar Setting Bed - Mortar used to adhere the ACMV to the substrate or scratch coat.
Adhered Concrete Masonry Veneer (ACMV)- lightweight, architectural, non-load bearing product that is manufactured by wet cast blending cementitious material, aggregate, iron oxide pigments, and admixtures to simulate the appearance of natural stone.

> Note: The MVMA recognizes there are many names used to described Adhered Concrete Masonry Veneer products. Manufactured Stone Veneer is used commonly throughout the industry and among manufacturers. In the International Building Code, Adhered Concrete Masonry Veneer products are referred to as Adhered Masonry Veneer. In the ICC-ES Acceptance Criteria, AC51, the product is called Precast Stone Veneer. This guide will use ACMV (Adhered Concrete Masonry Veneer) when referencing the product.

Mortar Grout - Mortar mixture used to fill joints and cavities in masonry construction.
Sealer- Liquid material used over ACMV to protect against staining and moisture penetration.

Abbreviations

ACMV - Adhered Concrete Masonry Veneer
Blk'g - Blocking
GSM - Galvanized Sheet Metal
Lbs. Pounds
Mfr's - Manufacturer's

Min - Minimum
O.S.H.A. Occupational Safety and Hazard Association
psi. Pounds per square inch
Req'd - Required
SAF - Self Adhering Flashing
WRB - Water Resistive Barrier

References

International Building Code-(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 multi single-family townhomes not more than three stories in height.

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 story dwellings and multi single-family townhomes not more than three stories in height.

International Code Council - Evaluation Service-(ICC-ES) A non-profit organization that performs technical evaluations on building products, components, and construction methods for building code compliance. In cases where no building code covers a product or construction method, ICC-ES develops "Acceptance Criteria" (AC) for the product or construction method.

AC38- The ICC-ES Acceptance Criteria for Water Resistive Barriers.

AC51- The 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)

ACI530- Building code requirements for masonry structures (TMS402\ACI530\ASCE5).

ASTM International- American Society for Testing and Materials. ASTM is one of the largest developers of technical standards of products, systems and services.

ASTM C144- Standard Specification for Aggregate for Masonry Mortar

ASTM C270- Standards Specification for Mortar for Unit Masonry

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

ASTM C847- Standard Specification for Metal Lath

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 D226- Standard Specification for Asphalt Saturated Organic Felt Used in Roofing and Water Proofing

Summary Table

Wall System	Water Resistive Barrier	Lath	Fastening	Scratch Coat
Wall Type: Wood or steel stud, no more than 16" O.C. **Rigid Sheathing:** Gypsum wall board Plywood OSB Concrete Board Fiber Board Note: Non-rigid insulation board over rigid sheathing is limited to max 1/2" thick.	Minimum 2 separate layers #15 felt (ASTM D 226 No. 15, Type 1) Or Minimum 2 separate layers Grade D paper (ICC-ES Acceptance Criteria AC 38) Or 1 layer house wrap (ICC-ES Acceptance Criteria AC 38), and 1 layer Grade D paper (ICC-ES Acceptance Separate Criteria AC 38), or #15 felt ASTM D 226 No. 15, Type 1) Note: One layer of paper backed lath meeting the requirements of Grade D paper may qualify for one layer of WRB.	2.5 lb. or 3.4 lb. self-furring corrosion-resistant lath (ASTM C 847) Or 18 gauge woven wire mesh (ASTM C 1032)	Corrosion resistant fasteners (ASTM C 1063) min. 1" into wood framing member or 3/8" through metal framing member.	Mortar, nominal 3/8" thick, Type N or Type S meeting ASTM C270. "Scratch" surface when "thumbprint hard"

Wall System	Water Resistive Barrier	Lath	Fastening	Scratch Coat
"Open Stud" construction Wood or steel, no more than 16" O.C No sheathing or Insulation Board only (open studs): Note: Non-rigid insulation board over rigid sheathing is limited to max 1/2" thick.	Minimum 2 separate layers #15 felt (ASTM D 226 No. 15, Type 1) Or Minimum 2 separate layers Grade D paper (ICC-ES Acceptance Criteria AC 38) Or 1 layer house wrap (ICC-ES Acceptance Criteria AC 38), and 1 layer Grade D paper (ICC-ES Acceptance Separate Criteria AC 38), or #15 felt ASTM D 226 No. 15, Type 1) Note: One layer of paper backed lath meeting the requirements of Grade D paper may qualify for one layer of WRB.	3.4 lb. self-furring 3/8" ribbed corrosion-resistant lath (ASTM C 847) Alternate lath acceptable. Verify.	Corrosion resistant fasteners (ASTM C 1063) min. 1" into wood framing member or 3/8" through metal framing member.	Mortar, nominal 3/8" thick, Type N or Type S meeting ASTM C270.

Wall System	Water Resistive Barrier	Lath	Fastening	Scratch Coat
Clean Concrete, Masonry / CMU, or Stucco Note: walls / surfaces must be clean and free from release agents, paints, stains, sealers, or other bond-break materials, that may reduce strength of mortar adhesion.	Note: When installing stone on an inhabited area one may need to use a WRB to prevent moisture from penetrating the wall.	Install lath if any question or concern regarding ability of veneer to adhere to wall	If lath applied: Use corrosion resistant fasteners	If a scratch coat is required use a nominal 3/8" thick Type N or Type S mortar, meeting ASTM 270. "Scratch" surface when "thumbprint hard"

Wall System	Water Resistive Barrier	Lath	Fastening	Scratch Coat
Existing Concrete, Masonry / CMU, Stucco, or Brick (structurally sound) (e.g. painted or not clean)	Note: When installing stone on an inhabited area one may need to use a WRB to prevent moisture from penetrating the wall.	2.5 lb. or 3.4 lb. self-furring 3/8" ribbed corrosion-resistant lath (ASTM C 847) Or 18 gauge woven wire mesh (ASTM C 1032)	Corrosion resistant	If a scratch coat is required use a nominal 3/8" thick Type N or Type S mortar, meeting ASTM 270. "Scratch" surface when "thumbprint hard"

Wall System	Water Resistive Barrier	Lath	Fastening	Scratch Coat
Metal Buildings or other surfaces / wall construction not listed above. See manufacturer for recommendations regarding sheathing.	See manufacturer for recommendations.			

Workmanship

This Installation Guideline is prepared with the consideration that appropriate construction personnel have knowledge of the materials described and the proper methods of installation of the materials referenced.

Prior to commencing activity related to the scope of this Guideline, review all adjacent products and other subcontractor's work that precedes the installation of ACMV to ensure that proper workmanship has been exercised and there are no recognizable errors or deficiencies.

Building Code Requirements

Building code requirements vary from area to area. Check with local authorities for building code requirements for your area and application. Carefully read all sections of this guide and follow the manufacturers Installation Instructions before proceeding with your ACMV application. In the event the manufacturers' Installation Instructions conflict with the intent of statements made in this document, contact the manufacturer for additional guidance.

Project Site Requirements

Always follow proper job site safety requirements when installing ACMV . Follow all OSHA requirements when installing ACMV products.

Material Requirements

Flashing

All flashing and flashing accessories must be corrosion resistant materials and integrated with the WRB materials. Flashing must be installed at all through wall penetrations and at terminations of ACMV installations.

Rainscreen Drainage Plane Systems (Optional)

Rainscreen products (such as drainage mats or formed polymer sheeting) or construction techniques (such as strapping or furring) that create a defined capillary break space can be effectively incorporated into ACMV applications to improve the escape of incidental water from the wall. The system should create a minimum gap of 3/16" (5mm) and a maximum gap of 3/4" (19mm).

Weep Screed

Weep screeds must be of corrosion resistant material with a minimum vertical attachment flange of 3 1/2" and a minimum No. 26 corrosion resistant metal.

Lath

The MVMA recommends using the following lath materials:

- 2.5lb/yd^2 metal lath meeting ASTM C 847
- 3/8" rib, 3.4lb/yd^2 metal lath meeting ASTM C 847
- 18 gauge (or heavier) woven wire mesh meeting ASTM C 1032
- Other code approved lath: Alternate lath products not listed above are acceptable for use with ACMV provided the lath product has an ICC-ES Evaluation Service Report (ESR) and is approved for use by the ACMV manufacturer

All lath and lath accessories must be made of corrosion resistant material. All lath material must be self-furred or use self-furring fasteners. Refer to the Summary Table on page 5 and 6 for specific lath and fastener recommendations.

Fasteners

Corrosion resistant fasteners are used to secure flashing and lath. A variety of fasteners are available such as staples, screws, and nails. For specific fastener selective criteria, refer to ASTM 1063 Sec. 7.10.2.

- Wood framing - Corrosion resistant staples, corrosion resistant roofing nails, or corrosion resistant screws and washers, all to be of sufficient length to penetrate a minimum of one inch into framing members with a 6d common nail with a 7/16 inch head.
- Metal framing or panels - Corrosion resistant, self-tapping screws with a 7/16 inch head with sufficient length penetrate 3/8 inch through metal studs or panels, with heads or washers large enough to not pull through lath.
- Masonry walls or panels - Corrosion resistant concrete screws or powder actuated fasteners (or cap fastener), which are shot into the wall surface.

Mortar

Mix 1:

- 1 part portland Cement (ASTM C 150)
- 1 part Lime (ASTM C 207)
- 4.5 parts Sand (ASTM C 144)
- potable water

Mix 2:

- 1 part Type S Masonry Cement (ASTM C 91)
- 2.25 parts Sand (ASTM C 144)
- potable water

Mix 3:

- 1 part Type N Masonry Cement (ASTM C 91)
- 2.25 parts Sand (ASTM C 144)
- potable water

Mix 4

- Premixed mortars must also meet the above requirements. Check with the mortar manufacturer to determine if their product is suitable for installation manufactured stone veneer and it meets the building code requirement of 50 psi shear bond when tested in accordance with ASTM C 482.

Check with the ACMV manufacturer on additional requirements and recommendations if using color pigments, integral bonding agents, or other admixtures in your mortar mix.

Mortars mixed with higher amounts of sand will tend to be less workable. Mortar mixed with higher amounts of cement will provide a greater bond strength but may be prone to increased dry-shrinkage cracking. Type N mortars are generally easier to grout with than Type S. For the scratch coat, installation of ACMV, and grouting, Type N or Type S mortar meeting the above requirements are acceptable.

Surface Preparation

Wall system

Verify structural and surface integrity of existing wall prior to installation. ACMV units must only be applied to structurally sound walls or other structures.

Wall systems not mentioned below (e.g. structural insulated panels and insulated concrete forms) are outside the scope of this document and may require the need of a designed system.

Wall systems shown on these details are wood frame with rigid sheathing unless otherwise noted. Other wall systems that can be successfully used with ACMV include all standard wood and metal framing, rigid sheathing, and cementitious stucco scratch or brown coat that has not been slicked or burned.

Other wall systems are acceptable with qualifications.

- **Masonry walls, poured-in-place concrete walls, and concrete tilt up panels** must be free of dirt, waterproofing, paint, form oil, or any other substance that could inhibit the mortar bond. These surfaces must have a rough texture to ensure a mortar bond. Acid washing, sand/bead blasting, pressure washing, or a combination of these methods may be necessary to achieve the required bondable surface. If a bondable surface cannot be achieved, attach lath and scratch coat before installing ACMV.
- **Existing masonry surfaces** must be evaluated for mortar and face integrity and must be free of dirt, waterproofing, paint, or any other substance that could inhibit the mortar bond. Surfaces may be cleaned by pressure washing, acid washing, sand/bead blasting, or a combination of these methods to achieve a bondable surface. If the surface cannot be cleaned, attach metal lath before applying the mortar scratch coat.
- **Open studs, non-rigid sheathing and metal siding** must be prepared with 3.4 lb paper backed lath with a minimum ½" thick scratch coat and allowed to cure for a minimum of 48 hours prior to AMV installation.

The following substrates are considered unacceptable and may require designed systems: existing siding in unsound condition; EIFS; deteriorating or unsound masonry surfaces.

Water Resistive Barrier

Where a WRB is required, the MVMA recommends installing two separate layers in shingle fashion, starting from the bottom of the wall. The upper layers of the WRB should lap on top of the lower layers by a minimum of two inches. The vertical joints of the WRB must be lapped a minimum of six inches. The WRB should be installed in accordance with the manufacturer's recommendations and be integrated with all flashing accessories, adjacent WRBs, doors, windows, wall penetrations, and wall transitions.

Lath

Lath should be applied horizontally with the cups up, and should overlap a minimum of one inch on the horizontal and vertical seams. The ends of adjoining lath places should be staggered.

Lath should be wrapped around inside and outside corners with attachment every six inches at the next stud allowing a 16 inch overlap. Lath should be fastened every six inches vertically on each stud or similar spacing on concrete wall surfaces. Lap metal lath around all inside and outside corners. Do not end lath at corner framing. Effort should be made so that lath fasteners do not penetrate through the exterior sheathing between the studs.

Flashings/Weep Screeds/Casing Bead/Movement Joints

All flashing and metal detail pieces should be manufactured of corrosion resistant material.

Verify that all flashing including roofing kickout flashing has been properly installed. Although roof flashings are not part of the wall cladding system, they are necessary for proper moisture management. Flashing material should extend above horizontal terminations, roofing material, and drainage planes or vent mat products. Weep Screeds and other base flashings should be held a minimum of 4" above grade and a minimum of 2" above hard surfaces such as driveways, patios, etc. All flashing material should be integrated with water resistive barrier to prevent moisture penetration into structure.

- **Movement Joints** -Do not install ACMV over these joints.

Installation of Adhered Concrete Masonry Veneer

Prior to commencing installation of ACMV, ensure that the WRB and flashing are properly installed and integrated with each other. Refer to the flashing details, referenced in the Guideline, for detailing around windows, doors, through-wall penetrations, and ACMV terminations.

Before installing ACMV, lay out a minimum of 25 square feet at the jobsite so that you have a variety of sizes, shapes, and colors to choose from. Mixing ACMV sizes, shapes, textures and color will allow for variety and contrast in your design to achieve the desirable finished project.

Mortar Scratch Coat

After the lath is installed, apply a nominal 1/2" thick layer of mortar over the lath, ensuring the lath is completely covered with mortar to allow for scoring of the surface. The mortar should be applied with sufficient pressure and thickness to fully embed the lath in mortar. Once the mortar is thumb-print hard, scratch (score) the surface horizontally to create the mortar scratch coat.

Moist curing the mortar scratch coat will ensure there is minimal cracking and proper hydration. Before applying ACMV, the mortar scratch coat should be dampened so that the surface appears wet but without free standing water.

Grouted Adhered Concrete Masonry Veneer Application

Tip: Installing ACMV from the top down will minimize cleanup requirements.

Prior to the application of mortar to the backs of the ACMV or the scratch coat, the back of the ACMV and the scratch coat should be moistened so that the surfaces appear damp but without free standing water.

The back of each ACMV should be entirely buttered with mortar to a nominal thickness of 1/2". It is important to cover the entire back of the ACMV, not just the perimeter.

Buttered ACMV should be firmly worked onto the scratch coat and slid slightly back and forth or with a slight rotating motion to set the ACMV. With the proper mortar mix, moisture content, and scratch coat preparation, the installer will feel the mortar start to grab within a few seconds of the setting movement process. At this point, no further movement of that ACMV should be made as bonding will be broken. If the ACMV is inadvertently moved after initial set has begun, it should be removed, mortar scraped off the back of the ACMV and scratch coat, and then reinstalled following the application process.

Grouting the joints should be completed only after there is sufficient cure time of the installation of ACMV units, when mild contact will not break the bonding. Grouting may be done with a grout bag, filling joints to the desired depth, ensuring that mortar is forced into all voids. Grout should be "thumbprint" hard" before any raking is done. This curing time before the grout is ready will vary significantly with temperature and humidity. Use a wooden raking stick, or pointed tool to rake the joints to the desired depth. Extra precaution should be taken while raking so the surface of the ACMV is not damaged.Clean off remaining grout debris on the ACMV surface with a dry, soft-bristled brush.

To prevent mortar smearing, DO NOT use a wet brush to treat uncured mortar joints.

Tight Fitted Adhered Concrete Masonry Veneer Application

The back of the ACMV and the scratch coat should be moistened with the surfaces appearing damp but without free standing water.

The back of each ACMV should be entirely buttered with mortar to a nominal thickness of 1/2". It is important to cover the entire back of the ACMV, not just the perimeter. Buttered ACMV should be firmly worked onto the scratch coat and slid slightly back and forth to set the ACMV. With the proper mortar mix, moisture content and scratch coat preparation, the installer will feel the mortar start to grab within a few seconds of the setting movement process. At this point, no further movement of that ACMV should be made as bonding will be broken. If the ACMV is inadvertently moved after initial set has begun, it should be removed, mortar scraped off the back of the ACMV and scratch coat, and then reinstalled following the application process.

Tight fitted ACMV should be applied from the corners toward the middle of a wall, and from the bottom toward the top of the wall.

Cold Weather Application

Applications should be protected from temperatures below 40 degrees F (4 degrees C). The use of anti-freeze admixtures to lower the freezing point of the mortar is not recommended. Accelerating admixtures shall comply with C 1384; accelerating admixtures containing calcium chloride are not recommended. ACMV pieces containing visible frozen moisture shall not be installed.

The installation area should be sheltered and heated to keep the temperature above 40 degrees F (4 degrees C).

Hot Weather Application

If the environmental conditions during installation exceed 90 degrees F (32 degrees C) additional water may be needed on the scratch coated surface and the backs of the ACMV being applied. Providing shade and/or frequent misting of the wall may be required. Consult with mortar manufacturer to determine if mortar mix hot weather mix options are available. Local building code hot weather methods should be followed.

Cleaning the Adhered Concrete Masonry Veneer

Refer to ACMV manufacturer recommendations on cleaning and maintenance. Do not use harsh chemicals for cleaning, such as muriatic acid, or abusive tools, such as wire brushes to clean the surface.

Sealing Adhered Concrete Masonry Veneer

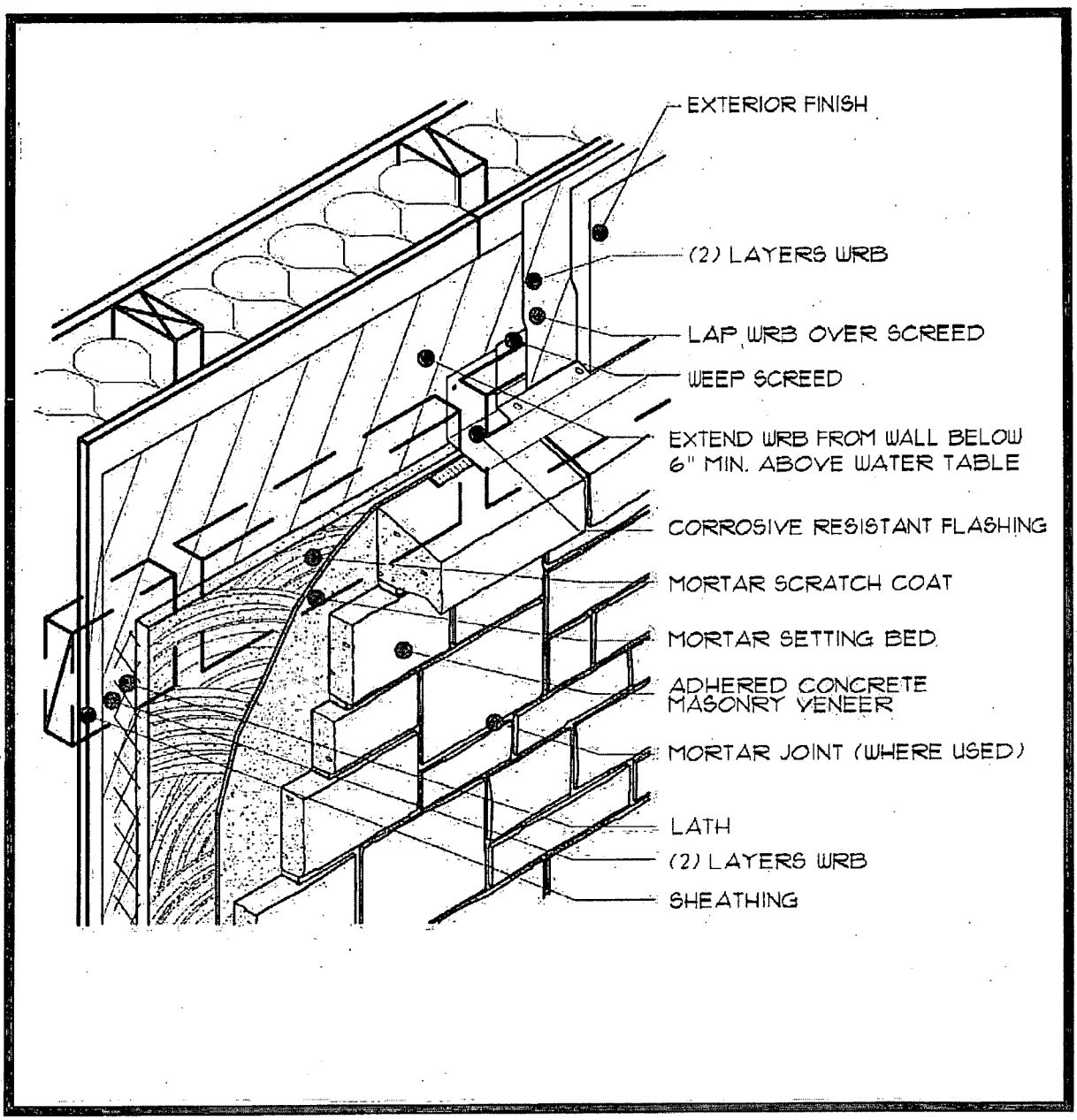
Refer to the ACMV manufacturer for recommendations regarding the use of sealants or topically applied water or graffiti-resistant coatings.

Caution

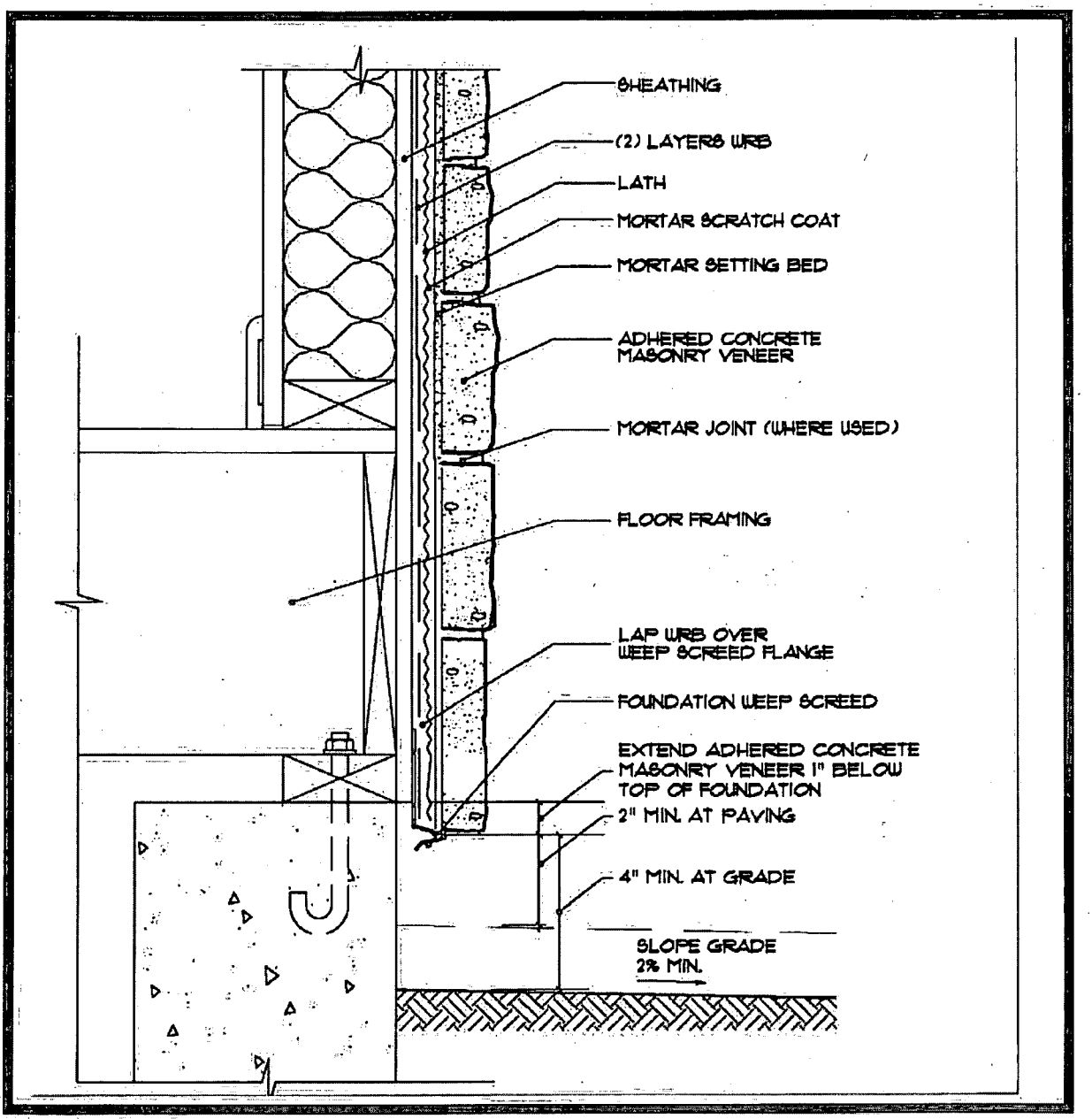
The following precautions should be taken to ensure a successful and durable ACMV installation.

- Do not subject ACMV to direct water contact. For example, avoid allowing sprinklers to directly spray onto the surface. Also, downspouts or drainage pipes should be placed so that water is not constantly saturating the ACMV units.
- Do not subject ACMV to contact with de-icing materials, salt, or other harsh chemicals. Prolonged exposure to these conditions may discolor the ACMV or result in surface damage.

Wall Assembly

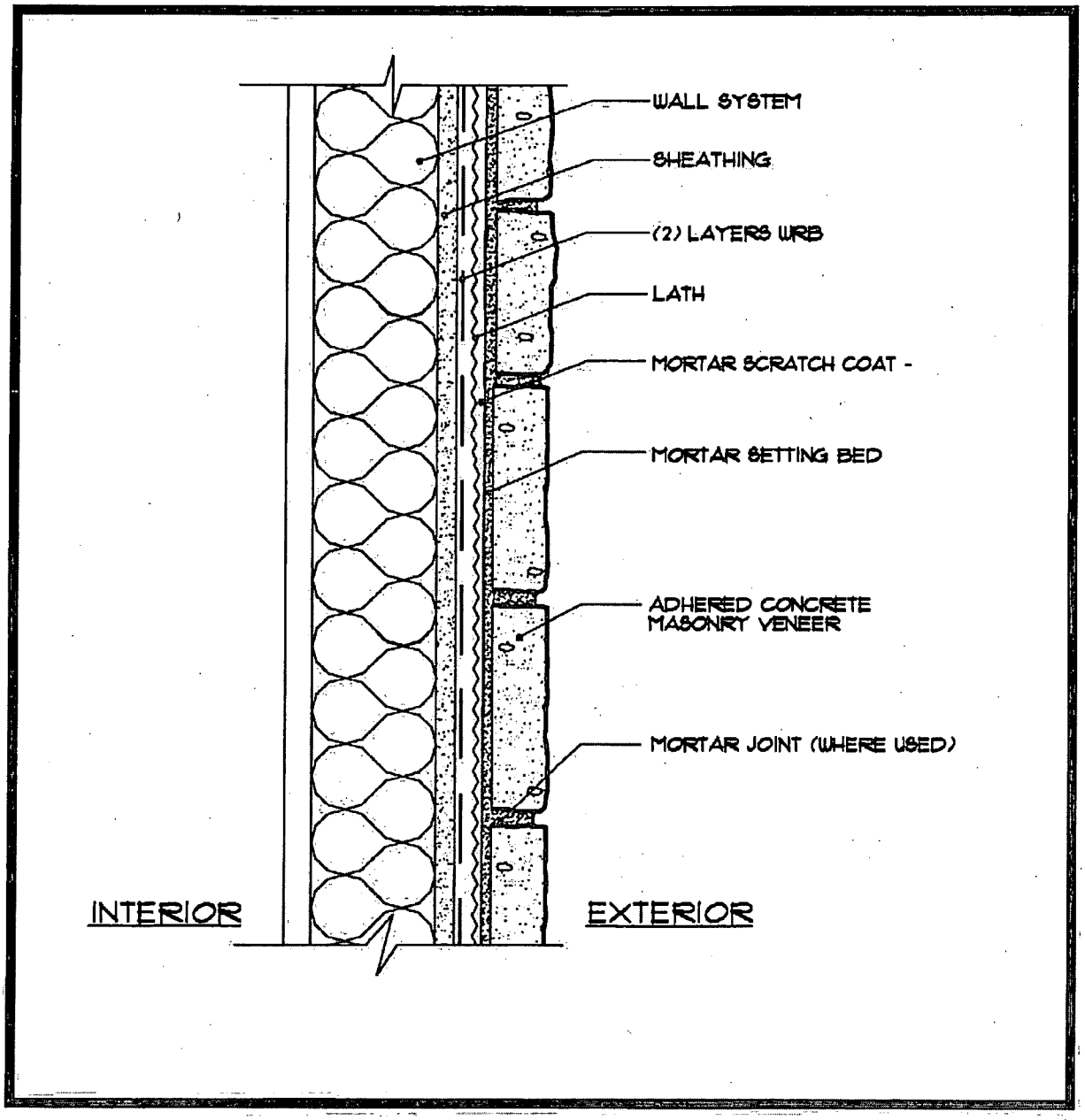


Foundation Wall Base



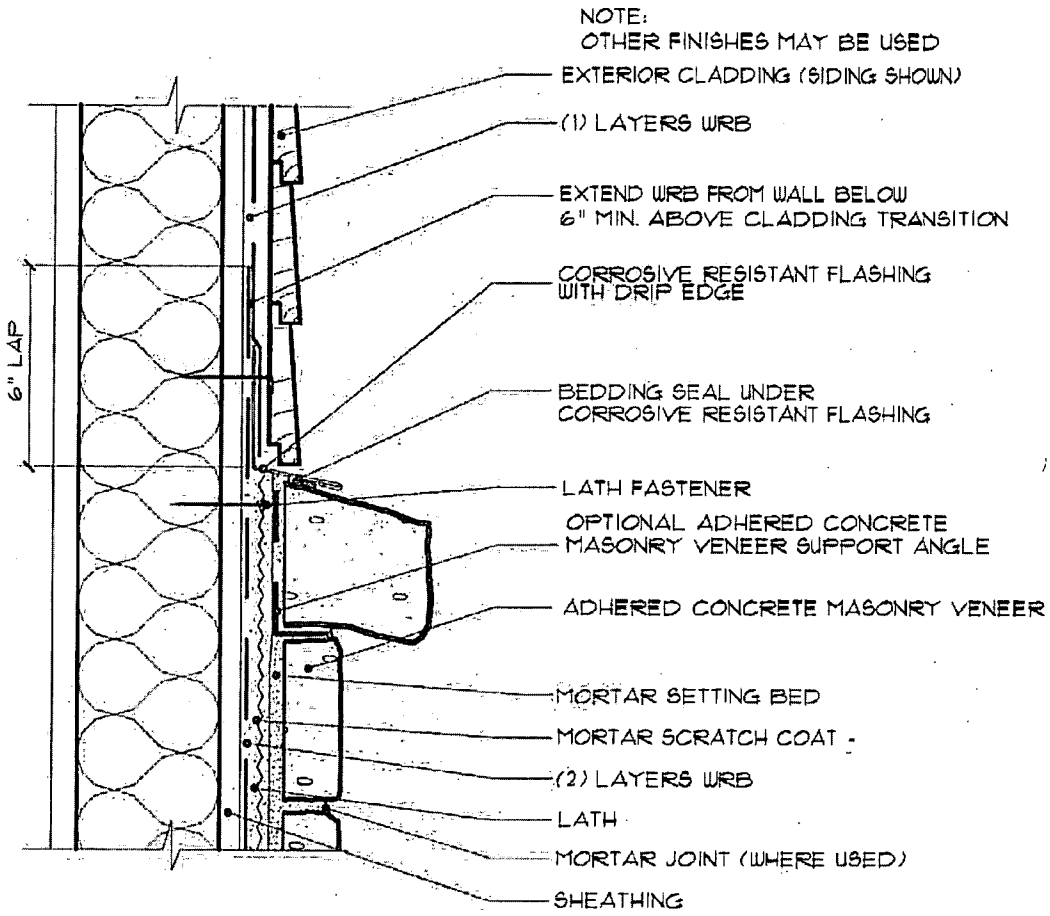
A minimum of a four inch gap is required at the base of the wall for proper drainage and to avoid water intrusion into the assembly.

Typical Wall Section



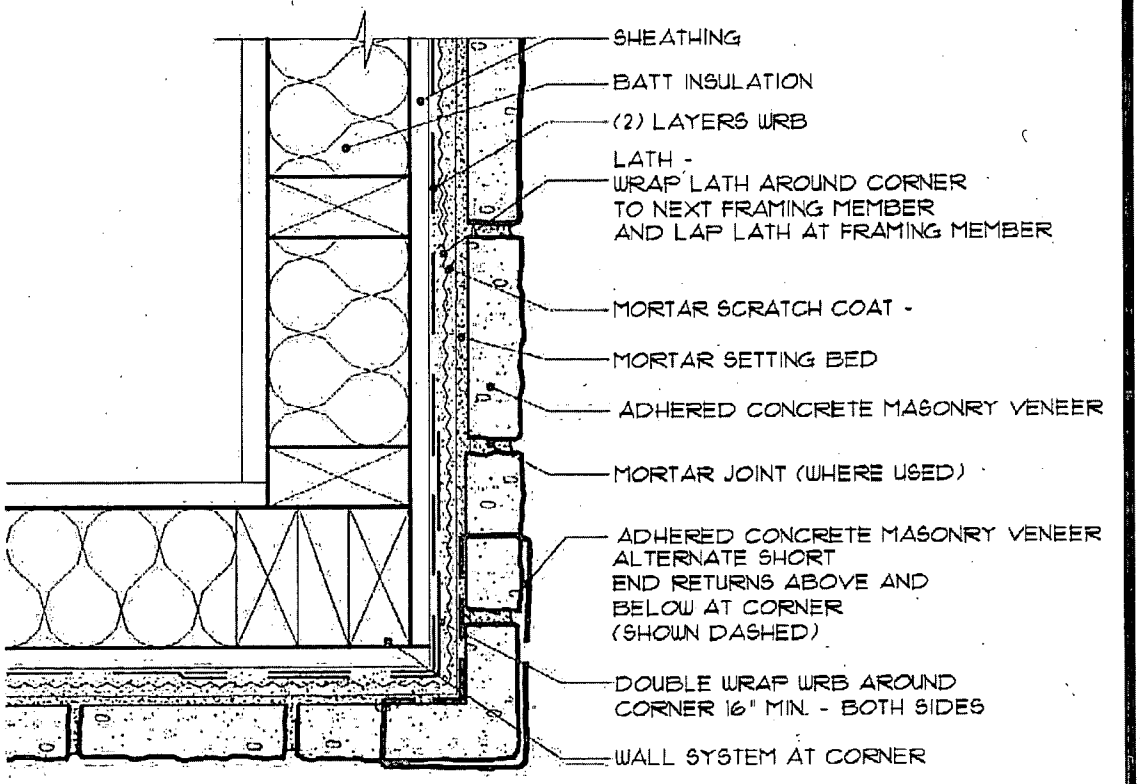
Note layering of sheathing, water resistive barrier, lath, scratch coat, and adhered concrete masonry veneer.

Cladding Transition



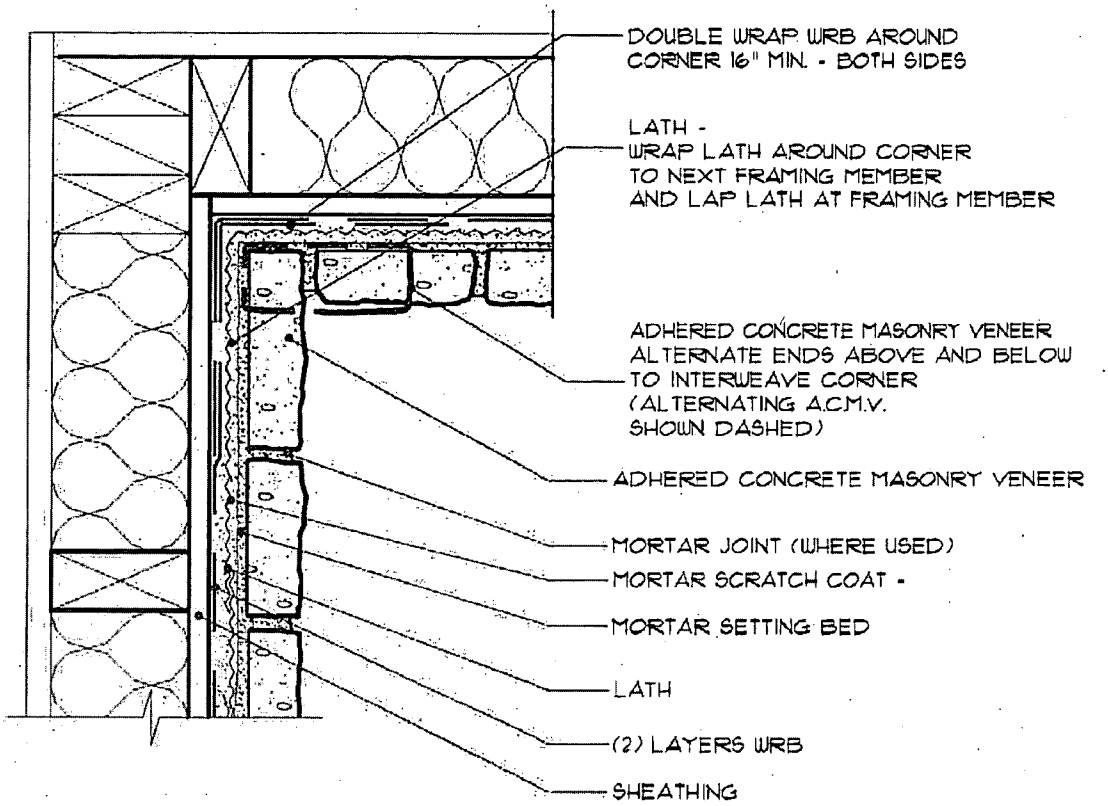
The flashing should be installed prior to the adhered concrete masonry veneer. Water resistive barrier laps over the back leg of flashing for positive drainage. Optional support anchor shown. Verify installation requirements with adhered concrete masonry veneer manufacturer.

Outside Corner



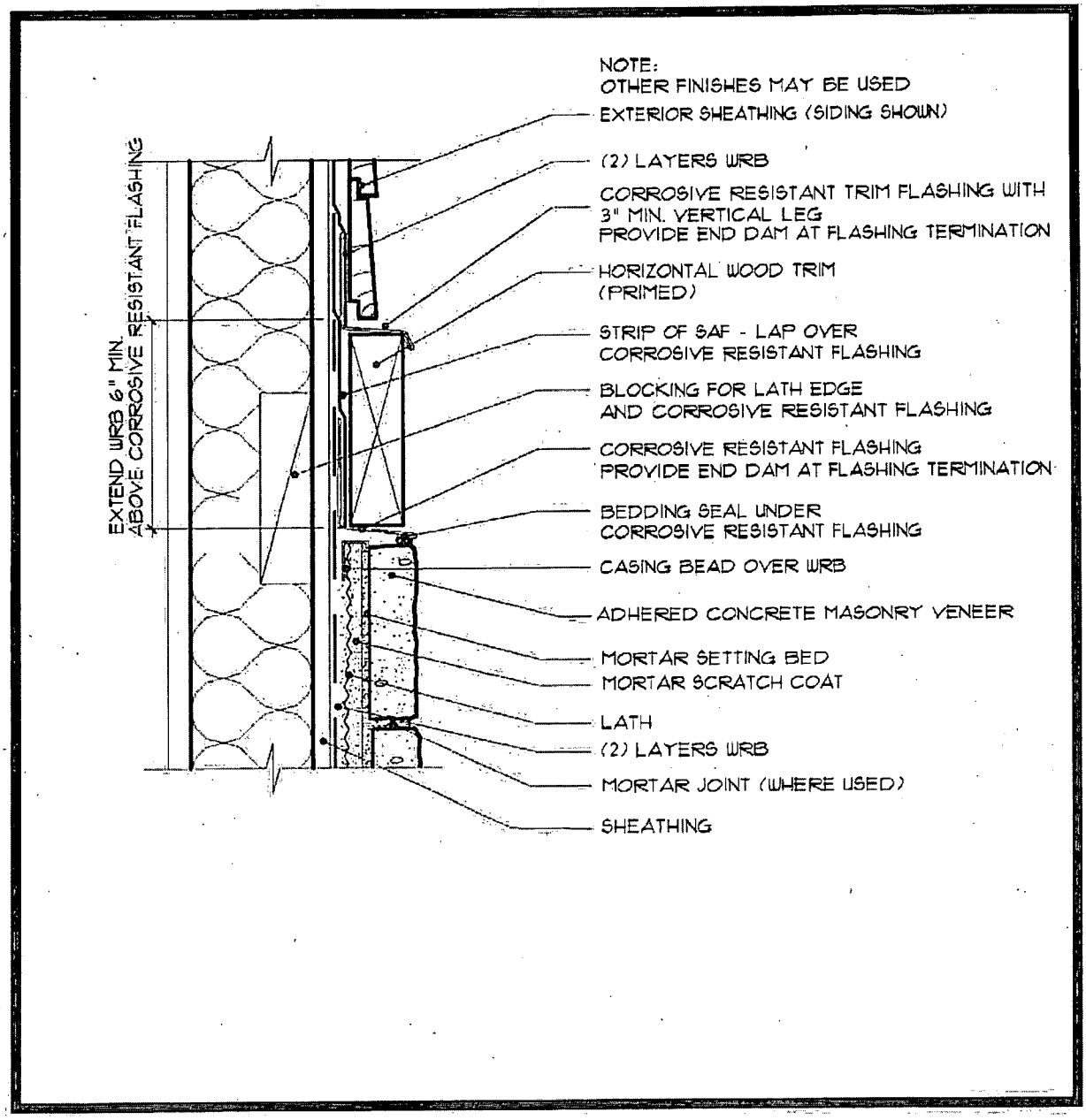
Randomly alternate short end returns above and below at the corner. Lap lath around the corner to the next framing member.

Inside Corner



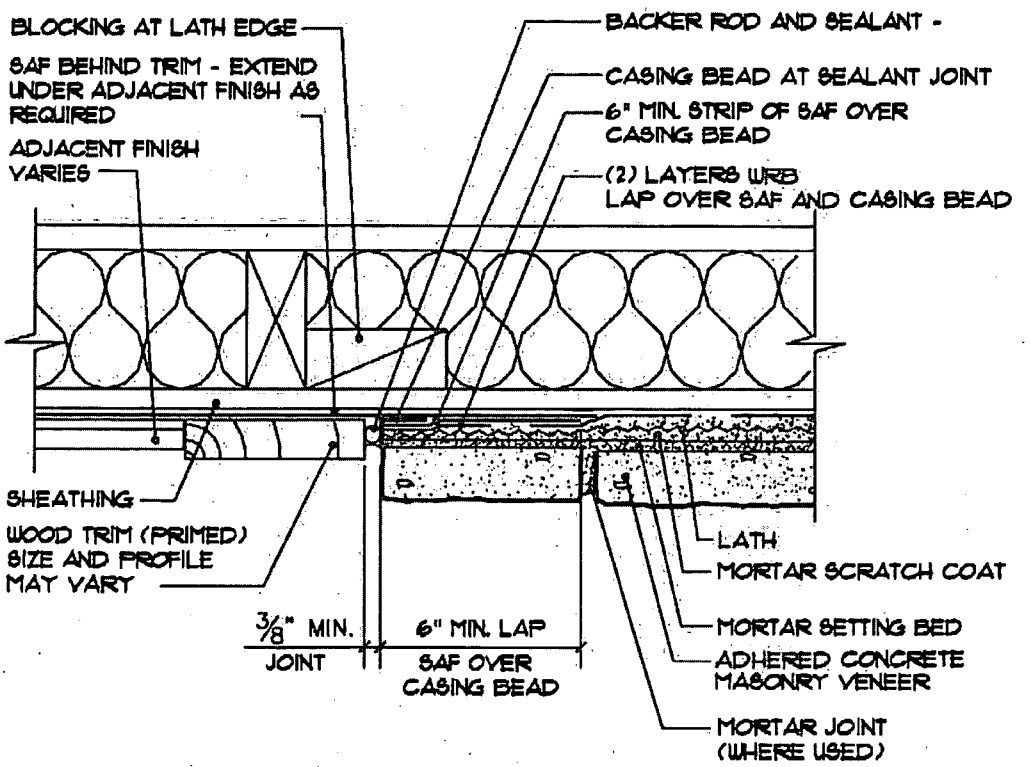
Randomly alternate ends above and below to interweave the corner. Double wrap water resistive barrier around both sides of the corner. Lap lath to the framing at least 16 inches to the next framing member.

Horizontal Transition



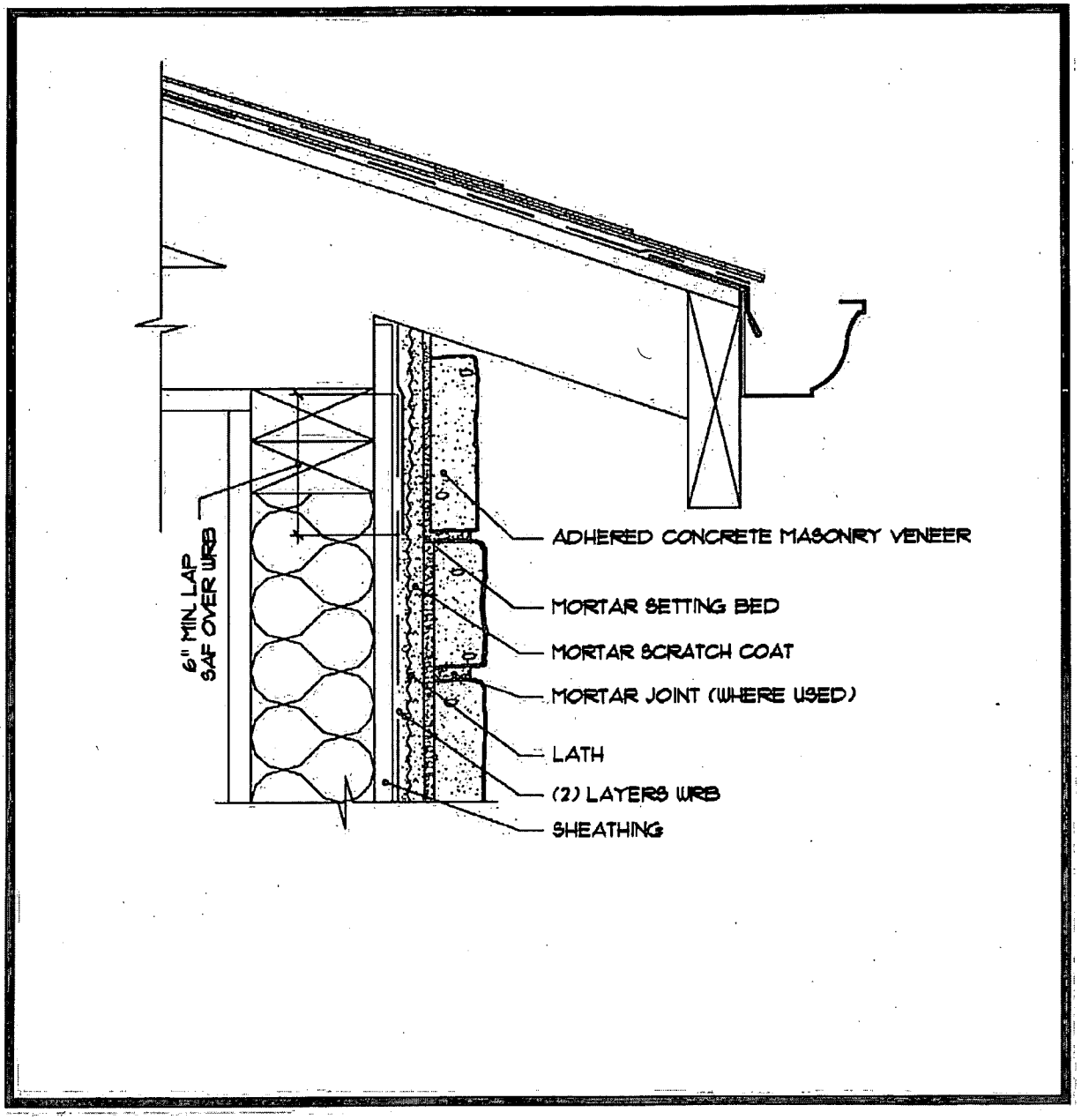
Note that self adhering flashing is lapped shingle-fashion with corrosive resistant sheet metal. A bedding seal is used under the corrosive resistant sheet metal next to the adhered concrete masonry veneer.

Vertical Transition



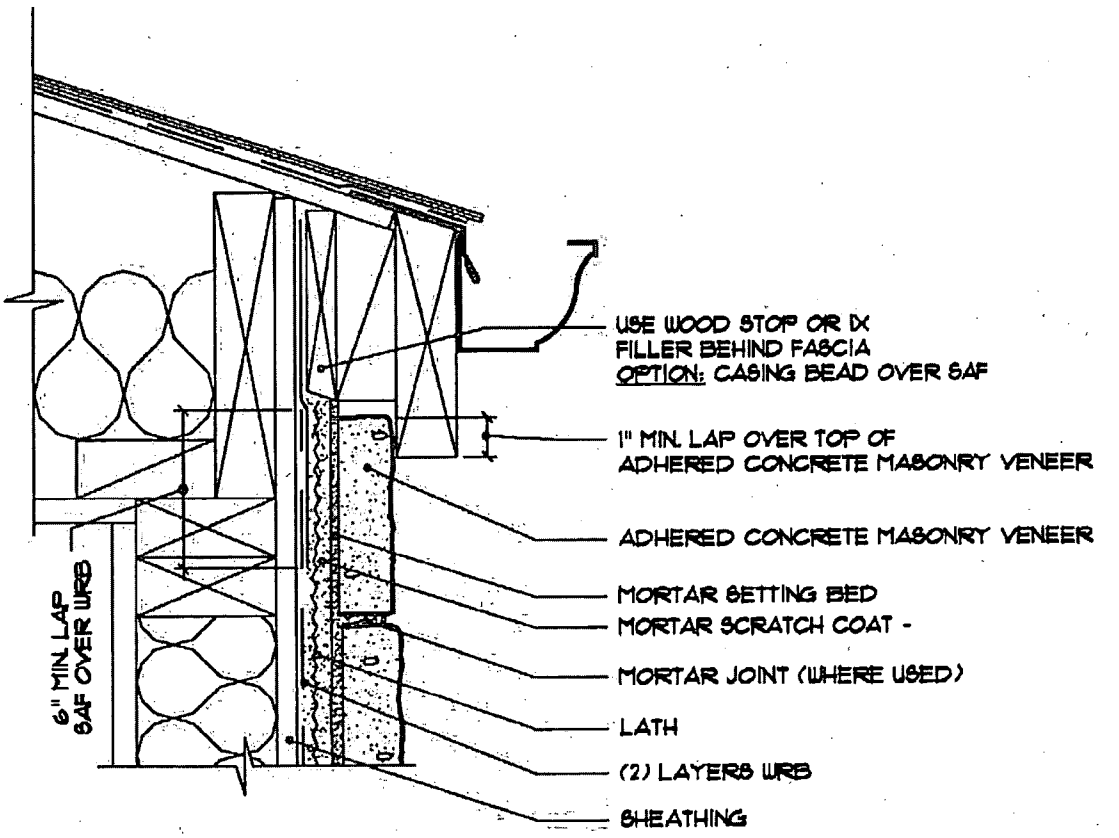
Self adhering flashing extends under the adjacent finishes. A 3/8" minimum gap should be used between finishes.

Open Eave - Overhang



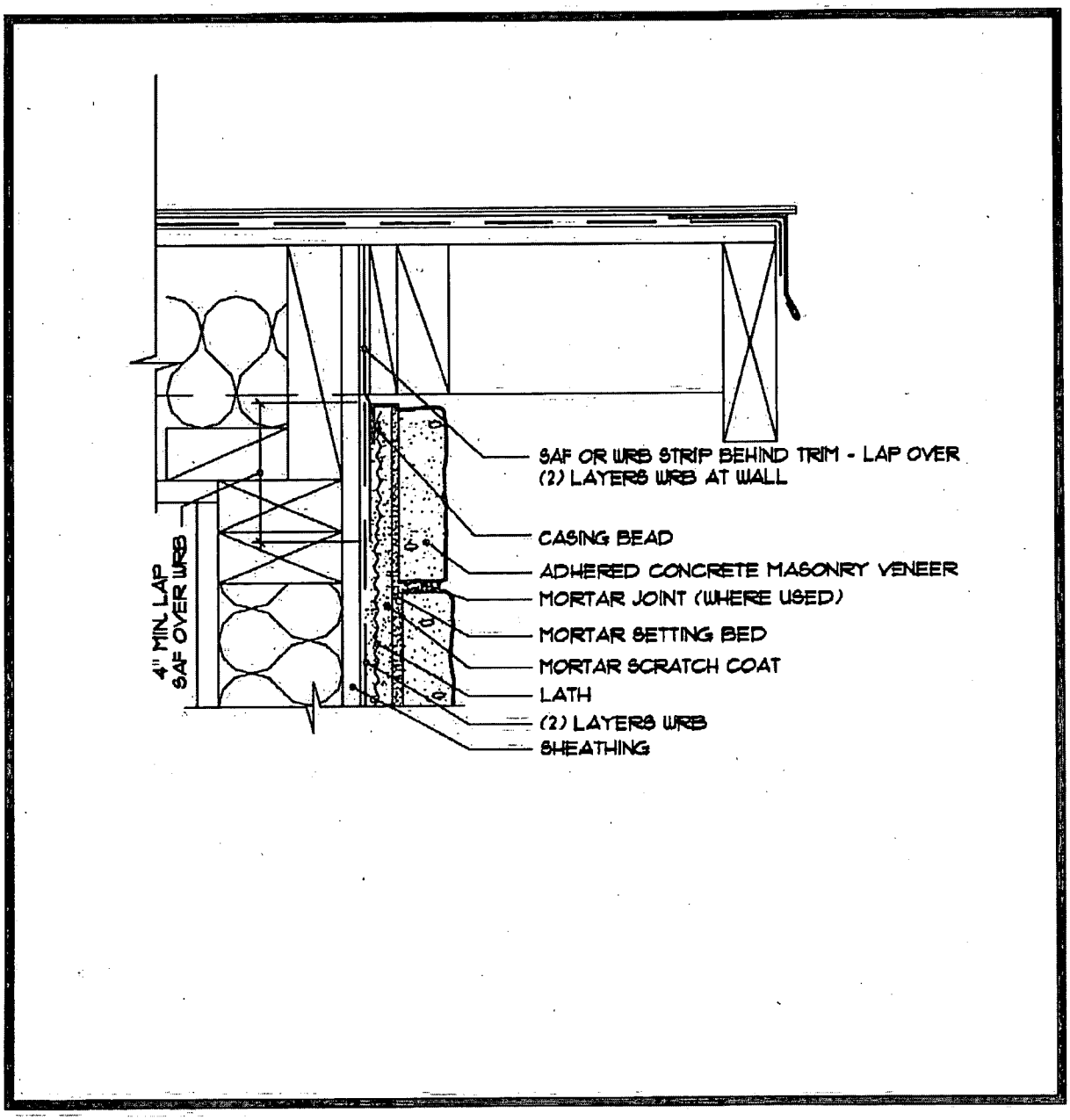
Water resistive barrier should be in place prior to soffit installation followed by adhered concrete masonry veneer.

Open Eave - Flush



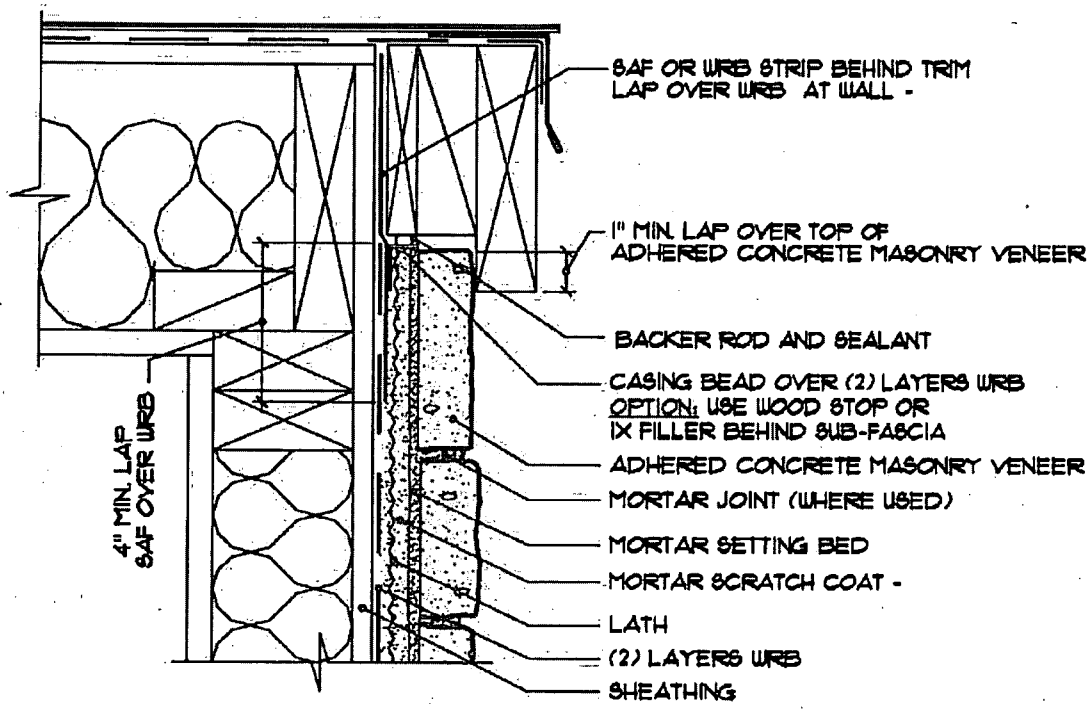
Water resistive barrier should be in place prior to soffit installation followed by adhered concrete masonry veneer.

Rake - Overhang



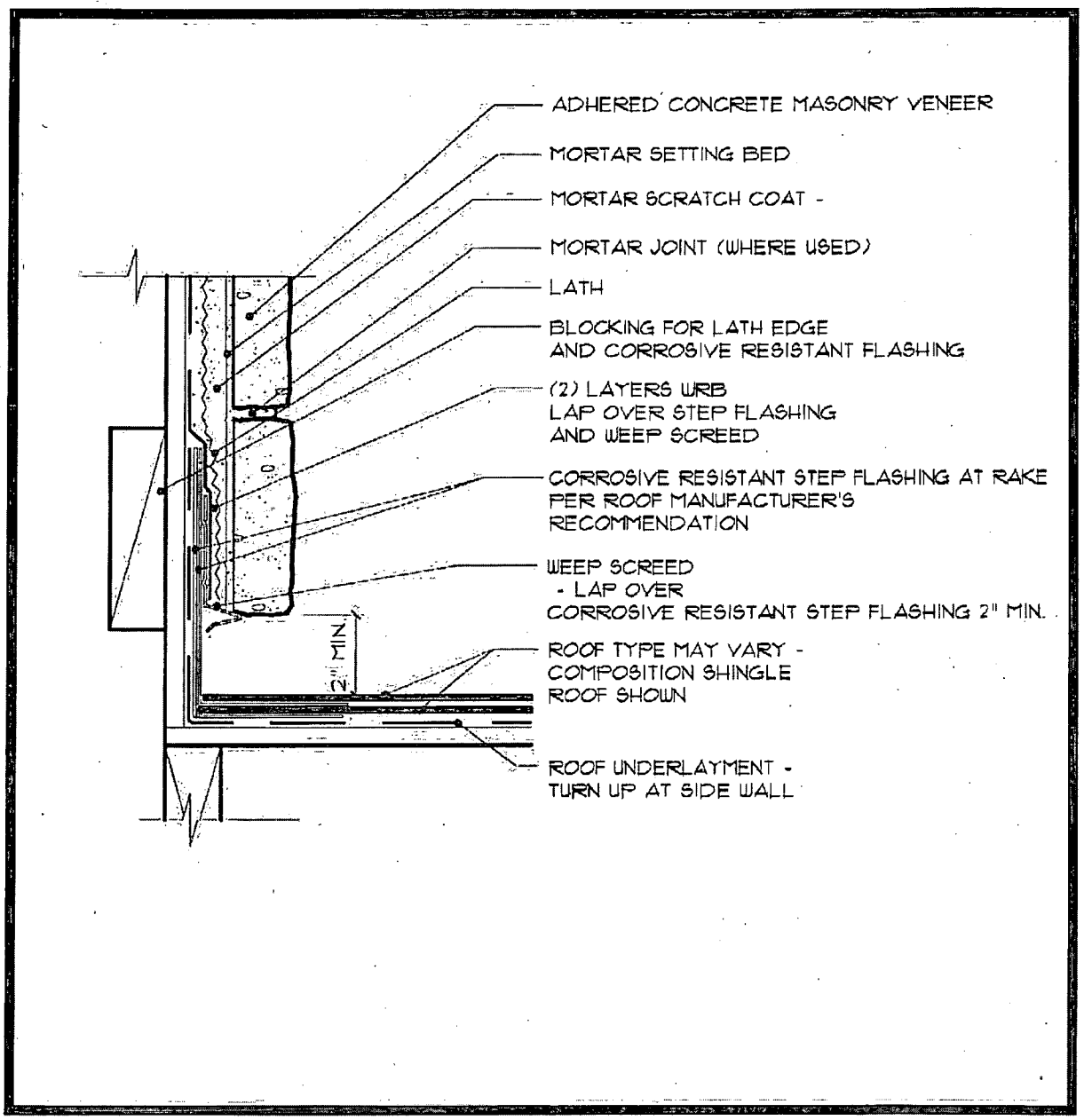
The intent of these details is to limit exposure to wind driven rain.

Rake - Flush



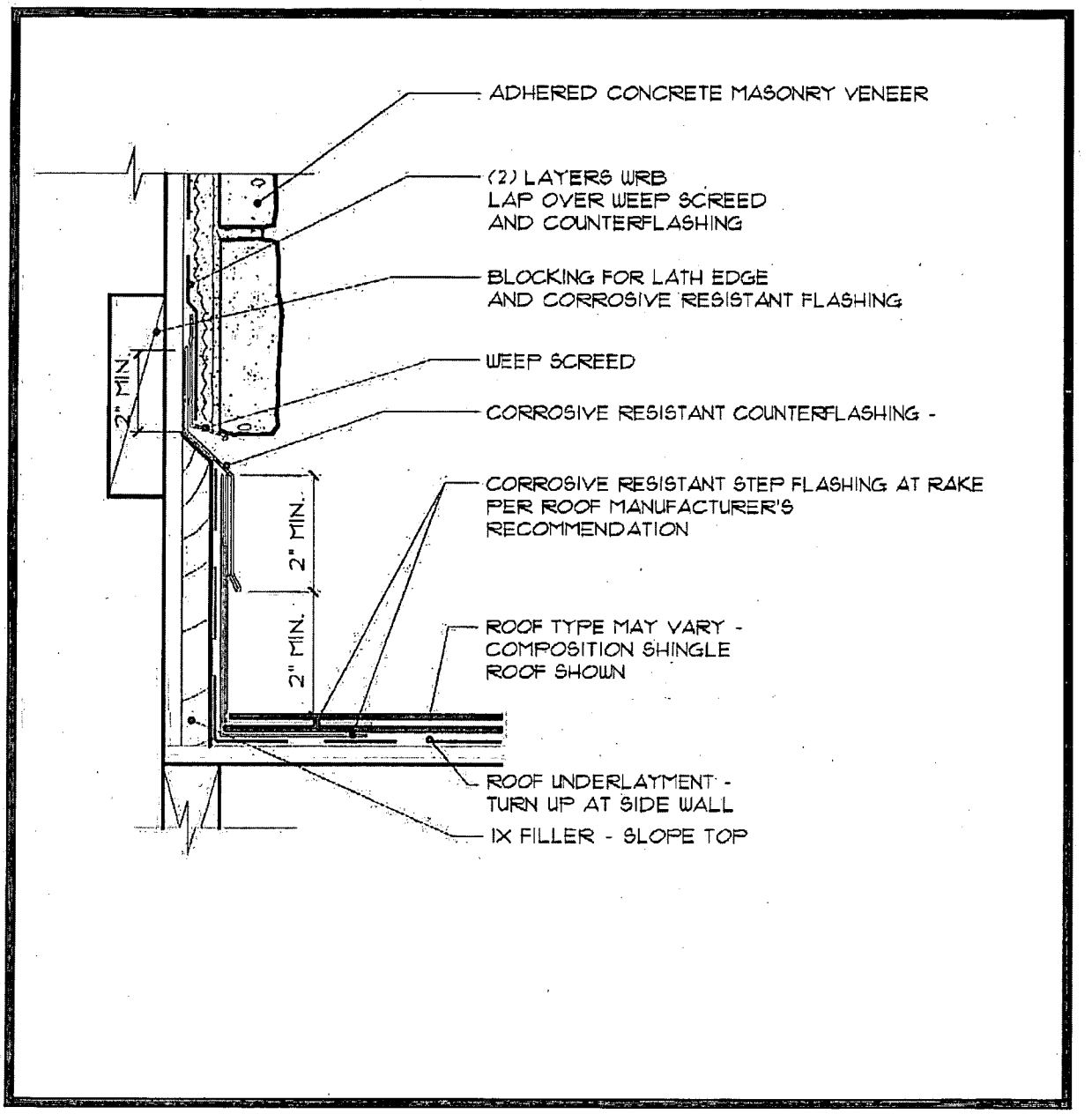
Note the use of backer rod and sealant.

Side Wall - Composition Shingles



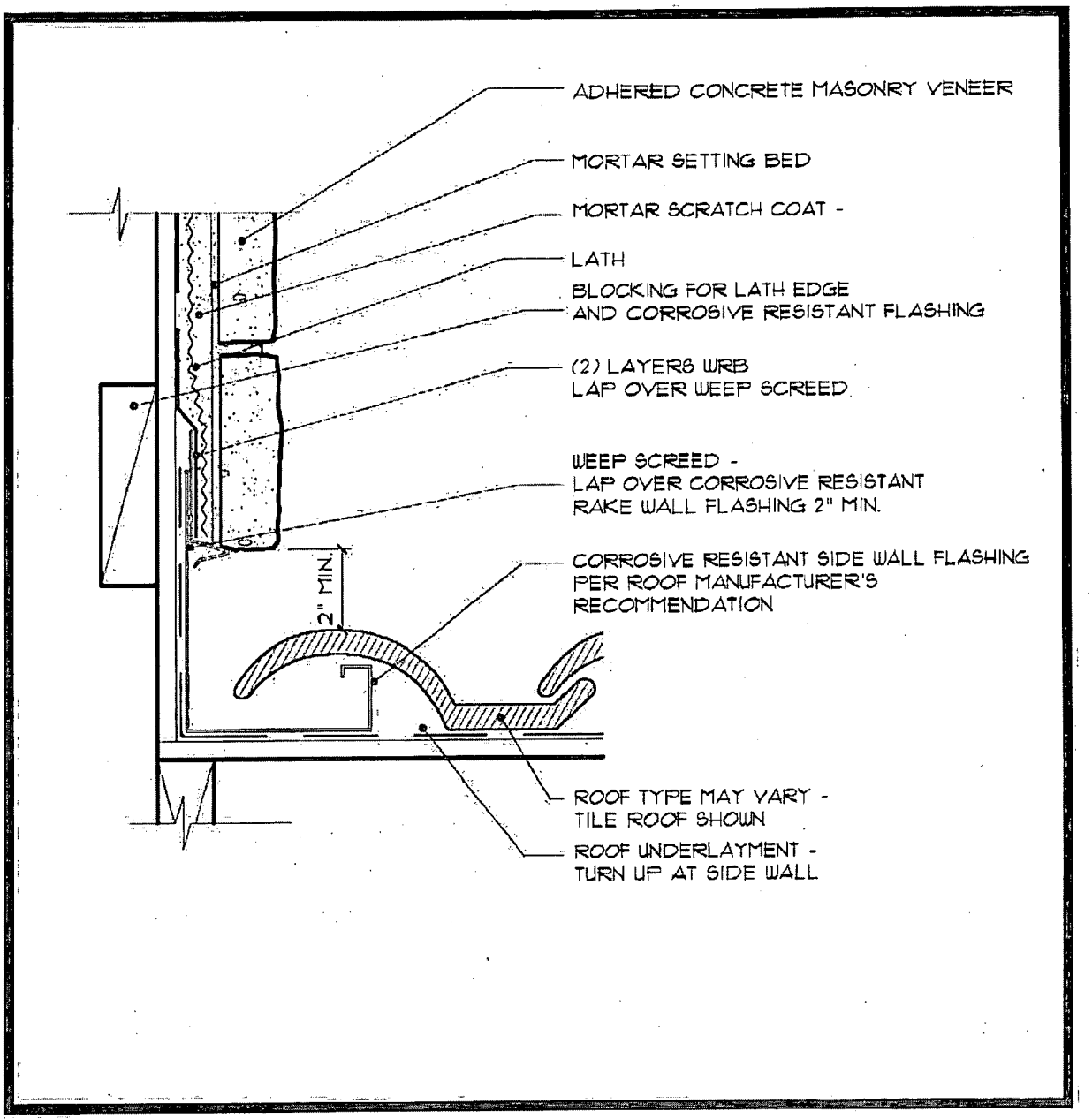
Water resistive barrier laps over step flashing and weep screed.

Side Wall - Composition Shingles Curbing



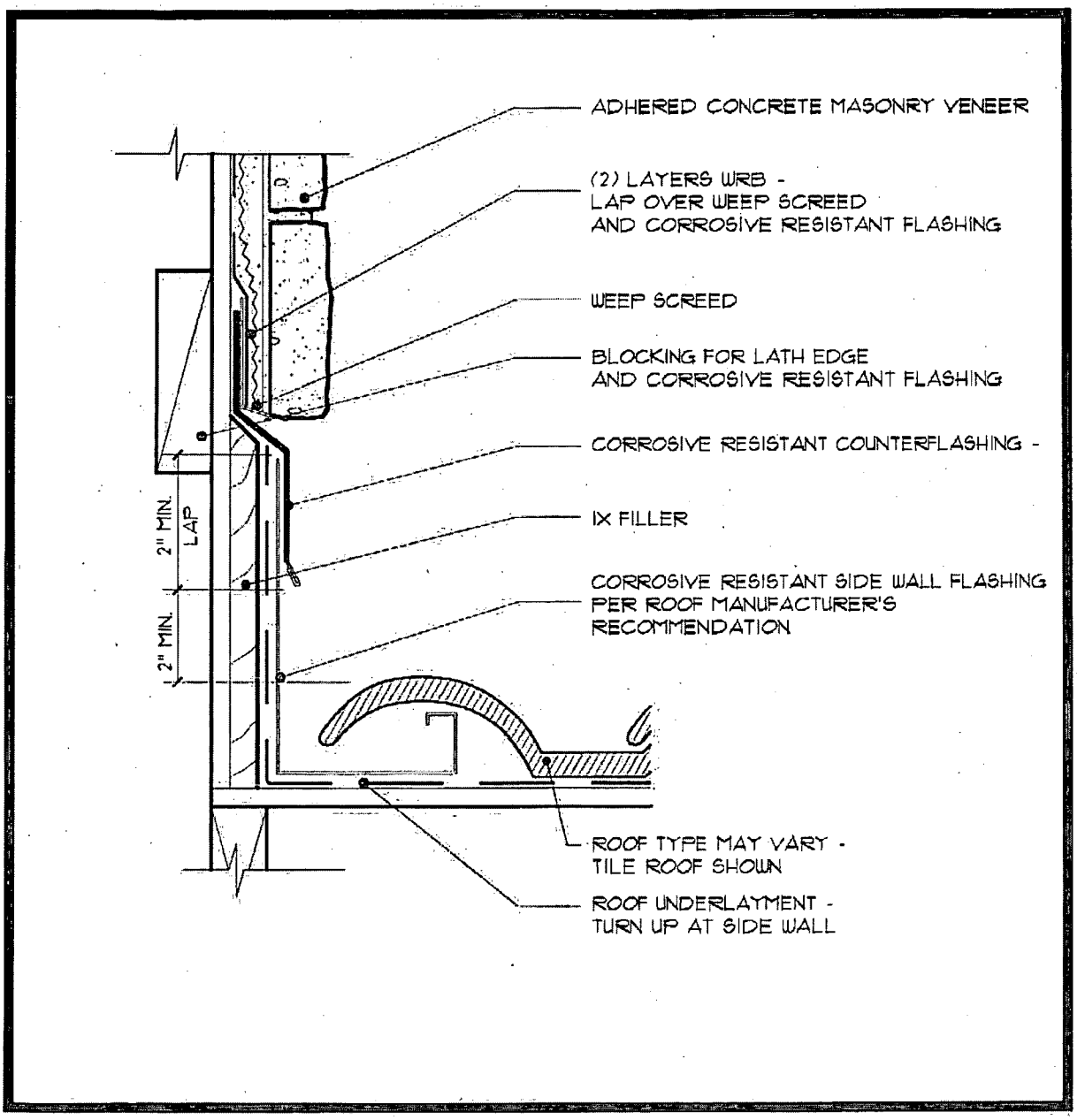
This detail includes base trim. Note the counterflashing between trim and adhered concrete masonry veneer.

Side Wall - Tile Shingles



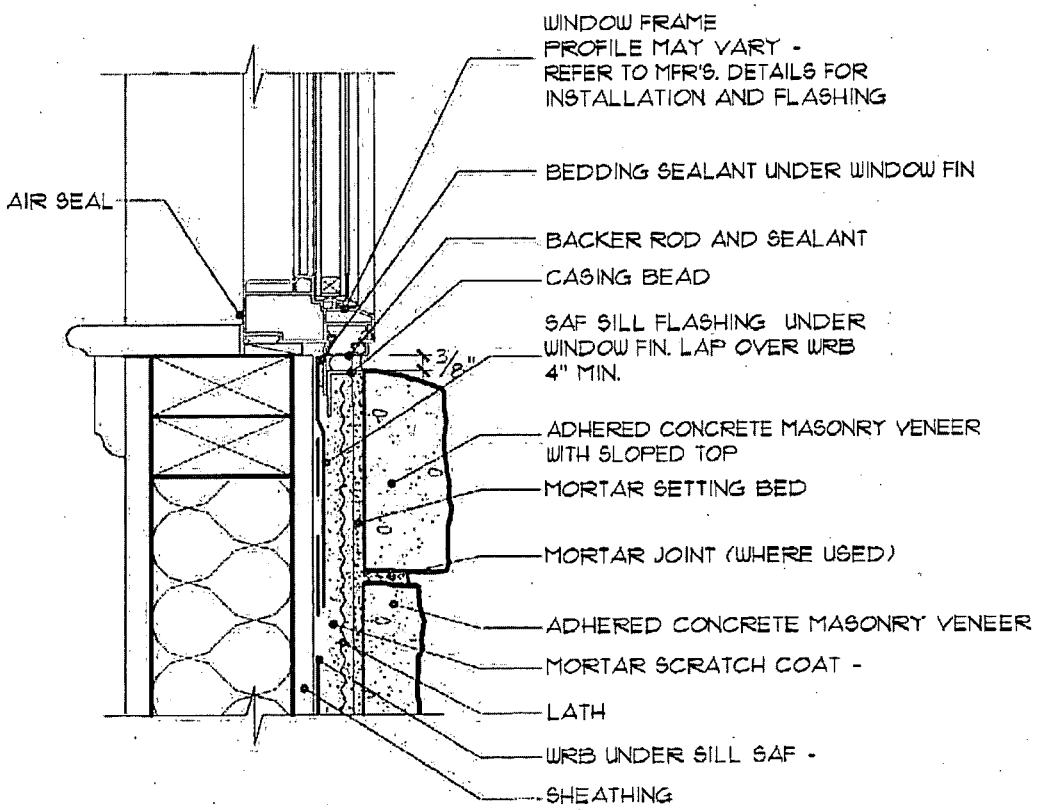
Water resistive barrier laps over step flashing and weep screed.

Side Wall - Tile Shingles Curbing



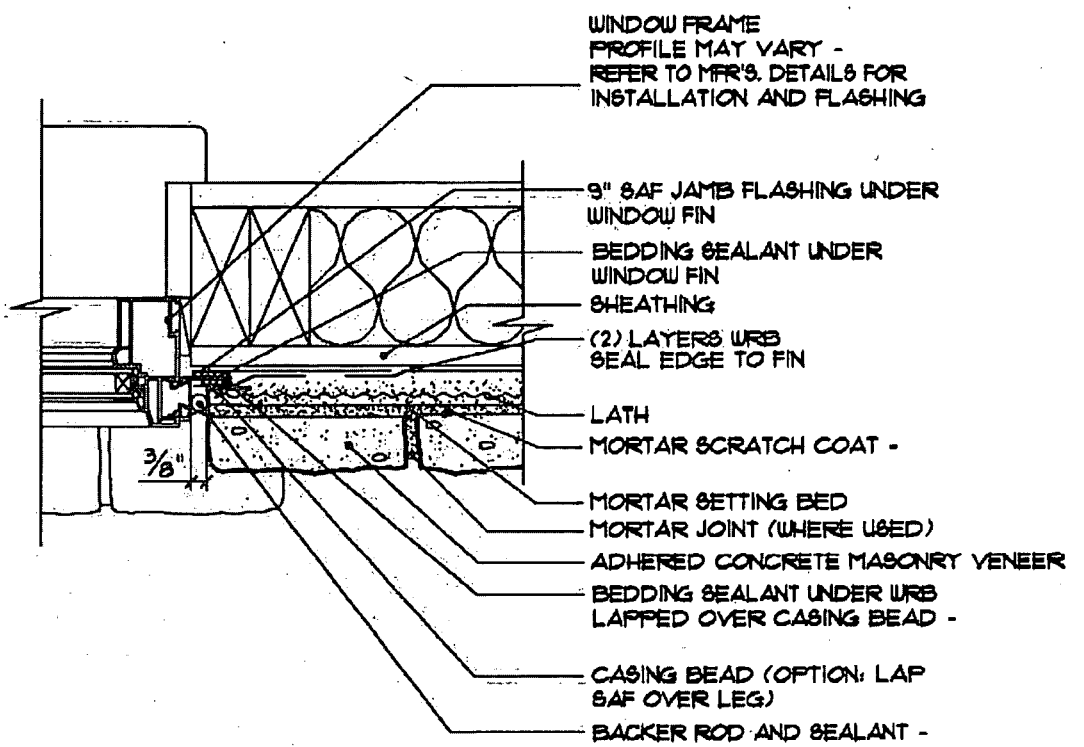
This detail includes curbing. Note the counterflashing between trim and adhered concrete masonry veneer.

Window Sill



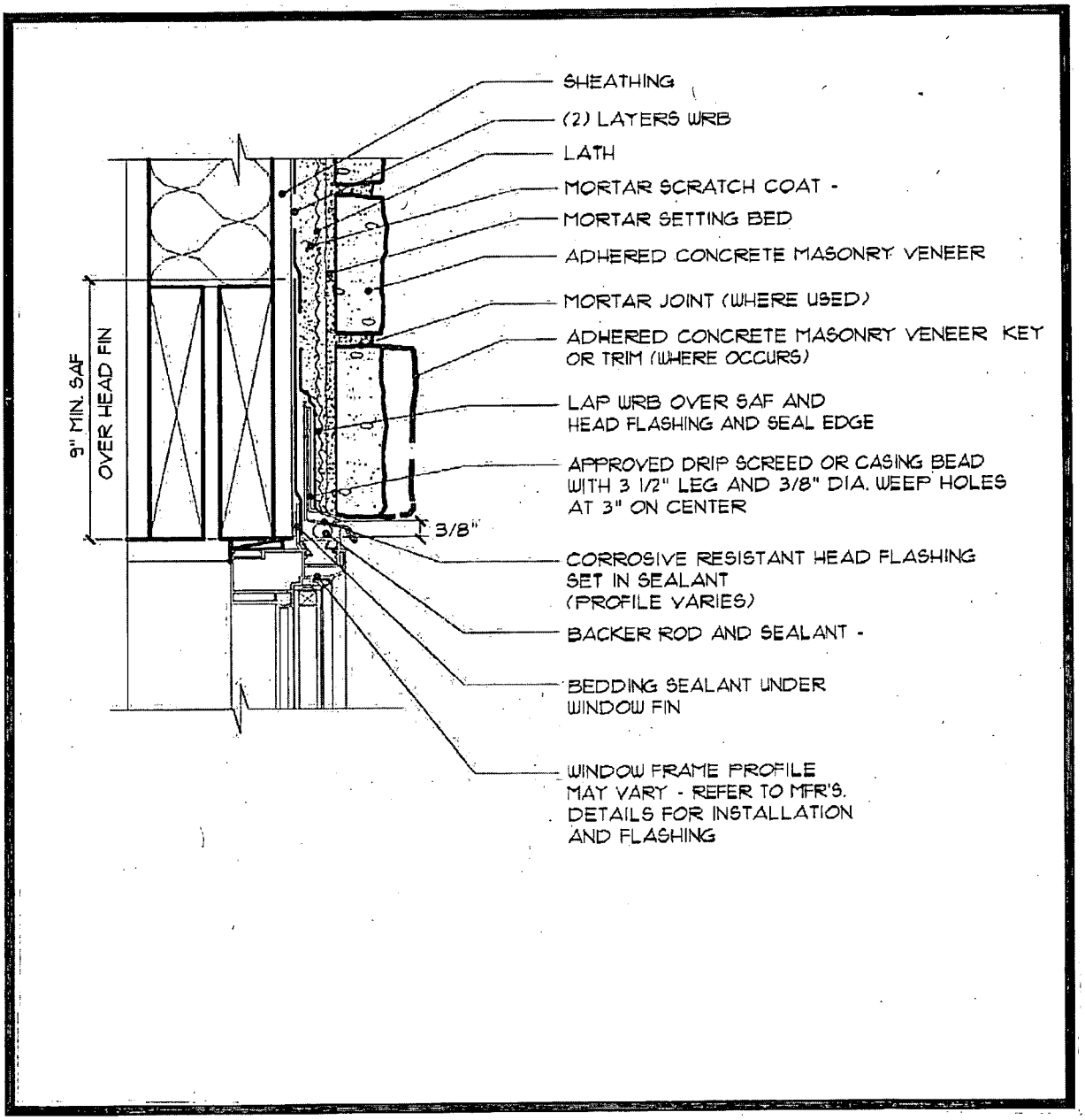
Rough openings must be properly flashed prior to window installation. Tuck water resistive barrier under pan flashing at sill. Sill flashing should drain between layers of WRB or to exterior of adhered concrete masonry veneer.

Window Jamb



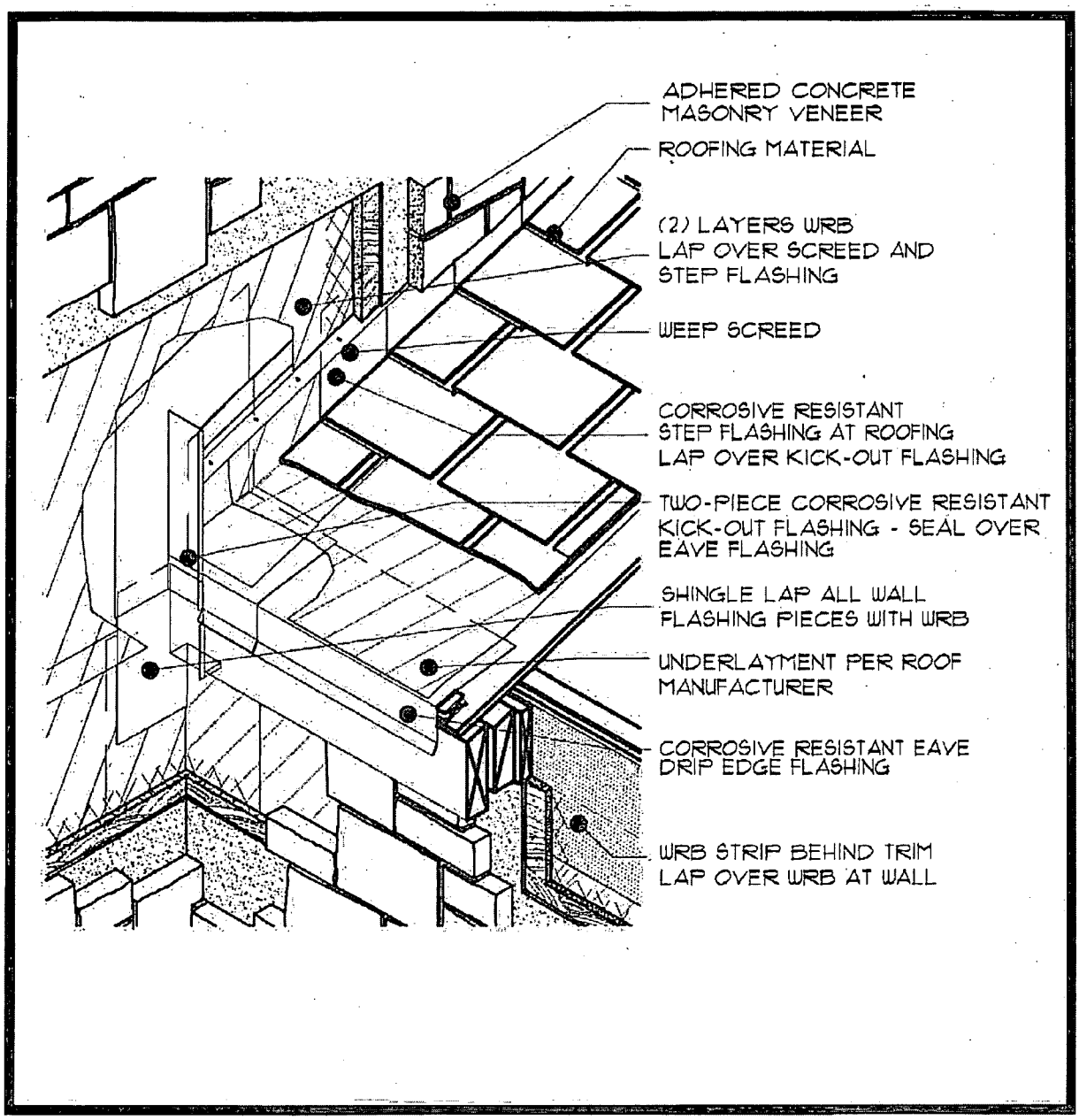
Rough openings must be properly flashed prior to window installation. Tuck water resistive barrier under paper at sill. Flashing should drain layers between of WRB. Extend layers of flashing to extreme of adhered concrete masonry veneer.

Window Head



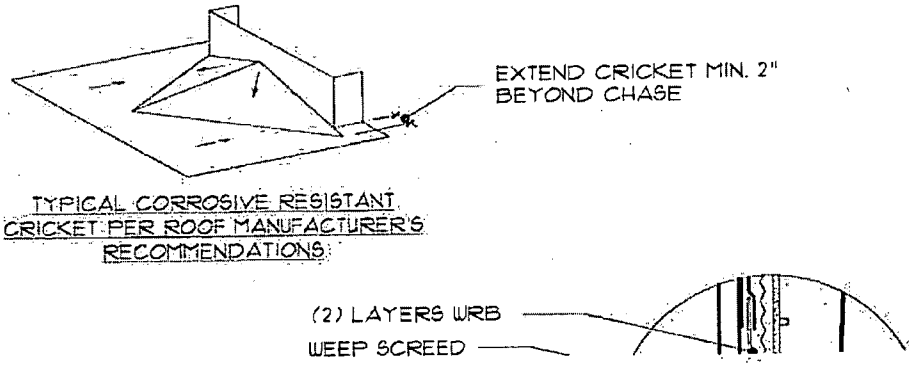
Apply adhesive membrane at window head to cover drip cap and membrane at jambs.

Kickout Flashing

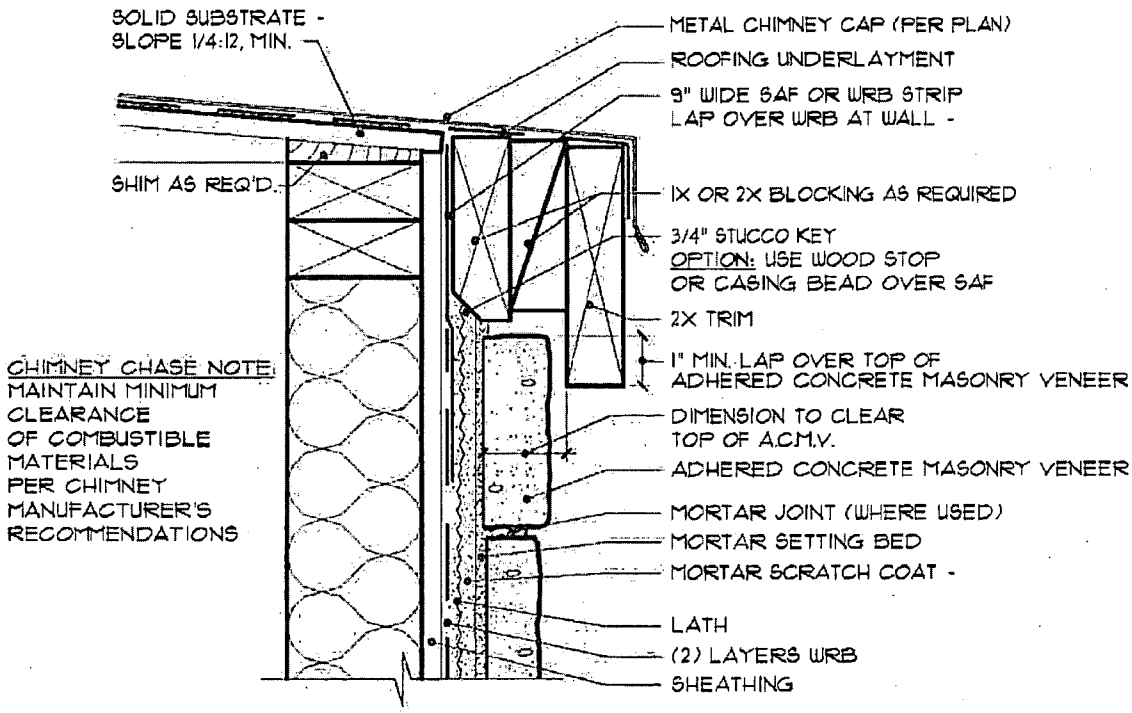


Kickout flashing should be sized properly to accommodate thickness of ACMV.

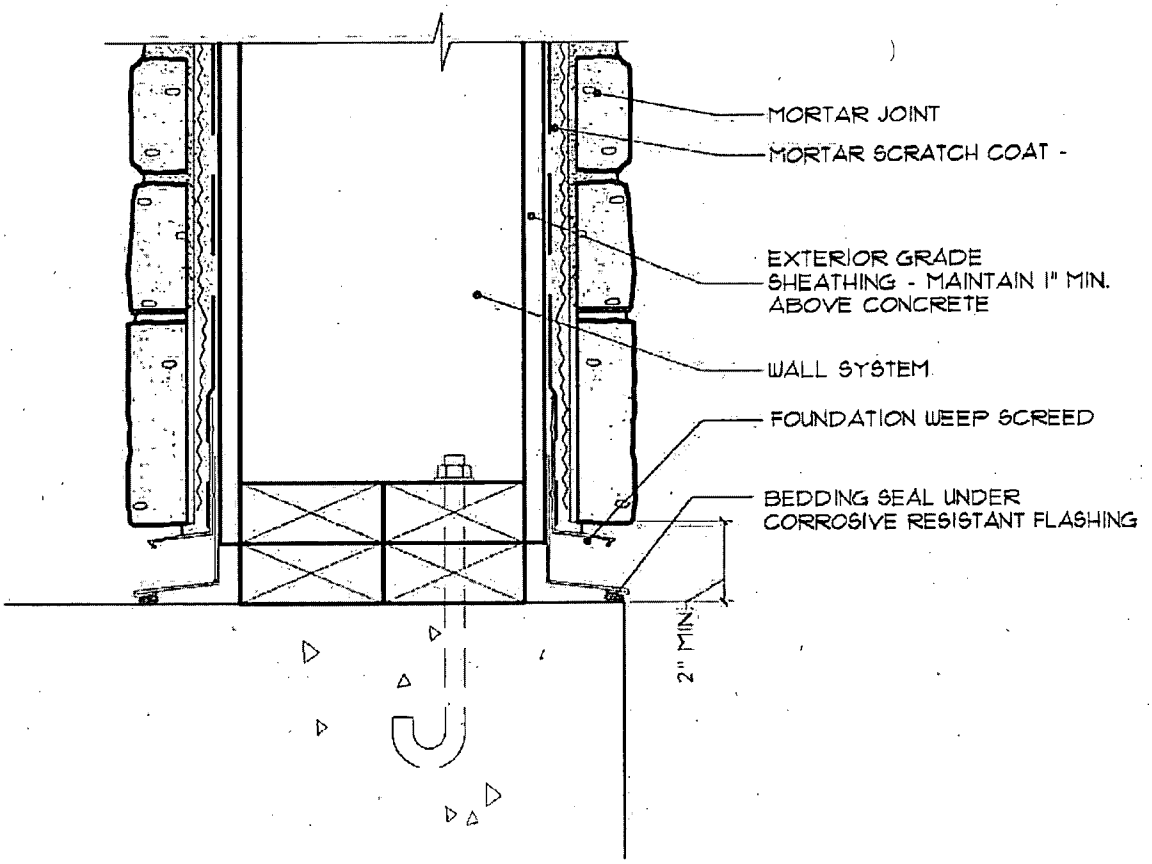
Cricket


EXTEND CRICKET MIN. 2" BEYOND CHASE
TYPICAL CORROSIVE RESISTANT CRICKET PER ROOF MANUFACTURER'S RECOMMENDATIONS
(2) LAYERS WRB
WEEP SCREED

Chimney Chase

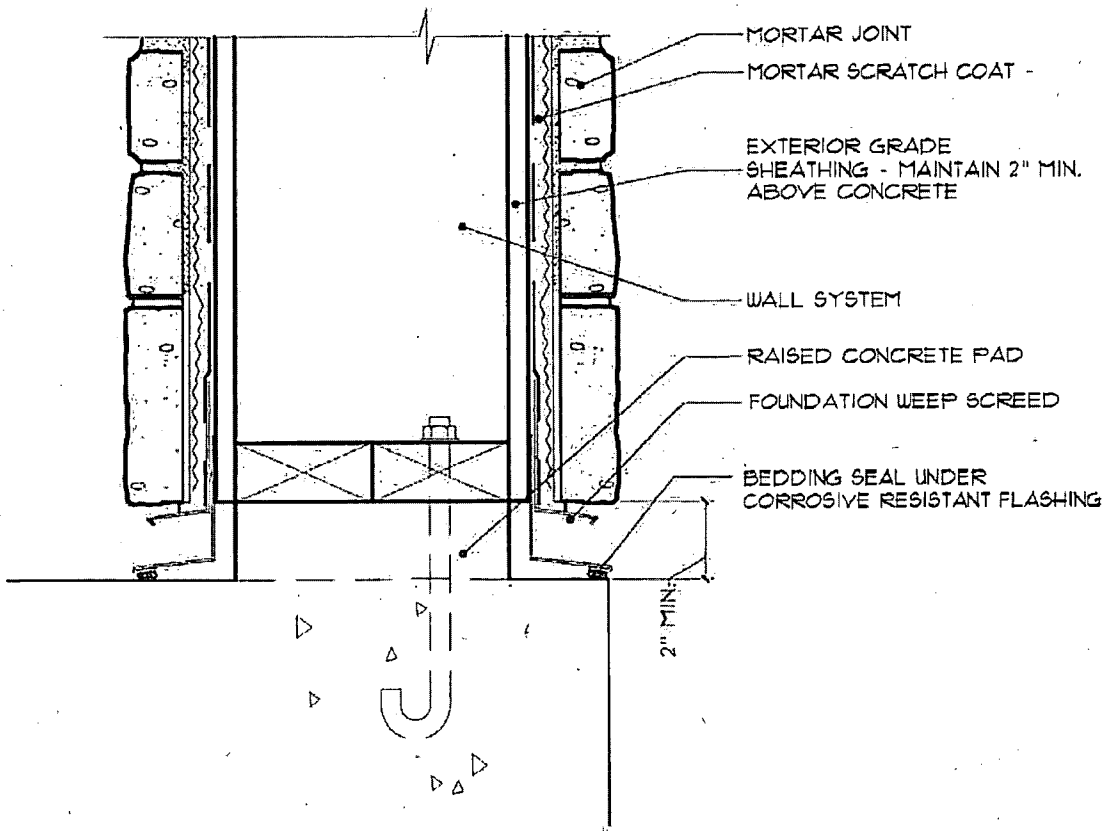


Column Base



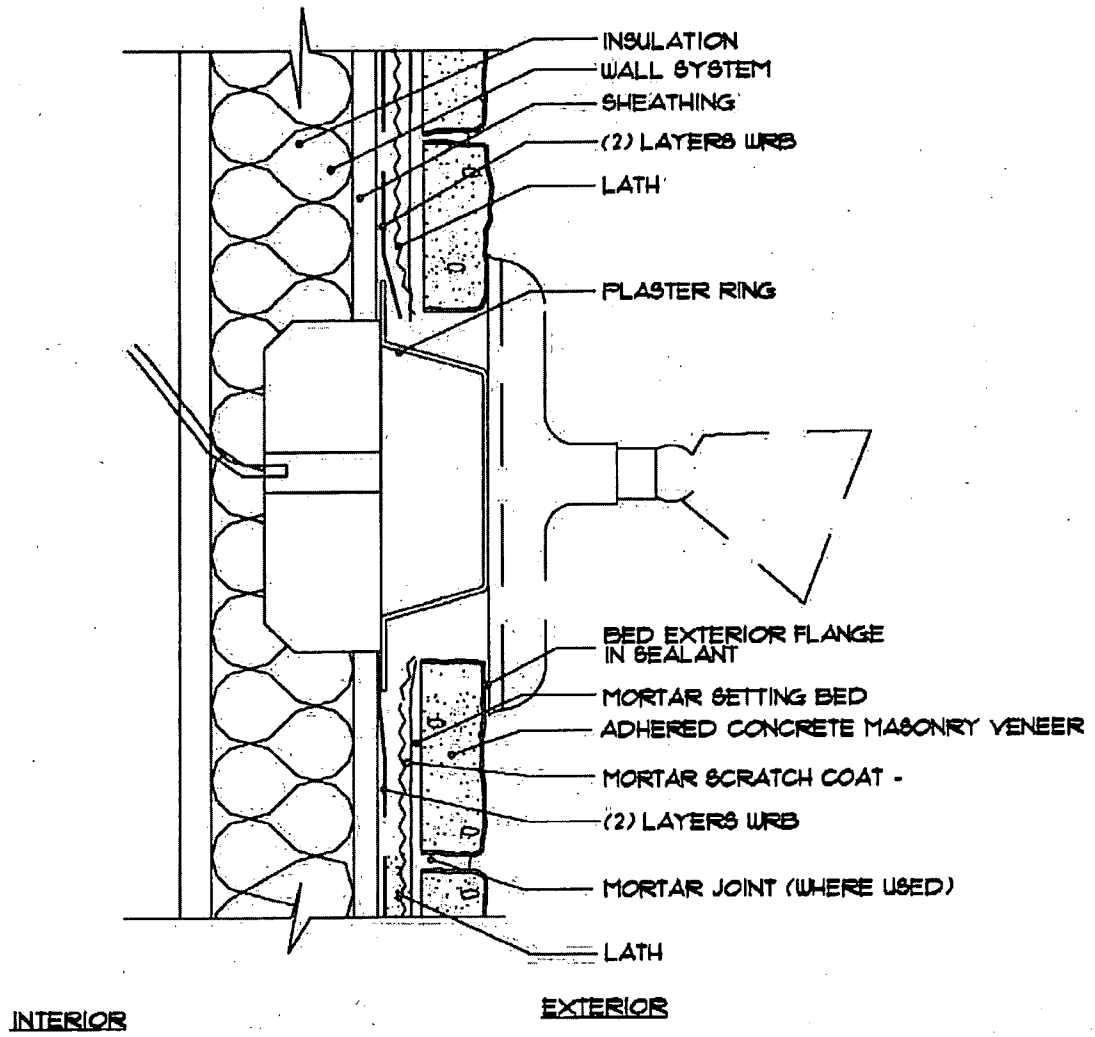
A minimum two inch clearance should be maintained at all sides of the base. All column materials to be exterior grade. Do not extend flashing past edge of ACMV for safety reasons.

Raised Column Base



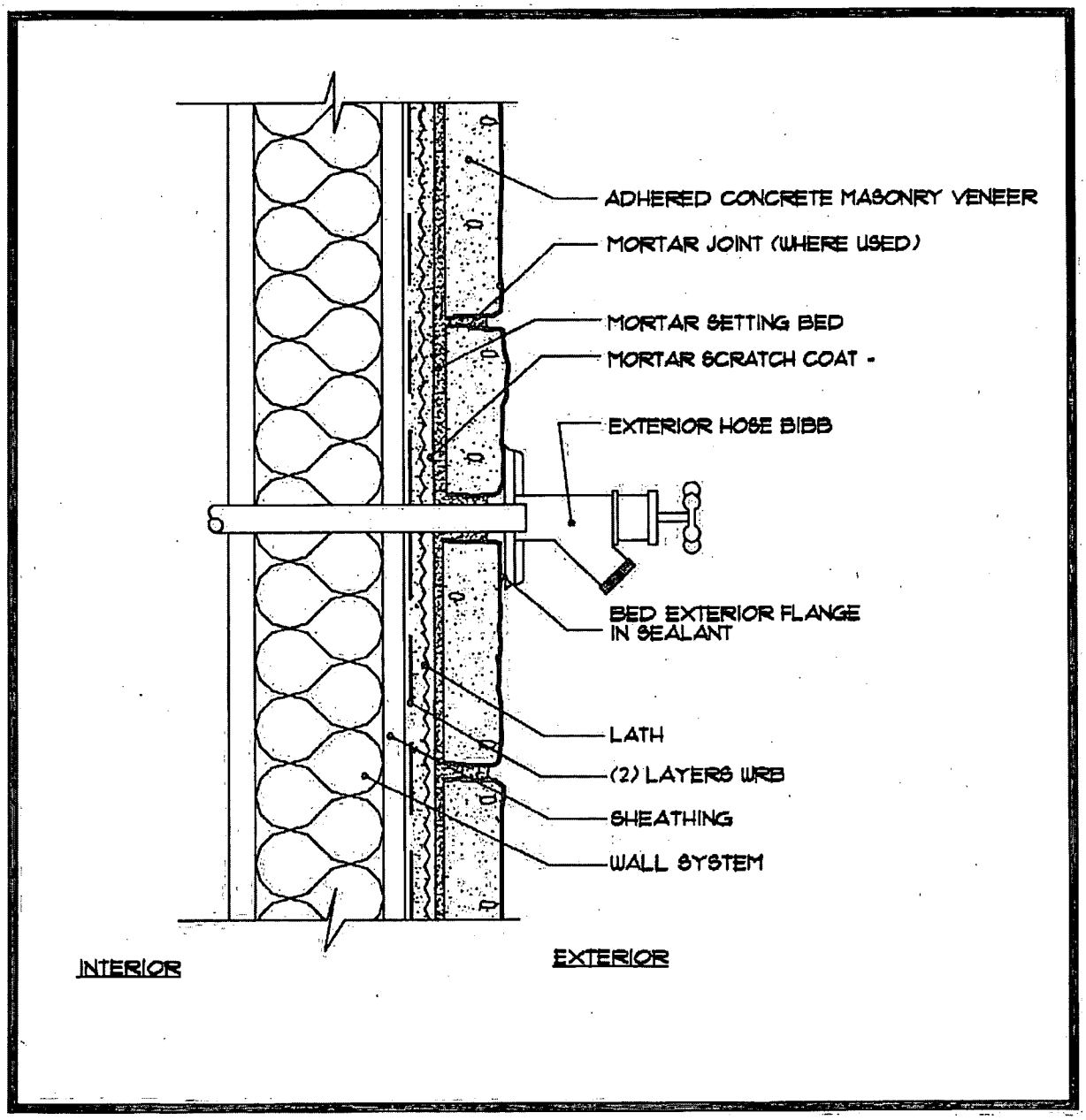
Adhered concrete masonry veneer may overlap the raised concrete pad, but a clearance of two inches should be maintained at all sides of the base. Do not extend flashing past edge of ACMV.

Fixture Penetration



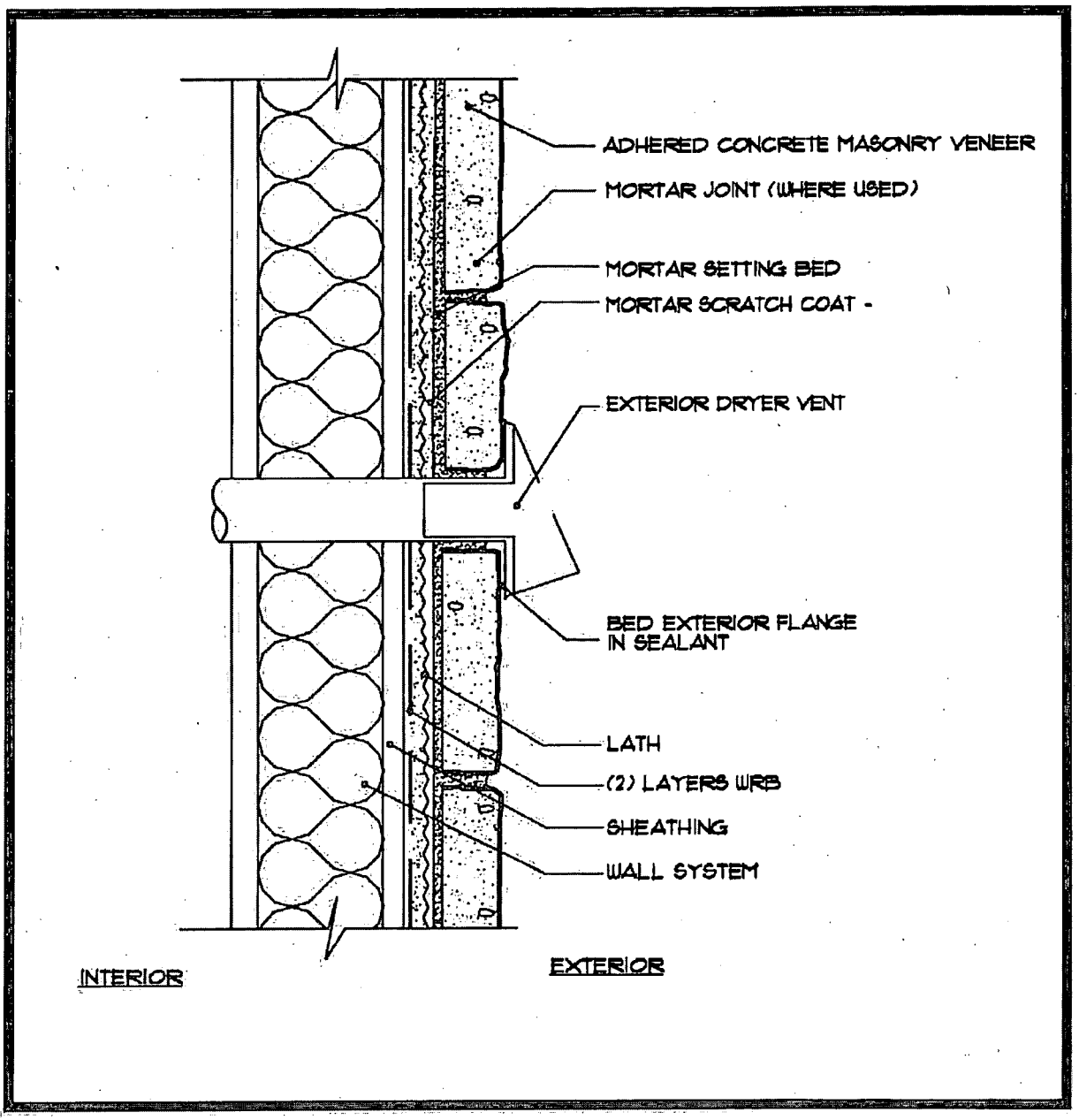
Plaster rings should be affixed over the service box to bring the face of the box flush with the adhered concrete masonry veneer. Be sure to bed the exterior flange in sealant. Water resistive barrier should be installed snugly around the plaster ring flange.

Pipe Penetration



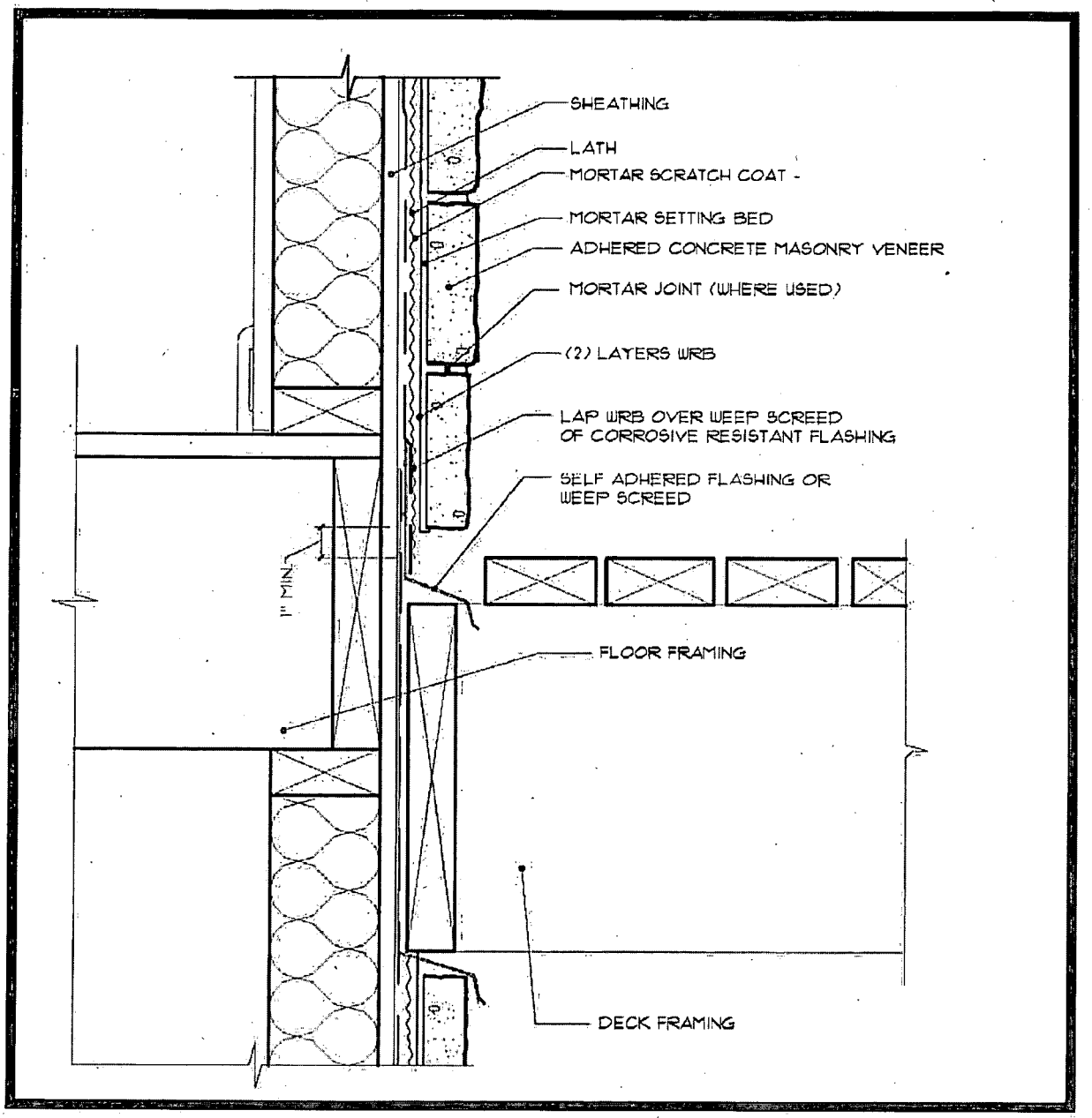
Be sure to bed all covers, flanges, and escutcheons in sealant before fastening them to the wall.

Dryer Vent Penetration



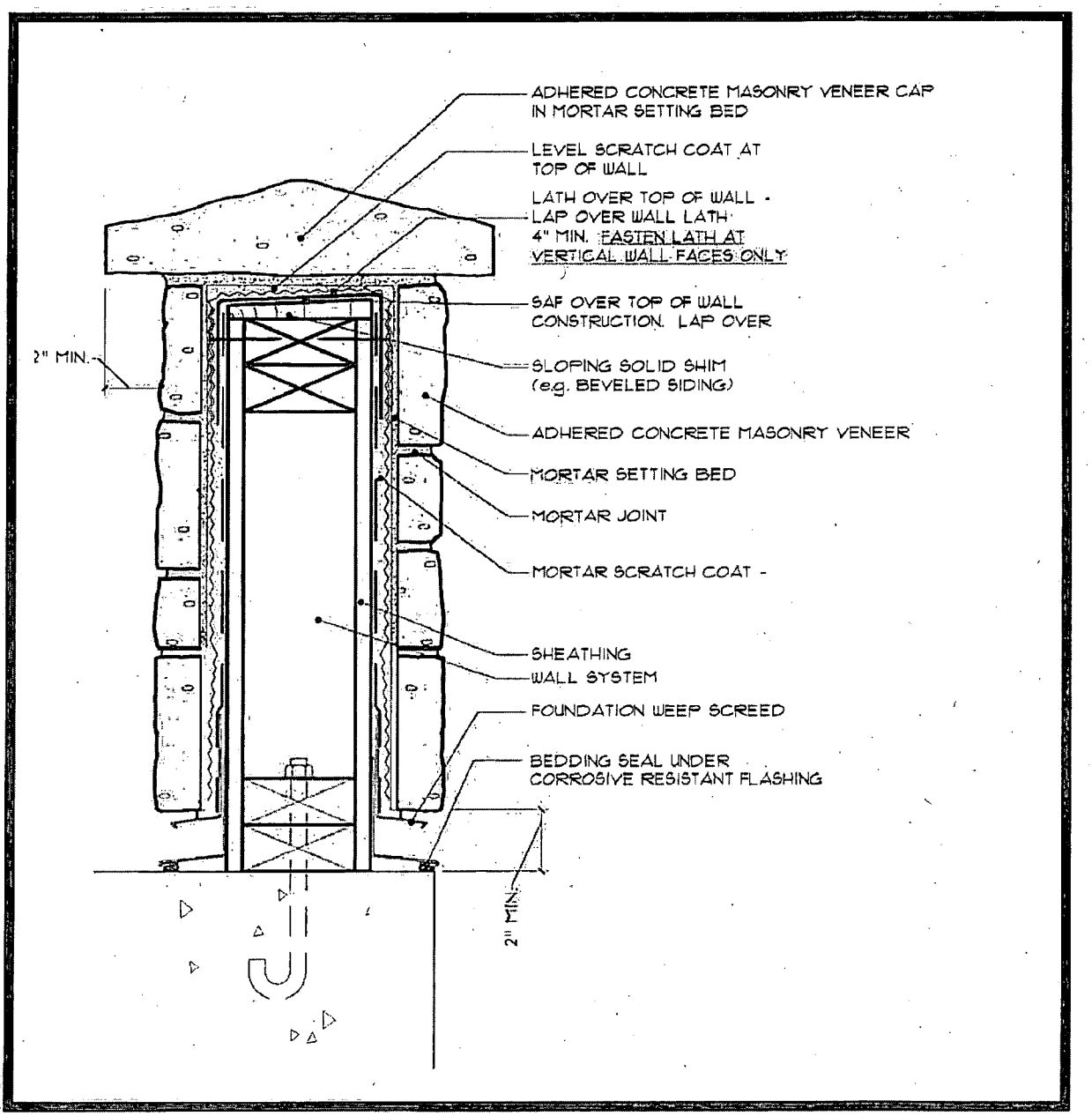
Be sure to bed all covers, flanges, and escutcheons in sealant before fastening them to the wall.

Deck Termination



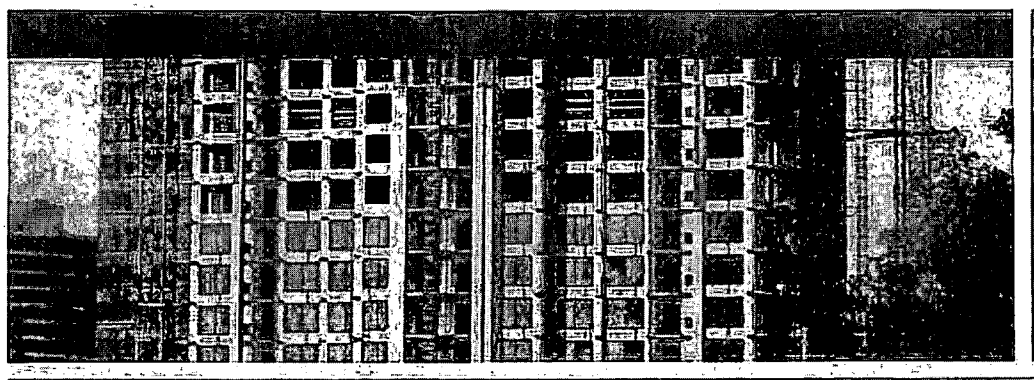
Be sure to lap water resistive barrier over weep screed and floor framing to manage water intrusion. Provide gap between adhered concrete masonry veneer and decking for drainage.

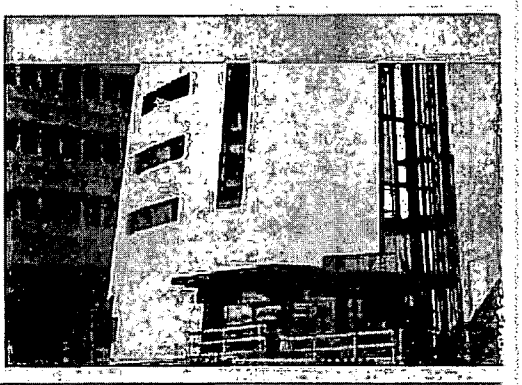
Wall Cap



Lath should lap over the top of the wall but be fastened only to vertical wall faces. Self adhering flashing should lap top of the wall. A sloping solid shim should top the wall under the SAF and lath.

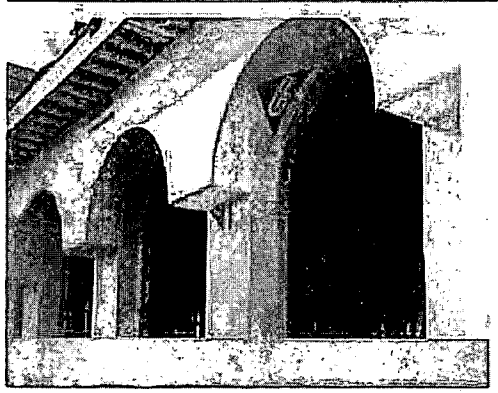
Georgia-Pacific
Gypsum

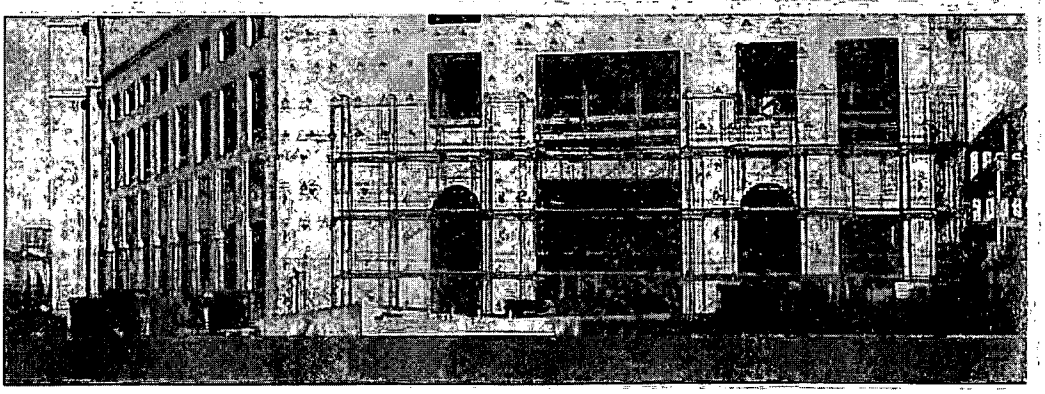




DensGlass® Sheathing

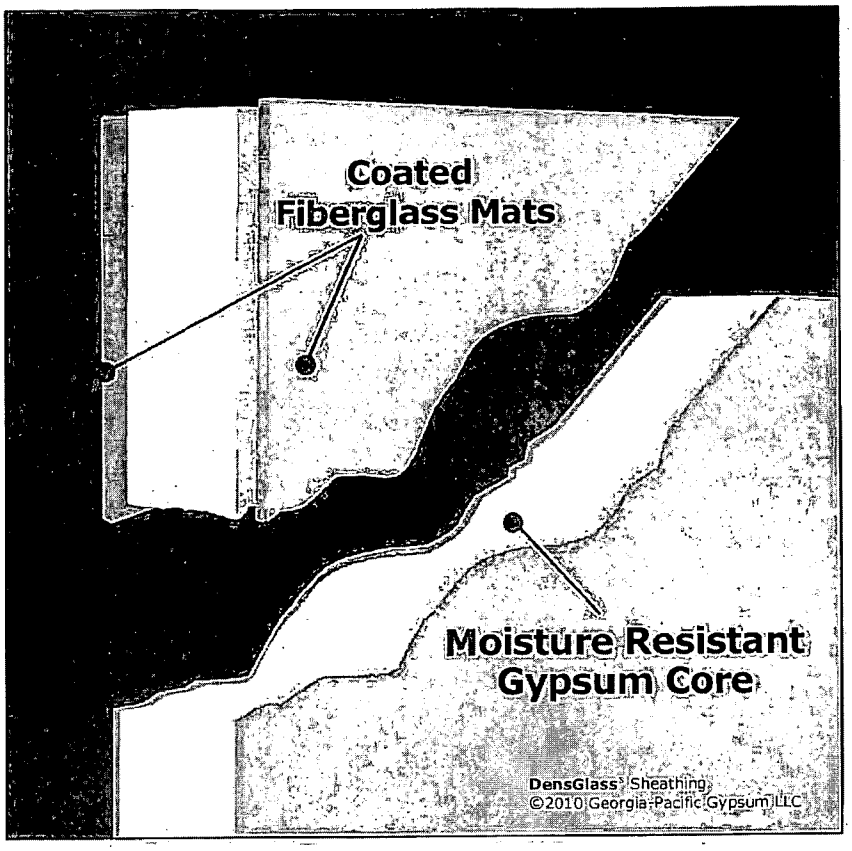
Preferred substrate under brick, stone, stucco, siding and Exterior Insulation and Finishing Systems (EIFS).





MOISTURE- AND MOLD-RESISTANT HIGH-PERFORMANCE SOLUTIONS

Product Overview



DensGlass® Sheathing has fiberglass mats for superior mold and moisture resistance compared to paper-faced sheathings.

- *Fiberglass mats eliminate a potential food source for mold and may reduce remediation and scheduling delays associated with paper-faced drywall.*
- *Replaces traditional paper-faced sheathing.*
- *Backed with a 12-month limited warranty against in-place weather exposure damage (delamination, deterioration and decay).**

**For complete warranty details, visit www.gpgypsum.com*

When tested, as manufactured, in accordance with ASTM D 3273, DensGlass Sheathing scored a 10, the highest level of performance for mold resistance under the ASTM D 3273 test method.

The score of 10, in the ASTM D 3273 test, indicates no mold growth in a 4-week controlled laboratory test. The mold resistance of any building product when used in actual job site conditions may not produce the same results as were achieved in the controlled, laboratory setting. No material can be considered mold proof. When properly used with good design, handling and construction practices, Dens™ Brand gypsum products provide increased mold resistance compared to standard paper-faced wallboard.

Available Sizes/Dimensions

DensGlass Sheathing is available in 1/2" (12.7 mm) thickness and DensGlass® Fireguard® Sheathing is available in 5/8" (15.9 mm) thickness. DensGlass Sheathing is manufactured in a 4' (1219 mm) width and 8' (2438 mm), 9' (2743 mm) and 10' (3048 mm) lengths. Other lengths are available upon request.

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DensGlass® Sheathing is the preferred substrate under brick, stone, stucco, siding and Exterior Insulation and Finishing Systems (EIFS) because of its exemplary track record. DensGlass Sheathing should be specified for any project where flexibility and easy sheathing installation are paramount without the headaches and expense of delamination, deterioration, sagging and warping. Look for the distinctive GOLD color to ensure you're using genuine DensGlass Sheathing.

Mold Resistance

Independent tests confirm that DensGlass Sheathing, with its patented fiberglass mat design, resists the growth of mold when tested, as manufactured, per ASTM D 3273.

Strength

Fiberglass mats penetrate into the panel to make an integrated unit that offers superb strength; outstanding resistance to delamination, deterioration, warping and job site damage; and an excellent bonding surface for EIFS. The flexural strength of DensGlass Sheathing is approximately the same in both directions. This means DensGlass Sheathing can be installed either vertically or horizontally without sacrificing wall strength between studs. DensGlass panels also protect and help stabilize structural framing.

Stability

DensGlass Sheathing is extremely resistant to rippling, buckling and sagging, even under humid conditions — which makes it particularly suitable for soffits. In actual tests, DensGlass panels exceeded ASTM C 1396 and ASTM C 79 standards for humidified deflection by a factor of five times over the standard for paper-faced gypsum sheathing.

Fire Resistance

DensGlass Sheathing is noncombustible as described and tested in accordance with ASTM E 136. Tests of 5/8" (15.9 mm) DensGlass® Fireguard® Sheathing conducted in accordance with ASTM E 119/CAN ULC S-101 qualify the product for a variety of UL listings and other designs in the GA-600 Fire Resistance Design Manual.

Superior Weather Protection

DensGlass Sheathing integrates a water-resistant, treated core with a fiberglass mat face and back to provide superb protection from the elements. Panels will not delaminate or deteriorate due to normal weather conditions — even during construction delays that last as long as 12 months after installation.

A water-resistive barrier is not required over DensGlass Sheathing to provide for the protection of the gypsum sheathing itself. Consult with the local building code, design professional, owner or cladding manufacturer for water-resistive barrier requirements. DensGlass Sheathing is the ideal substrate for a wide variety of air and water-resistive barriers including building wraps, liquid applied coatings and self-adhering membranes. See page 9 for details.

Easy to Handle

DensGlass Sheathing is lightweight and easy to handle. It can be cut and fastened with standard drywall tools and fasteners. The product is much easier to work with than wood substrate, cement board or fiber cement sheathing, which tend to be heavy and bulky.

Outstanding Warranty

DensGlass Sheathing is covered by a 12-month limited warranty for weather exposure, a five-year limited warranty against manufacturing defects and a 12-year limited warranty when used as a substrate for architecturally specified EIFS. For a copy of the limited warranty, call 1-800-225-6119. Or visit our Web site at www.gpgypsum.com.

Standards and Code Compliance

DensGlass Sheathing is manufactured to meet ASTM C 1177. Application standards where applicable are in accordance with Gypsum Association Publication GA-253 for gypsum sheathing or ASTM C 1280.

Evaluated by:

- ICC-ES Legacy Report NER 574
- CCMC-12064-R
- ICC-ES Legacy Report ER 4305
- N.Y. City MEA 244-88-M
- Florida Product Approval Code FL 2524-R3

The data relating to fire- and sound-tested assemblies is based on the characteristics, properties and performance of materials and systems obtained under controlled test conditions as set forth under the appropriate ASTM standard, such as E 119 (fire), E 90 (sound) or E 72 (structural).

Georgia-Pacific Gypsum Products and LEED®

Many of our products may contribute to LEED® credits. To find out more, please reference the Sustainable Materials Data Sheets (SMDS) on our website (www.gpgypsum.com) for recycled content, regional materials, low emitting materials and other potential categories for LEED credit contributions.

Physical Properties

Product Comparison	5/8" (15.9 mm) DensGlass® Fireguard®	5/8" (15.9 mm) Gypsum Sheathing, Type X (Paper-faced)	1/2" (12.7 mm) DensGlass Sheathing	1/2" (12.7 mm) Regular Gypsum Sheathing (Paper-faced)
Width, Nominal	4' (1219 mm)	4' (1219 mm)	4' (1219 mm)	4' (1219 mm)
Length, Standard	8', 9', 10' (2438, 2743, 3048 mm) ± 1/4" (6 mm)	8', 9', 10' (2438, 2743, 3048 mm) ± 1/4" (6 mm)	8', 9', 10' (2438, 2743, 3048 mm) ± 1/4" (6 mm)	8', 9', 10' (2438, 2743, 3048 mm) ± 1/4" (6 mm)
Weight/lbs/SF (kg/m²)	2.5 (12)	2.2 (11)	1.9 (9)	1.9 (9)
Bending Radius	8' (2438 mm)[9]	n/a	6' (1829 mm)[9]	n/a
Composition	Fiberglass mats gypsum core	Paper facings gypsum core	Fiberglass mats gypsum core	Paper facings gypsum core
Racking Strength, lbs./ft. (dry) (N/m) (Ultimate – not design value)	>654[5] (>9544)	654[1] (9544)	>540[9] (>7878)	540[1] (7878)
Flexural Strength,[4] parallel, lbf. (N) (4' weak direction)	100[7] (445)	50[2] (222)	80[7] (356)	40[2] (178)
Compressive Strength	min. 500 psi (3445 kPa)	min. 400 psi (2750 kPa)	min. 500 psi (3445 kPa)	min. 350 psi (2400 kPa)
Humidified Deflection,[3,4,7] inches	1/8" (3 mm)	5/8" (15.9 mm)	2/8" (6 mm)	10/8" (32 mm)
Permeance (perms)[5] [ng/Pa·s·m²]	17 [970]	25 [1400]	23 [1300]	27 [1600]
"R" Value[6] °F·ft²·hr/BTU (K·m²/w)	.67 (0.118)	.56 (0.099)	.56 (0.099)	.45 (0.079)
Combustibility[10]	Noncombustible	Combustible	Noncombustible	Combustible
Linear Expansion with Change Moisture in/in/%RH(mm/mm %RH)	6.25×10^{-6}	7.5×10^{-6}	6.25×10^{-6}	7.5×10^{-6}
Flame Spread, E84 CAN ULC-S102	10	15	10	15
Coefficient of Thermal Expansion in/in/°F (mm/mm/°C)	8.5×10^{-6} (15.3×10^{-6})	10×10^{-6} (18×10^{-6})	8.5×10^{-6} (15.3×10^{-6})	10×10^{-6} (18×10^{-6})
Resists Growth of Mold (tested, as manufactured, per ASTM D 3273)	Yes	No	Yes	No
Handling Characteristic	Scores with utility knife and snaps easily	Scores with utility knife and snaps easily	Scores with utility knife and snaps easily	Scores with utility knife and snaps easily
Fasteners	Standard	Standard	Standard	Standard

1. Gypsum Association – GA-253
2. Minimum requirements for ASTM C 1396
3. Maximum requirements for ASTM C 1396
4. Tested in accordance with ASTM C 473
5. Tested in accordance with ASTM E 96 (dry cup method)
6. Tested in accordance with ASTM C 518 (heat flow meter)
7. Minimum requirements for ASTM C 1177
8. Double fasteners on ends as needed
9. Tested in accordance with ASTM E 72
10. As defined and tested in accordance with ASTM E 136

Installation Recommendations

- DensGlass® Sheathing must be installed in accordance with the instructions in this brochure, Gypsum Association document GA-253 or ASTM C 1280. DensGlass Sheathing can be attached parallel or perpendicular to wood or metal framing. Use appropriate board orientation for specific fire assemblies and shear wall applications within this document, other reference documents or as required by designing authority. The framing width shall not be less than 1-1/2" (38 mm) wide for wood framing and 1-1/4" (32 mm) for steel framing. Framing members shall not vary more than 1/8" (3 mm) from the plane of the faces of adjacent framing.
- Fasteners should be driven flush with the panel surface (not countersunk) and into the framing system. Locate fasteners at least 3/8" (9 mm) from the ends and edges of the sheathing. Nails or screws, as listed in the fastener chart, may be used to attach DensGlass Sheathing to framing. When a pneumatic fastening system into metal is specified to attach DensGlass Sheathing, consult with manufacturer for application specifications and shear resistance data. DensGlass Sheathing is not to be used as a base for nailing or other fastening.
- Install DensGlass Sheathing with end joints staggered on horizontal applications. Ends and edges of the sheathing should fit tightly. DensGlass Sheathing panels shall not be less than 8" (203 mm) from the finish grade in fully weather- and water-protected siding systems, and not less than 12" (305 mm) from the ground for properly drained and ventilated crawl spaces. Consult with the design authority for control joint recommendations.

Wall Applications

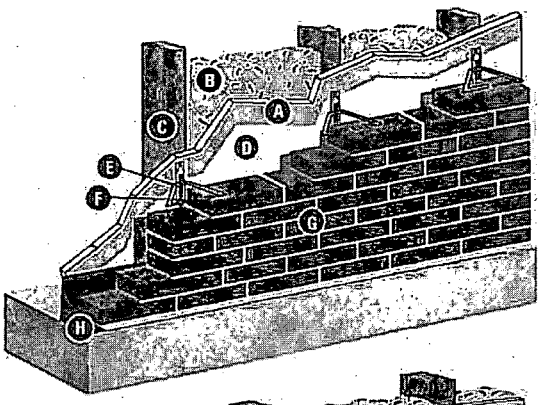
Installing Cladding over DensGlass Exterior Sheathing

Most conventional exterior sidings and wall coverings — including wood, vinyl, composition, metal, stone, brick, wood shingles, shakes and plywood panels — may be applied over DensGlass Sheathing. Consult your local building codes for water resistive barriers (WRB) requirements.

A. DensGlass Sheathing
B. Insulation
C. Framing
D. Water-Resistive Barrier
E. Masonry Tie
F. 2" (50mm) Max. Air Space
G. Brick Masonry or Stone Veneer
H. Flashing and Weeps
I. Wood Shingles or Shakes
J. Plywood Siding
K. Vinyl Siding
L. Fiber Cement Siding
M. Metal Siding

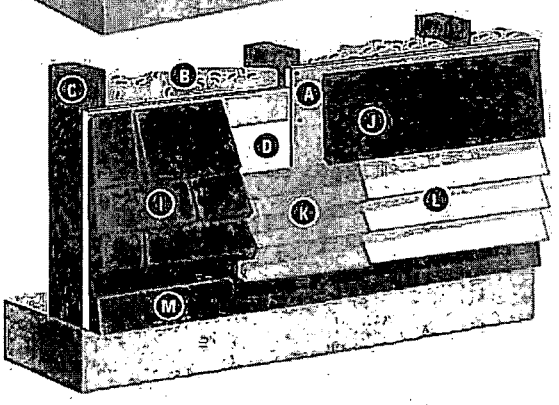
Brick Cavity Wall

Masonry or stone veneer can be applied over DensGlass Sheathing just as it would be over any other type of sheathing. Attach the masonry ties securely through the panels and into the steel or wood framing. Space the ties as required by masonry courses. Apply water-resistive barrier as required by building code or design authority.



Shingles, Shakes, Vinyl, Metal, Wood, Fiber Cement Siding

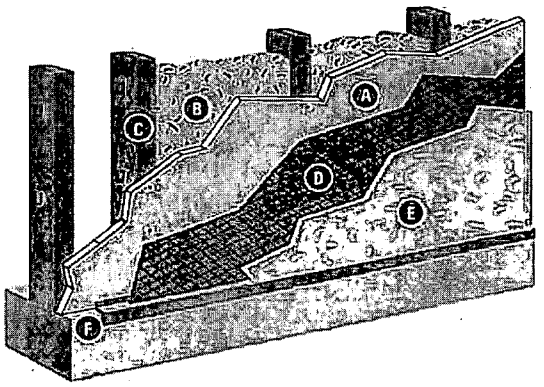
DensGlass Sheathing can be used in applications such as under wood shakes or shingles, plywood panel siding or other horizontal siding applications. All siding must be attached through the DensGlass Sheathing and into the steel or wood framing. Apply water-resistive barrier as required by building code or design authority.



Illustrations not intended for design or specification purposes.

Wall Applications continued

A. DensGlass® Sheathing
B. Insulation
C. Framing
D. Paper-Backed Metal Lath
E. Conventional Stucco
F. Minimum 1/4" (6 mm) Gap



Conventional Stucco

Stucco systems may be applied over DensGlass Sheathing using paper-backed metal lath. Paper-backed metal lath must be mechanically attached through the DensGlass Sheathing into the steel or wood framing. Install stucco system in accordance with the manufacturer's instructions, the Portland Cement Association guidelines and local building code requirements.

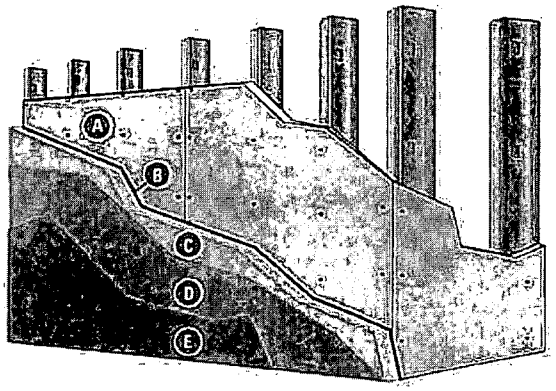
Exterior Insulation and Finish Systems (EIFS)

DensGlass Sheathing is an ideal substrate for adhesive or mechanical application of expanded polystyrene (EPS) or extruded polystyrene insulation in EIFS applications and is recommended for all climate zones.

DensGlass Sheathing is designated as the preferred gypsum substrate for EIFS by EIMA, the EIFS industry members association, in the EIFS Durability Specifications Guideline. DensGlass panels are treated with an exclusive GOLD color primer coating. This coating, proprietary to Georgia-Pacific Gypsum and developed especially for DensGlass Sheathing, has several important advantages for EIFS applications:

- Eliminates the need for sealer/primer with adhesively applied EIFS.
- Strengthens the bond between panel and surfacing product.
- Makes the panel more resistant to surface water. The result: labor cost and callbacks go down while customer satisfaction on each project goes up.
- 12-year limited warranty when used in an architecturally specified EIFS application.
- Maximum framing spacing 16" (406 mm) o.c. for 1/2" (12.7 mm) and 24" (610 mm) o.c. for 5/8" (15.9 mm) DensGlass® Fireguard® Sheathing.

A. DensGlass Sheathing
B. Adhesive or Mechanically Attached
C. Polystyrene Insulation
D. Reinforcing Mesh Embedded in Base Coat
E. Finish Coat



High Velocity Hurricane Zone (HVHZ)

The ability to withstand the destructive winds and the impact of various objects during a hurricane in a coastal area is key to the survival of any exterior cladding system. DensGlass Sheathing from Georgia-Pacific Gypsum helps BASF, Sto Corp, Dryvit, Parex Lahabra, Inc., Fiberweb, Inc. and Wellbilt International's systems pass the strict Miami-Dade County and Florida Building Code requirements for High Velocity Hurricane Zones (HVHZ). The systems were tested independently to determine the performance against specific criteria for impact resistance, air and water infiltration resistance and wind load resistance. For more information, please visit www.gpgypsum.com or contact the system manufacturer.

Fastening and Framing

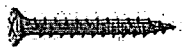
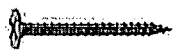
Thickness	Framing Spacing	Panel Orientation	Fastener Spacing – Wood Framing[1]	Fastener Spacing – Metal Framing[1]
1/2" (12.7 mm)	24" (610 mm) o.c. max[1,3]	Parallel[3] or Perpendicular	8" (203 mm) o.c. field[2] & perimeter	8" (203 mm) o.c. along framing
5/8" (15.9 mm)	24" (610 mm) o.c. max[3]	Parallel[3] or Perpendicular	8" (203 mm) o.c. field[2] & perimeter	8" (203 mm) o.c. along framing

1. Only for mechanically attached claddings. When specified behind EIFS, maximum framing spacing for 1/2" (12.7 mm) DensGlass® Sheathing is 16" (406 mm) o.c.

2. Fastener spacing around the perimeter of the wall and along intermediate vertical framing members. To meet the racking shear strength listed in the physical properties table, fastener spacing is 4" (102 mm) o.c. around the perimeter of each panel and 8" (203 mm) o.c. along vertical framing members.

3. For racking strength resistance apply panel edges parallel with framing spaced a maximum of 16" (406 mm) o.c. for both 1/2" (12.7 mm) and 5/8" (15.9 mm) DensGlass Sheathing.

4. Fire-rated assemblies may require additional fasteners, see specific assembly details.

Fastener*	Length 1/2" Thick	Length 5/8" Thick	Description	Application
	1" (25 mm)	1-1/4" (32 mm)	Bugle head fine thread, rust-resistant drill point drywall screw	DensGlass Sheathing to heavy-gauge steel
	1" (25 mm)	1-1/4" (32 mm)	Bugle head fine thread, rust-resistant sharp point drywall screw	DensGlass Sheathing to light-gauge metal framing furring
	1-1/4" (32 mm)	1-5/8" (41 mm)	Bugle head, rust-resistant, coarse thread sharp point screw	DensGlass Sheathing to wood framing
	1-1/4" (32 mm)	1-1/4" (32 mm) metal 1-5/8" (41 mm) wood	Wafer head, rust-resistant screws, drill or sharp point	DensGlass Sheathing to heavy-gauge or light-gauge, metal or wood, respectively
	1-1/2" (38 mm)	1-3/4" (45 mm)	11-gauge, galvanized nail	DensGlass Sheathing to wood framing or equivalent

**For screws, meet or exceed ASTM C 1002 or C954. Contact fastener manufacturer for correct amount of corrosion resistance.*

Negative Uniform Lateral Loads (Wind Load)

5/8" (15.9 mm) DensGlass® Fireguard® Sheathing Horizontally Applied

Stud Spacing In./O.C. (mm)	Screws In./O.C. (mm)	Ultimate load PSF* (kPa)
16 (406)	8 (203)	127 (6.08)
16 (406)	6 (152)	142 (6.80)
16 (406)	4 (102)	192 (9.19)
12 (305)	8 (203)	157 (7.51)
12 (305)	6 (152)	204 (9.77)
12 (305)	4 (102)	270 (12.93)
8 (203)	8 (203)	208 (9.96)
8 (203)	6 (152)	354 (16.95)
8 (203)	4 (102)	410 (19.63)

NOTE: Apply DensGlass Sheathing to appropriately engineered framing system. Tested applied to 6" (152 mm) x 1-5/8" (41 mm) 18-gauge (43 mils) steel studs using #6 1-1/4" (32 mm) bugle head screws. Other stud sizes may be suitable.

Source: Tested in accordance with ASTM E 330 by Hurricane Test Laboratory. For a copy of report #G488-1001-07, contact Georgia-Pacific Gypsum Technical Hotline at 1-800-225-6119.

**Maximum load capacity (not design load) of the 5/8" (15.9 mm) DensGlass Fireguard Sheathing applied horizontally. Apply appropriate safety factor from the design method used to calculate design load. For example, a safety factor of 3 applied to an ultimate load of 127psf (6.08 kPa) results in a design load of 42 psf (2.01 kPa).*

1/2" (12.7 mm) and 5/8" (15.9 mm) DensGlass Fireguard Sheathing Vertically or Horizontally Applied

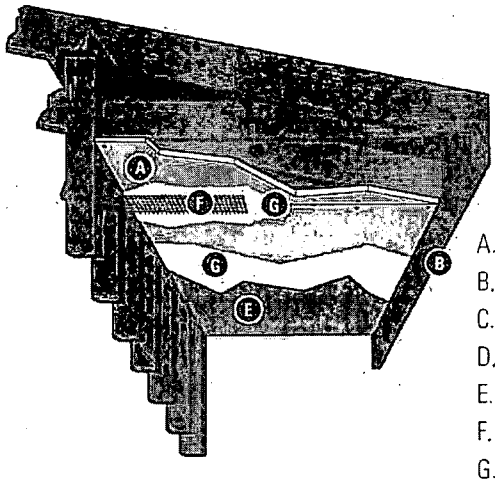
Thickness Inches (mm)	Board Orientation	Stud Spacing in. o.c. (mm)	Ultimate Load Psf (kPa)
1/2" (12.7)	Vertical	16 (406)	65 (3.11)
1/2" (12.7)	Horizontal	16 (406)	70 (3.35)
5/8" (15.9)	Vertical	24 (610)	68 (3.26)
5/8" (15.9)	Horizontal	24 (610)	85 (4.07)
5/8" (15.9)	Vertical	16 (406)	92 (4.40)

Source: TPI Report #89-047; wind load per ASTM E330 (bugle head screws 8" (203 mm) o.c.)

Soffit Applications, Fastening, Framing and Finishing

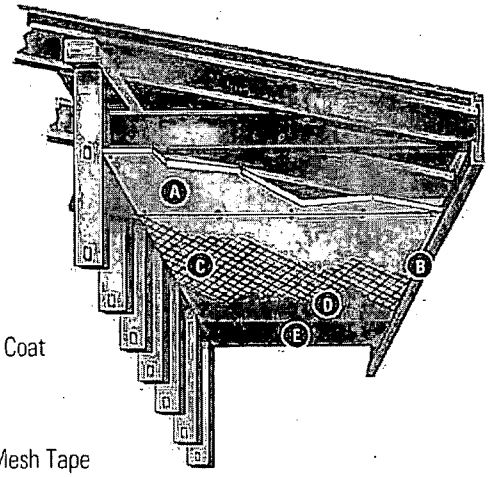
Method #1

Painted Ceilings and Soffits
Finished Joints



Method #2

Exterior Ceilings and Soffits



A. DensGlass® Sheathing
B. Drip Edge
C. Reinforcing Mesh/Base Coat
D. Base Coat
E. Finish Coat
F. 2" (51 mm) Fiberglass Mesh Tape
G. ToughRock® Setting Compound*

**Sandable setting compounds are not recommended.*

Thickness	Framing Spacing	Orientation	Screw Spacing
1/2" (12.7 mm)	16" (406 mm) o.c. max	Parallel or Perpendicular	8" (203 mm) o.c. along framing
1/2" (12.7 mm)	24" (610 mm) o.c. max	Perpendicular 24" o.c. framing	8" (203 mm) o.c. along framing
5/8" (15.9 mm)	24" (610 mm) o.c. max	Parallel or Perpendicular	8" (203 mm) o.c. along framing

Method #1

Embed 2" (51 mm) wide fiberglass mesh tape in ToughRock® 90 Setting Type joint compound, or equivalent, over all joints. Once dry, apply a skim coat of ToughRock 90 setting compound, or equivalent, over the panels to achieve a uniform, smooth finish over the entire area. Prime with exterior-grade primer and finish with two coats of exterior-grade paint.

Method #2

Apply a synthetic-type Direct Applied Finish System in accordance with the coating manufacturer's recommendation.

Special Conditions:

1. Control joints are recommended a maximum of 30 feet (9144 mm) or closer as specified by the design authority.
2. The roof must be dried in or protection from the elements must be provided prior to installing DensGlass Sheathing in horizontal applications to prevent moisture from ponding or settling on top of the sheathing panel or within the finished soffit.
3. Sandable setting compounds are not acceptable for use over DensGlass Sheathing in exterior soffit applications.
4. Georgia-Pacific Gypsum's ToughRock 90 setting compound is not available in all markets. It is permissible to use setting-type joint compounds from other manufacturers that are equivalent to ToughRock 90 setting compound.

Soffit Board Comparison

Product Comparison	1/2" (12.7 mm) DensGlass®	1/2" (12.7 mm) Gypsum Soffit Board (Paper-faced)	5/8" (15.9 mm) DensGlass Sheathing	5/8" (15.9 mm) Gypsum Soffit Board (Paper-faced)
Humidified Deflection[1] (Sag)	2/8" (6 mm)	7/8" (22 mm)	1/8" (3 mm)	4/8" (13 mm)
Water Absorption[1]	<10%	40%	<10%	40%
Surface Water Absorption[1]	83 grams	2.5 grams	83 grams	2.5 grams
Surface	Fiberglass mat	Paper-faced	Fiberglass mat	Paper-faced

1. Specified values for DensGlass Sheathing are found in ASTM C 1177, ASTMC 1396 and ASTM C 931 for gypsum soffit board, tested in accordance with ASTM C 473.

Air- and Water-Resistive Barriers

The need for moisture control, greater energy savings, comfort and improved environment is driving the use of air- and water-resistive barriers. Manufacturers, building codes and standards organizations are improving the ways moisture is controlled in buildings. DensGlass® Sheathing has been widely accepted for years as the preferred substrate with these systems and provides superior performance over other sheathings. The ultimate in wall performance and peace of mind is starting with the best substrate – DensGlass Sheathing.

DensGlass Sheathing is a superior substrate for a wide variety of air and water-resistive systems which include:

- #15 asphalt felt, ASTM D 226, type 1 or equivalent
- Synthetic wraps such as Tyvek®, Typar® MetroWrap®, ASTM E 1677 or equivalent
- Liquid- or fluid-applied air or vapor barriers such as Tremco ExoAir® 120, Grace Perm-A-Barrier® VP, Henry Air-Bloc™ 32 or Carlisle Barriseal®
- Water barrier systems such as Sto Guard® as manufactured by Sto Corp., Dryvit's Backstop® NT, Prosoco R-GUARD™ or equivalent
- Asphalt-based coatings
- Self-adhering membranes such as Carlisle CCW, Grace Perm-A-Barrier®, Henry Air-Bloc Vapor Barriers, Protecto Wrap
- Water-resistive barrier and drainage membranes such as DELTA-DRY®

Follow manufacturer's installation recommendations for use with DensGlass panels, local building code requirements and design authority's specifications.

Note: It is not required to provide a water-resistive barrier over DensGlass Sheathing for the protection of the gypsum sheathing itself during the 12-month weather exposure limited warranty. Consult with local building code, design professional, owner or cladding manufacturer for water-resistive barrier requirements and compatibility with the wall cladding.

Protection of Penetrations

All penetrations should be protected to prevent air and water infiltration. Follow building code, door/window manufacturer, or design authority's recommendations for flashing around openings, abutments to dissimilar materials and wall terminations.

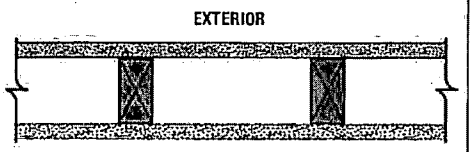
In areas that do not prescribe to current code requirements but still require long-term joint protection, either of the following two methods may be specified in lieu of an air- and water-resistive barrier system: **Method 1)** Apply minimum 3/8" (9 mm) bead of sealant to joints and trowel to provide a layer approximately 2" (51 mm) wide by 1/16" (2 mm) thick spanning the joint. Use backer rod for openings larger than 1/8" (3 mm). **Method 2)** Apply glass mesh joint tape to all joints, overlapping at intersections by the width of the tape. Apply approximately 3/8" (9 mm) bead of caulk along the joint. Embed the caulk into the entire surface of the tape with a trowel. Use backer rod for openings larger than 1/8" (3 mm). Follow manufacturer's installation recommendations for use with DensGlass Sheathing, and design authority specifications.

A variety of caulk and polymer-based "fill" materials may be specified, including GE, Dow Corning, Tremco, Sto, Dryvit, BASF and Proseco. Please contact the caulk manufacturer for its recommended caulks over DensGlass Sheathing.

Fire-Rated Assemblies (Wood-Framed)[1] continued

Design assemblies for illustrative purposes only. Consult appropriate fire resistance directory for assembly information. See Fire Safety Caution on back panel.

1-Hour Fire Rating



Test Reference: UL U305, U337, WHI 495-0702, ULC W301, GA WP 5515

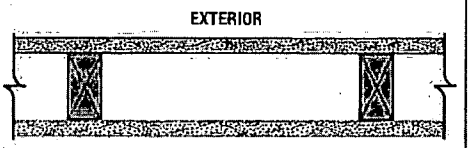
Wall Thickness: 4-7/8" (124 mm)

Weight per Sq. Ft.: 7.5 (37 kg/m²)

Exterior: 5/8" (15.9 mm) DensGlass® Fireguard® Sheathing applied parallel (U337, W301, U305) or at right angles (U305) to 2 x 4 wood studs 16" (406 mm) o.c. with 1-3/4" (45 mm) galvanized roofing nails 7" (178 mm) o.c. for all framing members. Exterior surface covered with weather exposed cladding or finish system.

Interior: 5/8" (15.9 mm) DensArmor Plus® Fireguard® interior panels or 5/8" (15.9 mm) ToughRock® Fireguard® gypsum board applied parallel or at right angles to studs with 1-7/8" (48 mm) 6d coated nails 7" (178 mm) o.c. Stagger joints each side. **(Load-bearing)**

1-Hour Fire Rating



Test Reference: UL U309, cUL U309

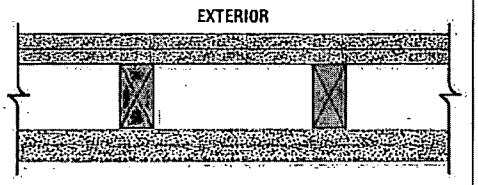
Wall Thickness: 4-7/8" (124 mm)

Weight per Sq. Ft.: 7.5 (37 kg/m²)

Exterior: 5/8" (15.9 mm) DensGlass Fireguard Sheathing applied parallel or at right angles to 2 x 4 wood studs spaced 24" (610 mm) o.c. with 1-7/8" (48 mm) galvanized roofing nails 7" (178 mm) o.c.

Interior: 5/8" (15.9 mm) DensArmor Plus Fireguard or 5/8" (15.9 mm) ToughRock Fireguard gypsum board to framing with 1-7/8" (48 mm) 6d coated nails 7" (178 mm) o.c. **(Load-bearing)**

2-Hour Fire Rating



Test Reference: UL U301, cUL U301

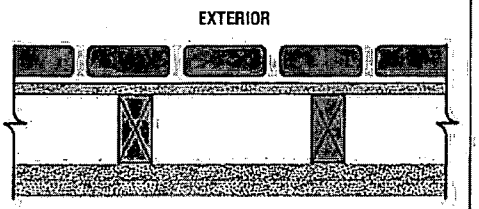
Wall Thickness: 6-1/8" (156 mm)

Weight per Sq. Ft.: 12.5 (61 kg/m²)

Exterior: Two layers 5/8" (15.9 mm) DensGlass Fireguard Sheathing applied parallel or at right angles to 2 x 4 wood studs 16" (406 mm) o.c. Base layer attached with 1-7/8" (48 mm) galvanized roofing nails 16" (406 mm) o.c. Face layer attached with 2-3/8" (60 mm) galvanized roofing nails 8" (203 mm) o.c. Stagger joints between layers and on base layer of both sides.

Interior: Two layers 5/8" (15.9 mm) DensArmor Plus Fireguard or 5/8" (15.9 mm) ToughRock Fireguard gypsum board applied horizontally or vertically to framing. Base layer attached with 1-7/8" (48 mm) 6d cement coated nails 6" (152 mm) o.c. Face layer attached with 2-3/8" (60 mm) 6d cement coated nails 8" (203 mm) o.c. Stagger joints between layers and on base layer of both sides. **(Load-bearing)**

2-Hour Fire Rating



Test Reference: UL U302, cUL U302, GA WP 8410

Wall Thickness: 10-1/8" (257 mm)

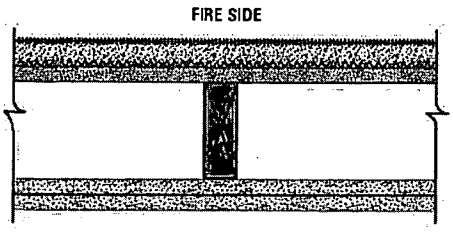
Exterior: One layer 1/2" (12.7 mm) DensGlass Sheathing applied parallel or at right angles to studs with 1-3/4" (45 mm) galvanized roofing nails 6" (152 mm) o.c. Face layer is 2" x 4" x 8" (51 mm x 102 mm x 203 mm) clay brick with 1" (25 mm) air space between brick and exterior sheathing. 20-gauge (30 mils) galvanized wire ties attached to each stud with 8d coated nails as described above, located at every sixth course of bricks. **(Load-bearing)**

Interior: Two layers 5/8" (15.9 mm) DensArmor Plus Fireguard or 5/8" (15.9 mm) ToughRock Fireguard gypsum board applied parallel or at right angles to 2 x 4 wood studs 16" (406 mm) o.c. Base layer attached with 1-7/8" (48 mm) 6d coated nails 8" (203 mm) o.c. Face layer attached with 2-3/8" (60 mm) coated nails 8" (203 mm) o.c.

[1]*Load restricted for Canadian applications—see UL Guide BXUV7.*

Fire-Rated Assemblies (Wood-Framed)[1] continued

2-Hour Fire Rating



Test Reference: UC 12-21-67, GA WP 8420

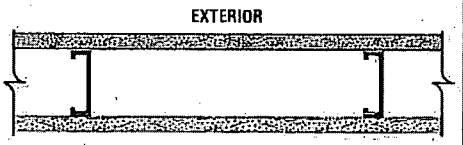
Wall Thickness: 8-5/8" (219 mm)

Exterior: Base layer 5/8" (15.9 mm) DensGlass® Fireguard® Sheathing retardant treated 2 x 6 wood studs 16" (406 mm) o.c. with 6d coated nails, 1-7/8" (48 mm) long, 0.0915" (2 mm) shank, 1/4" (6 mm) heads, 12" (305 mm) o.c. and covered with a single layer fire resistant protective weather retarder paper stapled along each edge at 16" (406 mm) o.c. Galvanized self-furring wire mesh applied over sheathing with 8d galvanized roofing nails, 2-3/8" (60 mm) long, 0.113" (3 mm) shank, 9/32" (7 mm) heads, 6" (152 mm) o.c. Cement-stucco applied over wire mesh in two 1/2" (12.7 mm) thick coats with bonding agent applied between coats.

Interior: Base layer 5/8" (15.9 mm) DensArmor Plus® Fireguard® or 5/8" (15.9 mm) ToughRock® Fireguard® applied parallel to studs with 6d coated nails, 1-7/8" (48 mm) long, 0.0915" (2 mm) shank, 1/4" (6 mm) heads, 12" (305 mm) o.c. Face layer 5/8" (15.9 mm) DensArmor Plus Fireguard or 5/8" (15.9 mm) ToughRock Fireguard applied at right angles to studs with 8d coated nails, 2-3/8" (60 mm) long, 0.113" (3 mm) shank, 9/32" (7 mm) heads, 8" (203 mm) o.c. at edges and 12" (305 mm) o.c. at intermediate studs. **(Load-bearing)**

Fire-Rated Assemblies (Steel-Framed)

1-Hour Fire Rating



Test Reference: UL U465, ULC W415, cUL U465, GA WP 1081

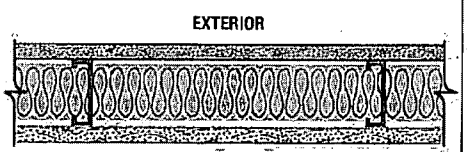
Wall Thickness: 4-7/8" (124 mm)

Weight per Sq. Ft.: 6 psf (29 kg/m²)

Exterior: 5/8" (15.9 mm) DensGlass Fireguard Sheathing applied vertically to min. 3-5/8" (92 mm) corrosion resistant 25-gauge (18 mils) steel studs 24" (610 mm) o.c. with 1" (25 mm) corrosion resistant bugle head screws 8" (203 mm) o.c. at board edges and 8" (203 mm) at intermediate studs.

Interior: 5/8" (15.9 mm) DensArmor Plus Fireguard or 5/8" (15.9 mm) ToughRock Fireguard gypsum board applied vertically to framing with 1" (25 mm) Type S bugle head screws 8" (203 mm) o.c. at board edges and 12" (305 mm) at intermediate studs.

1-Hour Fire Rating



Test Reference: UL U425,[1] cUL U425

Wall Thickness: 4-3/4" (121 mm)

Weight per Sq. Ft.: 6 psf (29 kg/m²)

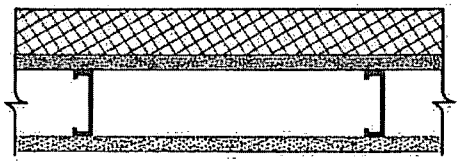
Exterior: 5/8" (15.9 mm) DensGlass® Sheathing applied vertically to min. 3-1/2" (89 mm) corrosion resistant 20-gauge (30 mils) steel studs 24" (610 mm) o.c. with 1" (25 mm) Type S corrosion resistant bugle head screws 8" (203 mm) o.c.

Interior: 5/8" (15.9 mm) DensArmor Plus Fireguard or 5/8" (15.9 mm) ToughRock Fireguard gypsum board applied vertically to framing with 1" (25 mm) Type S bugle head screws 12"(305 mm) o.c. Insulation to completely fill stud cavity. **(Load-bearing: 100% of design load)**

[1]Load restricted for Canadian applications—see UL Guide BXUV7.

Fire-Rated Assemblies (Steel-Framed) continued

1-Hour Fire Rating



Test Reference: SWRI 01-4409-003, GA WP 8122

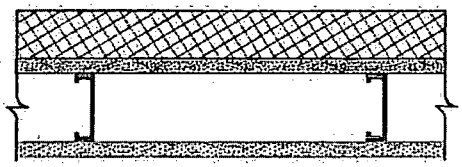
Partition Thickness: 6" – 7" (152 – 178 mm) Varies based on insulation thickness

Weight per Sq. Ft.: 7.0 (34 kg/m²)

Exterior: 5/8" (15.9 mm) DensGlass® Fireguard® Sheathing applied parallel to 3-5/8" (92 mm) 18-gauge (43 mils) steel studs 16" (406 mm) o.c. with #6 x 1-1/4" (32 mm) self-drilling, corrosion-resistant, bugle head, drywall screws 8" (203 mm) o.c. at edges and ends and 8" (203 mm) o.c. at intermediate studs. Proprietary polymer modified exterior insulation and finish system applied over sheathing. 2" (51 mm) maximum foam-plastic thickness.

Interior: 5/8" (15.9 mm) ToughRock® Fireguard® or 5/8" (15.9 mm) DensArmor Plus® Fireguard® gypsum board applied parallel to studs with #6 x 1-1/4" (32 mm) self-drilling, bugle head drywall screws 8" (203 mm) o.c. at edges and ends and 12" (305 mm) o.c. at intermediate studs.

1-Hour Fire Rating



Test Reference: SWRI 01-4409-001, GA WP 8123

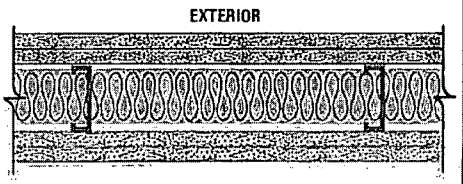
Partition Thickness: 6" – 9" (152 – 229 mm) Varies based on insulation thickness

Weight per Sq. Ft.: 7.0 (34 kg/m²)

Exterior: 5/8" (15.9 mm) DensGlass Fireguard Sheathing applied parallel to 3-5/8" (92 mm) 18-gauge (43 mils) steel studs 24" (610 mm) o.c. with #6 x 1-1/4" (32 mm) self-drilling, corrosion-resistant, bugle head, drywall screws 8" (203 mm) o.c. at edges and ends and 8" (203 mm) o.c. at intermediate studs. Polymer-based exterior insulation and finish system applied over sheathing. 4" (102 mm) maximum foam-on-plastic thickness.

Interior: One layer 5/8" (15.9 mm) ToughRock Fireguard or 5/8" (15.9 mm) DensArmor Plus Fireguard gypsum board applied parallel to studs with #6 x 1-1/4" (32 mm) self-drilling, bugle head drywall screws 8" (203 mm) o.c. at edges and ends and 12" (305 mm) o.c. at intermediate studs.

2-Hour Fire Rating



Test Reference: UL U425[1], cUL U425

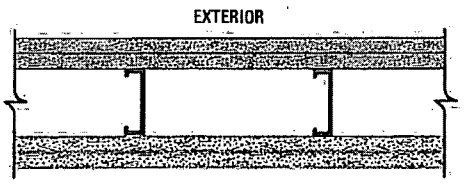
Wall Thickness: 6" (152 mm)

Weight per Sq. Ft.: 11.0 psf (54 kg/m²)

Exterior: Two layers 5/8" (15.9 mm) DensGlass Fireguard Sheathing applied vertically to min. 3-1/2" (89 mm) corrosion resistant 20-gauge (30 mils) steel studs 24" (610 mm) o.c. Base layer attached with 1" (25 mm) Type S-12 corrosion resistant bugle head screws 8" (203 mm) o.c. Face layer attached with 1-5/8" (41 mm) Type S-12 corrosion resistant bugle head screws spaced 8" (203 mm) o.c. Joints staggered.

Interior: Two layers 5/8" (15.9 mm) DensArmor Plus Fireguard or 5/8" (15.9 mm) ToughRock Fireguard gypsum board applied vertically to framing. Base layer attached with 1" (25 mm) Type S-12 bugle head screws 12" (305 mm) o.c. Face layer attached with 1-5/8" (41 mm) Type S-12 bugle head screws spaced 12" (305 mm) o.c. Joints staggered. Insulation to completely fill stud cavity. **(Load-bearing: 80% of design load)**

2-Hour Fire Rating



Test Reference: UL U411, cUL U411

Wall Thickness: 5" (127 mm)

Weight per Sq. Ft.: 11.0 (54 kg/m²)

Exterior: Two layers 5/8" (15.9 mm) DensGlass Fireguard Sheathing applied vertically to min. 2-1/2" (64 mm) corrosion resistant 25-gauge (18 mils) steel studs 24" (610 mm) o.c. Base layer attached with 1" (25 mm) Type S corrosion resistant bugle head screws 16" (406 mm) o.c. Face layer attached with 1-5/8" (41 mm) Type S corrosion resistant bugle head screws spaced 8" (203 mm) o.c. Joints staggered.

Interior: Two layers 5/8" (15.9 mm) DensArmor Plus Fireguard or 5/8" (15.9 mm) ToughRock Fireguard gypsum board applied vertically to framing. Base layer attached with 1" (25 mm) Type S bugle head screws 16" (406 mm) o.c. Face layer attached with 1-5/8" (41 mm) Type S bugle head screws spaced 16" (406 mm) o.c. in the field and along vertical edges and 12" (305 mm) o.c. to the floor and ceiling runners. Joints staggered. Batt or blanket insulation optional.

[1]*Load restricted for Canadian applications—see UL Guide BXUV7.*

CAUTION: For product fire, safety and use information, go to gp.com/safetyinfo.

Architectural Specifications

Part 1 – General

1.0 Description

Work in this section includes, but is not limited to: wall, ceiling and soffit sheathing.

Related work specified elsewhere:

Brick masonry	Finish carpentry	Joint sealers
Stone	Exterior Insulation and Finish Systems (EIFS)	Light-gauge metal framing
Cold-formed metal framing	Siding	Painting
Rough carpentry		

1.1 Submittals

Product Data: Submit manufacturer's descriptive literature indicating material composition, thickness, sizes and fire resistance.

1.2 Quality Assurance

Fire-resistance ratings: Where applicable, provide materials and construction that are identical to those of assemblies whose fire-resistance ratings are indicated.

1.3 Delivery, Storage and Handling

Delivery: Deliver materials to the job site in manufacturer's original packaging, containers and bundles with manufacturer's brand name and identification intact and legible. Product also may be wrapped in temporary factory-applied plastic packaging (plastic wrap) that **must** be removed upon receipt. Reference GA801 for storage information. **Failure to remove the plastic shipping covers and plastic wrap may result in entrapment of condensation or moisture, which may cause application problems.**

Storage and handling: Store flat on a level surface and handle materials to protect against contact with damp and wet surfaces, exposure to weather, breakage and damage to edges. Provide air circulation under covering and around stacks of materials.

Part 2 – Products

2.0 Sheathing Board

Acceptable Products: 1/2" (12.7 mm) DensGlass® Sheathing; 5/8" (15.9 mm) DensGlass® Fireguard® Sheathing

Size: DensGlass Sheathing: 1/2" (12.7mm) thick by 4' (1219 mm) by 8' (2438 mm), 9' (2743 mm) or 10' (3048 mm) (1.9 lb. per square foot) (9.3 kg/m²); DensGlass Fireguard Sheathing: 5/8" (15.9mm) thick x 4' (1219 mm) x 8' (2438 mm), 9' (2743 mm) or 10' (3048 mm) (2.5 lb. per square foot) (12 kg/m²).

Composition: Gypsum sheathing manufactured in accordance with ASTM C 1177 with fiberglass mats both sides and long edges, water-resistant treated core.

Fire resistance: Noncombustible as described and tested in accordance with ASTM E 136 and CAN/ULC-S114.

1/2" or 5/8" (12.7 mm or 15.9 mm) DensGlass Sheathing: Flame spread 10, when tested in accordance with ASTM E 84 and CAN/ULC S-102. 5/8" (15.9 mm) DensGlass Fireguard Sheathing is rated Type X as defined in ASTM C 1177 and can be used as a replacement to any other generic assembly utilizing a 5/8" (15.9 mm) Type X gypsum board (see GA-600 for numeric assemblies). DensGlass Fireguard Sheathing is UL classified, Type DGG, in UL designs G501, G520, G531, L501, L508, L532, L556, L591, N501, N502, N505, N602, P225, P227, P230, P235, P254, P259, P266, P302, P516, P517, P701, P710, P711, P713, P714, P717, P718, P719, P720, P722, P725, P728, P729, P730, P731, P732, P733, P734, P735, P738, P739, P740, P741, P742, P801, P811, P815, P819, P824, P825, P826, P827, P828, S728, S736, U017, U032, U040, U204, U207, U301, U302, U305, U309, U326, U329, U330, U332, U337, U338, U339, U341, U342, U351, U354, U355, U356, U357, U358, U360, U364, U369, U379, U411, U418, U420, U425, U434, U436, U439, U442, U449, U450, U460, U465, U467, U473, U475, U487, U494, U495, U502, U504, U505, U506, U510, U512, U531, U603, U617, U623, U626, U633, U640, U646, U647, U648, U649, U651, U652, U926, V415, V417, V419, V420, V421, V430, V432, V434, V435, V450, V473, V486, V487, V490, X508, X516, X517, X525, X526, X527, X528, X535, X602, X604 and ULC classified, Type DGG in ULC designs: EW10, EW17, U301, U302, W301, W404, W415, W442 and W465. DensGlass Fireguard Sheathing can be used in UL assemblies where the gypsum board is listed as *Gypsum Board (Classified or Unclassified)* for thicknesses up to 5/8" (15.9 mm).

2.1 Air- and Water-Resistive Barrier

If required by local building code, #15, nonperforated, asphalt saturated felt complying with ASTM D 226, Type 1, synthetic building wraps complying with ASTM E 1677, or other water-resistive barrier system meeting local building code requirements.

2.2 Accessories

Joint tape: 2" (51 mm) wide fiberglass mesh tape, see 3.2.A.

Joint compound: ToughRock® setting-type joint compound, see 3.2.A.

Nails, wood framing: 11-gauge galvanized roofing nails, 1-1/2" (38 mm) min. length for 1/2" (12.7 mm) DensGlass® Sheathing and 1-3/4" (45 mm) length for 5/8" (15.9 mm) DensGlass® Fireguard® Sheathing.

Screws, metal framing: Bugle or wafer head, self-tapping, rust-resistant, fine thread for heavy-steel gauge. Bugle or wafer head, rust-resistant sharp point, fine thread for light-gauge metal framing or furring.

Screws, wood framing: Rust-resistant, bugle or wafer head, coarse thread, 1-1/4" (32 mm) length sharp point for wood.

Part 3 – Execution

3.0 Preparation

Examine subframing; verify that surface of framing and furring members to receive sheathing does not vary more than 1/8" (3 mm) from the placement of faces of adjacent members.

3.1 Sheathing

Provide DensGlass Sheathing where indicated on drawings. Install sheathing in accordance with manufacturer's instructions and applicable instructions in GA-253 and ASTM C 1280.

Install DensGlass Sheathing with GOLD side out.

Use maximum lengths possible to minimize number of joints.

Attach DensGlass Sheathing to wood framing with nails spaced 4" (102 mm) o.c. at perimeter for racking shear resistance; 8" (203 mm) o.c. at perimeter where there are framing supports and where racking shear resistance is not required; and 8" (203 mm) o.c. along intermediate framing in field for both conditions. Unless specified otherwise, attach DensGlass Sheathing to metal framing with screws spaced 8" (203 mm) o.c. at perimeter where there are framing supports; and 8" (203 mm) o.c. along intermediate framing in field. A greater number of fasteners may be specified to obtain specific values.

Drive fasteners to bear tight against and flush with surface of sheathing. Do not countersink. Locate fasteners minimum 3/8" (10 mm) from edges and ends of sheathing panels, tight against and flush with surface of sheathing.

Water-Resistive Barrier: If a water-resistive barrier is required by the local building code, design professional, owner or cladding manufacturer over DensGlass Sheathing, one of the following procedures may be used. Consult building code or design authority for proper application selection. Follow manufacturer's installation recommendations.

A. Entire exterior face of gypsum sheathing covered with an asphalt impregnated felt or synthetic fiber wrap such as Tyvek® Commercial Wrap, or equal.

B. Liquid applied barriers such as Sto Guard® as manufactured by Sto Corp., Dryvit's Backstop® NT, Prosoco R-GUARD™, or equal.

C. Self adhering membranes.

3.2 Painted Ceilings and Soffits

Soffits must be dried in and protected from the elements during and after installation.

A. Apply fiberglass mesh joint tape over joints and embed in setting-type joint compound specified. Skim coat surface with setting-type joint compound for smooth finish. Prime and paint with exterior grade, high quality paint.

B. Apply EIFS with or without insulation; install as recommended by manufacturer.

Limitations

DensGlass® Sheathing is resistant to normal weather conditions, but it is not intended for immersion in water. Cascading roof/floor water should be directed away from the sheathing until appropriate drainage is installed.

Avoid any condition that will create moisture in the air and condensation on the exterior walls during periods when the exterior temperature is lower than the interior. The use of forced air heaters creates volumes of water vapor which, when not properly vented, can condense on building materials. The use of these heaters and any resulting damage is not the responsibility of Georgia-Pacific Gypsum. Consult heater manufacturer for proper use and ventilation. Vapor barrier may also restrict ventilation.

When DensGlass Sheathing panels are used in slanted wall applications, that portion of the wall must be temporarily protected from the elements by the use of a water-resistant barrier prior to application of the cladding. Do not allow water to pond or settle on sheathing. Also, exposed wall ends such as those that may be found in parapets must be covered to prevent water from infiltrating the cavity.

Georgia-Pacific Gypsum does not warrant and is not responsible or liable for the performance of the cladding or exterior systems applied over DensGlass Sheathing. The suitability and compatibility of any system is the responsibility of the system manufacturer or design authority.

Do not laminate DensGlass Sheathing to masonry surfaces; use furring strips or framing.

DensGlass Sheathing is not intended for roof applications. For roof applications, consult our DensDeck® Roof Board brochure.

DensGlass Sheathing is not intended for interior or exterior tile applications. For interior tile applications, consult our DensShield® Tile Backer brochure.

DensGlass Sheathing should not be used in lieu of plywood where required.

Do not apply DensGlass Sheathing below grade.

For all installations, design details such as fasteners, sealants and control joints per system specifications must be properly installed. Openings and penetrations must be properly flashed and sealed. Failure to do so will void the warranty.

Do not use DensGlass Sheathing as a base for nailing or mechanical fastening. Fasteners should be flush to the face of the board, not countersunk.

COMMONLY USED METRIC CONVERSIONS

Gypsum Board Thickness

1/4 in. – 6 mm
1/2 in. – 12.7 mm
5/8 in. – 15.9 mm
1 in. – 25.4 mm

Gypsum Board Width

2 ft. – 610 mm
4 ft. – 1219 mm
32 in. – 813 mm

Gypsum Board Length

4 ft. – 1219 mm
5 ft. – 1524 mm
8 ft. – 2438 mm
9 ft. – 2743 mm
10 ft. – 3048 mm
12 ft. – 3658 mm

Framing Spacing

16 in. – 406 mm
24 in. – 610 mm

Fastener Spacing

2 in. – 51 mm
2.5 in. – 64 mm
7 in. – 178 mm
8 in. – 203 mm
12 in. – 305 mm
16 in. – 406 mm
24 in. – 610 mm

Temperature

40°F – 5°C
50°F – 10°C
125°F – 52°C

The Dens™ Brand of High-Performance Gypsum Products from Georgia-Pacific

DensGlass® Sheathing	The original and universal standard of exterior gypsum sheathing offers superior weather resistance, with a 12-month weather exposure limited warranty. Look for the familiar GOLD color.
DensShield® Tile Backer	Acrylic-coated tile backer stops moisture at the surface. Lightweight and strong, built for speed on the job site. IBC/IRC Code Compliant. GREENGUARD listed for microbial resistance.
DensDeck® Roof Boards	Fiberglass mat roof board used as the ideal thermal barrier and cover board to improve resistance to wind uplift, hail, foot traffic, fire, moisture and mold in a broad range of commercial roofing applications. Look for green DensDeck Prime and DensDeck DuraGuard, too.
DensGlass® Shaftliner	Specially-designed panels for moisture-prone vertical or horizontal shafts, interior stairwells and area separation wall assemblies. 12-month weather exposure limited warranty. GREENGUARD listed for microbial resistance.
DensArmor Plus® High-Performance Interior Panel	High-performance interior panel accelerates scheduling because it can be installed before the building is dried-in. 12-month weather exposure limited warranty. GREENGUARD Indoor Air Quality Certified,® GREENGUARD Children & Schools℠ Certified and CHPS™ listed for low emissions. GREENGUARD listed for microbial resistance.
DensArmor Plus® Abuse-Resistant Interior Panel	Same benefits as DensArmor Plus® High-Performance Interior Panel with added resistance to scuffs, abrasions and surface indentations. Ideal for healthcare facilities and schools. GREENGUARD Indoor Air Quality Certified,® GREENGUARD Children & Schools℠ Certified and CHPS™ listed for low emissions. GREENGUARD listed for microbial resistance.
DensArmor Plus® Impact-Resistant Interior Panel	Even greater durability with an embedded impact-resistant mesh for the ultimate resistance in high traffic areas. Ideal for healthcare facilities, schools and correctional institutions. GREENGUARD Indoor Air Quality Certified,® GREENGUARD Children & Schools℠ Certified and CHPS™ listed for low emissions. GREENGUARD listed for microbial resistance.

Georgia-Pacific
Gypsum

U.S.A. Georgia-Pacific Gypsum LLC
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FIRE SAFETY CAUTION – Passing a fire test in a controlled laboratory setting and/or certifying or labeling a product as having a one-hour, two-hour, or any other fire resistance or protection rating and, therefore, as acceptable for use in certain fire rated assemblies/systems, does not mean that either a particular assembly/system incorporating the product, or any given piece of the product itself, will necessarily provide one-hour fire resistance, two-hour fire resistance, or any other specified fire resistance or protection in an actual fire. In the event of an actual fire, you should immediately take any and all actions necessary for your safety and the safety of others without regard for any fire rating of any product or assembly/system.

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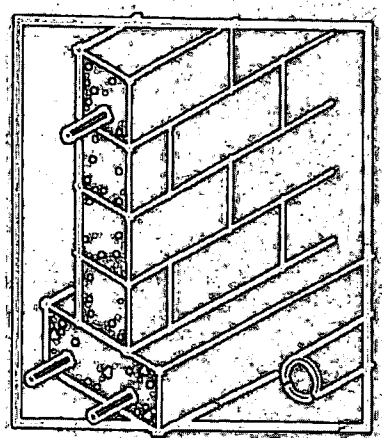
Volume 1

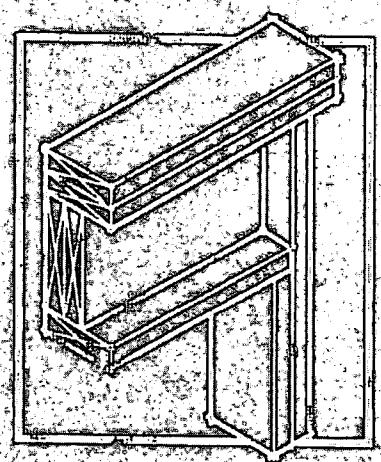
JLC FIELD GUIDE

TO RESIDENTIAL CONSTRUCTION

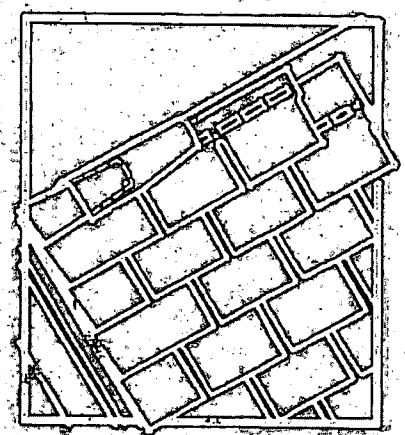
A Manual of Best Practice



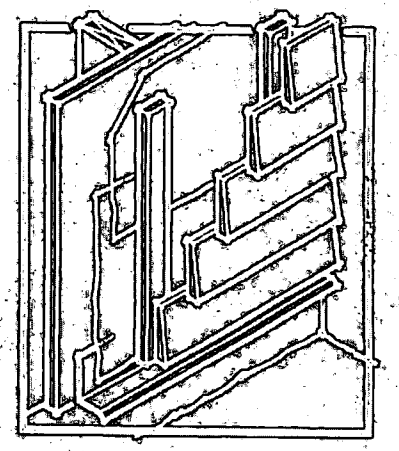
FOUNDATIONS



FRAMING



ROOFING



EXTERIORS

A JOURNAL OF LIGHT CONSTRUCTION BOOK

2560

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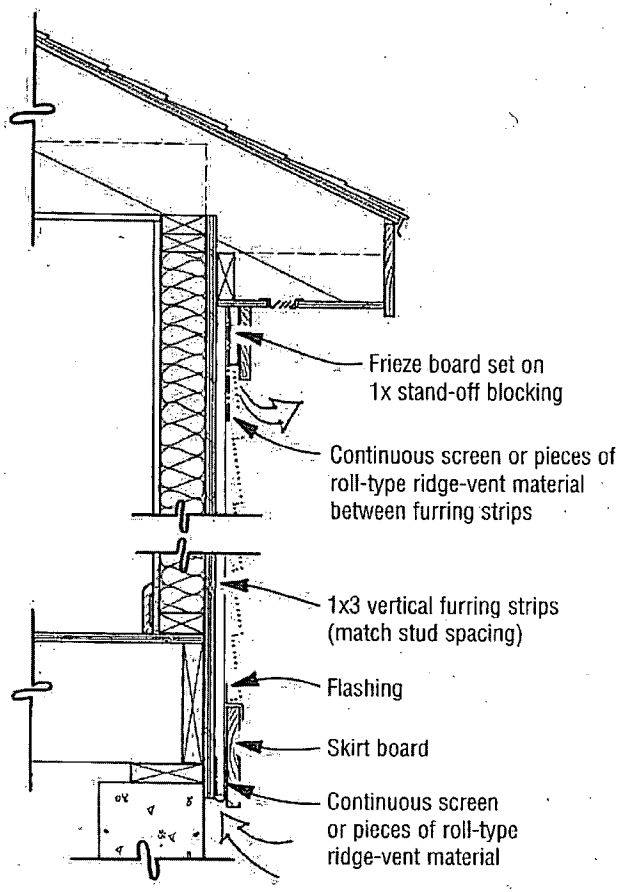
Figure 4-9. Drainage Plane



Siding that is pressed up tight against sheathing (even with felt or plastic housewrap) will retain moisture, causing the siding and finish to fail prematurely and water to move into walls. All siding should be installed over battens that create an air space behind the siding so water can drain down and out.

For more information: "Water-Managed Wall Systems," JLC 3/06

"Making Walls Watertight," JLC 12/95

ALL SIDINGS WILL LEAK. MOST WATER THAT LEAKS BEHIND THE siding is driven by rain or wicks into small cracks. Caulks and sealants are not an answer to stopping water penetration. Instead, all siding materials should be applied over a drainage plane (also called a rain screen) to allow water to fall down and out. This drainage plane is created by first applying sheathing wrap and flashings — lapped to shed water — and then by creating an air space and weep holes so water can drain away from the building (Figure 4-9).

SHEATHING WRAP MATERIALS

Sheathing wraps that work well include asphalt-saturated felt and plastic housewraps.

Type D kraft paper (a lighter black paper than asphalt felt), sisal kraft paper (asphalt sandwiched between two layers of kraft paper), and cross-laminated plastic housewraps all perform poorly in rainy and snowy climates. However, two layers of Type D paper work well beneath stucco in most climates (see "Stucco Drainage Plane," page 346).

All sheathing wrap must be integrated with flashing materials. It's not enough to wrap a house, and then to simply X-cut the openings and fold the flaps inside. Follow the guidelines in Figure 4-10 when installing any sheathing wrap.

Asphalt-Saturated Felt

Commonly available in two weights, asphalt felt, or "black paper," is made from recycled corrugated papers mixed with sawdust and an asphalt resin. When it actually was made from cotton felt, 15-lb. felt weighed 15 pounds per square, and 30-lb. felt weighed 30 pounds per square. These days, asphalt felt weighs considerably less (between 6 and 12 pounds per square) and is now simply designated No. 15 and No. 30.

When choosing No. 15 felt, look for material rated ASTM D4869 or ASTM D229. The better material is rated by the more stringent ASTM D229 standard, which ensures a weight of at least 11.5 lbs. per square.

The biggest drawback to using asphalt felt as a sheathing wrap is that it's difficult to apply well on walls. Generally, wrinkles are not a problem, but tears — particularly at inside corners — should be avoided. Also, try to prevent sags between the relatively narrow (36-in.) courses.

Plastic Housewrap

Drainage Planes

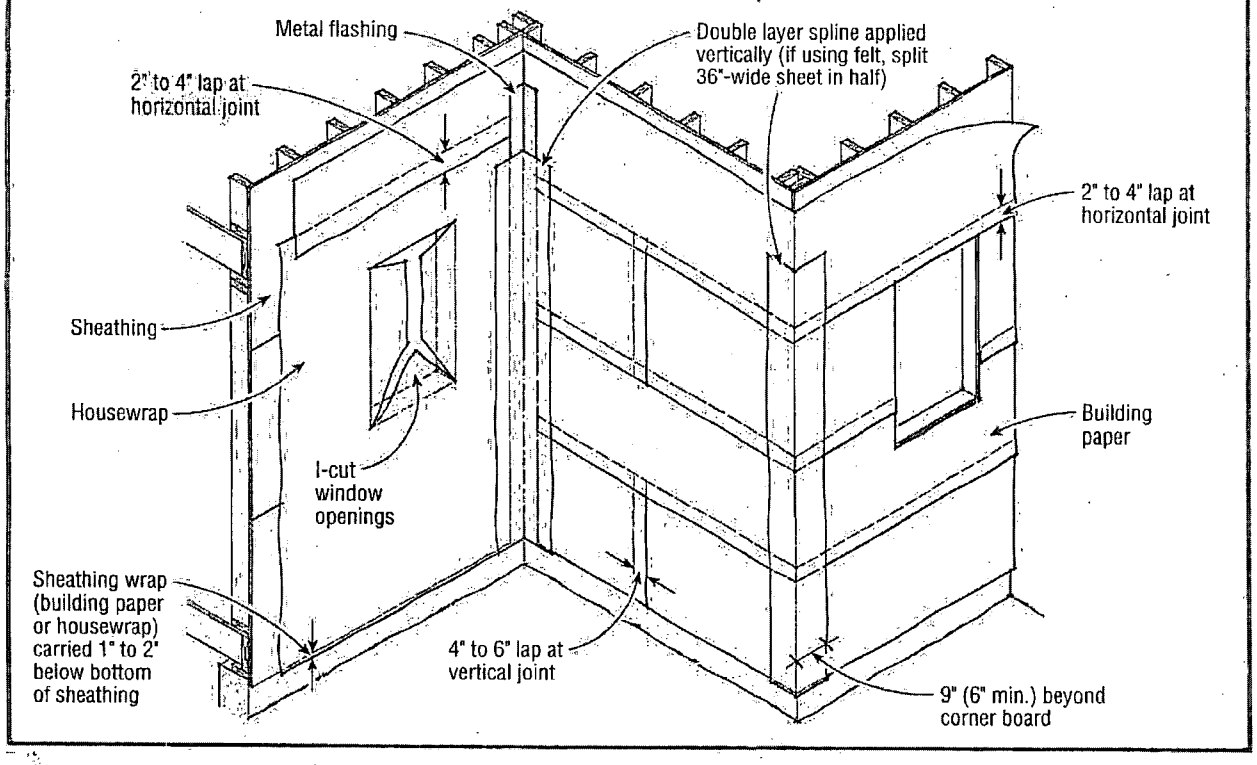
Sheathing Wrap

In cold temperatures, plastic housewraps stay more flexible than paper and felt wraps. Also, plastic housewraps resist tearing, so they are easier to apply.

Plastic housewraps typically are made of polyolefin fabric — either polyethylene or polypropylene. The primary difference in housewraps is whether or not they are perforated:

- Perforated products are made from a vapor-tight plastic, and then needle-punched to allow the wrap to "breathe"

Figure 4–10. Sheathing Wrap Details



All sheathing wraps must be applied from the bottom to the top, so upper courses lap over lower courses and shed water away from the house. Always carry the sheet around corners, then reinforce the barrier at the corner by applying a second layer, or spline. This spline should extend at least 6 in. beyond the joint between the siding and corner boards.

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(allow vapor to pass through). Unfortunately, these holes also allow liquid water to seep through, particularly when the siding is pressed tight against it. The housewrap will slow the seepage but will not block it entirely.

- **Non-perforated** housewraps are made from a plastic fiber that allows vapor to pass between the fibers. These generally perform much better than perforated products at resisting liquid water, which should be considered their primary task. Relatively few houses suffer from water vapor penetrating from outside, but many suffer from rain and snow infiltration.

Leaching

Housewraps are susceptible to damage from extractives that can leach from wood siding materials, particularly cedar and redwood. This can be prevented in two ways:

- Install siding on battens to create an air gap, which reduces contact between the sheathing wrap and siding (**Figure 4-9, page 296**).
- Back-prime all wood siding materials. This reduces leaching and blocks moisture from moving through the siding and blistering the finish (see "Finishes," **pages 373-380**).

INSTALLING SHEATHING WRAP

For more information: "Choosing a Sheathing Wrap," JLC 8/00

"Wrapping the House," JLC 3/00

The primary purpose of housewrap is to stop water, not air. Air-sealing and vapor control are secondary. See **Figure 4-10, previous page**, for details about how to lap sheathing wrap to shed water.

- Use sheathing wrap or felt paper on all houses, no matter what kind of siding is used.
- The wrap should be continuous; avoid a patchwork of small pieces. Review flashing details (**pages 302-306**), as some flashings (such as those around electrical fixtures, mechanical penetrations, etc.) should be installed concurrent with sheathing wrap.
- Lap upper courses of housewrap over lower courses 4 in. and lap vertical seams 12 in. Code requires a horizontal lap of only 2 in. and a vertical lap of 6 in., but water may still back up beyond these minimal overlaps.
- Do not X-cut sheathing wrap at openings. Instead, I-cut the sheathing wrap, running the knife along the rough opening at the head and sill, and then slitting vertically in the center of the opening (see **Figure 4-10, previous page**).
- If the walls are wrapped while they are lying on the deck before standing them up, be sure to add a course of sheathing wrap to cover the rim joist. Remember, this course must lap under the sheathing wrap above it.
- Always wrap gable ends. This part of a house sees a lot of exposure to wind-driven water, but often is neglected when contractors assume that the sheathing wrap is meant to stop air.
- Add a second layer of sheathing wrap along inside and outside house corners, lapping at least 9 in. (an even multiple of 36-in.-wide asphalt felt) on each wall.
- Control splashback by sloping the grade around the house and keeping siding at least 8 in. above grade. At decks and stoops where splashback may be a problem, use a wide peel-and-stick flashing membrane (see "Flexible Flashing Materials," opposite page). Make sure this membrane laps under the sheathing wrap above it.
- All flashing (for windows, doors, deck ledgers, electrical fixtures, vents, pipes, and cantilevered beams) must lap

under the sheathing wrap above it. Do not rely on tape to seal the flashing.

To Tape or Not

Manufacturers of plastic housewrap recommend taping all seams to block air leakage through walls. However, typical plywood and OSB sheathing are impermeable to air, so there is no need to tape all the seams.

Some tape is useful for stopping water leaks by repairing rips (particularly tears around staples) and for securing the wrap to flashing before the siding is in place. For best results, use a polypropylene tape intended for sheathing wrap or a flexible, peel-and-stick flashing. A high-quality polyurethane rubber caulk may also be used to seal plastic housewrap (see "Caulks and Sealants," page 371).

Do not patch over housewrap and rely on the stickiness of tape to seal the patch. Always lap housewrap and flashings under the piece of sheathing wrap above.

FLEXIBLE FLASHING MATERIALS

Flexible flashing — a self-adhering bituminous tape — should be used to flash all the following: exterior door sills; deck ledgers; inside and outside corners of wall sheathing; stucco shelves and parapets; below-grade concrete cracks; and wall areas subject to splashback.

Flexible flashings come in several varieties, including "peel-and-stick" products, as well as non-stick products.

RUBBERIZED-ASPHALT FLASHINGS

Self-adhesive, rubberized asphalt flashings are made from the same materials as the eaves membranes used to prevent ice dam leaks. Typically available in rolls from 4- to 12-in. wide (but sometimes available up to 36 in. wide), these flexible flashings can be applied directly to the sheathing, as long as the surface is warm and relatively clean.

Flexible Flashing

Thickness varies from 25- to 60-mils. The thinner the material, the easier it can be folded and tucked beneath siding, but also the easier it will tear and degrade in sunlight.

Climate Cautions

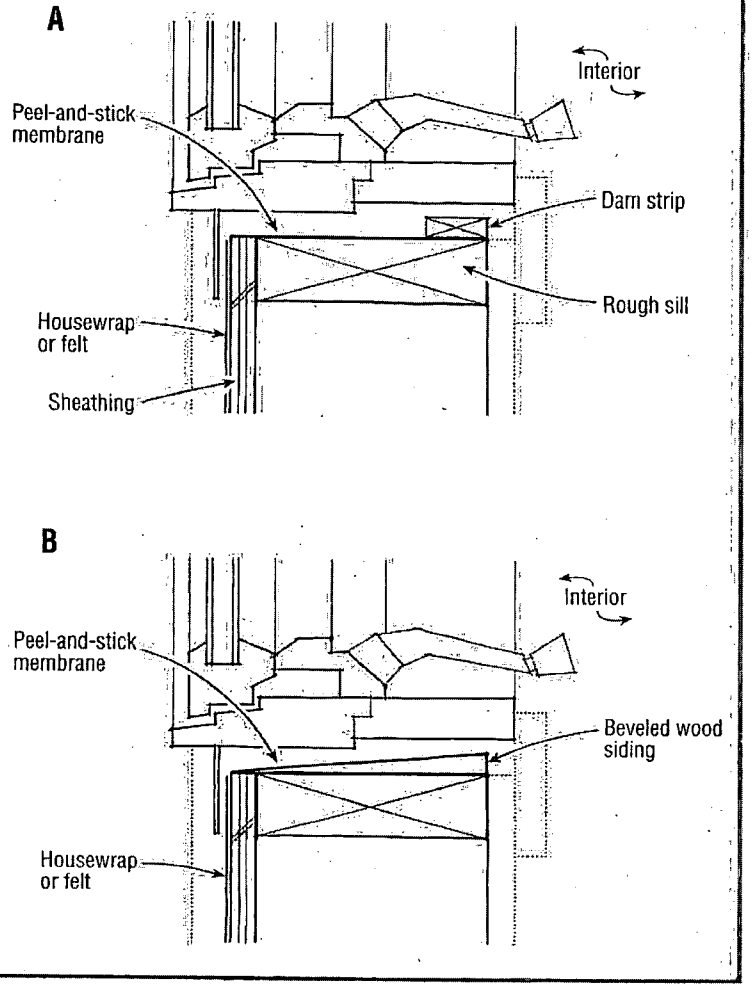
- **In warm temperatures,** when rubberized asphalt is the stickiest, it is nearly impossible to reposition it once the flashing has touched the surface. Make sure to dry-fit before pulling the release paper. It is also very difficult to handle alone when it is this sticky.
- **In hot temperatures,** rubberized asphalt tends to ooze, making it messy to handle. In sunbelt areas (or wherever surface temperatures might exceed 180°F), avoid using with metal flashings; the flashings will cook and the asphalt soon dries out, usually after creating a dripping mess.
- **In cold weather,** self-adhering flashings often don't stick well. Check the manufacturer's minimum application temperature. Some stick in temperatures below 25°F, but most require surface temperatures of 40°F or greater.

Compatibility

The solvents in rubberized asphalt will stain rolled vinyl flashing — the flexible coiled trim stock — but generally will not hurt the more rigid vinyls used for window fins and siding.

Do not use rubberized asphalt and butyl tapes together. On concrete, masonry, or OSB, rubberized-asphalt flashings may not stick well unless a primer is applied. On these surfaces, a butyl flashing works better.

Figure 4-11. Sill Flashing Details



Apply a narrow dam strip or bevel cant strip to the rough sill before flashing with sheathing wrap or a flexible flashing membrane.

For more information: "Choosing Flexible Flashing," JLC 6/01

"Controlling Moisture in Mixed Climates," JLC 8/97

"Avoiding Moisture Problems in Cooling Climates," 10/97

Poly vs. foil. Rubberized-asphalt flashings typically come with a polyethylene or foil covering to protect them from sunlight. Poly-covered products need to be covered from sunlight within 30 to 60 days; foil-covered tapes have no exact exposure limitations but eventually will dry out and become brittle in full sunlight. Once the flashing has become brittle, any shift in surface movement will pull at the bond until either the bond fails or the membrane cracks.

Exposed applications. In permanently exposed applications, use an EPDM flashing tape instead of an inexpensive flexible flashing material. The drawback with EPDM tape is that it's expensive, as well as quite thick (about 70-mil), making it awkward to fold into small areas.

BUTYL RUBBER FLASHINGS

Butyl costs about twice as much as rubberized asphalt, but concedes great results: The adhesive lasts longer and sticks over a wider range of temperatures. Butyl grabs better onto rough surfaces, such as concrete and OSB, yet the bond develops slowly, allowing for easy repositioning. Also, butyl is less likely to ooze in high temperatures or to stain a finished surface.

Like rubberized asphalt products, butyl flashings are available with either a polyethylene or foil surface. Poly-covered flashings should be covered within 30 days to protect from UV light. Foil does a good job at reflecting the UV light, but it still heats up in exposed sunlight. It will hold out longer, but when left exposed, foil-faced flashing eventually will degrade.

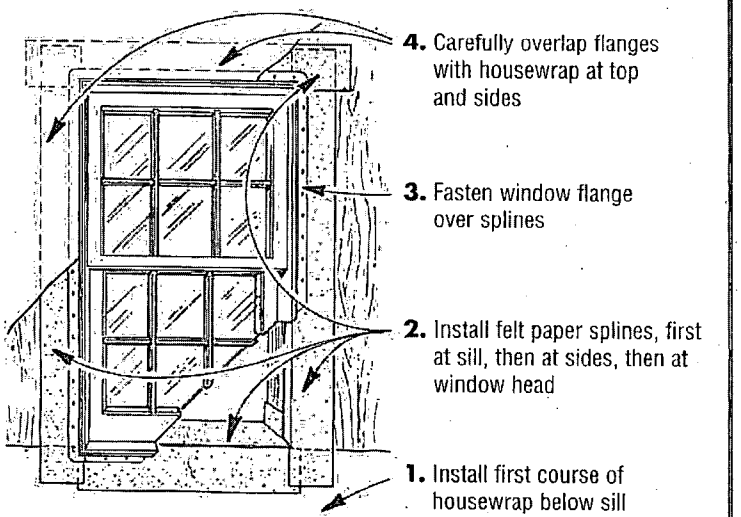
Compatibility. Do not use butyl flashing near any

asphalt-based products. The butyl and the asphalt products will both dry out faster and loose their adhesion.

NONSTICK FLASHINGS

Not all flexible flashings are self-adhering. Some must be secured with staples or roofing nails. While generally thinner and the quickest to deteriorate in sunlight, these are often the best choice for applying beneath siding and trim in consistently cold temperatures, or when the surface is rough or dirty — factors that can diminish the bond of peel-and-stick flashings. Cover nonstick flashing as soon as possible to protect it from sunlight.

Figure 4-12. Window Splines

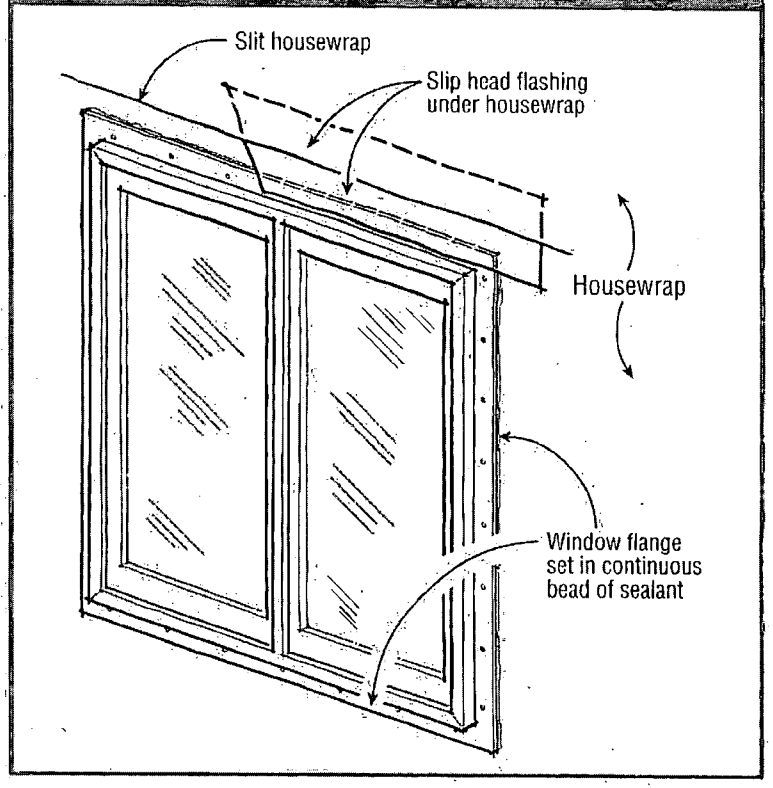


Flash windows and doors with window splines cut from felt paper or flexible flashing. Make sure the sheathing wrap laps over the splines at the top and sides. At the sill, however, the bottom end of the spline and the sill flashing should overlap the sheathing wrap..

DRAINAGE PLANE

Water will always get behind siding. Wind blows in through gaps, and when the sun beats down on wet siding, it drives

Figure 4-13. Window Head Flashing



If the window flange is not tucked under the sheathing when the window is installed, slit the housewrap and then slip in a piece of flexible flashing and drape it over the flange.

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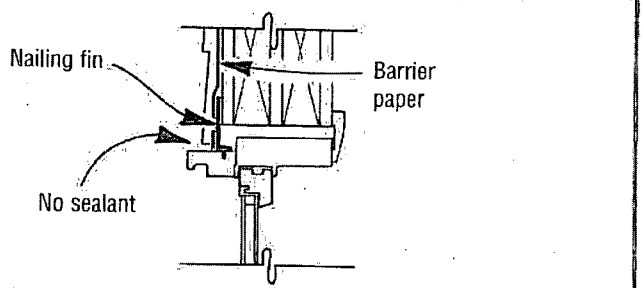
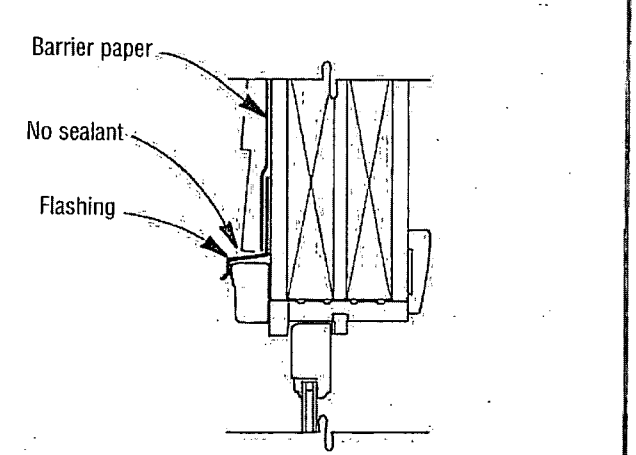
Figure 4-14. Flanged Window Head



With flanged windows, make sure the sheathing wrap laps over the top fin. Leave a 1/4-in. gap between the siding and the flange, but don't caulk this gap. Water draining from above must have a place to exit.

Figure 4-15. Unflanged Window Head



With unflanged windows, install metal Z-flashing under the sheathing wrap and over the window head trim.

For more information: "Water Managed Wall Systems," JLC 3/03

"Making Walls Watertight," JLC 12/95

moisture inward. No siding material is impervious to water, and if the siding is pressed tight against plastic housewrap or applied over foam sheathing, the front of the siding tends to dry while the back stays wet. This stresses all types of siding: It cups boards, curls shingles, accelerates stucco cracks, and weakens mortar bonds in brick veneer. With all siding, an air space behind the siding (1/4- to 3/8-in. is enough) will allow water to drain and the backside of the siding to dry.

Well-Drained Wall Systems

Different sidings call for different drainage details. Typical details for well-draining walls are shown for different types of siding:

Board siding, Figure 4-37, page 322;

Shake and shingle siding, Figure 4-41, page 326;

Vinyl siding, Figure 4-51, page 333;

Stucco, Figure 4-66, page 346.

In each case, an air space must be created behind the siding and an exit provided for water to drain out.

FLASHING DETAILS

- Never rely on the stickiness of peel-and-stick flashings for sealing; the bond is unlikely to last over the life-span of the house.
- Always lap flashings under the sheathing wrap above.

FLASHING WINDOWS

Do not X-cut sheathing wrap at openings. Instead, I-cut the sheathing wrap, running the knife horizontally along the rough opening at the head and sill, then slitting vertically in the center of the opening (Figure 4-10, page 297). This way,

the window flange can be slipped under the sheathing wrap when installing the window.

Sill details: Install a beveled cant strip or narrow dam strip to the rough opening sill, then wrap the sill with sheathing wrap or a flexible flashing membrane (**Figure 4-11, page 300**). Make sure this membrane drapes over the sheathing wrap below.

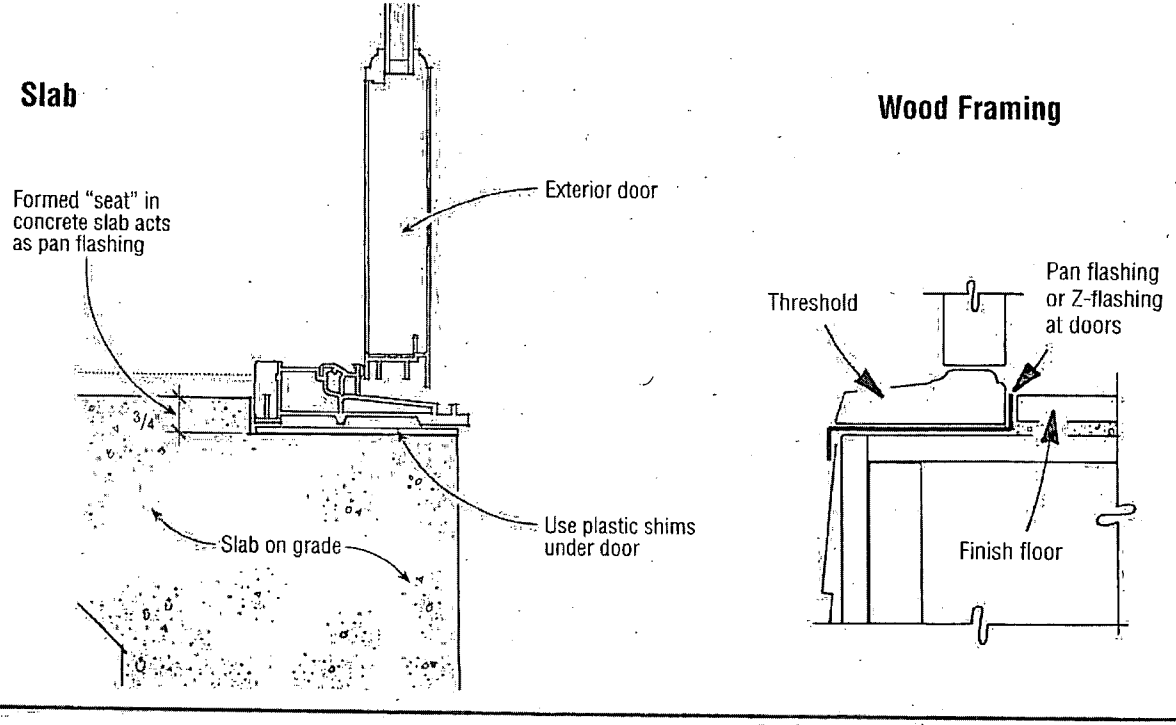
All sheathing wrap must be integrated with flashing materials. It's not enough to wrap a house, and then to simply X-cut the openings and fold the flaps inside. Follow the guidelines in **Figure 4-10 (page 297)** when installing any sheathing wrap.

Flashing Windows and Doors

Window and Door Splines

Water will leak through the gap where the siding butts the casing. Even if this joint is caulked, the sealant won't last as long as the paint job, and water will eventually work itself inside. Windows and doors should be flashed with felt paper or flexible flashing splines (**Figure 4-12, page 301**).

Figure 4-16. Flashing Door Thresholds



Mulled entry doors and sliders are most prone to leaks at the threshold. Provide a formed seat in the slab (far left) or a metal pan flashing to keep water off the floor.

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The splines should be installed after the sill flashing, and the sheathing wrap should go on afterwards or be slit so it laps over the splines.

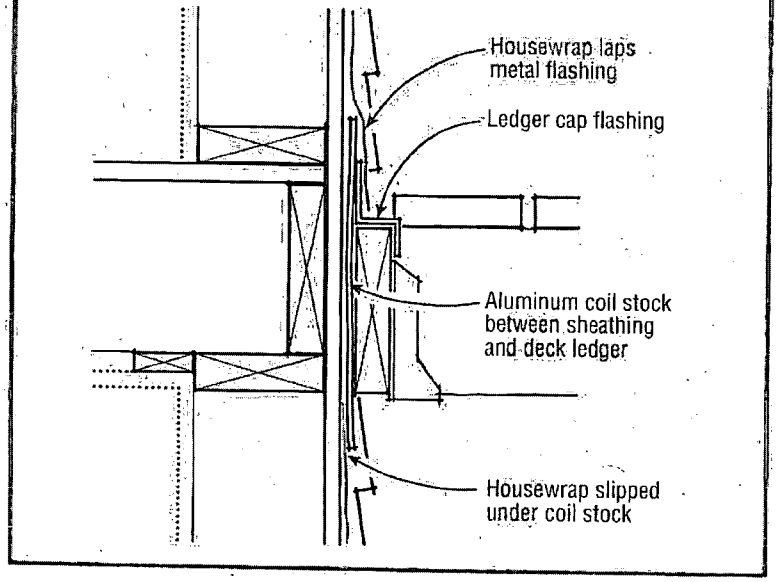
Flanged window heads do not need additional flashing. The nailing fin will do a good job sealing the head if it can be tucked beneath the sheathing wrap when the window is installed (**Figure 4-14, page 302**). Leave a 1/4-in. gap between the siding and the window along the head, but do not caulk this gap: Otherwise, water that runs behind the siding from above won't have a place to drain.

If the flange cannot be tucked under the sheathing wrap when the window is installed, slit the wrap and add a head flashing, as shown in **Figure 4-13, page 301.**

Unflanged windows will need an additional metal Z-flashing above the head casing or brick mold, as shown in **Figure 4-15, page 302.** Make sure this Z-flashing laps underneath the sheathing wrap.

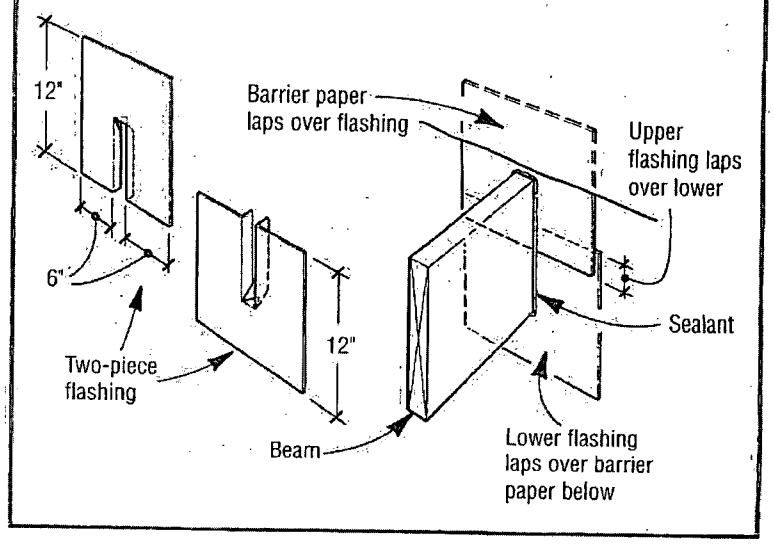
Mulled windows and window walls must have a continuous head flashing; the manufacturer's mullion cover will not prevent water from running between the window units from above.

Figure 4-17. Flashing Deck Ledgers



To properly flash a ledger, run the flashing behind the ledger to a drip-edge.

Figure 4-18. Flashing Cantilever Beams



Protect cantilevered balcony and deck beams with a two-part flashing sealed with urethane. The top flashing piece must lap over the bottom one.

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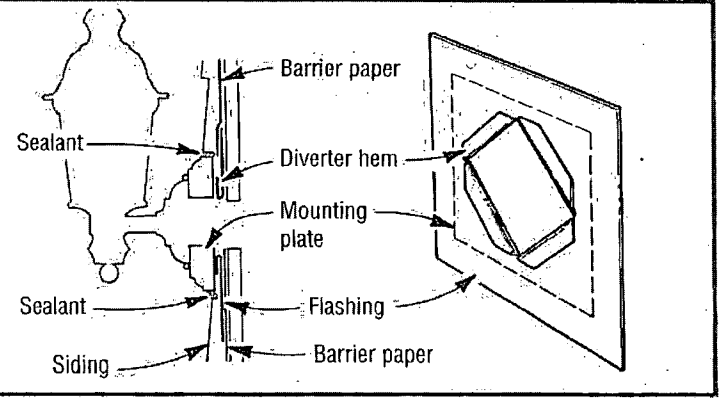
Round-top windows should be flashed with a peel-and-stick flexible flashing. Slit the sheathing wrap and slip it underneath, letting it drape over the window top. Then cut the flashing to conform to the nailing fin. Rely on proper lapping of the flashing, not on caulk.

FLASHING DOORS

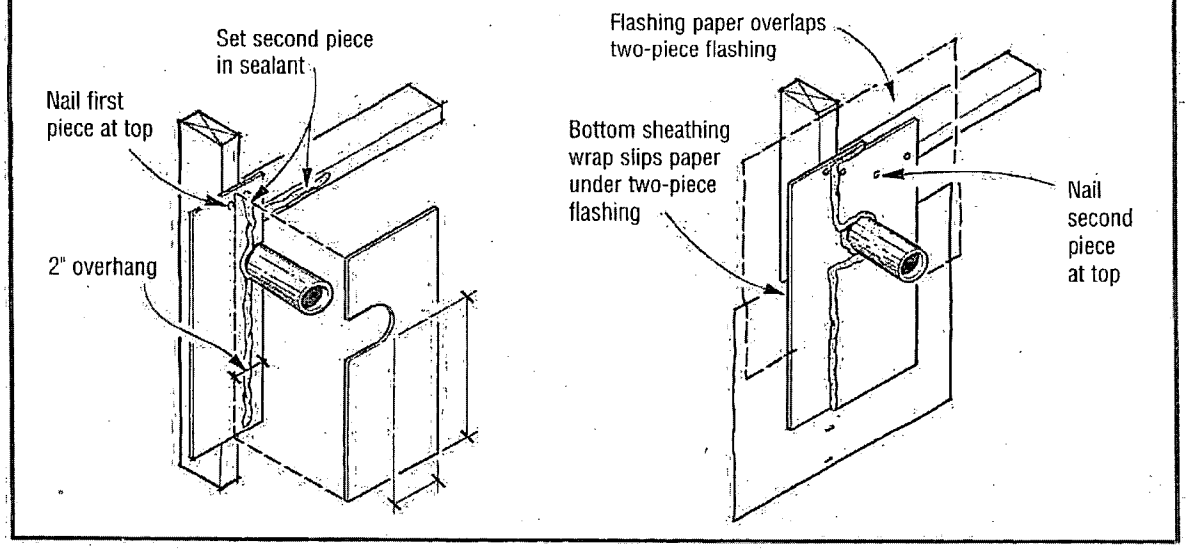
Water that gets past siding and trim around doors can run along the floor, ruining finish flooring. This is a particular problem where splashback from dripping eaves and overhangs soaks the door. Over wood floors, door thresholds should be flashed with a metal pan or Z-flashing. Slabs should be formed with a "seat" to hold the threshold (Figure 4-16, page 303).

Figure 4-19: Flashing Electrical Fixtures



Exterior electrical boxes and fixtures can be sealed with a hemmed metal plate. Slit the sheathing wrap above the fixture and slip the plate beneath.

Figure 4-20: Flashing Penetrations



To seal around wall penetrations, use a two-piece metal plate bedded in urethane sealant. Sheathing wrap above the metal plate should lap over the plate while sheathing wrap below it should be slipped beneath.

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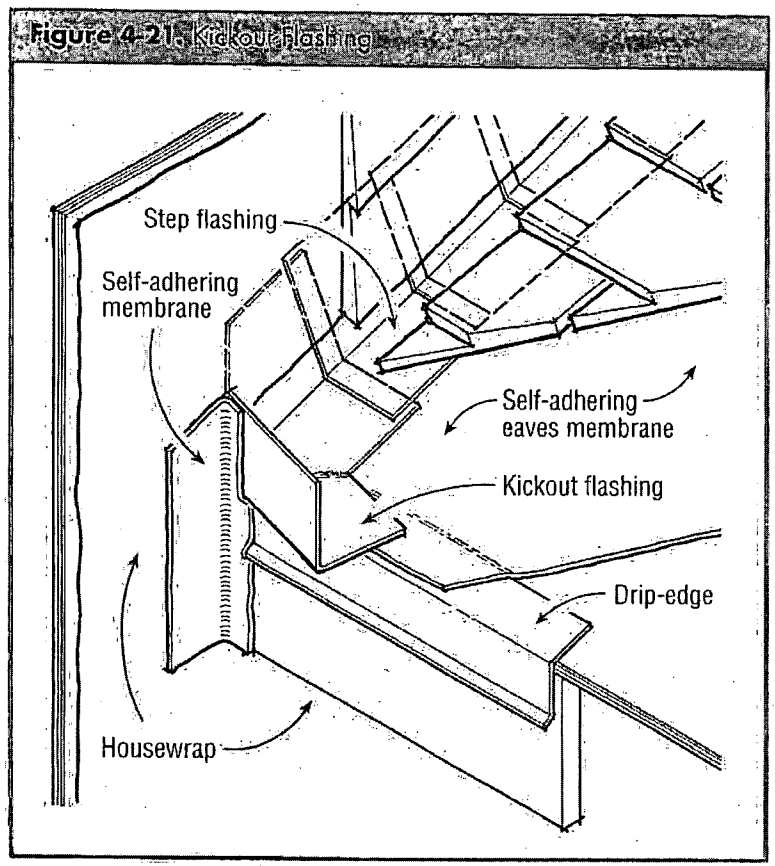
FLASHING LEDGERS AND BEAMS

Ledger flashing needs to be more than a Z-flashing running along the top edge of the ledger board. Use metal coil stock behind the ledger, as shown in **Figure 4-17**. Make sure the coil stock slips under the sheathing wrap above the ledger, and drapes over the sheathing wrap below the ledger.

Alternatively, build a deck completely free-standing from the wall, or insert spacers between the ledger board and the wall, so it stands out and allows water to drain freely.

Cantilevered deck or balcony joists that project through the wall framing are trouble spots. Flash with a two-piece flashing membrane, as shown in **Figure 4-18**.

Figure 4-21. Kickout Flashing



To prevent water from dumping behind the siding at the end of a roof intersection, bend a small "kickout" from metal flashing to divert water running down the roof away from the siding.

Flashing Wall Penetrations

Electrical fixtures. Install electrical boxes and lighting fixtures on a hemmed metal flashing plate, as shown in **Figure 4-19**. Do not tape the plate over the sheathing wrap; slit the sheathing wrap and tuck it beneath.

Mechanical penetrations. Gas line, conduit, water spigots, and other small penetrations should be flashed with a two-piece metal flashing plate (**Figure 4-20**). Seal the two plates with a "low modulus" urethane caulk (see "Caulks and Sealants," **page 371**).

Sidewall Flashing

Because of the volume of water that can pour down a sloped roof, one of the most critical flashing details occurs where a roof intersects a sidewall. The roof should be flashed with a step flashing (see **Figure 3-76, page 277**). Where the roof terminates, install a kick-out to deflect water away from the siding (**Figure 4-21**).

Though not always possible in the schedule, it's best to install a full 36-in. piece of rubberized asphalt flashing on the wall before the subfascia and trim boards are nailed in place, and then come back to install the kickout.

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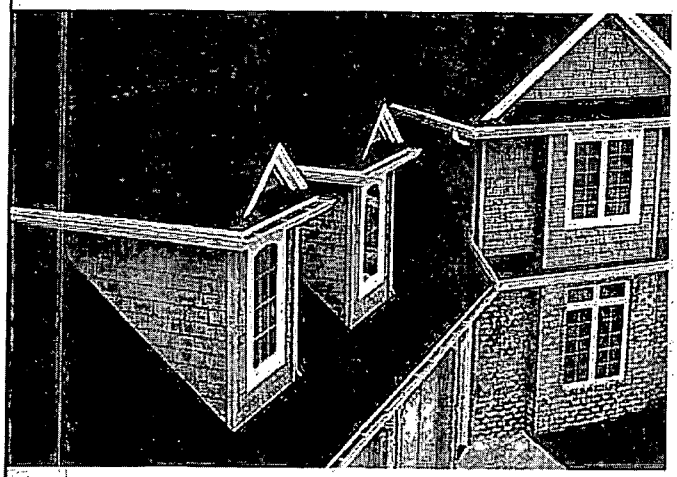

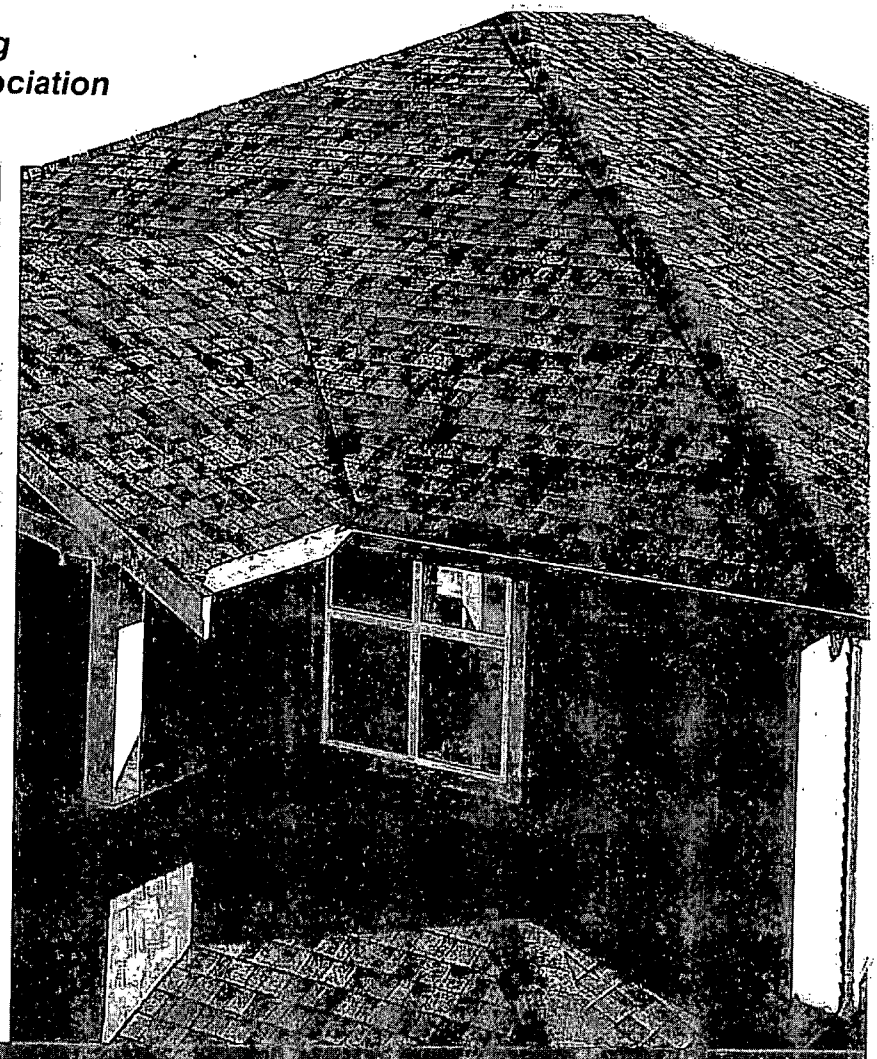

Asphalt Roofing Residential Manual

The Asphalt Roofing Manufacturers Association
Design and Application Methods

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CHAPTER 3
DESIGN CONSIDERATIONS

VENTILATION AND MOISTURE CONTROL

Proper ventilation of attic areas is an essential factor in gaining the maximum service life out of the building materials used in the roof assembly, in addition to improving heating and cooling costs. Overlooking this consideration may result in:

- Premature failure of the roofing including blistering.
- Buckling of the roofing due to deck movement.
- Rotting of wood members.
- Moisture accumulation in insulation.
- Ice dam formations in cold climates.
- Mold growth due to moisture accumulation.
- Deck distortion.

BUILDING CODE COMPLIANCE

Local building code requirements should be followed for ventilation. Ventilation requirements will be found in the building code or energy code enforced by your local building code compliance office. The ventilation requirements stated in this manual are the minimum required by shingle manufacturers. Consult your shingle manufacturer for their specific ventilation requirement in order to conform to the terms of the shingles' product warranty.

VENTILATION EFFECTS ON HEATING AND COOLING COSTS

In Northern climates, during the winter months, moisture control is a major concern. Increased insulation and tighter construction techniques help seal the side walls more effectively against air migration. At the same time, large volumes of occupancy-generated water vapor are pushed upwards toward the attic space and the much drier outside air. This can result in the blistering of shingles when proper ventilation is not followed. Vapor retarders will reduce the flow, but not stop it.

Condensation results when water vapor comes in contact with a cold surface such as the underside of a roof deck. Condensed water vapor can soak insulation and affect its performance. It can also cause mold to grow, wood roof decks and structural members to rot, plaster to crack, and paint to peel. Proper attic ventilation can remove water vapor from the attic space before condensation can occur and cause trouble.

Ice dams are formed by the cyclical thawing of snow over the warmed portions of the roof and subsequent refreezing at the cold eave. Proper ventilation can reduce the overall temperature of the roof deck, minimizing the thawing of snow and ice on the surface of the roof.

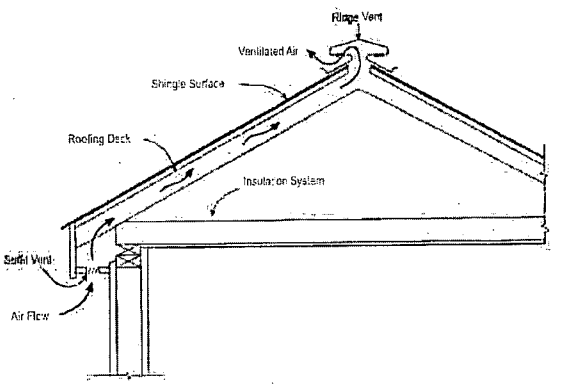


Fig 3-1 Proper Ventilation
With proper ventilation, air will circulate freely under the roof deck and carry away water vapor before it can condense. One of the best methods is a combination of continuous eaves and ridge vents that together provide uniform natural draft ventilation from the bottom to the top of the attic space. Louver and vent openings should not be covered during the winter. Eaves or soffit vents should not be blocked by insulation. Structures with bath and kitchen vents that are vented directly to the attic space should have these rerouted through the roof deck to discharge outside of the structure to remove excess water vapor.

During the summer months and in hot and humid climates, radiant heat from the sun can cause high roof deck temperatures. Gradually, the entire attic space is heated, and, in turn, the entire dwelling feels the effect of a hot roof. This heat buildup can be short-circuited by ventilating the underside of the roof deck. Research has reinforced the idea that prolonged exposure to high heat levels will accelerate aging and shorten the service life of asphalt roofing products and wood deck products. Having a properly ventilated flow-through air space between the roof deck and a radiant barrier or layers of insulation will offer relief from heat and moisture buildups.

The minimum specifications underlined in building codes of one square foot net free ventilating area for every 150 ft.^{2} of attic floor space is a good starting point for providing proper ventilation. It should be pointed out, though, that those specifications were written well before the concern for energy conservation and the subsequent trend towards tighter house construction and may not be sufficient for every structure. The manufacturers of asphalt shingles, ventilating systems and vapor retarders should be consulted for proper use of their products.

VENTILATION HINTS AND PRACTICES

[Note]
Do not vent exhaust air directly into roof cavity or attic.

1. Minimum net free ventilation area, that is, the area permitting unrestricted airflow, of 1 ft.^{2} for each 150 ft.^{2} of attic floor space is recommended. When vents are located at eaves or soffits and near the roof's peak or along the ridge for maximum net airflow, the net free vent area may be reduced (minimum 1 ft.^{2} for each 300 ft.^{2}). For a balanced system, ventilation should be equal at the undereave and at or near the ridgeline. In cases where a balanced system cannot be achieved, always provide more than 50% of the total required ventilation at the undereave and the remainder at the upper portion of the roof. Wire screening can reduce ventilation by half so allow for this during design.

2. Vent exhaust air from kitchens and bathrooms to the outdoors with vent pipes that run through the roof cavity or attic to roof exhaust vents.

3. Provide for free airflow between framing and/or under roof sheathing at eaves to insure that ceiling or roof insulation does not block ventilation paths. For vaulted or cathedral roof construction provide a free ventilation path from the eave vent to the ridge vent, between all rafters, below the shingle roof decking and above the insulation. See ARMA Technical Bulletin – "Application of Asphalt Shingles over Insulation or Insulated decks."

SLOPE

Asphalt shingles are intended to be applied to a minimum of 2" per foot. Of all the factors to consider in choosing an asphalt roofing product, one of the most critical is the slope of the roof. It affects the surface drainage of water. These roofs are intended to be water shedding, not a waterproof barrier. Therefore, free drainage dictates the limits within which shingles or roll roofing may be used. Consideration of roof drainage can make the difference between a weather-tight roof and one that leaks.

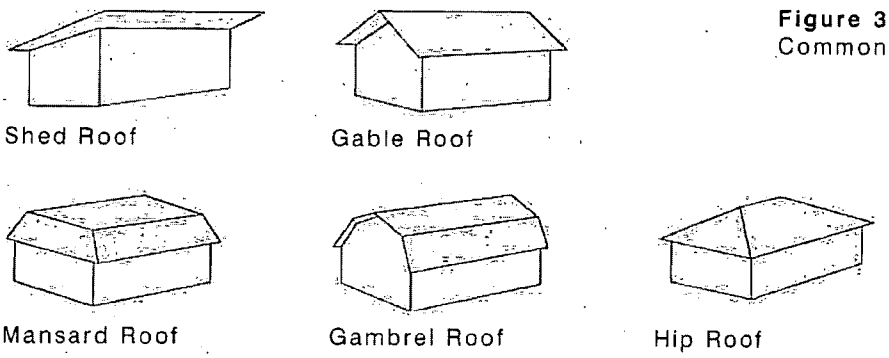


Figure 3-2
Common roof styles

The slope of a roof is determined in part by its style. A number of common styles are illustrated in Figure 3-2.

In general, most asphalt shingles may be used on roof slopes from 4" per foot to 21" per foot using standard application methods. For roofs having a slope greater than 21" per foot, special steep slope application procedures must be followed (see page 82). Most asphalt shingles may be used on slopes from 2" per foot to 3.9" per foot if special low slope application procedures are followed (see page 81).

The minimum slope on which roll roofing may be used depends on the application method and the type of roll roofing. Roll roofing may generally be used on roof slopes down to 2" per foot using the exposed nail method and down to 1" per foot using the concealed nail method.

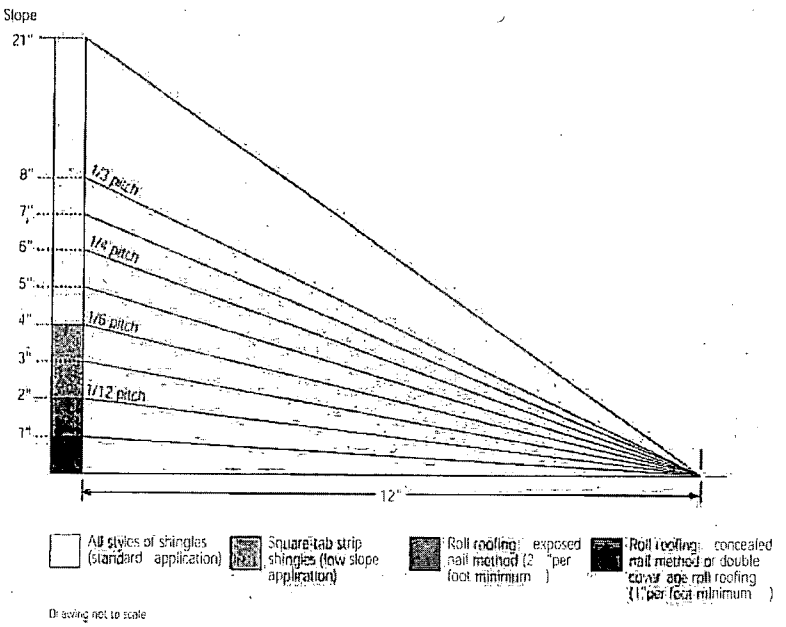


Figure 3-3
Minimum pitch and slope requirements for various asphalt roofing products

Double coverage roll roofing, which typically provides a top lap of 19", may be used on slopes down to 1" per foot. In general, roll roofing should not be used on slopes less than 1" per foot unless specified by the manufacturer.

Slope limitations for asphalt roofing materials are summarized in Figure 3-3.

DECK MATERIALS

[Note]
The type, grade, thickness and installation of structural materials used for roof decks should conform to the requirements of building codes.

The deck should be built in accordance with local building codes with structural sheathing panels rated by building code accredited third-party approval agencies. All wood products must be properly conditioned to be at moisture equilibrium. Failure to use properly conditioned deck materials can result in deck movement, which will distort or damage the overlying roofing materials. Distortion or damage of asphalt roofing materials resulting from deck movement is not a manufacturing defect of the roofing product. To avoid or reduce the appearance of buckles or distortions caused by old lumber roof decks, it is recommended that old and distorted lumber be replaced.

Check with individual roofing manufacturers for their specific requirements for type and thickness of roof decking. Additionally, be sure that the selected roof decking materials comply with local building codes.

DIRECT APPLICATION OF ASPHALT SHINGLES OVER INSULATION OR RADIANT BARRIER DECKS

With today's high cost of energy and the emphasis placed on energy conservation, some homeowners, when reroofing, are applying insulation on the exterior side of the existing roof and then applying asphalt shingles directly over insulation.

Asphalt roofing manufacturers recommend against this practice for the following reasons:

1. Shingles may be damaged or punctured when nailed to a non-rigid surface.
2. The nail-holding power of shingles applied directly over insulation may not be adequate, leaving shingles prone to wind damage.
3. Due to the insulation and radiant barriers preventing heat dissipation underneath the shingles, heat buildup may accelerate the weathering and reduce the life of the roof.
4. Fire and wind ratings on asphalt shingles may be affected. Individual systems should be checked with the manufacturer for the appropriate rating.
5. Proper ventilation underneath the roof deck is impossible to accomplish when applying shingles directly over insulation or radiant barriers. See ARMA Technical Bulletin – "Application of Asphalt Shingles over Insulation or Insulated decks."

For insulated decks and radiant barriers, it is recommended that a flow-through ventilated air space be provided between the top of the insulation and the nailable deck to assist in vapor and heat dissipation.

Structural Insulated Panels (SIP) are being used for roof decks and they may or may not be approved for use under shingles even if they have an approved nailable surface. Consult the roofing material manufacturer for approval over SIP products. Some SIP manufacturers are making panels with ventilation cavities.

For more details, see ARMA Technical Bulletin, "Application of Asphalt Shingles Over Insulation or Insulated Decks."

DECK PREPARATION

A number of roofing problems may result from failures within the underlying roof structure. Therefore, it is important that the materials supporting the roofing are properly installed.

The underlying structure should provide a rigid deck surface. It should not sag, shift or deflect under the weight of roofing materials, the workers installing the materials or the snow or rain loads the roof may have to support. An unstable structure could lead to movement and may affect the structural integrity and water shedding ability of the roofing and flashing.

Warping as well as other problems may result even with well seasoned lumber if the attic space under the roof deck or the spaces between the rafters and beams in a cathedral ceiling or mansard roof are not properly ventilated. Poor ventilation can result in an accumulation of moisture that eventually condenses on the underside of the roof deck.

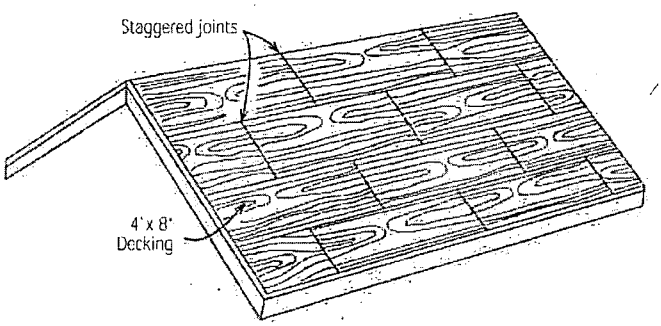


Figure 3-4
Typical Roof Deck

Inspect the lumber before installation. Do not use any board that is badly warped, has loose knots or has excessively resinous areas. Wood resin may chemically affect asphalt roofing materials.

Always check for a flat and dry nailing surface before installing deck panels. Follow the deck manufacturer's attachment instructions carefully when installing each panel. For more information, contact APA - The Engineered Wood Association at P.O. Box 11700, Tacoma, WA 98411, (253) 565-6600 or www.apawood.org.

If the sheathing is already in place, check it for deteriorated or rotted areas, which should be replaced. For excessively resinous areas and loose knots, cover any large areas with sheet metal patches. Underlayment may be used for small areas before the roofing is applied.

DRIP EDGES

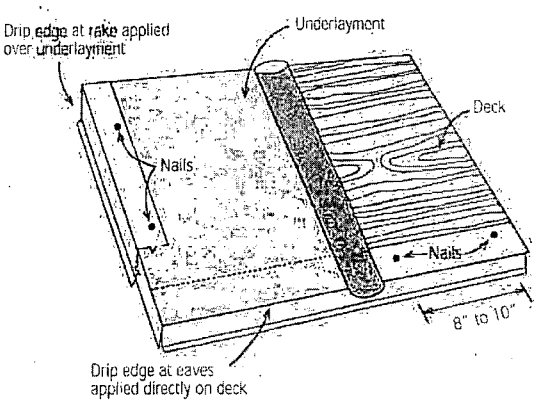


Figure 3-5
Application of drip edge at rake and eaves

Drip edge provides efficient water shedding at the rakes and eaves and protects the underlying wood from rotting. Drip edge should be made of a corrosion-resistant material that extends approximately 3" back from the roof edge and bends downward over the fascia.

Apply the drip edge underneath the underlayment along the eaves and over the underlayment on the rakes. Figure 3-5 details the placement and fastening of drip edge in combination with the underlayment. The use of a drip edge is strongly recommended and may be required by local building codes. If no drip edge or a wood strip is used as a drip edge, then all rake and eave overhangs should be ⅜" to 1".

D Flashing Drip Edge

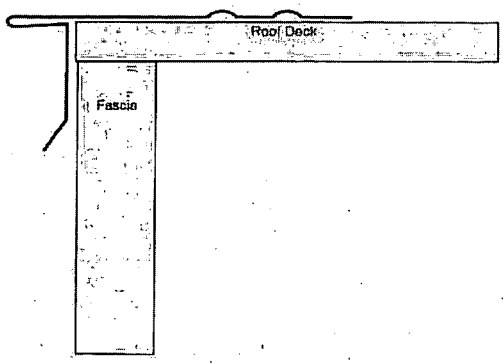


Figure 3-6a
Recommended drip edge:

On rake edge:

1. All underlayment goes under the drip edge.
2. Starter course shingle and remaining field shingles can be trimmed flush with drip edge.

On eaves:

1. All underlayment goes on top of drip edge.
2. Starter shingles and field shingles should be aligned flush with the drip edge or with an overhang up to ¾".

90 degree with Drip Edge

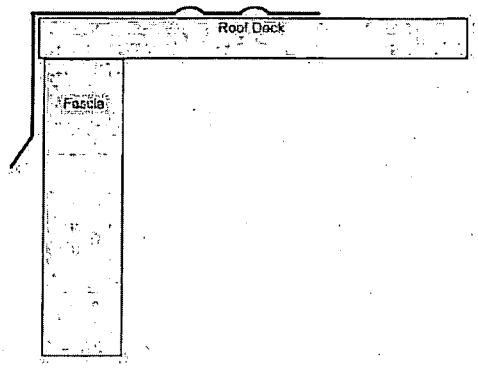


Fig 3-6b
Acceptable drip edge:

On rake edge:

1. All regular underlayments go under the drip edge.
2. Self-adhered shingle underlayment may go on top or under the drip edge (See the manufacturer's application instructions).
3. Starter course shingles and remaining field shingles should overhang the drip edge ¼" to ¾".

On eaves:

1. All underlayment goes on top of drip edge. [See above]
2. Shingles should be aligned to overhang the drip edge ¼" to ¾".

ROOFING NAILS

It is recommended by ARMA that properly driven and applied roofing nails are utilized as the preferred nailing system for asphalt shingles. Nails are also required in the International Building Code.

Nails

Nails should have a minimum nominal shank diameter of 12 gauge, 0.105", and a minimum head diameter of ⅜". Nails will have smooth shanks (except for "gripper marks" sometimes located just below the head) although nails with shank deformations such as "barbs" may be used.

Corrosion Resistance

Galvanizing by various processes is the typical means of achieving corrosion resistance. Aluminum roofing nails do not require additional coatings for corrosion resistance. Steel nails must be corrosion resistant.

Nail Length

Nails should be long enough to penetrate ¾" into the roof deck. Where the deck is less than ¾" thick, the nail should be long enough to penetrate fully and extend at least ⅛" through the roof deck.

In determining the nail length, consideration should be given to the number of layers of shingles, shingle thickness(es), underlayment and flashings (eaves, sidewall and valley, etc.).

In some cases, the underside of the deck is exposed to view. In this case, using nails of the recommended length may result in the nail points penetrating through the deck and being exposed to view. Consult the roofing material manufacturer and building code requirements for approved alternatives.

NAILING

Proper nailing is essential to good performance. To ensure proper nailing during shingle application:

- Use the correct type, size and grade of nail as specified in the shingle manufacturer's application instructions.
- Use corrosion resistant nails.
- Use the recommended number of nails per shingle.
- Position the nails as required by the shingle manufacturer.
- Align the shingles properly before nailing to avoid exposing nails in the course below.
- Drive the nails straight and flush with the shingle surface.
- Do not break the shingle surface with the nail head.
- Do not drive nails into knotholes or cracks in the roof deck.
- Repair faulty nailing immediately.
- Follow manufacturer's instructions concerning special nailing procedures for steep slopes, high wind areas, and any special requirements.
- Comply with local building codes

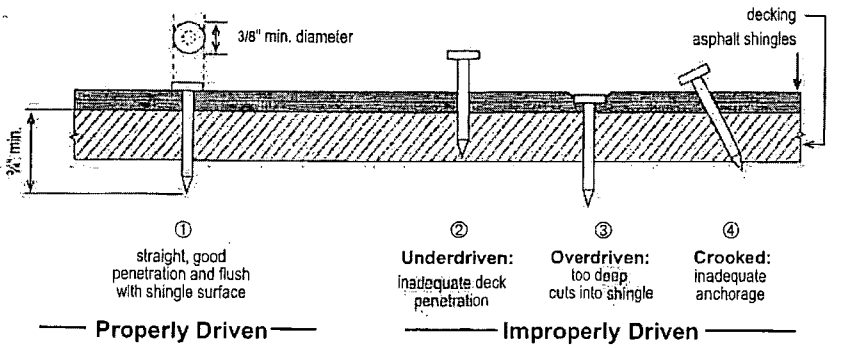


Figure 3-7
Proper and improper application of roofing nails

If a nail does not penetrate the deck properly and cannot be tapped down to be properly driven, remove the nail, repair the hole in the shingle with asphalt roofing cement that complies with ASTM D4586 and place another nail nearby. If necessary, replace the entire shingle. (See Figure 3-7)

QUANTITY AND PLACEMENT OF NAILS

The following practices reflect the general recommendations of most shingle manufacturers. However, the specific recommendations of the shingle manufacturer, as printed on each shingle wrapper, should be followed when applying shingles.

Align each shingle carefully. Whenever possible, make sure that no cutout or end joint is less than 2" from a nail in an underlying course. Start nailing from the end nearest the shingle just laid and proceed across. This will help prevent buckling. To help prevent distortion, do not attempt to realign a shingle by shifting the free end after two nails are in place. Drive nails straight so that the edge of the nail head does not cut into the shingle. Nail heads should be driven flush with the shingle surface, not sunk into it. Figure 3-7 illustrates examples of proper and improper nailing.

NAILING METHOD (NORMAL WEATHER CONDITIONS)

In areas with normal weather conditions, the following application methods should be utilized:

A. Placement of nails on three-tab strip shingles

Each of these shingles, both the conventional 36" long shingles and the "metric" shingles, should be fastened with four nails. When the shingles are applied with an exposure of 5" (5⅝" for metric), the nail locations should be on a line ⅝" above the top of the cutouts, 1" in from each end, and centered over each cutout. The center of the nail should be applied on center at all four nail locations. (See Figure 3-8)

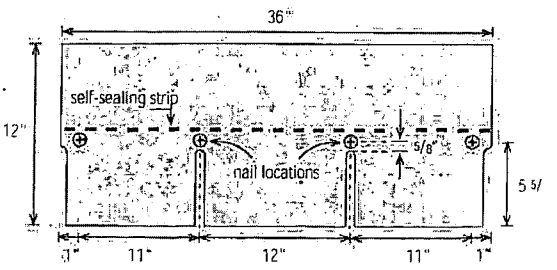


Figure 3-8
Nail locations for three-tab strip shingle

B. Placement of nails on laminated shingles

Each of these shingles, both the conventional 36" long shingles and the "metric" shingles, should be fastened with four nails. When the shingles are applied with an exposure of 5" (5⅝" for metric), the nail locations should be on a line 5½" (6⅛" for metric) above the butt edge. For laminated shingles, locate nails 1" from each end, with two nails spaced in between. For details, see the manufacturer's application instructions. (See Figure 3-9)

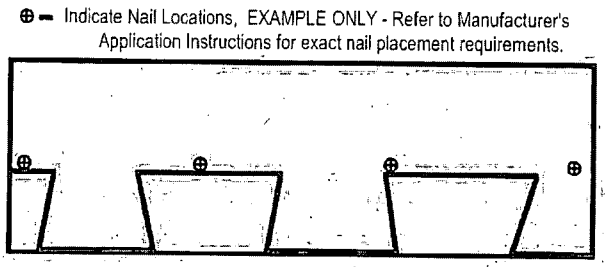


Figure 3-9
Nail locations for laminated shingle

NAILING METHOD (HIGH WIND REGIONS)

(6-nail method)

For areas considered to be high wind regions from historical experience or by local building code authorities, the following six nail method should be considered:

A Placement of nails on three-tab strip shingles

Both the conventional 36" long shingles and the "metric" shingles should be fastened with six nails. When the shingles are applied with an exposure of 5" (5⅝" for metric), the nail locations should be on a line ⅝" above the top of the cutouts, 1" in from each end, and 1" to the left and right of center of each cutout. The center of the nail should be applied on center at all six nail locations. (See Figure 3-10)

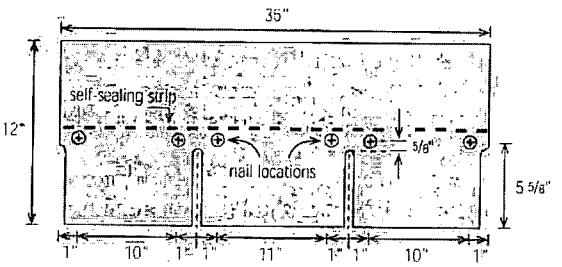


Figure 3-10
Nail locations for three-tab strip shingle

B Placement of nails on laminated shingles

Both the conventional 36" long shingles and the "metric" shingles should be fastened with four or six nails. High wind application should comply with the manufacturer's application instructions. Number and location of nails on laminated shingles depend on the product, on the product design, on course offsets, and on approved test application methods. (See Figure 3-11)

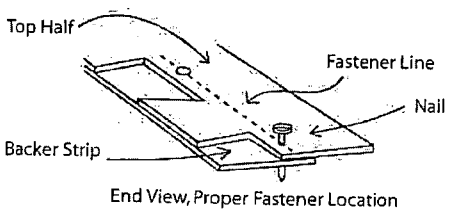


Figure 3-11
Nail locations on laminated shingle

STORAGE

Asphalt roofing materials must be kept dry prior to installation. As a result, make provisions at the job site for protecting them against the weather. Because of the importance of proper storage, techniques discussed in Chapter 2 are reemphasized here:

- Never stack shingle bundles more than 4' high.
- Never store asphalt roofing products in direct contact with the ground. Place them on a raised flat platform.
- Never leave the materials exposed to the weather. Cover them with tarpaulins or plastic bags that are vented to provide free air circulation.
- Never store shingles in extreme cold. Store in a warm place prior to application
- Care must be taken when working with asphalt products that have been stored in temperature below 40° F, to avoid potential problems with the product.

CHAPTER 7
APPLICATION OF SHINGLES ON NEW CONSTRUCTION -DECK PREPARATION

Some building codes have specific requirements for underlayment and/or ice dam protection. The requirements of these codes must be followed. Follow the ARMA directions (below) where permitted.

No roof is better than the quality of its installation. Asphalt roofing materials are no exception. They are designed to give years of service when applied carefully and correctly.

UNDERLAYMENT

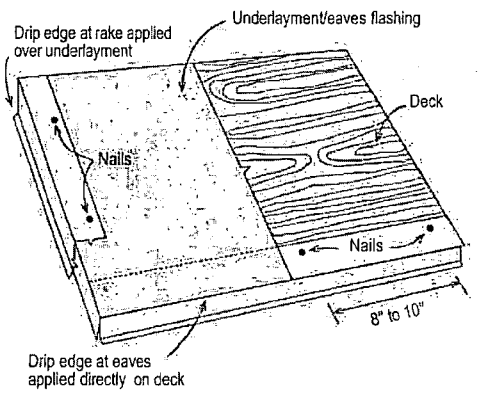


Figure 7-1
Application of Underlayment

After the deck has been properly prepared and is dry, cover it with the appropriate underlayment. Typically, asphalt saturated felt products are specified for use as underlayment. However, ambient conditions may warrant the use of a self-adhered shingle underlayment (a type of modified bituminous sheet material). Refer to "Eave Flashing for Ice Dam Protection" on page 47. Underlayment material used beneath roofing shingles is recommended to comply with one of the following: ASTM D4869, ASTM D6757, ASTM D1970, or as recommended by the individual shingle manufacturer.

On decks having a slope of 4" per foot or greater, one layer of non-perforated underlayment should be applied. The use of asphalt coated base sheets, self-adhered shingle underlayments, polyethylene sheets or laminated waterproof papers could result in vapor retardation — trapping moisture or frost between the covering and the roof deck when the deck is not properly ventilated. Consult with the individual manufacturer for specific recommendations when using these types of products.

[Note]
The underlayment application figures in this chapter all show the proper use of drip edges. Drip edges should be used on all roof rake and eave edges. Drip edge installation is covered in Chapter 3.

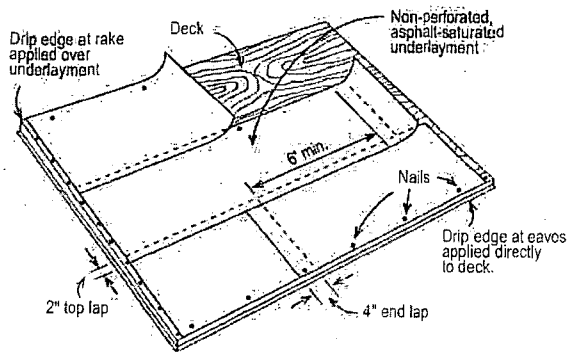


Figure 7-2
Application of Underlayment on Inclines 4/12" or greater

Always lay the felt parallel to the eaves, lapping each course at least 2" over the underlying course. Underlayment should not run perpendicular to the eaves. Secure the felt with nails to hold it in place. (See Figure 7-2) Nails should be driven straight and flush with the surface. If two or more pieces are required to continue a course, lap the ends at least 4". End laps in a succeeding course should be located at least 6' from end laps in the preceding course. Lap the underlayment a minimum of 6" from both sides over all hips, ridges and valleys. Where the roof meets a vertical surface, carry the underlayment at least 4" up the surface.

Underlayment should always be used in new construction as it provides many benefits.

Important reasons for installing underlayment when applying shingles over wood decks include:

- Underlayment is water-resistant and provides secondary protection by helping to shield the deck from wind-driven rain and helping to prevent water from reaching the deck.
- Underlayment keeps the deck dry until shingles are applied, minimizing problems that may result if shingles are placed on wet decks. Shingles should be applied as soon after the application of the felt as possible.
- Meeting Class A or Class C fire ratings when used with proper decking material and shingles. A shingle by itself is not fire-rated, but is, in fact, a component of a roof assembly. In many municipalities, a Class A or Class C fire rating for roof assemblies is required by code or ordinance.
- Installing underlayment helps reduce "picture framing" (the visible outline of deck panels caused by irregularities in roof decking thicknesses).
- Underlayment offers protection from resins that may come from wood board sheathing.

Proper application techniques should be followed to ensure optimum performance of asphalt saturated felt.

CHALK LINE

The dimensional variations of individual strip shingles are seldom significant, but on a large expanse of roof, the accumulated effect of these slight variations could result in diverging butt lines or misaligned cutouts. Whether there is a large expanse of roof or a small one, chalk lines provide visible guides that help ensure the application of the shingles in proper horizontal and vertical alignment with the proper exposure and the intended coverage. Never vary the shingle exposure between courses by more than ±⅛", as this deviation may negatively affect roof performance and aesthetics. Shingle sides should be butted, but not forced together to maintain adequate shingle coverage.

To place a horizontal chalk line parallel to the eaves, measure the appropriate distance on the roof and mark it at three locations — at each end and in the middle as a check against possible measurement errors. Put a nail on the mark at each end, stretch the chalk line between them and pull it taut. Check the alignment of the middle mark, and then snap the line from the center.

Vertical chalk lines are important for aligning cutouts on shingles that are designed to create a pattern from eaves to ridge. They are also important for aligning shingles on each side of a dormer so that when the application of shingles passes it, the shingles and cutouts meet above the dormer in proper alignment without any gaps or overlaps.

On long runs, snap a vertical chalk line in the center of the run and apply shingles to the left and right of the line. Check horizontal chalk lines as the shingle application approaches the ridge so that the upper courses will be parallel to it.

EAVE FLASHING FOR ICE DAM PROTECTION

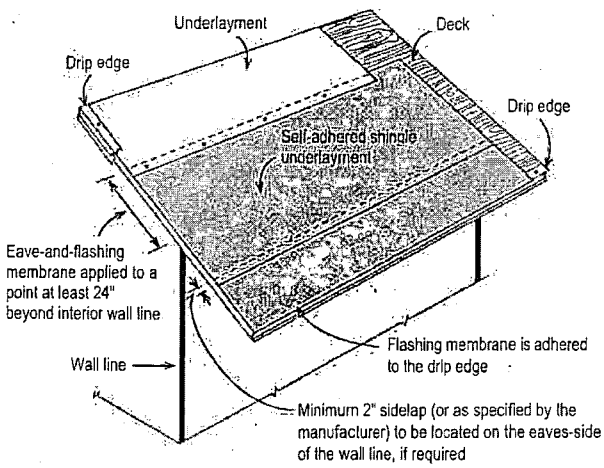


Figure 7-3
Application of self-adhered Shingle underlayment for eave flashing

Ice dams are formed by the continual thawing of snow over the warmer portions of the roof and refreezing over the cold eave. The ice dams can cause the backing up of water and slush under the exposed roofing material and cause damage to the structure. Eave flashing is recommended when applying roofing material to this potentially vulnerable area to help prevent such water penetrations. In climates where icing along the eaves is anticipated or where the average January temperature is 25°F or less, eave flashing must be installed to ensure maximum protection against ice damming damage. The appropriate selection of flashing material and the flashing strip width will depend upon the roof slope and the severity of icing conditions anticipated.

The recommended method is to use self-adhered shingle underlayment that complies with ASTM D1970, or as approved by the shingle manufacturer or local code. The self-adhered shingle underlayment is applied directly to the deck and is applied at a width to extend up the roof from the eaves or rake edge to a point at least 24" inside the interior wall line (heated space). If the membrane is not wide enough to reach that point, install additional course(s) of membrane as needed, overlapping the previous course by 2" or as specified by manufacturer.

[Note]
When a self-adhered shingle underlayment is used as underlayment, no additional eave flashing application is required.

Self-adhered shingle underlayments are also excellent for use on ridges, hips, flashings and valleys, as well as around dormers, skylights and chimneys. Because most eave flashing materials are vapor retarders, they should not be used beyond recommended areas without proper ventilation. A lack of proper ventilation in these cases will result in the possibility of water vapor condensation under the roof deck.

VALLEY UNDERLAYMENT & FLASHING

Valleys are formed where two sloping roof planes meet at an angle. The sloping planes direct water toward the valley, concentrating the drainage along the joint and making it especially vulnerable to leakage. As a result, one of the most important installation details for good roof performance is proper valley flashing. Consult the appropriate roofing manufacturers for recommendations on a particular application.

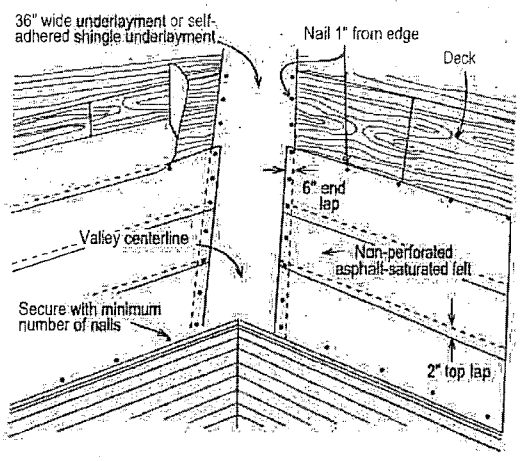


Figure 7-4
Application of underlayment in a valley

To install underlayment in a valley, first center a 36" wide strip of the appropriate underlayment in the valley and secure it with only enough nails to hold it in place or place a 36" wide strip of self-adhered shingle underlayment directly to the deck. Then trim the horizontal courses of felt underlayment applied on the roof to overlap the valley strip at least 6" (See Figure 7-4). In all valleys the underlayment or self-adhered shingle underlayment should be tight in the valley but not creased or wrinkled.

Following application of the underlayment, roofs with multiple planes require the construction of one of three types of valleys: open, woven or closed cut. Regardless of the type of valley used, it must be smooth, unobstructed, of sufficient capacity to carry water away rapidly and capable of withstanding occasional backing up of water.

A. Open Valleys

The recommended flashing material is a 26-gauge galvanized metal or an equivalent corrosion resistant, non-staining material (check with shingle manufacturer and local code). The width should be no less than 24", but local building codes or shingle manufacturer may require a greater width. (See Figure 7-5)

If the valley is covered with a minimum 36" wide self-adhered shingle underlayment that complies with ASTM D1970, adhered directly to the deck, the valley is ready for the metal valley flashing. If the valley is covered with felt underlayment an additional layer of #50 felt or heavier valley underlayment is required before the metal flashing is applied. Center the strip in the valley, securing the non-self-adhered materials with only enough nails to hold it in place (See Figure 7-5). Nail the strip along a line 1" from the edges, first on one edge all the way up, then on the other while pressing the flashing strip firmly and smoothly into the valley. Laps should be 12" and cemented.

Center the metal flashing in the valley. Trim the lower edge flush with the eaves drip edge. Install it up the entire length of the valley. If two or more strips of flashing are required, lap the upper piece over the lower so that drainage will be carried over the joint, not into it. The overlap should be 12" and fully bonded with asphalt roofing cement.

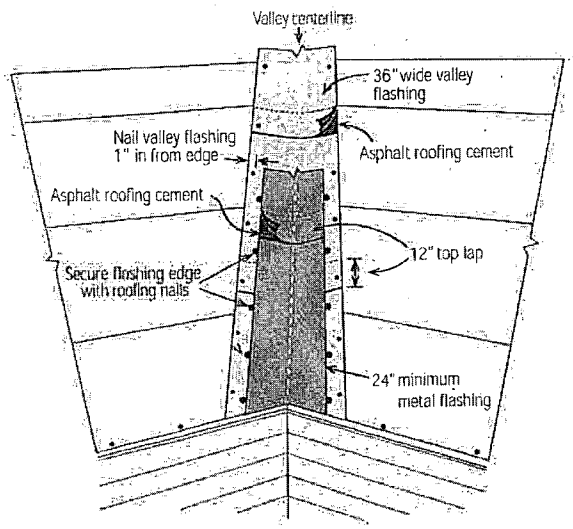


Figure 7-5
Application of corrosion resistant metal as flashing for an open valley
(The figure shows 50# or heavier felt for the valley flashing.)

Secure the valley metal to the roof deck without puncturing, with roofing nails spaced 8"-12" apart. The valley will be completed with shingle application.

B. Woven and Closed Cut Valleys

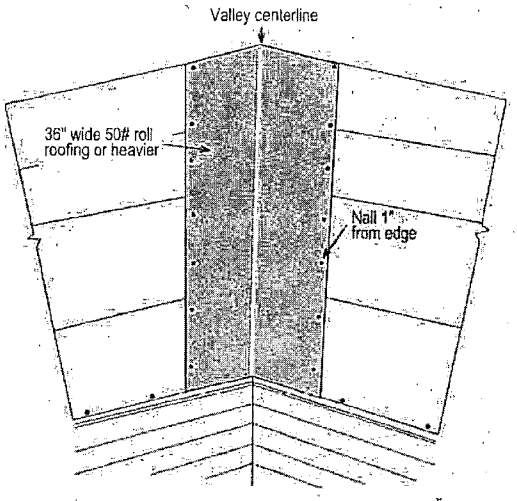


Figure 7-6
Application of flashing for a woven or closed cut valley

If self-adhered shingle underlayment that complies with ASTM D1970 was adhered directly to the deck as shown in Figure 7-4 then no additional valley flashing is required. If the valley was covered with felt underlayment as shown in Figure 7-4, cover the valley with a minimum 36" wide of roll roofing, #50 or heavier center the roll roofing strip in the valley, securing the materials with only enough nails to hold it in place (See Figure 7-6). Nail the strip along a line 1" from the edges, first on one edge all the way up, then on the other while pressing the flashing strip firmly and smoothly into the valley. Laps should be 12" and cemented. The valley will be completed as the shingles are installed. When installing a closed-cut valley installation, weave the first course.

CHAPTER 9
APPLICATION OF LAMINATED SHINGLES ON NEW CONSTRUCTION

No roof is better than the quality of its installation. Laminated shingles are no exception. They are designed to give decades of service when applied carefully and correctly. Laminated shingles are applied in general, similar to strip shingles, but are different in appearance and construction.

For best appearance and shingle function, the manufacturer's application instructions for shingle offsets and repeat pattern must be followed as indicated on the shingle wrapper. Each manufacturer has determined the optimum application pattern (for function and appearance) for each of their products. (See Fig. 9-2 as an example of one method.)

SHINGLE APPLICATION – LAMINATED SHINGLES

While the general application procedures for all asphalt laminated shingles are essentially the same, differences do exist depending upon the product dimensions, exposure, and product design. Thus, it is necessary to study and follow the shingle manufacturer's application directions as printed on the shingle bundle wrapper.

Before beginning to apply shingles, check that all chimneys are completed and all vent pipes, soil stacks and ventilators are in place (See Chapter 10 for flashing and roof penetration details). Also make provisions for the additional flashings that will be required as the shingles are applied, such as those around chimneys and stacks and at vertical wall joints.

If a roof surface is broken by a dormer or valley, start applying the shingles from a rake and work toward the break. If the surface is unbroken, start at the rake that is most visible.

[Note]
The release tape found on the shingles prevents the shingles from sticking together in the package. It should not be removed during application.

No matter where the application begins (left edge, right edge, or center), apply the shingles across with designated course offsets resulting in a diagonal application pattern. If vertical shingle application is being considered (referred to as racking) refer to shingle manufacturer's requirements. Horizontal application is preferred and will ensure that each shingle is fastened properly.

A. Starter Strip

The starter strip may be either a row of shingles trimmed to the shingle manufacturer's recommendations or a strip of mineral-surfaced roll roofing at least 2" wider than the shingle exposure. Precut starter shingles are also available. The starter strip protects the roof deck by filling in the spaces under the shingle joints of the first course of shingles. It should overhang the eaves and rake edges by ¼" to ¾".

Where the drip edge extends out from the eaves and rakes, the shingles may be cut flush with the drip edge or extend out no more then ¾".

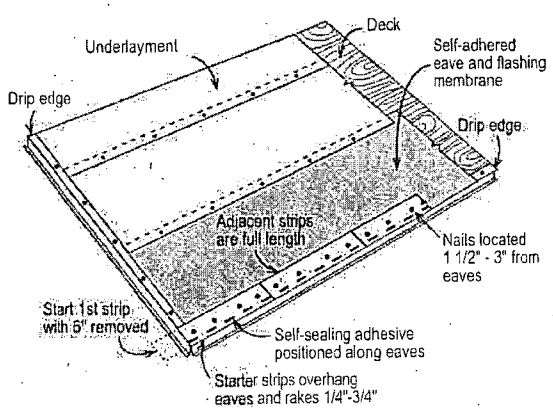


Figure 9-1
Application of starter strip

If self-sealing shingles are used for the starter strip, remove the tab portion of each shingle and position the remaining strip with the factory-applied adhesive face up along the eaves. Trim at least 4" [Figure 9-1 shows 6" removed] from the end of the first shingle in the starter strip. Fasten the starter strips parallel to the eaves along a line 1½"-3" above the eaves. Position the fasteners so that they will not be exposed under the shingle ends in the first course. (See Figure 9-1.)

Manufacturers may require different starter strip techniques or provide starter strip materials that require specific application instructions.

For shingles that have the self-sealing sealant on the top of the shingle and shingles or a strip of mineral-surfaced roll roofing without a self-sealing adhesive are used for the starter strip perform the following procedure. Bond the shingle in the first course to the starter strip by placing a spot of asphalt roofing cement (conforming to ASTM D 4586) about the size of a quarter on the starter strip beneath each shingle corner and two more spots equally spaced between the ends of the shingle. Then press the shingle firmly into the cement.

[Caution]
Excessive use of asphalt cement may cause blistering.

B. First and Succeeding Courses

Proper application of the first course of shingles is the most critical. Be sure it is laid out perfectly straight; check against the chalk lines to ensure proper alignment of subsequent courses. Shingles should be installed so that shingle ends are offset. The first course typically starts with a full shingle, but individual laminated shingles will have specific instructions for beginning the first course of shingles. As a general rule, shingle ends should be offset from the course above and below by at least 4". Make sure that no end joint is less than 2" from any nail in an underlying course. Begin nailing from the end nearest the shingle just laid, and proceed across, aligning each shingle carefully.

For best appearance and shingle function, the manufacturer's application instructions for shingle offsets and repeat pattern must be followed as indicated on the shingle wrapper. Each manufacturer has determined the optimum application pattern (for function and appearance) for each of their products. (See Fig. 9-2 as an example of one method.)

APPLYING THE SHINGLES

The first course starts with a full shingle, while succeeding courses start with portions removed according to the style of shingle being applied. By removing different amounts from the first shingle in each course, shingle joints or multiple thickness areas in one course do not line up directly with those of the course below, creating the desired pattern.

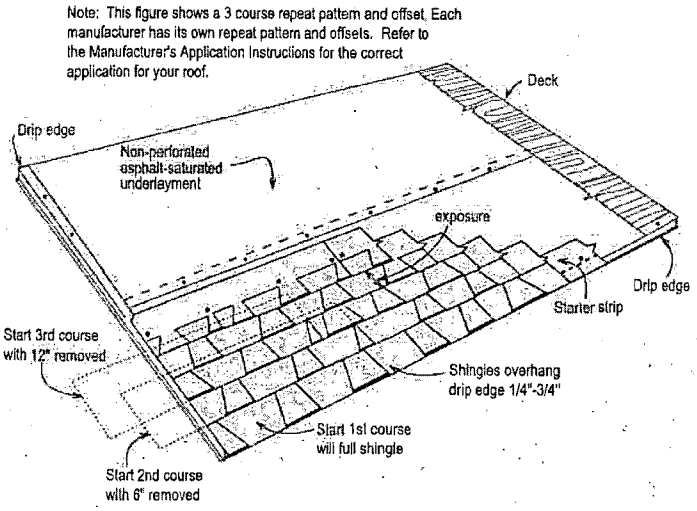


Figure 9-2

For ease of illustration, the 6" method is discussed and shown here in Fig. 9-2. For directions and illustration on proper application methods, consult the manufacturer's application Instructions.

With the 6" method, the first course begins with a full-length shingle. The second course begins with a shingle that is 6" shorter, and the third course starts with a shingle having 12 inches removed. The pattern repeats itself beginning with the fourth course, when a full-length shingle is used.

VALLEYS

Several different methods of treating valleys are possible including the open and closed cut methods. Open or closed cut valleys are the preferred method for laminated shingles. Open valleys are preferred for heavy weight and very thick shingles, because of the difficulty in forming the shingles to the valley to make a cosmetically appealing appearance with the closed cut construction. For all the methods, valley flashing should be in place before shingle application is begun except for open valleys around dormers where the valley flashing must overlap the top courses of shingles along the dormer sidewalls. Thoroughly working all valley materials well into the break of the valley prior to fastening is recommended.

A. Open Valleys

Snap two chalk lines, one on each side of the valley centerline over the full length of the valley flashing. Locate the upper ends of the chalk lines 6" apart at the ridge (i.e., 3" to either side of the valley centerline). The lower ends of the valley chalk lines should diverge from each other at a rate of ⅛" per foot of the valley length. Thus, for an 8' long valley, the chalk lines should be 7" apart at the eaves; for a 16' valley, they should be 8" apart. The minimum shingle overlap on each side of the metal valley is 6". (See Figure 9-3)

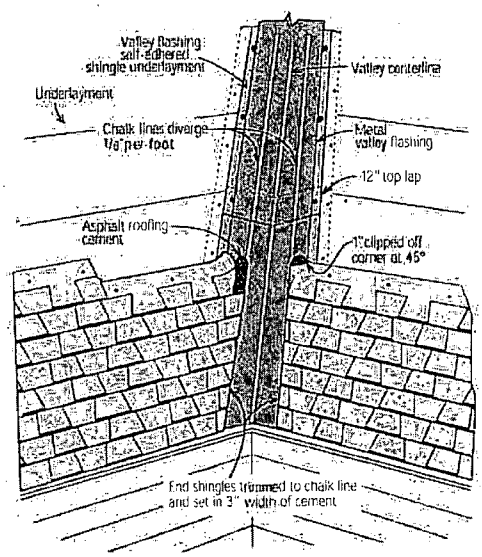


Figure 9-3
Application of shingles in an open valley

As shingles are applied toward the valley, trim the last shingle in each course to fit on the chalk line. Never use a shingle trimmed to less than 12" in length to finish a course running into a valley. If necessary, trim a section off the adjacent shingle in the course to allow a longer portion to be used. Clip 1" from the upper corner of the shingle on a 45° angle to direct water into the valley and prevent it from penetrating between the courses. Finally, to form a tight seal, cement the shingle to the valley lining with a 3" width of asphalt roofing cement (conforming to ASTM D 4586). There should be no exposed nails along the valley flashing.

B. Open Valleys for Dormer Roofs

The valley between a dormer and main roof requires special treatment. Do not install the metal valley flashing until the shingle application reaches a point just above the lower end of the valley when using self-adhered shingle underlayment for the initial valley flashing. (See Figure 9-4)

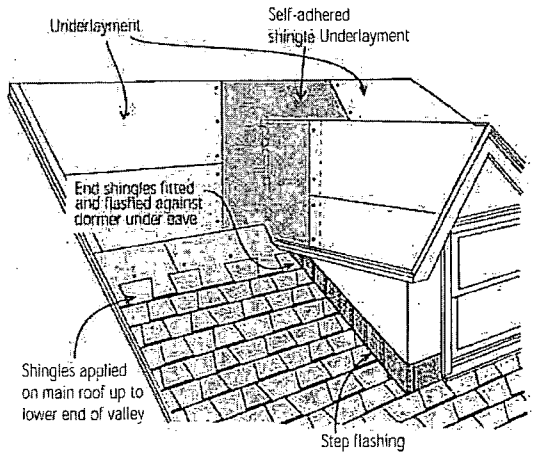


Figure 9-4
Point at which installation of open valley at dormer roof begins

Apply the first or bottom layer of valley flashing (36" wide self-adhered shingle underlayment in the same manner as any open valley flashing). Trim the lower section of the flashing so that it extends ¼" below the edge of the dormer deck. The lower section in contact with the main roof deck should project at least 2" below the point where the two roofs meet. Extend the upper section so that the portion on the main roof extends 18" above the point where the dormer intersects the roof. Trim the portion on the dormer at the ridge. (See Figure 9-5)

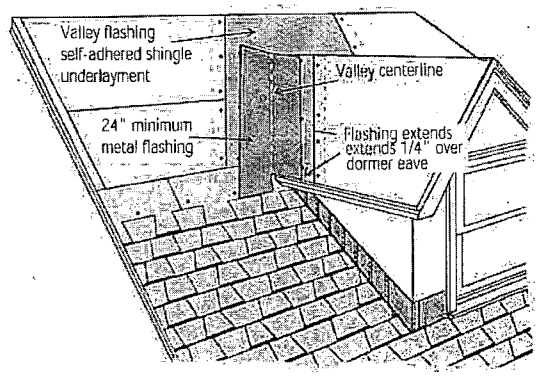


Figure 9-5
Application of flashing for an open valley at a dormer roof

Apply the valley flashing on the other side of the dormer in the same manner, extending the portion on the main roof up and over the portion from the first valley.

Trim the second or top layer of flashing (24" minimum width non-corrosive metal valley flashing) on the dormer side to match the lower end of the underlying strip. Trim the side that will lie on the main deck to overlap the nearest course of shingles. This overlap is the same as the normal lap of one shingle over another for the shingles being applied. For example, for laminates it extends to the top of the shingle exposure.

C. Closed Cut Valleys

[Note]
The first course and only the first course of shingles from the intersecting roof surface should be woven with the first course of shingles on the starting roof.

With valley flashing already in place, apply the first course of shingles along the eaves of one of the intersecting roof planes and across the valley. The first course and only the first course of shingles from the intersecting roof surface should be woven with the first course of shingles on the starting roof. For proper flow of water over the trimmed shingle, always start applying the shingles on the roof plane that has the lower slope or lesser height. Extend the end shingle at least 12" onto the adjoining roof. Do not make a joint in the valley. If a shingle falls short, add in section so that the joint occurs outside the line of the valley. Apply succeeding courses in the same manner, extending them across the valley and onto the adjoining roof. Press the shingles tightly into the valley. Use normal shingle fastening methods except that no fastener should be within 6" of the valley centerline and two fasteners should be placed at the end of each shingle crossing the valley.

Snap a chalk line 2" from the centerline of the valley on the unshingled side. Then apply shingles on the unshingled side. Trim the shingles as they are being installed to the chalk lines and to ensure a neat installation. Trim 1" on a 45° angle from the upper corner of each end shingle upon installation. This will direct water into the valley. Finally, embed the end of each shingle in a 3" wide strip of asphalt roofing cement. (See Figure 9-8)

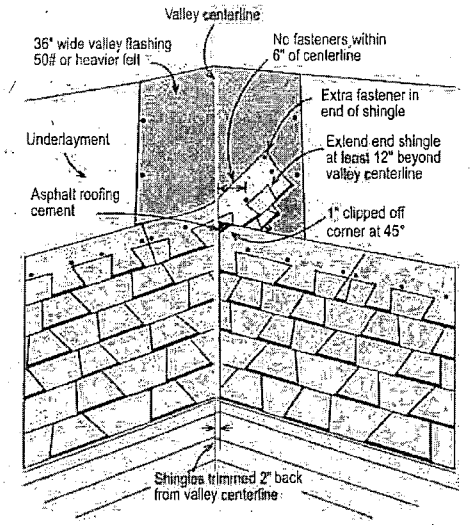


Figure 9-8
Shingle application in a closed cut valley

CHAPTER 10
FLASHING

All areas on the roof surface where there is an intersection of roof planes or a projection through the roof surface (i.e., chimneys, vent stacks, dormer walls, etc.) require "flashing." Flashing is the construction procedure necessary to make these areas watertight. Careful attention to flashing details is essential for proper leak-free roof performance. Some of the figures showing details may be shown as a strip shingle and/or as a laminated shingle, however, in most cases, the application techniques are identical.

FLASHING AGAINST VERTICAL SIDEWALLS

Roof planes that butt against vertical walls at the end of shingle courses are best protected by metal "flashing shingles" placed over the end of each course. The method is called "step flashing."

The metal flashing shingles are rectangular, 10" long and 2" wider than the expected exposure of the roofing shingles. For example, when used with shingles with a 5" exposure, they are 10" x 7". The 10" length is bent to extend 5" over the roof deck and 5" up the wall surface. Each flashing unit is placed up-roof from the exposed edge of the shingle that will overlap it so that it is not visible when the overlapping shingle is in place. (See Figure 10-1 a & b)

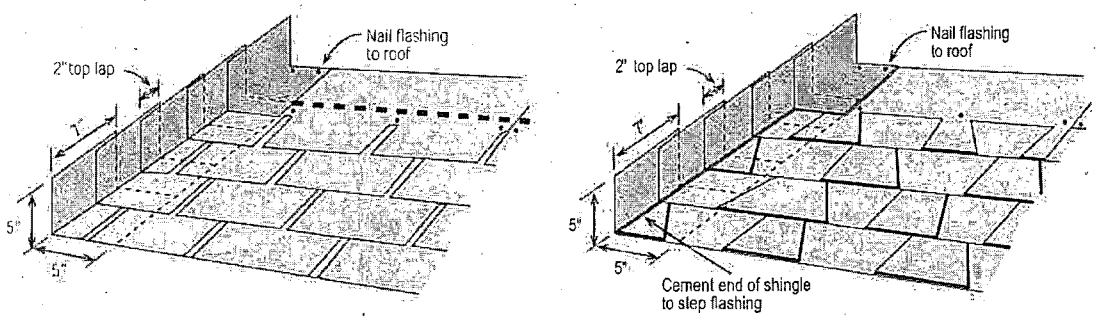


Figure 10-1 a & b
Application of step flashing

To install step flashing, place the first flashing unit over the end of the starter strip and position it so that the end shingle in the first course covers it completely. Secure the horizontal flange to the roof with two nails. Do not nail flashing to the wall as differential movement of the wall and roof could damage the seal. Then apply the first course of shingles up to the wall. Position the second step flashing strip over the end shingle in the first course 5" up from the butt or the same distance as the shingle exposure so that the end shingle in the second course covers it completely. Fasten the horizontal flange to the roof.

The second course of shingles follows; the end is flashed as in preceding courses and so on to the top of the intersection. Because the metal strip is 7" wide, when the roof shingles are laid with a 5" exposure, each flashing unit will overlap the one on the course below by 2".

Bring wall siding down over the vertical sections of the step flashing to serve as counter flashing. Keep wood siding far enough away from the roof shingles so that it may be painted. (See Figure 10-2)

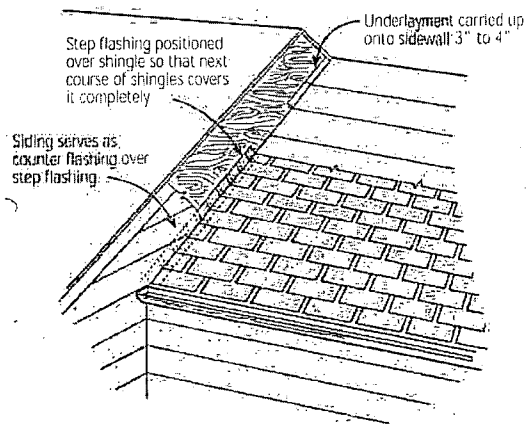


Figure 10-2
Application of step flashing against vertical sidewall

FLASHING AGAINST VERTICAL FRONT WALLS

Apply shingles up the roof until a course must be trimmed to fit at the base of the vertical wall. Plan ahead and adjust the exposure slightly in the previous two courses so that the last course is at least 8" wide. Apply a continuous piece of metal flashing over the last course of shingles by embedding it in asphalt roof cement and nailing it to the roof. The metal flashing strip should be bent to extend at least 5" up the vertical wall and at least 4" onto the last shingle course. Do not nail the strip to the wall. Apply an additional row of shingles in asphalt roof cement, (conforming to ASTM D 4586) over the metal flashing strip, trimmed to the width of the strip. (See Figure 10-3).

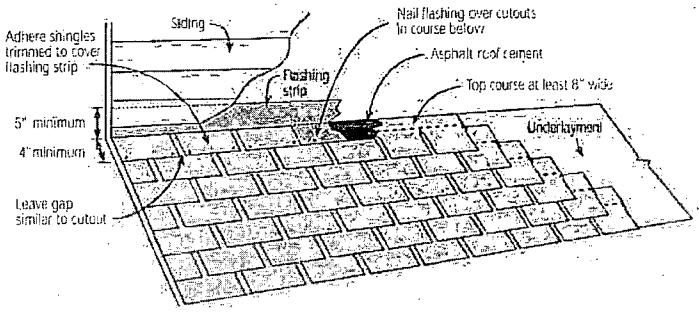


Figure 10-3
Application of flashing against vertical front wall

[Caution]
Excessive use of asphalt cement may cause blistering.

Bring siding down over the vertical flashing to serve as cap flashing. Keep wood siding far enough away from the roof shingles so that it may be painted. Do not nail siding into the vertical flashing.

If the vertical front wall meets a sidewall, as in dormer construction, cut flashing so that it extends at least 7" around the corner. Then continue up the sidewall with step flashing as described earlier.

SOIL STACKS AND VENT PIPES

Practically all dwellings have vent pipes or ventilators projecting through the roof that are circular in section and require special flashing methods.

Apply shingles up to the vent pipe. Then cut a hole in a shingle to go over the pipe and set the shingle in asphalt roof cement conforming to ASTM D 4586. (See Figure 10-4)

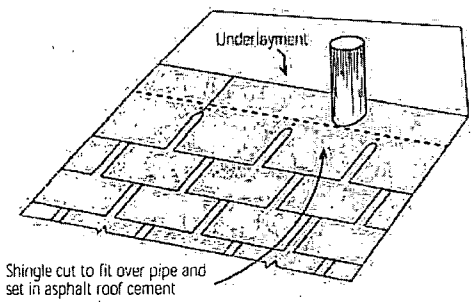


Figure 10-4
Application of shingle over vent pipe

[Caution]
Excessive use of asphalt cement may cause blistering.

A preformed flashing flange that fits snugly over the pipe is then placed over the shingle and vent pipe and set in asphalt roof cement. Place the flange over the pipe to lay flat on the roof. (See Figure10-5 a & b)

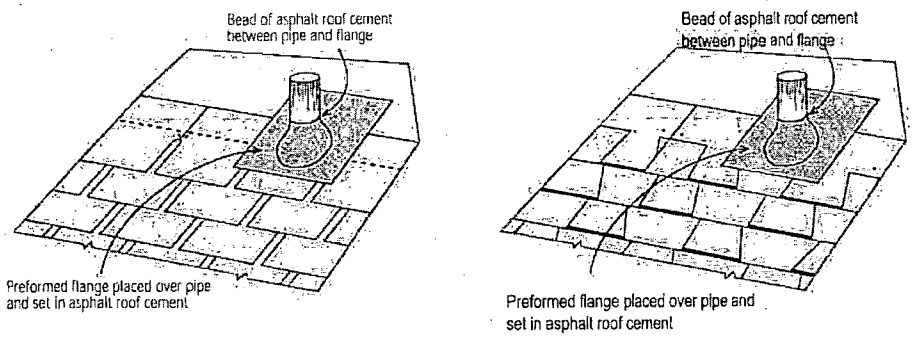


Figure10-5 a & b
Application of flashing over vent pipe

After the flashing is in place, resume shingle application. Cut shingles in successive courses to fit around the pipe and embed them in asphalt roof cement where they overlay the flange. Avoid excessive use of cement as it may cause blistering. Do not drive fasteners too close to the pipe. The completed installation should appear as shown in Figure 10-6 a & b with the lower part of the flange overlapping the lower shingles and the side and upper shingles overlapping the flange.

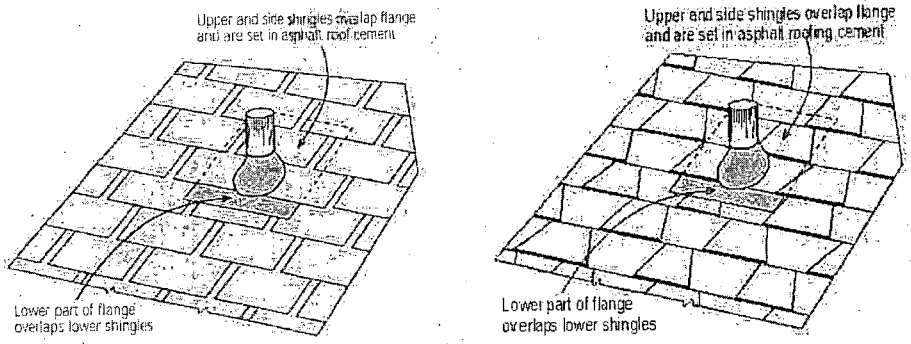


Figure 10-6 a & b
Application of shingles around flashing

Follow the same procedure where a ventilator or exhaust stack is located at the ridge, but bring the shingles up to the pipe from both sides and bend the flange over the ridge to lie in both roof planes, overlapping the roof shingles at all points. Ridge shingles are then positioned to cover the flange. Embed the ridge shingles in asphalt roof cement where they overlap the flange.

FLASHING AROUND CHIMNEYS

To prevent problems that uneven settling can cause chimneys on older homes were usually built on a separate foundation from that of the main structure. This does not eliminate possible differential settling between the chimney and the main structure. It only frees the chimney from the stresses and distortions that would be imposed on it if both were on the same foundation.

Because of these differential movements, flashings at the point where the chimney projects through the roof calls for a construction that will allow movement without damage to the water seal. To accomplish this, it is necessary to apply apron flashings that are secured to the roof deck and counter flashings that are secured to the masonry. If movement occurs, the counter flashing slides over the apron flashing without affecting water runoff.

[NOTE]
It is strongly recommended a cricket be installed on any chimney that is 24" or more wide. The International Residential Building Code (IRC) requires a cricket or saddle be installed on any chimney greater than 30"

Chimneys that project through the roof surface should have a cricket installed at the intersection of the back face of the chimney and the roof deck. The cricket (or wood saddle) is an important element in preserving the integrity of the flashing that will be installed because it prevents the buildup of ice and snow at the rear of the chimney and diverts water runoff around the chimney. (See Figure 10-7)

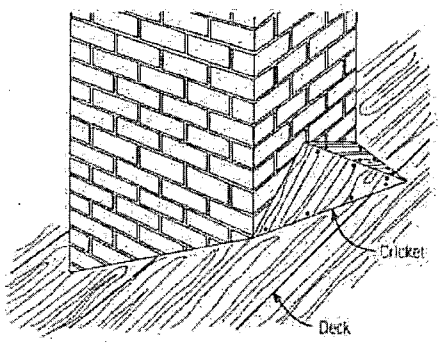


Figure 10-7
Location and configuration of chimney cricket

The cricket should be in place from the start because all roofing materials from the felt underlayment to the roofing shingles are carried over it. If it is not in place, build one as part of the deck preparation prior to applying underlayment and shingles.

Commonly, a cricket consists of two triangular sections of sheathing supported by appropriate framing members, joined to form a level ridge that extends from the centerline of the chimney back to the roof deck. Nail the sections to the deck and to each other along their meeting edge.

Apply shingles up to the front edge of the chimney before any flashings are installed. In addition, apply a coat of asphaltic masonry primer (conforming to ASTM D 41) to the chimney's brickwork to seal the surface and to provide good adhesion at all points where asphalt roof cement will later be applied.

Begin the flashing construction with the installation of 26-gauge corrosion-resistant metal apron flashing between the chimney and the roof deck on all sides.

Apply the apron flashing to the front first, as shown in Figures 10-8 and 10-9. Bend the apron flashing so that the lower section extends at least 4" over the shingles and the upper section extends at least 12" up the vertical face of the chimney. Work the flashing firmly and smoothly into the joint between the shingles and chimney. Set both the roof and chimney overlaps in asphalt roof cement placed over the shingles and on the chimney face. The flashing may be secured against the chimney with one or two nails driven into the mortar joints to hold it in place until the cement sets.

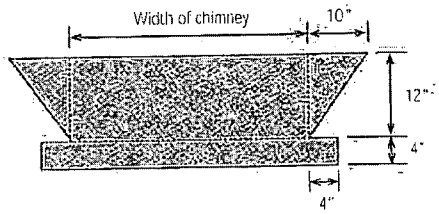


Figure 10-8
Pattern for cutting front apron flashing

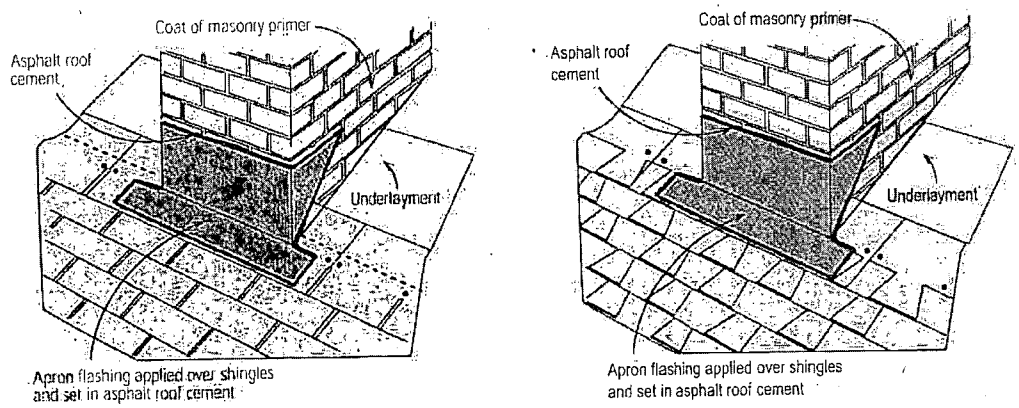


Figure 10-9 a & b
Application of apron flashing at front of chimney

Use metal step flashing for the sides of the chimney, positioning the units in the same manner as flashing a vertical sidewall. Cut, bend and apply the step flashing as shown in Figure 10-10. Secure each flashing unit to the masonry with asphalt roof cement and to the deck with nails. Embed the end shingles in each course that overlaps the flashing in asphalt roof cement.

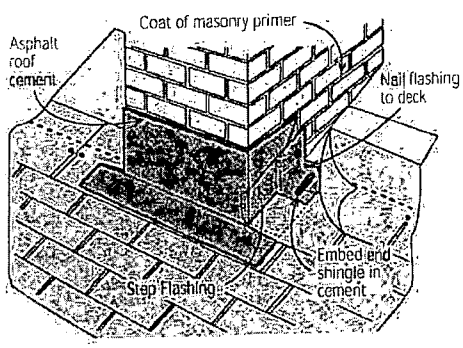


Figure 10-10
Application of step flashing at side of chimney

Place the rear cricket flashing over the base and the back of the chimney as shown in Figures 10-11 through 10-13. Cut and bend the metal cricket flashing to cover the cricket and extend onto the roof surface at least 6". It should also extend at least 6" up the brickwork and far enough laterally to lap the step flashing on the sides.

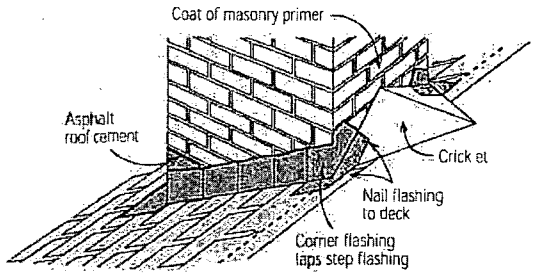


Figure 10-11
Application of corner flashing at rear of chimney

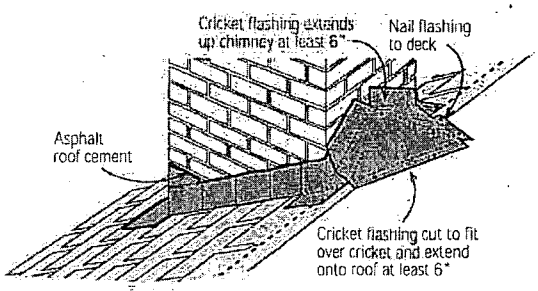


Figure 10-12
Application of flashing over cricket

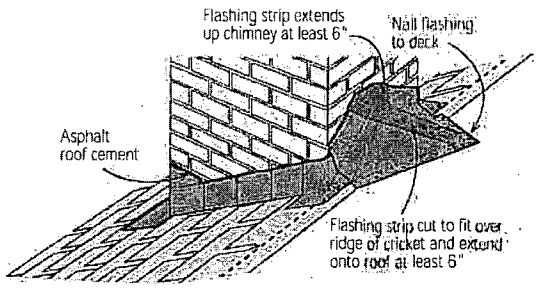


Figure 10-13
Application of flashing over ridge of cricket

If large enough, the base may be covered with shingles. Otherwise, apply the rear apron flashing, bring the end shingles in each course up to the cricket and cement them in place.

Counter flashings must now be placed over all apron, cricket and step flashings for positive exclusion of water from the joint. Begin by setting the metal counter flashing into the brickwork as shown in Figure 10-14. This is done by raking out a mortar joint to a depth of 1½" and inserting the bent edge of the flashing into the cleared joint. Once in place and being under a slight amount of spring tension, the flashing cannot be dislodged easily. Refill the joint with Portland cement mortar. Finally, bend the flashing down to cover the flashing and to lie snugly against the masonry.

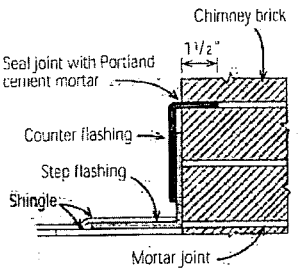


Figure10-14
Application of counter flashing

Use one continuous piece of counter flashing on the front of the chimney as shown in Figure 10-15. On the sides and back of the chimney, use several pieces of similar-sized flashing, trimming each to fit the particular location of brick joint and roof pitch. (See Figure 10-16 a & b.)

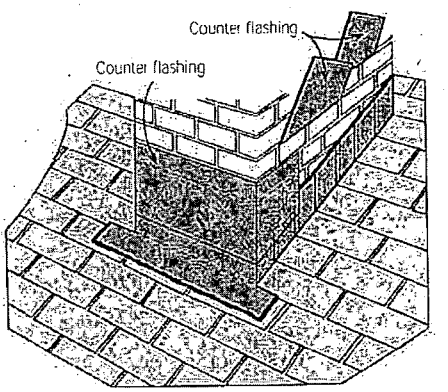


Figure 10-15
Application of counter flashing at front and side of chimney

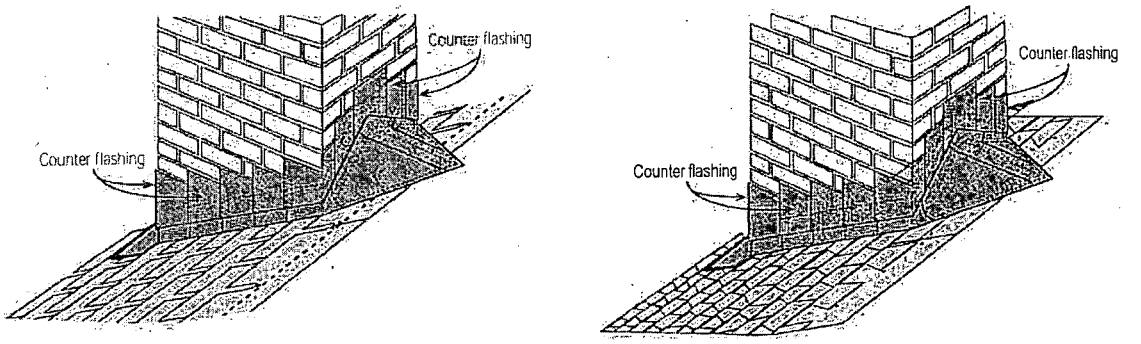


Figure 10-16 a & b
Application of counter flashing at side and rear of chimney

Start the side units at the lowest point and overlap each at least 3". As this is a metal cricket, it should be left unshingled in case a leak occurs (a leak would not be readily detectable if the cricket were shingled).

CHAPTER 11
HIPS AND RIDGES

The correct application of hip and ridge products is an important part of a completed roof. Most shingle manufacturers market at least one hip and ridge product. While some are simple, match the shingle, and are easy to apply, others add character to the finished roof. In each case it is important to follow the manufacturer's application instructions regardless of which hip and ridge product is used.

The following application technique is a simple hip and ridge application showing the use of 3-tab strip shingles that can be used with many types of shingles. Care must be taken if you use a three-tab shingle for the hip and ridge that is not made by the same manufacturer of the shingle used on the roof to make sure the colors match. Laminated shingles are not designed to be cut and applied to hips and ridges.

Apply shingles up to a hip or ridge from both sides of the roof before finishing the intersection. To facilitate finishing, adjust the last few courses so that the ridge capping will cover the top courses of shingles equally on both sides of the ridge. There should not be any of the shingle's headlap exposed and the ridge cap should provide at least 2" overlap on each side of the hip or ridge.

Hip and ridge shingles may be made from the shingles used to cover the roof. Cut shingles down to 12" x 12" through the tab cutouts on three-tab shingles or to a minimum of 9" x 12" on two-tab or no-cutout shingles. Taper the lap portion of each cap shingle slightly so that it is narrower than the exposed portion. This produces a neater job. (See Figure 11-1)

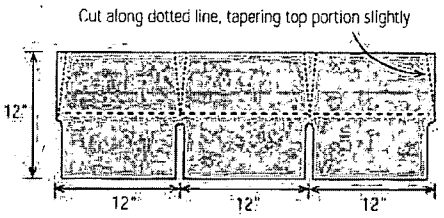


Figure 11-1
Fabrication of hip and ridge shingles from three-tab strip shingles

To apply the ridge shingles, bend each shingle along the centerline so that it will extend an equal distance on each side of the hip or ridge. Chalk lines may assist in proper alignment. In cold weather, warm the shingle until it is pliable before bending. Apply the shingles with a 5" their designated exposure, or according to the manufacturer's instructions on pre-cut hip and ridge, beginning at the bottom of the hip or from the end of the ridge opposite the direction of the prevailing winds. See Figure 11-2. Secure each shingle as illustrated in Figure 11-3 with one fastener on each side, 5½" back from the exposed end ½" more than the (or ½" from the exposure line) and 1" up from the edge. Length of fastener for hip and ridge shingles should be long enough to penetrate ¾" into the decking or go completely through the decking boards.

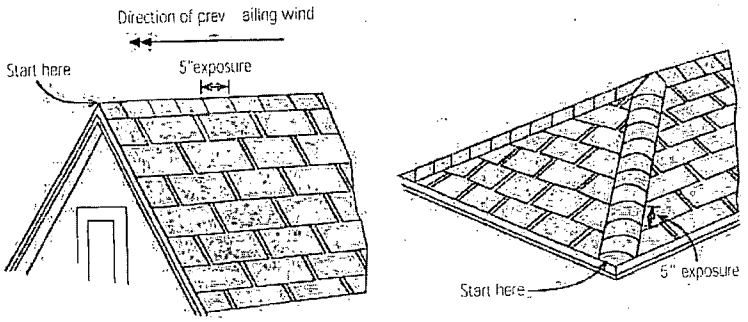


Figure 11-2
Application of hip and ridge shingles

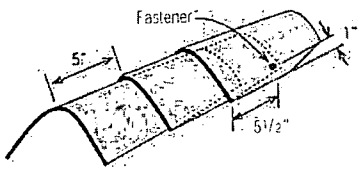


Figure 11-3
Fastener location of hip and ridge shingles

Where two hips meet the ridge as shown in Figure 11-2 or where the ridge cap ends face nailing may be required to hold the hip and ridge shingles in place. If any of the ridge shingles are face nailed, set the ridge shingle in asphalt roofing cement before nailing it in place. It is recommended to cover the head of the nails with a small spot of asphalt roof cement and granules.

NOTE:
If ridge vent is used, consult with individual manufacturer's application instructions.

NOTE:
In high wind areas, hip and ridge shingles that do not have sealant tabs should be hand sealed with quarter sized dots of asphalt roof cement (ASTM D4586) under the leading edge corners of the exposed tab.

CHAPTER 12
APPLICATION OF SHINGLES ON LOW AND STEEP SLOPES

LOW SLOPE APPLICATIONS

Asphalt strip shingles may be used on slopes ranging from 2"-4" per foot if special procedures are followed. Never use shingles on slopes lower than 2" per foot.

Low slopes can lead to problems because water drains slowly from these slopes, creating the greater possibility of water backup and damage from ice dams. The special application method described below for applying shingles on low slopes ensures that the roof remains weather-tight.

A. Underlayment

There are two methods of applying underlayment for low slope application. There is the traditional method shown in Figure 12-1 that is described below. The second method uses the self-adhered shingle underlayment in place of the non-perforated asphalt saturated felt.

On low slope applications, cover the deck with two layers of non-perforated asphalt saturated felt or one layer of an appropriate self-adhered shingle underlayment. Begin by fastening a 19" wide strip of underlayment placed along the eave. Place a full width sheet over the starter sheet with the long edge placed along the eave and completely overlapping the initial layer.

All succeeding courses will be a minimum of 36" wide and should be positioned to overlap the preceding course by 19". Secure each course by using only enough fasteners to hold it in place until the shingles are applied. End laps should be 12" wide and located at least 6 feet from end laps in the preceding course.

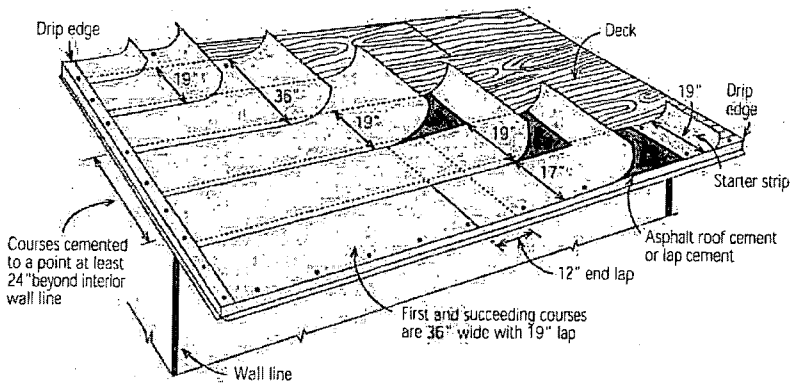


Figure 12-1
Application of underlayment on low slopes where icing along the eave is anticipated

[Note]
Self-adhered shingle underlayments are commonly used for ice dam protection. If one of these products is used, follow the manufacturer's application instructions.

If the second method using self-adhered shingle underlayment is used on the low slope area, it should be applied as shown in Chapter 7 and figure 7-3. The only change is that you cover the entire low slope deck with the self-adhered shingle underlayment. When the entire roof is covered with self-adhered shingle underlayment, adequate ventilation of the attic space is required. Using self-adhered shingle underlayment over the entire deck is a moisture barrier, the installer must ensure that ventilation requirements are met. See ARMA Technical Bulletin on Moisture control.

In roof areas where a steep slope (greater than 4" slopes) transitions into a low slope roof area (less than 4" slopes), the low slope underlayment application should extend at least 24" up on the steep slope roof. The transition area between the steep slope and low slope is an area that needs special attention due to water build up that can occur in transition areas.

B. Eave Flashing for Ice Dam Protection

The preferred method for ice-dam protection is the use of self-adhered shingle underlayment as shown in Chapter 7. The following method is also acceptable.

Wherever there is a possibility of ice build-up along the eave or a backup of water from pine needles or leaves, cement all laps in the underlayment courses from the eave to a point at least 24" beyond the interior wall line of the building using asphalt roofing cement (conforming to ASTM D 4586) or asphalt lap cement (conforming to ASTM D 3019). The cemented double ply underlayment serves as the eave flashing. (See Figure 12-1)

To construct the eave flashing, cover the entire surface of the initial underlayment starter course with a continuous layer of asphalt roof cement applied at the rate of 2 gallons per 100 ft.^{2}; alternatively lap cement may be used at a rate of 1 gallon per 100 ft.^{2}.

Consult with the individual manufacturer, as specifications may vary. Place the first course over the starter, pressing it firmly into the cement.

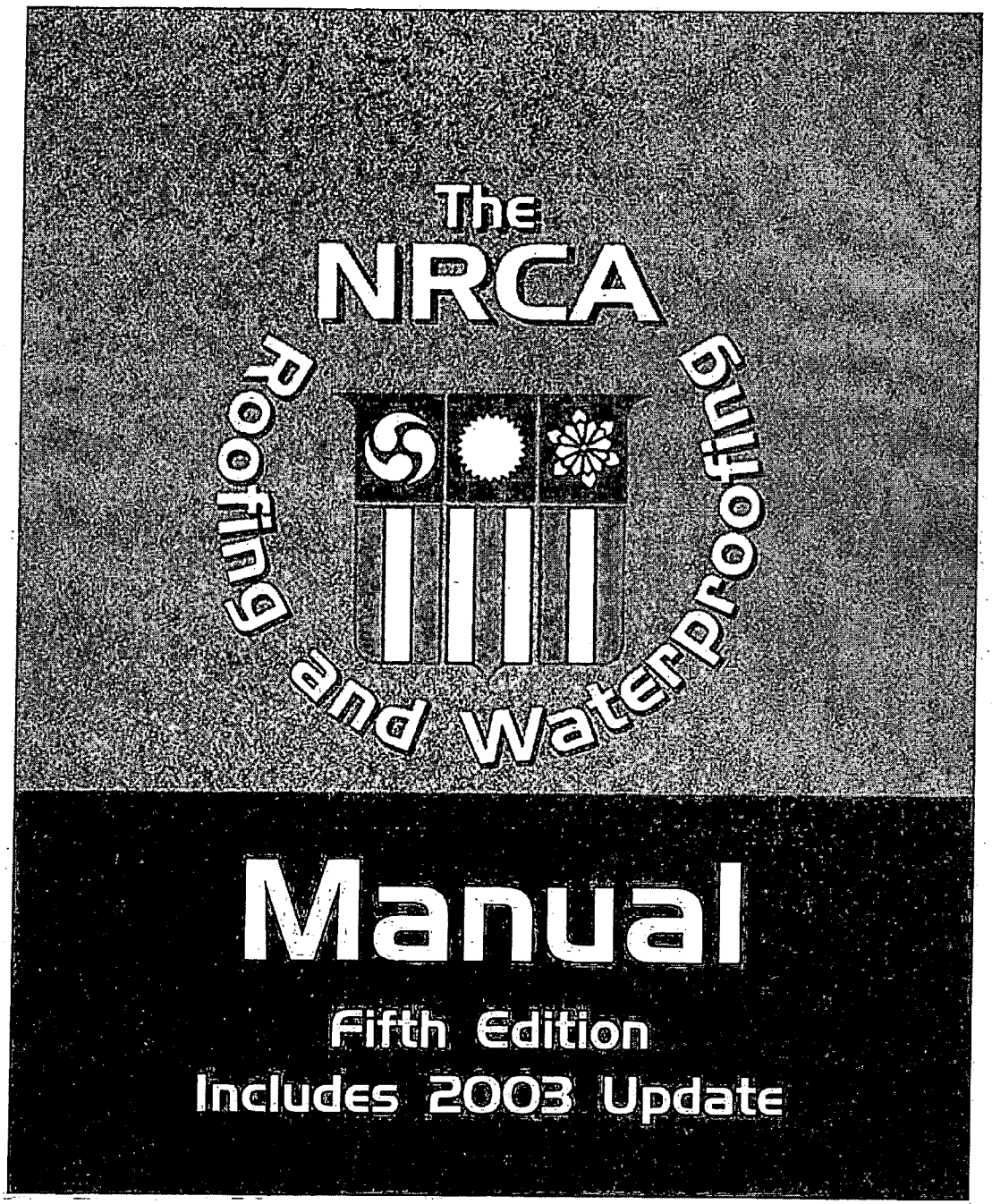
After the first course is in place, coat the upper 19" with cement. Position the second course and press it into the cement. Repeat the procedure for each course that lies within the eave flashing distance. It is important to apply the cement uniformly so that the overlapping felt will float completely on the cement without touching the felt in the underlying course. Avoid excessive use of cement as it may cause blistering. Asphalt roofing cement conforming to ASTM D 4586 is recommended.

After completing the eave flashing, secure each successive course by using only enough fasteners to hold it in place until the shingles are applied. Use care when walking on the eave flashing prior to application of shingles.

STEEP SLOPE APPLICATIONS

Recent architectural trends that make much greater use of steep slopes have created radical departures from traditional roof concepts. Mansard roofs are perhaps the best examples of these trends.

Steep slopes tend to reduce the effectiveness of factory-applied self-sealing adhesives especially on colder or shaded areas of the roof. Thus, special application methods may be necessary.


The
NRCA
Roofing and Waterproofing
Manual
Fifth Edition
Includes 2003 Update

1. GENERAL INFORMATION

Asphalt shingles have been used in North America since the early 1900s and are the most common type of roof covering used for steep-slope roof system construction. Asphalt shingles are factory manufactured roofing materials that are installed in courses to create a multi-layered, overlapping, water-shedding roof covering.

Asphalt shingles first were produced around 1901 and came into general use about 1910. Around 1915, machinery was developed for roller-die cutting of granular roll roofing materials into irregular shapes on a continuous production line. These new products were more fire resistant than wood shingles; offered more colors, shapes and patterns; and were less expensive. Single unit shingles often were 12 inches by 16 inches (300 mm by 410 mm). Early strip shingles were 10 inches to 13½ inches (250 to 340 mm) by 36 inches (910 mm).

An asphalt shingle generally is composed of asphalt, fillers, a reinforcing mat and a granule surfacing. They are available in a variety of colors, shapes and thicknesses. Asphalt shingle roof systems typically are applied over wood decks, such as structural wood panels, wood boards or planks, and are attached to decks with nails. An underlayment, positioned between asphalt shingles and a roof deck, is part of an asphalt shingle roof system.

2. COMPONENTS

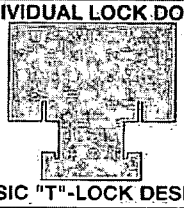
2.1 Asphalt Shingles

Asphalt shingles are categorized in different ways depending on their reinforcements and shapes. Asphalt shingles that use organic reinforcing mats are referred to as "organic-reinforced asphalt shingles," and those that use glass fiber reinforcing mats are referred to as "glass fiber-reinforced asphalt shingles."

The shapes or styles of asphalt shingles are identified as follows:

- strip shingles — These shingles are in a strip form and are the most common type of asphalt shingles produced. They generally are longer in width than height. Common dimensions for standard shingles are 12 inches by 36 inches (300 mm by 910 mm). For metric shingles, the common dimensions are approximately 13 inches by 39⅜ inches (330 mm by 1 m). These dimensions can vary depending on the manufacturer, and some newer products are available in larger dimensions than traditional standard- or metric-sized asphalt strip shingles. Products referred to as "3-tab", "4-tab", "random tab" and "no-cut out" shingles all are categorized as strip shingles. Most strip shingles are "self-sealing," that is, they contain adhesive seal strips that bond to overlying or underlying courses of shingles for increased wind resistance.
- laminated strip shingles — Sometimes called "dimensional" or "architectural" shingles, these shingles have additional material laminated to strips to create random thicknesses thereby giving the shingles more dimensional looks. Most laminated shingles are "self-sealing," that is, they contain adhesive seal strips that bond to overlying or underlying courses of shingles for increased wind resistance. Dimensions and weights can vary depending on the manufacturer, and some newer products are available in larger dimensions than traditional standard- or metric-sized asphalt strip shingles.
- individual shingles — Individual shingles typically are smaller than strip shingles, and more pieces are required to cover the same roof area than with strip shingles. Particularly in the past, individual shingles were known for their unique visual patterns. Scalloped, fish scale, diagonal, diamond and octagon are a few of the patterns that can be achieved with individual shingles depending on their design, and some of these products still are available in some regions of North America. Some individual shingles offer a locking feature for increased wind resistance, because individual shingles typically do not contain self-sealing adhesive strips. The "T-lock" design is an example of this locking type feature.

Table 1: Asphalt shingles

PRODUCT	APPROX. SIZE		TYPICAL EXPOSURE	QUANTITY PER SQUARE	
	WIDTH	LENGTH		SHINGLES	BUNDLES
SELF-SEALING STRIP SHINGLE "3 -TAB"	12 to 13-1/4 inches (300 to 337 mm)	36 to 39-3/8 inches (910 mm to 1 m)	5 or 5-5/8 inches (125 or 143 mm)	65 to 80	3
STRIP SHINGLE MORE THAN ONE THICKNESS PER STRIP LAMINATED	11-1/2 to 15 inches (290 to 380 mm)	36 to 39-3/8 inches (910 mm to 1 m)	4 to 8 inches (100 to 203 mm)	64 to 90	3 to 5
SELF-SEALING STRIP SHINGLE NO CUT OUT	12 to 13-1/4 inches (300 to 337 mm)	36 to 39-3/8 inches (910 mm to 1 m)	5 or 5-5/8 inches (125 or 143 mm)	65 to 81	3 or 4
INDIVIDUAL LOCK DOWN  BASIC "T"-LOCK DESIGN	18 to 22-1/4 inches (460 to 565 mm)	20 to 22-1/2 inches (510 to 572 mm)		72 to 120	3 or 4
OTHER TYPES AVAILABLE FROM SOME MANUFACTURERS IN CERTAIN AREAS OF THE COUNTRY					

2.1.1 Materials

Asphalt shingle products are manufactured from three basic components: asphalt and fillers, reinforcing mat and surfacing. Asphalt strip and laminated strip shingles also use adhesives to provide self-seal strips.

2.1.1.1 Asphalt and Fillers

The weatherproofing material used to manufacture asphalt shingles is asphalt flux. Asphalt flux is obtained from the fractional distillation of petroleum that occurs toward the end of the petroleum refining process. Asphalt flux is further refined by air blowing to produce roofing-grade asphalt at an oil refinery and then is delivered to an asphalt roofing material manufacturer. Some manufacturers do their own air blowing.

Asphalt may be used in two processes: first as a saturant and second as the primary coating and weatherproofing material for an asphalt roofing product.

Saturant-grade asphalt — Asphalt used in the saturation process is a "soft," less viscous asphalt than coating asphalt and only is used for asphalt shingles that are reinforced with organic mats. It is used to impregnate an organic reinforcing mat before application of a coating asphalt.

Coating-grade asphalt — Coating asphalt is more viscous than saturant asphalt. Mineral additives, or "fillers" are added to coating asphalt to stabilize the bitumen, reduce its natural flow characteristics and increase fire resistance, making it more suitable as a coating material. Some examples of mineral additives used are limestone, fly

ash, traprock, slate dust or other rock particulates. Filler materials may differ among manufacturers or manufacturing sites.

Some manufacturers have developed asphalt shingle materials using asphalt that has been modified with various polymers. The most common polymer currently used is styrene butadiene styrene (SBS). Polymers can alter the basic physical characteristics of asphalt and may provide enhanced weathering and aging characteristics.

2.1.1.2 Reinforcing

All asphalt shingles are reinforced with a component that is designed to support the asphalt. Reinforcement most commonly is made out of one of the following materials:

- Organic Mats

During the years, organic mats have been produced from various combinations of cotton rag, wood fiber and other cellulose fibers. Currently, wood and other cellulose fibers are the reinforcement types most widely used in organic mats. Before organic reinforcing mats are coated with coating grade asphalt, it is first impregnated with a soft, saturant-grade asphalt intended to fill voids between fibers.

- Glass Fiber Mats

Glass fiber mats are composed of thin inorganic glass fibers. The fibers may be continuous or random and are bonded together with plastic binders or resin. Unlike organic mats, glass fiber mats used for asphalt shingles are not saturated with a soft asphalt before the application of coating grade asphalt.

2.1.1.3 Surfacing

Asphalt shingles most commonly are surfaced with coarse mineral granules.

Mineral granules are used for the following reasons:

- to protect an underlying asphalt coating from the degrading effects of ultraviolet light and weathering. Therefore, the granules must be opaque, properly graded for maximum coverage and densely applied over the coating-grade asphalt surface
- to increase the external fire resistance of an asphalt roofing product
- to provide a greater variety of design possibilities and aesthetic choices because of their wide range of texture, color and color blends.
- to add weight, which increases wind resistance.

Mineral granules either are made from natural colored rock granules or rock granules colored by a ceramic-coating process. Ceramic granules are currently the most commonly used coarse mineral surfacing.

Many asphalt shingle products are available with special granule surfacings that use zinc or copper particles to minimize algae growth. Zinc or copper particles are applied with a granule surfacing, or some granules may be coated with a zinc or copper compound. Once exposed to moisture, copper or zinc granules produce an algaecide for a period of time. The duration of time and effectiveness of the algaecide will vary from region to region depending on climatic conditions.

Although less common, a few asphalt shingle products are available that use foil laminate surfacing in place of mineral granule surfacing.

On the back side of asphalt shingles, finely ground minerals are applied to prevent the shingles from sticking together in a package or bundle. The materials most frequently used as fine mineral surfacings are talc and mica.

2.1.1.4 Self-sealing Strip

Commonly, asphalt strip shingles and laminated shingles contain adhesive, self-sealing strips. A self-sealing strip gives an asphalt shingle increased wind resistance by securing the leading edge of the shingle. A self-sealing strip is generally composed of an asphaltic-based, heat-sensitive adhesive that is designed to adhere to the overlying or underlying course of shingles. A modifier, similar to SBS-modified bitumen, may be added to the adhesive to make it tackier, allowing the adhesive to seal at lower temperatures. Typically, individual shingles, such as "T-Lock" shingles, do not contain this type of adhesive self-sealing strip.

During the manufacturing process, a strip of cellophane may be applied to each shingle to prevent the self-seal strips from bonding the shingles together when packaged. When packaged for shipping, the self-sealing strips align with cellophane strips. However, when strip shingles or laminated strip shingles are installed on a roof, self-sealing strips will not align with cellophane strips but will correctly bond to shingles above or below. For this reason, cellophane strips do not need to be removed from shingles before application.

2.1.2 Standards

The following American Society for Testing and Materials (ASTM) standards apply to asphalt shingle products:

- ASTM D 225, "Standard Specification for Asphalt Shingles (Organic Felt) Surfaced With Mineral Granules." This standard addresses material mass, and low and high temperature behavior, as well as other physical properties.
- ASTM D 3018, " Standard Specification for Class A Asphalt Shingles Surfaced with Mineral Granules." This standard addresses fire test classification, wind resistance, loss of volatile matter after heating and other properties.
- ASTM D 3462, "Standard Specification for Asphalt Shingles Made from Glass Felt and Surfaced with Mineral Granules." This standard addresses tear strength, fastener pull-through resistance and pliability, as well as other physical properties.

NRCA recommends that organic-reinforced asphalt shingles conform to ASTM D 225, and glass fiber-reinforced asphalt shingles comply with ASTM D 3462.

2.2 Underlayment

NRCA recommends the use of underlayments with asphalt shingle roof systems. An underlayment is applied over a roof deck before the application of asphalt shingles. An underlayment performs two primary functions: it provides temporary weather protection until a roof covering is installed, and it provides a secondary weatherproofing barrier should moisture infiltrate the asphalt shingles.

In addition, underlayments generally are necessary with asphalt shingle roof systems for the following reasons:

- to comply with local building codes
- to maintain a Class A, B or C fire rating for a roof assembly
- to meet the requirements of the manufacturer for a material or system warranty

There are different underlayment configurations that can be used for asphalt roof systems:

- single layer of underlayment
- single layer of self-adhered membrane
- double layer of underlayment

2.2.1 Asphalt-saturated Felt

Asphalt-saturated felt underlayment is the most common underlayment used in steep-slope roof systems and typically uses an organic reinforcing mat.

The weatherproofing material used to manufacture roof underlayment felt is asphalt flux. Asphalt flux is obtained from the fractional distillation of petroleum that occurs toward the end of the petroleum refining process. Asphalt flux sometimes is further refined by air blowing to produce roofing-grade asphalt at a refinery or at a product manufacturer's facility.

Depending on the type of underlayment, asphalt may be used in two processes: first as a saturant and second as a coating.

Saturant-grade asphalt — Asphalt used in the saturation process is a "soft," less viscous asphalt than a coating asphalt and is used to impregnate organic reinforcing mats. A saturant-grade asphalt has a lower melting point than a coating-grade asphalt.

Coating-grade asphalt — If a felt underlayment is a coated felt, a coating-grade asphalt is applied to the felt after the saturation process. The coating asphalt is more viscous than a saturant asphalt. Mineral additives, or "fillers," are added to coating asphalt to stabilize the bitumen and reduce its natural flow characteristics and increase fire resistance and weatherability, making it more suitable as a coating material.

Underlayments are reinforced with mats that are designed to support the asphalt. Reinforcing mats of different thicknesses are used to produce underlayments of different weights. These reinforcements, sometimes referred to as carriers, are most commonly made from of organic fibers. However, some underlayments are produced that use reinforcing mats made from glass fibers.

- Organic Mats

During the years, organic mats have been produced from various combinations of cotton rag, wood fiber and other cellulose fibers. Currently, wood and other cellulose fibers are the types of reinforcements most widely used in organic mats. Organic mats then are saturated with a soft, saturant-grade asphalt intended to fill voids between fibers.

- Glass Fiber Mats

Glass fiber mats are composed of inorganic glass fibers. The fibers may be continuous or random and are bonded with plastic binders or resin. Additionally, these glass fiber mats may be further reinforced with chopped glass fiber strands. The mats then are coated with asphalt. These fiberglass reinforced felt underlayments differ from perforated glass fiber ply sheets used in bituminous, low-slope roof systems.

- Polyester or Synthetic Mats

Although not as common, some underlayments now are available that use synthetic fibers, such as polyester, as reinforcing mats.

The following American Society for Testing and Materials (ASTM) standards apply to asphalt-saturated organic felt underlayments:

- ASTM D 226, "Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing." This standard addresses material characteristics and physical properties, and provides two classifications: Type I, commonly called No. 15 asphalt felt and Type II, commonly called No. 30 asphalt felt.
- ASTM D 4869, "Standard Specification for Asphalt-Saturated Organic Felt Shingle Underlayment Used in Roofing." This standard addresses material characteristics and physical properties, and provides two classifications: Type I (No. 15), Shingle Underlayment, and Type II (No.30), Heavy Duty Shingle Underlayment.

NRCA recommends that asphalt-saturated/coated organic felt underlayments comply with the minimum physical property values listed in ASTM D 226, Type I (i.e., No. 15) or ASTM D 4869, Type I (i.e., No. 15). The primary difference between these two standards is that ASTM D 226 has higher requirements for the mass of felts and saturants. However, ASTM D 226 addresses asphalt-saturated organic felts with or without perforations. When used as underlayments, only nonperforated asphalt felts should be used.

2.2.2 Polymer-modified Bitumen Sheet Underlayments

Polymer-modified bitumen sheet membrane products are now being used as underlayments in some steep-slope roof systems. Some of these materials are marketed for use specifically as underlayments for steep-slope roof systems. Others are heavy, nonporous base sheets commonly used in low-slope roof systems.

Bitumen used in this type of underlayment is an asphalt that has been modified with polymers. The common polymers currently used are atactic polypropylene (APP) and styrene butadiene styrene (SBS). These polymers alter the basic physical characteristics of asphalt and provide enhanced weathering, aging and sealing characteristics. Polymer-modified bitumen base sheets generally are reinforced with either a glass fiber or polyester mat. Polymer-modified bitumen products used as underlayments range in thickness from approximately 35 mils to 90 mils (0.9 mm to 2.3 mm). In some cases, self-adhering polymer-modified bitumen membranes, most often used as ice-dam protection membranes, are installed over roof decks as underlayments. Self-adhering polymer modified underlayments range from 20 mils to 60 mils thick (0.5 mm to 1.5 mm). However, NRCA recommends the use of a minimum thickness of 40 mils (1.1 mm).

Some materials are more resistant to wrinkling and distortion upon exposure or after installation and exhibit better water-shedding properties than traditional asphalt-saturated organic felts. As a result, more of these types of underlayments are used for projects where a higher degree of underlayment performance is desired.

2.2.3 Ice Dam Protection Membranes

A specialized type of underlayment is an ice dam protection membrane. This underlayment provides additional protection from moisture intrusion along the eaves and in valleys where ice dams can occur during winter.

An ice dam protection membrane may consist of:

- a single layer of self-adhering polymer-modified bitumen membrane
- two plies of asphalt-saturated, nonperforated felt; first ply sheet is fastened to a deck, and the second ply sheet is adhered to the first with roof cement or cold adhesive.

The most common product used for ice dam protection is a self-adhering, polymer-modified bitumen membrane. The bitumen used in this type of membrane is an asphalt that has been modified with polymers, typically SBS. These polymers alter the basic physical characteristics of the asphalt and provide enhanced weathering and sealing characteristics.

Self-adhering, polymer-modified bitumen membranes generally are reinforced with either glass fiber or a thin layer of polyethylene on the top side. These membranes should not be exposed for extended periods of time before the application of asphalt shingles. Some polymer-modified bitumen membrane products incorporate a granule surfacing to provide a more slip-resistant surface for workers. A release paper covers the bottom side of such a membrane to prevent it from sticking to itself after it is wound into a roll.

The following American Society for Testing and Materials (ASTM) standard applies to modified bitumen ice dam protection membranes:

- ASTM D 1970, "Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials used as Steep Roofing Underlayment for Ice Dam Protection." This standard addresses thickness, tear resistance, adhesion properties, low-temperature flexibility and thermal stability, as well as other physical properties.

NRCA recommends that self-adhering, polymer-modified bitumen sheet membranes used as ice dam protection membranes on asphalt shingle roof systems be a minimum of 40 mils (1.0 mm) thick and comply with ASTM D 1970.

2.3 Asphalt Roof Cements

Roof cements commonly are used in the application of asphalt shingle roof systems. The base material used in the manufacture of roofing cement is an air-blown asphalt. The asphalt is thinned, or "cutback", with a petroleum-based solvent to create a softened, workable mixture. Some roof cements contain mineral fibers as stabilizers. Some manufacturers are now offering modified bitumen roof cements.

There are two common types of asphalt roof cement: flashing cement and lap cement. Flashing cements commonly are used on vertical surfaces and are of a trowelable consistency. Lap cements are used more specifically for bonding asphaltic materials together, and their consistencies are characterized as either trowelable or brushable.

Asphalt roof cements also are available in different grades. The two most common grades are winter or summer grades. The primary difference between the winter and summer grades is their softening point temperatures; winter grades have lower softening point temperatures than summer grades.

Common uses for asphalt roof cement in asphalt shingle roof systems are:

- to bond two layers of felt underlayment together to form an ice dam protection membrane along the eaves in place of a self-adhering modified bitumen membrane
- as a bedding cement for the purpose of sealing the base or flange of a metal accessory to a roof system
- to provide a temporary seal around roof penetrations or at walls prior to installing flashing components
- to manually seal the tabs or leading edges of asphalt shingles applied to more extreme slopes or in some cold weather applications

The following American Society for Testing and Materials (ASTM) standards apply to asphalt roof cement used as a utility cement or flashing cement:

ASTM D 2822, "Standard Specification for Asphalt Roof Cement." This standard addresses composition, pliability, high-heat behavior and adhesion properties, as well other physical requirements. Type I is a cement com-

posed of a low-softening point asphalt, and Type II is composed of a high-softening point asphalt. These classifications are further categorized by the intended application: Class I for dry surfaces or Class II for wet surfaces.

- ASTM D 4586, "Standard Specification for Asphalt Roof Cement, Asbestos Free". This standard addresses composition, pliability and high-heat behavior, as well other physical requirements. The Type I and Type II classifications are the same as ASTM D 2822; however, this standard does not differentiate between wet or dry surfaces.

The following ASTM standard applies to asphalt roof cement used as a lap cement:

- ASTM D 3019, "Standard Specification for Lap Cement Used with Asphalt Roll Roofing, Non Fibered, Asbestos Fibered, and Non Asbestos Fibered." Three types of lap cement are described in this standard: Type I, brushing consistency with no stabilizers: Type II, heavy brushing or light troweling consistency with a quantity of short-fibered asbestos stabilizers: Type III, heavy brushing or light troweling consistency with nonasbestos stabilizers.

3. DESIGN CONSIDERATIONS

3.1 Roof Deck

A roof deck provides a structural substrate over which a roof system is applied. A roof deck also must be able to provide adequate withdrawal resistance for fasteners used to attach a roof system. A roof deck material of long-term expected service life is important.

Asphalt shingles may be applied over the following substrates:

- wood plank
- wood board
- structural wood panels

For new construction, NRCA recommends designers specify roof deck slopes intended for the application of steep-slope materials at 4:12 (18 degrees) or greater. Asphalt shingles should be applied only over continuous or closely spaced wood plank or board decking and not over a spaced, or "skipped," application of wood plank or board decking.

The proper thickness and species of wood decking required for a specific roof assembly is determined by the design loads, including uplift, anticipated for the roof assembly and the distance between the supporting members. End joints of each piece of decking should be staggered. The end joints, except for matched ends (e.g., tongue-and-groove) should also be centered over the supporting members.

3.1.1 Wood Plank and Board Decking

Asphalt shingles may be applied over wood plank or board decking that is not warped, cupped or bowed. The terms wood "plank" and wood "board" generally are differentiated by thickness. The Western Wood Products Association (WWPA) defines the term plank as "a piece of lumber, from 2 but not including 5 inches thick, generally used with wide face horizontal ...". The term "board" is defined by the WWPA as "... term generally applied to lumber when the nominal size is 1 inch thick and 2 or more inches wide." Wood boards used for decks should be a minimum of 6 inches (150 mm) nominal width.

A wood plank or board roof deck is composed of solid-sawn dimensional lumber. It is typically supported by wood beams, often glue-laminated timber or glulams, and/or solid lumber joists, purlins or rafters. Wood planks or boards may be single or double tongue-and-groove, straight-edged, ship-lapped, or grooved for splines or longitudinal edges.

3.1.2 Structural Wood Panel Decking

Structural wood panel decking consists of either plywood or oriented strand board (OSB).

- Plywood Roof Decks

A plywood roof deck is composed of panels made of thin wood layers called veneers that are peeled from logs. The veneers are laid at right angles to each other, then glued together under heat and pressure. This cross-lamination adds strength and stability to the all-veneer panels. Panels consist of a number of cross-laminated layers that vary in number according to a panel's thickness.

Oriented Strand Board (OSB) Roof Decks

An OSB roof deck is composed of panels made from layers of compressed, glued wood strands. These strand layers are oriented at right angles to one another before being glued and formed into panels.

NRCA is concerned with potential fastener-holding problems and dimensional stability because of the effects of moisture where OSB and other nonveneer products are used as roof decking.

All plywood and wood-based panel roof decks suitable for application should be made from plywood or wood-based panels rated for structural use as roof sheathing. Most building codes require a label on plywood or wood-based panels ensuring that the plywood or wood-based panel complies with the criteria set forth in U.S. Product Standards (PS) PS 1-95, "Construction and Industrial Plywood", for all-veneer plywood or PS 2-92, "Performance Standard for Wood-Based Structural-Use Panels;" or APA—The Engineered Wood Association (APA) standard PRP-108, "Performance Standards and Policies for Structural-Use Panels," for structural-use panels (e.g., oriented strand board, all-veneer plywood).

Performance standards PS 1-95 and PS 2-92, which were initiated by APA—The Engineered Wood Association, formerly the American Plywood Association, have been developed under the "Procedures for the Development of Voluntary Product Standards" of the U.S. Department of Commerce. Performance standard PRP-108 was developed by APA—The Engineered Wood Association.

NRCA recommends plywood or wood-based panels intended for use as roof sheathing meet or exceed the requirements set forth by PS 1-95, PS 2-92 or PRP-108. Some roof material manufacturers will allow application of roof products over other wood substrates.

When plywood is used as a roof deck material, NRCA recommends the use of a minimum 15/32 inch (12 mm) thick or ½ inch (13 mm) nominal thickness exterior-grade plywood for 16 inch (410 mm) rafter spacings, and ⅝ inch (16 mm) nominal thickness exterior-grade plywood for 24 inch (610 mm) rafter spacings. When OSB is used as a roof deck material, a minimum of 15/32 inch (12 mm) thick exterior-grade OSB is recommended for 16 inch (410 mm) rafter spacings. The proper thickness of the structural wood panels required for a specific roof assembly is also determined by the design loads anticipated for the roof assembly and the distance between the supporting members.

All wood panel roof decks should consist of panels rated for structural use as roof sheathing. For particularly demanding applications, such as prefabricated panelized roof deck systems where cross-panel strength and stiffness or shear properties are critical, designers are recommended to use panels meeting the standard requirements for "Structural I Rated Sheathing."

Wood sheathing panels should be spaced approximately 1/8 inch (3 mm) apart to allow for expansion. End joints of wood sheathing panels that do not occur over supporting members should be blocked to provide adequate support for the sheathing panel ends.

3.1.3 Preservative-treated and Fire-retardant-treated Wood

Caution should be exercised when roof decks are constructed of wood that has been treated with an oil-borne preservative. Many roofing material manufacturers recommend that wood roof decks be constructed with wood that has been treated with a nonoil preservative pressure treatment or with nontreated, air- or kiln-dried lumber. For additional information regarding preservative wood treatment, consult the American Wood Preservers Association (AWPA).

Because of the deterioration of some fire-retardant-treated wood panels caused by chemical reaction, special care should be given to investigate the use of fire-retardant-treated wood panel decks in the design of a steep-slope roof assembly.

3.1.4 Other Deck Types

NRCA recognizes that other types of structural decking are becoming more common in steep-slope roof system construction, specifically in the commercial sector; however, NRCA recommends that asphalt shingles be attached only to structural wood panel decks or to wood plank or board decks. NRCA does not recommend the direct attachment of shingles to gypsum, concrete plank, cementitious wood fiber or similar, nonwood materials.

If deck types other than structural wood are used, NRCA suggests that a nailing substrate consisting of structural wood panels, such as plywood be installed over a structural deck.

Examples of deck types over which NRCA suggests a layer of plywood are:

- Steel roof decks
- Poured and precast, structural concrete decks

When installing asphalt shingle roof systems, NRCA does not recommend the installation of a nailing substrate over cementitious wood fiber deck panels, poured and precast lightweight insulating concrete, or poured and precast gypsum roof decks.

For ventilation purposes, if necessary, and to allow acceptable clearance for proper fastener penetration of the plywood nailing substrate, NRCA suggests the use of wood battens or metal channels attached over a structural deck to raise and separate the plywood panels from the deck surface below. The design, placement, spacing, height and attachment of wood battens or metal channels are the responsibilities of a designer. A complete roof assembly, including the structural deck, plywood nailing substrate and roof system, should be designed to meet local building code requirements. Key factors to consider during the design phase are fire resistance, structural loading, ventilation, and wind-resistance requirements of the applicable building code.

3.1.5 Steep-slope Compact Roof Assemblies

Steep-slope compact or "warm" roof assemblies are configured with each component placed immediately on top of its preceding component. Insulation is placed directly on top of or beneath a deck (or vapor retarder), and the primary roof covering is applied directly on top of rigid insulation or a deck. The name "compact" is given to these systems because each component is in immediate contact with its adjacent component with no space for ventilating the roof assembly.

In some instances, a lack of ventilation in steep slope compact roof assemblies has caused problems with premature shingle failure because of heat build-up. Other problems, such as shingle buckling, underlayment buckling and deck warping, have been reported with steep-slope compact roof assemblies and may be related to moisture accumulation.

Many asphalt shingle manufacturers will not issue warranties for shingles installed over nonventilated steep-slope compact roof assemblies. Contact asphalt shingle manufacturers to obtain warrant information and/or limitations for a steep-slope compact roof assemblies. For more information about ventilating steep-slope compact roof assemblies, see the Moisture Control section of *The NRCA Roofing and Waterproofing Manual, Fifth Edition*.

3.1.5.1 Nail-base Insulation Systems

Some types of steep-slope compact roof assemblies are constructed using nail-base insulation. Nail-base insulation is composed of a layer of insulation that is factory-adhered or laminated directly to a nailable wood panel, such as plywood or OSB. The wood panel serves as the nailing surface for underlayment and asphalt shingle roof system. When nail-base insulation is used, the insulation adhered directly to the wood panel prevents any ventilation from occurring between the shingles and insulation. A lack of ventilation and the heat-resistant properties of insulation increases the temperature to which shingles are subjected during high-temperature periods. The increased temperature may prematurely age the asphalt in the shingles and reduce the shingles' service life.

Some types of nail-base insulations provide a narrow ventilation space between the insulation and wood panel by using spacers to separate the two components. The amount of ventilation provided by these products is limited but may prevent heat buildup to some extent. Problems have been reported with venting nail-base insulation products caused by moisture accumulation in the limited ventilation space in the vented panels and vapor drive through the joints of both vented and non- vented panel joints. The types of problems that have been reported are condensation within the ventilation space, dimensional changes in wood panels, underlayment buckling and the resulting shingle buckling. Designers should carefully consider moisture control when they specify nailbase insulation systems.

3.2 Underlayment and Roof Slope

Adequate drainage of water from a roof's surface is essential for the satisfactory performance of asphalt shingles and the prevention of premature deterioration. The limitations imposed by a roof deck's slope must be taken into account during design of a roof system.

Asphalt shingles are designed for use as multi-layered, water-shedding systems. Asphalt shingles rely on slope to shed water off a roof's surface.

3.2.1 Underlayment Configurations

There are different underlayment configurations that can be used for asphalt shingle roof systems. Generally, these configurations can be categorized as follows:

- single layer of underlayment
- single layer of self-adhering underlayment
- double layer of underlayment

A "single layer of underlayment" is one layer of underlayment fastened to the deck before application of a roof covering. For single layer applications, all felts should be applied horizontally in shingle fashion and lapped a minimum of 2 inches (50 mm) over the preceding felt sheet. Endlaps should be a minimum of 4 inches (100 mm). An underlayment should be fastened with nails or staples, as necessary to hold the felts in place until the installation of a primary roof covering. (See Figures 1 and 2)

A "single-layer of self-adhering underlayment" consists of one layer of self-adhering, polymer-modified bitumen sheet membrane applied over a roof deck. This type of membrane is designed to be used as an ice dam protection membrane. Designers should note that these types of membranes, when installed over an entire roof area, act as air and vapor retarders. Potential problems with ventilation, moisture control and vapor retarder placement should be considered during the design phase. See Figures 1 and 2.

A "double-layer underlayment" is two layers of underlayment fastened to a roof deck before the application of asphalt shingles. When a double-layer underlayment is required, felt should be applied horizontally in shingle fashion. For double-layer applications, all felts should be lapped a minimum of 19 inches (480 mm) over the preceding felt sheet. Endlaps should be a minimum of 4 inches (100 mm). An underlayment should be fastened appropriately for the slope of the roof to hold the felts in place until a primary roof covering material is applied. See Figures 3 and 4

When a double-layer configuration is used and underlayment layers are identical materials, they are commonly installed in shingle fashion with 19 inches (480 mm) overlap and 17 inches (430 mm) exposure. However, if one layer is used to "dry-in" the building temporarily or underlayments of two differing compositions are used, it is common for each layer to be applied in a single-layer configuration.

3.2.2 Roof Slope

The following are recommendations for underlayments used with asphalt shingles with respect to roof slope.

- On roof decks having a slope of 4:12 (18 degrees) or more, a minimum of one layer of No. 15 asphalt-saturated felt underlayment should be applied horizontally in shingle fashion to serve as the underlayment. See Figures 1 and 2.

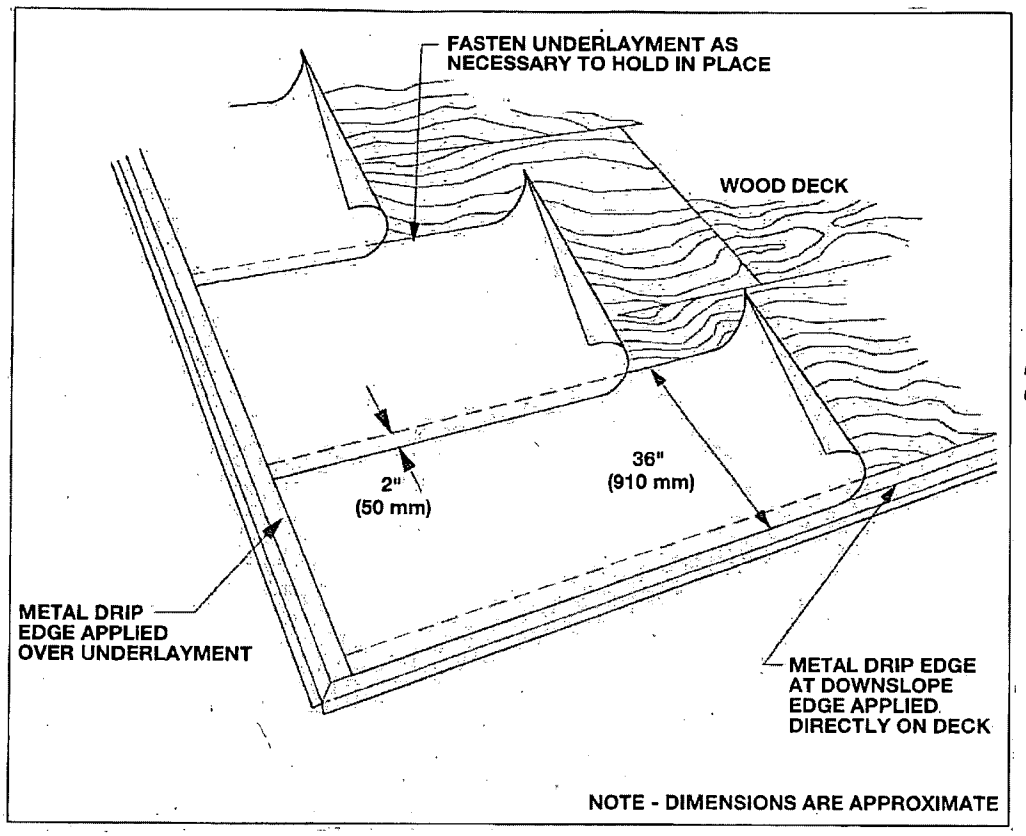


Figure 1: Single layer underlayment

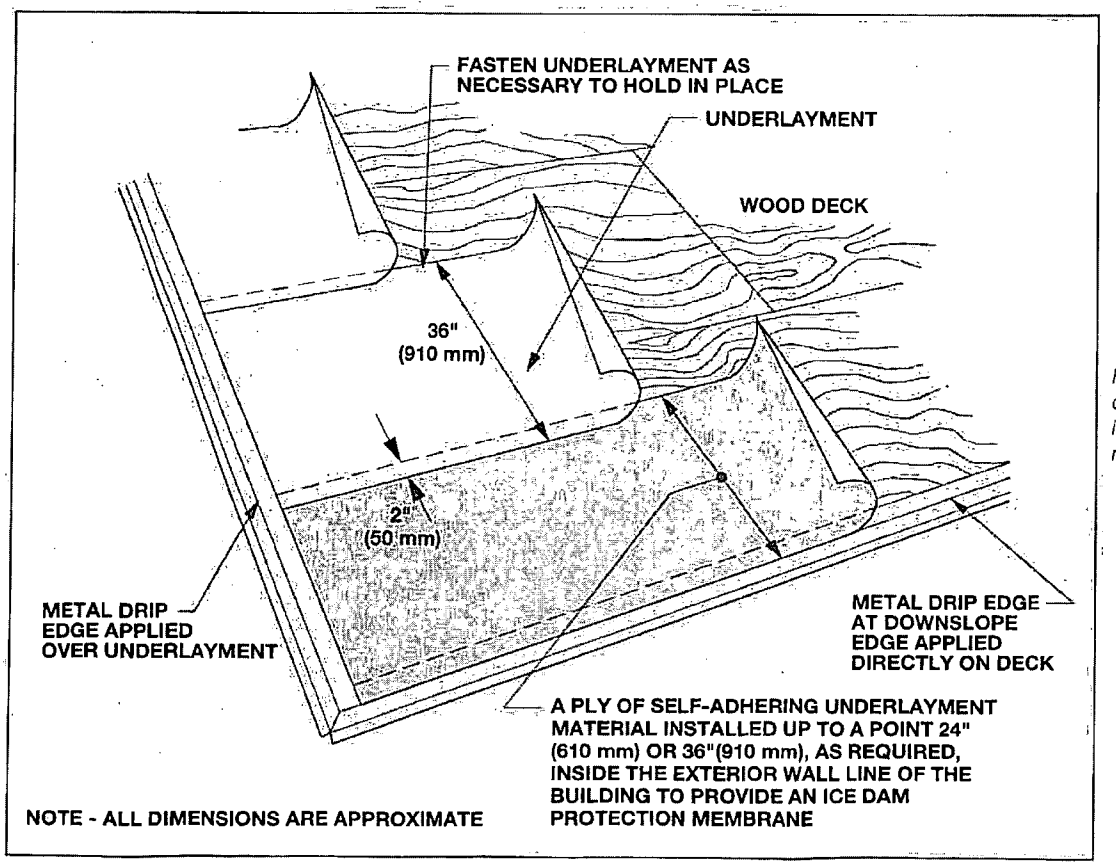


Figure 2: Single layer of underlayment with ice dam protection membrane

For roof decks having slopes of 3:12 (14 degrees) up to 4:12 (18 degrees), a minimum of two layers of No. 15 asphalt-saturated underlayment should be applied horizontally in shingle fashion, with 17 inch (430 mm) exposure and 19 inch (480 mm) underlap. See Figures 3 and 4.

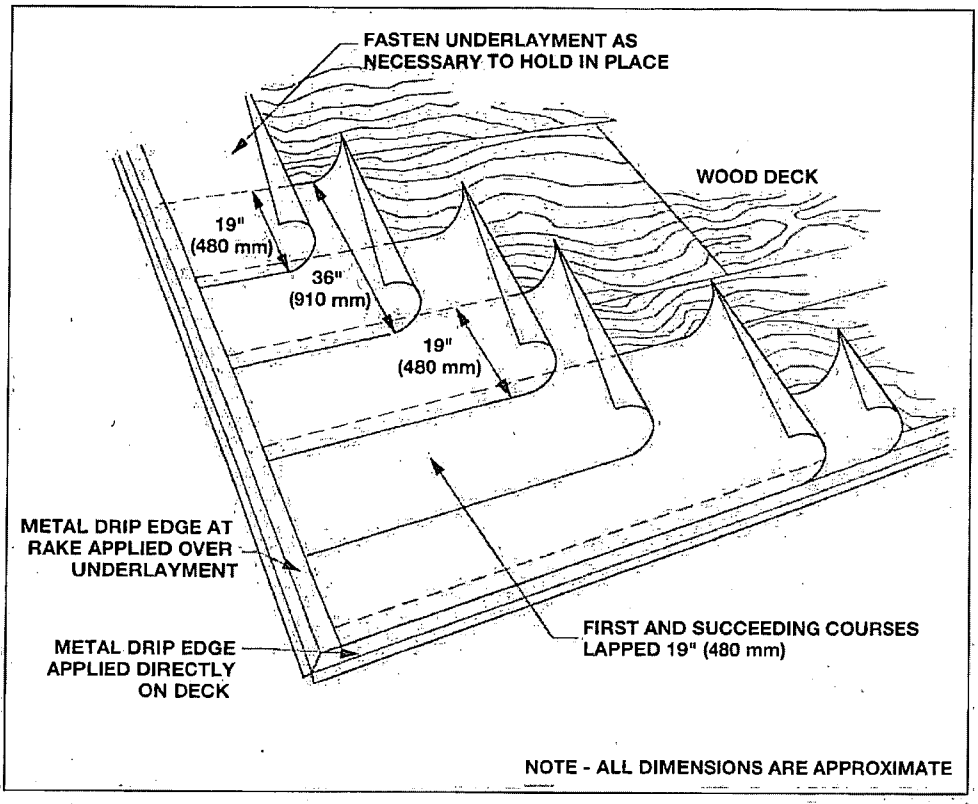


Figure 3: Double layer of underlayment

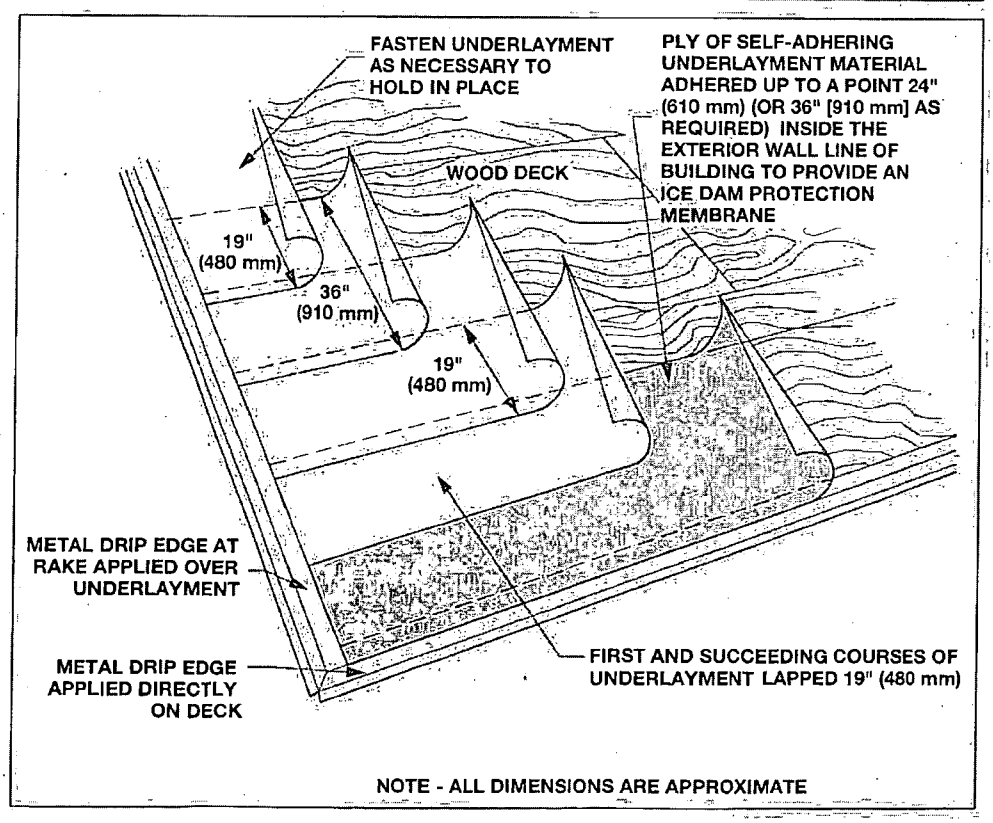


Figure 4: Double layer of underlayment with ice dam protection membrane

Some manufacturers will allow application of asphalt shingles on lesser slopes. However, NRCA does not recommend application of asphalt shingles on slopes less than 4:12 (18 degrees) for new construction.

3.3 Ice Dam Protection Membranes

Regardless of the type of underlayment required or roof slope, in locations where the average temperature for January is 30° F (-1° C) or less, NRCA suggests installation of an ice dam protection membrane. See Figure 5). An ice dam protection membrane generally is a self-adhering polymer-modified bitumen membrane. NRCA recommends that these types of self-adhering membranes be a minimum of 40 mils (1.0 mm) thick and comply with ASTM D 1970.

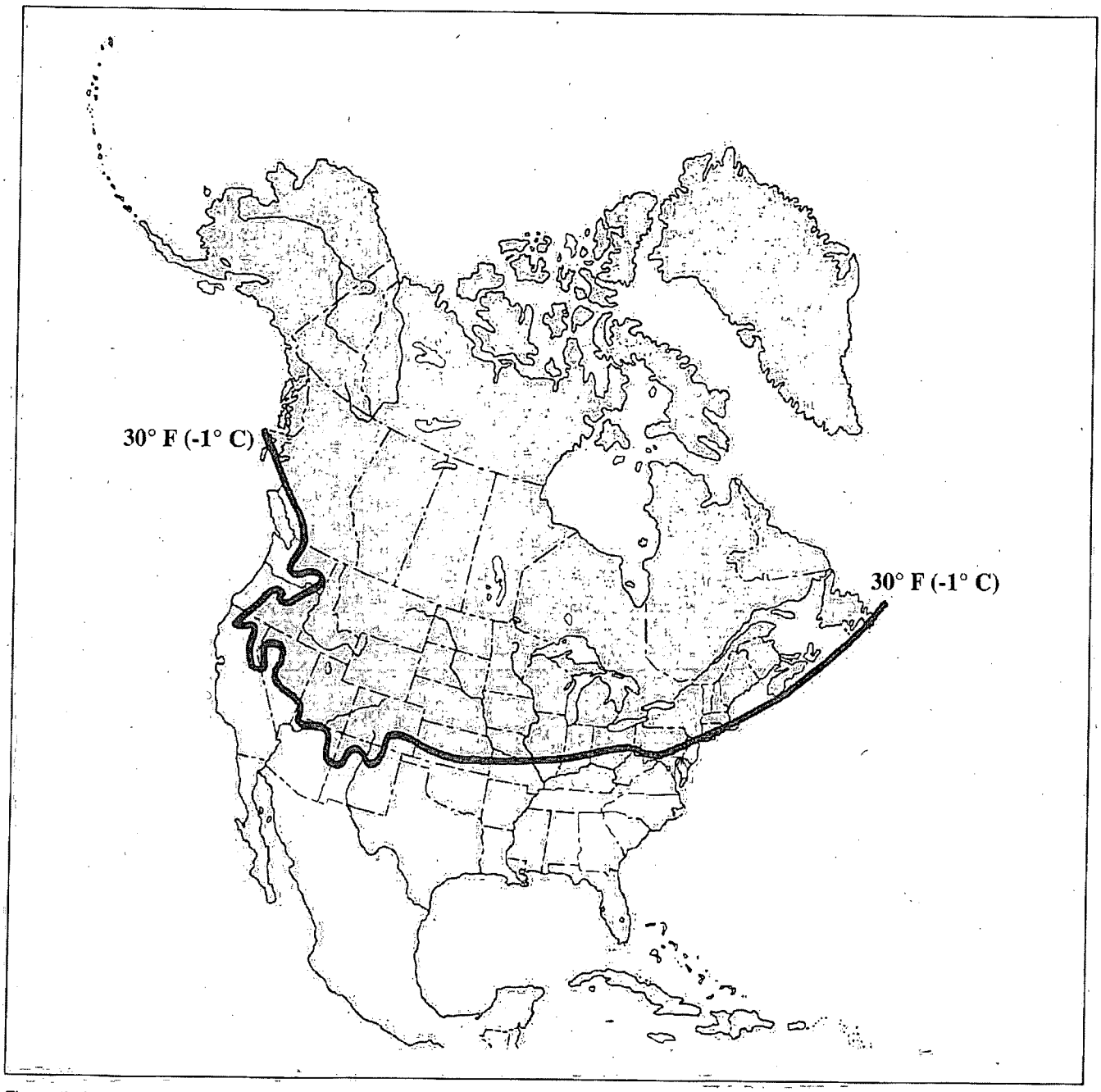


Figure 5: Approximate area of North America that has an average January temperature below 30° F (-1° C). Map courtesy of the Coastal Weather Research Center, University of Alabama.

Underlayment felts, as well as polymer-modified bitumen base sheets, cemented together with asphalt roof cement or cold adhesive also can be used as ice dam protection membranes.

An ice dam protection membrane should be applied starting at a roof system's eaves, and extending upslope a minimum of 24 inches (610 mm) from inside the exterior wall line of a building. For slopes less than 4:12 (18 degrees), NRCA recommends ice dam protection membranes be applied starting at the eaves and extending a minimum of 36 inches (910 mm) upslope from inside the exterior wall line of a building. See Figure 6.

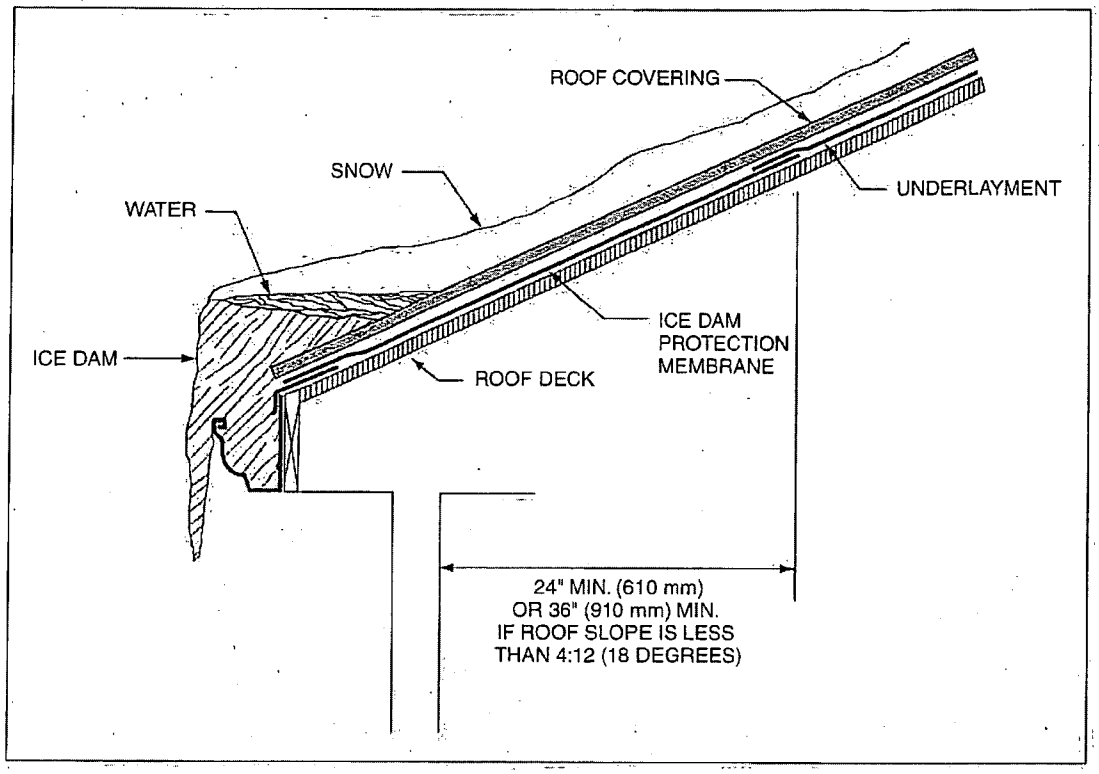


Figure 6: Example of ice damming

Ice dam protection membranes cannot be relied upon to keep leaks from occurring. Careful consideration of roof ventilation, insulation and project specific detailing for particular climatic conditions are vital. Also, self-adhering modified bitumen underlayments must not be left exposed for long periods of time. Self-adhering modified bitumen underlayments should be covered with primary roofing material as soon as practical to prevent premature degradation of the modified bitumen underlayment. See manufacturers' individual product requirements for additional information.

Designers should note that these types of membranes, when used as underlayments over entire roof area, tend to act as vapor retarders. Potential problems with ventilation, moisture control and vapor retarder placement should be considered during the design phase.

3.4 Fasteners

NRCA recommends that roofing nails used to apply asphalt shingles to wood plank, wood board or wood panel roof decks be round-headed, sharp-pointed, 11- or 12-gauge (0.105 or 0.12 inch [2.67 or 3.06 mm]) galvanized steel or the equivalent corrosion-resistant roofing nails. Nail head sizes recommended are ⅜ inch (10 mm) to 7/16 inch (12 mm) in diameter. Nail heads should be low- profile, smooth and flat. Shanks should be barbed or otherwise deformed for added pull-out resistance. Nails should comply with ASTM F 1667, "Specification for Driven Fasteners, Nails, Spikes and Staples," Type I, Style 20. Not all nails that comply with ASTM F 1667, Type I, Style 20 have dimensions or shanks NRCA recommends.

Nails should be long enough to penetrate through all layers of roofing materials and achieve secure anchorage into a roof deck. Nails should extend through the underside of plywood or other acceptable wood panel decks and penetrate at least ¾ inch (19 mm) into wood plank or board decks.

Nails should be driven straight, flush and snug to the surface of asphalt shingles.

The nailing of hips, ridges and some roof accessories may require the use of longer nails because fasteners must penetrate through more layers of roofing and/or material.

For full-width shingles, a minimum of four nails should be used per shingle. See Figure 7.

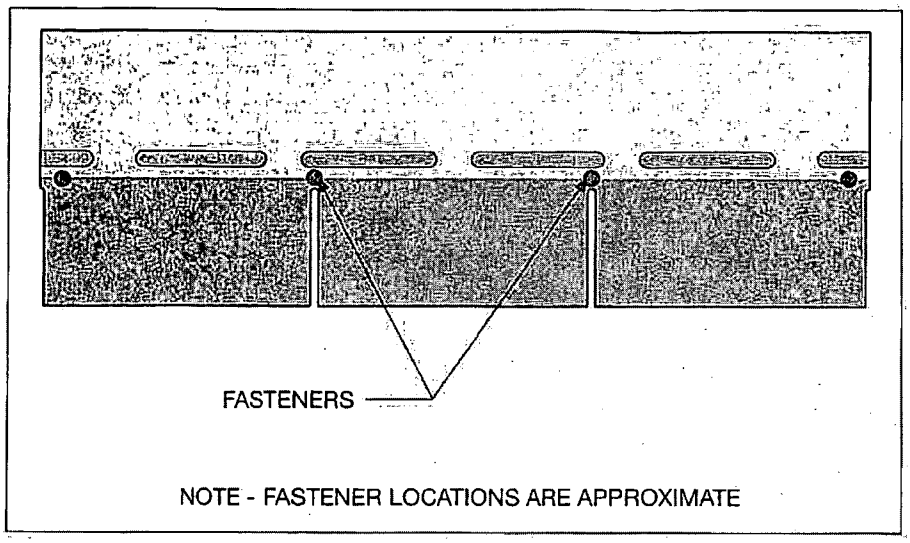


Figure 7: Approximate fastener locations for four-nail pattern

Six nails per full-width strip shingle may be required by building codes in some high-wind areas. See Figure 8.

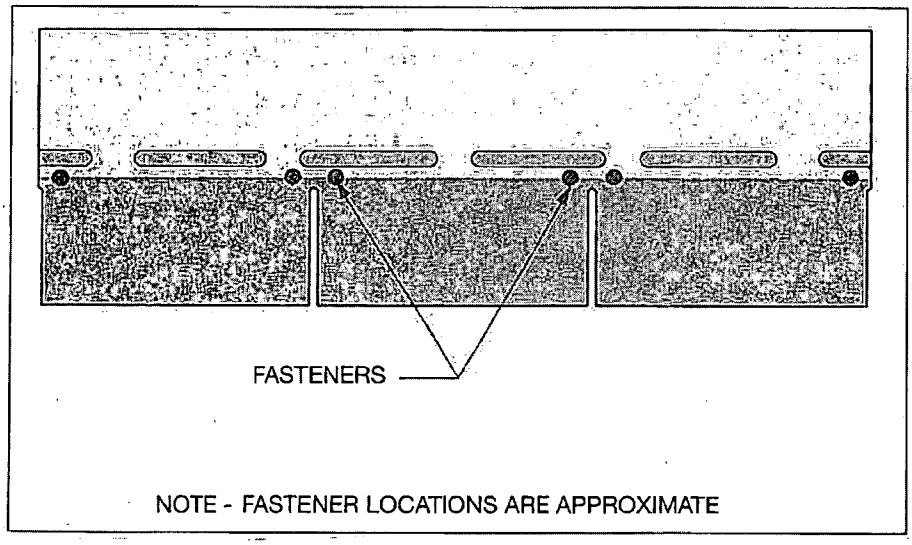


Figure 8: Approximate fastener locations for a six-nail pattern

For roof slopes 18:12 (56 degrees) and greater, NRCA recommends that asphalt shingles be fastened with six nails and manually sealed with asphalt flashing cement. The latter process is commonly known as "hand tabbing." Some manufacturers require six nails per shingle and hand tabbing on slopes as low as 12:12 (45 degrees) depending on the shingle product. Consult manufacturers for specific product requirements.

For individual shingles, a minimum of two nails should be used per shingle.

The locations for asphalt shingle fasteners as shown in Figures 7 and 8 and manufacturers' printed installation instructions should be recognized as the approximate locations where attachment is intended. Actual consistent fastener placement in the exact locations depicted is not possible in the application of asphalt shingles under normal rooftop conditions. The application of asphalt shingles in a rooftop environment is not an exact process and minor deviations from the intended fastener locations should be anticipated and tolerated.

3.5 Exposure and Appearance

Starter courses for asphalt shingles are consistent for each shape or style of shingle. Typical exposure for standard size strip shingles is 5 inches (125 mm) and for metric size strip shingles is 5 ⅝ inches (143 mm). The offset patterns illustrated only apply to three-tab shingles. Laminated strip shingles vary in style and appearance and each manufacturer's installation guidelines should be consulted for specific exposure and offset instructions.

3.5.1 Starter Courses

Before the first course of shingles is installed, a starter course is applied directly over the underlayment or ice dam protection membrane along the eave of a roof system. Its primary purpose is to shed water that may migrate through the joints and cut-outs of the shingles in the overlying first course.

NRCA suggests using self-sealing asphalt shingles for starter courses. To prepare the starter course consisting of self-sealing shingles, cut the exposed tab portion off of enough shingles to accommodate the total length of the downslope perimeter roof edge (e.g., eaves). Then, cut approximately 3 to 6 inches (76 to 152 mm) off the end of the first shingle. (See Figure 17.) Alternatively, a 9 inch (229 mm) or wider starter strip of mineral-surfaced asphalt roll roofing material may be applied along the downslope edges of the roof to serve as a starter course.

The lower edge or edges of the roofing material should be even with the outer edge of the perimeter metal flashing if extended drip edge flashing is used. (See Figure 8A.) If an "L"-type metal flashing or no flashing is used, extend the starter course beyond the perimeter eave and rake edges ¼ to ¾ inch (6 to 19 mm), according to the manufacturer's recommendations, to assist in directing runoff away from the fascia board and other underlying building components. Fasten the starter course with roofing nails along a line that is parallel to and 2½ to 4 inches (65 to 100 mm) above the downslope perimeter edges of the roof. Place the nails in such a way that the nail heads will not be exposed through the overlying shingle's cutouts or at butt joints between individual shingles that make up the first course.

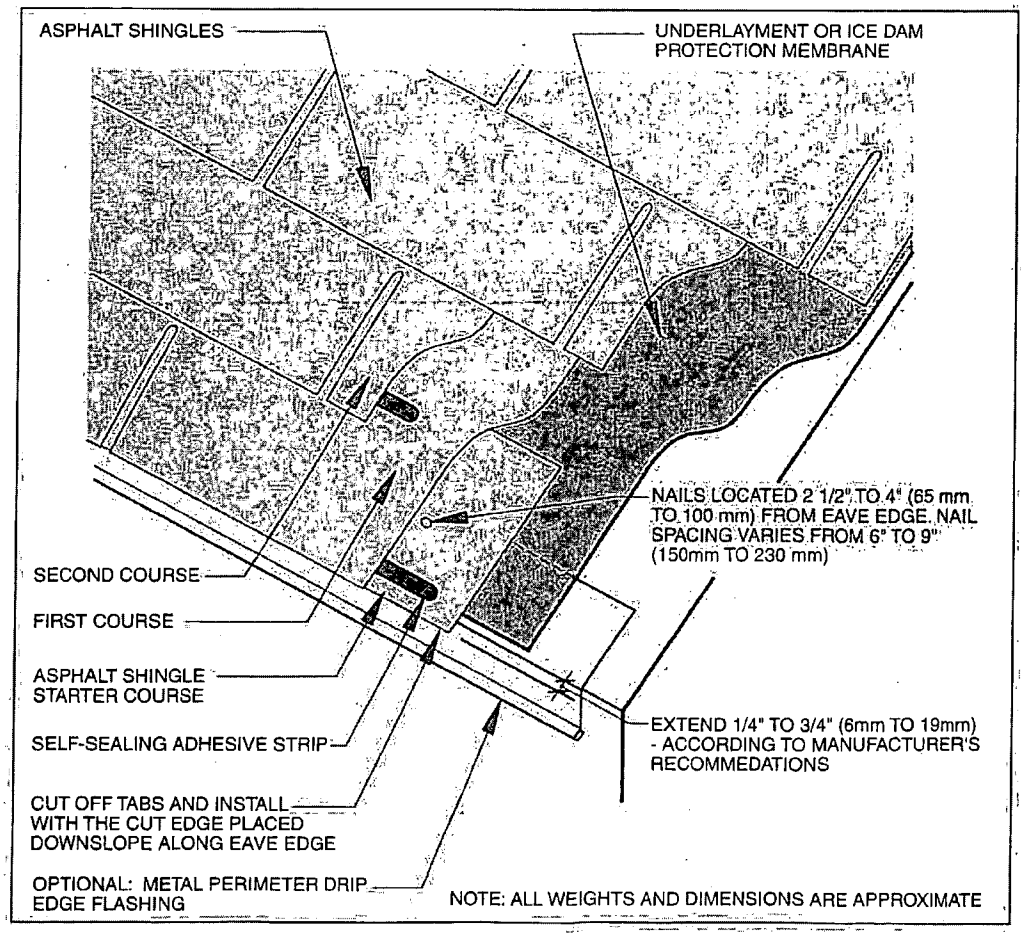


Figure 8A: Example of a starter course of asphalt shingles

3.5.2 Offset Patterns

There are several offset or side-lap gauge patterns used with three-tab shingles, and the pattern used generally is selected based on manufacturer or installer preference, regional or climatic experience, or common practice. However, there are three general pattern variations that are common for the application of square-butt, three-tab strip shingles.

Following are descriptions of these three patterns.

- Cutouts that break joints on thirds, or the 4-inch method — A cutout is the section of a three-tab asphalt shingle that has been cut out at a factory to separate individual tabs. For standard size shingles, the offset pattern is achieved by offsetting the consecutive shingle courses by 4 inches (100 mm) as shown in Figure 9. For metric-sized shingles, the offset pattern is achieved by offsetting each consecutive course 112 mm (4⅜ inches). Cutouts are also referred to as key-way or water-slots. However, it is the gauging of these cutouts in neighboring shingle courses that gives a shingle roof system a particular pattern. See Figure 9.

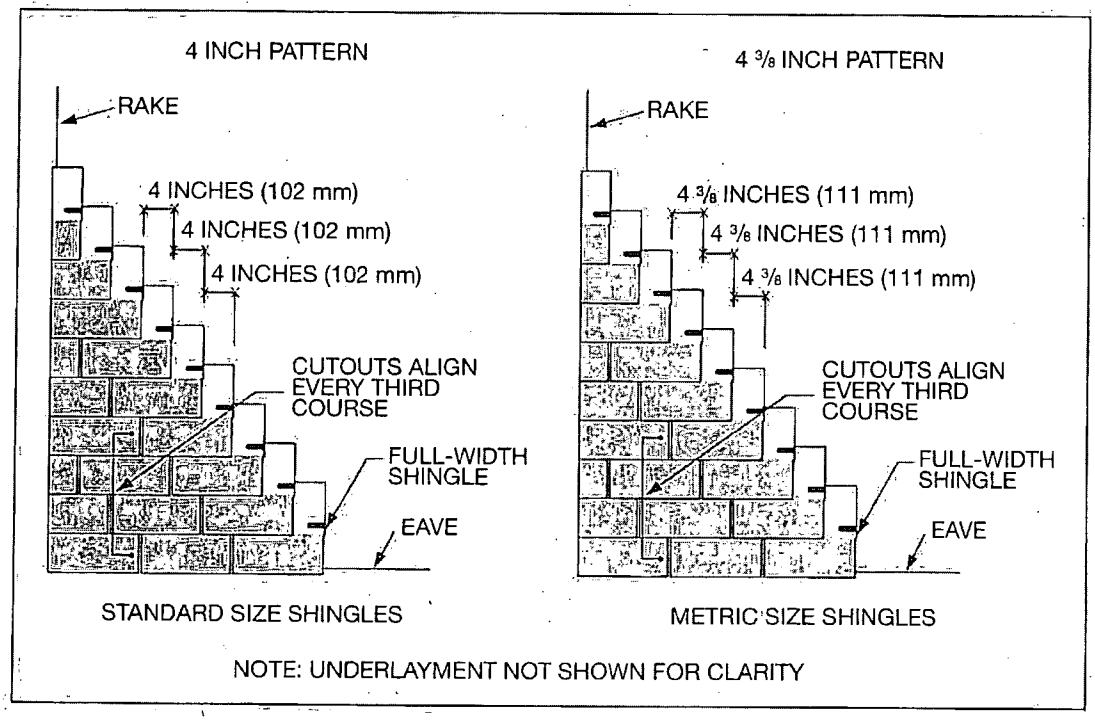


Figure 9: Example of aesthetics of a 4-inch pattern

- 5- and 5⅝-inch methods — A more random visual affect of a finished roof system can be achieved by offsetting cutouts in neighboring courses. For standard-sized shingles, the offset pattern is usually accomplished by removing approximately 5 inches (125 mm) from each consecutive course (after the first full-width shingle in the first course). For metric-sized shingles, this offset pattern is achieved by offsetting each consecutive course 143 mm (5⅝ inches) as shown in Figure 10.

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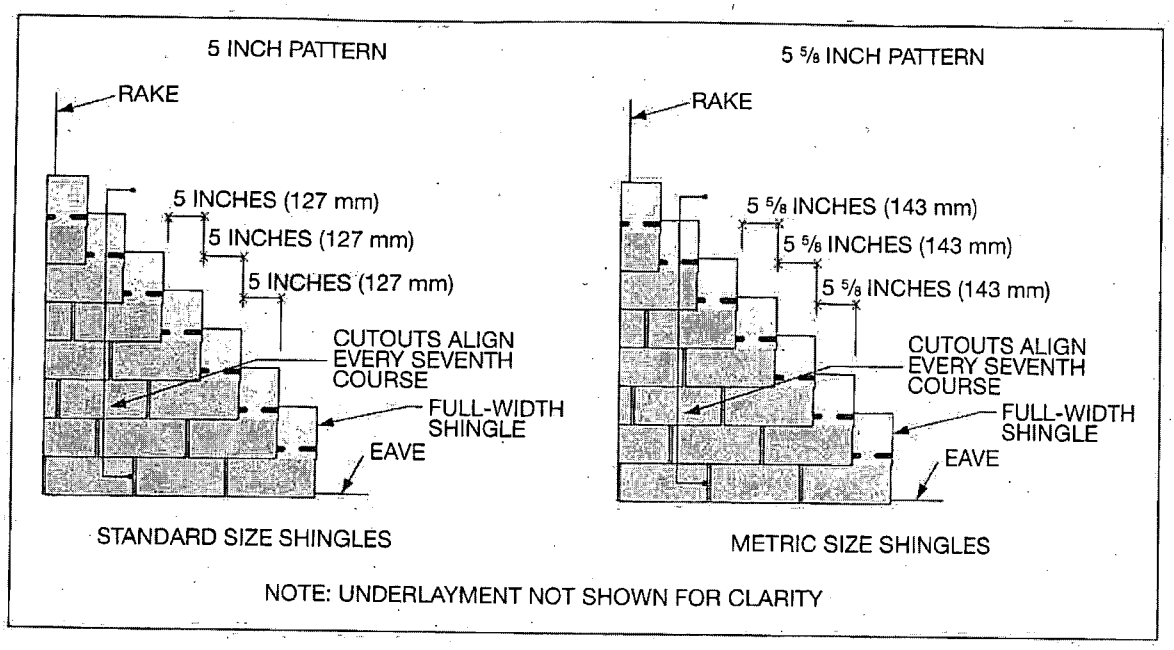

Figure 10: Aesthetics of a 5-inch pattern

- Cutouts that break joints on halves, or the 6-inch method — This procedure will establish a sidelap gauge pattern for a roof system whereby the cutouts break joints on halves with the course below the cutouts line up in every other course. For standard-size shingles, the offset pattern is achieved by offsetting consecutive shingle courses by 6 inches (150 mm). For metric- sized shingles, the offset pattern is achieved by offsetting each consecutive course 168 mm (6 ⅝ inches). (see Figure 11).

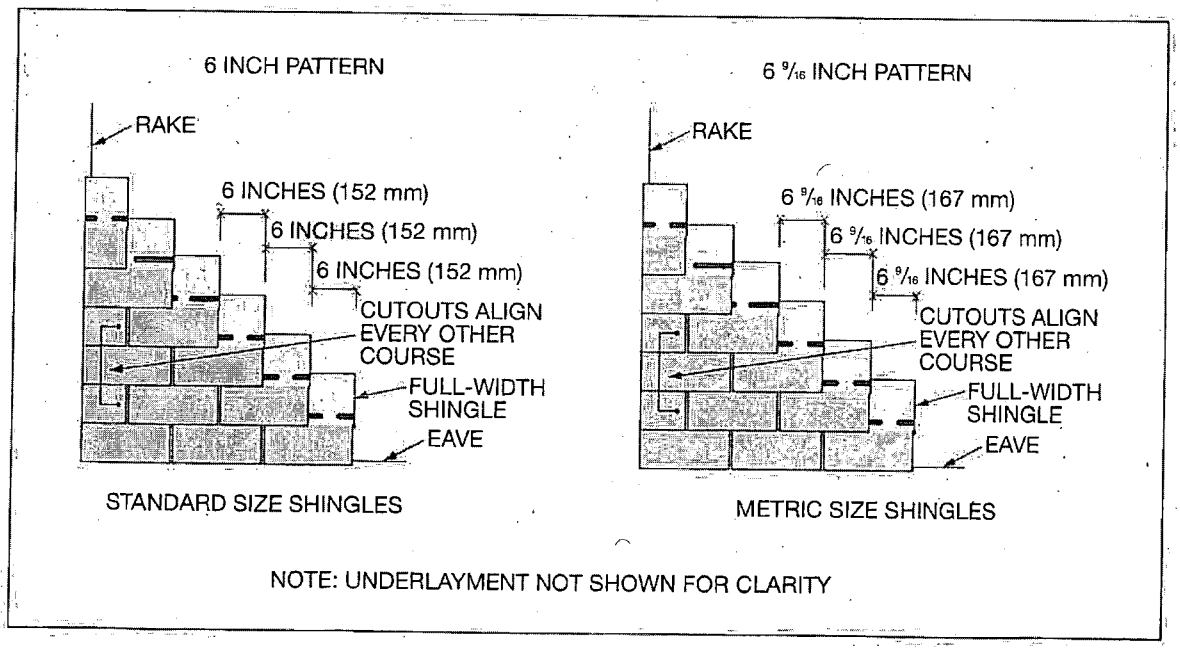

Figure 11: Aesthetics of a six-inch pattern

Because of the brittleness of some asphalt shingles and potential shading problems, NRCA does not recommend application of asphalt strip shingles using the racking method unless specifically recommended or instructed by manufacturers. Some laminate shingles require racking by manufacturers. Refer to a particular manufacturer's application instructions for the specific shingle being applied.

3.6 Flashings

Because asphalt shingle roof systems are frequently interrupted by the intersection of adjoining roof sections, adjacent walls or penetrations such as chimneys and plumbing soil-pipe stacks, all of which create opportunities for leakage, special provisions for weather protection must be made at these locations. The components used to control water entry are commonly called flashings. Careful attention to flashing details is essential to successful long-term roof system performance, regardless of roof system construction.

Flashings in this section are divided into the following categories:

- perimeter edge metal
- penetrations
- valleys
- vertical surfaces

Metal flashing should be fabricated from materials of thick enough gauges to achieve at least the expected design lives of the steep-slope roof systems used with them.

Metal used in flashings for asphalt shingle roof systems should be of a type and minimum thickness commensurate with the anticipated service life of the roof system.

3.6.1 Perimeter Edge Metal

Depending on the severity of climate, anticipated rainfall and freeze-thaw cycling, the use of perimeter edge metal should be considered. Where climate and/or roof edge construction dictates the need for perimeter edge metal, NRCA recommends a corrosion-resistant metal be specified for perimeter edge metal. See Figure 12.

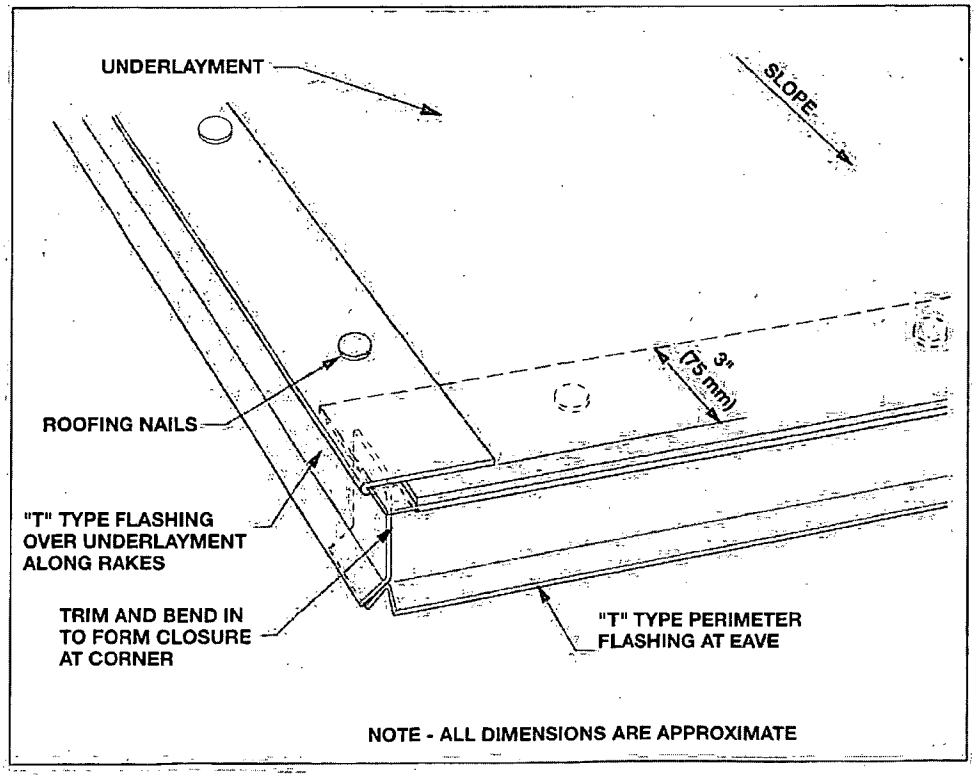

Figure 12: Perimeter edge metal at eave and rake

Where climate or roof edge construction dictates the need for perimeter edge metal, the type and minimum thickness of the metal should be commensurate with the anticipated service life for the asphalt shingle roof system. NRCA suggests perimeter edge metal for asphalt shingle roof systems be fabricated from one of the following metal types and minimum thicknesses.

- 26 gauge (0.019 inch [0.48 mm] thick) galvanized steel
- 26 gauge (0.019 inch [0.48 mm] thick) prefinished galvanized steel
- 0.032 inch (0.81 mm) thick aluminum
- 0.032 inch (0.81 mm) thick prefinished aluminum
- 26 gauge (0.018 inch [0.46 mm] thick) stainless steel
- 16 ounce (0.022 inch [0.56 mm] thick) copper
- 16 ounce (0.026 inch [0.66 mm] thick) lead-coated copper

In some regions, particularly those with mild climates, other types of metal and/or metals of lesser thickness than are shown above may be used successfully. NRCA considers these applications to be area practices. Refer to the Introduction for additional information about area practices.

3.6.1.1 Bleeder Strips

Bleeder strips, also referred to as "rake starters," may be installed in place of or in combination with edge metal along the rake edges of a roof. Bleeder strips perform a function similar to starter strips that are used for a starter course and provide an extended straight edge that each course's terminating rake shingle may be cut to match.

3.5.2 Penetration Flashings

There are many other smaller penetrations that need to be flashed into asphalt shingle roof systems, such as plumbing soil stack vents, exhaust vents, furnace or water heater flue pipes, electrical standpipes and others. This is typically accomplished with the use of some type of flat flange that extends around a penetration and is installed under shingles on the upslope side of a flange. Attached and sealed to the flange is a cylinder, rectangular box or neoprene gasket that is used to seal around a penetration. These flashing components are often supplied by other trades but may be installed by a roofing contractor. See Figure 13.

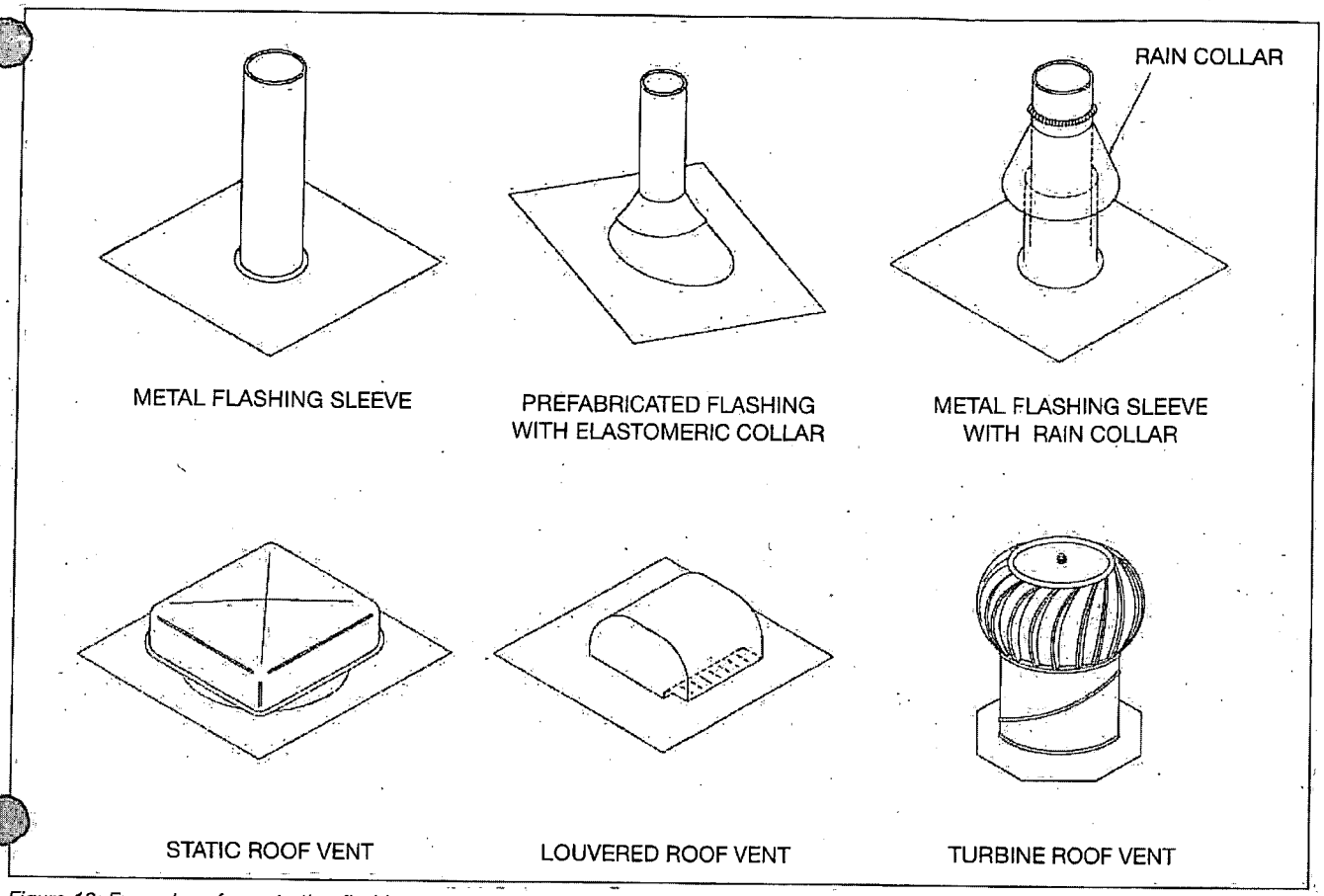

Figure 13: Examples of penetration flashings

The type and minimum thickness of the metal used for penetration flashings should be commensurate with the anticipated service life for the asphalt shingle roof system. NRCA suggests metal penetration flashings for asphalt shingle roof systems be fabricated from one of the following metal types and minimum thicknesses.

- 26 gauge (0.019 inch [0.48 mm] thick) galvanized steel
- 26 gauge (0.019 inch [0.48 mm] thick) prefinished galvanized steel
- 0.032 inch (0.81 mm) thick aluminum
- 0.032 inch (0.81 mm) thick prefinished aluminum
- 26 gauge (0.018 inch [0.46 mm] thick) stainless steel
- 16 ounce (0.022 inch [0.56 mm] thick) copper
- 16 ounce (0.026 inch [0.66 mm] thick) lead-coated copper
- 4 pound (0.062 inch [1.57 mm] thick) lead.

In some regions, particularly those with mild climates, other types of metal and/or metals of lesser thickness than are shown above may be used successfully. NRCA considers these applications to be area practices. Refer to the Introduction for additional information about area practices.

3.6.3 Valley Construction

A valley is created at the downslope intersection of two sloping roof planes. Water runoff from the portions of roof areas sloping into a valley flows toward and along the valley. Because of the volume of water and the lower slope along a valley line, such an area is especially vulnerable to leakage. A clear, unobstructed drainage way is desired in valleys, so the valley may carry water away quickly and perform successfully for the life of the roof system.

Where roofs of two equal slopes join to form a valley, the slope of the valley is less than that of the two adjacent fields of the roof. For example, where two sloped roofs with slopes of 4:12 (18 degrees) intersect at a valley, the actual valley slope is only about 3:12 (14 degrees).

With asphalt shingle roof systems, there are three basic types of valleys:

- open valleys
- closed-cut valleys
- woven valleys

These three general types of valleys are constructed only after the necessary layer(s) of underlayment and any valley lining material specified have been applied to a deck.

Valley underlayment construction consists of an additional full-width 36 inch (910 mm) sheet of No. 15 or No. 30 asphalt-saturated underlayment felt or polymer-modified bitumen underlayment, base sheet or ice dam protection membrane. This valley underlayment is centered in a valley. Valley underlayment sheets are secured with only enough roofing nails to hold them in place until the balance of valley materials are applied. The courses of underlayment from the fields of two adjoining roof areas are extended so that each course overlaps the valley underlayment by at least 12 inches (300 mm). A valley is then lined with the balance of the valley flashing. Another recognized installation method is weaving intersecting underlayment courses through a valley in addition to the sheet centered in the valley.

To prevent leakage it is important with all types of valley construction to avoid placing fasteners near the center of a valley. Generally, underlayment fasteners should be kept back from the center of the valley a minimum of 8 inches (200 mm). However, on low-sloped roof valleys or in climates where freeze-thaw cycling or intense rainfall may be regularly anticipated, holding nails back further from the center of the valley is not uncommon.

3.6.3.1 Open Valleys

Open valleys are typically lined with sheet metal. A metal valley is constructed by installing typically 8 feet or 10 feet (2.4 m or 3 m) lengths of corrosion-resistant metal through the valley. Asphalt shingles are lapped onto either side of the valley metal, leaving a clear space between the roofing material to channel water runoff down the valley. An example of open valley construction using metal valley material is illustrated in Figure 14.

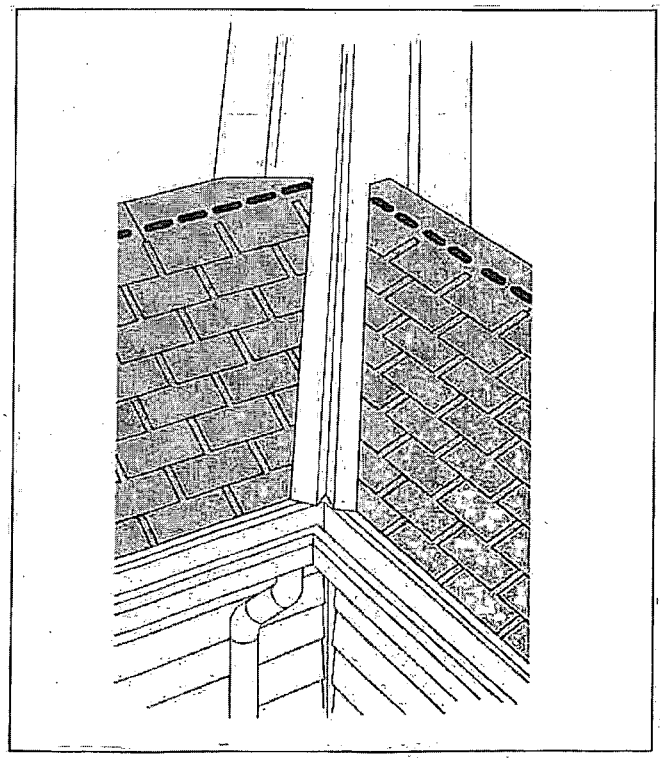

Figure 14: Typical open valley using metal valley flashing

The type and minimum thickness of the metal used in an open valley should be commensurate with the anticipated service life for the asphalt shingle roof system. NRCA suggests valley metal for asphalt shingle roof systems be fabricated from one of the following metal types and minimum thicknesses.

- 26 gauge (0.019 inch [0.48 mm] thick) galvanized steel
- 26 gauge (0.019 inch [0.48 mm] thick) prefinished galvanized steel
- 0.032 inch (0.81 mm) thick aluminum
- 0.032 inch (0.81 mm) thick prefinished aluminum
- 26 gauge (0.018 inch [0.46 mm] thick) stainless steel
- 16 ounce (0.022 inch [0.56 mm] thick) copper
- 16 ounce (0.026 inch [0.66 mm] thick) lead-coated copper
- 4 pound (0.062 inch [1.57 mm] thick) lead.

In some regions, particularly those with mild climates, other types of metal and/or metals of lesser thickness than are shown above may be used successfully. NRCA considers these applications to be area practices. Refer to the Introduction for additional information about area practices.

NRCA also suggests that valley metal be formed with a "W"-shaped splash diverter or rib in the center. A center rib can be especially beneficial in valleys where adjoining roof areas are of unequal slope because the rib helps prevent "wash over" of runoff. A center rib should not be less than 1 inch (25 mm) high. For easier installation and for controlling thermal expansion and contraction, NRCA suggests that valley metal pieces used with asphalt shingle roofing be no longer than 10 feet (3 m). NRCA recognizes that "V-"shaped valley metal performs satisfactorily in certain environments but not when a valley is formed by two roof slopes.

NRCA recommends that valley metal for use with asphalt shingles be a minimum of 18 inches (460 mm) wide. This means that the flanges on either side of a metal valley center line are approximately 8 inches (200 mm) wide. Having a flange width of approximately 8 inches (200 mm) allows asphalt shingles to lap onto a flange at least 4 inches (100 mm).

Open valleys permit clear, unobstructed drainage and are advantageous in locations where fallout from surrounding foliage settles on a roof system and tends to accumulate in valleys. Valley metal should be made from a material sufficiently thick enough to achieve at least the expected design life of a steep-slope roof covering.

3.6.3.1.1 Enhanced Open Valleys

In some climates, particularly those in areas prone to accumulations of snow and ice or regular freeze-thaw cycling, open valley construction can be enhanced by one of the following procedures:

- lining a valley with a self-adhering modified bitumen underlayment material before application of the metal valley
- stripping in the flanges on either side of a metal valley with a 9 inch to 12 inch (230 mm to 300 mm) strip of self-adhering modified bitumen underlayment material. The self-adhering material is adhered onto the valley metal flange and an underlying width of similar self-adhering membrane material
- tapering the valley so that it is wider at the low point than it is at the high point.

Tapering a valley has the following advantages:

- allows for increase in water runoff volume to be received at the downslope end
- allows any ice that may form within a valley to free itself when melting and slide down and exit the valley rather than lodging somewhere along the length of the valley

A valley's width or the amount of space between the intersecting asphalt shingles, should increase uniformly so the valley widens as it continues downslope. The difference in the width of the upper end of a valley and lower end is referred to as the taper. In most climates, the amount of valley taper is suggested to be approximately ¼ inch (3 mm) for 12 inches (300 mm). For example, in a valley 16 feet (5 m) long, the distance between asphalt shingles should be 2 inches (50 mm) greater at the bottom of the valley than at the top.

3.6.3.2 Closed-cut valleys

In closed-cut valleys, shingles on one side of the valley are installed across the valley and shingles from the other side are cut about 2 inches (50 mm) off the center line of the valley and may be sealed with asphalt roof cement. See Figure 15.

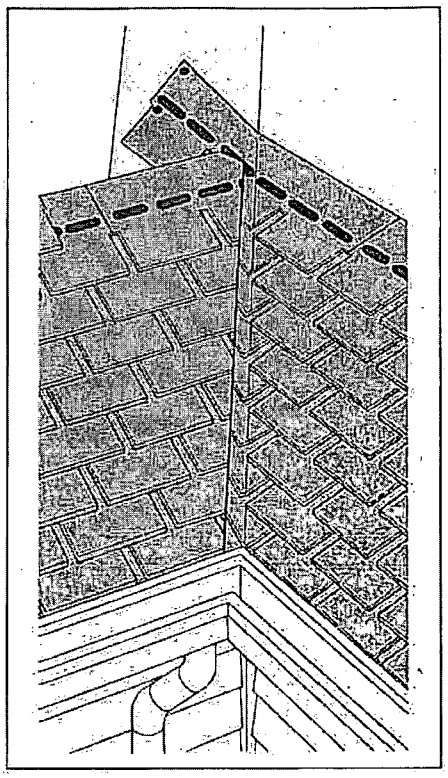

Figure 15: Closed-cut valley

3.6.3.3 Woven Valleys

Shingles from adjoining roof areas are woven to form a closed valley. The woven valley method illustrated in Figure 18, is generally limited to strip shingles on roof systems where the valley slopes are at least 4:12 (18 degrees). Where heavy accumulations of debris or plant growth may accumulate between shingle cutouts and joints, a woven valley may hamper runoff. Therefore, as with all valley types, specifying a woven valley should be carefully considered to be sure it is beneficial for a particular project.

NRCA does not recommend the use of woven valleys with laminated or individual locking-type shingles. Laminated shingles can be difficult to use to create a woven valley. When laminated shingles from opposite sides of a valley are woven, they can make for a relatively thick buildup of material, which can make the resultant valley irregularly sloped and slower draining. Individual locking-type shingles cannot be used with woven valley construction because nails are required for each tab, which would mean placing nails at or near the center of a valley. See Figure 16.

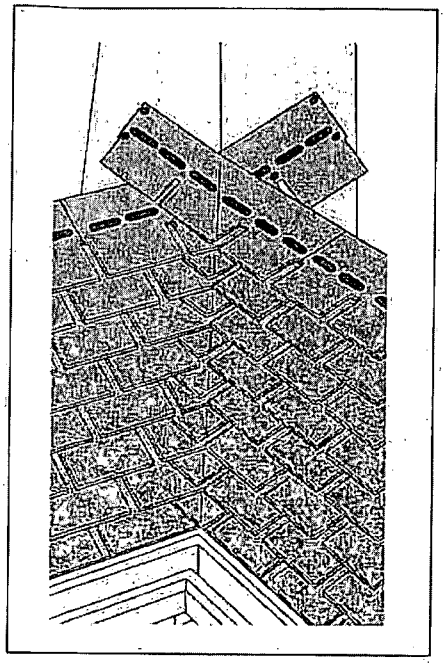

Figure 16: Woven valley

3.6.4 Vertical Surfaces

There are four types of metal flashings that are commonly used at locations where a roof system abuts a vertical wall:

- apron flashing — a metal used at a head-wall transition, such as the downslope side of a chimney.
- step flashing — used at a side-wall transition, such as the side of a dormer.
- cricket or backer flashing — used at the upslope side of a roof penetration, such as a chimney
- counterflashing — secured to a vertical wall and used to cover and protect the top edge of an apron, step and cricket (or backer) flashing.

Figure 17 shows a chimney penetration and the use of all four flashing types.

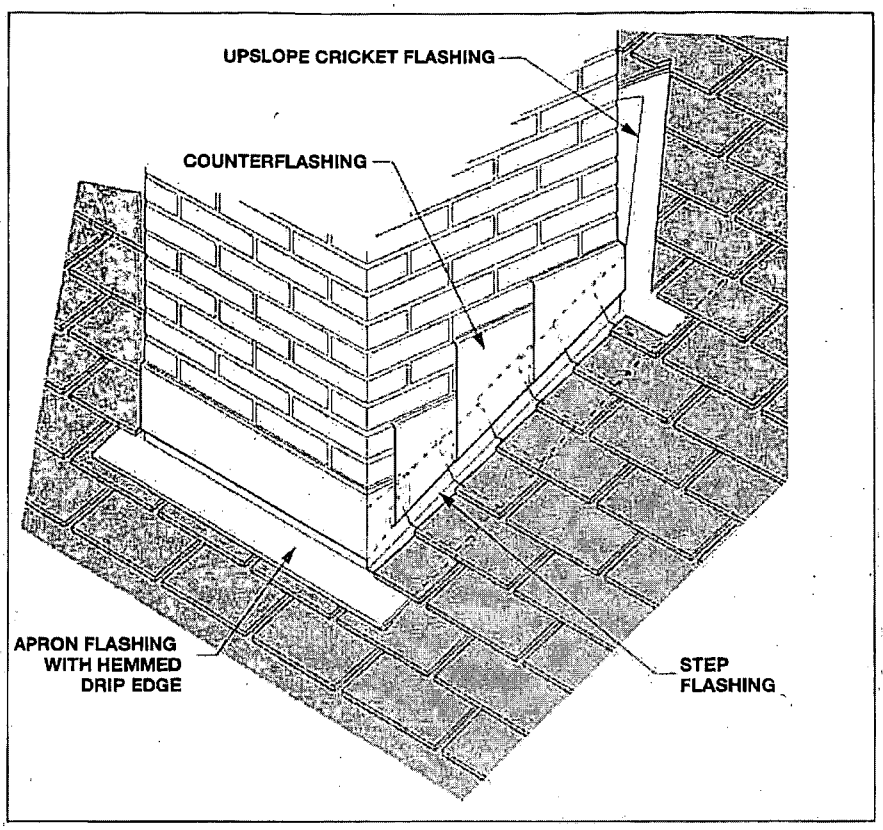

Figure 17: Basic sheet metal flashing components used at chimney

Generally, before flashings are applied, an asphalt-saturated felt underlayment should be applied to a roof deck around roof penetrations. However, in moderate and severe climates, before an underlayment is applied, an ice dam protection membrane may be installed around the base of chimneys or curbs. If appropriately specified and constructed, an ice dam protection membrane can assist in keeping water from migrating into a roof system at these roof-to-wall intersections during times of severe freeze-thaw cycling.

3.6.4.1 Apron Flashings

Apron flashings provide a weatherproofing transition material where a roof area intersects a head wall. Common locations for apron flashings are the front downslope side of a dormer or chimney, curbed roof penetrations and clerestory transitions. See Figure 18.

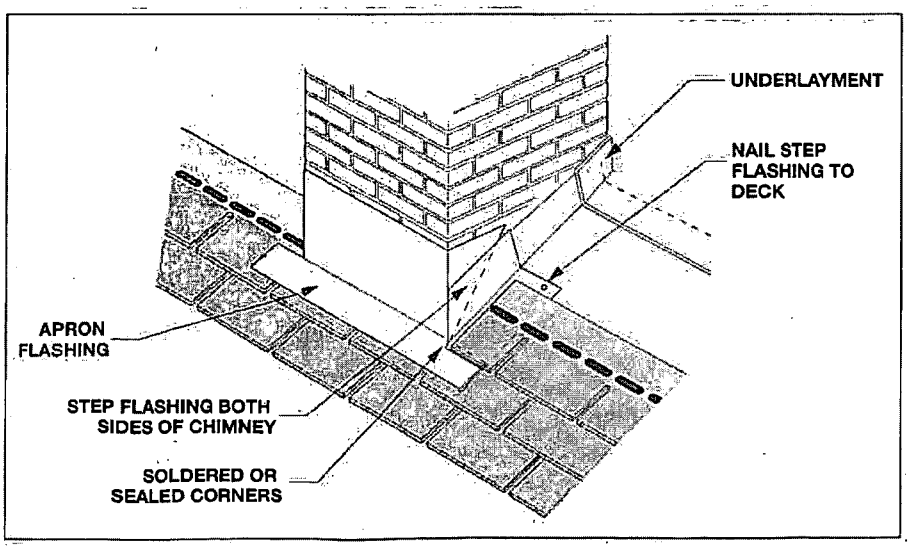

Figure 18: Apron flashing at chimney

The type and minimum thickness of the metal used for apron flashing should be commensurate with the anticipated service life for the asphalt shingle roof system. NRCA suggests metal apron flashings for asphalt shingle roof systems be fabricated from one of the following metal types and minimum thicknesses.

- 26 gauge (0.019 inch [0.48 mm] thick) galvanized steel
- 26 gauge (0.019 inch [0.48 mm] thick) prefinished galvanized steel
- 0.032 inch (0.81 mm) thick aluminum
- 0.032 inch (0.81 mm) thick prefinished aluminum
- 26 gauge (0.018 inch [0.46 mm] thick) stainless steel
- 16 ounce (0.022 inch [0.56 mm] thick) copper
- 16 ounce (0.026 inch [0.66 mm] thick) lead-coated copper
- 4 pound (0.062 inch [1.57 mm] thick) lead.

In some regions, particularly those with mild climates, other types of metal and/or metals of lesser thickness than are shown above may be used successfully. NRCA considers these applications to be area practices. Refer to the Introduction for additional information about area practices.

3.6.4.2 Step Flashings

When a roof area intersects a side wall, individual pieces of metal flashing are installed at the end of each shingle course. This is referred to as step flashing. See Figure 19.

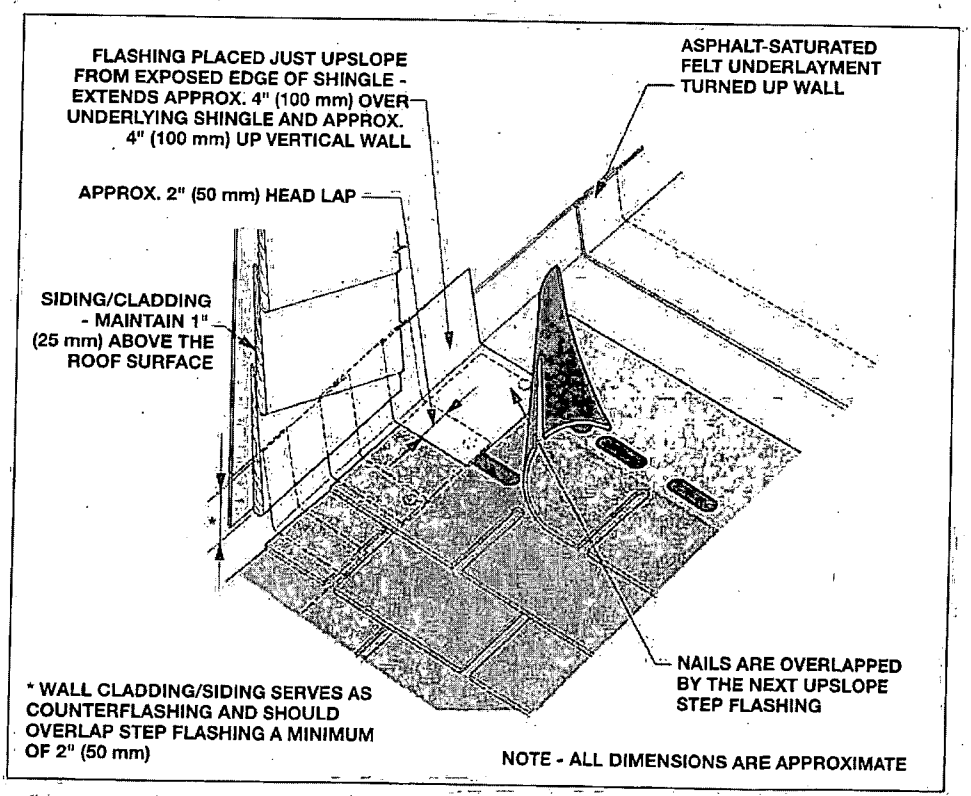

Figure 19: Use of metal step flashing for weatherproofing the intersections of sloping roof and vertical wall

The type and minimum thickness of the metal used for step flashing should be commensurate with the anticipated service life for the asphalt shingle roof system. NRCA suggests metal step flashing for asphalt shingle roof systems be fabricated from one of the following metal types and minimum thicknesses.

- 26 gauge (0.019 inch [0.48 mm] thick) galvanized steel
- 26 gauge (0.019 inch [0.48 mm] thick) prefinished galvanized steel
- 0.032 inch (0.81 mm) thick aluminum

- 0.032 inch (0.81 mm) thick prefinished aluminum
- 26 gauge (0.018 inch [0.46 mm] thick) stainless steel
- 16 ounce (0.022 inch [0.56 mm] thick) copper
- 16 ounce (0.026 inch [0.66 mm] thick) lead-coated copper
- 4 pound (0.062 inch [1.57 mm] thick) lead.

In some regions, particularly those with mild climates, other types of metal and/or metals of lesser thickness than are shown above may be used successfully. NRCA considers these applications to be regional practices. Refer to the Introduction for additional information about regional practices.

For most regions, NRCA suggests using metal step flashing that is 7 inches (180 mm) long by 8 inches (200 mm) wide for standard-size shingles, so a 2 inch (50 mm) minimum step flashing headlap is achieved and a 4 inch (100 mm) extension is obtained onto each underlying shingle and 4 inches (100 mm) up the vertical surface.

Many suppliers and contractors are continuing to use a narrow width of step flashing (as narrow as 5 inches [125 mm]), so only 2 ½ inches (64 mm) extends out onto underlying shingles. Experience has shown this detail can work in some relatively mild geographic areas.

For nonstandard shingles, the length of step flashing can be determined by using the general guideline:

Exposure + 2 inches = length of step flashing

(Exposure + 50 mm = length of step flashing)

For example, if a shingle's exposure is 8 inches (200 mm), the size of the step flashing would be 8 inches (200 mm) wide by 10 inches (250 mm) long.

Special attention needs to be paid to the first (i.e., bottom most) step flashing where an eave intersects a continuous vertical surface to ensure water is diverted to the outside of the wall covering. See Figures 20 and 21.

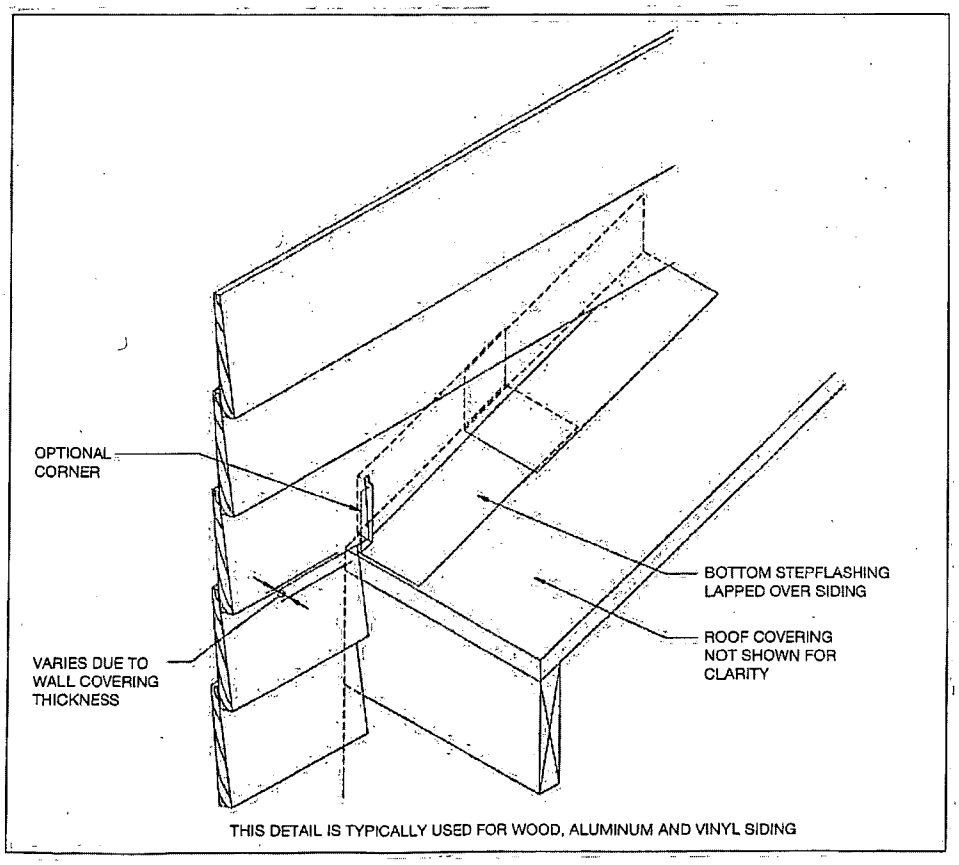

Figure 20: Soldered one-piece step flashing at eave-to-wall interface

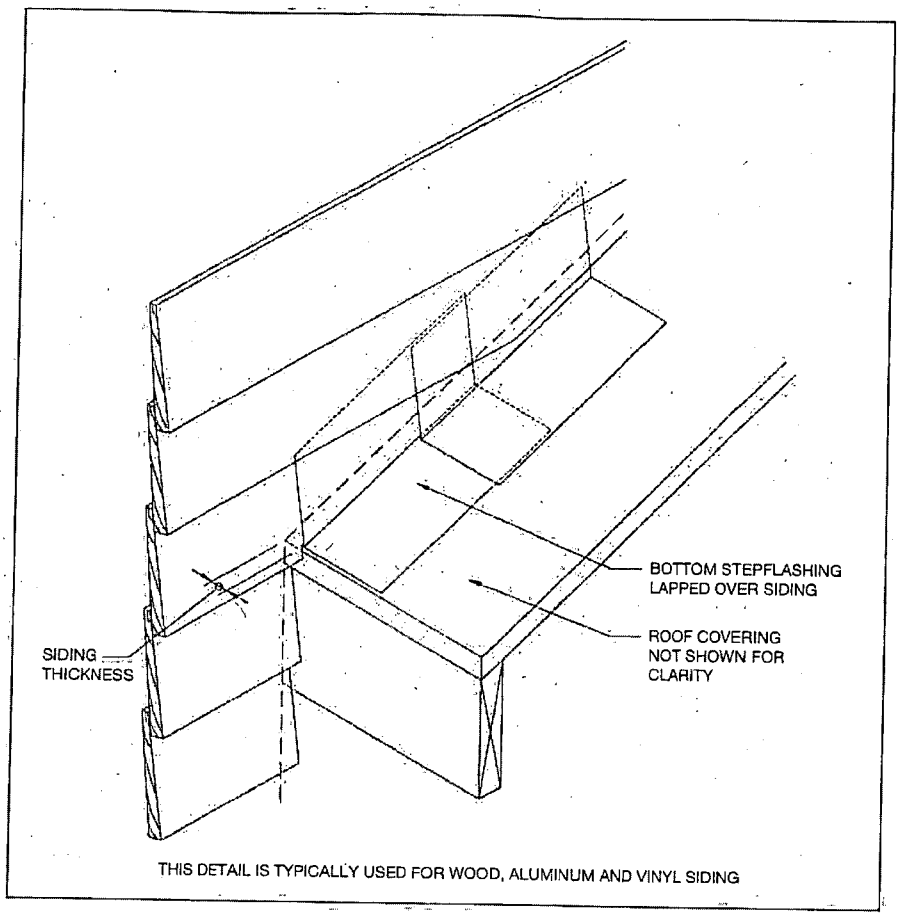

Figure 21: Step flashing at eave-to-wall interface

3.6.4.3 Cricket or Backer Flashings

When a roof area intersects the upslope side of a chimney or curbed roof penetration, either a cricket or backer flashing is installed. A cricket diverts water around the penetration, and a backer flashing provides a weatherproofing transition material where the roof intersects the back of the penetration. See Figure 22.

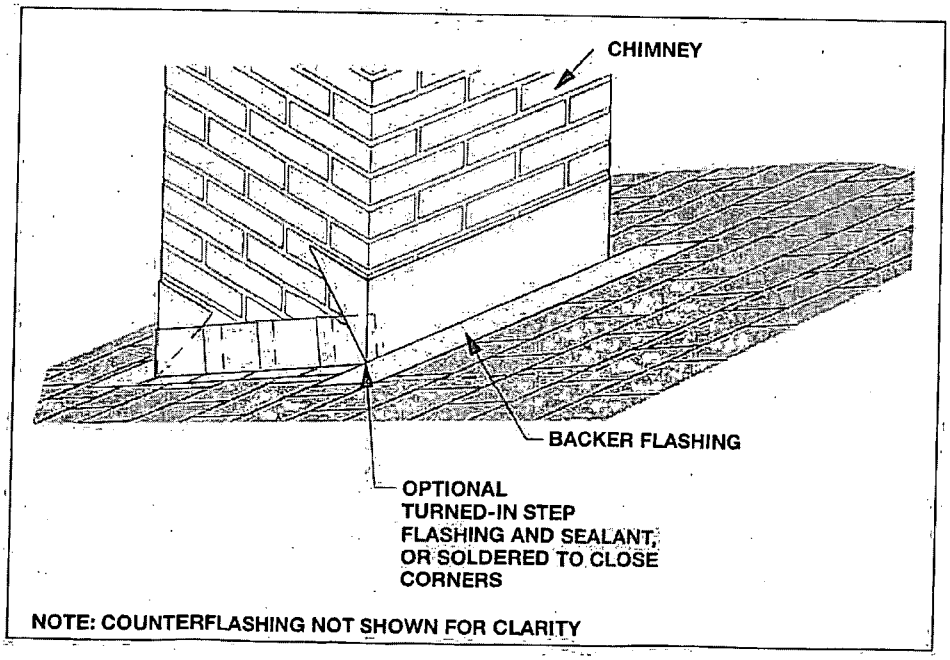

Figure 22: Example of sheet metal backer flashing at chimney

NRCA recommends that designers specify crickets at the upslope side of chimneys or curbed roof penetrations when:

- a large volume of water, snow, ice or debris is expected
- the chimney or curb is more than 24 inches (600 mm) wide
- the roof slope is 6:12 (27 degrees) or greater
- the average January temperature is 30° F (-1° C) or lower and significant accumulations of snow and ice are anticipated on the upslope side of the chimney or curb

The type and minimum thickness of the metal used for cricket or backer flashings should be commensurate with the anticipated service life for the asphalt shingle roof system. NRCA suggests metal cricket and backer flashings for asphalt shingle roof systems be fabricated from one of the following metal types and minimum thicknesses.

- 26 gauge (0.019 inch [0.48 mm] thick) galvanized steel
- 26 gauge (0.019 inch [0.48 mm] thick) prefinished galvanized steel
- 0.032 inch (0.81 mm) thick aluminum
- 0.032 inch (0.81 mm) thick prefinished aluminum
- 26 gauge (0.018 inch [0.46 mm] thick) stainless steel
- 16 ounce (0.022 inch [0.56 mm] thick) copper
- 16 ounce (0.026 inch [0.66 mm] thick) lead-coated copper
- 4 pound (0.062 inch [1.57 mm] thick) lead.

In some regions, particularly those with mild climates, other types of metal and/or metals of lesser thickness than are shown above may be used successfully. NRCA considers these applications to be area practices. Refer to the Introduction for additional information about area practices.

For metal crickets wider than 18 inches (460 mm), NRCA suggests wood framing be installed at the underside to support the metal cricket.

In some instances, a roof deck at the upslope side of a chimney or curbed roof penetration forms a cricket. When this occurs, it is generally treated in the same way as a dormer where similar valley and ridge detailing conditions occur, and asphalt shingles are used to cover the main surface area of the cricket. Figures 23, 24 and 25 illustrate examples of crickets used behind chimneys.

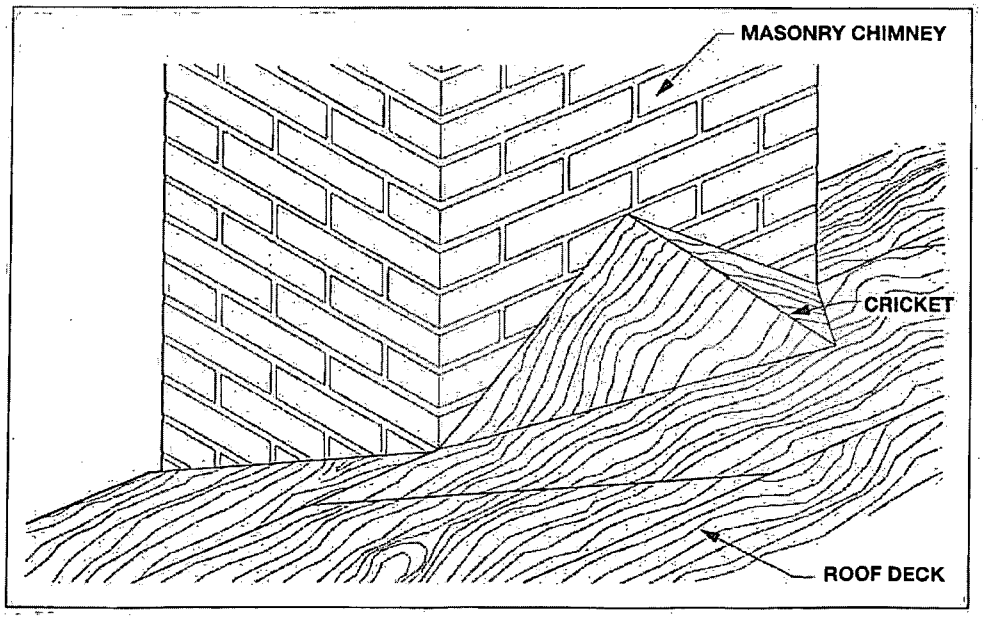

Figure 23: Example of wood cricket built on upslope of chimney

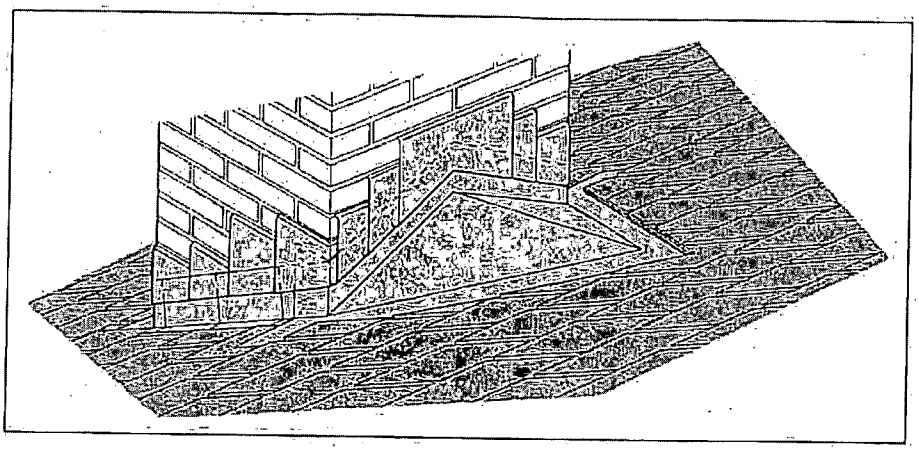

Figure 24: Example of cricket flashing for upslope portion of masonry chimney

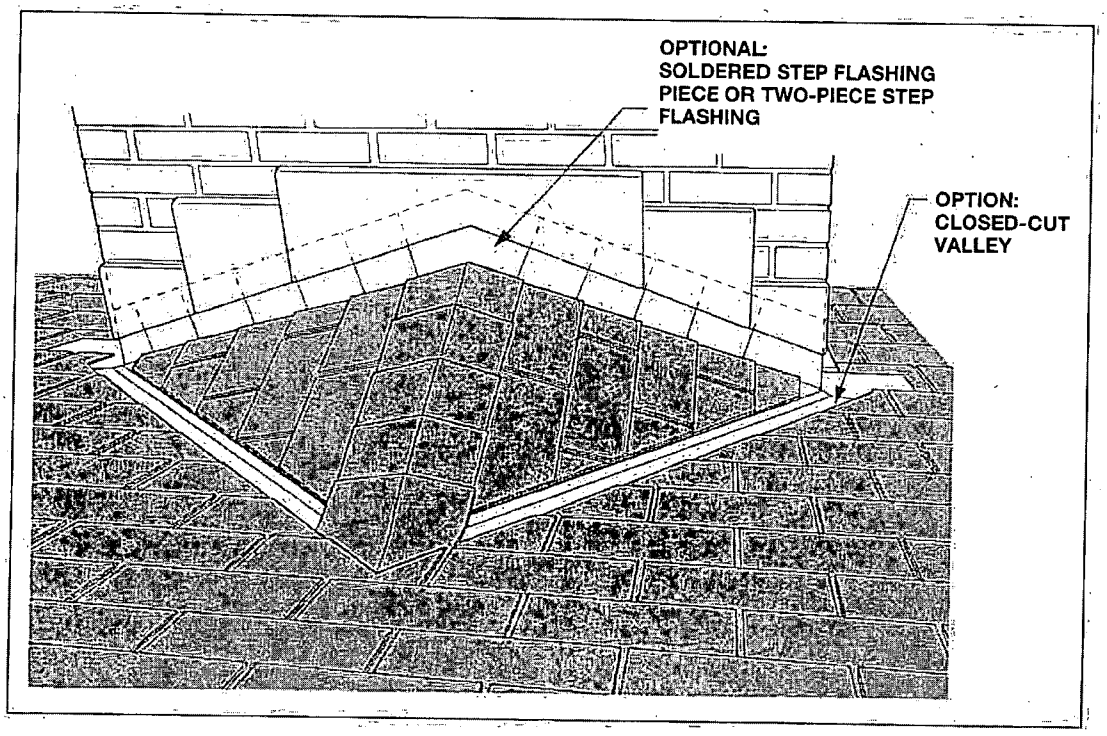

Figure 25: Example of cricket roofed-in with shingles

Generally, before any valley metal is applied, an asphalt-saturated felt underlayment should be applied to a roof deck around a chimney. However, in moderate and severe climates, before an underlayment is applied, an ice dam protection membrane should be installed around a chimney. If appropriately specified and constructed, an ice dam protection membrane can assist in keeping water from migrating into a roof system at the intersection with a chimney during times of severe freeze-thaw cycling.

3.6.4.4 Counterflashings

Apron, step, cricket and backer flashings require some form of counterflashing to cover and protect their top edges from water intrusion. In many instances, the wall covering or cladding material performs the counterflashing function. Where this does not occur, a metal counterflashing mounted to the vertical wall should be installed along the top edge of flashing metal. See Figures 26, 27 and 28.

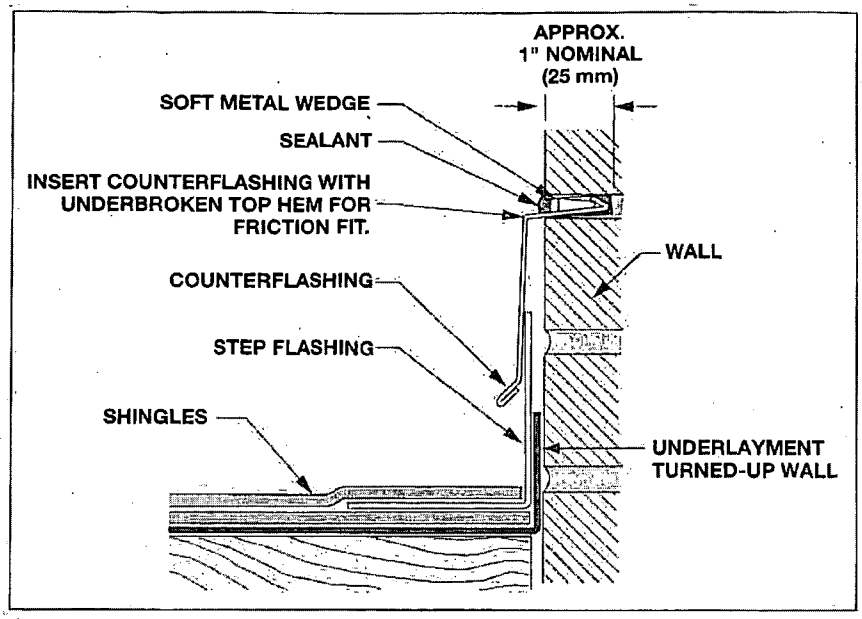

Figure 26: Metal counterflashing inset in masonry mortar joint

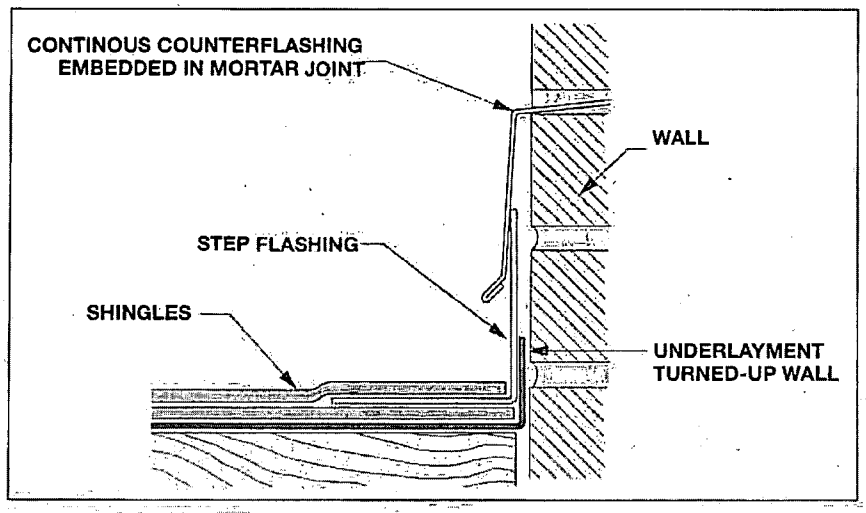

Figure 27: Through-wall metal counterflashing embedded in masonry

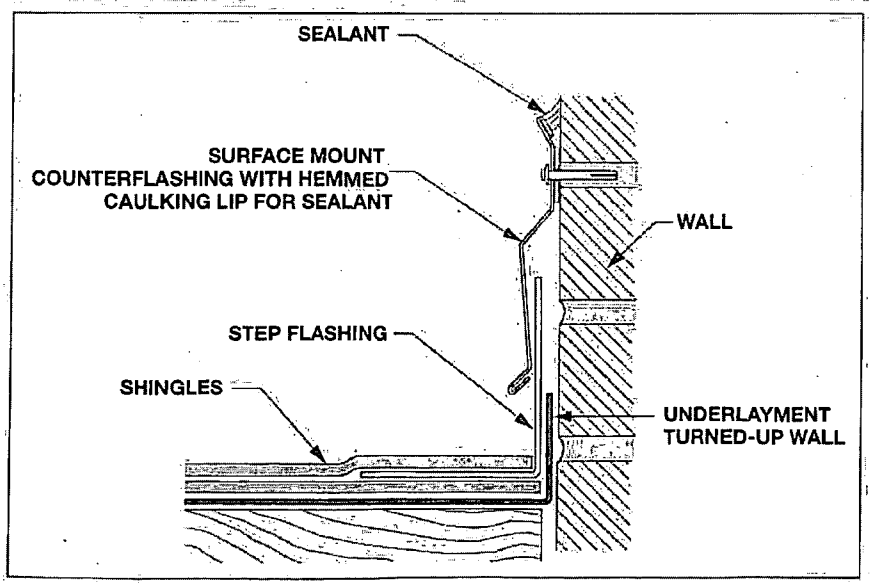

Figure 28: Surface mount metal counterflashing

The type and minimum thickness of the metal used for counterflashings should be commensurate with the anticipated service life for the asphalt shingle roof system. NRCA suggests metal counter flashings for asphalt shingle roof systems be fabricated from one of the following metal types and minimum thicknesses.

- 26 gauge (0.019 inch [0.48 mm] thick) galvanized steel
- 26 gauge (0.019 inch [0.48 mm] thick) prefinished galvanized steel
- 0.032 inch (0.81 mm) thick aluminum
- 0.032 inch (0.81 mm) thick prefinished aluminum
- 26 gauge (0.018 inch [0.46 mm] thick) stainless steel
- 16 ounce (0.022 inch [0.56 mm] thick) copper
- 16 ounce (0.026 inch [0.66 mm] thick) lead-coated copper

In some regions, particularly those with mild climates, other types of metal and/or metals of lesser thickness than are shown above may be used successfully. NRCA considers these applications to be area practices. Refer to the Introduction for additional information about area practices.

Where wall cladding counterflashes wall flashing metal (e.g., step flashing), NRCA recommends that the cladding material and underlayment extend past and cover the top edge of the flashing metal a minimum of 2 inches (50 mm).

3.7 Standards Applicable to Asphalt Shingle Roof Assemblies

The following standards apply to asphalt shingle roof assemblies:

- ASTM E 108, "Standard Test Methods for Fire Tests of Roof Coverings." This standard contains a test method to assess and classify a roof assembly's resistance to external fire exposure. A material is rated as Class A, B or C. The Class A rating denotes the greatest resistance to external fire exposure, and Class C denotes the least resistance.
- ANSI/UL 790, "Tests for Fire Resistance of Roof Covering Materials." This standard contains a test method to assess and classify a roof assembly's resistance to external fire exposure. A material is rated as Class A, B or C. The Class A rating denotes the greatest resistance to external fire exposure, and Class C denotes the least resistance. This standard is similar to ASTM E 108.
- ASTM D 3161, "Standard Test Method for Wind Resistance of Asphalt Shingles." In this test, asphalt shingle test assemblies are exposed to an air velocity of 60 mph (27 m/sec). An assembly fails if shingle tabs lift or if locking ears, for interlocking shingles only, disengage or tear loose during the two-hour test period.
- UL 997, "Wind Resistance of Prepared Roof Covering Materials." Similar to ASTM D 3161, this standard contains a test method to gauge wind resistance of prepared roof covering materials installed on a test deck. The test panel is subjected to a 60 mph (27 m/s) for two hours. An assembly fails if any full shingle tab or any free portion of a shingle lifts up or if locking ears, for interlocking shingles only, disengage or tear loose during the test period.
- UL 2218, "Impact Resistance of Prepared Roof Covering Materials." This standard evaluates a roof covering's resistance to impact. Four classifications—Class 1, 2, 3, or 4— are contained in the standard and relate to the roof system ability to withstanding impacts from 1¼, 1½, 1¾, and 2 inch (32, 38, 44 and 50 mm) steel balls, respectively.

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To learn the correct procedure for installing Laminated shingles.

LANDMARK™ SERIES AND LANDMARK™ TL

Landmark shingles have the installer-friendly **WideTrack QB™** feature, which provides **1½" wide nailing area** and specially formulated Quadra-Bond laminating adhesive *(See Figure 12-3)*.

Landmark Special is impact resistant and is specially manufactured with a reinforced fiberglass scrim to meet UL 2218 Class 4 impact resistance rating.

NOTE: Landmark Special must be installed over a clean deck (no roof-overs) to obtain the UL 2218 rating. It is strongly recommended that impact resistant cap shingles made from XT 30 IR shingles be installed on all hips and ridges. Some insurance carriers may not consider the roof system as compliant to UL 2218 Class 4 without impact resistant cap shingles.

Landmark TL is unique because its patented Tri-Laminate™ design combines three layers of material to provide a dramatically thick shingle with a wood shake style.

With the exception of Landmark TL, closed-cut valleys are preferred by CertainTeed when applying these shingles. **Open valleys are recommended when applying Landmark TL;** however closed-cut valleys are also acceptable. Woven valleys are not recommended for Landmark TL because the tri-laminated shingle can buckle and become damaged when shaped into the valley. **Nails are required as fasteners for Landmark TL,** staples are not allowed.

STANDARD OR STEEP SLOPE UNDERLAYMENT: Shingle underlayment* meeting ASTM D 4869 Type I standards is suggested. CertainTeed's Roofers' Select™, ShingleFelt™, or RoofWrap™ is preferred.

LOW SLOPE UNDERLAYMENT: One layer of WinterGuard™ or its equivalent*, or two layers of 36" (915 mm) wide felt shingle underlayment lapped 19" (485 mm) must be applied over the entire roof.

IMPORTANT: When installing LandMark TL on low slopes, one layer of WinterGuard or an equivalent waterproofing shingle underlayment must be applied over the entire roof. **Applying two layers of felt shingle underlayment is not an acceptable alternative to WinterGuard.** One layer of shingle underlayment meeting ASTM D4869 applied over the required WinterGuard is also recommended.

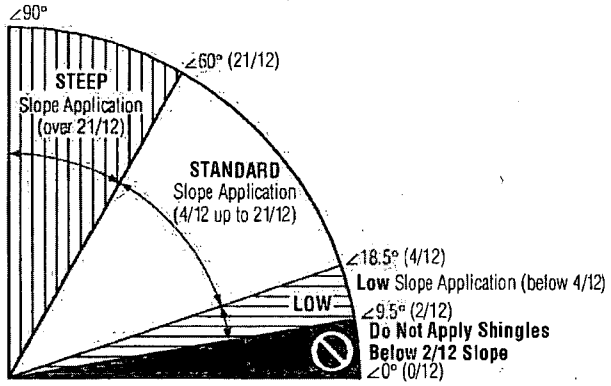


Figure 12-1: Slope definitions.

THE ROOF DECK* MUST BE AT LEAST: 3/8" (9.5 mm) thick plywood, **or** 7/16" (11 mm) thick non-veneer, **or** nominal 1" (25 mm) thick wood deck.

COLD WEATHER CLIMATES (ALL SLOPES): Applying WinterGuard or its equivalent* is strongly recommended wherever there is a possibility of ice build-up.

FLASHING: Corrosion-resistant flashing must be used to help prevent leaks where a roof meets a wall, another roof, a chimney or other objects that penetrate a roof.

SEALING: Shingle sealing may be delayed if shingles are applied in cool weather and may be further delayed by airborne dust accumulation. If any shingles have not sealed after a reasonable time period, hand sealing may be necessary.

CAUTION: To prevent cracking, shingles must be sufficiently warm to allow proper forming for hips, ridges and valleys.

WARRANTY: These shingles are warranted against manufacturing defects and are covered by SureStart™ protection. See the warranty itself for specific details and limitations.

*

For technical questions, information on acceptable alternative application methods and materials, or a copy of the product warranty, contact the sources listed below:		Warranty	Alternate Instructions	Technical Questions
Your supplier or roofing applicator		✔		
CertainTeed Home Institute	800-782-8777	✔	✔	
CertainTeed-RPG Technical Services	800-345-1145	✔	✔	✔

FASTENING

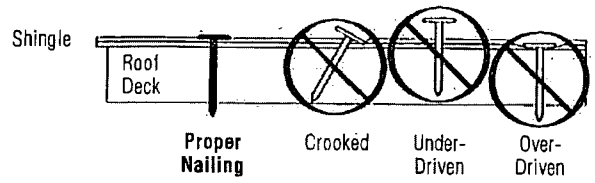


Figure 12-2: Proper and improper nailing.

IMPORTANT: For decks ¾" (19 mm) thick or thicker, nails must go at least ¾" (19 mm) into the deck. On thinner decks, nails must go at least ⅛" (3.2 mm) through the deck.

Nails must be 11- or 12-gauge roofing nails, corrosion-resistant, with at least ⅜" (9.5 mm) heads, and at least 1" (25 mm) long. **LandMark TL requires nails at least 1¼" long.**

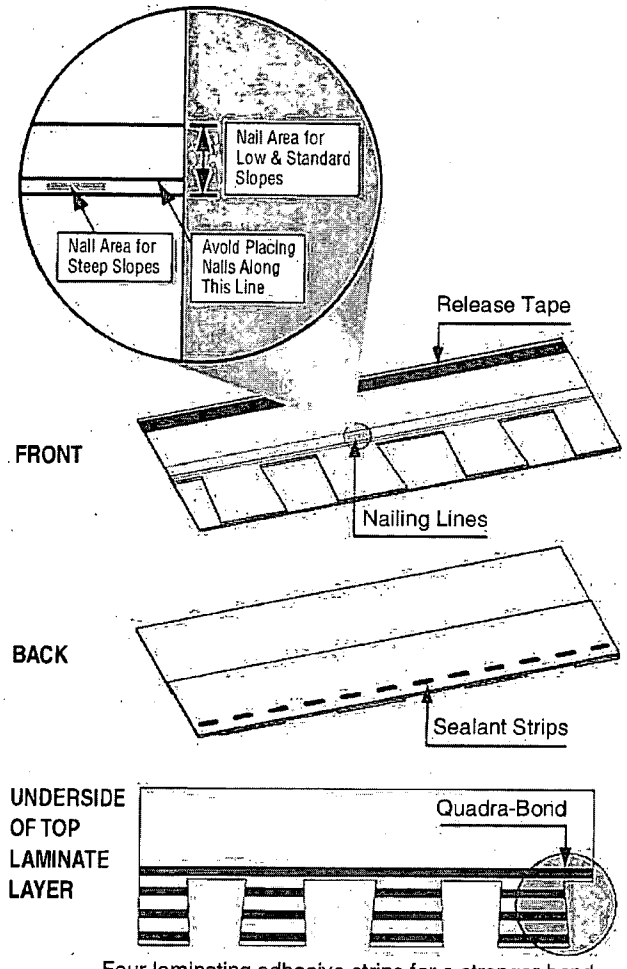
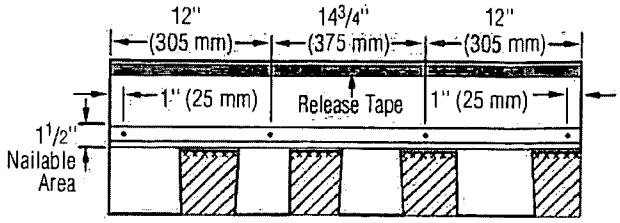
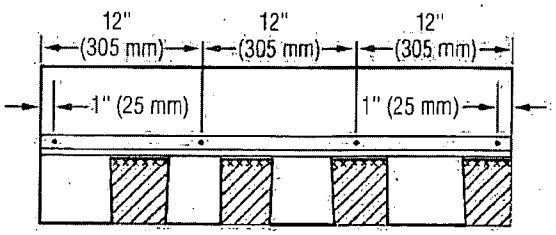


Figure 12-3: WideTrack QB™ features a wider nail area and extra-strong Quadra-Bond construction.

LOW AND STANDARD SLOPE
WIDETRACK QB METRIC DIMENSIONS



WIDETRACK QB ENGLISH DIMENSIONS



LANDMARK TL

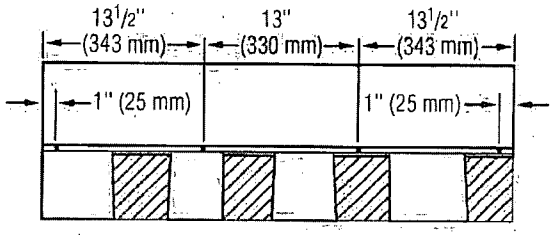
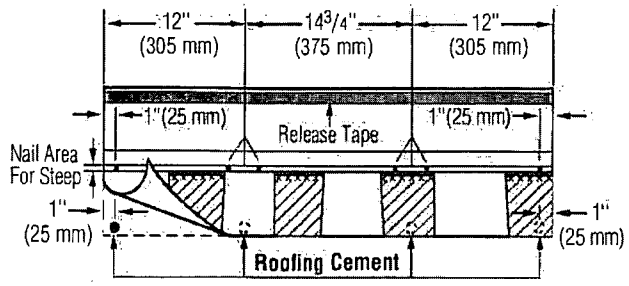


Figure 12-4: Use four nails for every full shingle.

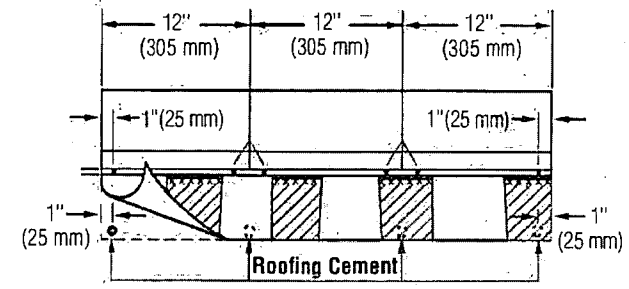
STEEP SLOPE

Use six nails and four spots of asphalt roofing cement for every full laminated shingle. See below. Asphalt roofing cement should meet ASTM D 4586 Type II. Apply 1" spots of asphalt roofing cement under each corner and at about 12" to 13" in from each edge.

WIDETRACK QB METRIC DIMENSIONS



WIDETRACK QB ENGLISH DIMENSIONS



LANDMARK TL

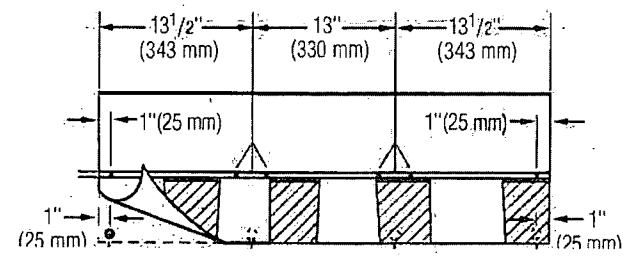


Figure 12-5: Use six nails and four spots of asphalt roofing cement on steep slopes.

CAUTION: Excessive use of roofing cement can cause shingles to blister.

ONE CLEAN-DECK APPLICATION METHOD FOR ENGLISH DIMENSION SHINGLES

FIVE-COURSE DIAGONAL METHOD ("SEVENS AND FOURTEENS")

PREPARING THE DECK:

- Apply underlayment as required. CertainTeed suggests that a layer of shingle underlayment be applied. For UL fire rating, underlayment is generally required. Apply flat and unwrinkled.
- Snap horizontal and vertical chalklines to assure shingles will be correctly aligned. Expose all shingles 5" (125 mm).

CAUTION: Use of other installation methods may result in an objectionable pattern.

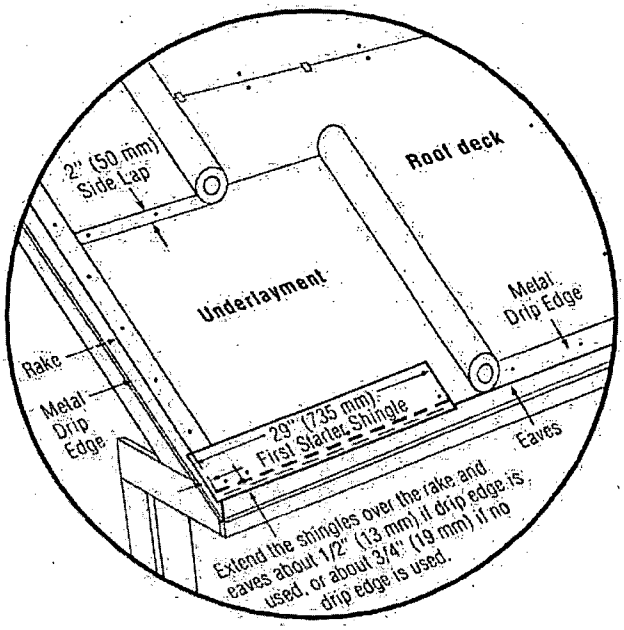


Figure 12-6: Standard slope underlayment and starter drip edge details.

STARTER COURSE:

1. Use CertainTeed Swiftstart or Universal Starter, or use standard three-tab self-sealing shingles with the lower 5" tab portions removed to provide starter shingles that are 7" in height *(Figure 12-7)*.

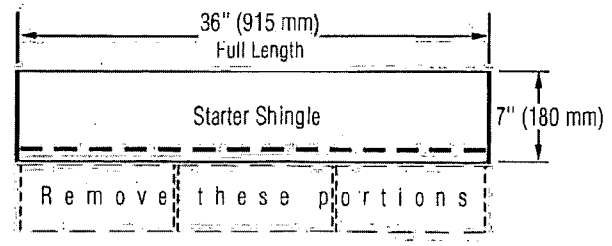


Figure 12-7: Make starter shingles by removing the lower 5" tabs.

2. For the first starter, cut 7" from one side of the starter shingles.
3. Apply the 29" piece to the lower left corner of the roof. Make sure there is 1/2" overhanging the rakes and eaves if drip edge is being used. If you are not using drip edge, make the overhang 3/4".
4. Use full 36" long, 7" wide starter shingles for the rest of the course.

1ST COURSE: Apply a full shingle at the lower left corner of the roof. Make the lower edge and left edge lie flush with the edges of the starter course *(Figure 12-8)*.

2ND THROUGH 5TH COURSES:

CAUTION! Failure to follow instruction steps 1-5 below will bring joints too close together and may cause unattractive patterns!

1. Cut 7" off the left end of the first shingle and save this piece for later use. Apply the 29" long piece over and above the first-course shingle. Leave the bottom 5" tab portion of the first-course shingle exposed *(Figure 12-8)*.
2. Cut 14" off the first shingle of the third course and save this for later. Install the 22" long piece over and above the second-course shingle.
3. Apply the previously removed 14" long piece over and above the third-course shingle.
4. Apply the previously removed 7" long piece from the second course over and above the fourth-course shingle.
5. Install a full shingle against the right edge of each shingle in courses one through five.

CONTINUING UP THE ROOF:

1. Beginning again with a full shingle, repeat the five-course pattern up the left rake *(Figure 12-10 – see B)*.
2. Fill-in courses across the roof in a stepped diagonal fashion using full shingles *(Figure 12-10 – see A and B)*. Do **not** run courses straight across.

IMPORTANT: Do not align joints of shingles closer than 3½" from one another.

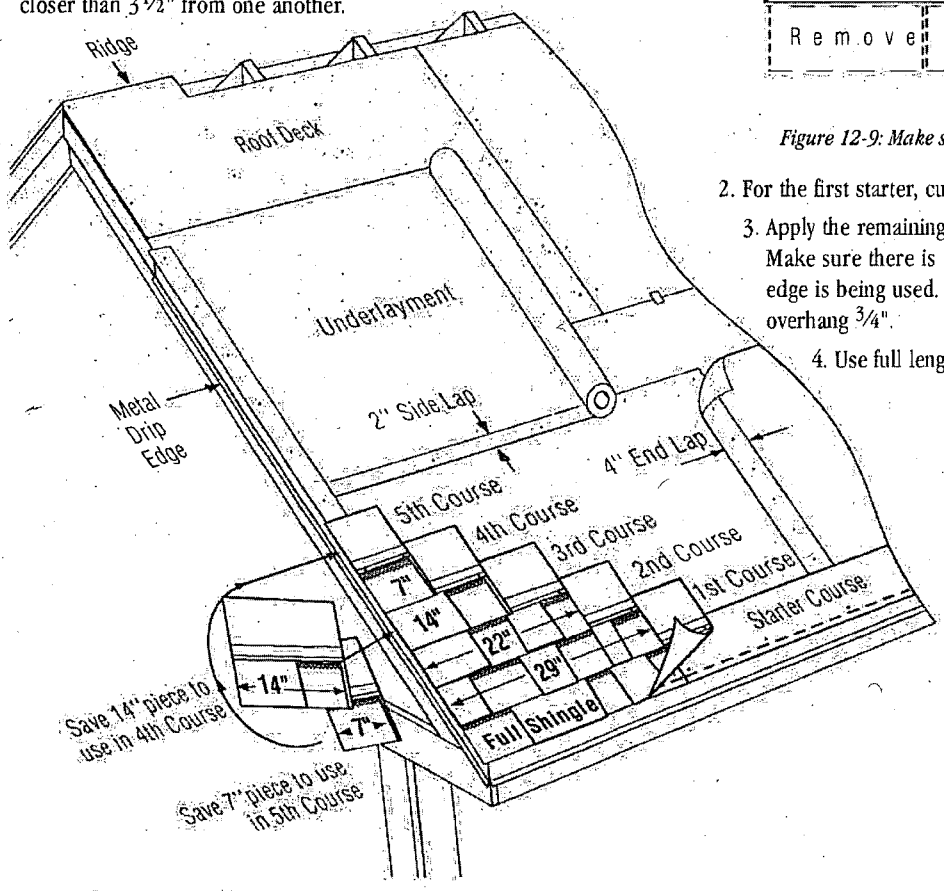


Figure 12-8: Applying the first 5 courses on a standard slope.

TWO CLEAN-DECK APPLICATION METHODS FOR METRIC DIMENSION AND LANDMARK TL SHINGLES

★ FIVE-COURSE DIAGONAL METHOD (6" AND 11") FIVE-COURSE DIAGONAL METHOD (5⅝" AND 11¼")

NOTE: The 6" and 11" method is shown below. The 5⅝" and 11¼" method follows the same application instructions as the 6" and 11" method except the dimensions of the shingle cut-offs in the second and third courses are 5⅝" and 11¼" respectively.

CAUTION: Use of other installation methods may result in an objectionable pattern.

PREPARING THE DECK:

- Apply underlayment as required. CertainTeed suggests that a layer of shingle underlayment be applied. For UL fire rating, underlayment is generally required. Apply flat and unwrinkled.
- Snap chalklines to assure shingles will be correctly aligned. Expose all shingles 5⅝" (143 mm).

STARTER COURSE:

1. Use CertainTeed Swiftstart Starter, or three-tab self-sealing shingles with the lower tab portions removed. Be sure that the starter shingles are at least 7⅝" in height. *(Figure 12-9)*.

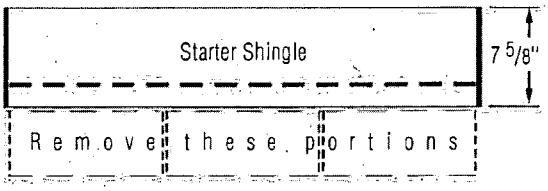


Figure 12-9: Make starter shingles that are 7⅝" in height.

2. For the first starter, cut 6" from one side of the starter shingle.
3. Apply the remaining piece to the lower left corner of the roof. Make sure there is ½" overhanging the rakes and eaves if drip edge is being used. If you are not using drip edge, make the overhang ¾".
4. Use full length starter shingles for the rest of the course.

Figure 12-10: "Five-Course Diagonal Method" installation schematic.

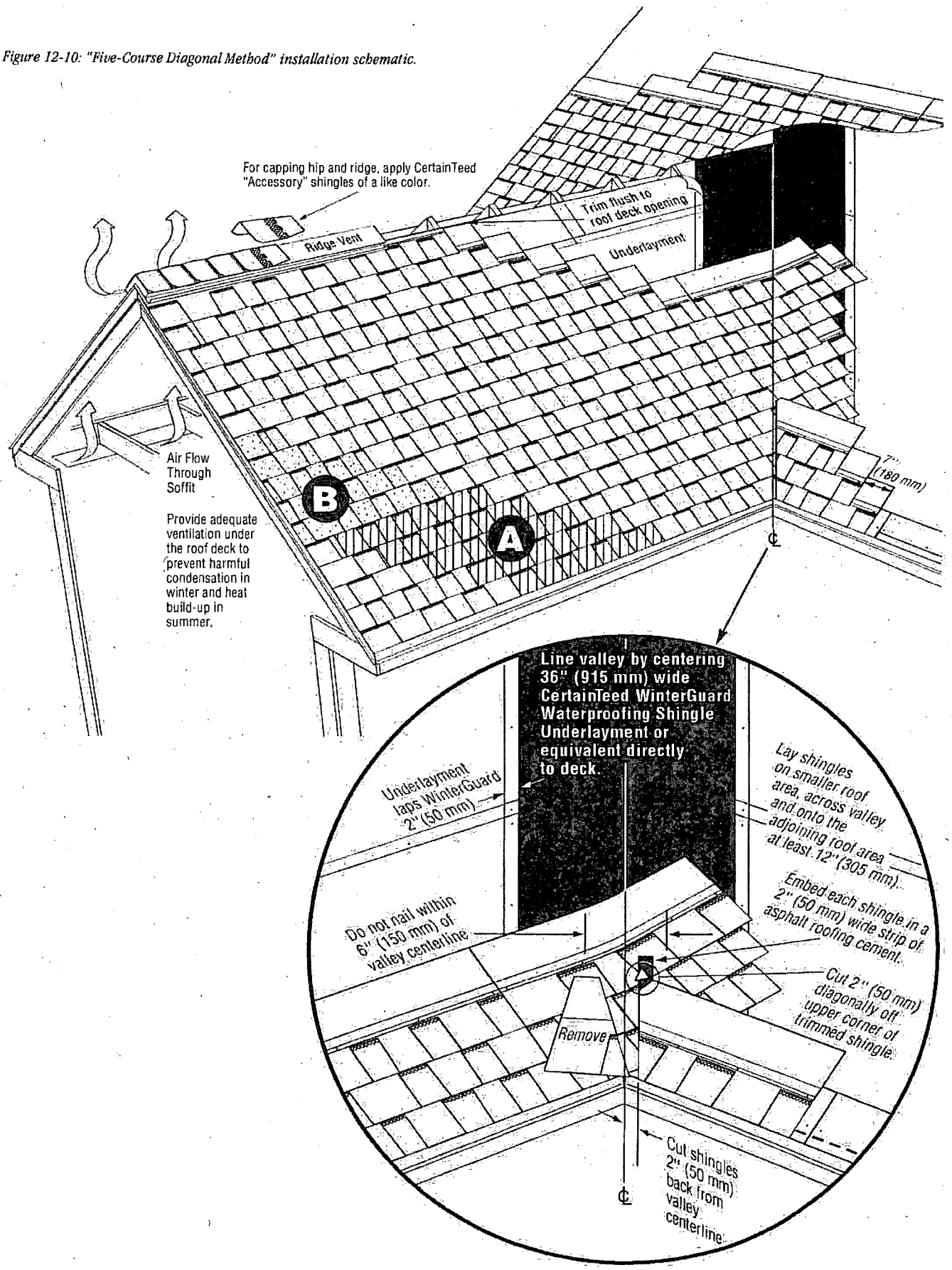


Figure 12-11: Highlight of closed-cut valley details.

1ST COURSE: Apply a full shingle at the lower left corner of the roof. Make the lower edge and left edge lie flush with the edges of the starter course *(Figure 12-12)*.

2ND THROUGH 5TH COURSES:

CAUTION! Failure to follow instruction steps 1-5 below will bring joints too close together and may cause unattractive patterns!

1. Cut 6" off the left end of the first shingle and save this piece for later use. Apply the 32¾" (34" for Landmark TL) long piece over and above the first-course shingle. Leave the bottom 5⅝" tab portion of the first-course shingle exposed *(Figure 12-12)*.
2. Cut 11" off the first shingle of the third course and save this for later. Install the 27¾" (29" for Landmark TL) long piece over and above the second-course shingle.
3. Apply the previously removed 11" long piece over and above the third-course shingle.
4. Apply the previously removed 6" long piece from the second course over and above the fourth-course shingle.
5. Install a full shingle against the right edge of each shingle in courses one through five.

CONTINUING UP THE ROOF:

1. Beginning again with a full shingle, repeat the five-course pattern up the left rake.
2. Fill-in courses across the roof in a stepped diagonal fashion using full shingles. Do **not** run courses straight across.

IMPORTANT: Do not align joints of shingles closer than 3½" from one another.

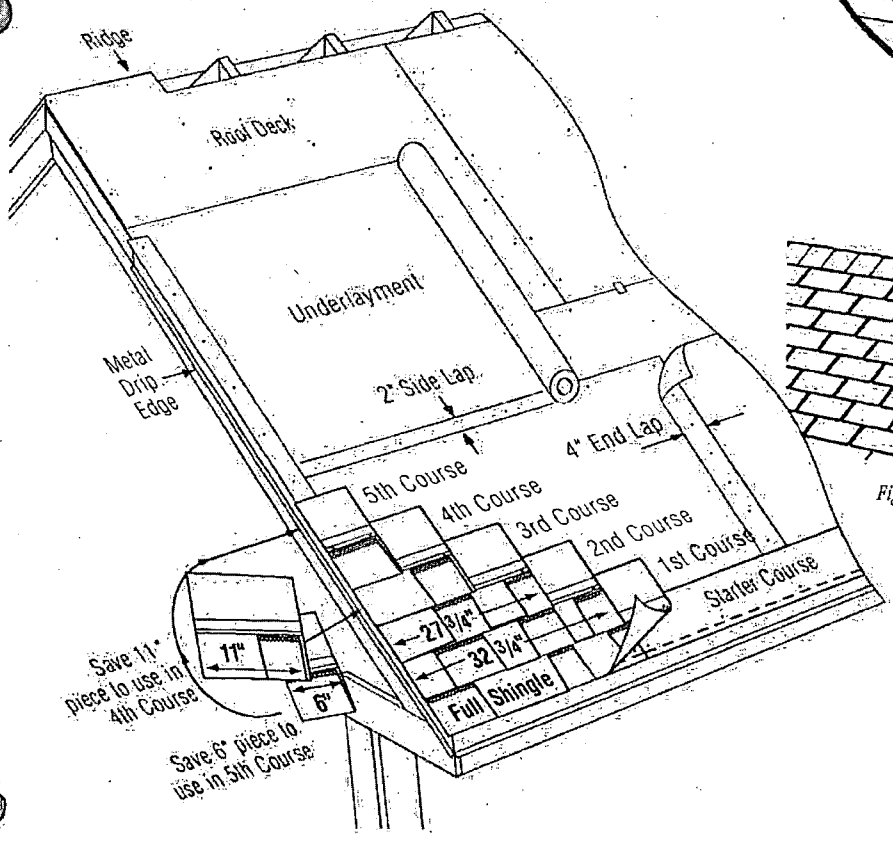


*Figure 12-12: Applying the first 5 courses of **Metric** dimension.*
Note: The LandMark TL dimensions differ.

CHIMNEY FLASHING

Metal Step Flashing

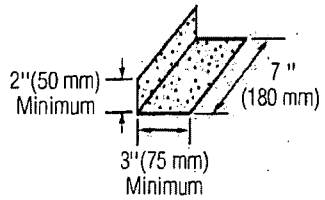


Figure 12-13: Step flashing minimum dimensions.
**NOTE: Use 7⅝" or more for Metric dimension and LandMark TL shingles.*

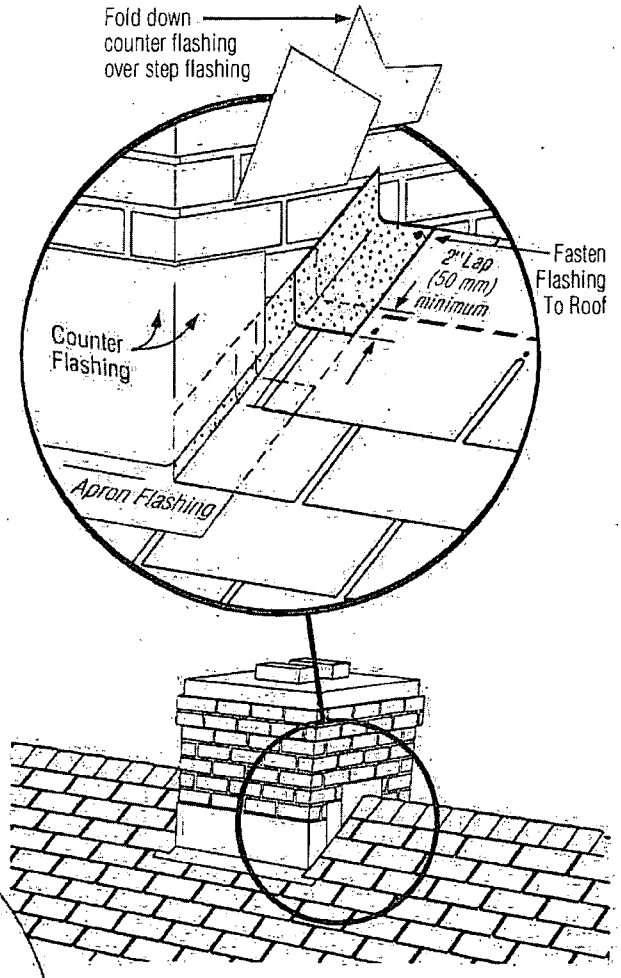


Figure 12-14: Flashing around a chimney.

ONE ROOF-OVER METHOD FOR ENGLISH DIMENSION SHINGLES

PREPARING THE ROOF SURFACE FOR REROOFING

- Make the surface of the old roof as smooth as possible by replacing missing shingles. Split and nail flat all buckled, raised tabs and curling shingles.
- It's a good idea to cut old shingles back flush to the rakes and eaves.
- We suggest that you apply corrosion-resistant drip edge along the rakes and eaves, covering the edges of the old shingles. This will provide a uniform and straight edge that will help prevent water from seeping under the shingle edges.

"NESTING" COMBINED WITH THE FIVE-COURSE DIAGONAL METHOD ("SEVENS AND FOURTEENS")

NOTE: Nesting is preferred over "bridging" methods when reroofing because nesting sheds water best and looks better. Nesting, as described below, is an easy application over square-tab asphalt strip shingles with a 5" exposure. If you are covering a different type or size shingle, you may need to cut back the tabs so that nesting is possible. To do this, simply cut off the leading edge of all old shingles when they are lapped less than 2½" by the new shingles. This permits a flat nested application that avoids lifted edges and slumps.

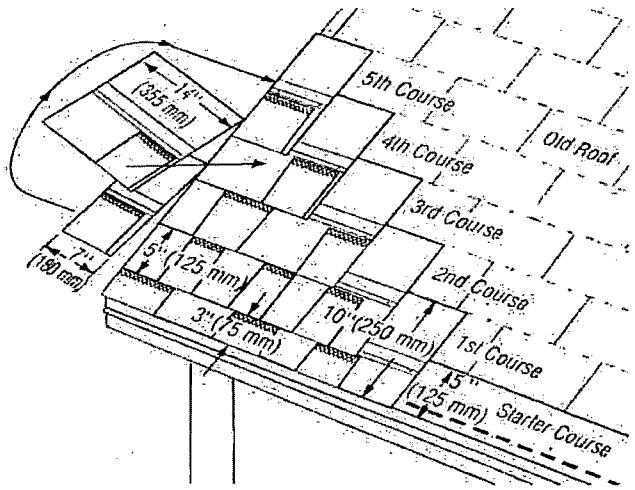


Figure 12-15: Five-Course Diagonal, Nested.

STARTER COURSE:

1. Remove the tabs and the top 2" from standard self-sealing shingles, leaving 5" by 36" strips.
2. Cut 7" off the length of the first strip, apply the 29" remaining piece over the old first course at the lower left corner, overhanging the rakes and eaves ½" if drip edge is used, or ¾" if no drip edge is used.
3. Continue with full-length starter shingles along the eaves

1ST COURSE:

1. The first-course shingles are made of full LandMark shingles with 2" cut off the bottom of the tabs.
2. Align the first-course strips with the left and lower edges flush with the starter course.

2ND THROUGH 5TH COURSES:

CAUTION! Failure to follow instruction steps 1-5 below will bring joints too close together and may cause unattractive patterns!

1. Cut 7" off the left end of the first shingle and save this piece for later use. Apply the 29" long piece over and above the first-course shingle. For this and all succeeding courses, align the top edge of the shingle to be applied with the bottom edge of old shingles in the next course. Exposure of first course only is reduced to 3".
2. Cut 14" off the first shingle of the third course and save this for later. Install the 22" long piece over and above the second-course shingle.
3. Apply the previously removed 14" long piece over and above the third-course shingle.
4. Apply the previously removed 7" long piece from the second course over and above the fourth-course shingle.
5. Install a full shingle against the right edge of each shingle in courses one through five. Remember that course one shingles are only 10" wide.

CONTINUING UP THE ROOF:

1. Beginning again with a full shingle, repeat the five-course pattern up the left rake.
2. Fill-in courses across the roof in a stepped diagonal fashion using full shingles. Do **not** run courses straight across.

IMPORTANT: Do not align joints of shingles closer than 3 ½" from one another.

TWO ROOF-OVER METHODS FOR METRIC DIMENSION AND LANDMARK TL SHINGLES

The same methods used for clean-deck application of these shingles are used for roof-overs. Application of these shingles ***over*** English dimension shingles is not recommended — due to the high cost of workmanship and greater risk of worker error.

HIPS AND RIDGES

SHADOW RIDGE™ ACCESSORY SHINGLES FOR HIPS AND RIDGES

Shadow Ridge shingles have an accented shadow line that is designed to complement these shingles. Simply fold along the pre-cut lines and detach individual cap pieces. Save valuable installation time compared to cutting 3-tab shingles.

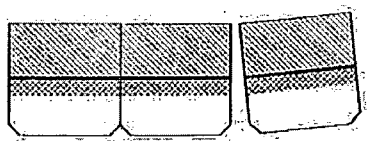


Figure 12-16: Shadow Ridge accessory shingles detach easily from three-piece units to make 72 individual cap pieces.

There are 24 three-piece units in each Shadow Ridge bundle, providing 72 individual caps that will cover 30 linear feet (33¾ linear feet, Metric) of a hip or ridge. Each English dimension cap piece is 12" by 12" (Metric caps are 13¼" by 9⅞") and features clipped corners on the bottom edge of the exposed portion.

APPLICATION IS AS FOLLOWS:

1. Apply shingles up to the hip or ridge on both sides, then trim flush.

   NOTE: The last course of shingles should have an exposure of 5" (5⅝" for metric) or less when the shingle cap or ridge vent is fastened in place. Otherwise, a potential water leak could occur at exposed shingle end joints. The figures used in this section illustrate the application of accessory shingles over a ridge vent; application directly to the roof deck is very similar.

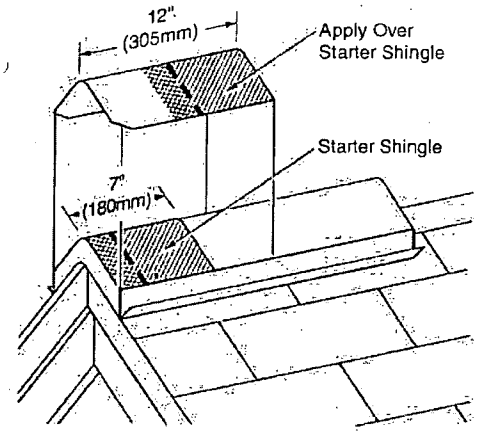


Figure 12-17: Apply a full cap shingle over the starter piece, flush with the bottom and side edges of the starter.

2. Install caps beginning at the bottom of a hip or at either end of a ridge. Apply a starter piece that has the bottom 5" (5⅝" for metric) removed *(Figure 12-18)*. Fasten the starter with two nails located about 3" from the rake edge, and 1" in from each side edge. Make sure fasteners used to apply caps penetrate at least ¾" into or through the decking.

   NOTE: To assist in proper alignment when ridge vent is not used, snap a chalk line parallel to the hip or ridge along the line where the side edges of the cap shingles should be.

3. Apply a full cap shingle over the starter (*Figure 12-18*), and place fasteners at 5⅝" (6¼" for metric) up from the exposed bottom edge and 1" in from each side. Nails must not be exposed on the finished roof. All nail heads must be driven straight and must not cut into the shingle surface.

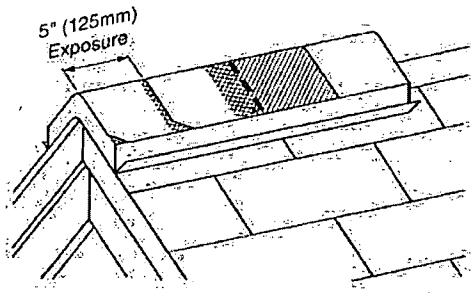


Figure 12-18: Install cap shingles at their correct exposure and cover all fasteners.

NOTE: Each cap has a laying/alignment notch at the top edge to center the piece on the ridge line, and two notches on each side to indicate the correct exposure and shadow-line placement (*Figure 12-19*). The side notches of the cap being applied should be aligned with the top edge of the previously applied cap.

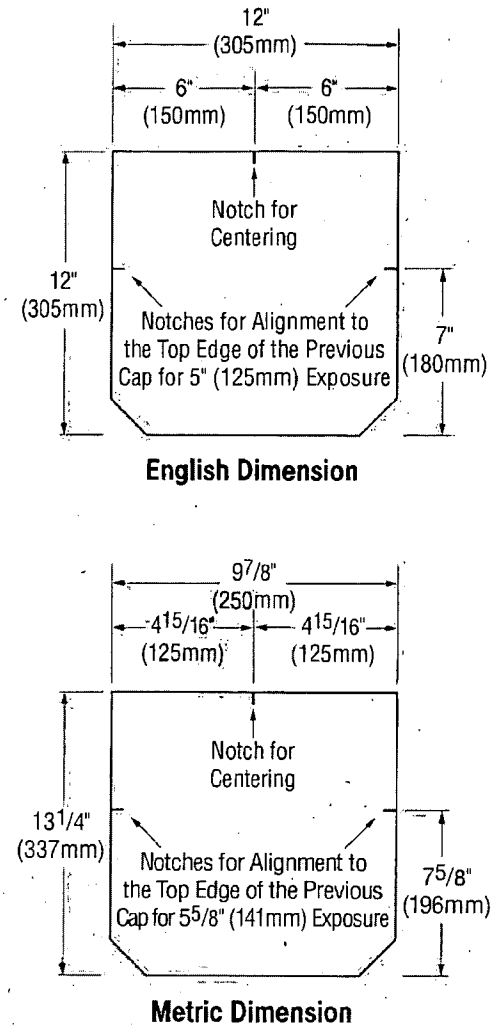


Figure 12-19 : Each Shadow Ridge shingle has a centering notch and two side-alignment notches to help ensure proper placement

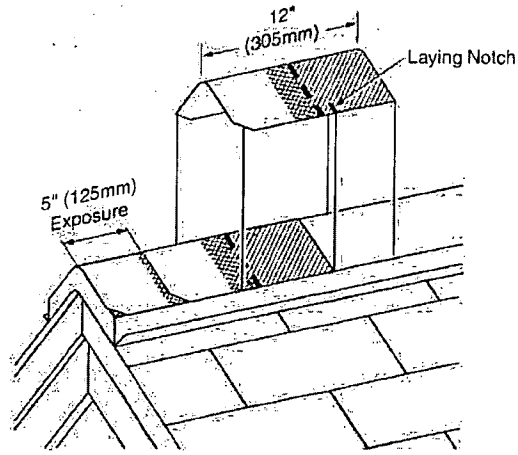


Figure 12-20: Use laying notches to center shingles on hips and ridges, and to locate the correct exposure.

MOUNTAIN RIDGE HIGH-PROFILE HIP AND RIDGE ACCESSORY

Use Mountain Ridge accessory shingles to cover hips, ridges or rake edges. One box will cover 20 linear feet. To prevent damage to shingles during application, they must be sufficiently warm to allow proper forming.

FASTENING

IMPORTANT: Use two nails to fasten each shingle. Nails must be **minimum 1¾" (45 mm) long.** For the 4" (100 mm) starter shingle, place fastener 1" (25 mm) in from each side edge and about 2" (50 mm) from the rake (or eave) edge, making sure the fastener goes ¾" into the deck or all the way through. For each full Mountain Ridge shingle, place fasteners 8⅝" (219 mm) up from its exposed butt edge and 1" (25 mm) in from each side edge.

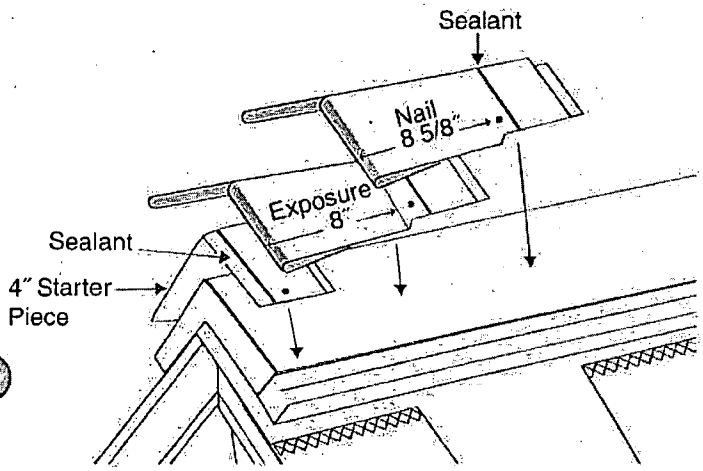


Figure 12-21: Hip and ridge application.

HIP, RIDGE AND RAKE SHINGLE APPLICATION

Apply the primary field roofing up to the hip or ridge from both sides of the roof and trim flush or lap over one side, not more than half the width of a Mountain Ridge shingle.

Assure that the installed Mountain Ridge shingles properly cover hip and ridge field shingles on both sides and the field shingles applied along rake edges. For a rake edge installation, cut the field shingles flush to the rake edge. Apply Mountain Ridge shingles ensuring they fit securely against the rake board. **To assist in proper alignment, snap a chalk line parallel to the hip, ridge or rake along the line where the side edges of the Mountain Ridge shingles should fall.**

Prepare a 4" **Starter shingle** by cutting off the lower 8" color granule butt portion of one Mountain Ridge shingle. Apply the 4" starter piece (with sealant nearest the outer edge) over the bottom corner of the hip or rake, or on either end of the ridge, overhanging the corner or end by approximately ½" and bending the starter shingle along its centerline to form into place (see figures below.) Install a nail on each side about 2" up from the starter shingle's exposed butt edge and 1" in from each side edge of the shingle. The 8" piece that was cut off may be used to finish the opposite end of hip, ridge or rake.

Next, apply a full Mountain Ridge shingle over the installed starter shingle, bending it along its centerline and forming into place over the hip, ridge or rake, flush with the bottom and side edges of the starter shingle. Install a nail on each side of the shingle 8⅝" up from the bottom edge and 1" in from each side edge.

Continue application of the Mountain Ridge shingles along the hip, ridge or rake as shown. Expose Mountain Ridge shingles 8", covering all fasteners.

Here's a Tip... In the winter put hip and ridge cap shingles in your truck with the heater blasting for 20 minutes so the caps don't crack when formed. (Thanks to Mark Dulz, Richmond, MI.)

OWENS CORNING CULTURED STONE®

The Preferred Name In Stone®

MANUFACTURER'S INSTALLATION INSTRUCTIONS

Cultured Brick® Product Installation Instructions are available separately from your Dealer and can also be found at www.culturedstone.com

Building code requirements vary from area to area. Check with local authorities for building code requirements in your area. Carefully read all Installation Instructions before proceeding with your Cultured Stone® products application. Observe safety precautions. Cultured Stone® products are covered by a 50-Year Limited Warranty when installed in accordance with the manufacturer's Installation Instructions. See warranty on page 7.

ESTIMATING THE STONE REQUIRED

Determine the amount of Cultured Stone® products needed by measuring the area to be covered. Measure the length times the height to arrive at the gross square footage of flat stone needed. Subtract square footage for window, door and other openings. Measure the linear feet of outside corners to determine the amount of corner pieces needed. One linear foot of corner pieces covers approximately ¾ of a square foot of flat area. Subtract the flat area covered by the linear feet of corner pieces from the square footage of flat stone required. You may wish to obtain some extra stone to allow for cutting and trimming. In addition, be sure to verify whether the texture chosen is sold based on coverage with a ½" mortar joint or tight-fitted. Most texture coverages are listed for a ½" joint, the exceptions being Drystack Ledgestone, European Castle Stone, Pro-Fit® Ledgestone and Pro-Fit® Alpine Ledgestone. If you are installing a texture, which states coverage is for ½" mortar joint, in a tightfit application, increase stone by 10-22%.

Formula:

Length x Height = Wall Area
Window Width x Window Height = Window Area
Lineal Feet of Corners Required x .75 = Wall Area Covered by Corners
Wall Area – Window Area – Wall Area Covered by Corners = Square Ft. Flats Required

TOOLS REQUIRED

Choose the tools required for your installation—see page 7 for illustrations and appropriate use.

• Safety Glasses and other personal protective equipment • Staple Gun or Hammer • Wheelbarrow & Hoe • Hock & Trowel • Mason's Trowel • Margin Trowel • Masonry, Circular, Table, Wet Saw or Grinder with Carborundum or Diamond Blade • Wide-Mouth Nippers or Hatchet • Dust Mask[1] • Level • Metal Jointing Tool or Wood Stick • Grout Bag • Whisk Broom

SUNDRY MATERIAL REQUIREMENTS

A. Mortar Components

1. Premixed: Type N or Type S mortar, meeting ASTM C270
2. Mortar mixed: as per Table #2 on page 3.
3. Mortar color: iron oxide color (if desired).
4. Water: Potable water

NOTE: Mortar must comply with IBC Section 2103.8, IRC Section R607.1, BNBC Section 2104.7, SBC Section 2104.7.1 or UBC Table 21-A as applicable.

NOTE: Additives should not be used unless approved by building official. Additives should meet the requirements of ASTM C 270 or CSA A179.

B. Water-Resistive Barrier

Depending on local building code requirements, barrier shall meet the requirements of ICC Acceptance Criteria 38 "Acceptance Criteria for Water Resistive Barriers."

Note: Water-resistive barrier must be used on all exterior and interior mortar applications. Water-resistive barrier is not required for application over masonry or concrete.

C. Flashing

1. To maintain the weather-resistance of the exterior wall on which stone products are installed, corrosion-resistant flashing, weep screed and a means of drainage shall be installed at all penetrations and terminations of the stone cladding. Flashing type and locations shall be in accordance with the requirements of the applicable building code.
2. For additional recommendations regarding flashing, refer to the following trade associations, standards, organizations and resources:
   a. ASTM E 2112
   b. Asphalt Roofing Manufacturers Association (ARMA)
   c. Brick Institute of America (BIA)
   d. The American Plywood Association (APA)
   e. Local building department
   f. Architect or engineer
   g. Masonry Veneer Manufacturers Association (MVMA) installation guide for adhered concrete masonry veneer, available at www.masonryveneer.org

D. Metal Lath

1. Minimum 2.5-lb. galvanized self-furring expanded metal lath (diamond mesh) meeting the requirements of ASTM C 847, or min. 18-gauge galvanized self-furring woven wire mesh meeting the requirements of ASTM C 1032.
2. For metal buildings and open stud construction—minimum 3.4-lb. ⅜" rib, paper-backed, expanded galvanized metal lath.
3. Or other code accepted mesh or lath.

E. Fasteners

1. Galvanized nails, staples, concrete nails.
2. Corrosion-resistant, self-drilling, self-tapping pancake-head screw with 7/16" head, of 1¼" length or suitable to obtain ⅜" penetration beyond inside surface of metal. (Used for installing to metal surfaces such as metal studs or metal building siding.)

F. Masonry Sealer

1. Silane-based breather-type sealer (if required). See "Sealers" in General Information section (page 6).

SURFACE PREPARATION FOR MORTAR INSTALLATIONS

Using Table 1, determine the correct surface preparation for your installation.

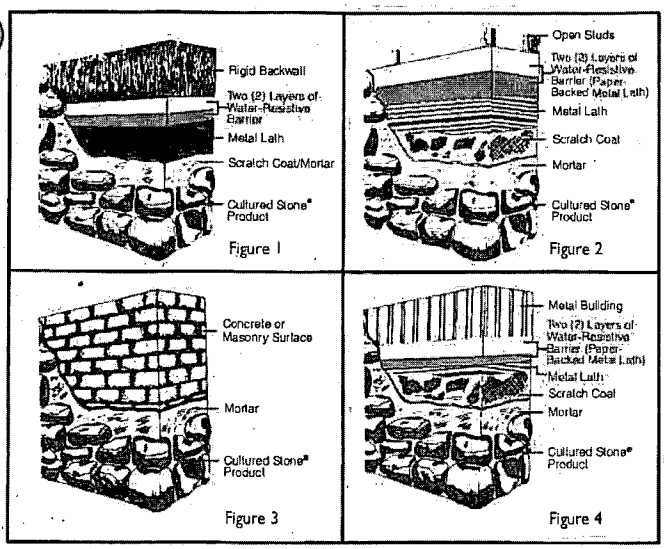


Table 1

WALL SURFACE	INTERIOR & EXTERIOR PREPARATION REQUIRED
Rigid Backwall Wallboard Plywood Paneling OSB Concrete Board Polystyrene Insulation Board installed over a Rigid Backwall	Cover sheathing with a minimum of one (1) layer of breather-type water-resistive barrier, lap joints minimum 6" at vertical joints and minimum 2" at horizontal joints in shingle fashion. Then, in accordance with local building code, lap and install lath or mesh using galvanized nails or staples 6" on center vertically, penetrating studs a minimum of 1". Continuously wrap water-resistive barrier and metal lath a minimum of 16" to next framing member around all outside and inside corners (Fig. 1). Apply ½" to ¾" scratch coat.
Clean & Untreated Concrete Masonry Stucco*	Examine newly poured concrete closely to ensure that its finished surface contains no release agents (form oil). If it does contain form oil, etch surface with muriatic acid, rinse thoroughly and/or score with a wire brush, beadblast or sandblast (Fig. 3). No further preparation needed.
Dirty, Painted or Sealed Concrete, Masonry or Stucco	Sandblast, beadblast or waterblast to original surface (remove sandblasting dust by washing) or securely attach lath.
Metal Buildings	Install primary water-resistive barrier. Lap and install 3.4-lb. ¼" rib, paper-backed, expanded metal lath to metal cladding supports of 20 ga. to 12 ga. using corrosion-resistant, self-drilling, self-tapping pancake-head screw with ⅜" head, of 1¼" length or suitable to obtain ¾" penetration beyond inside surface metal. Screws are to be installed on center equal to 1 screw/sq. ft. and shall not exceed 6" on center in one direction. Apply ½" to ¾" scratch coat and allow to dry 48 hours (Fig. 4).
Insulation Board or Open Studs Polystyrene Foam Board Please see Installation Over Thick Foam note page 7	Install primary water-resistive barrier. Lap and install 3.4-lb. ¼" rib, paper-backed, expanded metal lath to studs using nails which penetrate a minimum of 1" at 4" on center. Apply ½" to ¾" scratch coat and allow to dry 48 hours (Fig. 2).

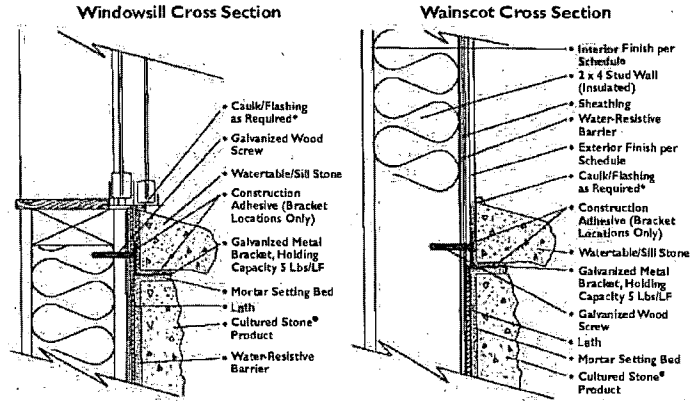
*Stucco cement plaster meeting requirements of ASTM C926, or other building code approved stucco. EIFS systems are not an approved backing for Cultured Stone®.

WEATHER RESISTANT BARRIER/WATER RESISTIVE BARRIER (WRB)

When installing manufactured stone veneer in an exterior application requiring a WRB, two separate layers of WRB shall be used. Each layer of WRB should meet the requirements for Water Resistive Barrier (Grade D) as defined by ICC Acceptance Criteria AC-38. Installation of the WRB should follow instructions provided by specific manufacturer. When installing manufactured stone veneer in an interior application, a single layer of WRB is recommended.

WATERTABLE/SILL INSTALLATIONS

Watertables/sills provide a transition piece between a stone wainscot and other exterior finishes and for water runoff. They can also be used as a windowsill. Install using galvanized metal support brackets (Simpson Strong-Tie A-21 or other galvanized right angle bracket with holding capacity minimum 5 lbs./LF) fastened with galvanized nails or screws penetrating studs 1" at a minimum of 16" on center. Two brackets per sill is preferred if blocking is present. Use construction adhesive to bond stone at bracket locations. Caulk and flash as required at Watertable/Sill locations using an approved corrosion-resistive flashing that extends to the surface of exterior wall finish and is installed to prevent water from re-entering the exterior wall envelope.



*Failure to properly caulk/flash as described in these installation directions may result in water damage to the structure.

INSTALLING STONE AT GROUND LEVEL

Keep the finished edge of the Cultured Stone® product a minimum of 4" above grade if earth or 2" above pavement. Use a 2" x 4" leveling strip (straightedge) or weep screed/flashing. Framed (wood or metal) applications are required by code in many jurisdictions to have weep screed or a weeped casing bead, at the base of the wall or foundation transition. This will:

- Provide drainage as required by applicable building code.
- Avoid possible staining of the stone by soils containing alkali or other minerals.

PREPARE YOUR WORK AREA

Spread Cultured Stone® wall veneer out at the job site so you have a good variety of sizes, shapes and colors to choose from. Plan for some variety and contrast in the overall design. Use small stones next to large ones, heavy-textured pieces next to smooth, thick stones next to thinner ones. Mixing Cultured Stone® wall veneer from different boxes during application will allow you to achieve a desirable balance of stones on your finished project.

MORTAR

NOTE: Weather Conditions

If stone is being applied in hot or dry weather, the back of each piece should be moistened with a fine spray of water or a wet brush to adequately prevent excessive absorption of moisture from the mortar. If being installed over concrete, masonry or scratch coat substrate, the substrate surface area should also be dampened before applying mortar. Surfaces should appear damp but free of surface water.

Applications should be protected from temperatures below 40°F as mortar will not cure properly under such conditions. Do not use antifreeze compounds to lower the freezing point of mortar. See International Building Code Section 2104.3 for cold weather construction requirements.

A. Mixing Mortar/Grout

Using Premixed Type N or Type S mortar or components from Table 2, mix to a firm, moist consistency. Mortar that is too dry and crumbly will not provide proper bond. Mortar that is too wet will be weak and messy.

Table 2 – Proportions for Mortar

Parts By Volume					
Mortar type	Portland Cement or Blended Cement	Masonry Cement Type N	Masonry Cement Type S	Hydrated Lime or Lime Putty	Aggregate
N	1			1	4½ to 6
N		1			2¼ to 3
S			1		2¼ to 3

B. Mortar Color

Tinting mortar complements the color of the stone being installed. Example: Use tan mortar with earth-tone stones. This will greatly enhance the appearance of the finished installation. Regular mortars can be tinted to complement your Cultured Stone® product using iron oxide pigments available from your dealer.

C. Applying Mortar to Prepared Surface Area

Using a plasterer's or mason's trowel (Fig. 5 and 6), apply mortar ½" to ¾" thick to prepared surface area. Do not spread more than a workable area (5 to 10 sq. ft.) so that mortar will not "set up" before stone is applied.

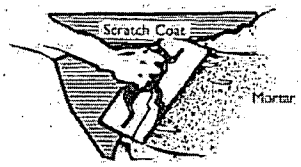


Figure 5 Apply mortar using a plasterer's trowel.

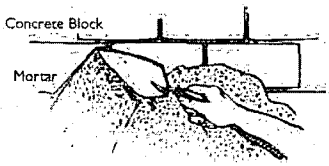


Figure 6 Apply mortar using a mason's trowel.

APPLYING CULTURED STONE® PRODUCTS

See page 4 for additional instructions concerning Pro-Fit® Ledgestone, Pro-Fit® Alpine Ledgestone and European Castle Stone.

A. Starting Point

Apply mortar and stone working from the bottom up, or most stones can also be applied from the top down. Working from the top down may help avoid splashing previously applied stone with dripping mortar. Ledgestone types should be installed from the bottom up.

B. Joint Width

In order to obtain the most natural look, joints should be as narrow as possible. The average should not exceed ½" in width. An attractive look can also be achieved by fitting stones tightly together if desired. If using tight fit/drystack method, it is important to make sure scratch coat/backing has been covered completely by the setting bed of mortar. This will conceal the scratch coat/backing and prevent pockets from forming behind stones that could trap water.

C. Setting the Stones

Press each stone into the mortar setting bed firmly enough to squeeze some mortar out around the stone's edges. Apply pressure to the stone to ensure a good bond. **Ensure complete coverage between the mortar bed and back surface of the stone.** Mortar may also be applied to the entire back of the stone (Fig. 7). When stone is installed correctly, lath will not be visible. The mortar setting bed shall be between ⅜" minimum and 1⅛" maximum.

Figure 7
Mortar applied to the entire back of the stone.

Care must be taken to avoid smearing mortar on surface of stone. Accidental smears or mortar droppings should be removed using a whisk broom only after mortar has become crumbly.

D. Install Corner Pieces First

If your application requires corner pieces, apply these first. Notice that the corner pieces have a long and a short leg. Alternate these in opposite directions (Fig. 8).

Figure 8
Apply corners—alternating long and short legs in the opposite directions.

E. Install Flat Pieces

After the corner pieces are in place, flat pieces are applied working toward the wall center (Fig. 9).

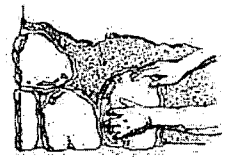
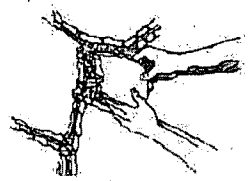


Figure 9
Apply flat pieces.

F. Keep Your Mortar Joints Consistent

Place the individual stones close together, creating uniform joints between them. Cut and trim as required to achieve consistent width in the mortar joints. Then trim and fit small pieces into any remaining voids (Fig. 10).

Figure 10
Position large pieces first, then trim and fit in smaller pieces.



G. Cutting and Trimming

Stones can be cut and shaped for fit. Use wide-mouth nippers or a hatchet (Fig. 11 and 12). (Refer to page 7–Tools Required.) Some broken stones may be found in the box. These also may be used in filling gaps between large stones. For best finished appearance, coat cut or broken edges with mortar. If possible, position cut edges up when they are above eye level, down when below eye level. **SAFETY GLASSES AND A DUST MASK(!) SHOULD ALWAYS BE WORN WHEN CUTTING ANY CULTURED STONE® PRODUCTS.**

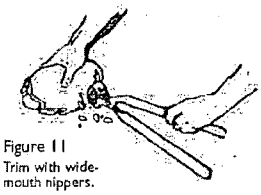


Figure 11
Trim with wide-mouth nippers.

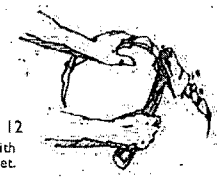


Figure 12
Trim with a hatchet.

NOTES:

Level and Plumb Joint Lines

When applying Cobblefield® manufactured stone veneer, European Castle Stone, Limestone, Rockface, Coral or Ledgestone, endeavor to maintain level and plumb joint lines. Also, long rectangular pieces will look most natural if applied horizontally.

River Rock and Stream Stone

When applying River Rock or Stream Stone, plan the placement of stones to minimize trimming and cutting to maintain the natural look of the rounded shapes.

Ledgestone Types

When applying ledgestone types, keep joints as small as possible to maintain a natural look, and install from the bottom up. Strike joints deeply, being careful not to expose the back edge of stones or scratch coat/backing. See page 4 for additional instructions regarding Pro-Fit® Ledgestone, Pro-Fit® Alpine Ledgestone and European Castle Stone.

GROUTING AND FINISHING JOINTS

A. Grouting Joints

If additional mortar is required, use a grout bag to fill in joints (Fig. 13). Care must be taken to avoid smearing mortar on surface of stone. Accidental smears or mortar droppings should be removed only after mortar has become crumbly using a whisk broom or dry bristle brush. Never use a wet brush or wire brush.

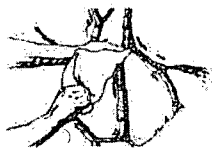


Figure 13
Grout joints.

B. Finishing Joints

When the mortar joints have become firm or "thumb-print" dry (setting time will vary depending on wall surface and climatic conditions), they should be pointed up with a wood stick or metal jointing tool. Rake out excess mortar, compact and seal edges around stones (Fig. 14). Careful attention to proper and even jointing will result in a professional looking finish.

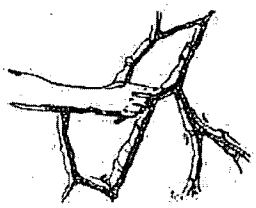


Figure 14
Finishing the job.

C. Cleaning Finished Job

At the end of the work day, or when mortar is sufficiently set up, the finished job should be broomed or brushed to remove loose mortar and to clean the face of the stone. **A wet brush or sponge should never be used to treat the mortar joints** as this will cause staining that will be difficult, or impossible, to remove. **Do not use acid or acid-based products.**

ADDITIONAL INSTRUCTIONS FOR PRO-FIT® LEDGESTONE, PRO-FIT® ALPINE LEDGESTONE AND EUROPEAN CASTLE STONE

Fit the Joints Tightly

Install all these products with tight-fitted joints. Generally, components should be placed butting each other and aligned for level and plumb. When installing, the backs of all these components must be wet. They should be noticeably damp, but free from surface water. Mortar must be tinted to match the color of the stone you are installing to help conceal the joint lines.

A. Starting Point

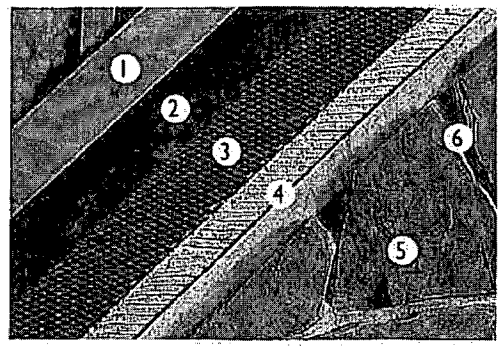
Products are applied starting from the bottom and working up. Start each ProFit® Ledgestone course level and continue horizontally completing each course before starting the next. European Castle Stone is done in a similar sequence to achieve a random ashlar pattern. If required, cut the appropriate size component to fit at the end or top of the finish area (Fig. 18). Frequently check the installation for level and alignment.

B. Install Corner Pieces First

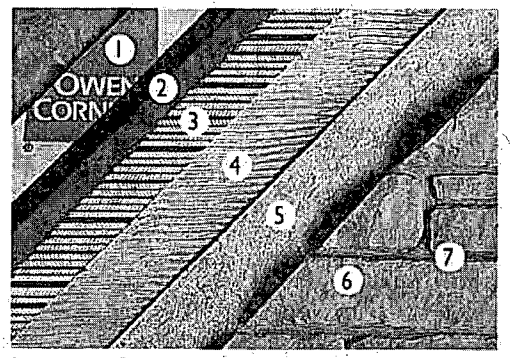
If your application requires corner pieces, start by installing a corner piece first, followed by the adjoining flat pieces. Notice that the corner pieces have a long and short leg. Alternate these in opposite directions.

TYPICAL INSTALLATIONS:

Wood Frame:

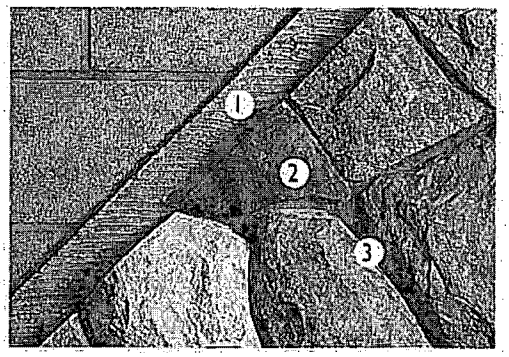


In sequence: (1) sheathing, (2) two layers of water-resistive barrier, (3) galvanized metal lath, (4) mortar/scratch coat/setting bed (5) Cultured Stone® manufactured stone veneer, (6) mortar joint.



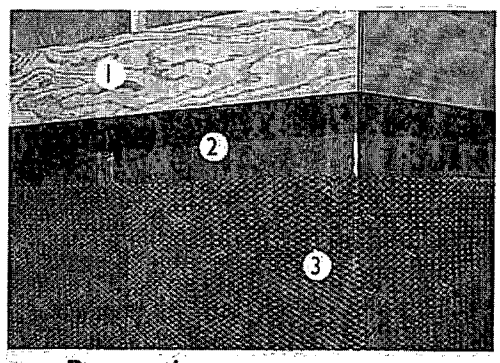
Rigid Foam Insulation:

In sequence: (1) rigid foam insulation, (2) two layers of water-resistive barrier, (3) galvanized metal lath, (4) scratch coat, (5) mortar setting bed, (6) Cultured Stone® manufactured stone veneer, (7) mortar joint.



Masonry or Concrete:

In sequence: (1) mortar applied directly to untreated, unpainted masonry, concrete or stucco, (2) Cultured Stone® manufactured stone veneer, (3) mortar joint.



Corner Preparation:

Water-resistive barrier and galvanized metal lath must continuously lap a minimum of 16" beyond outside and inside corners. Lap materials 4" on horizontal and vertical joints. (1) wall substrate, (2) two layers of water-resistive barrier, (3) metal lath.

C. Setting the Stones

Press each stone into the mortar setting bed firmly enough to squeeze some mortar out around the mortar groove at the back edge of component. Apply pressure to the component to ensure a good bond. **Ensure complete coverage between the mortar bed and back surface of stone.** Mortar may also be applied to the entire back of the stone. Check for level and plumb.

D. Install Flat Pieces

After the first corner piece is in place, the adjoining flat pieces of each course or pattern are applied. Using a trowel, strike off the excess mortar around the edges of the component prior to placing the next component. This will allow the next adjacent component to fit tightly (see Fig. 15). **Choose the correct length component to ensure that vertical joints do not line up.**

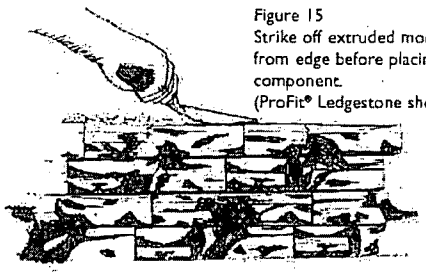


Figure 15
Strike off extruded mortar from edge before placing next component.
(ProFit® Ledgestone shown)

E. Cutting and Trimming

Vertical or horizontal cuts can be made using a table saw, circular saw or small grinder equipped with a dry cutting diamond or carborundum blade.

CUTTING SHOULD BE DONE OUTSIDE AS SOME DUST WILL OCCUR. SAFETY GLASSES AND A DUST MASK(1) SHOULD ALWAYS BE WORN WHEN CUTTING ANY CULTURED STONE® PRODUCTS.

Stones can also be cut and shaped using wide-mouth nippers or a hatchet.

Additional Information on Cutting and Fitting

Finished Edges—Place finished edges at exposed areas.
Cut Edges—Place cut edges within courses.

Finishing Joints

The design simplicity of Pro-Fit® Ledgestone, Pro-Fit® Alpine Ledgestone and European Castle Stone allows for easy installation of components and provides a finished, tightfit joint between the stones. This reduces the time required for cutting, grouting and jointing.

Surface Cleaning

Care must be taken to avoid smearing mortar on the surface of components. Accidental smears or mortar droppings should be removed with a whisk broom or dry bristle brush only after mortar has become crumbly. **Do not use a wet brush, sponge or a wire brush. Do not use acid or acid-based products, power-washing, sandblasting or wire-brush cleaning.**

INSTALLING FINISHING TOUCHES

Hearthstone Installation Instructions

Hearthstones are not recommended or warranted for exterior use or as a surface area subject to foot traffic. TERRA CRAFT® Pavers are available from your dealer for use as a hearthstone or for patios and walkways.

Consult surface preparation table 1 for requirements prior to installing Hearthstone.

A. Place Mortar

Place mortar ¾" deep in 3-inch wide strips 1 inch apart on prepared surface (Fig. 16).

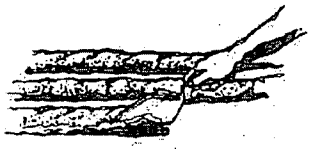


Figure 16
Place mortar for Hearthstone installation.

B. Install Hearthstones

Place the first Hearthstone onto the mortar bed and level (Fig. 17). Place adjacent Hearthstones, aligning and leveling with the first piece.

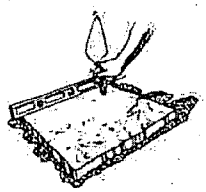


Figure 17
Place Hearthstone.

If joints need additional mortar, fill joints using a grout bag. Tool and finish joints following previous instructions under "Grouting and Finishing Joints." Ensure Hearthstones are set in a complete bed of mortar.

C. Cutting and Trimming Hearthstones

Hearthstones can be cut as required using a circular saw fitted with a carborundum or diamond blade or using a mason's brick or tile saw. Place finished edges at exposed areas.
SAFETY GLASSES AND A DUST MASK(1) SHOULD ALWAYS BE WORN WHEN CUTTING ANY CULTURED STONE® PRODUCTS.

NOTES: Hearthstone Installation UL Listed

Cultured Stone® manufactured stone veneer and hearth products are made from non-combustible materials (UL Listing #209T). They are listed by Underwriters Laboratories, Inc., for use as floor protectors and wall shields with stoves and on fireplace hearths. To comply with UL Listing, mortar joints must not exceed ½" in width and the mortar must be even with the top of the hearth surface.

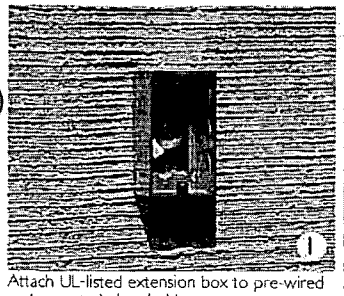
Raised Hearth

Do not cantilever or extend Hearthstones more than 1½" beyond direct support. When grouting the extended portion of a cantilevered Hearthstone, bring the grout to the front edge. Push a long galvanized nail horizontally into the grout to add support, then cover the nail with mortar.

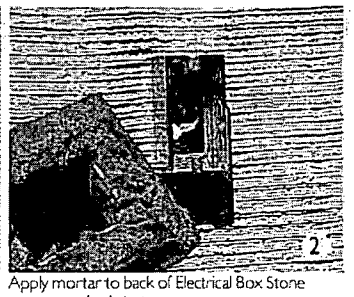
Sealing Fireplaces/Hearths

If desired, sealing the Cultured Stone® facing or hearth of a fireplace installation will assist in the removal of smoke and soot stains should they occur. See "Sealers" in General Information section for more information (page 6).

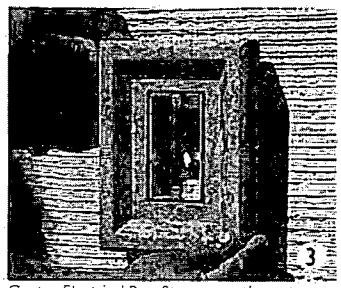
Cultured Stone® Electrical Box Stones Installation Instructions



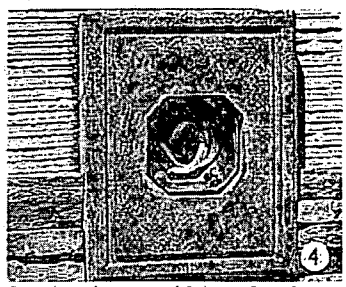
Attach UL-listed extension box to pre-wired and mounted electrical box.



Apply mortar to back of Electrical Box Stone or prepared substrate.



Center Electrical Box Stone over the extension box. Level and plumb. Use removable shims if required.



Complete placement of Cultured Stone® veneer or other exterior material around Electrical Box Stone.

NOTES: Electrical Box Stones Installation

- Electrical Box Stones must be installed in accordance with Cultured Stone® Installation Instructions.
- Extension box, light fixture or receptacle plate must be attached in accordance with manufacturer's instructions and local building codes.

Tuscan Lintel Installation Instructions

Method One

On installations where the top of the opening provides no support for the bottom edge of the Tuscan Lintel: Install metal support brackets as per Cultured Stone® Installation Instructions for Watertables/Sills. Then install Lintel stones in a full setting bed of mortar in accordance with Cultured Stone® Installation Instructions.

Method Two

On installations where the bottom edge of the Tuscan Lintel will be supported by a window or door frame's molding or profile: Install lintel stones in a full setting bed of mortar in accordance with Cultured Stone® Installation Instructions.

Make sure you do not cause deflection to window with weight of Lintel. If there is any question, use method one.

GENERAL INFORMATION

Cleaning

Dirt, etc., may be removed by using a strong solution of granulated soap or detergent and water with a bristle brush. **Do not use a wire brush** as it will cause damage to the surface. Rinse immediately with fresh water. For help with serious cleaning problems, contact your local dealer. **Do not attempt to clean using acid or acid-containing products, power-washing, sandblasting or wire-brush cleaning.**

Salt and De-Icing Chemicals

Because all concrete and masonry are vulnerable to damage by salt, Cultured Stone® products are not warranted against damage incurred from salt or other chemicals used to remove snow or ice. Do not use de-icing chemicals on areas immediately adjacent to a Cultured Stone® manufactured stone veneer application.

Scuffing

Scuffing occurs on all natural stone. Occasionally some scuffing will occur on the surface of Cultured Stone® products. This can enhance the natural appearance of your Cultured Stone® manufactured stone veneer installation. Some scuff marks can be removed by cleaning as described above.

Efflorescence

Efflorescence is a water-soluble salt that is deposited on the surface of stucco, concrete, brick and other masonry products by the evaporation of water from the wall. On rare occasions efflorescence will occur on Cultured Stone® products. To remove efflorescence, allow the stone to dry thoroughly, then scrub vigorously with a stiff bristle brush and clean water. Rinse thoroughly—do not use a wire brush. For more difficult efflorescence problems, scrub thoroughly with a solution of 1 part white household vinegar to 5 parts water. Rinse thoroughly. For unusually difficult cleaning problems, contact your local Cultured Stone® dealer.

Sealers

Sealers are not necessary on Cultured Stone® products. However, some customers use sealers to help prevent staining in applications prone to smoke, soot, dirt or water splashing. If you choose to use a sealer, make sure it is a silane-based, breathable sealer. Take note that sealers may darken the color of the stone. A sealer may also slow the natural movement of moisture out of the stone and increase the possibility of efflorescence and/or spalling. For information regarding actual performance or application of sealers, contact the manufacturer of the sealer directly.

Use of Cultured Stone® Below Water Levels

Cultured Stone® veneer is a lightweight concrete material and will not deteriorate from exposure to fresh liquid water. The use of Cultured Stone® veneer below water level, in which the water is chlorinated, treated with chemicals or dirty will likely cause discoloration as it would on any concrete, natural stone or other materials. Pool chemicals which contain acid, such as muriatic acid, may cause damage to Cultured Stone® products, which would not be covered by the Cultured Stone® 50 Year Limited Warranty. Cultured Stone® veneer, concrete and many natural stone materials are subject to potential damage from adverse freeze thaw conditions. For that reason, water should be drained below susceptible materials prior to freezing temperatures. Pressure and abrasion from constant fast flowing water may cause some surface deterioration as it would on other concrete materials. The surfaces of concrete and many other materials may be affected by exposure to extensive salt-water conditions. Cultured Stone® veneer should not be considered a waterproof material.

INCORPORATE GOOD BUILDING PRACTICES

Building Code Requirements

Building code requirements vary from area to area. Check with local authorities for building code requirements in your area. Carefully read all Installation Instructions before proceeding with your Cultured Stone® manufactured stone veneer application.

Exterior Applications

Make sure that the application of Cultured Stone® products and the structure they are being applied to incorporate good building practices. Rigid, corrosion-resistant flashing shall be installed at all wall penetrations. Flashing type and locations shall be in accordance with the requirements of the applicable

building code. On exterior applications, the incorrect installation or absence of flashing, cant strips, gutters and downspouts may result in diversion of water run-off onto finished surface areas. Masonry and other building products subjected to these conditions may develop staining and, when combined with severe freeze-thaw conditions, may eventually cause damage. The application of Cultured Stone® products under these conditions is not recommended.

Rainscreen Statement

Some building codes require a rainscreen behind cladding materials, including manufactured stone veneer. If you are installing manufactured stone/brick veneer in one of these jurisdictions, or are concerned about extreme weather conditions, it is recommended that you choose a rainscreen system that can achieve the following:

- The system should create a space with a minimum depth of 3/16" (10mm) and maximum depth of ¾" (19mm).
- The materials should be corrosion and rot resistant.
- Unless otherwise designed to manage moisture vapor, the system should be vapor open.
- If rainscreen space is created with a material other than solid strapping/ furring attached directly to framing, the following must be considered. Lath fasteners must be capable of supporting the weight of the finished wall cladding system considering the unsupported/cantilevered portion of fastener that is equal to the thickness of the rainscreen materials.

Overhead Application

Overhead, horizontal or sloped applications are not included in our building code evaluation reports or acceptances. These applications often require special approval/inspections by local building code inspectors. Contact your architect or engineer for assistance designing these installations.

Installation Over Thick Foam

Installation over foam board thicker than ½" may require special fasteners. Consult your architect or engineer for assistance designing a thick foam installation.

Capping Off the Exposed Top of Exterior Walls

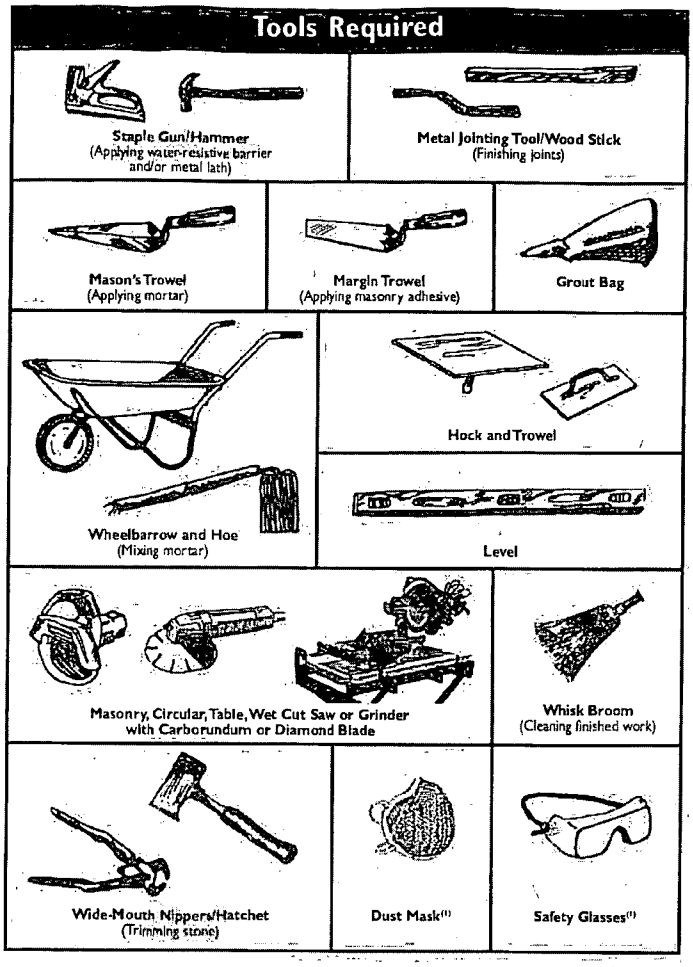
To achieve a finished architectural look on horizontal or sloping top areas of exterior walls, piers, retaining walls or other surfaces, Cultured Stone® Capstones or a poured-in-place concrete cap must be used to provide adequate run-off protection to the wall areas. Caps should extend approximately 1"–2" beyond the finished stone surface. **Cultured Stone® corner pieces, flat pieces, or hearthstones should not be used to cap walls.**

Retaining Walls

All retaining walls must be waterproofed at the fill side. Wall construction should incorporate proper use of granular backfill and provisions for good drainage. A continuous longitudinal drain along the back of the wall set in drain rock is recommended.

Chimney Cap

All chimney chases must be capped with a one-piece cap that extends 1"–2" beyond the finished stone surface to prevent water from entering the wall system. Chimney or chase construction should incorporate proper flashing.



Cultured Stone® 50-Year Limited Warranty

Cultured Stone® products are covered for a period of 50 years from the date of purchase when used on a structure which conforms to local building codes and when installed in accordance with the manufacturer's instructions. Cultured Stone® will repair or provide, free of charge, new materials to replace any determined to be defective. This warranty is limited to the original purchaser and may not be transferred to any subsequent owner. This warranty does not cover damage resulting from:

- Settlement of the building or other wall movement
- Contact with chemicals or paint
- Discoloration due to airborne contaminants
- Staining or oxidation

This warranty covers only manufacturing defects in Cultured Stone® manufactured stone products. Cultured Stone® is not responsible for labor costs incurred in removal and replacement of defective products. Hearthstones are not warranted for use on the ground or as a surface area subject to foot traffic.

CODE COMPLIANCE EVALUATION AND LISTINGS

ICC-ES ESR-1364. Tested or listed by Underwriters Laboratories, Inc., City of Los Angeles RR23744, HUD Materials Release No. 1316, Texas Dept. of Insurance Product Evaluation EC-21.

(1) **CAUTION:** Contains Crystalline Silica. Dusts from cutting or sawing may create possible cancer hazard. Dusts of this product may cause irritation of the nose, throat and respiratory tract. Avoid prolonged or repeated inhalation of dusts from this product. A properly fitted NIOSH approved N-95 series disposable particulate filtering facepiece respirator (formerly referred to as "dust masks") should be used when mechanically altering this product (e.g., sawing, cutting, drilling or similar dust generating processes). Wear long sleeved shirt, long pants, gloves and safety glasses with side shields when handling and installing material. Wash hands and face with soap and warm water immediately after handling this product.

AUTHORIZED DEALER

For additional information on
Owens Corning Cultured Stone® products
visit **www.culturedstone.com**
or call
1-800-255-1727

CULTURED STONE®

The Preferred Name In Stone™

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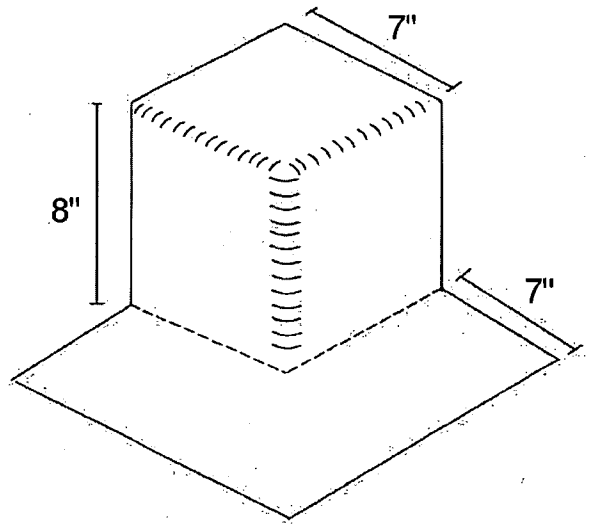
POLYGUARD PREFORMED OUTSIDE CORNER



DESCRIPTION:

The ***POLYGUARD PREFORMED FLASHING CORNER*** is a 40 mil combination of rubberized asphalt bonded to polyethylene. The adhesive surface is covered with a release liner.

POLYGUARD LIQUID ADHESIVE is used to prepare surfaces for ***POLYGUARD PREFORMED CORNERS***.

USES:

The ***PREFORMED FLASHING CORNER*** provides maximum protection against moisture infiltration at outer corners. It bridges the flashing where it terminates, forming a continuous water deterrent seal. ***PREFORMED CORNERS*** can be used wherever a continuous water seal around outer corners is desired.

ADVANTAGES:

At present, flashing around corners requires a series of cuts, folds, flaps and patching with mastic. This is a time consuming, difficult procedure which often results in a less than desirable corner condition.

POLYGUARD PREFORMED CORNERS offer an easy and practical method of field installation, eliminating as much as 10 minutes *(per corner)* of expensive field labor time. But most important, the design provides maximum protection against water penetration at outside corner conditions.

PRODUCTS/HANDLING:

POLYGUARD THRU WALL FLASHING SYSTEMS components should be unloaded and stored in such a manner that prevents injury to the materials.

EXECUTION:

SURFACE PREPARATION: Clean all surfaces of dust, dirt and foreign matter. Eliminate sharp protrusions, which may puncture membrane. Surfaces should be dry prior to application of ***POLYGUARD 650 LT LIQUID ADHESIVE*** and ***POLYGUARD PREFORMED CORNERS***.

APPLICATION OF CORNER: Remove silicone release liner and apply to properly prepared surface. Then apply ***THRU WALL FLASHING MEMBRANE*** over lapping 2" onto the ***PREFORMED CORNER*** or ***END DAM***. All vertical terminations must be sealed immediately with a tooled bead of ***POLYGUARD 650 MASTIC***.

Polyguard

This Information is based on our best knowledge, but POLYGUARD cannot guarantee the results to be obtained.

Polyguard has been ISO 9000 certified since 1996. Current certifications are:
- American Nat'l. Standards Institute.
- Dutch Council for Certification
- Deutscher Akkreditierungs Rat

POLYGUARD PRODUCTS, INC • ENNIS, TEXAS 75120-0755
PH: 214-515-5000 • 800-541-4994 • FAX: 972-875-9425
Web Site: www.polyguardproducts.com

LIMITATIONS:

POLYGUARD THRU WALL FLASHING COMPONENTS are recommended for concealed applications behind brick, marble, granite, siding or other exterior wall covering system. ***POLYGUARD MEMBRANES*** should be covered within 30 days to prevent prolonged exposure to sunlight.

PRECAUTIONS:

POLYGUARD LIQUID ADHESIVES are industrial coatings and would be harmful or fatal if swallowed. Marked as a red label flash point product, prohibit flames, sparks, welding and smoking during application. Refer to product label and Material Safety Data Sheets for handling, use and storage.

Solvents could be irritating to the eyes. In case of contact with eyes, flush with water and contact physician.

Avoid prolonged contact with skin and breathing of vapor or spray mist from ***LIQUID ADHESIVE***. If in confined areas, use adequate forced ventilation, fresh air masks, explosion proof equipment, and clean clothing. Close container after each use. **Keep out of reach of children.**

This material is offered for sale by ***POLYGUARD PRODUCTS, INC***, only for the expressed purposes as described in this literature. Any use of the products described in this literature for purposes other than taught therein by ***POLYGUARD PRODUCTS, INC.*** shall be the responsibility of the purchaser and ***POLYGUARD PRODUCT, INC.*** does not warrant nor will be responsible for any misuse of these products. ***POLYGUARD PRODUCTS, INC.*** will replace F.O.B. Ennis, Texas, material not meeting our manufacturer's specifications one year from date of sale. ***POLYGUARD*** products as described herein are for industrial use only. The application procedures should be performed by workmen who are skilled in the application of materials described herein in accordance with manufacturer specifications.

MATERIAL SAFETY DATA:

All Material Safety Data Sheets and precautionary labels should be read and understood by all user supervisory personnel and employees before using. Consult ***POLYGUARD PRODUCTS, INC.*** Material Safety Data Sheets and OSHA regulations for additional safety and health information for the products described herein. Purchaser is responsible for complying with all applicable federal, state or local laws and regulations covering use of the product including waste disposal.

This is not a Material Safety Data Sheet and is not to be used as such. ***POLYGUARD*** has prepared separate Material Safety Data Sheets on each product.

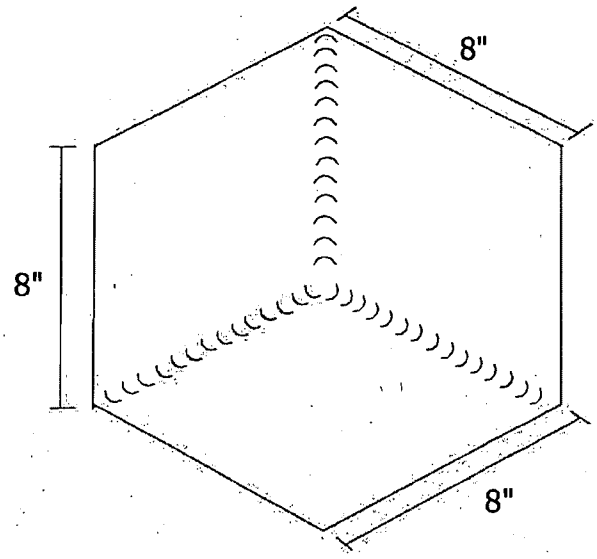
TECHNICAL SERVICE AND AVAILABILITY:

Technical assistance, information and ***POLYGUARD*** products are available through a nationwide network of distributors and architectural representatives, or contact ***POLYGUARD PRODUCTS, INC.***

NOTE ON ISO 9000

POLYGUARD PREFORMED OUTSIDE CORNERS are not covered by ***POLYGUARD'S*** ISO 9001 quality system.

POLYGUARD PREFORMED INSIDE CORNER AND END DAMS



DESCRIPTION:

The ***POLYGUARD PREFORMED INSIDE FLASHING CORNER AND END DAMS*** are a 40 mil combination of rubberized asphalt bonded to a cross laminated polyethylene film. The adhesive surface is covered with a release liner.

POLYGUARD LIQUID ADHESIVE is used to prepare surfaces for ***POLYGUARD PREFORMED INSIDE CORNERS AND END DAMS***.

AVAILABLE SIZES:

3" x 3" x 3"
6" x 6" x 6"
8" x 8" x 8" (also used as inside corners)

USES:

The ***PREFORMED FLASHING CORNERS AND END DAMS*** provides maximum protection against moisture infiltration at inner corners as well as any vulnerable location such as near the jamb lines above and below wall openings. It bridges the flashing where it terminates, forming a continuous water deterrent seal.

ADVANTAGES:

At present, flashing around corners requires a series of cuts, folds, flaps and patching with mastic. This is a time consuming, difficult procedure which often results in a less than desirable corner condition.

POLYGUARD PREFORMED INSIDE CORNERS AND END DAMS offer an easy and practical method of field installation, eliminating as much as 10 minutes *(per corner)* of expensive field labor time. But most important, the design provides maximum protection against water penetration at outside corner conditions.

PRODUCTS/HANDLING:

POLYGUARD THRU WALL FLASHING SYSTEMS components should be unloaded and stored in such a manner that prevents injury to the materials.

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This Information is based on our best knowledge, but POLYGUARD cannot guarantee the results to be obtained.

Polyguard has been ISO 9000 certified since 1996. Current certifications are:
- American Natl. Standards Institute
- Dutch Council for Certification
- Deutscher Akkreditierungs Rat

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Web Site: www.polyguardproducts.com

EXECUTION:

SURFACE PREPARATION: Clean all surfaces of dust, dirt and foreign matter. Eliminate sharp protrusions, which may puncture membrane. Surfaces should be dry prior to application of ***POLYGUARD 650 LT LIQUID ADHESIVE*** and ***POLYGUARD PREFORMED CORNERS***.

APPLICATION OF INSIDE CORNER AND END DAMS: Remove silicone release liner and apply to properly prepared surface. Then apply ***THRU WALL FLASHING MEMBRANE*** as per the manufacture's recommendation overlapping 2" onto the preformed corner. All vertical terminations must be sealed immediately with a tooled bead of ***POLYGUARD 650 MASTIC***.

LIMITATIONS:

POLYGUARD THRU WALL FLASHING COMPONENTS are recommended for concealed applications behind brick, marble, granite, siding or other exterior wall covering system. ***POLYGUARD MEMBRANES*** should be covered within 30 days to prevent prolonged exposure to sunlight.

PRECAUTIONS:

POLYGUARD LIQUID ADHESIVES are industrial coatings and would be harmful or fatal if swallowed. Marked as a red label flash point product, prohibit flames, sparks, welding and smoking during application. Refer to product label and Material Safety Data Sheets for handling, use and storage.

Solvents could be irritating to the eyes. In case of contact with eyes, flush with water and contact physician.

Avoid prolonged contact with skin and breathing of vapor or spray mist from ***LIQUID ADHESIVE***. If in confined areas, use adequate forced ventilation, fresh air masks, explosion proof equipment, and clean clothing. Close container after each use. Keep out of reach of children.

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TECHNICAL SERVICE AND AVAILABILITY:

Technical assistance, information and ***POLYGUARD*** products are available through a nationwide network of distributors and architectural representatives, or contact ***POLYGUARD PRODUCTS, INC.***

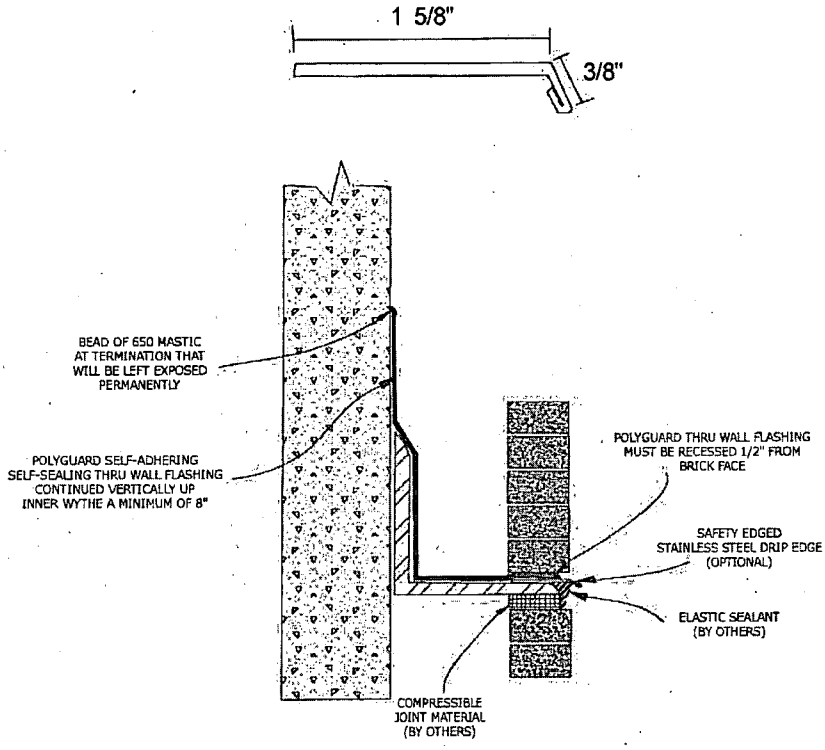
NOTE ON ISO 9000

POLYGUARD PREFORMED INSIDE CORNERS AND END DAMS are not covered by ***POLYGUARD'S*** ISO 9001 quality system.

SELF-ADHERING FLASHING AND STAINLESS STEEL DRIP EDGE

- ***Preformed Stainless Steel Drip Edges*** can be used in conjunction with ***Polyguard Thru Wall Flashings***. The ***Drip Edge*** is 28 gauge (15 mils thick), 1 5/8" inches wide with a 3/8" inch bend at one end made of Type 304 grade, dull finish stainless steel which complies to ASTM A-167. They are supplied in 8 foot pieces.

- The ***Drip Edge*** is set along the edge of the shelf angle. Apply the ***Thru Wall Flashing*** to ***Drip Edge*** leaving approximately 1 inch from drip edge.



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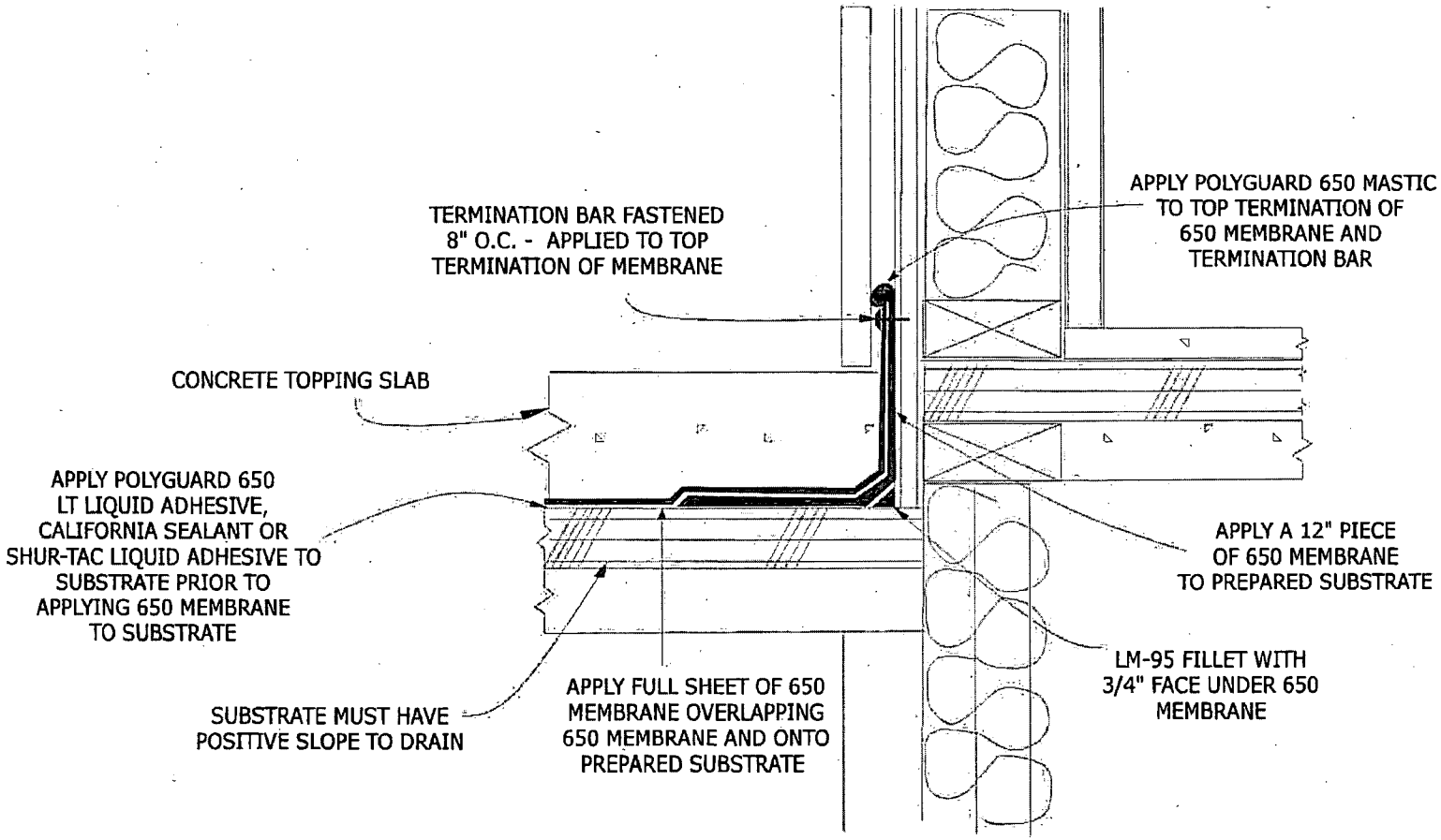
Web Site: www.polyguardproducts.com

As of 9/1/2003 Polyguard Products' quality system has been certified to American, Dutch and German quality system requirements:
- AMERICAN NATIONAL STANDARDS INSTITUTE
- DUTCH COUNCIL FOR CERTIFICATION
- DEUTSCHER AKKREDITIERUNGS RAT



WP3

SECTION @ WALL FLASHING AT BALCONY

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(NOT TO SCALE)

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Web Site - www.polyguardproducts.com

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Polyguard

The information provided is based on data and knowledge considered to be true and accurate and is offered for the users' consideration, investigation and verification, but we do not warrant the results to be obtained. Please read all data sheets, statements, recommendations or suggestions in conjunction with our conditions of sale, which apply to all goods supplied by us.

Georgia-Pacific
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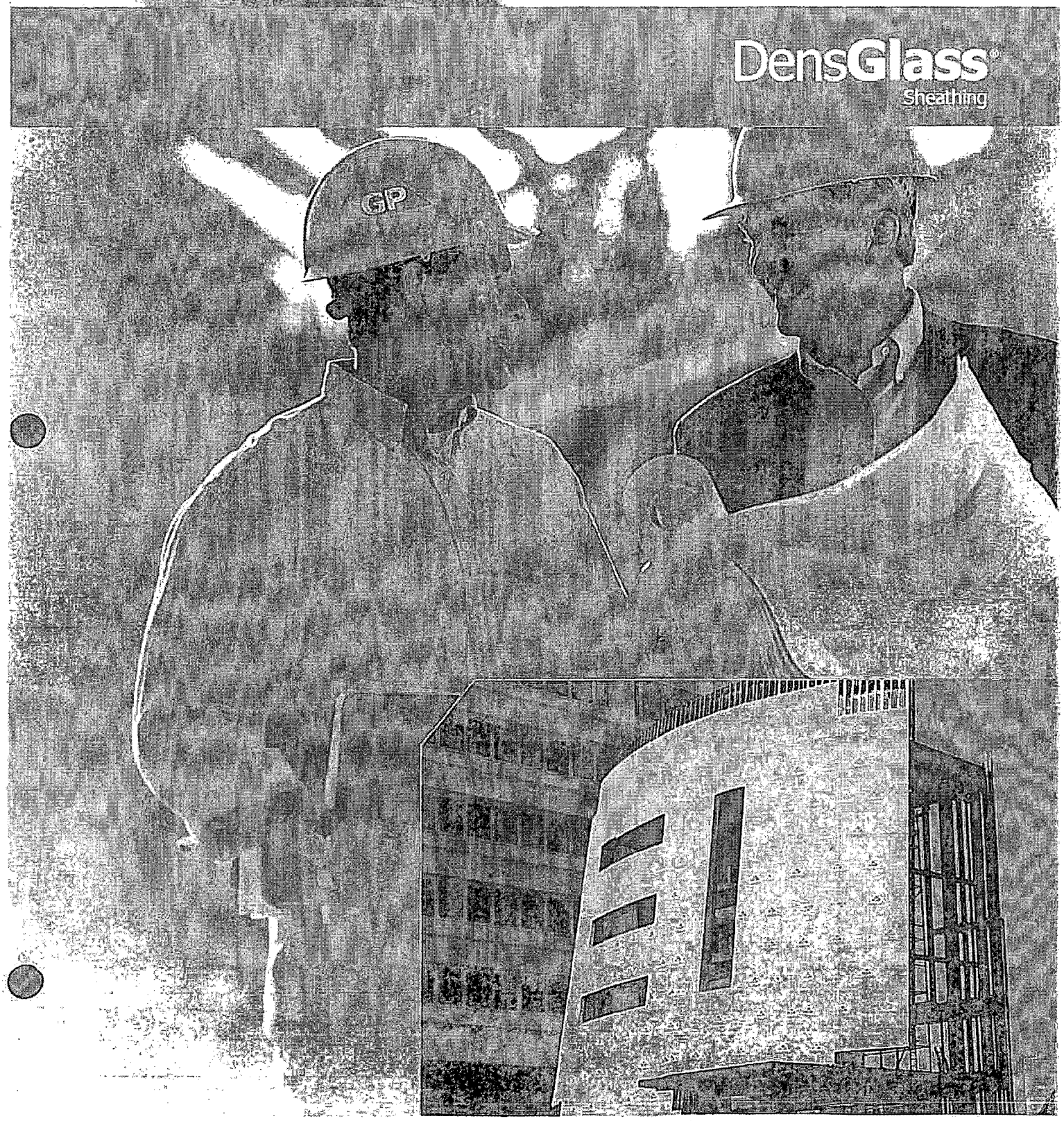
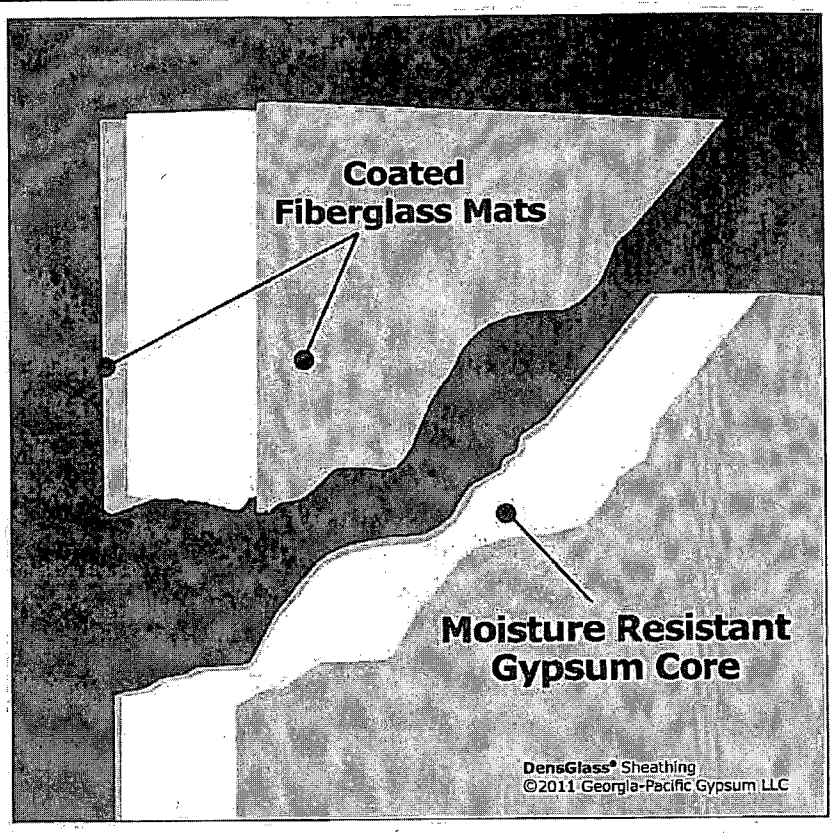
DensGlass® Sheathing



Product Overview



DensGlass® Sheathing has fiberglass mats for superior mold and moisture resistance compared to paper-faced sheathings.

- *Fiberglass mats eliminate a potential food source for mold and may reduce remediation and scheduling delays associated with paper-faced drywall.*
- *Replaces traditional paper-faced sheathing.*
- *Backed with a limited warranty against delamination and deterioration for up to 12 months of exposure to normal weather conditions.**

**For complete warranty details, visit www.gpgypsum.com*

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When tested, as manufactured, in accordance with ASTM D 3273, DensGlass Sheathing has scored a 10, the highest level of performance for mold resistance under the ASTM D 3273 test method.

The score of 10, in the ASTM D 3273 test, indicates no mold growth in a 4-week controlled laboratory test. The mold resistance of any building product when used in actual job site conditions may not produce the same results as were achieved in the controlled, laboratory setting. No material can be considered mold proof. When properly used with good design, handling and construction practices, Dens® Brand gypsum products provide increased mold resistance compared to standard paper-faced wallboard. For additional information, go to www.gp.com/safetyinfo.

Available Sizes/Dimensions

DensGlass Sheathing is available in 1/2" (12.7 mm) thickness and DensGlass® Fireguard® Sheathing is available in 5/8" (15.9 mm) thickness. DensGlass Sheathing is manufactured in a 4' (1219 mm) width and 8' (2438 mm), 9' (2743 mm) and 10' (3048 mm) lengths. Other lengths are available upon request.

DensGlass® Sheathing is the preferred substrate under brick, stone, stucco, siding and Exterior Insulation and Finishing Systems (EIFS) because of its exemplary track record. DensGlass Sheathing should be specified for any project where flexibility and easy sheathing installation are paramount without the headaches and expense of delamination, deterioration, sagging and warping. Look for the distinctive GOLD color to ensure you're using genuine DensGlass Sheathing.

Mold Resistance

In independent testing, DensGlass Sheathing, with its fiberglass mat design, has achieved a score of 10, the highest level of performance for mold resistance under ASTM D 3273.

Strength

Fiberglass mats penetrate into the panel to make an integrated unit that offers superb strength; outstanding resistance to delamination, deterioration, warping and job site damage; and an excellent bonding surface for EIFS. The flexural strength of DensGlass Sheathing is approximately the same in both directions. This means DensGlass Sheathing can be installed either vertically or horizontally without sacrificing wall strength between studs. DensGlass panels also protect and help stabilize structural framing.

Stability

DensGlass Sheathing is extremely resistant to rippling, buckling and sagging, even under humid conditions—which makes it particularly suitable for soffits. In actual tests, DensGlass panels exceeded ASTM C 1396 and ASTM C 79 standards for humidified deflection by a factor of five times over the standard for paper-faced gypsum sheathing.

Fire Resistance

DensGlass Sheathing is noncombustible as described and tested in accordance with ASTM E 136. Tests of 5/8" (15.9 mm) DensGlass® Fireguard® Sheathing conducted in accordance with ASTM E 119/CAN ULC S-101 qualify the product for a variety of UL listings and other designs in the GA-600 Fire Resistance Design Manual.

Superior Weather Protection

DensGlass Sheathing integrates a water-resistant, treated core with a fiberglass mat face and back to provide superb protection from the elements.

A water-resistive barrier is not required over DensGlass Sheathing to provide for the protection of the gypsum sheathing itself. Consult with the local building code, design professional, owner or cladding manufacturer for water-resistive barrier requirements. DensGlass Sheathing is the ideal substrate for a wide variety of air and water-resistive barriers including building wraps, liquid applied coatings and self-adhering membranes. See page 10 for details.

Easy to Handle

DensGlass Sheathing is lightweight and easy to handle. It can be cut and fastened with standard drywall tools and fasteners. The product is much easier to work with than wood substrate, cement board or fiber cement sheathing, which tend to be heavy and bulky.

Outstanding Warranty

DensGlass Sheathing is covered by a 12-month limited warranty for exposure to normal weather conditions, a five-year limited warranty against manufacturing defects and a 12-year limited warranty when used as a substrate for architecturally specified EIFS. For a copy of the limited warranty, visit our website at www.gpgypsum.com.

Standards and Code Compliance

DensGlass Sheathing is manufactured to meet ASTM C 1177. Application standards where applicable are in accordance with Gypsum Association Publication GA-253 for gypsum sheathing or ASTM C 1280.

Evaluated by:

- CCMC-12064-R
- N.Y. City MEA 244-88-M
- Florida Product Approval Code FL 2524

The data relating to fire- and sound-tested assemblies is based on the characteristics, properties and performance of materials and systems obtained under controlled test conditions as set forth under the appropriate ASTM standard, such as E 119 (fire), E 90 (sound) or E 72 (structural).

Georgia-Pacific Gypsum Products and LEED®

Our definition at Georgia-Pacific of sustainability is meeting the needs of society today without jeopardizing our ability to do so in the future. The Georgia-Pacific Gypsum manufacturing process is influenced by our concern for the environment, our commitment to the responsible use of natural resources and doing the right thing.

In the coming years, we will continue to focus on:

- Improving energy efficiency at our manufacturing plants, with innovative technologies, that will also result in reduced greenhouse gas emissions.
- Opportunities to reduce water use, and to reuse water more effectively.
- Finding cost effective ways to further reduce air emissions.

By using recycled materials for nearly 50 years, we have found innovative ways to recover and reuse materials that otherwise would end up in landfills. We recover and reuse the wallboard that does not meet our standards, and are developing beneficial applications for the very small amount of material left over at the end of each production cycle.

Green building codes, programs and standards are establishing themselves all across the country. They all promote the use of products that contribute to both the building science performance of the structure and to minimize the environmental and human health impacts of the products used in construction and over the life of the building or home. Because we are embracing sustainable practices in the manufacture of our products, architects and owners can feel good about the structures they build with our products. It is all a part of being mindful of the environment, and the social and economic impact of our products from start to finish.

Many of our products may contribute to LEED credits. To find out more, please reference the Sustainable Materials Data Sheets (SMDS) at www.gpgypsum.com for recycled content, regional materials, low emitting materials and other potential categories for LEED credit contributions. For general information on sustainability, click the "Sustainability" tab on the website.

Architectural Specifications

Georgia-Pacific Gypsum's 3-part guide specifications are downloadable, as rewritable Microsoft® Word documents, in both CSI and ARCOM MasterSpec® formats. Please visit www.gpgypsum.com for details. Downloadable specifications are also available online from Building Systems Design, Inc. at www.bsdsoftlink.com, and ARCOM Product Masterspec at http://www.arcomnet.com/users/masterspec_sections_manufacturers.php. Georgia-Pacific Gypsum specifications and 3-D Revit® compatible models can also be generated in the Georgia-Pacific Design Studio at www.gpdesignstudio.com.

Physical Properties

Product Comparison	1/2" (12.7 mm) Regular Gypsum Sheathing (Paper-faced)	1/2" (12.7 mm) DensGlass® Sheathing	5/8" (15.9 mm) Gypsum Sheathing, Type X (Paper-faced)	5/8" (15.9 mm) DensGlass® Fireguard®
Width, Nominal	4' (1219 mm)	4' (1219 mm)	4' (1219 mm)	4' (1219 mm)
Length, Standard	8', 9', 10' (2438, 2743, 3048 mm) ± 1/4" (6 mm)	8', 9', 10' (2438, 2743, 3048 mm) ± 1/4" (6 mm)	8', 9', 10' (2438, 2743, 3048 mm) ± 1/4" (6 mm)	8', 9', 10' (2438, 2743, 3048 mm) ± 1/4" (6 mm)
Weight[1] nominal, lbs./sq. ft. (Kg/m²)	1.7 (9)	1.9 (9)	2.2 (11)	2.5 (12)
Bending Radius	n/a	6' (1829 mm)[7]	n/a	8' (2438 mm)[7]
Racking Strength,[8] lbs./ft. (dry) (N/m) (Ultimate – not design value)	540[1] (7878)	>540 (>7878)	654[1] (9544)	>654 (>9544)
Flexural Strength,[9] parallel, lbf. (N) (4' weak direction)	40[2] (178)	≥80[6] (356)	50[2] (222)	≥100 (445)
Compressive Strength	min. 350 psi[1] (2400 kPa)	min. 500 psi (3445 kPa)	min. 400 psi[1] (2750 kPa)	min. 500 psi (3445 kPa)
Humidified Deflection[3,6] inches	10/8" (32 mm)	2/8" (6 mm)	5/8" (15.9 mm)	1/8" (3 mm)
Permeance[4] Perms (ng/Pa·s·m²)	27 [1600][1]	>23 [1300]	25 [1400][1]	>17 [970]
R Value[5], ft²·°F·hr/BTU (m²·K/W)	.45 (0.079)[1]	.56 (0.099)	.56 (0.099)[1]	.67 (0.118)
Combustibility[9]	Combustible	Noncombustible	Combustible	Noncombustible
Linear Expansion with Change Moisture in/in/%RH (mm/mm %RH)	7.5×10^{-6}	6.25×10^{-6}	7.5×10^{-6}	6.25×10^{-6}
Surface burning characteristics (per ASTM E 84 or CAN/ULC-S102): flame spread/smoke developed	15/0[1]	0/0	15/0[1]	0/0
Coefficient of Thermal Expansion in/in/°F (mm/mm/°C)	10×10^{-6} (18×10^{-6})	8.5×10^{-6} (15.3×10^{-6})	10×10^{-6} (18×10^{-6})	8.5×10^{-6} (15.3×10^{-6})

1. Gypsum Association – GA-253, GA-235
2. Specified values per ASTM C 1396
3. Tested in accordance with ASTM C 473
4. Tested in accordance with ASTM E 96 (dry cup method)
5. Tested in accordance with ASTM C 518 (heat flow meter)
6. Specified values per ASTM C 1177
7. Double fasteners on ends as needed
8. Tested in accordance with ASTM E 72
9. As defined and tested in accordance with ASTM E 136

Installation Recommendations

- DensGlass® Sheathing must be installed in accordance with the instructions in this brochure, Gypsum Association document GA-253 or ASTM C 1280. DensGlass Sheathing can be attached parallel or perpendicular to wood or metal framing. Use appropriate board orientation for specific fire assemblies and shear wall applications within this document, other reference documents or as required by designing authority. The framing width shall not be less than 1-1/2" (38 mm) wide for wood framing and 1-1/4" (32 mm) for steel framing. Framing members shall not vary more than 1/8" (3 mm) from the plane of the faces of adjacent framing.
- Fasteners should be driven flush with the panel surface (not countersunk) and into the framing system. Locate fasteners at least 3/8" (9 mm) from the ends and edges of the sheathing. Nails or screws, as listed in the fastener chart, may be used to attach DensGlass Sheathing to framing. When a pneumatic fastening system into metal is specified to attach DensGlass Sheathing, consult with manufacturer for application specifications and shear resistance data. DensGlass Sheathing is not to be used as a base for nailing or other fastening.
- Install DensGlass Sheathing with end joints staggered on horizontal applications. Ends and edges of the sheathing should fit tightly. DensGlass Sheathing panels shall not be less than 8" (203 mm) from the finish grade in fully weather- and water-protected siding systems, and not less than 12" (305 mm) from the ground for properly drained and ventilated crawl spaces. Consult with the design authority for control joint recommendations.

Wall Applications

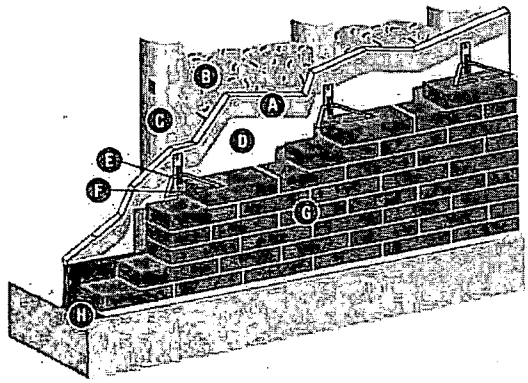
Installing Cladding over DensGlass® Sheathing

Most conventional exterior sidings and wall coverings—including wood, vinyl, composition, metal, stone, brick, wood shingles, shakes and plywood panels—may be applied over DensGlass Sheathing. Consult your local building codes for water resistive barriers (WRB) requirements.

A. DensGlass Sheathing
B. Insulation
C. Framing
D. Water-Resistive Barrier
E. Masonry Tie
F. 2" (50mm) Max. Air Space
G. Brick Masonry or Stone Veneer
H. Flashing and Weeps
I. Wood Shingles or Shakes
J. Plywood Siding
K. Vinyl Siding
L. Fiber Cement Siding
M. Metal Siding

Brick Cavity Wall

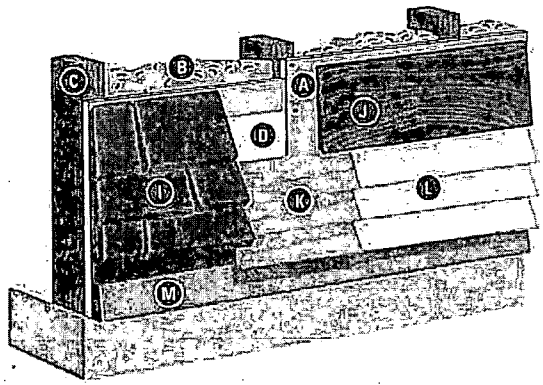
Masonry or stone veneer can be applied over DensGlass Sheathing just as it would be over any other type of sheathing. Attach the masonry ties securely through the panels and into the steel or wood framing. Space the ties as required by masonry courses. Apply water-resistive barrier as required by building code or design authority.



Shingles, Shakes, Vinyl, Metal, Wood, Fiber Cement Siding

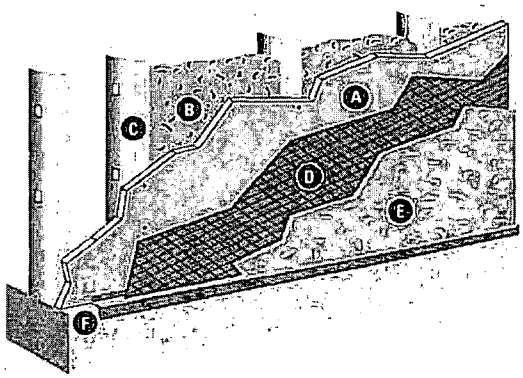
DensGlass Sheathing can be used in applications such as under wood shakes or shingles, plywood panel siding or other horizontal siding applications. All siding must be attached through the DensGlass Sheathing and into the steel or wood framing. Apply water-resistive barrier as required by building code or design authority.

Illustrations not intended for design or specification purposes.



Wall Applications continued

A. DensGlass® Sheathing
B. Insulation
C. Framing
D. Paper-Backed Metal Lath
E. Conventional Stucco
F. Minimum 1/4" (6 mm) Gap



Conventional Stucco

Stucco systems may be applied over DensGlass Sheathing using paper-backed metal lath. Paper-backed metal lath must be mechanically attached through the DensGlass Sheathing into the steel or wood framing. Install stucco system in accordance with the manufacturer's instructions, the Portland Cement Association guidelines and local building code requirements.

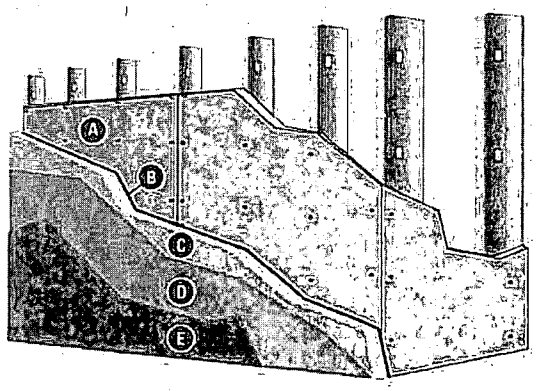
Exterior Insulation and Finish Systems (EIFS)

DensGlass Sheathing is an ideal substrate for adhesive or mechanical application of expanded polystyrene (EPS) or extruded polystyrene insulation in EIFS applications and is recommended for all climate zones.

DensGlass Sheathing is designated as the preferred gypsum substrate for EIFS by EIMA, the EIFS industry members association, in the EIFS Durability Specifications Guideline. DensGlass panels are treated with a primer coating in our exclusive GOLD color. This coating, developed especially for DensGlass Sheathing, has several important advantages for EIFS applications:

- Eliminates the need for sealer/primer with adhesively applied EIFS.
- Strengthens the bond between panel and surfacing product.
- Makes the panel more resistant to surface water. The result: labor cost and callbacks go down while customer satisfaction on each project goes up.
- 12-year limited warranty when used in an architecturally specified EIFS application.
- Maximum framing spacing 16" (406 mm) o.c. for 1/2" (12.7 mm) and 24" (610 mm) o.c. for 5/8" (15.9 mm) DensGlass® Fireguard® Sheathing.

A. DensGlass Sheathing
B. Adhesive or Mechanically Attached
C. Polystyrene Insulation
D. Reinforcing Mesh Embedded in Base Coat
E. Finish Coat



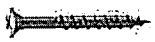
High Velocity Hurricane Zone (HVHZ)

The ability to withstand the destructive winds and the impact of various objects during a hurricane in a coastal area is key to the survival of any exterior cladding system. DensGlass Sheathing from Georgia-Pacific Gypsum helps BASF, Sto Corp, Dryvit, Parex Lahabra, Inc., Fiberweb, Inc. and Wellbilt International's systems pass the strict Miami-Dade County and Florida Building Code requirements for High Velocity Hurricane Zones (HVHZ). The systems were tested independently to determine the performance against specific criteria for impact resistance, air and water infiltration resistance and wind load resistance. For more information, please visit www.gpgypsum.com or contact the system manufacturer.

Fastening and Framing

Thickness	Framing Spacing	Panel Orientation	Fastener Spacing – Wood Framing[4]	Fastener Spacing – Metal Framing[4]
1/2" (12.7 mm)	24" (610 mm) o.c. max[1,3]	Parallel[3] or Perpendicular	8" (203 mm) o.c. field[2] & perimeter	8" (203 mm) o.c. along framing
5/8" (15.9 mm)	24" (610 mm) o.c. max[3]	Parallel[3] or Perpendicular	8" (203 mm) o.c. field[2] & perimeter	8" (203 mm) o.c. along framing

1. *Only for mechanically attached claddings. When specified behind EIFS, maximum framing spacing for 1/2" (12.7 mm) DensGlass® Sheathing is 16" (406 mm) o.c.*
2. *Fastener spacing around the perimeter of the wall and along intermediate vertical framing members. To meet the racking shear strength listed in the physical properties table, fastener spacing is 4" (102 mm) o.c. around the perimeter of each panel and 8" (203 mm) o.c. along vertical framing members.*
3. *For racking strength resistance, apply panel edges parallel with framing spaced a maximum of 16" (406 mm) o.c. for both 1/2" (12.7 mm) and 5/8" (15.9 mm) DensGlass Sheathing.*
4. *Fire-rated assemblies may require additional fasteners, see specific assembly details.*

Fastener*	Length 1/2" Thick	Length 5/8" Thick	Description	Application
	1" (25 mm)	1-1/4" (32 mm)	Bugle head fine thread, rust-resistant drill point drywall screw	DensGlass Sheathing to heavy-gauge steel
	1" (25 mm)	1-1/4" (32 mm)	Bugle head fine thread, rust-resistant sharp point drywall screw	DensGlass Sheathing to light-gauge metal framing furring
	1-1/4" (32 mm)	1-5/8" (41 mm)	Bugle head, rust-resistant, coarse thread sharp point screw	DensGlass Sheathing to wood framing
	1-1/4" (32 mm)	1-1/4" (32 mm) metal 1-5/8" (41 mm) wood	Wafer head, rust-resistant screws, drill or sharp point	DensGlass Sheathing to heavy-gauge or light-gauge, metal or wood, respectively
	1-1/2" (38 mm)	1-3/4" (45 mm)	11-gauge, galvanized nail	DensGlass Sheathing to wood framing or equivalent

**For screws, meet or exceed ASTM C 1002 or C954. Contact fastener manufacturer for correct amount of corrosion resistance.*

Negative Uniform Wind Load

5/8" (15.9 mm) DensGlass® Fireguard® Sheathing Horizontally Applied

Stud Spacing, In./O.C. (mm)	Screws, In./O.C. (mm)	Ultimate load, PSF* (kPa)
16 (406)	8 (203)	127 (6.08)
16 (406)	6 (152)	142 (6.80)
16 (406)	4 (102)	192 (9.19)
12 (305)	8 (203)	157 (7.51)
12 (305)	6 (152)	204 (9.77)
12 (305)	4 (102)	270 (12.93)
8 (203)	8 (203)	208 (9.96)
8 (203)	6 (152)	354 (16.95)
8 (203)	4 (102)	410 (19.63)

NOTE: Apply DensGlass Sheathing to appropriately engineered framing system. Tested applied to 6" (152 mm) x 1-5/8" (41 mm) 18-gauge (43 mils) steel studs using #6 1-1/4" (32 mm) bugle head screws. Other stud sizes may be suitable.

Source: Tested in accordance with ASTM E 330 by Hurricane Test Laboratory. For a copy of report #G488-1001-07, contact Georgia-Pacific Gypsum Technical Hotline at 1-800-225-6119.

**Maximum load capacity (not design load) of the 5/8" (15.9 mm) DensGlass Fireguard Sheathing applied horizontally. Apply appropriate safety factor from the design method used to calculate design load. For example, a safety factor of 3 applied to an ultimate load of 127psf (6.08 kPa) results in a design load of 42 psf (2.01 kPa).*

1/2" (12.7 mm) and 5/8" (15.9 mm) DensGlass Fireguard Sheathing Vertically or Horizontally Applied

Thickness Inches (mm)	Board Orientation	Stud Spacing in. o.c. (mm)	Ultimate Load Psf (kPa)
1/2" (12.7)	Vertical	16 (406)	65 (3.11)
1/2" (12.7)	Horizontal	16 (406)	70 (3.35)
5/8" (15.9)	Vertical	24 (610)	68 (3.26)
5/8" (15.9)	Horizontal	24 (610)	85 (4.07)
5/8" (15.9)	Vertical	16 (406)	92 (4.40)

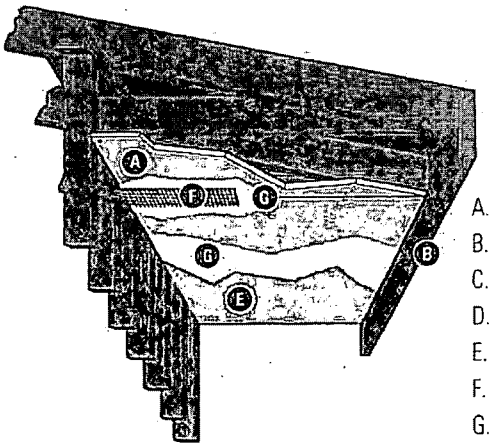
Source: TPI Report #89-047; wind load per ASTM E330 (bugle head screws 8" (203 mm) o.c.).

CAUTION: For product fire, safety and use information, go to gp.com/safetyinfo.

Soffit Applications, Fastening, Framing and Finishing

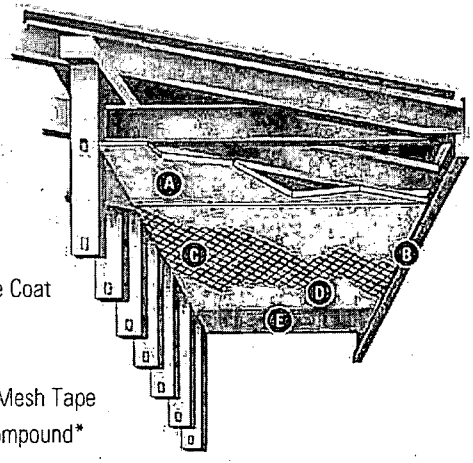
Method #1

Painted Ceilings and Soffits Finished Joints



Method #2

Exterior Ceilings and Soffits



A. DensGlass® Sheathing
B. Drip Edge
C. Reinforcing Mesh/Base Coat
D. Base Coat
E. Finish Coat
F. 2" (51 mm) Fiberglass Mesh Tape
G. ToughRock® Setting Compound*

**Sandable setting compounds are not recommended.*

Thickness	Framing Spacing	Orientation	Screw Spacing
1/2" (12.7 mm)	16" (406 mm) o.c. max	Parallel or Perpendicular	8" (203 mm) o.c. along framing
1/2" (12.7 mm)	24" (610 mm) o.c. max	Perpendicular 24" o.c. framing	8" (203 mm) o.c. along framing
5/8" (15.9 mm)	24" (610 mm) o.c. max	Parallel or Perpendicular	8" (203 mm) o.c. along framing

Method #1

Embed 2" (51 mm) wide fiberglass mesh tape in ToughRock® 90 Setting Type joint compound, or equivalent, over all joints. Once dry, apply a skim coat of ToughRock 90 setting compound, or equivalent, over the panels to achieve a uniform, smooth finish over the entire area. Prime with exterior-grade primer and finish with two coats of exterior-grade paint.

Method #2

Apply a synthetic-type Direct Applied Finish System in accordance with the coating manufacturer's recommendation.

Special conditions for both methods:

1. Control joints are recommended a maximum of 30 feet (9144 mm) or closer as specified by the design authority.
2. The roof must be dried in or protection from the elements must be provided prior to installing DensGlass Sheathing in horizontal applications to prevent moisture from ponding or settling on top of the sheathing panel or within the finished soffit.
3. Sandable setting compounds are not acceptable for use over DensGlass Sheathing in exterior soffit applications.
4. Georgia-Pacific Gypsum's ToughRock 90 setting compound is not available in all markets. It is permissible to use setting-type joint compounds from other manufacturers that are equivalent to ToughRock 90 setting compound.

Air- and Water-Resistive Barriers

The need for moisture control, greater energy savings, comfort and improved environment is driving the use of air- and water-resistive barriers. Manufacturers, building codes and standards organizations are improving the ways moisture is controlled in buildings. DensGlass® Sheathing has been widely accepted for years as the preferred substrate with these systems and provides superior performance over other sheathings. The ultimate in wall performance and peace of mind is starting with the best substrate–DensGlass Sheathing.

DensGlass Sheathing is a superior substrate for a wide variety of air- and water-resistive systems which include:

- #15 asphalt felt, ASTM D 226, type 1 or equivalent
- Synthetic wraps such as Tyvek®, Typar® MetroWrap®, ASTM E 1677 or equivalent
- Liquid- or fluid-applied air or vapor barriers such as Tremco ExoAir® 120, Grace Perm-A-Barrier® VP, Henry Air-Bloc® 32 or Carlisle Barriseal®
- Water barrier systems such as Sto Guard® as manufactured by Sto Corp., Dryvit's Backstop® NT, Prosoco R-GUARD® or equivalent
- Asphalt-based coatings
- Self-adhering membranes such as Carlisle CCW, Grace Perm-A-Barrier®, Henry Air-Bloc Vapor Barriers, Protecto Wrap
- Water-resistive barrier and drainage membranes such as DELTA-DRY®

Follow manufacturer's installation recommendations for use with DensGlass panels, local building code requirements and design authority's specifications.

In areas that do not prescribe to current code requirements but still require long-term joint protection, either of the following two methods may be specified in lieu of an air- and water-resistive barrier system: **Method 1)** Apply minimum 3/8" (9 mm) bead of sealant to joints and trowel to provide a layer approximately 2" (51 mm) wide by 1/16" (2 mm) thick spanning the joint. Use backer rod for openings larger than 1/8" (3 mm). **Method 2)** Apply glass mesh joint tape to all joints, overlapping at intersections by the width of the tape. Apply approximately 3/8" (9 mm) bead of caulk along the joint. Embed the caulk into the entire surface of the tape with a trowel. Use backer rod for openings larger than 1/8" (3 mm). Follow manufacturer's installation recommendations for use with DensGlass Sheathing, and design authority specifications.

A variety of caulk and polymer-based "fill" materials may be specified, including GE, Dow Corning, Tremco, Sto, Dryvit, BASF and Proseco. Please contact the caulk manufacturer for its recommended caulks over DensGlass Sheathing.

Note: It is not required to provide a water-resistive barrier over DensGlass Sheathing for the protection of the gypsum sheathing itself during the 12-month weather exposure limited warranty. Consult with local building code, design professional, owner or cladding manufacturer for water-resistive barrier requirements and compatibility with the wall cladding.

Protection of Penetrations

All penetrations should be protected to prevent air and water infiltration. Follow building code, door/window manufacturer or design authority's recommendations for flashing around openings, abutments to dissimilar materials and wall terminations.

Fire-Rated Assemblies

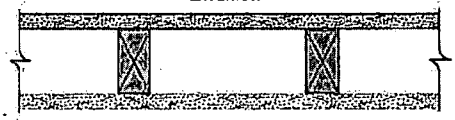
DensGlass® Fireguard® Sheathing is UL and ULC classified as **Type DGG** and is included in numerous assembly designs investigated by UL and ULC for hourly fire resistance ratings.

In addition, 5/8" DensGlass Fireguard Sheathing is classified as "Type X" in accordance with ASTM C 1177 and may replace 5/8"gypsum sheathing specified as Type X in generic fire-rated wall assemblies. Generic systems in the GA-600 Fire Resistance Design Manual are applicable to the products of any manufacturer, including Georgia-Pacific Gypsum, provided they meet certain standards set forth in such manual, such as Type X gypsum board per applicable ASTM standard with specified thickness and size described in the design. "Type X" as used in this technical guide designates gypsum board manufactured and tested in accordance with specific ASTM standards for increased fire resistance beyond regular gypsum board. Please consult the ASTM standard for the specific product (for example, ASTM C 1177 for glass mat gypsum substrate for use as sheathing) for further information and significance of use.

The following design assemblies are for illustrative purposes only. Consult the appropriate fire resistance directory or test report for complete assembly information. For additional fire safety information concerning DensGlass Sheathing, visit www.gp.com/safetyinfo.

1-Hour Fire Rating
Design Reference: UL U305, U337, WHI 495-0702, ULC W301[1], GA WP 5515

EXTERIOR



30-34 STC Sound Trans.
Test Reference: OR 64-8

Wall Thickness: 4-7/8" (124 mm)

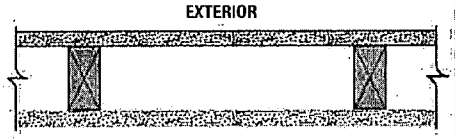
Weight per Sq. Ft.: 7.5 (37 kg/m²)

Exterior: 5/8" (15.9 mm) DensGlass® Fireguard® Sheathing applied vertically (U337, W301, U305) or horizontally (U305) to 2 x 4 wood studs 16" (406 mm) o.c. with 1-3/4" (45 mm) galvanized roofing nails 7" (178 mm) o.c. for all framing members. Exterior surface covered with weather exposed cladding or finish system.

Interior: 5/8" (15.9 mm) DensArmor Plus® Fireguard® interior panels or 5/8" (15.9 mm) ToughRock® Fireguard® gypsum board applied vertically (U337, U305) or horizontally (U305) to studs with 1-7/8" (48 mm) 6d coated nails 7" (178 mm) o.c. Stagger joints each side.

1-Hour Fire Rating
Design Reference: UL U309, cUL U309, WP 3510

EXTERIOR



35-39 STC Sound Trans.
Test Reference: NGC 35-39

Wall Thickness: 4-7/8" (124 mm)

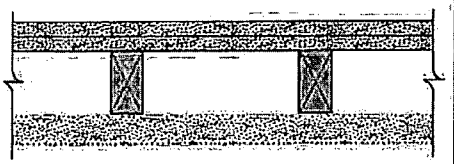
Weight per Sq. Ft.: 7.5 (37 kg/m²)

Exterior: 5/8" (15.9 mm) DensGlass Fireguard Sheathing applied vertically or horizontally to 2 x 4 wood studs spaced 24" (610 mm) o.c. with 1-7/8" (48 mm) galvanized roofing nails 7" (178 mm) o.c.

Interior: 5/8" (15.9 mm) DensArmor Plus Fireguard or 5/8" (15.9 mm) ToughRock Fireguard gypsum board to framing with 1-7/8" (48 mm) 6d coated nails 7" (178 mm) o.c.

2-Hour Fire Rating
Design Reference: UL U301, cUL U301

EXTERIOR



40-44 STC Sound Trans.
Test Reference: NGC-2363

Wall Thickness: 6-1/8" (156 mm)

Weight per Sq. Ft.: 12.5 (61 kg/m²)

Exterior: Two layers 5/8" (15.9 mm) DensGlass Fireguard Sheathing applied vertically or horizontally to 2 x 4 wood studs 16" (406 mm) o.c. Base layer attached with 1-7/8" (48 mm) galvanized roofing nails 16" (406 mm) o.c. Face layer attached with 2-3/8" (60 mm) galvanized roofing nails 8" (203 mm) o.c. Stagger joints between layers and on base layer of both sides.

Interior: Two layers 5/8" (15.9 mm) DensArmor Plus Fireguard or 5/8" (15.9 mm) ToughRock Fireguard gypsum board applied horizontally or vertically to framing. Base layer attached with 1-7/8" (48 mm) 6d cement coated nails 6" (152 mm) o.c. Face layer attached with 2-3/8" (60 mm) 6d cement coated nails 8" (203 mm) o.c. Stagger joints between layers and on base layer of both sides. Sound tested with studs 16" (406 mm) o.c. and nails for base layer spaced 6" (152 mm) o.c.

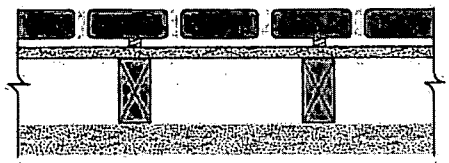
Important Note:

1. ***UL and ULC Assemblies:*** *For 5/8" ToughRock® Fireguard® gypsum boards, UL designation "Type 9" should be used for all UL and cUL assemblies, and ULC designation "Type GF-6" should be used for all ULC assemblies. Please check UL, cUL or ULC certification mark on product for confirmation prior to use.*

Fire-Rated Assemblies continued

2-Hour Fire Rating
Design Reference: UL U302, cUL U302, GA WP 8410

EXTERIOR



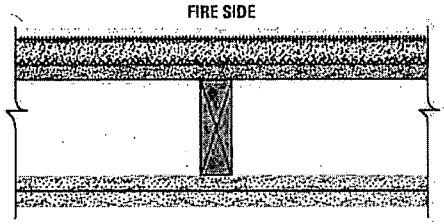
Wall Thickness: 10-1/8" (257 mm)

Exterior: One layer 1/2" (12.7 mm) DensGlass Sheathing applied vertically or horizontally to studs with 1-3/4" (45 mm) galvanized roofing nails 6" (152 mm) o.c. Face layer is 2" x 4" x 8" (51 mm x 102 mm x 203 mm) clay brick with 1" (25 mm) air space between brick and exterior sheathing. 20-gauge (30 mils) galvanized wire ties attached to each stud with 8d coated nails as described above, located at every sixth course of bricks.

Interior: Two layers 5/8" (15.9 mm) DensArmor Plus Fireguard or 5/8" (15.9 mm) ToughRock Fireguard gypsum board applied vertically or horizontally to 2 x 4 wood studs 16" (406 mm) o.c. Base layer attached with 1-7/8" (48 mm) 6d coated nails 8" (203 mm) o.c. Face layer attached with 2-3/8" (60 mm) coated nails 8" (203 mm) o.c.

Generic 2-Hour Fire Rating
Design Reference: UC 12-21-67, GA WP 8420[2]

FIRE SIDE



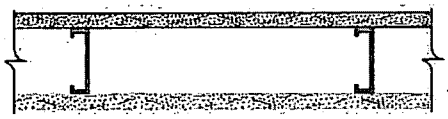
Wall Thickness: 8-5/8" (219 mm)

Exterior: Base layer 5/8" (15.9 mm) DensGlass® Fireguard® Sheathing retardant treated 2 x 6 wood studs 16" (406 mm) o.c. with 6d coated nails, 1-7/8" (48 mm) long, 0.0915" (2 mm) shank, 1/4" (6 mm) heads, 12" (305 mm) o.c. and covered with a single layer fire resistant protective weather retarder paper stapled along each edge at 16" (406 mm) o.c. Galvanized self-furring wire mesh applied over sheathing with 8d galvanized roofing nails, 2-3/8" (60 mm) long, 0.113" (3 mm) shank, 9/32" (7 mm) heads, 6" (152 mm) o.c. Cement-stucco applied over wire mesh in two 1/2" (12.7 mm) thick coats with bonding agent applied between coats.

Interior: Base layer 5/8" (15.9 mm) DensArmor Plus® Fireguard® or 5/8" (15.9 mm) ToughRock® Fireguard® applied vertically to studs with 6d coated nails, 1-7/8" (48 mm) long, 0.0915" (2 mm) shank, 1/4" (6 mm) heads, 12" (305 mm) o.c. Face layer 5/8" (15.9 mm) DensArmor Plus Fireguard or 5/8" (15.9 mm) ToughRock Fireguard applied horizontally to studs with 8d coated nails, 2-3/8" (60 mm) long, 0.113" (3 mm) shank, 9/32" (7 mm) heads, 8" (203 mm) o.c. at edges and 12" (305 mm) o.c. at intermediate studs.

1-Hour Fire Rating
Design Reference: UL U465, ULC W415[1], cUL U465, GA WP 1081[7]

EXTERIOR



48 STC Sound Trans.
Test Reference: RAL TL 103

Wall Thickness: 4-7/8" (124 mm)

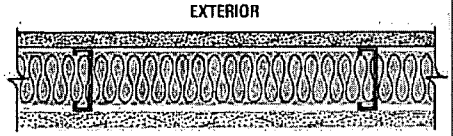
Weight per Sq. Ft.: 6 psf (29 kg/m²)

Exterior: 5/8" (15.9 mm) DensGlass Fireguard Sheathing applied vertically to min. 3-5/8" (92 mm) corrosion resistant 25-gauge (18 mils) steel studs 24" (610 mm) o.c. with 1" (25 mm) corrosion resistant bugle head screws 8" (203 mm) o.c. at board edges and 8" (203 mm) at intermediate studs.

Interior: 5/8" (15.9 mm) DensArmor Plus Fireguard or 5/8" (15.9 mm) ToughRock Fireguard gypsum board applied vertically to framing with 1" (25 mm) Type S bugle head screws 8" (203 mm) o.c. at board edges and 12" (305 mm) at intermediate studs. Sound tested with 3" mineral fiber, 2.5 psf, in stud space.

1-Hour Fire Rating
Design Reference: UL U425, cUL U425

EXTERIOR



40-44 STC Sound Trans.
Test Reference: NGC-2835

Wall Thickness: 4-3/4" (121 mm)

Weight per Sq. Ft.: 6 psf (29 kg/m²)

Exterior: 5/8" (15.9 mm) DensGlass® Sheathing applied vertically to min. 3-1/2" (89 mm) corrosion resistant 20-gauge (30 mils) steel studs 24" (610 mm) o.c. with 1" (25 mm) Type S corrosion resistant bugle head screws 8" (203 mm) o.c.

Interior: 5/8" (15.9 mm) DensArmor Plus Fireguard or 5/8" (15.9 mm) ToughRock Fireguard gypsum board applied vertically to framing with 1" (25 mm) Type S bugle head screws 12"(305 mm) o.c. Insulation to completely fill stud cavity..

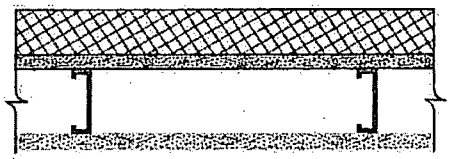
Important Notes:

1. ***UL and ULC Assemblies:*** *For 5/8" ToughRock® Fireguard® gypsum boards, UL designation "Type 9" should be used for all UL and cUL assemblies, and ULC designation "Type GF-6" should be used for all ULC assemblies. Please check UL, cUL or ULC certification mark on product for confirmation prior to use.*
2. ***Proprietary GA-600 Designs:*** *Assemblies listed as proprietary in the GA-600 Fire Resistance Design Manual only list one product per manufacturer and may not include all products referenced in the illustrations above. Please consult the specified UL, cUL, ULC or other fire listing or test for a complete list of approved products.*

CAUTION: For product fire, safety and use information, go to gp.com/safetyinfo.

Fire-Rated Assemblies continued

Generic 1-Hour Fire Rating
Design Reference: SWRI 01-4409-003, GA WP 8122[2]



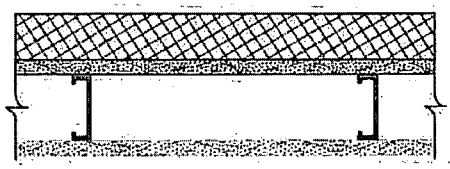
Partition Thickness: 6" – 7" (152 – 178 mm) Varies based on insulation thickness

Weight per Sq. Ft.: 7.0 (34 kg/m²)

Exterior: 5/8" (15.9 mm) DensGlass® Fireguard® Sheathing applied vertically to 3-5/8" (92 mm) 18-gauge (43 mils) steel studs 16" (406 mm) o.c. with #6 x 1-1/4" (32 mm) self-drilling, corrosion-resistant, bugle head, drywall screws 8" (203 mm) o.c. at edges and ends and 8" (203 mm) o.c. at intermediate studs. Proprietary polymer modified exterior insulation and finish system applied over sheathing, 2" (51 mm) maximum foam-plastic thickness.

Interior: 5/8" (15.9 mm) ToughRock® Fireguard® or 5/8" (15.9 mm) DensArmor Plus® Fireguard® gypsum board applied vertically to studs with #6 x 1-1/4" (32 mm) self-drilling, bugle head drywall screws 8" (203 mm) o.c. at edges and ends and 12" (305 mm) o.c. at intermediate studs.

Generic 1-Hour Fire Rating
Design Reference: SWRI 01-4409-001, GA WP 8123[2]



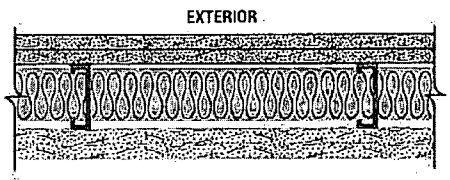
Partition Thickness: 6" – 9" (152 – 229 mm) Varies based on insulation thickness

Weight per Sq. Ft.: 7.0 (34 kg/m²)

Exterior: 5/8" (15.9 mm) DensGlass Fireguard Sheathing applied vertically to 3-5/8" (92 mm) 18-gauge (43 mils) steel studs 24" (610 mm) o.c. with #6 x 1-1/4" (32 mm) self-drilling, corrosion-resistant, bugle head, drywall screws 8" (203 mm) o.c. at edges and ends and 8" (203 mm) o.c. at intermediate studs. Polymer-based exterior insulation and finish system applied over sheathing. 4" (102 mm) maximum foam-on-plastic thickness.

Interior: One layer 5/8" (15.9 mm) ToughRock Fireguard or 5/8" (15.9 mm) DensArmor Plus Fireguard gypsum board applied vertically to studs with #6 x 1-1/4" (32 mm) self-drilling, bugle head drywall screws 8" (203 mm) o.c. at edges and ends and 12" (305 mm) o.c. at intermediate studs.

2-Hour Fire Rating
Design Reference: UL U425, cUL U425, WP 1716



40-44 STC Sound Trans.
Test Reference: NGC-2250

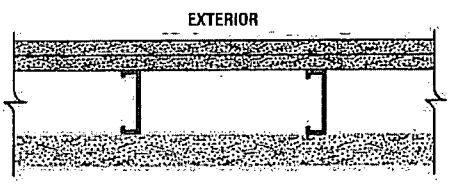
Wall Thickness: 6" (152 mm)

Weight per Sq. Ft.: 11.0 psf (54 kg/m²)

Exterior: Two layers 5/8" (15.9 mm) DensGlass Fireguard Sheathing applied vertically to min. 3-1/2" (89 mm) corrosion resistant 20-gauge (30 mils) steel studs 24" (610 mm) o.c. Base layer attached with 1" (25 mm) Type S-12 corrosion resistant bugle head screws 8" (203 mm) o.c. Face layer attached with 1-5/8" (41 mm) Type S-12 corrosion resistant bugle head screws spaced 8" (203 mm) o.c. Joints staggered.

Interior: Two layers 5/8" (15.9 mm) DensArmor Plus Fireguard or 5/8" (15.9 mm) ToughRock Fireguard gypsum board applied vertically to framing. Base layer attached with 1" (25 mm) Type S-12 bugle head screws 12" (305 mm) o.c. Face layer attached with 1-5/8" (41 mm) Type S-12 bugle head screws spaced 12" (305 mm) o.c. Joints staggered. Insulation to completely fill stud cavity. (Load Bearing: 80% of design load)

2-Hour Fire Rating
Design Reference: UL U411, cUL U411



50-54 STC Sound Trans.
Test Reference: WHI 218

Wall Thickness: 5" (127 mm)

Weight per Sq. Ft.: 11.0 (54 kg/m²)

Exterior: Two layers 5/8" (15.9 mm) DensGlass Fireguard Sheathing applied vertically to min. 2-1/2" (64 mm) corrosion resistant 25-gauge (18 mils) steel studs 24" (610 mm) o.c. Base layer attached with 1" (25 mm) Type S corrosion resistant bugle head screws 16" (406 mm) o.c. Face layer attached with 1-5/8" (41 mm) Type S corrosion resistant bugle head screws spaced 8" (203 mm) o.c. Joints staggered.

Interior: Two layers 5/8" (15.9 mm) DensArmor Plus Fireguard or 5/8" (15.9 mm) ToughRock Fireguard gypsum board applied vertically to framing. Base layer attached with 1" (25 mm) Type S bugle head screws 16" (406 mm) o.c. Face layer attached with 1-5/8" (41 mm) Type S bugle head screws spaced 16" (406 mm) o.c. in the field and along vertical edges and 12" (305 mm) o.c. to the floor and ceiling runners. Joints staggered. Batt or blanket insulation optional. Sound tested with 2-1/2" fiberglass insulation.

Important Note:

2. ***Proprietary GA-600 Designs:*** *Assemblies listed as proprietary in the GA-600 Fire Resistance Design Manual only list one product per manufacturer and may not include all products referenced in the illustrations above. Please consult the specified UL, cUL, ULC or other fire listing or test for a complete list of approved products.*

Delivery, Handling and Storage

All materials shall be delivered in original bundles bearing the brand name, if any; applicable standard designation; and name of the manufacturer or supplier for whom the product is manufactured. The plastic packaging used to wrap gypsum panel products for rail and/or truck shipment is intended to provide temporary protection from moisture exposure during transit only and is not intended to provide protection during storage after delivery. Such plastic packaging shall be removed immediately upon receipt of the shipment. **WARNING:** Failure to remove protective plastic shipping covers can result in condensation which can lead to damage, including mold.

All materials should be kept dry. Gypsum panel products shall be neatly stacked flat with care taken to prevent sagging or damage to edges, ends and surfaces. Gypsum panel products and accessories shall be properly supported on risers on a level platform, and fully protected from weather, direct sunlight exposure, and condensation. Gypsum panel products shall be stacked flat rather than on edge or end. **WARNING:** Gypsum panel products stacked on edge or end can be unstable and present a serious hazard in the workplace should they accidentally topple.

Refer to *Handling Gypsum Panel Products*, GA-801, for proper storage and handling requirements.

Reference: Application and Finishing of Gypsum Panel Products, GA-216-2010, Gypsum Association.

Recommendations and Limitations for Use

The following recommendations and limitations are important to ensure the proper use and benefits of DensGlass Sheathing. Failure to strictly adhere to such recommendations and limitations may void the limited warranty provided by Georgia-Pacific Gypsum for such product. For additional details, please go to www.gpgypsum.com and select DensGlass Sheathing for warranty information.

DensGlass® Sheathing is resistant to normal weather conditions, but it is not intended for immersion in water. Cascading roof/floor water should be directed away from the sheathing until appropriate drainage is installed.

Avoid any condition that will create moisture in the air and condensation on the exterior walls during periods when the exterior temperature is lower than the interior. The use of forced air heaters creates volumes of water vapor which, when not properly vented, can condense on building materials. The use of these heaters and any resulting damage is not the responsibility of Georgia-Pacific Gypsum. Consult heater manufacturer for proper use and ventilation. Vapor barrier may also restrict ventilation.

When DensGlass Sheathing panels are used in slanted wall applications, that portion of the wall must be temporarily protected from the elements by the use of a water-resistant barrier prior to application of the cladding. Do not allow water to pond or settle on sheathing. Also, exposed wall ends such as those that may be found in parapets must be covered to prevent water from infiltrating the cavity.

Georgia-Pacific Gypsum does not warrant and is not responsible or liable for the performance of any cladding, coating, finishes, coverings or other materials or exterior systems applied over DensGlass Sheathing. The suitability and compatibility of any system is the responsibility of the system manufacturer or design authority.

Do not laminate DensGlass Sheathing to masonry surfaces, use furring strips or framing.

DensGlass Sheathing is not intended for roof applications. For roof applications, consult our DensDeck® Roof Board brochure.

DensGlass Sheathing is not intended for interior or exterior tile applications. For interior tile applications, consult our DensShield® Tile Backer brochure.

DensGlass Sheathing should not be used in lieu of plywood where required.

Do not apply DensGlass Sheathing below grade.

For all installations, design details such as fasteners, sealants and control joints per system specifications must be properly installed. Openings and penetrations must be properly flashed and sealed. Failure to do so will void the warranty.

Do not use DensGlass Sheathing as a base for nailing or mechanical fastening. Fasteners should be flush to the face of the board, not countersunk.

COMMONLY USED METRIC CONVERSIONS

Gypsum Board Thickness

1/4 in. – 6 mm
1/2 in. – 12.7 mm
5/8 in. – 15.9 mm
1 in. – 25.4 mm

Gypsum Board Width

2 ft. – 610 mm
4 ft. – 1219 mm
32 in. – 813 mm

Gypsum Board Length

4 ft. – 1219 mm
5 ft. – 1524 mm
8 ft. – 2438 mm
9 ft. – 2743 mm
10 ft. – 3048 mm
12 ft. – 3658 mm

Framing Spacing

16 in. – 406 mm
24 in. – 610 mm

Fastener Spacing

2 in. – 51 mm
2.5 in. – 64 mm
7 in. – 178 mm
8 in. – 203 mm
12 in. – 305 mm
16 in. – 406 mm
24 in. – 610 mm

Temperature

40°F – 5°C
50°F – 10°C
125°F – 52°C

High-Performance Gypsum Products from Georgia-Pacific

DensDeck® Roof Boards	Fiberglass mat roof board used as the ideal thermal barrier and cover board to improve resistance to wind uplift, hail, foot traffic, fire and mold in a broad range of commercial roofing applications. Look for DensDeck Prime and DensDeck DuraGuard, too.
DensGlass® Sheathing	The original and universal standard of exterior gypsum sheathing offers superior weather resistance, with a 12-month weather exposure limited warranty. Look for the familiar GOLD color.
DensGlass® Shaftliner	Specially-designed panels for moisture-prone vertical or horizontal shafts, interior stairwells and area separation wall assemblies. 12-month weather exposure limited warranty. GREENGUARD listed for microbial resistance.
DensArmor Plus® High-Performance Interior Panel	High-performance interior panel accelerates scheduling because it can be installed before the building is dried-in. 12-month weather exposure limited warranty. GREENGUARD Indoor Air Quality Certified,® GREENGUARD Children & Schools℠ Certified. GREENGUARD listed for microbial resistance. Listed in CHPS℠ High Performance Product Database as a low emitting product.
DensArmor Plus® Abuse-Resistant Interior Panel	Same benefits as DensArmor Plus® High-Performance Interior Panel with added resistance to scuffs, abrasions and surface indentations. Ideal for healthcare facilities and schools. GREENGUARD Indoor Air Quality Certified,® GREENGUARD Children & Schools℠ Certified. GREENGUARD listed for microbial resistance. Listed in CHPS℠ High Performance Product Database as a low emitting product.
DensArmor Plus® Impact-Resistant Interior Panel	Even greater durability with an embedded impact-resistant mesh for the ultimate resistance in high traffic areas. Ideal for healthcare facilities, schools and correctional institutions. GREENGUARD Indoor Air Quality Certified,® GREENGUARD Children & Schools℠ Certified. GREENGUARD listed for microbial resistance. Listed in CHPS℠ High Performance Product Database as a low emitting product.
DensShield® Tile Backer	Acrylic-coated tile backer stops moisture at the surface. Lightweight and strong, built for speed on the job site. Conforms to requirements of IBC/IRC Code. GREENGUARD listed for microbial resistance.
ToughRock® Gypsum Boards	Paper-faced line of gypsum panels for a variety of applications including interior wall and ceiling applications, abuse-resistant boards, veneer plaster base systems, and panels for use in fire-rated assemblies. Listed in CHPS℠ High Performance Product Database as a low emitting product. Use Mold-Guard™ treated paper gypsum boards for enhanced mold resistance.

Georgia-Pacific
Gypsum

U.S.A. Georgia-Pacific Gypsum LLC
CANADA Georgia-Pacific Canada LP

SALES INFORMATION AND ORDER PLACEMENT
U.S.A. Midwest: **1-800-876-4746** West: **1-800-824-7503**
South: **1-800-327-2344** Northeast: **1-800-947-4497**

CANADA Canada Toll Free: **1-800-387-6823**
Quebec Toll Free: **1-800-361-0486**

TECHNICAL HOTLINE U.S.A. and Canada: **1-800-225-6119**

Some of our products have been certified by Scientific Certification Systems (SCS). SCS is an internationally recognized third-party evaluation, testing and certification organization. Its program spans a wide cross-section of the economy, including manufacturing and retailing, consumer products, the energy industry, and the home improvement and construction sectors. For details on specific Georgia-Pacific Gypsum products and plants, please contact our Technical Hotline at 1-800-225-6119.

www.gpgypsum.com

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WARRANTIES, REMEDIES AND TERMS OF SALE – For current warranty information for this product, please go to www.gpgypsum.com and select the product for warranty information. All sales of this product by Georgia-Pacific are subject to our Terms of Sale available at www.gpgypsum.com.

UPDATES AND CURRENT INFORMATION – The information in this document may change without notice. Visit our website at www.gpgypsum.com for updates and current information.

CAUTION: For product fire, safety and use information, go to gp.com/safetyinfo or call 1-800-225-6119.

HANDLING AND USE – CAUTION: This product contains fiberglass facings which may cause skin irritation. Dust and fibers produced during the handling and installation of the product may cause skin, eye and respiratory tract irritation. Avoid breathing dust and minimize contact with skin and eyes. Wear long sleeve shirts, long pants and eye protection. Always maintain adequate ventilation. Use a dust mask or NIOSH/MSHA approved respirator as appropriate in dusty or poorly ventilated areas.

FIRE SAFETY CAUTION – Passing a fire test in a controlled laboratory setting and/or certifying or labeling a product as having a one-hour, two-hour, or any other fire resistance or protection rating and, therefore, as acceptable for use in certain fire rated assemblies/systems, does not mean that either a particular assembly/system incorporating the product, or any given piece of the product itself, will necessarily provide one-hour fire resistance, two-hour fire resistance, or any other specified fire resistance or protection in an actual fire. In the event of an actual fire, you should immediately take any and all actions necessary for your safety and the safety of others without regard for any fire rating of any product or assembly/system.

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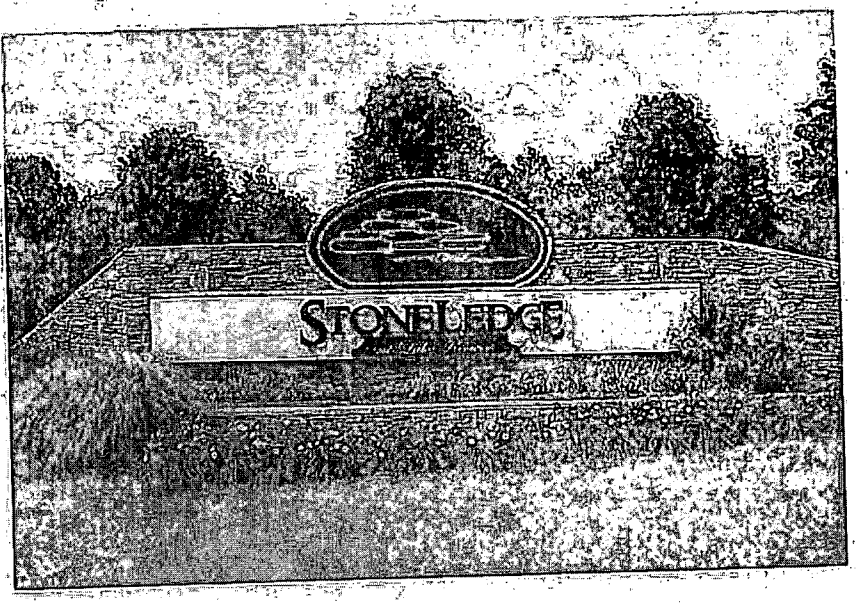
Stoneledge at Lake Kewoee

West Union, South Carolina

September 30, 2011

Below Grade Repair Documents



Construction Science and Engineering, Inc.
218 East Main Street
Westminster, SC 29693
Phone: (864) 647-1065

PLAINTIFF'S EXHIBIT
28
10-31-13

Stoneledge- Below Grade Remediation

January 30, 2012

Line	Item	Takeoff Quantity	Takeoff Units	Labor Unit Price	Matl Unit Price	Sub/Eqpt Unit Price	Labor Total	Matl Total	Sub/Eqpt Total	Line total:	Notes
	Costs to Excavate and Waterproof One Typical Unit (50 LF average)										
	A. Site & Building Selective Demolition						0	0	0	0	
1	Relocate & Store Condensing Units	3	ea			134	0	0	402	402	General HVAC
2	Remove & Store fence around condensing units	1	ea	50			50	0	0	50	
3	Dig up existing landscaping & store	40	MH	15			600	0	0	600	
4	Sawcut, demo, haul away sidewalk	20	MH	15			300	0	0	300	
5	Shore up front porch roof	1	est	80	45		80	45	0	125	
6	Demo front porch slab & steps on grade	1	est	500			500	0	0	500	
7	Remove 2' high strip of cultured stone	100	sfca	2			200	0	0	200	
							0	0	0	0	
	B. Excavation:						0	0	0	0	
1	Excavate foundations:	153	cy			10.00	0	0	1530	1530	Fowler
2	scrape off existing waterproofing & clean	550	sfca	0.75			412.5	0	0	412.5	
							0	0	0	0	
							0	0	0	0	
	C. Waterproofing & Drainage:						0	0	0	0	
1	waterproofing materials:						0	0	0	0	
	a. Polyguard 650 liquid adhesive	6	gal		23		0	138	0	138	Newsouth Supply
	b. Polyguard 650 membrane	550	sf		0.6		0	330	0	330	Newsouth Supply
	c. Termination bar at top of wall	50	lf		1.6		0	80	0	80	Newsouth Supply
	d. Polyguard sheet flow drain at footer	200	sf		2.36		0	472	0	472	Newsouth Supply
	e. 6" foundation drain w/ filter fabric	50	lf		1.3		0	65	0	65	Newsouth Supply
	f. Polyguard 15P sheet drain	500	sf		2.36		0	1180	0	1180	Newsouth Supply
							0	0	0	0	
2	backfill materials:						0	0	0	0	
	a. #57 washed stone	240	tons		20		0	4800	0	4800	Fowler
	b. Filter fabric	600	sfca		0.08		0	48	0	48	Newsouth Supply

Line	Item	Takeoff Quantity	Takeoff Units	Labor Unit Price	Matl Unit Price	Sub/Eqpt Unit Price	Labor Total	Matl Total	Sub/Eqpt Total	Line total:	Notes
3	Waterproofing & backfill labor:						0	0	0	0	
	a. Apply primer & membrane	550	sfca	0.75			412.5	0	0	412.5	
	b. Install sheet flow drain at footing	200	sfca	1.00			200	0	0	200	
	c. Install sheet drain from footing to grade	500	sfca	1.00			500	0	0	500	
	d. Install 6" foundation drain	50	lf	4.00			200	0	0	200	
	e. Backfill with washed stone	240	tons			10.00	0	0	2400	2400	Fowler
	f. Backfill dirt	0	cy			15.00	0	0	0	0	Fowler
	g. Haul excess dirt offsite	150	cy			6.00	0	0	900	900	Fowler
							0	0	0	0	
D.	**Hardscape, landscaping, finish items**						0	0	0	0	
1	Form and pour concrete stoop	1	ea	480	250		480	250	0	730	
2	Form and pour sidewalks	40	sf			3	0	0	120	120	
3	Repair paving	1	ls			250	0	0	250	250	
4	backfill & spread topsoil	10	cy		18	4	0	180	40	220	Fowler
5	install new irrigation system or repair existing	1	ls			150	0	0	150	150	
6	install plants, shrubs, & mulch	1	ls			500	0	0	500	500	
7	Re install condensing units & concrete pads	3	ea			350	0	0	1050	1050	General HVAC
8	Re install condensing unit fence	1	ls	50	25		50	25	0	75	
9	install cultured stone	100	sfca			15	0	0	1500	1500	
10	Remediate lay down area/cleanup site	1	ls	100			100	0	0	100	
							0	0	0	0	
E.	**Interior Work:**						0	0	0	0	
1	Allowance for interior repairs to drywall, framing, trim, flooring, & painting	1	ls.			1500	0	0	1500	1500	
							0	0	0	0	
							0	0	0	0	
General Conditions:							0	0	0	0	
1	Site Superintendent	1	wks	1500			1500	0	0	1500	
2	super's truck	1	wks		75		0	75	0	75	
3	cell phone	1	wks		55		0	55	0	55	
4	temp toilet	1	wks		20		0	20	0	20	
5	dumpster	1	pull		350		0	350	0	350	
6	seavan storage unit	1	wks		25		0	25	0	25	
7	Daily Cleanup	6	MH	14			84	0	0	84	
8	Final Cleanup	6	MH	14			84	0	0	84	
							0	0	0	0	
							0	0	0	0	
	Direct Total:						5753	8138	10342	24233	*24233*

Line	Item	Takeoff Quantity	Takeoff Units	Labor Unit Price	Matl Unit Price	Sub/Eqpt Unit Price	Labor Total	Matl Total	Sub/Eqpt Total	Line total:	Notes
Indirect Costs:											
1	Sales Tax	6%	total Matl			5753				345.18	
2	Labor Burdon	45%	total labor			8138				3662.1	
3	Permit Fee	0.60%	total			[redacted]				217.182	
4	utility relocation contingency	1.00	ls			500				500	
5	Overhead and Fee	10%	total			[redacted]				3619.7	
6	Contingency	10%	total							3619.7	
	Total per Average Unit:									**$ 36,197**	*36196.862*
	Total number of units with basements:	**73**	**ea**								
	Average cost per unit x total basement units:	**73**	**ea**			**36197**				**$ 2,642,371**	
	Garage shoring or demo/rebuild allowance:	**43**	**ea**			**10000**				**$ 430,000**	
	Total Estimate, Entire Project:									**$ 3,072,371**	

CSE File No. 237.01
September 30, 2011

Stoneledge at Lake Keowee HOA
c/o Mr. Robert Lyles
Lyles and Lyles, Inc.
P.O. Box 773
(342 East Bay Street)
Charleston, SC 29402 (29401)

Re: Scope of Repairs for Below Grade Repairs
Stoneledge at Lake Keowee
West Union, SC

Dear Mr. Lyles:

Pursuant to the request of The Stoneledge at Lake Keowee Homeowners Association (HOA), Construction Science & Engineering, Inc. (CSE) has performed visual surveys of below grade conditions at the subject property. The purpose of our surveys was to determine the extent of construction deficiencies and provide repair recommendations, as necessary to address water intrusion issues identified in finished basements at the subject property.

Prior to this letter, CSE consulted with the Structural Group (SG) in an effort to obtain a separate scope of work for a nontraditional below grade repair utilizing electro osmotic pulse (EOP) technology. SG provided a proposal for this work to the HOA. This letter provides an outline scope of repairs utilizing more traditional below grade repair methods. The scope provided below is based on visual surveys and destructive testing performed to date. In order for CSE to provide final opinions about the extent of construction defects at the subject property, additional destructive testing may be necessary to substantiate our initial findings at certain locations. The outline scope of repairs for below grade repairs should be provided to a qualified general contractor for purposes of preparing a cost estimate.

DESCRIPTION

General Project

The subject project is located in West Union, South Carolina on the shore of Lake Keowee. The subject project includes a total of twenty (20) buildings, which include nineteen (19)

residential townhouse structures and one (1) common use clubhouse structure. Each residential structure contains three (3) to seven (7) townhouse units. There are a total of eighty (80) townhouse units located at the subject project.

The subject project was developed in two (2) phases, Phase One and Phase Two, respectively. Phase One includes all structures located on the south and west sides of the lake (eight (8) buildings total). Phase Two includes all structures located north of the lake (eleven (11) residential buildings total). The clubhouse building is adjacent to an exterior pool area and is located in Phase Two. For descriptive purposes, the front of each unit will be considered the elevation facing the street and parking areas. Subsequently, all other elevations (i.e. left, right, and rear) will be referenced relative to the front elevation.

Townhouse Models

Three (3) different townhouse models were constructed, and are referred to as Parkside, Hampton, or Hickory in the original architectural drawings. The three (3) models vary from one another by exterior window locations and interior floor plans. All residential buildings are two (2) stories, with most units also having full walk-out basements with covered patio areas. However, a few units do not have basements. Units without basements are constructed over a shallow crawlspace. For units with basements, the interior finish level of the basement ranges from unfinished to fully finished. All units with walk-out basements have elevated balconies. A portion of each balcony is uncovered, while the remaining portion is screen enclosed. A copy of the original construction permit drawings were provided to CSE by the Oconee County (South Carolina) Building Department. Copies of the plans will be provided by CSE upon request.

Townhouse Construction

Typical construction for the residential townhouse units includes concrete slab-on-grade foundations for the basement floors. Concrete foundation walls enclose three (3) sides (front, right and left) of the basement and support the conventional wood framing above. The rear basement walls are constructed with conventional wood framing. The roofs are constructed using prefabricated metal plate connected wood trusses. Architectural grade composition shingles cover all roof areas. The exterior wall cladding includes cultured stone veneer (CSV) at the lower area of first floor and basement, cedar lapped siding over the main body of exterior walls, and accent areas of cedar shake. Oriented Strand Board (OSB) wall sheathing and/or gypsum wall sheathing products were used for exterior wall substrates. Windows are typically aluminum clad wood casement windows with insulated glazing (IG). Patio doors are painted wood, full lite (IG); outswing doors with fixed full lite (IG) panel(s) separated by wood framing and trim. Entry doors are stained wood, partial lite (IG), inswing doors of a different style, compared to the patio doors.

Garages

Most townhouse units include a detached garage located in front of the unit. Units 328 Blue Water Way and 335 Blue Water Way do not have a detached garage. The detached garages are located in close proximity to the front of the townhouse units. The detached garages accommodate a separate parking area for either one (1) or two (2) townhouse units. All detached garages are one (1) story structures. Garage roofs are constructed using either a gable or hip configuration covered with architectural grade composition shingles. The garages are wood frame construction supported by a concrete slab-on-grade foundation. The exterior walls have CSV along the base, with cedar lapped siding above.

BACKGROUND

Phase One

Phase One construction was permitted from August 2002 to June 2005. The applicable building code for this time period was the 2000 International Residential Code for One and Two Family Dwellings (2000 IRC). All repairs included in this Scope of Repairs will be required to meet the current applicable building code, which is the 2006 IRC.

Phase Two

Phase Two construction was permitted in March 2006. The applicable building code for this time period was the 2003 International Residential Code for One and Two Family Dwellings (2003 IRC). All repairs included in this Scope of Repairs will be required to meet the current applicable building code, which is the 2006 IRC.

OUTLINE SCOPE OF REPAIRS

1. Impacted Area

   A. Impacted area(s) include all exterior soil bearing walls (including end walls) that enclose interior basement spaces.
   B. Impacted area(s) also include portions of exterior soil bearing walls that occur at the main level (floor level directly above basement level). This occurs where the interior finish floor level is lower than the exterior grade level, as exemplified on the front elevation of 410 Sunset Point Drive.
   C. Impacted areas also include all exterior excavation areas required to access exterior walls for below grade repairs.
   D. Shoring locations required to support excavated soil and existing structures are considered as impacted area(s).
   E. All staging areas (to be determined) and access route(s) to repairs should be treated as impacted areas in so much that any existing element is repaired if damaged during the implementation of this repair scope.

2. Site Preparation

A. Identify, remove, disconnect and/or relocate all below grade utilities located within (or immediately adjacent to) impacted areas. This includes electrical, gas, telephone, cable, satellite TV, ethernet water and sewer.
B. Remove all landscaping materials adjacent to impacted wall areas as required. Salvage plantings as capable, and retain for future use appropriately. Note that all planting areas will be required to match the existing conditions at the conclusion of repairs.
C. Properly disconnect, remove and store exterior HVAC units located within or adjacent to impacted wall areas. All existing HVAC units will be assumed to be in proper working order at time of project commencement, unless documented otherwise by HOA and/or contractor.
D. Remove all paving adjacent to impacted wall areas as required to perform repair work.
E. Remove and store downspouts and drainage leaders as required.
F. Provide adequate protection for all adjacent windows and doors, as determined to be necessary.
G. Provide adequate protection for all existing site drainage inlets adjacent to impacted areas to maintain proper site drainage from other site areas.

3. Site Excavation

A. Verify that all utilities located within impacted area have been properly relocated and/or disconnected.
B. Provide proper shoring for all excavations as required to maintain structural integrity of existing structures (residential, garage and concrete walks) and all existing structural walls (existing structure foundations and site retaining walls) for duration of repair work. Shoring to comply with all applicable codes and standards, including OSHA standards.
C. Remove existing site drainage elements (as applicable) in impacted repair areas during excavations.
    I. Cut site drainage to allow for proper future attachment.
    II. Protect remaining, existing site drainage material from construction debris infiltration.
D. Remove existing utility lines in impacted repair areas during excavations.
    I. Cut utility lines to allow for proper future attachment.
    II. Protect remaining, existing utility material from damage and construction debris infiltration.
E. Remove existing site irrigation in impacted repair areas during excavations.
    I. Cut and cap irrigation lines to allow for proper future attachment.
    II. Salvage and store site irrigation components for future use.
    III. Protect remaining, existing site irrigation from damage and construction debris infiltration.

F. Remove top soil and planting medium material. Store separately from fill soil for reuse as planting medium material.
G. Remove remaining fill soil as required to implement remainder of repair work. Store fill soil separately from top soil.

4. Below Grade Wall Repair

A. Remove and dispose of existing wall barrier material.
B. Clean face of wall in preparation for installation of new material in accordance with manufacturer installation instructions.
C. All new materials should be continuous around corners in a manner consistent with all manufacturer installation instructions.
D. Prepare and prime exterior face of below grade concrete foundation wall with Polyguard 650 LT Liquid Adhesive in accordance with manufacturer installation instructions.
E. Install Polyguard 650 membrane system from the bottom of the foundation of footer continuous to under the through wall flashing at the bottom of the synthetic stone veneer in accordance with the manufacturer installation instructions. Refer to attached Below Grade Exterior Wall Detail(s) A12, A13 and A14.
F. Install Polyguard Total-flow Sheet Drain from 2'-0" above top of the footer, continuous over grouted cant and down footer edge per manufacturer installation instructions. Terminate Total-flow Sheet Drain at bottom of footer. Integrate with Polyguard Flow 15P Sheet Drain (2'-0" above the footer) per manufacturer installation instructions. Integrate with 6" diameter foundation drain with integrated filter fabric at base of footer in accordance manufacturer installation instructions. Refer to attached Below Grade Exterior Wall Detail(s) A12, A13 and A14.
G. Install 6" diameter foundation drain with integrated filter fabric at base of footer continuous from corner to corner of below grade wall(s). Slope to drain 1/8" per foot, minimum. Tie new foundation drain(s) into existing storm water management system.
H. Install Polyguard Flow 15P sheet drain from 2'-0" above top of footer continuous to approximately 3" below grade level per manufacturer installation instructions. Integrate with Polyguard Total-flow Drain Sheet per manufacturer installation instructions.
I. Install gravel drainage plane with filter fabric surround to cover all of the Polyguard Total-flow Sheet Drain, Polyguard Flow 15P Sheet Drain and foundation drain with integrated filter fabric. Refer to attached Below Grade Exterior Wall Detail(s) A12, A13 and A14.
J. Restore function of all impacted utilities.
K. Reinstall any disturbed site drainage components. Integrate all site drainage components (new and existing) to provide adequate site drainage away from structure.

L. Backfill excavated areas and replace layer of top soil. Provide adequate soil compaction in accordance with code requirements and/or accepted industry standards. Slope soil away from structures in accordance with building code(s).

5. Interior Finishes

A. Repair damaged interior gypsum wallboard as needed to match existing finish (i.e. damage due to water intrusion or consequential damages caused by exterior wall repairs, etc.). Repairs should include removal and replacement of damaged interior gypsum wallboard, incidental nail pops, spackling, prepping and painting exterior walls/finishes. For the purposes of this repair scope assume that twenty (20) square feet of gypsum wallboard will be replaced in half of the subject structures.
B. Repair or replace damaged flooring as needed to match existing finish (i.e. damage due to water intrusion or consequential damages caused by exterior wall repairs, etc.).

6. Exterior Finishes

A. Repair damaged synthetic stone as needed to match existing finish in accordance with all repair documents by CSE (i.e. consequential damages caused by exterior wall repairs, etc.).
B. Repair or replace damaged cedar siding as needed to match existing finish in accordance with all repair documents by CSE (i.e. consequential damages caused by exterior wall repairs, etc.).

7. Landscaping

A. Install / re-install site irrigation as required to provide site irrigation as existed prior to commencement of repairs.
B. Install / re-install plants and planting material as required to provide similar landscaping as existed prior to commencement of repairs.
C. Install paving (concrete walks, stairs, stoops, and asphalt paving) to match all paving that was removed in order to perform repairs to below grade wall(s).
D. Install / re-install any retaining wall material removed to perform below grade wall repairs to finish level prior to commencement of repairs and in accordance with all other repair documents by CSE.

8. General Notes for All Repairs

A. All materials specified in this Scope of Repairs and associated Repair Drawings should be installed according to the respective manufacturers' installation instructions.
B. Material / system substitutions may occur with prior acceptance by CSE. Any proposed substitutions should be submitted for approval to CSE with

documentation supporting that the proposed material is equivalent and will properly integrate with all surrounding material(s).

C. All work should be performed in accordance with applicable building codes and accepted industry standards.

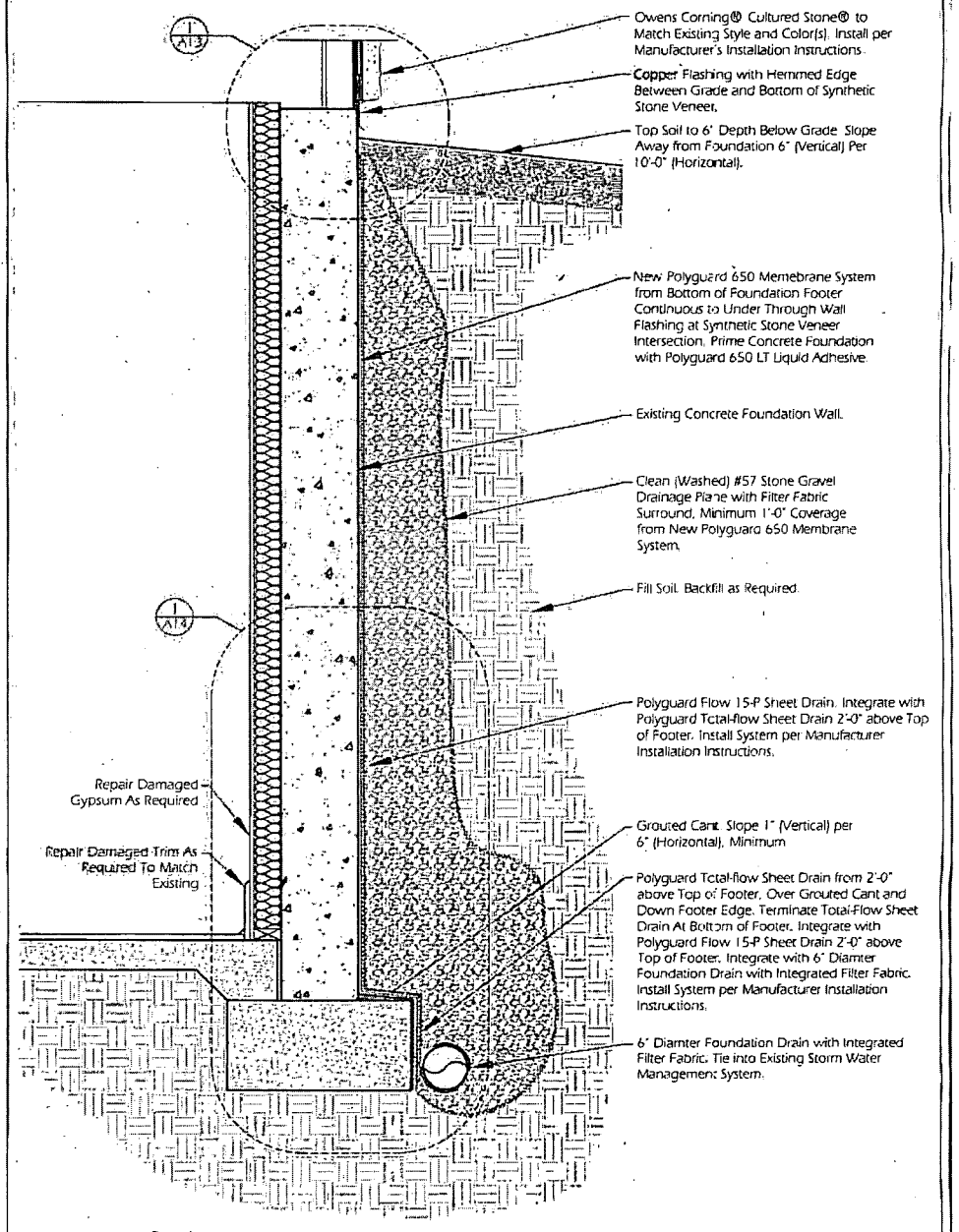
This scope of repairs is based on a reasonable degree of engineering certainty regarding the extent of known defects at the subject property. In the event that additional relevant information becomes available, we respectively reserve the right to amend the repair recommendations provided herein. Please feel free to contact me if you have any questions or require additional assistance.

Sincerely,

CONSTRUCTION SCIENCE AND ENGINEERING, INC.

Derek A. Hodgin, P.E.

237.01 stoneledge scope of repair_below grade_2011_08_24.doc



1/A12 Wall Section Detail
Below Grade Exterior Wall

Scale: 1" = 1'-0"

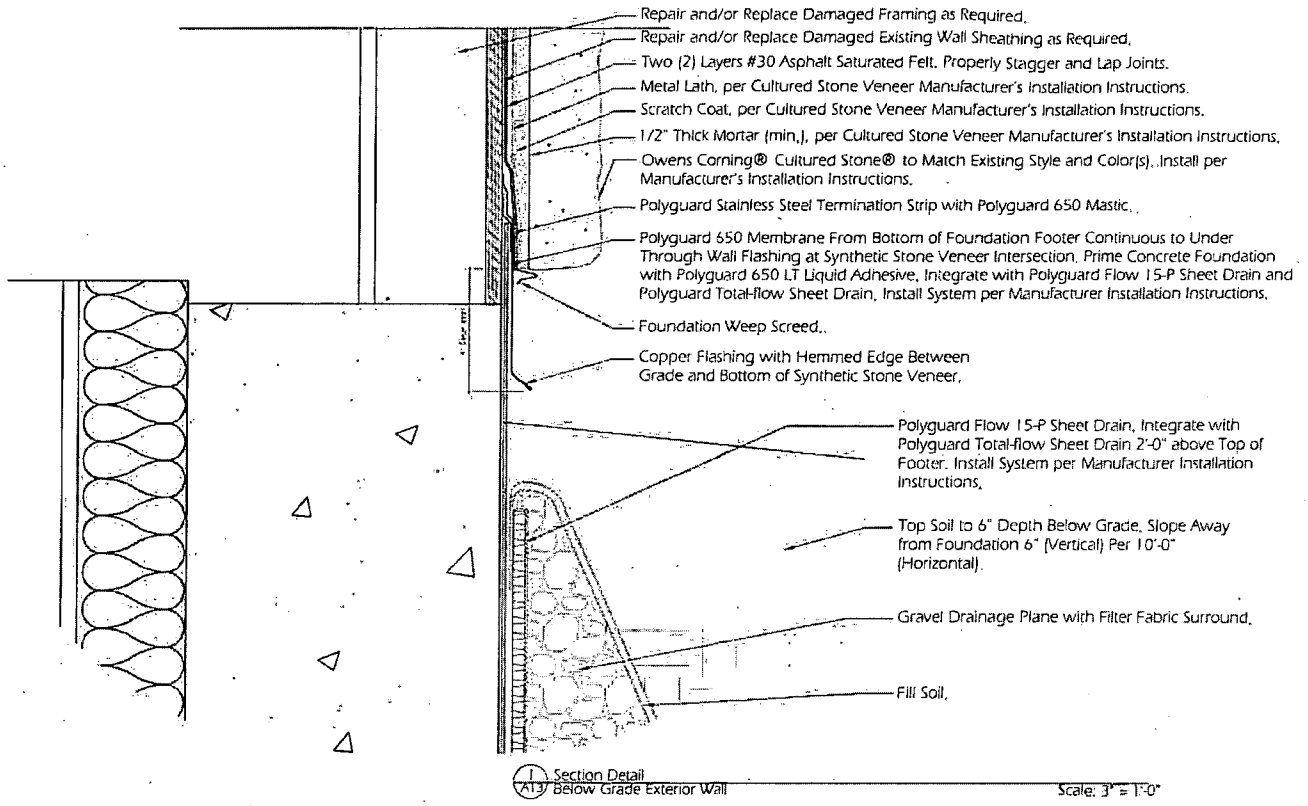
CSE
Construction Science and Engineering, Inc.
110 East Main Street
Westminster, South Carolina 29693
T 864-647-1065
www.constructionscience.org
Forensic Engineering and Architecture, Construction Science and Roof Consulting

237.01 Stoneledge at Lake Keowee

Repair Detail

September 30, 2011

A12



237.01 Stoneledge at Lake Keowee
Repair Detail
September 30, 2011
A13

Construction Science and Engineering, Inc.
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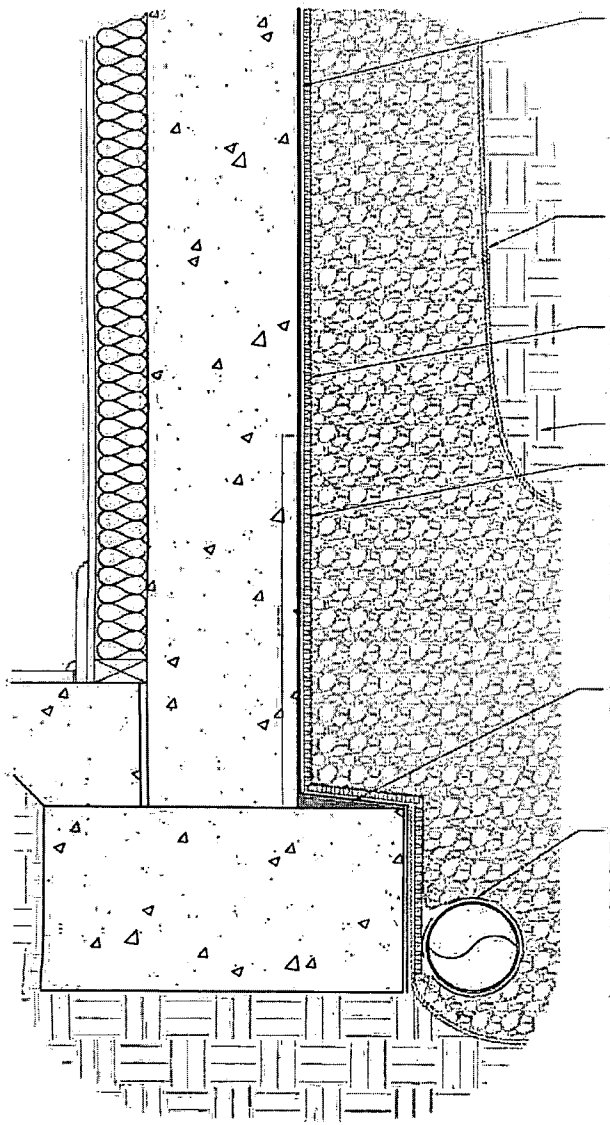


Polyguard 650 Membrane From Bottom of Foundation Footer Continuous to Under Through Wall Flashing at Synthetic Stone Veneer Intersection. Prime Concrete Foundation with Polyguard 650 LT Liquid Adhesive. Integrate with Polyguard Flow 15-P Sheet Drain and Polyguard Total-flow Sheet Drain. Install System per Manufacturer Installation Instructions.

Clean (Washed) #57 Stone Gravel Drainage Plane with Filter Fabric Surround, Minimum 1'-0" Coverage from New Polyguard 650 Membrane System.

Polyguard Flow 15-P Sheet Drain. Integrate with Polyguard Total-flow Sheet Drain 2'-0" above Top of Footer. Install System per Manufacturer Installation Instructions.

Fill Soil.

Polyguard Total-flow Sheet Drain from 2'-0" above Top of Footer, Over Grouted Cant and Down Footer Edge. Terminate Total-Flow Sheet Drain At Bottom of Footer. Integrate with Polyguard Flow 15-P Sheet Drain 2'-0" above Top of Footer. Integrate with 6" Diamter Foundation Drain with Integrated Filter Fabric. Install System per Manufacturer Installation Instructions.

Grouted Cant. Slope 1" (Vertical) per 6" (Horizontal), Minimum.

6" Diamter Foundation Drain with Integrated Filter Fabric. Integrate with Polyguard Total-flow Sheet Drain per Manufacturer Installation Instructions. Tie into Existing Storm Water Management System.

1 / A14 Wall Section Detail
Below Grade Exterior Wall

Scale: 2" = 1'-0"

2698

Construction Science and Engineering, Inc. 218 East Main Street Westminster, South Carolina 29693 T (864) 647-1065 www.constructionsciencesc.com Forensic Engineering and Architecture, Commercial Services, and Roof Consulting	237.01 Stoneledge at Lake Keowee Repair Detail September 30, 2011	A14

PRODUCT NAME

Waterproofing Membrane, Liquid Adhesive and Mastic

MANUFACTURER

POLYGUARD PRODUCTS. INC.
Ennis, TX 75120-0755
Phone: (214) 515-5000
Fax: (972) 875-9425
Web: www.polyguardproducts.com

PRODUCT DESCRIPTION

Basic Use: *POLYGUARD 650 MEMBRANES* are used on concrete for foundation waterproofing, mud slabs, sills and spandrel beams, tunnels, plaza decks, parking garages and related applications where waterproofing is critical. *POLYGUARD MEMBRANES* may also be used on wood, concrete block structures and insulated concrete forms. Wide membrane widths allow fast and easy application to continuous flat surfaces. Narrow width material is available for trim corners, construction joints and other applications. *POLYGUARD MEMBRANES* should be applied according to specifications. Remedial work can offer special problems in the use of waterproofing materials. Specifiers should discuss remedial work with *POLYGUARD* prior to specification and detailing.

POLYGUARD MEMBRANES are cold applied and selfadhered to poured concrete over *POLYGUARD LIQUID ADHESIVES.*

POLYGUARD 650 MASTIC is used with *POLYGUARD SHEET MEMBRANE* at all T-joints and terminations. It is used as a night seal at the top edge of the membrane and to seal the bottom termination edge of the membrane at the base of the foundation.

POLYGUARD LM-95 LIQUID MEMBRANE is used with *POLYGUARD SHEET MEMBRANES* to eliminate double-ply sheet on inside and outside corners. As a fillet on inside corners, *POLYGUARD LM-95 LIQUID MEMBRANE* insures adhesion to concrete in difficult areas to seal. It is also recommended for planter boxes and all slab penetrations.

Substitutions of components to the *POLYGUARD System* may compromise the quality and performance of the installation. Therefore, substitutions are not allowed.

No other use of these materials can be made without prior approval of *POLYGUARD* as to service and method of application.

Limitations: Porous surfaces may adversely affect adhesion.

POLYGUARD MEMBRANES are not recommended for pond or tank liners except when applied between two concrete slabs.

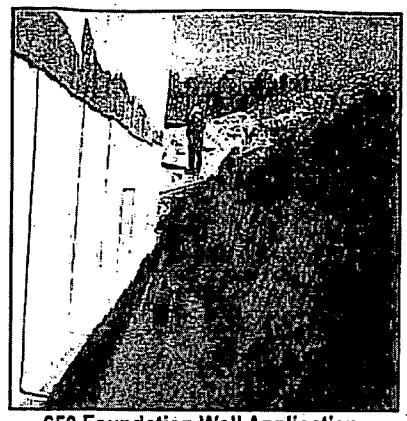
Waterproofing of T-beam structures requires placing a 12" *(305 mm)* wide strip of *POLYGUARD MEMBRANE* centered over the joint. *POLYGUARD MEMBRANE* should then be placed over the entire surface.

Caution should be taken to prevent contact of the rubberized asphalt element with any product containing fresh coal tar or coal tar pitch. Sealants and liquid waterproofing products containing polysulfide polymer or silicone may be incompatible. Contact *POLYGUARD* for specific information.

Composition of Materials:

POLYGUARD 650 MEMBRANE is a strong, pliable, self-adhesive sheet consisting of high density polyethylene film bonded to a layer of rubberized asphalt waterproofing compound. Factory bonding assures uniform membrane thickness of 60 mils. *POLYGUARD 650 MEMBRANE* is formulated for low temperature application down to 25°F *(-4°C).* *MEMBRANE* is wound on a disposable treated release sheet to prevent blocking in the rolls. Standard roll size is 48" x 50' *(1.22m x 15.2m),* and 39.36" x 61' *(1m x 18.59m).*

POLYGUARD 650 LT LIQUID ADHESIVE is a fast drying, high tack rubber-based adhesive in solvent solution used on horizontal and vertical surfaces at temperatures above 25°F *(-4°C).*



650 Foundation Wall Application

TYPICAL PROPERTIES OF POLYGUARD 650 WATERPROOFING MEMBRANES

Property	Test Method	English	Metric
Film Color		Blk./White	*Blk./White*
Membrane Thickness	ASTM D 1000 inch *(mm)*	.060	*1.5*
Tensile Strength - Membrane	ASTM D-412 (Modified Die C) PSI *(N/mm2)*	325	*2.24*
Tensile Strength - Film	ASTM D-882 PSI *(N/mm2)*	6500	*44.82*
Elongation - Ultimate failure of rubberized asphalt	ASTM D-412	600%	*600%*
Permeance	ASTM E-96-B grains/sq.ft./hr./in.HGF *(grains/hr/m2)*	.03	*.02*
Cycling Over Crack @ -15°	ASTM C836	No effect	*No effect*
Peel Adhesion	ASTM D-1000 lb/in. width (N/mm)	10.0	*1.75*
Overlap Bond	ASTM D-1000 lb/in. width (N/mm)	8.0	*1.4*
Pliability	ASTM D-146 - 180° bend over 1" mandrel at -25°F *(-32°C)*	No effect	*No effect*
Puncture Resistance - Membrane	ASTM E-154 (Blunt Instrument) lb *(N)*	50	*182*
Resistance to Hydrostatic head	ASTM-D 5385-93 ft *(M)*	231	*70.4*
Exposure to Fungi in Soil	GSA-PBS 07.115-16 Weeks	No effect	*No effect*
Water Absorption	ASTM D-570	.1%	*.1%*

Polyguard

This Information is based on our best knowledge, but POLYGUARD cannot guarantee the results to be obtained.

Polyguard has been ISO 9000 certified since 1988. Current certifications are:
- American Nat. Standards Institute
- Dutch Council for Certification
- Deutscher Akkreditierungs Rat

POLYGUARD SHUR-TAC WATER-BASE LIQUID ADHESIVE is available where VOC limitations may apply.

POLYGUARD 650 MASTIC is a rubberized asphalt mastic with a low solvent content.

POLYGUARD LM-95 LIQUID MEMBRANE is a two-component elastomeric extended rubber urethane, mixed prior to application. *POLYGUARD LM-95 LIQUID MEMBRANE* is formulated to be compatible with the *POLYGUARD* rubberized asphalt compound.

Applicable Standards: *POLYGUARD MEMBRANE* conforms to the following specifications:

- Corps of Engineers CEGS-0711
- AIA MASTERSPEC SECTION 07111
- Federal Construction Guide FCGS 07111
- General Service Administration PBS (PCD) 07111
- Department of the Navy NAV FAC TS 07111
- Veterans Administration 14-08-1 SECTION 07311
- American Railway Engineering Association (AREA) 29-2

TECHNICAL DATA

Typical properties of *POLYGUARD 650 MEMBRANE* are shown in the table below.

INSTALLATION

Material Storage: Membrane and accessories should be unloaded and stored carefully. Cartons and containers must be protected from weather, sparks, flames, excessive heat, cold and lack of ventilation. DO NOT stack membrane material higher than 5' *(1.5m)* vertically, nor double stack pallets. Cartons should be stored on pallets and covered to prevent water damage. For best results, membrane should be stored 50-75°F prior to application.

Application Temperatures: Apply *POLYGUARD 650 LT LIQUID ADHESIVE* on both vertical and horizontal surfaces at temperatures above 25°F *(-4°C)*.

Apply *POLYGUARD SHUR-TAC WATERBASE LIQUID ADHESIVE* by sprayer, when temperature is 25°F *(-4°C)* and rising. At this temperature the weather conditions and substrate must be dry.

Apply POLYGUARD 650 MEMBRANE at temperatures above 25°F *(-4°C)*.

Preparatory Work: Prior to starting work, check that all horizontal surfaces to be waterproofed slope towards drainage. This material is not designed to be applied in areas where water will pond. *Surface Preparation:* A smooth monolithic concrete surface is required. Broom surfaces are not recommended. Concrete should be dry, frost free and cured a minimum of seven days prior to application of *POLYGUARD MEMBRANE* and *LIQUID ADHESIVE*. Surface must be free of voids, spalled areas, sharp projections, loose aggregate and form release agents. Concrete curing compounds containing oil, wax or pigments should not be used. Form release agents must be the self dissipating type which will not transfer to the membrane. Surface defects such as cracks, holes or cavities should be filled and finished flush with a Portland cement grout or concrete. Top surfaces of projecting ledges, below grade, except footings, should be finished to a bevel with Portland cement mortar. Concrete block walls or brick require a well adhered parge coat before application of membrane. Striking off joints flush with surface is also required.

Clean all surfaces to remove debris, dust and loose stones before application begins. DO NOT apply *LIQUID ADHESIVE or* MEMBRANE to frozen concrete.

Priming: Stir *LIQUID ADHESIVE* before use. *POLYGUARD 650 LT LIQUID ADHESIVE* should be applied over the entire surface at a rate of 250-350 square feet, per gallon *(6-8.5 m^2/l)*. Primed surfaces must be re-primed if membrane is not applied to the *LIQUID ADHESIVE* within the same working day. Use brush or lambs wool roller for application. *LIQUID ADHESIVE* must be dry prior to application of membrane. *POLYGUARD 650 LT LIQUID ADHESIVE* retains a tacky adhesive surface.

Primed surfaces should be immediately covered or protected to prevent contamination occurring on the *LIQUID ADHESIVE*. Metal surfaces may require *LIQUID ADHESIVE* to obtain bond of membrane to substrate. Field test to determine adhesion level. Surface must be free of contaminates.

Liquid Membrane: Apply fillets formed by *POLYGUARD LM-95 LIQUID MEMBRANE*, latex modified cement mortar or epoxy mortar at the base of foundation walls and footings. DO NOT use wood or fiber cant strips. Fillets or *POLYGUARD LM-95 LIQUID MEMBRANE* should be applied to provide a 3/4" *(19mm)* face and extend 6" *(152mm)* vertically and horizontally, 90 mils *(2.286 mm)*.

DO NOT prime underneath *POLYGUARD LM-95 LIQUID MEMBRANE*.

Cover all corners, joints and the base of the foundation wall and footing using a 12" *(305 mm)* wide strip of membrane centered along the axis. Press or roll firmly to achieve a complete seal. Apply a second ply of membrane. *POLYGUARD LM-95 LIQUID MEMBRANE* may be substituted for the initial 12" *(305 mm)* wide membrane strip on inside corners.

Pretreat inside corners with *POLYGUARD LM-95 LIQUID MEMBRANE* 6" *(152 mm)* in each direction from corners, and form a fillet with *POLYGUARD LM-95 LIQUID MEMBRANE* and apply a 12" *(305 mm)* strip of membrane centered on the corners.

POLYGUARD LM-95 LIQUID MEMBRANE may be substituted for the initial layer of sheet membrane on drains and protrusions by applying a 90 mil *(2.286 mm)* thick layer from the drain or protrusion out and extending 6" *(152 mm)* underneath sheet membrane. Apply *POLYGUARD LM-95 LIQUID MEMBRANE* vertically to be level with height of wearing surface. Flash drains and projections with a second ply of *MEMBRANE* for a distance of 6" *(152 mm)* from drain or projection. Seal all terminations with *POLYGUARD 650 MASTIC*.

Two coats, 45 mils *(1.1430 mm)* each, of *POLYGUARD LM-95 LIQUID MEMBRANE* should be used for waterproofing irregular shapes or circular structures such as planter boxes.

Detail work should be completed prior to mixing *POLYGUARD LM-95 LIQUID MEMBRANE*. Pot life of this product is approximately 60 minutes after mixing at 70°F *(21°C)*.

Sheet Membranes:

POLYGUARD MEMBRANE can be applied in any width up to 48" *(1.2 M)* wide. Side laps must be a minimum of 2-1/2" *(64 mm)*. Staggered end laps should be minimum 6" *(152 mm)*.

When applying *POLYGUARD MEMBRANE* on vertical walls, a determined effort must be made to assure complete adhesion of membrane to the primed surface. Hand roll over lap seams with a wall type narrow roller. Use heavy hand pressure while smoothing out the membrane surface, as it is applied.

On horizontal surfaces, apply membrane from low to high pitch for maximum drainage. Use linoleum

roller or water filled garden roller, covered with two plies of indoor-outdoor carpet to roll membrane immediately after application, with special attention at overlaps and "T-Joint". Seal all end laps with *POLYGUARD 650 MASTIC*.

It is recommended that when vertical sections of more than 8' *(2.4 M)* are to be waterproofed, membrane should be applied in sections no longer than 8' *(2.4 M)*, starting from the lower foundation base and rising to the top with the 6" *(152 mm)* overlap, shingling down on each ply of membrane. *POLYGUARD MEMBRANE* should be applied over the edge of the footing at the foundation base.

The upper terminating edge of *POLYGUARD MEMBRANE* applied to a vertical wall should be completed over the top of the wall. If terminated in the vertical surface, such termination should be at a reglet or counter flashing. The terminated edge should be pressed firmly with a silicone roller and protected with a troweled bead of *POLYGUARD 650 MASTIC*.

Cracks of more than 1/16" *(1.5 mm)* on horizontal or vertical surfaces should be properly sealed in accordance to sealant manufacturer's instruction and prestripped with a 12" *(305 mm)* wide strip of membrane.

Cold joints, T-Joints and evident working cracks should be properly sealed with joint fillers, waterstop or sealant. A 12" *(305 mm)* strip should be placed directly over and centered in the crack with the final applied membrane providing double strength at the area of movement.

All expansion joints, contraction joints and control joints should be properly sealed with joint fillers, waterstop or sealant. An inverted 8" *(203 mm)* strip, covered by a 12" *(305 mm)* strip, shall be placed directly over the joint, before the final membrane application.

All intersections must be reinforced, including footings as well as projections, such as drains, pipe, conduit, etc.

Inspection and Repairs: Visually inspect membrane for tears, punctures, air blisters and "fishmouths", prior to water tests, placement of protection board and backfilling. Make repairs by removing all damaged membrane so that only well bonded membrane remains. Reprime any exposed concrete. After *LIQUID ADHESIVE* is dry, apply a new sheet of membrane over the concrete, extending 6" *(152 mm)* onto previously applied membrane. Care should be taken to obtain good adhesion between membrane used for repairs and originally applied membrane.

Slit all "fishmouths", overlap the pieces, place patch over area and roll or press in place. Puncture air blisters, expel the air, prime and cover with patch. Seal edges with *POLYGUARD 650 MASTIC*.

Mastic Application: *POLYGUARD 650 MASTIC* should be applied at all terminations at the end of each day's work. *POLYGUARD 650 MASTIC* should never be applied underneath the *POLYGUARD MEMBRANE*.

Flashing: Finish vertical wall membrane on top edge under flashing or in reglet. Seal T-Joints and terminations with a toweled bead of *POLYGUARD 650 MASTIC*.

Ultraviolet Protection: *POLYGUARD 650 MEMBRANE* can be adversely affected by ultraviolet light. The waterproofing system must be covered as soon as possible and not left exposed to sunlight for over 30 days.

Testing: On horizontal areas, a 24 hour flood test with minimum of 2" *(51 mm)* head of water is recommended. Leaks in membrane must be repaired before any slabs or wearing surfaces are applied. Before flooding, make sure structure will withstand the dead load.

Membrane Protection: Protection board is required over *POLYGUARD 650 MEMBRANE*. Extruded polystyrene is actable for vertical applications. *POLYGUARD LOWFLOW™* and *POLYGUARD FLOW 15-P* as well as some other drainage boards have built in protection which is adequate for vertical surfaces. *POLYGUARD 1/8" (3 mm) ASPHALT PROTECTION BOARD* should be used to protect membrane on horizontal surfaces subject to normal construction traffic. *POLYGUARD 1/4" (6 mm) ASPHALT PROTECTION BOARD* should be used to protect the membrane on horizontal surfaces subject to heavy construction traffic. Protection board systems are to be applied according to the manufacturer's application and guide specifications.

Protection board should be installed over the membrane the same day the membrane is installed or immediately after a 24 hour flood test. If flood testing is not going to be performed the same day membrane is applied, a temporary covering should be applied over the membrane to protect it from damage by traffic, other trades, and to prevent outgassing of moisture in the concrete under the membrane that is exposed to direct sunlight. Membrane left exposed on top of foundation walls or parapets should be covered with weather resistant flashing.

Membrane surfaces should be free of stones and dirt prior to protection board installation.

When adhering protection board systems to *POLYGYARD MEMBRANE*, use a *POLYGUARD* approved adhesive system. Spot adhesion, rather than full adhesion, should be used so that in the event of backfill settlement exerting downward pressure, the protection system will detach from the membrane and slip downwards.

The use of chairs with rolled feet or plastic tips are required to prevent holes being punctured In the protection board and membrane surface. Wire mesh must be supported to prevent the concrete weight from pushing the cut ends of the mesh into the membrane.

Drainage Board: *POLYGUARD's FLOW 15-P* and *LOWFLOW™ PROTECTION / DRAINAGE BOARD* with built in protection for vertical surfaces or *POLYGUARD 18-H* for horizontal surfaces are used to expedite water dispersion. Most require a protection course or slip sheet to be placed before application over *POLYGUARD 650 MEMBRANE*.

Consult *POLYGUARD* for specific recommendations.

Drainage: Drainage systems should be designed with pipe sizes large enough to prevent water accumulation against the foundation. Perforated pipe should be covered with fabric to prevent fines or dirt from plugging perforations. Pipe should be of sufficient strength to prevent deformation due to soil weight or movement. Consideration should be given to provide drain outlets to the interior of the building when the water table level is above the base of the waterproofing membrane.

Backfill: No waiting is required before backfilling. Backfill material should be dry sand or dry soil dirt as following:

- Fill material must be free of large dirt clods, rock, tree roots and debris.
- Backfill should be of a type readily compactable upon deposit.
- It should be placed against the protection board in 6" *(152mm)* to 8" *(203mm)* compacted layers to avoid vertical settlement.
- Backfill should not have a high water content that would cause the soil to shrink upon drying.
- Mechanical compaction in horizontal layers should be used to achieve these results if necessary.

- Avoid sharp impact to the protection board when backfilling.

Topping Systems: Topping, such as concrete, soil or pavers, may be used to finish a horizontal application. Multi level drainage systems are recommended at both topping and POLYGUARD 650 MEMBRANE elevations.

Precautions: The *LIQUID ADHESIVE* is an industrial coating and would be harmful or fatal if swallowed. It is marked as red label from the stand-point of flash point.

Prohibit flames, sparks, welding and smoking during application.

Refer to product label for handling, using and storage precautions.

Solvents could be irritating to the eyes, flush with water and contact physician.

Avoid prolonged contact with skin and breathing of vapor or spray mist from liquid adhesive. *In confined areas, use adequate forced ventilation, fresh air masks, explosion-proof equipment and clean clothing.*

Avoid solvent contact with light bulbs or other high temperature surfaces.

CLOSE CONTAINER AFTER EACH USE. KEEP OUT OF REACH OF CHILDREN.

This material is offered for sale by *POLYGUARD PRODUCTS, INC.* only for the expressed purposes as described in this literature. Any use of the products other than taught therein by *POLYGUARD PRODUCTS, INC.* shall be the responsibility of the purchaser, and *POLYGUARD PRODUCTS, INC.* does not warrant, nor will be responsible for any misuses of these products.

POLYGUARD PRODUCTS, as described, herein, are for industrial use ONLY. The application procedures should be performed by workmen who are skilled in the application of materials described herein in accordance with the manufacturer specifications.

Material Safety Data: All Material Safety Data Sheets and precautionary labels should be read and understood by all user supervisory personnel and employees before using. Consult *POLYGUARD PRODUCTS, INC.* Material Safety Data Sheets and OSHA regulations for additional safety and health information for the products described herein. Purchaser is responsible for complying with all applicable federal, state or local laws and regulations covering use of the product, including waste disposal.

This is not a Material Safety Data Sheet and is not to be used as such. *POLYGUARD PRODUCTS, INC.* has prepared separate Material Safety Data Sheets on each product.

AVAILIBILITY AND COST

Contact *POLYGUARD PRODUCTS Inc.*, for further information.

WARRANTY

POLYGUARD products are warranted to be free of defects in manufacture for five years. Material will be provided at no charge to replace any defective product.

MAINTENANCE

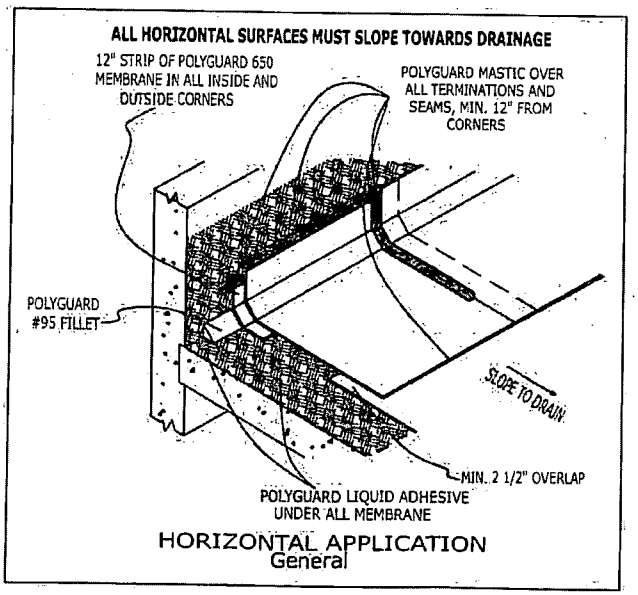
None required, if installed according to instructions.

TECHNICAL SERVICES

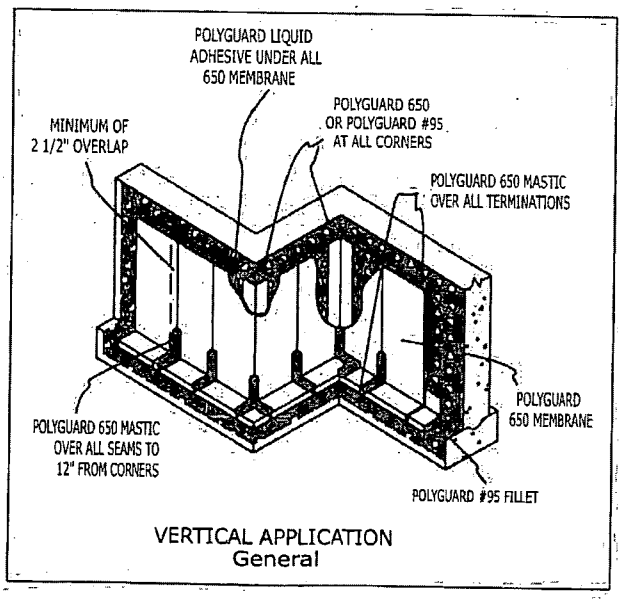
Technical assistance and information are available from any *POLYGUARD* dealer, or contact *POLYGUARD PRODUCTS, INC.*

FILING SYSTEMS

POLYGUARD brochures are available from *POLYGUARD* dealers, website, or the manufacturer.



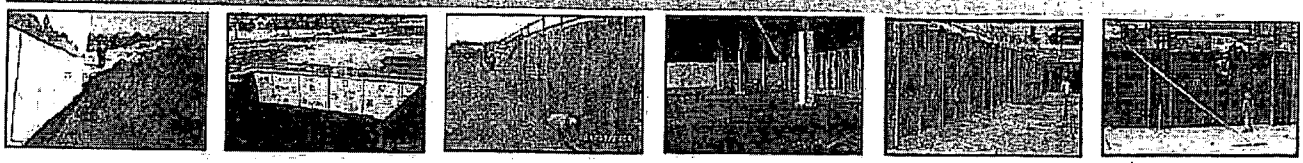
HORIZONTAL APPLICATION
General



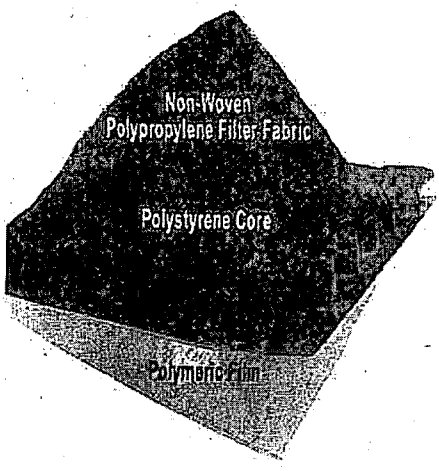
VERTICAL APPLICATION
General

Polyguard Architectural Products

Architectural Products
Architectural Products



Polyflow™ 15 & Polyflow™ 15-P
DRAINAGE MATS FOR VERTICAL DRAINAGE



TYPICAL PROPERTIES	ASTM TEST METHOD	UNIT OF MEASURE (English and *Metric*)	*Polyflow*™ 15-P	*Polyflow*™ 15
DRAIN PROPERTIES:			with soft waterproofing	if no soft waterproofing
Flow Capacity	D 4716	gpm/ft of width *l/min/m of width*	16 */200*	16 / *200*
Roll Length, feet	-	Feet / *m*	50 / *15.24*	50 / *15.24*
Roll Width, feet	-	Feet / *m*	4 / *1.22*	4 / *1.22*
Roll Weight, lbs	-	Lbs / *kg*	45 / *20.4*	45 / *20.4*
CORE PROPERTIES:				
Material	-	-	Polystyrene	Polystyrene
Thickness	D 1777	Inch / cm	.375 / *.952*	.375 / *.952*
Compressive Strength, lbs/ft^2 (+ or – 5%)	D 1621 (modified)	lbs/ft^2 / kg/m^2	15,000 / *719*	15,000 / *719*
Polymeric film layer	-	-	yes	No
FABRIC PROPERTIES:				
Material	-	-	Polypropylene	Polypropylene
Grab Tensile Strength	D 4632	Lb / kg	110 / *50*	110 / *50*
Grab Elongation	D 4632	Percent	60	60
Puncture Strength	D 4833	PSI	65 psi	65 psi
EOS *(AOS)*	D 4751	US Sieve mm	100 /*0.152*	100 /*0.152*
Flow Rate, gpm/ft	D 4491	gpm/ft^2 / $(l/min/m^2)$	150 / *6110*	150 / *6110*
UV at 500 hours *(strength retained)*	D 4355	percent	70	70

POLYGUARD *Polyflow™ DRAINAGE MATS* are three-part prefabricated geocomposite drain consisting of a formed polystyrene core covered on one side with polypropylene filter fabric. The fabric allows water to pass into the drain core while restricting the movement of soil particles which might clog the core. The core allows the water to flow to designated drainage exits. ***Polyflow™15*** and ***15-P*** are designed for vertical applications.

Polyflow™ DRAINAGE MAT also has a built-in film protection layer. Use of a protection board is not necessary on most applications as the polymeric film layer and core protect softer waterproofing materials such as ***POLYGUARD 650*** waterproofing membrane. If the drainage mat is not to be used over a soft waterproofing system, it can be ordered without the built-in protection layer as ***Polyflow™ 15***.

The many uses of ***Polyflow™ DRAINAGE MATS*** include foundation walls, retaining walls, inclined drains, french drains, trench drains, interceptor drains, embankment drainage, earthen dams, planters, under slabs, and under foot traffic pavers. Virtually anywhere an aggregate drainage system has been used to relieve hydrostatic pressure ***Polyflow™*** can be used more efficiently.

Collection Systems:

Polyflow™ DRAINAGE MATS may be used with ***Polyguard TotalFlow™***, perforated pipe, or drain tile for collection of drainage to the designed exit drainage.

Vertical Installation:

Measuring:

If using ***TotalFlow™***, measure perimeter of wall and place a two foot section of ***TotalFlow™*** around the perimeter. Measure wall height from top of ***TotalFlow™***, unroll the ***Polyflow™ DRAINAGE MAT,*** and cut to length.

If using perforated pipe, measure wall height or lift, adding sufficient material for overlapping pipe detail. Unroll ***Polyflow™ DRAINAGE MAT*** and cut to length. Peel back fabric from drainage core and remove 4 " of core. Drain core should remain 6"-12" below backfill.

If using drain tile, measure wall height, adding sufficient material so that there is enough fabric, when fabric is peeled back from drainage core, to wrap around the drainage tile.

Installing:

At the top termination, glue fabric to wall or, if using a furring strip or ***Polyguard*** termination bar, tuck fabric under core. Furring strip / termination bar can be removed after backfill is completed.

Glue or tape adjacent panels at the vertical joints, making sure the fabric overlaps to prevent soil intrusion during backfill.

Tie-in to the collection system can be done with a simple fabric overlap (if using the ***TotalFlow™*** system). If using perforated pipe, peel back fabric from ***Polyflow™ DRAINAGE MAT*** core and remove 4" of core. Drain core should remain 6"-12" below backfill. If using drain tile, wrap fabric which has been pulled away from the core completely around the drain tile. Tuck excess fabric back behind the core. Make sure the drain tile is in direct contact with the ***Polyflow™ DRAINAGE MAT*** core.

Backfill as soon as possible after drain installation.

DRAINAGE MATS

For Vertical: *Flow 15-P*
For Horizontal: *Flow 18-H*

Soil Drainage Mat with Built-In Protection Layer

POLYGUARD DRAINAGE MATS are three-part prefabricated geocomposite drain consisting of a formed polystyrene core covered on one side with polypropylene filter fabric. The fabric allows water to pass into the drain core while restricting the movement of soil particles which might clog the core. The core allows the water to flow to designated drainage exits. ***POLYGUARD FLOW 15-P*** is designed primarily for vertical applications and ***POLYGUARD FLOW 18-H*** is designed for horizontal applications.

POLYGUARD DRAINAGE MATS also have a built-in film protection layer. Use of a protection board is not necessary on most applications as the polymeric film layer protects softer waterproofing materials such as ***POLYGUARD 650*** waterproofing membrane.

The many uses include foundation walls, retaining walls, inclined drains, french drains, trench drains, interceptor drains, embankment drainage, athletic fields, earthen dams, planters, under slabs, and under pavers.

TYPICAL PROPERTIES	TEST METHOD	15-P	18-H
FABRIC PROPERTIES:			
Material		Polypropylene	Polypropylene
Weight, oz/yd^2	ASTM D3776	4.0	4.0
Grab Tensile Strength, lbs	ASTM D4632	110	365x200
Puncture Strength	ASTM D4833	65psi	105lbs
EOS *(AOS)*	ASTM D4751	100	40
Flow Rate, gpm/ft	ASTM D4491	150	100
CORE PROPERTIES:			
Material		Polystyrene	Polystyrene
Thickness, inch		.375	.375
Compressive Strength, lbs/ft^2	ASTM D1621 *(Mod.)*	15,000	21,000
DRAIN PROPERTIES:			
Flow Capacity, gpm/ft of width	ASTM D4716	16	18
Roll Length, feet		50	50
Roll Width, feet		4	4
Roll Weight, lbs		40	46

Polyguard

This Information is based on our best knowledge, but POLYGUARD cannot guarantee the results to be obtained.

Polyguard has been ISO 9000 certified since 1996. Current certifications are:
- American Natl. Standards Institute
- Dutch Council for Certification
- Deutscher Akkreditierungs Rat

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Web Site: www.polyguardproducts.com

VERTICAL INSTALLATION *(Primarily FLOW 15-P)*

1. Measure wall height or lift, adding sufficient material for overlapping pipe detail. Unroll ***FLOW 15-P*** and cut to length.
2. Peel back fabric from drainage core and remove 4" of core. *(Drain core should remain 6-12 inches below backfill.)*
3. At top termination glue fabric to wall or tuck fabric under core when using a furring strip. *(Furring strip can be removed after backfilling.)*
4. Glue adjacent panels at the vertical joints, making sure that fabric overlaps to prevent soil intrusion when backfilling.
5. At drain tile, peel back fabric from drainage core and wrap around drain tile. Tuck excess fabric under core, making sure inner core has direct contact with drain tile.
6. Backfill as soon as possible.

HORIZONTAL INSTALLATION *(FLOW 18-H)*

1. Clean horizontal surface of loose debris and unroll ***FLOW 18-H*** fabric side up in the direction of maximum slope.
2. Attach ***FLOW 18-H*** to the surface with double-sided tape or adhesive that is compatible with waterproofing membranes.
3. For overlaps, place adjacent panels so that the cores abut.
4. Secure the fabric overlap at five foot intervals with glue or tape.
5. Join roll ends by peeling back fabric and removing 4" of core.
6. Place end panels so that cores abut, then glue or tape fabric overlap.

NOTE: All core joints must be covered by fabric overlay. Protect waterproofing with approved protection system.

RECOMMENDED ADHESIVES

Polyguard 650 LT Liquid Adhesive, Maxbond Construction Adhesive, H B Fuller Co Plionail, Goodyear Liquid Nails, Miracle 297, 294, and Gibson-Homans Shur-Stick 94.

NOTE ON ISO 9000

Polyguard drainage mats are not covered by Polyguard's ISO 9001 quality system registration.

TOTAL FLOW
Soil Sheet Drain

POLYGUARD TOTAL FLOW is a combination of our Polyguard ***TOTAL FLOW*** sheet drain products with our unique ***TOTAL FLOW*** product. In the ***TOTAL FLOW*** System, the sheet drain performs its normal function of water collection, while the ***TOTAL FLOW*** section provides both water collection and a high-profile section allowing for high-capacity water flow to designated drainage exits. The ***TOTAL FLOW*** System provides three advantages over the use of perforated pipe:

- The high-profile ***TOTAL FLOW*** section has a larger open area than perforated pipe, allowing it to accept higher water flow from the sheet drain and surrounding soil.
- ***TOTAL FLOW***, with its manufactured transition between the sheet drain and high profile section, provides a secure flow path that is not dependent upon field installation.
- The ***TOTAL FLOW*** System is fast and easy to install. It eliminates the select backfill requirements that are normally required to provide strength to perforated pipe.

TYPICAL PROPERTIES	TEST METHOD	TOTAL FLOW
FLOW CAPACITY:		
Sheet Section	ASTM D 4716	16 gal/min/ft
High Profile Section	ASTM D 4716	100 gal/min/ft
CORE THICKNESS:		
Sheet Section		7/16 in
Roll Length, feet		50
Roll Width, feet		2
Roll Weight, lbs		30

NOTE ON ISO 9000

Polyguard drainage mats are not covered by Polyguard's ISO 9001 quality system registration.

x:/lit/arch/data sheets/38-Total Flow.doc R6/20/07

Polyguard

This Information is based on our best knowledge, but POLYGUARD cannot guarantee the results to be obtained.

Polyguard has been ISO 9000 certified since 1996. Current certifications are:
- American Nat'l. Standard's Institute
- Dutch Council for Certification
- Deutscher Akkreditierungs Rat

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Web Site: www.polyguardproducts.com

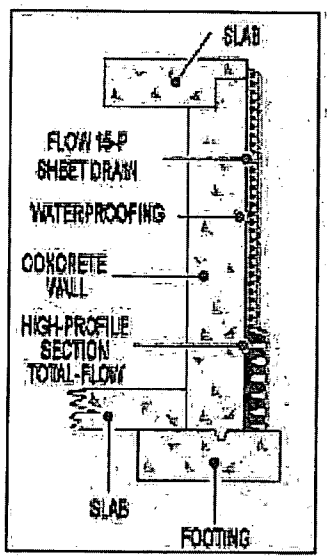
INSTALLATION INSTRUCTIONS
TOTAL-FLOW AND FLOW 15-P
Prefabricated Soil Sheet Drain

REQUIRED MATERIALS
1. 2' X 50' rolls of TOTAL-FLOW sheet drain.
2. 4' x 50' rolls of FLOW 15P sheet drain, if full wall drainage is required.
3. TOTAL-FLOW sheet drain corner guards
4. 3" wide underground tape
5. Attached materials (see below)
6. Knife or scissors, rubber hammer.

DRAIN ATTACHMENT METHODS
For attaching drain to waterproofing material, concrete or wood, several methods may be used including metal stick pins, nails driven through washers or wood lathing, construction adhesives or double sided tape. Discuss materials compatibility with waterproofing supplier before adhesives. Typically any method used for attaching waterproofing protection board will work for drain. For attaching drain to bare earth, 4-8" anchor pins with washers work well.

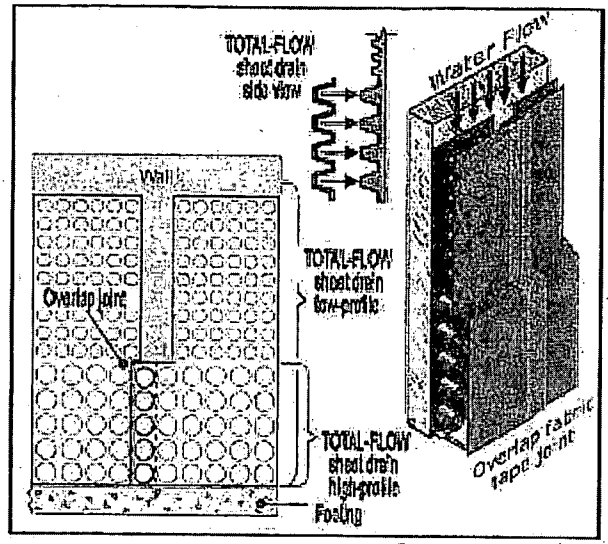
CLEAN WALL / WATERPROOF / INSULATE
Clean wall and apply waterproofing or insulation if required.

INSTALLING FIRST ROW OF DRAIN (The TOTAL-FLOW sheet drain row)
The first row of drain to be installed is the TOTAL-FLOW at the bottom of the wall. The drain should sit on top of the footing with the high profile part of the drain at the bottom to provide high lateral water flow.

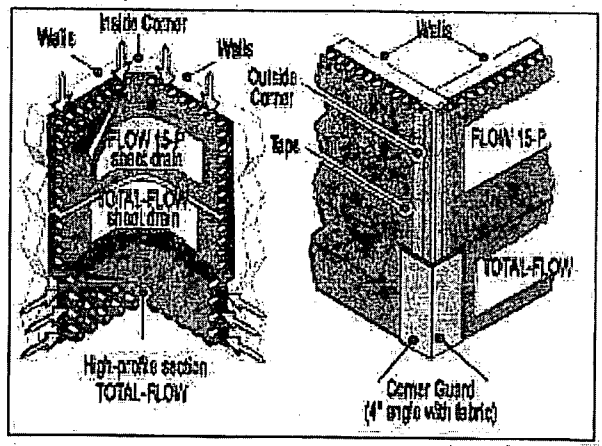


If not using Flow 15-P sheet drain for full wall coverage, close the top end of the drain to prevent soil intrusion by folding the fabric behind the drain. Close the high profile section with 3" underground tape.

INSTALLING NEXT ROLL OF FLOW
To attach the next roll of TOTAL-FLOW drain, cut one row of low-profile dimples from each end of the two sections to be joined. Do not cut fabric. Interlock one row of the high-profile section and secure connection. Overlap fabric and apply 3" wide underground tape from the top to the bottom of the joint to prevent soil intrusion.



GOING AROUND CORNERS
Bend drain to make inside corners. For outside corners, cut the low-profile core flush with corner and tape edges. Slit fabric on high-profile section, bend around corner, and place guard with fabric over slit of high-profile drain. Secure with underground tape.



Polyguard

This Information is based on our best knowledge, but POLYGUARD cannot guarantee the results to be obtained.

Polyguard has been ISO 9000 certified since 1966. Current certifications are:
- American Natl. Standards Institute
- Dutch Council for Certification
- Deutscher Akkreditierungs Rat

POLYGUARD PRODUCTS, INC • ENNIS, TEXAS 75120-0755
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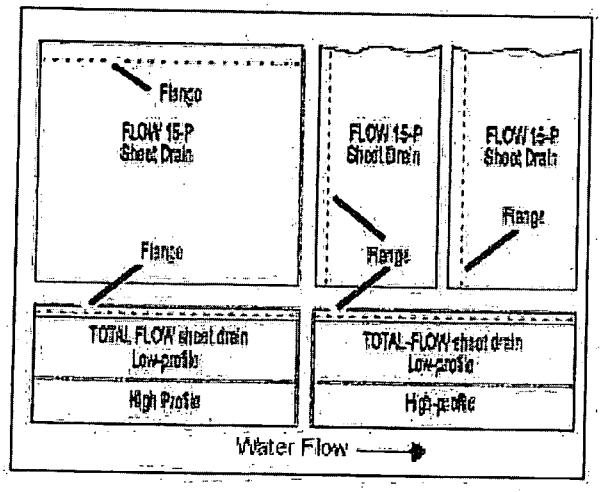
Web Site: www.polyguardproducts.com

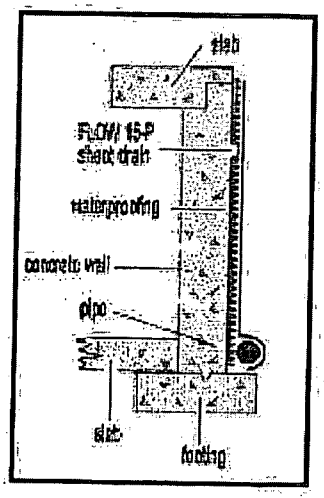
INSTALLATION INSTRUCTIONS
TOTAL-FLOW AND FLOW 15-P
Prefabricated Soil Sheet Drain

CONNECTING FLOW 15-P SHEET DRAIN:
If full wall drainage is required, FLOW 15-P soil sheet drain is attached above the TOTAL-FLOW sheet drain. The FLOW 15-P may be installed either horizontally or vertically.

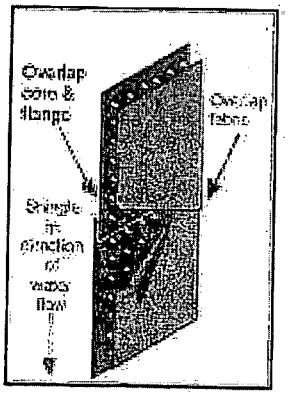
VERTICAL WALL:
When the FLOW 15-P sheet drain is installed vertically, the flange should be facing the direction opposite if the TOTAL-FLOW water flow. When the FLOW 15-P sheet drain is installed horizontally, the edge of the core with the flange should be at the top. This flange position, similar to roof shingle applications, minimizes seepage of water behind the drain. Fold back the fabric at the top of the TOTAL-FLOW sheet drain and place the FLOW 15-P sheet drain on top of the TOTAL-FLOW core flange. Fold fabric from sheet drain section down over the TOTAL-FLOW section and secure with 3" tape.

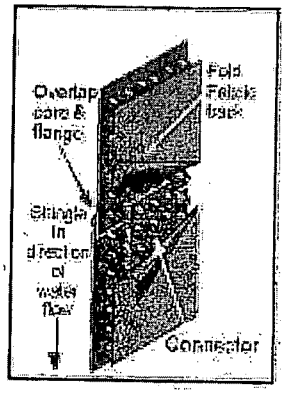


PIPE COLLECTION SYSTEM:
For foundation walls where a drain pipe will be used, position lower end of core horizontally on ground. Peel back fabric to allow drainage pipe to rest on core. Tuck fabric around drainage pipe and under core. Place small amount of select backfill material on fabric to hold in place until backfill is completed.



ATTACHING NEXT ROLL OF FLOW 15-P:
There are two acceptable methods for joining two sections of sheet drain.





METHOD #1
Fold back edge of fabric on lower (or downstream) drain. Do not detach from dimples. Place cones of upper (upstream) drain over flange of lower drain. Overlap fabric of upper drain over lower drain. Seal seam with 3" tape.

METHOD #2
Overlap drain core as shown at right. Peel back fabric exposing two rows of cones. Place connector over two rows of cones on each side of joint. Overlap fabric of upper drain over lower drain.

OPTIONAL METHOD
For either method, overlap fabric in direction of water flow. Use tape or spray adhesive, if necessary, to keep fabric at joint in place prior to backfilling. All edges of drain should have extra fabric tucked behind core edge to prevent soil from entering core.

NOTE:
The non-woven fabric is bonded to the core on the flange side with permanent glue (will not adhere if pulled from core) and on the flush side away from the flange with pressure sensitive glue (will re-adhere if pressure is applied). The pressure sensitive glue permits the fabric to be peeled back easily to be placed around pipes. Woven fabric is attached with all pressure sensitive glue. Permanent glue can be softened, if necessary, with a blow drier. Do not use near open flame to avoid damaging the fabric.

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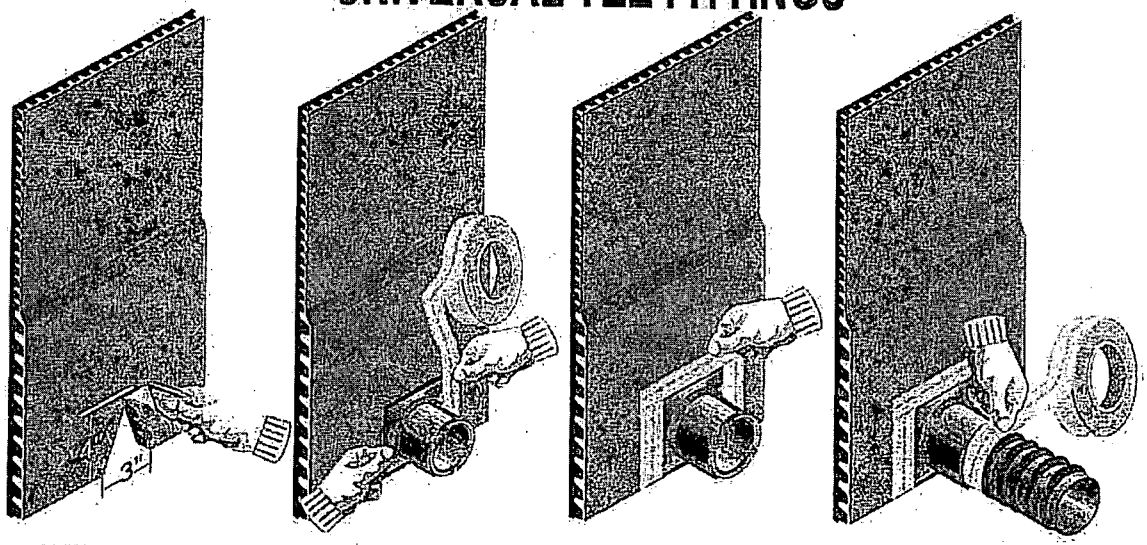
INSTALLATION INSTRUCTIONS
TOTAL-FLOW UNIVERSAL FITTINGS

UNIVERSAL TEE FITTINGS



STEP # 1

Use razor knife and cut a V-notch in the bottom portion of the TOTAL-FLOW approximately 3" wide at the bottom and 4" high and discard

STEP # 2

Insert fitting over notch and tape bottom of the TOTAL-FLOW

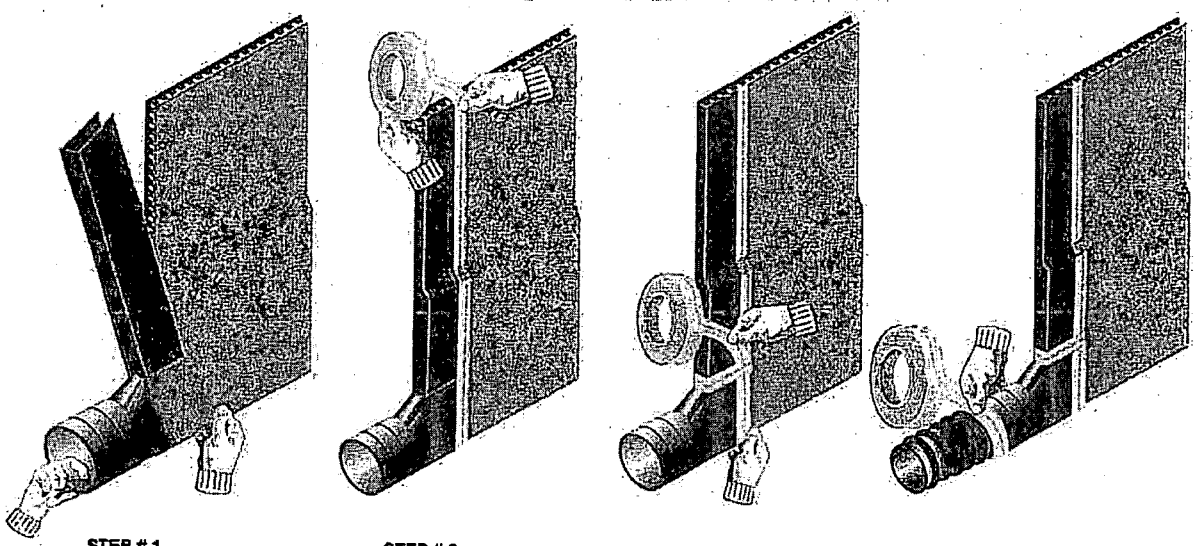
STEP # 3

Make sure all edges of fitting are covered with tape

STEP # 4

Insert pipe into fitting and secure with tape

UNIVERSAL OUTLET FITTINGS



STEP # 1

Place end outlet over bottom corner of TOTAL-FLOW with fabric up

STEP # 2

Fold fabric around exposed edge of core and tape with 3" underground tape

STEP # 3

Secure all edges with 3" tape to prevent soil intrusion

STEP # 4

Insert 4" pipe into end of outlet and secure connection with 3" tape

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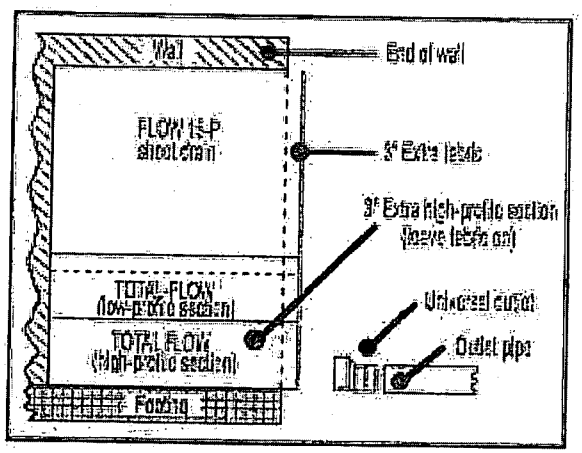
INSTALLATION INSTRUCTIONS
TOTAL-FLOW UNIVERSAL FITTINGS

GOING AROUND CORNERS
Bend drain to make inside corners. For outside corners, cut and bend drain core to reach corner and provide 3" of extra fabric to wrap around corner. Attach drain to wall and overlap fabric at joint.



RETAINING WALLS- (see Figure 1)
Cut bottom of drain to match bottom of wall. (Cut 1/2" diameter holes in flat back of core, opposite fabric) at weep locations. **DO NOT CUT FABRIC.** Place drain on wall fabric toward soil. Tuck extra fabric at downstream edge of core. Attach drain with appropriate attachment method.

SHORING WALLS - (see Figure 2) Place drain with fabric side toward soil to be drained. Cut 1/2" diameter holes on flat back of core at discharge pipe location. **DO NOT CUT FABRIC.** Concrete or gunnite/shotcrete may be placed directly against the core side of the drain.

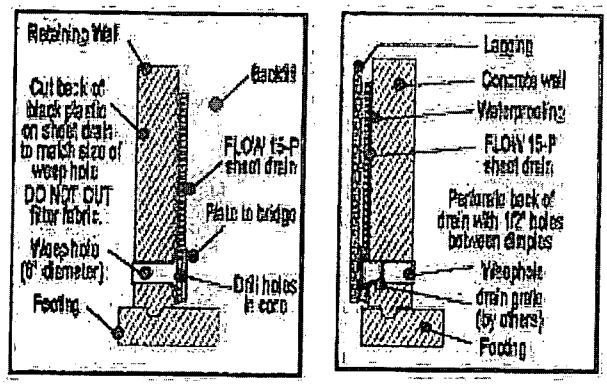


FIGURE 2

SEALING EDGES:
All edges of drain should have extra fabric tucked behind core edge seal to prevent soil from entering core.

BACKFILLING:
Soil should be placed and compacted directly against the drain. Direct compactor exhaust away from the drain to prevent damage. Backfill to a minimum of 6" above drain to allow for coverage after settlement.

FOR HORIZONTAL PLAZAS- (see Figure 3)
Place drain with fabric side up. Cut core and fabric to fit tightly around floor drain.

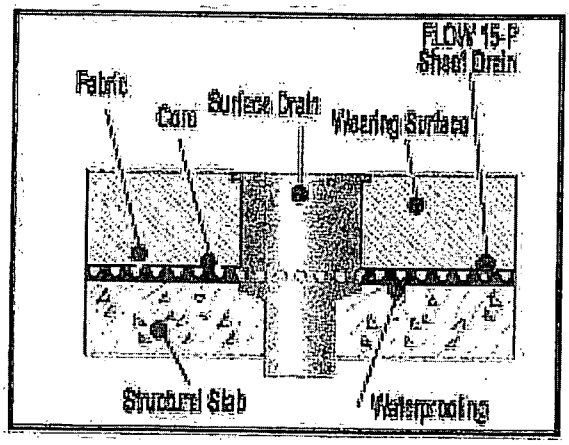
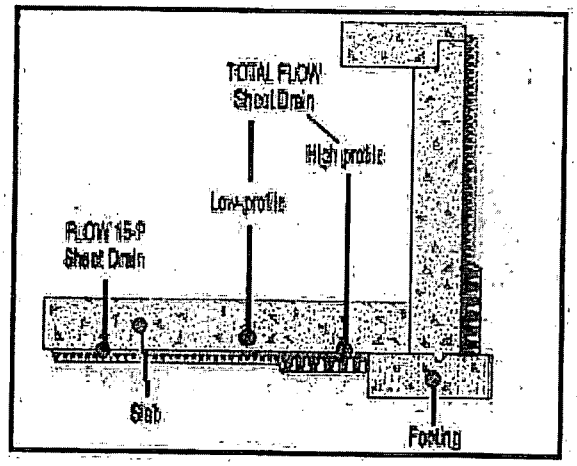


FIGURE 3

INSTALLATION UNDER SLABS
For under floor slab installation, position TOTAL-FLOW sheet drain as shown with geotextile to soil side. Waterproofing and/or floor slab can be applied directly to the back of the core.



QUANTITY TO ORDER:
It is suggested that in the absence of exact information on the amount of material required, add 5% to the estimated quantity.

X:/li/arch/totalflowandflow15-PInstallation.doc R, 4-10-06

Polyguard

[redacted] Services, Inc
Bus: (843)448-3900
Fax:(843)448-7150

Stoneledge @ La[redacted]eowee - Phase I

Apple To Apple

PRELIMINARY DRAFT 4/30/12

Item #	Description of Work	Unit	Qty	Mat/Sub	Mat/Sub T	Lab	Lab T	Total	Notes
1.00	**Roofing**								
1.01	Remove Existing Shingles	SF	75,806			0.40	30,322.40	30,322.40	
1.02	Remove Roof Sheathing	Sht	356			32.00	11,392.00	11,392.00	
1.03	Replace Roof Sheathing	Sht	356	16.00	5,696.00	48.00	17,088.00	22,784.00	
1.04	Install New 30lb Felt	SF	75,806	0.07	5,306.42	0.25	18,951.50	24,257.92	
1.05	Install New Shingles & Flashing	SF	75,806	1.00	75,806.00	1.25	94,757.50	170,563.50	
1.06	Structural Truss Repair Allowance	Allc	1					23,125.00	
	1.00 total							**282,444.82**	
2.00	**Exterior Wall Cladding System: Removal**								
2.01	Remove Cedar Lap Siding	SF	67,849			1.00	67,849.00	67,849.00	
2.02	Remove Cedar Shake Siding	SF	7,241			1.00	7,241.00	7,241.00	
2.03	Remove Existing WRB	SF	115,042			0.10	11,504.20	11,504.20	
2.04	Remove Exterior Windows	Ea	382			50.00	19,100.00	19,100.00	
2.05	Remove Exterior Doors	Ea	278			75.00	20,850.00	20,850.00	
2.06	Remove Cultured Stone	SF	39,952			1.50	59,928.00	59,928.00	
2.07	Remove Int Gyp Wall Shtg	SF							Not used
2.08	Remove Damaged OSB Shtg - 25%	SF	28,761			0.50	14,380.25	14,380.25	
	2.00 total							**200,852.45**	
3.00	**Exterior Wall Cladding System: Replacement**								
3.01	Repairs to Wood Stud Framing	Allc	1					46,250.00	
3.02	Replace Wall Sheathing	SF	28,761	0.75	21,570.38	1.50	43,140.75	64,711.13	
3.03	Install 30lb felt WRB	SF	115,042	0.10	11,504.20	0.40	46,016.80	57,521.00	
3.04	Reinstall Windows & Flashing	Ea	382	10.00	3,820.00	100.00	38,200.00	42,020.00	
3.05	Purchase New Window/Door	Allc	1					23,125.00	
3.06	Reinstall Door w/ Pans/Flashing	Ea	278	20.00	5,560.00	150.00	41,700.00	47,260.00	
3.07	Install New Cedar Lap Siding	SF	67,849	3.00	203,547.00	3.00	203,547.00	407,094.00	
3.08	Install New Cedar Shake Siding	SF	7,241	5.00	36,205.00	5.00	36,205.00	72,410.00	
3.09	Install New Cultured Stone	SF	39,952	7.00	279,664.00	6.00	239,712.00	519,376.00	
3.10	Stone Transition Flashing	LF	5,684	3.00	17,052.00	2.00	11,368.00	28,420.00	
3.11	Exterior Staining & Caulking	SF	75,090	0.50	37,545.00	1.25	93,862.50	131,407.50	
	3.00 total							**1,439,594.63**	
4.00	**Rear Elevated Concrete Balconies: Demo**								
4.01	Remove Concrete Toppings	SF	12,804			3.00	38,412.00	38,412.00	
4.02	Remove Damaged Subfloor	SF	12,804			1.00	12,804.00	12,804.00	
4.03	Inspect/Remove Damaged Framing	Unit	37			500.00	18,500.00	18,500.00	bldg 19 on slab
4.04	Demo Rotten T&G Ceilings	SF	10,656			0.75	7,992.00	7,992.00	4 units with crawlspace
4.05	Remove Screen Enclosure/Rails	Unit	37						in 5.07 & 5.09
	4.00 total							**77,708.00**	

[redacted] Services, Inc
Bus:(843)448-3900
Fax:(843)448-7150

Stoneledge @ La[redacted]eowee - Phase I

Apple To Apple

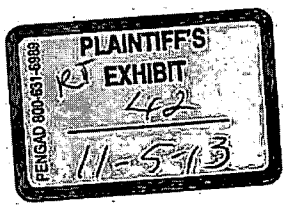
[redacted] 2

PRELIMINARY DRAFT 4/30/12

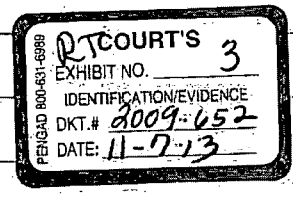
Item #	Description of Work	Unit	Qty	Mat/Sub	Mat/Sub T	Lab	Lab T	Total	Notes
5.00	**Rear Elevated Concrete Balconies: Replace**								
5.01	Repair Floor Framing/ Structure	Unit	37	2,127.66	78,723.42			78,723.42	
5.02	Install New PT Plywood Subfloor	SF	12,804	0.75	9,603.00	2.00	25,608.00	35,211.00	
5.03	Install Polyguard & Drain Mat	SF	12,804	8.00	102,432.00			102,432.00	
5.04	Install New Flashing	LF	3,267	3.00	9,801.00	2.00	6,534.00	16,335.00	
5.05	Install New Concrete Slabs	SF	12,804	5.00	64,020.00			64,020.00	
5.06	Install New T&G Ceilings	SF	10,656	1.50	15,984.00	3.00	31,968.00	47,952.00	
5.07	Remove/Replace screens	SF	14,724	2.50	36,810.00	3.00	44,172.00	80,982.00	changed
5.08	Remove/Reinstall handrails	LF	624			8.00	4,992.00	4,992.00	changed
5.09	Stain New T&G Ceilings	SF	10,656	0.25	2,664.00	1.00	10,656.00	13,320.00	
	5.00 total							**443,967.42**	
6.00	**Interior Finishes**								
6.01	Allowance for Gypsum Repairs	Unit	37	2,500.00	92,500.00			92,500.00	Allowance
6.02	Allowance for Flooring Repairs	Unit	37	2,500.00	92,500.00			92,500.00	Allowance
6.03	Allowance for Trim Carp. Repairs	Unit	37	1,000.00	37,000.00			37,000.00	Allowance
6.04	Allowance for Interior Painting	Unit	37	2,500.00	92,500.00			92,500.00	Allowance
	6.00 total							**314,500.00**	
7.00	**Fire Protection**								
7.01	Repair Fire Walls, Allowance	LS	1					46,150.00	Allowance
	7.00 total							**46,150.00**	
8.00	**Unforeseen Conditions Allowance**								
8.01	Contingency								In contingency
	8.00 total								
9.00	**General Conditions**								
9.01	General Conditions	Pct	7.00%		2,805,217.32			196,365.21	
	9.00 total							**196,365.21**	
	Sections 1.00 - 9.00 Total							**3,001,582.53**	
	Permits & License	Pct	1.25%					37,519.78	
	Overhead	Pct	10.00%					300,158.25	
	Profit	Pct	10.00%					300,158.25	
	Contingency	Pct	10.00%					300,158.25	
	P&P Bond	Pct	1.85%					55,529.28	
	TOTAL							**3,995,106.34**	

2713

CONTRACTOR	DATE	INVOICE #	ADDRESS(ES) OF REPAIRS		AMOUNT	
CDI of Seneca	5/14/2010	4657		220	$ 110.50	
	1/5/2010	4543		221	$ 185.00	
	1/1/2010	4592		333	$ 872.00	
	12/10/2009	4576		221	$ 680.00	
	12/1/2009	4572		402	$ 255.00	
	11/18/2009	4569		333	$ 2,445.00	
	10/23/2009	4556		333	$ 222.00	
	10/23/2009	4557		402	$ 860.00	
	10/1/2009	4498		219	$ 685.00	
	9/17/2009	4545		325	$ 185.00	
	9/17/2009	4544		324	$ 350.00	
	8/1/2009	4513		326	$ 1,150.00	
	7/31/2009	4514		324	$ 4,775.69	
	6/17/2009	4477		333	$ 125.00	
	6/17/2009	4478		227	$ 350.00	
	5/26/2009	4464		219	$ 375.00	
	5/26/2009	4467		327	$ 172.00	
	5/19/2009	4463		333	$ 372.50	
	4/23/2009	4445		333	$ 397.00	
	4/23/2009	4446		331	$ 1,235.00	
	4/23/2009	4447		225	$ 460.00	
	3/13/2009	4421		414,412,219	$ 2,262.50	
	1/22/2009	4384		326;331;333;225;414;219;220	$ 3,338.50	
CDI of Seneca		TOTAL			$ 21,862.69	
Trehel	4/29/2010	126333		414	$ 17,350.83	
	8/4/2010	126448		402;333;412;225	$ 26,836.00	
	9/30/2010	126506		424	$ 2,119.00	
	9/15/2010	126484			$ 2,350.00	
Trehel		TOTAL			$ 48,655.83	
Frano Stonework	8/24/2010				$300.00	
Paragon	8/27/2013	draw #8	418;420		$ 230.67	
	5/30/2013		414;416;326;223;230		$ 838.33	
	12/31/2012	draw #6	315;326		$ 476.00	
	12/31/2012	draw #7	414		$ 210.00	
	10/17/2012	draw #5	315;424		$ 753.00	
	8/28/2012		various phase 1		$ 3,776.29	
	7/19/2012	draw #3	various phase 1		$ 2,310.00	
	3/16/2012		various phase 1		$ 5,241.00	
	12/27/2011		various phase 1		$ 10,487.00	
	5/20/2011		various phase 1		$ 590.00	
	10/23/2009		BRACING OF PHASE 1 DECKS		$ 18,840.00	
Paragon					$ 43,752.29	TOTAL
Watkins Services	10/17/2013	3347	418,412,410,221		$ 25,230.00	
TOTAL					$ 139,800.81	



Please provide the charge for breach of warranty of workmanlike service and your charge for breach of fiduciary duty. These are numbers 2 and 3 of Verdict Form.



Stoneledge at Lake Keowee Owners' Association, Inc., v. IMK Development Co., LLC, et al

CASE NUMBER: 2009-CP-37-0652

SPECIAL JURY INTERROGATORIES

Please answer each question below. Once all questions have been answered, please alert the bailiff that you have completed this questionnaire.

1. When do you find that Stoneledge at Lake Keowee Owners' Association, Inc., by and through its board members, knew or reasonably should have known that some claim for construction deficiency(ies) might exist at the Stoneledge property?

_____ **(insert date here)**

2. Do you find that Stoneledge at Lake Keowee Owners' Association, Inc., by and through its governing board, could have filed a lawsuit against Bostic Brothers Construction and/or its subcontractors for construction deficiencies at the Stoneledge property on or before January of 2007?

YES

NO

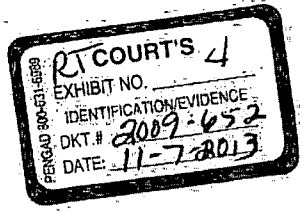
3. Do you find that Bostic Brothers Construction, Inc. prevented in some extraordinary way Stoneledge at Lake Keowee Owners' Association, Inc. from filing suit against them on or before January of 2007?

YES

NO

_____
MORRIS R. COBB, FOREMAN

Wallhalla, South Carolina
November ____, 2013.



Watkins Services, Inc
Bus:(843)448-3900
Fax:(843)448-7150

Stoneledge @ Lake Kewoee - Phase I

per Moore Hackney & Assc scope
& door hinge add

10/25/13

Item #	Description of Work	Unit	Qty	Mat	Lab	Total	Notes
GR	**GENERAL REQUIREMENTS**						
GR1	Project Manager	Wk	39		1,320.00	51,480.00	
GR2	Assistant Project Manager	Wk	39		1,000.00	39,000.00	
GR3	Telephone	Mo	9	220.00		1,980.00	
GR4	General Tools & Materials	Mo	9	150.00		1,350.00	
GR5	Mobilize Site with Equipment	LS	1		500.00	500.00	
GR6	Office/Storage rental	Mo	9	150.00		1,350.00	
GR7	Lifts & Scaffolding	Mo	9	3,000.00		27,000.00	
GR8	Pickup Truck	Mo	9	880.00		7,920.00	
GR9	Temporary Toilet	Mo	9	125.00		1,125.00	
GR10	Dumpster	Pull	10	660.00		6,600.00	
GR11	Landscaping	LS	7	2,000.00		14,000.00	
	General Requirements total					**152,305.00**	
	ROOFING					167,028.60	R1 through R13 total
R1	**No kick-out flashing installed**						
R1.1	Survey roofs for kickouts	Unit	37		10.00	370.00	
R1.2	Install Kick-out - ALLOWANCE	Ea	27	50.00	200.00	6,750.00	
	R1 total					**7,120.00**	
R2	**Missing/inadequate underlayment at eave**						
R2.1	Survey eaves & rakes	Unit	37		230.00	8,510.00	
R2.2	Remove/Reinstall shingles, install SAF to roof deck	LF	3,564	1.00	4.00	17,820.00	
	R2 total					**26,330.00**	
R3a	**Missing underlayment (Low Slope – 4:12 or less)**						
R3a.1	Survey low slope roofs for # of layers of underlayment	N/A					Move to R2.1 per MH&A
R3a.2	Remove/Replace shingles/underlayment where only 1 layer	SF	3,308	1.07	1.90	9,824.76	
	R3a total					**9,824.76**	
R3b	**Missing underlayment (Steep Slope - 4:12 or more)**						
R3b.1	Survey steep slope for underlayment	N/A					Move to R2.1 per MH&A
R3b.2	Remove/replace shingle, install underlayment	SF	1,000	1.07	1.90	2,970.00	* Allowance per MH&A
	R3b total					**2,970.00**	
R4	**Missing fasteners @ shingles**						
R4.1	Survey roofs for fasteners	Unit	37		40.00	1,480.00	
R4.2	Remove/replace shingle & underlayment	SF	8,886	1.07	1.90	26,391.42	
	R4 total					**27,871.42**	

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DEFENDANT'S EXHIBIT
B-4
11-6-13

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Stoneledge @ Lake Kewoee - Phase I

per Moore Hackney & Assc scope
& door hinge add

10/25/13

Item #	Description of Work	Unit	Qty	Mat	Lab	Total		Notes
R5	**Excessive edge distance of shingle overhang**							
R5.1	Survey eave & rake	N/A						Move to R2.1 per MH&A
R5.2	Trim shingles	LF	1,188		0.75	891.00		
	R5 total					**891.00**		
R6	**Shingles do not overhang roof edges**							
R6.1	Survey eave & rake	N/A						Move to R2.1 per MH&A
R6.2	Remove/Install Shingle - and adjust shingles	LF	1,188	2.50	4.00	7,722.00		
	R6 total					**7,722.00**		
R7	**Improper shingle, splice, broken shingles**							
R7.1	Survey roofs for improperly installed shingles	Unit	37		40.00	1,480.00		
R7.2	Remove/replace shingle	SF	8,886	1.00	3.00	35,544.00		
	R7 total					**37,024.00**		
R8	**Improper/inconsistent sidewall flashing**							
R8.1	Survey side walls	Unit	37		40.00	1,480.00		
R8.2	Remove/Reinstall shingles, install proper step flashing	LF	491	1.50	6.00	3,682.50		
R8.3	Remove/Replace sheathing	SF	50	0.75	3.50	212.50		
	R8 total					**5,375.00**		
R9	**Improper roof-to-wall flashing**							
R9.1	Survey roof-to-wall flashing	Unit	37		40.00	1,480.00		
R9.2	Remove/Reinstall shingle, siding, install new flashing	LF	787	3.00	10.00	10,231.00		
R9.3	Remove/Replace sheathing	SF	80	0.75	3.50	340.00		
	R9 total					**12,051.00**		
R10	**Inadequate roof sheathed deck attachment**							
R10.1	Survey roofs for sheathing attachment	N/A						Move to R2.1 per MH&A
R10.2	Remove/Replace Shingles/Underlayment, install fasteners in deck	SF	1,000	1.17	2.15	3,320.00		* Allowance per MH&A
	R10 total					**3,320.00**		
R11	**Inadequate construction for adjacent roof construction**							10% of the roof repair costs
R11.1	10% of roof cost	Pct	10%	151,844		15,184.42		
	R11 total					**15,184.42**		
R12	**Improper ventilation material/flashing**							
R12.1	Survey roof-to-wall ventilation	Unit	37		40.00	1,480.00		
R12.2	Remove/Replace roof-to-wall ventilation, underlayment	LF	590	5.00	10.00	8,850.00		Allowance
R12.3	Remove/Replace sheathing	SF	60	0.75	3.50	255.00		
	R12 total					**10,585.00**		

Item #	Description of Work	Unit	Qty	Mat	Lab	Total		Notes
R13	**Improper skylight installation**							
R13.1	Remove/Reinstall skylight, flash, shingle (for unit cost only)	Ea	1	100.00	500.00	600.00		
R13.2	Remove/Replace sheathing (for unit cost only) - 32 sf	LS	1	16.00	144.00	160.00		
	R13 total					**760.00**		
	ATTICS					3,875.00		A1 total
A1	**Broken Truss**							
A1.1	Survey trusses in attics	Unit	37		50.00	1,850.00		
A1.2	Repair broken truss - 12' 2x4, both sides of break	Loc	9	25.00	200.00	2,025.00		
	A1 total					**3,875.00**		
	LIFE SAFETY/FIRE PROTECTION					40,292.75		LS1 through LS3 total
LS1	**Missing fire protection between units**							
LS1.1	Survey attics	Unit	37		100.00	3,700.00		
LS1.2	Install fire protection were needed	SF	758	0.75	4.50	3,979.50		
	LS1 total					**7,679.50**		
LS2	**Incomplete fire protection between adjacent units**							
LS2.1	Survey attics	N/A						Move to LS1.1 per MH&A
LS2.2	Tape/Mud/Repair fire protection	SF	1,517	0.25	2.00	3,413.25		
	LS2 total					**3,413.25**		
LS3	**Windows(s) installed in fire protection/ adjacent units**							
LS3.1	Professional service for solution	LS	1	10,000.00		10,000.00		
LS3.2	Demo window, frame in, new exterior & interior finishes: Allowance	Ea	16	200.00	1,000.00	19,200.00		* Allowance per MH&A
	LS3 total					**29,200.00**		
	EXTERIOR WALLS					493,497.85		ews through EW25 total
ews	**EXTERIOR WALL SURVEYS (destructive tests) (ALLOWANCES)**							
ews.1	Window in siding	Bldg	7	200.00	1,000.00	8,400.00		
ews.2	Window in cultured stone	Bldg	7	200.00	1,500.00	11,900.00		
ews.3	Roof/Wall intersection in siding	Bldg	7	250.00	1,000.00	8,750.00		
ews.4	Intersect cedar/stone	Bldg	7	100.00	1,000.00	7,700.00		
ews.5	below grade waterproofing	Bldg	7		250.00	1,750.00		
	Exterior Wall Survey Total					**38,500.00**		
EW1	**Missing/incomplete WRB @ exterior side of walls**							
EW1.1	Install WRB behind cedar siding	SF	148	0.10	0.80	133.20		
EW1.2	Remove/Replace OSB	SF	8	0.50	3.00	28.00		
EW1.3	Remove/Replace Exterior Gyp	SF	71	0.75	3.00	266.25		
EW1.4	Remove/Replace Cedar Siding	SF	222	3.00	6.00	1,998.00		Assume OSB/Gyp @ missing WRB
	EW1 total					**2,425.45**		

Item #	Description of Work	Unit	Qty	Mat	Lab	Total		Notes
EW2	**Interior Gyp installed on exterior walls**							Assume full wall area
EW2.1	Install WRB behind cedar siding	SF	528	0.10	0.80	475.20		
EW2.2	Remove/Replace Exterior Gyp	SF	528	0.75	3.00	1,980.00		
EW2.3	Remove/Replace Cedar Siding	SF	528	3.00	6.00	4,752.00		
	EW2 total					**7,207.20**		
EW3	**Inadequate siding attachment**							
EW3.1	Install additional fasteners, paint nail head	SF	32,000	0.10	0.50	19,200.00		* Allowance per MH&A
EW3.2	Make repairs on building 7: Unit 32	N/A						Already repaired per MH&A
	EW3 total					**19,200.00**		
EW4	**Improper sealant @ weep side of flashing**							No repairs required
EW5	**No flashing @ cedar/stone water table**							
EW5.1	Install flashing @ cedar/stone intersection. Per 'b)" scope	LF	500	4.90	24.80	14,850.00		* Allowance per MH&A
EW5.2	Make repair to building 3: Unit 15	LF	60	4.90	24.80	1,782.00		
EW5.3	Make repairs to Building 7:Unit 33	LF	126	4.90	24.80	3,742.20		
	EW5 total					**20,374.20**		
EW6	**No flashing @ water table in stone**							
EW6.1	Install water table flashing (FOR unit cost only)	LF	500	11.10	15.15	13,125.00		* Allowance per MH&A
EW6.2	Make repairs to Building 7:Unit 32	N/A						Already repaired per MH&A
	EW6 total					**13,125.00**		
EW7	**WRB reverse lap @ cedar/stone intersection**	**N/A**						Covered in EW5
EW8	**No flashing @ head of window in stone**							
EW8.1	Remove/Reinstall window with proper flashing (per window unit cost)	Ea	100	275.00	600.00	87,500.00		* Allowance per MH&A
EW8.2	Make repairs to building 3: Unit 15	Ea	1	275.00	600.00	875.00		Allowance for 1 window
	EW8 total					**88,375.00**		
EW9	**No flashing @ sill of window in stone**							Covered in EW8
EW10	**No base of wall flashing @ stone**							
EW10.1	Grade, install base flash on wood frame (b1) (FOR unit cost only)	LF		13.10	20.15			Includded in EW14
EW10.2	Install base flash on wood frame (c1) (FOR unit cost only)	LF		13.10	17.15			Includded in EW14
EW10.3	Grade, install base flash on wood frame (b1)	LF		13.10	20.15			Includded in EW14
EW10.4	Install base flash on wood frame (c1)	LF		13.10	17.15			Includded in EW14
	EW10 total							
EW11	**Stone installed below grade**	**N/A**						Includded in EW14

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Stoneledge @ Lake Kewoee - Phase I

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Item #	Description of Work	Unit	Qty	Mat	Lab	Total		Notes
EW12	**Stone adhesion failure**							
EW12.1	Remove/Replace stone (FOR unit cost only)	SF		7.00	20.00			Unit cost
EW12.2	Remove/Replace stone	SF	3	7.00	20.00	81.00		
	EW12 total					**81.00**		
EW13	**Stone cracked/damaged**	**N/A**						Covered in EW12
EW14	**Inconsistent waterproofing detail @ below grade walls**							
EW14.1	Repair waterproofing - extent not known	Unit	37	8,000.00		296,000.00		* Allowance per MH&A
EW14.2	Repair waterproofing @ below grade pipe penetration	Unit		8,000.00				Included in EW14.1
	14.00 total					**296,000.00**		
EW15	**Water intrusion below grade. Corroded metal**	**N/A**						**No repairs required**
EW16	**Water intrusion below grade. Open cell foam**	**N/A**						**No repairs required**
EW17	**Water intrusion below grade. Open joints around pipe**	**N/A**						**No repairs required**
EW18	**Water intrusion @ main floor bath. (Allowance)**							
EW18.1	Remove/Replace wall tile	SF	30	4.00	15.00	570.00		
EW18.2	Remove/Reinstall garden tub	Ea	1	20.00	750.00	770.00		
EW18.3	Make repair to concrete around bathtub	SF	4	5.00	35.00	160.00		
EW18.4	Allowance for prep & cleanup & unknowns	LS	1	10.00	500.00	510.00		Vanity, toilet, anything
	EW18 total					**2,010.00**		
EW19	**Inadequate wall sheathing attachment**							Assumes cedar out of way
EW19.1	Install additional fasteners into wall sheathing	SF	1,000	0.05	0.50	550.00		* Allowance per MH&A
EW19.2	Make repairs to Building 7:Unit 32	N/A						Already repaired per MH&A
	EW19 total					**550.00**		
EW20	**Stone installed in contact with concrete path/stoop**							
EW20.1	remedy stone w/ 2" gap, non habitable	LF		11.10	15.15			Unit cost
EW20.2	stone w/ 2" gap, flashing, waterproof, habitable	LF		13.10	17.15			Unit cost
EW20.3	stone w/ 2" gap, flashing, waterproof, habitable	LF	100	13.10	17.15	3,025.00		* Allowance per MH&A
EW20.4	remedy stone w/ 2" gap, non habitable	LF	100	11.10	15.15	2,625.00		* Allowance per MH&A
	EW20 total					**5,650.00**		
EW21	**WRB reverse lapped with metal flashing**	**N/A**						Part of EW1 & 5-10, R1,8,9 & 12
EW22	**Hole in sheathing/insulation @ pipe penetrations**	**N/A**						Part of EW14
EW23	**Water intrusion @ framing, below grade & under front porch**	**N/A**						Part of B2
EW24	**Water intrusion @ below grade base of wall on front porch**	**N/A**						Part of EW14
EW25	**No flashing between cedar lap siding & cedar trim board**	**N/A**						No repair required

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Stoneledge @ Lake Kewoee - Phase I

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Item #	Description of Work	Unit	Qty	Mat	Lab	Total		Notes
	WINDOWS					90,000.00		W1 through W5 total
W1	**Incomplete/inadequate rough opening flashing @ windows**							
W1.1	R/R trim, siding, RSR window (FOR unit cost only)	Ea		150.00	750.00			Unit cost
W1.2	R/R trim, siding, RSR window,	Ea	100	150.00	750.00	90,000.00		* Allowance per MH&A
	W1 total					**90,000.00**		
W2	**Inadequate flashing @ window(s)**	**N/A**						Part of W1 & EW8
W3	**Improper material used as flashing @ windows**	**N/A**						Part of W1
W4	**Flashing above wood trim @ reverse lapped with WRB**	**N/A**						Part of W1
W5	**Window sill nailing fin sealed with flex flashing**	**N/A**						Part of W1 & EW8
	EXTERIOR DOORS							
D1	**Incomplete/inadequate rough openings flashing @ ext doors**	**N/A**						Part of B2
D2	**Incomplete/inadequate pan flashing @ ext doors**	**N/A**						Part of B2
	BALCONY & PATIO AREAS					671,520.13		B1a through B5 total
B1a	**Incomplete/inadequate WRB at posts with stone**							
B1a.1	Survey, remove/Replace Stone at posts	Unit	37	200.00	1,200.00	51,800.00		
B1a.2	Survey, Remove/Replace stone - 1 section per side @ columns	Unit	32	200.00	1,200.00	44,800.00		Was part of B3a
B1a.3	R/R column, sheathing & WRB	Clm	1	750.00	2,000.00			Unit cost
B1a.4	R/R stone, column, sheathing & WRB	Post	1	260.00	925.00			Unit cost
B1a.5	R/R column, sheathing & WRB - ALLOWANCE. Per column	Clm	93	750.00	2,000.00	255,750.00		* Allowance per MH&A
B1a.6	R/R stone, column, sheathing & WRB - ALLOWANCE. Per post	Post	93	260.00	925.00	110,205.00		* Allowance per MH&A
	B1a total					**462,555.00**		
B1b	**Incomplete/inadequate WRB at post(s) with stone**	**N/A**						
B2	**WRB reverse lap w/ flash extend out from edge concrete deck**							
B2.1	Survey all balcony/patios for issues with flashing	Unit	37		500.00	18,500.00		Allowance
B2.2	Remove/Replace Concrete topping slab	SF	5,580	2.00	6.00	44,640.00		Repair 31 exposed balconies
B2.3	Remove/Replace Stone for flashing	SF	2,418	13.10	17.15	73,144.50		
B2.4	Install new flashing	LF	1,209	3.00	2.00	6,045.00		
B2.5	New waterproofing	SF	5,580	3.00	5.00	44,640.00		
B2.6	Allowance for damaged sheathing	SF	1,395	0.75	4.25	6,975.00		
B2.7	Allowance for damaged framing	SF	605	1.50	5.75	4,382.63		
B2.8	Allowance for tying into screened porch waterproofing	LS	1	200.00	600.00	800.00		
	B2 total					**199,127.13**		
B3a	**Incomplete/inadequate WRB @ columns with stone**	**N/A**						Part of B1a
B3b	**Incomplete/inadequate WRB @ columns with stone**	**N/A**						No repair required.
B4a	**Stone in contact with top of concrete deck**	**N/A**						Part of B2
B4b	**Stone in contact with top of concrete deck**	**N/A**						No repair required.

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Item #	Description of Work	Unit	Qty	Mat	Lab	Total		Notes
B5	**Stone applied in hanging horizontal location**							
B5.1	Survey units for hanging stone	Unit	37		10.00	370.00		
B5.2	Remove stone, install stucco	SF	500	6.00	12.00	9,000.00		* Allowance per MH&A
B5.3	Make repairs to Building 5:Unit 25	SF	13	6.00	12.00	234.00		
B5.4	Make repairs to Building 7:Unit 33	SF	13	6.00	12.00	234.00		
	B5 total					**9,838.00**		
	ELECTRICAL					4,810.00		E1 total
E1	**No exterior electrical box @ exterior outlet**							
E1.1	Survey exterior electrical outlets	Unit	37		20.00	740.00		
E1.2	Install junction box where missing	Ea	1	10.00	100.00			Unit cost
E1.3	Install junction box where missing	Ea	37	10.00	100.00	4,070.00		* Allowance per MH&A
	E1 total					**4,810.00**		
	BALCONY/PATIO DOOR HINGES					27,170.00		H total
H	**Replace hinges: With Stainless steel, non-removal pin hinges**							
H1.1	Replace patio door hinges w/ stainless steel non removal pin	Dr	120	90.00	40.00	15,600.00		3 hinges per door
H1.2	Replace balcony door hinges w/ stainless steel non removal pin	Dr	89	90.00	40.00	11,570.00		3 hinges per door
	H total					**27,170.00**		
	subtotal					**1,650,499.32**		Does not include any unit cost
	Permits & License	Pct	1.25%			20,631.24		
	Contingency	Pct	10.00%			167,113.06		
	Overhead	Pct	10.00%			165,049.93		
	Profit	Pct	10.00%			165,049.93		
	Design & Administration Fees	Pct	7.50%			123,787.45		
	TOTAL					**2,292,130.93**		

FILED FOR RECORD
OCONEE COUNTY, SC
REGISTER OF DEEDS

STATE OF SOUTH CAROLINA) AMENDED AND RESTATED
) DECLARATION OF COVENANTS, CONDITIONS,
COUNTY OF OCONEE) AND RESTRICTIONS FOR STONELEDGE AT
2005 NOV 30 A 9:LAKE KEOWEE

Doc ID: 000879370003 Type: DCE
BK 1464 PG 33-65

THIS AMENDED AND RESTATED DECLARATION OF COVENANTS CONTAINS ARBITRATION PROVISIONS PURSUANT TO SECTION 15-48-10 ET. SEQ. CODE OF LAWS OF SOUTH CAROLINA, 1976, AS AMENDED.

THIS AMENDED AND RESTATED DECLARATION is made as of this 1st day of November, 2005, by IMK DEVELOPMENT CO., LLC, a South Carolina limited liability company, hereinafter referred to as the "Declarant," and STONELEDGE AT LAKE KEOWEE OWNERS' ASSOCIATION, INC., A South Carolina non-profit corporation, hereinafter referred to as the "Association" or "Homeowners' Association."

W I T N E S S E T H:

WHEREAS, the Declarant is the owner of certain property in Oconee County, South Carolina, which is more particularly described as follows:

(See EXHIBIT A attached hereto for description)

WHEREAS, Declarant's predecessor in interest, Keowee Townhouses, LLC, a South Carolina limited liability company, has previously filed an Amended and Restated Declaration of Covenants, Conditions and Restrictions for Stoneledge at Lake Keowee Phase I, Section 1, dated August 21, 2003, and recorded August 22, 2003, in the Office of the Register of Deeds for Oconee County, South Carolina, in Deed Book 1296, at Page 325, as amended by that certain First Amendment to the Amended and Restated Declaration of Covenants, Conditions and Restrictions for Stoneledge at Lake Keowee, dated August 29, 2003, recorded August 29, 2003, in Deed Book 1298, Page 194, and that certain Supplement to the Amended and Restated Declaration of Covenants, Conditions and Restrictions for Stoneledge at Lake Keowee, Phase I, Section1, dated October 23, 2003, recorded October 24, 2003 in Book 1309, page 12, subjecting the Property (hereinafter defined) to certain protective covenants, conditions, restrictions, liens and charges as therein set forth (the "Original Declaration");

WHEREAS, Keowee Townhouses, LLC, has assigned all of its right title and interest in the Property to IMK Development Co., LLC, a South Carolina limited liability company, as evidenced by that certain Assignment of Declarant's Rights by and between Keowee Townhouses, LLC and IMK Development Co., LLC dated as of April 28, 2005, recorded April 29, 2005 in Deed Book 1415, page 30, aforesaid records;

WHEREAS, Declarant has changed the name of the subdivision to "Stoneledge at Lake Keowee" as evidenced by the certain Second Amendment to the Amended and

Restated Declaration of Covenants, Conditions and Restrictions for Stoneledge at Lake Keowee dated June 30, 2005, recorded July 15, 2005, in Book 1432, at Page 182, in the aforementioned land records, and desires to file this Amended and Restated Declaration of Covenants Conditions; and,

WHEREAS, this Amended and Restated Declaration has been adopted by the Association at a duly called meeting on September 26, 2005, at which a quorum was present and at least seventy-five percent (75%) of the Lot Owner's were present; and,

WHEREAS, it is the intent of Declarant, the Association and Lot Owners that this Amended and Restated Declaration of Covenants, Conditions and Restrictions for Stoneledge at Lake Keowee superseded the Original Declaration;

NOW, THEREFORE, the Declarant hereby declares that all of the property described above shall be held, sold, and conveyed subject to the following easements, restrictions, covenants, and conditions, all of which are for the purpose of enhancing and protecting the value, desirability and attractiveness of the real property. These easements, restrictions, covenants, and conditions shall run with the real property and shall be binding on all parties having or acquiring any right, title or interest in the described property or any part thereof, and shall inure to the benefit of each owner thereof.

ARTICLE I.
DEFINITIONS

Section 1. "Association" or Homeowners' Association," shall mean and refer to Stoneledge at Lake Keowee, Inc., a South Carolina non-profit corporation, its successors and assigns.

Section 2. "Board of Directors" or "Board" means those persons elected or appointed and acting collectively as the Directors of the Association.

Section 3. "Boat dock" means any boat dock or combination of boat docks constructed on Lake Keowee by Declarant, including all sidewalks installed by Declarant around Lake Keowee providing access to each boat dock and the lighting facilities used in conjunction with each boat dock.

Section 4. "Boat slip" means the boat slips in any boat dock constructed on Lake Keowee by Declarant. In conjunction with the purchase of a unit within the Subdivision, each Owner is required to purchase a license to use a boat slip within a boat dock which license cannot be transferred except in conjunction with the sale of the unit.

Section 5. "Builder" shall mean and refer to a licensed builder in good standing with Declarant, its successors and assign.

Section 6. "Building" shall mean and refer to a structure containing one or more units constructed or erected on the Property.

Section 7. "By-laws" means the by-laws of the Association as they now or hereafter exist.

Section 8. "Common area" shall mean and refer to all tangible and intangible personal property, real property, buildings, private roads, garbage disposal facilities, if any, boat docks, if any, mailbox stations, cabana, tennis courts, pool, recreational parking facilities and other amenities, if any, within the Property owned by or to be conveyed to the Association, along with facilities and improvements erected or constructed thereon, for the exclusive use and enjoyment of the members of the Association as shown on the aforementioned recorded plat and the plats of additional properties hereafter annexed as hereinafter provided. The Common Area shall specifically exclude any areas designated as "Future Development" on a recorded plat which areas are specifically set aside for future development by the Declarant. Said common area shall be maintained by the Association at its expense, subject to any restrictions or limitations set forth in the deed of conveyance.

Section 9. "Common expenses" shall mean and include:

(a) All sums lawfully assessed by the Association against its members;

(b) Expenses for maintenance of the units as provided in this Declaration;

(c) Expenses of administration, maintenance, repair or replacement of the common areas;

(d) Expenses declared to be common expenses by the provisions of this Declaration or the By-laws;

(e) Hazard, liability or such other insurance premiums as the Declaration or By-laws may require the Association to purchase;

(f) Expenses agreed by the members to be common expenses of the Association.

Section 10. "Common profits" shall mean and refer to the balance of all income, rents, profits, and revenues of the Association remaining after the deduction of the common expenses or reserves therefor. Common profits shall not mean or include any sums lawfully assessed against members by the Association.

Section 11. "Declarant" shall mean and refer to IMK Development Co., LLC, a South Carolina limited liability company, its successors and assigns to whom the rights of Declarant are expressly transferred, or if such successors or assigns should acquire more than one undeveloped lot or undeveloped acreage for the purpose of development, or

acquire title to the property under a deed in lieu of foreclosure or judicial foreclosure, or one otherwise denominated a "Declarant" hereby.

Section 12. "Declaration" shall mean and refer to this Amended and Restated Declaration of Covenants, Conditions and Restrictions for Stoneledge at Lake Keowee.

Section 13. "Design Guidelines" shall mean and refer to the exterior plans and specifications and exterior color and finish requirements approved by the Architectural Committee from time to time.

Section 14. "Garbage disposal station" shall mean and refer to the area(s), if any are constructed, within the subdivision which is designated by the Declarant or the Association, as the case may be, as a garbage disposal station.

Section 15. "Limited common area" shall mean and refer to those common elements maintained by the Association in common with the common areas which are reserved for the use of a certain number of units or owners to the exclusion of other units or owners such as the boat slips, recreational parking facilities, and mail boxes in the mailbox station which the Association shall maintain in common with the common areas.

Section 16. "Lot" shall mean and refer to any plot of land within the Property, other than the common area and areas designated as Future Development, shown on a recorded subdivision plat of the Property and upon which a residence has been or may be constructed.

Section 17. "Mailbox station" shall mean and refer to the area(s) within the common area of the subdivision which are designated by the Declarant or the Association, as the case may be, as a mailbox station.

Section 18. "Member" shall mean and refer to every person who is a member of the Association.

Section 19. "Owner" shall mean and refer to the record owner, whether one or more persons or entities, of a fee simple title to any lot or unit which is a part of the Property, including contract sellers, but excluding those who have such interest merely as security for the performance of an obligation.

Section 20. "Person" shall mean and refer to any individual, corporation, partnership, association or trustee or other legal entity.

Section 21. "Property" shall mean and refer to that certain real property hereinbefore described in **Exhibit A** and such additions thereto as may hereafter be brought within the jurisdiction of the Association by annexation.

Section 22. "Recreational parking facilities" shall mean and refer to those parking facilities, if any, constructed within the subdivision by Declarant dedicated solely for the parking and storage of recreational vehicles. Licenses for the use of the parking spaces within the recreational parking facilities can be sold by Declarant to owners separate and apart from a unit on a first come first serve basis which license cannot be transferred except to another owner of a unit within the subdivision. In the event of any such transfer, the owner who purchases a license to use the recreational parking facilities from another owner shall promptly notify the Association in writing of the transfer.

Section 23. "Residence", "dwelling", "town home" "town house" or "unit" shall mean and refer to a dwelling or place of residence constructed upon a lot, including the lot, within the Property and constituting all or part of a building.

Section 24. "Subdivision", "project", "development", or "PUD" shall mean and refer to the Property.

ARTICLE II.
ANNEXATION OF ADDITIONAL PROPERTIES

Section 1. The Declarant may unilaterally annex additional properties to the Property herein described for the purpose of subjecting the annexed property to the provisions of this Declaration and the jurisdiction of the Homeowners' Association. Additional properties so annexed shall be merged with the Property herein described and any other previously annexed property, and shall be subject to the provisions of this Declaration and to the Articles of Incorporation and By-laws of the Association. All properties annexed shall be contiguous (i) to the Property herein described or (ii) to property previously annexed.

Section 2. Such annexation shall be accomplished by recording a supplemental Declaration annexing such property in the Register of Deeds Office for Oconee County, South Carolina. Such supplemental Declaration shall not require the consent of the Homeowners' Association or any Owner, but shall require the consent of the owner of the annexed property, if other than the Declarant. Said annexation shall be effective upon the filing of the supplemental Declaration unless otherwise provided therein.

Section 3. The Declarant reserves the right to amend this Declaration unilaterally at any time so long as it holds an option to annex property pursuant to this Article, without the prior notice or consent of the Homeowners' Association or any Owner, for the purpose of removing certain portions of the property subject to this Declaration then owned by Declarant, or one of its affiliates, including any portion of the property now or hereinafter designated as part of the sewer facilities, from the provisions of this Declaration.

ARTICLE III.
PROPERTY RIGHTS

Section 1. Owners' Easements of Enjoyment. Subject to the provisions of these covenants and the rules and regulations of the Association as adopted by the Board of Directors, every owner shall have a right and easement of enjoyment in and to the common area which shall be appurtenant to and shall pass with the title to every assessed unit, subject to each of the following provisions.

(a) The right of the Association to limit the number of guests of members.

(b) The right of the Association, in accordance with its Articles and By-laws, to borrow money for the purpose of improving the common area.

(c) The right of the Association to suspend the voting rights (and right to use of any recreational facilities located upon the common area) of a member, or any person to whom he has delegated his voting right, for any period during which any assessment against his unit remains unpaid and for a period as determined by the Board of Directors for any infraction of the Association's published rules and regulations.

(d) The right of the Association to formulate, publish, and enforce rules and regulations as provided in Article X.

(e) The right of the Association to levy assessments in accordance with Article VI hereof.

(f) The right of the Association to suspend the right of a member to use the recreational facilities or boat docks and boat slips for any period during which any assessment against his unit remains unpaid and for a period as determined by the Board of Directors for any infraction of the Association's published rules and regulations.

Section 2. Delegation of Use. Any owner may delegate, in accordance with the By-laws, his rights of enjoyment to the common area to the members of his family, his tenants, or contract purchaser provided, every such delegee shall reside on the Property.

Section 3. Title to Common Area and Limited Common Area. At such time as Class A Members shall take control of the Association, the Declarant hereby covenants for itself, its successors and assigns, that it will convey to the Association fee simple title to the common areas and limited common areas shown upon the recorded plat free and clear of all liens and encumbrances, except utility and drainage easements and easements to governmental authorities, upon condition that such common area shall be for the sole and exclusive use and benefit of members, as long as such area is maintained in conformity with the requirements of this Declaration, the By-laws, and the Articles of Incorporation of the Association at the sole expense of the Owners. Similarly, the Declarant will convey to

the Association, upon the same conditions and for the same uses and purposes, common areas and limited common areas which are part of any additional properties that are annexed by it in the future. The Association shall be bound to accept the conveyance by Declarant and shall own and maintain such common areas and limited common areas at its expense, subject to any restrictions or limitations set forth in the deed of conveyance.

Section 4. Parking and Access Rights. Subject to the provisions of these covenants and the rules and regulations of the Association, the owners of each unit shall park their automobile(s) in the spaces, driveways or garages reserved by the Declarant or the Association, as the case may be, to serve each unit. All unit owners are hereby granted the right of ingress and egress from their respective units to the roads located on the property which are to be private roads, as well as an easement from all private roads to Morgan Road. No recreational vehicles may be stored within the property or common area, except in a licensed recreational parking space designated for such use, or in a garage of a residence containing a garage, provided the garage door is closed and said vehicles or accessories are not visible to persons from the outside. No automobiles or trucks shall be parked or maintained on the property unless they have a current license plate affixed thereto.

Section 5. Sanitary Sewer Service. Sanitary sewer treatment service will be provided to the Property by United Utility Companies, Inc., a private utility company (hereinafter referred to as the "Utility") pursuant to an Operation and Maintenance Agreement by and between the Association and the Utility whereby the Utility will own the Treatment Facilities and will provide sanitary sewer treatment to the Property pursuant to the terms of the Operation and Maintenance Agreement and the regulations of appropriate regulatory agencies and governmental authorities. All sewer utility service facilities located on, under or within the boundaries of the Property shall be the property of the Association, who shall have and bear sole responsibility for the maintenance, repair and replacement of such sewer utility service facilities, including, but not limited to, all sanitary sewer mains, valves, cleanouts, pipes, lines, laterals, meters, or connections associated with such sewer utility facilities (hereinafter referred to as the "Service Facilities"). Such maintenance shall be the responsibility of the Association and shall be paid for as a common expense of the Association, unless it can be shown that such maintenance is being required as a result of the intentional or grossly negligent act of an Owner (in which case such Owner shall be responsible for the cost associated with the same). Several sanitary sewer service lines within the Property have been installed and are located partially under parking areas and garages. The Declarant, on behalf of each Owner, consents to such encroachment by the sanitary sewer service lines underneath such parking areas and garages and grants the Association an easement of access in, upon and to such areas within parking areas or garages under which a sanitary sewer line exists for the purpose of maintaining said sanitary sewer service line. Upon completion of any such maintenance, the Association shall, as a common expense, return those portions of the affected Residence to the condition it was in immediately preceding such maintenance. Each Owner, by taking title to a lot, hereby releases, discharges and acquits Declarant from and against all claims, demands, liabilities, costs, expenses, rights of action and/or causes of action of every kind

and nature, past, present or future, arising out of any sanitary sewer service line being located underneath a garage.

There is hereby reserved to United Utility Companies, Inc., its successors or assigns, an easement and right of way upon, across and over the property of each lot/unit owner and common areas owned by the Association for access to the sewer utility service facilities located on, under or within such properties, for the purpose of inspection in the normal course of operating the sewer utility treatment system serving the Property subject of the within restrictions. Any required repairs, maintenance or replacement of the sewer utility service facilities on the Property shall be promptly undertaken by the Association upon notification by United Utility Companies, Inc. that repair, maintenance or replacement is required to prevent a malfunctioning of the sewer treatment system serving the Property. The rights reserved to United Utility Companies, Inc. hereby are in addition to any other rights which it may hold as a public utility under its rate schedule, or under law, rule, regulation or order of appropriate governmental authority. The foregoing restrictions and easement rights may not be altered, amended, revised, or modified except with the written consent of United Utility Companies, Inc., its successors or assigns.

Section 6. No Dedication of Roadways or Entranceways. Declarant does not intend to dedicate the areas designated as a "Roadway," "Drive Way," "Avenue," Boulevard," "Court," "Drive," "Road," "Lane," "Place," or "Street" on the Plat to any public agency or authority, it being the Declarant's intent that the roads remain private. Prior to the conveyance of the first Lot to an Owner, Declarant shall covey the areas designated as "Avenue," Boulevard," "Court," "Drive," "Road," "Lane," "Place," or "Street" on the Plat to the Association to be maintained as provided herein. Notwithstanding the foregoing and for so long as Declarant owns real property within the Subdivision, Declarant specifically reserves the right to dedicate or convey any street, road or driveway to any governmental entity at any time following the date hereof without the consent or approval of any Owner or the Association. In such event, the Association shall cooperate with Declarant to accomplish such dedication.

ARTICLE IV.
HOMEOWNERS' ASSOCIATION

Section 1. Nonprofit Corporation. Stoneledge at Lake Keowee Owners' Association, Inc., is a nonprofit corporation organized under the laws of the State of South Carolina. The Association shall be managed by a Board of four (4) Directors who need not be members of the Association. The Association may increase the size of the Board up to seven (7) members by a majority vote of the members. Said Board shall be responsible for preparing the By-laws of the Association, and the rules and regulations governing the use of the Common Areas and distributing the same to the members thereof.

Section 2. Membership. Every record owner of a fee or undivided fee interest in any unit which is subject by covenants of record to assessment by the Association, including contract sellers, but excluding persons who hold an interest merely as security for the

performance of any obligations, shall be a member of Association. Ownership of such interest shall be the sole qualification for such membership. No owner shall have more than one membership per unit in the Association and there shall be only one vote for each unit in the development. Membership shall be appurtenant to, and may not be separated from, ownership of any unit which is subject to assessment. The Board of Directors may make reasonable rules regarding proof of ownership.

Section 3. Mergers. To the extent permitted by law, the Association may participate in mergers and consolidations with other nonprofit corporations organized for the same purposes, provided that any such merger or consolidation shall have the assent of two-thirds of the entire Class A Membership and two-thirds of the entire Class B Membership, if any.

ARTICLE V.
VOTING RIGHTS

Section 1. Classes. The Association shall have the following two classes of voting membership:

(a) Class A. Class A Members shall be all owners, with the exception of the Declarant. Class A members shall be entitled to one vote for each unit owned. When more than one person holds an interest in any unit all such persons shall be members. The vote for such unit shall be exercised as the owners thereof determine, but in no event shall more than one vote be cast with respect to any unit, and no fractional vote may be cast with respect to any unit.

(b) Class B. The Class B member shall be the Declarant, and it shall be entitled to eight (8) votes for each unit in which it holds a fee or undivided fee interest, provided that the Class B membership shall cease and be converted to Class A membership on the happening of either of the following events, whichever occurs earlier:

(1) When the total votes outstanding in Class A membership (excluding units owned by builders approved by Declarant) equals the total votes outstanding in Class B membership; or,

(2) On January 1, 2008; or,

(3) When Declarant elects by notice to the Association in writing to terminate its Class B membership.

Notwithstanding the foregoing provisions of this sub-paragraph (b), Class B membership shall be reinstated with all rights, privileges, and responsibilities, if, after conversion of the Class B membership to Class A membership as herein provided,

additional lands are annexed to the Property by the Declarant in the manner provided in Article II of this Declaration.

ARTICLE VI.
COVENANTS FOR ASSESSMENTS

Section 1. Creation of the Lien and Personal Obligation of Assessments. The Declarant, for each unit owned within the Property, hereby covenants, and every other owner of any unit by acceptance of a deed therefor, whether or not it shall be so expressed in any such deed or other conveyance, is deemed to covenant and agrees to pay to the Association:

(a) Annual assessments or charges;

(b) Special assessments for capital improvements, and

(c) Special assessments for purchase and reconstruction of residences as hereinafter provided, and

(d) As to the licensees of recreational parking facilities only, special assessments against such licensees for the re-construction of the recreational parking facilities.

Such assessments shall be fixed, established, and collected from time to time as hereinafter provided.

The annual and special assessments, together with interest thereon and costs of collection thereof, as hereinafter provided, shall be a charge on the land and shall be a continuing lien upon the unit and improvements against which each such assessment is made. Each such assessment, together with interest, costs and reasonable attorney's fees shall also be the personal obligation of the person who was the owner of the unit at the time when the assessment fell due. In the event that an owner fails to pay an assessment when due, the Association, in addition to those remedies available at law or equity, can file a lien against the Unit owned by such owner, such lien to be collectible in accordance with the laws of South Carolina. The personal obligation of an owner for delinquent assessments shall not pass to his successors in title unless the Association has filed a notice of lien of record in the land records for Oconee County, South Carolina putting the public on notice that the owner is delinquent in paying its assessments due under this Declaration. Any such notice of lien filed in the land records should state with clarity the Unit to which the lien attaches, the name of the owner who is responsible for the delinquent assessments, the amount of the delinquent assessments and the name of a contact person with the Association with whom any concerned party can contact to obtain additional information regarding the assessments due to the Association. In the event of the filing of the lien pursuant to the terms of this paragraph, such lien shall be valid and enforceable against the unit and any associated unit owner until such time as the assessments which are the

subject of the lien are satisfied in full at which time the lien shall be removed of record by the Homeowners' Association by filing a notice of cancellation of lien in the land records for the County of Oconee, South Carolina. All assessments shall be shared equally by the owners of each unit.

Section 2. Purpose of Assessments. The assessments levied by the Association shall be used exclusively for promoting the recreation, health, safety and welfare of the residents and the Property; payment of taxes on the common area and limited common area; payment of the sanitary sewer treatment fee charged by the Utility for sanitary sewer treatment services rendered to the Association; enforcing these covenants and the rules of the Association; improving and maintaining the Property, the Service Facilities and the exterior of the residences thereon, the common area, the limited common area; and providing the services, amenities and related facilities for purposes of, and related to, the use and enjoyment of the common area and limited common area. It is expressly understood that the intent of the Declarant is for any assessments levied under this Declaration to include each Owner's pro rata share of the sanitary sewer treatment fee charged to the Association by the Utility.

Section 3. Amount of Assessment.

(a) Initial Assessment. The initial Board of Directors of the Association shall establish a budget for recurring expenses and reserve funds and shall further establish the initial assessment per unit. Said budget and initial assessment shall be furnished to purchasers of units prior to the execution of any Contract of Sale for the purchase of any unit in this development.

(b) Increase by Association. Annual assessment effective from any year may be increased from and after January 1st of the succeeding year by the Board of Directors, without a vote of the membership, by an amount which may not exceed ten percent (10%) of the previous year's annual assessment.

(Explanatory Note. It is the objective of this paragraph (b) to enable the Board of Directors to increase dues sufficiently to assure the adequate maintenance to which every member is entitled. On the other hand, the Board of Directors should not have unlimited authority to raise dues without the consent of at least two-thirds of the members. The Declarant has provided that the Board of Directors may raise dues from year to year in order to assure property maintenance and thereby protect property values of the members. On the other hand, the Declarant feels that the members must be protected against any excessive increases in dues by the Board of Directors without the consent of the members.)

The Board must obtain the consent of a majority of the members as provided in paragraph (c) of this Section 3 in order to increase dues to an amount greater than is permitted hereunder.

(c) Increase by Members. Annual assessment may be increased by an amount greater than ten percent (10%) of the previous year's annual assessment by an affirmative vote of a majority of the members who are voting in person or by proxy at a meeting duly called for such purpose. Written notice of said meeting, setting forth the purpose of the meeting, shall be sent to all members not less than thirty (30) days, or more than sixty (60) days, in advance of the meeting. The limitations herein set forth shall not apply to any increase in assessments undertaken as an incident to a merger or consolidation in which the Association is authorized to participate under its Articles of Incorporation. Notwithstanding the above, the Board of Directors at all times is authorized to increase assessments to the extent necessary to pay insurance premiums, real estate taxes, and exterior maintenance of units as affect the Property.

(d) Establishment of Annual Assessment. In establishing the annual assessment for any assessment year, the Board of Directors shall consider all current costs and expenses of the Association, any accrued debts, and reserves for future needs, but it may not fix the annual assessment in an amount in excess of ten percent (10%) of the previous year's annual assessment.

All sums collected from assessments shall be divided into two parts with one part being used for current operations or recurring expenses and the other part being used as a reserve fund. Said reserve funds shall be maintained by the Association for the periodic maintenance, repair, and replacement of the Common Area and Service Facilities, improvements to the common area, and improvements to any applicable limited common area which the Association may be obligated to repair and maintain.

Two months assessment for each unit shall be required as a working capital fund for the initial months of the project's operation. Each unit's share of the working capital fund must be collected and transferred to the Association at the time of closing of the sale of each unit and maintained in an account for the use and benefit of the Association. The purpose of the fund is to insure that the Association Board will have cash available to meet unforeseen expenditures, or to acquire additional equipment or services deemed necessary or desirable. Amounts paid into the fund are not to be considered as advanced payment of regular assessments.

Section 4. Special Assessments for Capital Improvements. In addition to the annual assessments authorized above, the Association may levy, in any assessment year, a special assessment applicable to that year only for the purpose of defraying, in whole or in part, the costs of construction, reconstruction, unexpected repair or replacement of a described capital improvement upon the common area, including the necessary fixtures and personal property related thereto, provided that any such assessment shall have the consent of two-thirds (2/3) of the votes of each class of members who are voting in person or by proxy at a meeting duly called for this purpose. Written notice of said meeting, setting forth the purpose of the meeting, shall be sent to all members not less than thirty (30) days, or more than sixty (60) days, in advance of the meeting.

Section 5. Special Assessments for Recreational Parking Facilities. In addition to the annual assessments and special assessments authorized above, the Board of Directors may levy, in any assessment year, a special assessment against the licensees of recreational parking facilities applicable to that year for the purpose of defraying, in whole or in part, the costs of construction, reconstruction, unexpected repair or replacement of a described improvement upon the recreational parking facilities, including the necessary fixtures and personal property related thereto.

Section 5A. Special Assessments for Service Facilities. In addition to the annual assessments and special assessments authorized above, the Board of Directors may levy, in any assessment year, a special assessment against the Owners applicable to that year only for the purpose of defraying, in whole or in part, the costs of construction, reconstruction, unexpected repair or replacement of the Service Facilities, including the necessary fixtures and personal property related thereto.

Section 5B. Special Assessments for Boat Docks. In addition to the annual assessments and special assessments authorized above, the Association may levy, in any assessment year, a special assessment against the licensees of boat slips within the boat docks applicable to that year only for the purpose of defraying, in whole or in part, the costs of construction, reconstruction, unexpected repair or replacement of the boat docks or boat slips, including the necessary fixtures and personal property related thereto.

Section 6. Notice and Quorum for Any Action Authorized Under Sections 3, 4 and 5. Written notice of any meeting called for the purpose of taking any action authorized under Sections 3, 4 or 5, if required, shall be sent to all members not less than thirty (30) days, or more than sixty (60) days, in advance of the meeting. At the first such meeting called, the presence of members or of proxies entitled to cast sixty (60%) percent of all the votes of each class of membership shall constitute a quorum. If the required quorum is not present, another meeting may be called subject to the same notice requirement, and the required quorum at the subsequent meeting shall be one-half (1/2) of the required quorum at the preceding meeting. No such subsequent meeting shall be held more than sixty (60) days following the preceding meeting.

Section 7. Rate of Assessment. Both annual and special assessments shall be determined and collected by the Association on the following basis: All unit owners' assessment liability shall be equal, regardless of the square footage of any individual residence located on the property. The Association may collect separate assessments from the licensees of the Recreational Parking Facilities and Boat Docks and Boat Slips on a monthly basis for the annual maintenance of the Recreational Parking Facilities and the Boat Docks and Boat slips as determined by the Board of Directors on the following basis: All licensees' assessment liability shall be equal.

Section 8. Date of Commencement of Annual Assessments; Due Dates. The annual assessments provided for herein shall be paid in equal monthly installments and the payment of such shall commence as to each unit on the first day of the month following the

conveyance of the unit to the owner. The first annual assessment shall be adjusted according to the number of remaining months in the calendar year. The Board of Directors shall fix the amount of the annual assessment against each unit at least thirty (30) days in advance of each annual assessment period. Written notice of the annual assessment shall be sent to every owner subject thereto. The due dates shall be established by the Board of Directors. The Association, upon demand at any time, shall furnish a certificate in writing signed by an officer of the Association setting forth whether the assessments on a specified unit have been paid. A properly executed certificate of the Association as to the status of assessments on a unit is binding upon the Association as of the date of its issuance. Neither the Declarant nor Approved Builder will be responsible for the payment of assessments on units it owns until such time as the Declarant converts to Class A Membership; however, in order to insure that the Association has sufficient funds to meet its operating budget, the Declarant shall loan the Association an amount equal to the annual costs and assessments required of other members in the Association until the time of such conversion wherein Declarant shall be repaid any such amounts loaned to the Association, together with interest accrued thereon calculated at eight (8%) percent per annum.

Section 9. Effect of Nonpayment of Assessments: Remedies of the Association. Any assessment or portion thereof which is not paid when it falls due shall be delinquent. If the assessment or portion thereof is not paid within thirty (30) days after the due date, the same shall bear interest from the date of delinquency at the average prime lending rate in effect for Branch Banking and Trust, its successor or assign. The Association may bring an action against the owner personally obligated to pay the same, or foreclose the lien against the property, and, in either event, interest, costs, and reasonable attorney's fees of any such action shall be added to the amount of such assessment. No owner may waive or otherwise escape liability for the assessment provided for herein by non-use of the common area or abandonment of this unit.

Section 10. Subordination of the Lien to Mortgages. The lien of the assessments provided for herein on any unit shall be subordinate to the lien of any first mortgage on such unit. Sale or transfer of any unit shall not affect the assessment lien; however, the sale or transfer of any unit pursuant to mortgage foreclosure or any proceeding in lieu thereof, shall extinguish the lien of such assessments as to payments which became due prior to such sale or transfer. No sale or transfer shall relieve such unit from liability for any assessments thereafter becoming due or from the lien thereof.

Section 11. Exempt Property. Any portion of the Property owned by Declarant or Builder, or dedicated to, and accepted by, a local public authority and all properties owned by a charitable or non-profit organization exempt from taxation by the laws of the State of South Carolina shall be exempt from the assessments created herein. Owners of exempt property shall be responsible for maintaining the same and keeping it neat and clean.

ARTICLE VII
EXTERIOR MAINTENANCE

Section 1. In addition to maintenance of the common area and limited common area, the Association shall provide the exterior maintenance upon each unit which is subject to assessment hereunder, as follows: Stain and/or paint the exterior of residence, repair, replace and care for roofs, gutters, down spouts, exterior building surfaces, decks, trees, shrubs, grass, landscaping, walks, and other such exterior improvements. Such exterior maintenance shall not include glass, screening, or doors, with the exception of staining or painting as stated above. In order to enable the Association to accomplish the foregoing, there is hereby reserved to the Association the right and perpetual easement to unobstructed access over and upon each lot and the exterior of each unit at reasonable times to perform maintenance as provided in this Article.

Section 2. Owners may fence in or screen their deck or patio areas; however, any owner who fences or screens such areas shall first obtain the approval of the Association. No owner shall plant any vegetation in front or back of his residence except with the prior written approval of the Association and in the event of such approval by the Association, the maintenance of such additional plantings shall be the sole responsibility of the Association unless the Association agrees to allow the owner to maintain such additional plantings subject to the provisions of this Declaration and any rules and regulations of the Association. If an owner is allowed to maintain any additional plantings, and if in the opinion of the Association, any such owner fails to maintain his plants in a neat and orderly manner, the Association may revoke the owner's maintenance rights and remove said plants or assess said owner for any additional expenses incurred in the maintenance of said plants.

Section 3. In the event that the need for maintenance or repair of a unit or the improvements therein is caused through the willful or negligent acts of its owner or his family, tenants, contract purchasers, guests, or invitees, or is caused by fire, lightning, windstorm, hail, explosion, riot, not attending a strike, civil commotion, aircraft, vehicles, or smoke, as the foregoing are defined and explained in South Carolina standard fire and extended coverage insurance policies, the cost of such maintenance, replacement, or repairs shall be added to and become a part of the assessment to which such unit is subject.

ARTICLE VIII
PARTY WALLS

Section 1. General Rules of Law to Apply. Each wall which is built as a part of the original construction of the residence upon the property and placed on the dividing line between the lots shall constitute a party wall, and, to the extent not inconsistent with the provisions of this Article, the general rules of law regarding party walls and liability for property damage due to negligence or willful acts or omissions shall apply thereto.

Section 2. Sharing of Repair and Maintenance. Subject to the terms and provisions of Article XII, the cost of reasonable repair and maintenance of a party wall shall be shared by the owners who make use of the wall in proportion to such use.

Section 3. Destruction by Fire or Other Casualty. Reconstruction of a party wall after destruction by fire or other casualty shall be governed by the terms and provisions of Article XII of this Declaration.

Section 4. Weatherproofing. Subject to the terms and provisions of Article XII, notwithstanding any other provision of this Article, an owner who by his negligent or willful act causes the party wall to be exposed to the elements shall bear the whole cost of furnishing the necessary protection against such elements.

Section 5. Right to Contribution Runs With Land. The right of any owner to contribution from any other owner under this Article shall be appurtenant to the land and shall pass to such owner's successors in title.

Section 6. Easement and Right of Entry for Repair, Maintenance, and Reconstruction. Every owner shall have an easement and right of entry upon the unit of any other owner to the extent reasonably necessary to perform repair, maintenance, or reconstruction of a party wall. Such repair, maintenance, or reconstruction shall be done expeditiously, and, upon completion of the work, the owner shall restore the adjoining unit or units to as near the same condition as that which prevailed prior to commencement of the work as reasonably practicable.

Section 7. Certification With Respect to Contribution. If any owner desires to sell his unit, he may, in order to assure a prospective purchaser that no adjoining owner has a right of contribution as provided in this Article, request of the adjoining owner or owners a certification that no right of contribution exists, whereupon it shall be the duty of each adjoining owner to make such certification immediately upon request and without charge. If the adjoining owner claims the right of contribution, the certification shall contain a recital of the amount claimed and the basis therefor.

Section 8. Arbitration. In the event of any dispute arising concerning a party wall under any provision of this Article, such dispute shall be settled by arbitration as provided under the laws of the State of South Carolina as they are now or hereafter amended (Section 15-48-10 et seq. Code of Laws of South Carolina, 1976, as amended).

ARTICLE IX.
ARCHITECTURAL CONTROL

Section 1. Architectural Committee. The Board of Directors may appoint an Architectural Committee of up to seven (7) members by a majority vote of the Board. In the event of a vacancy on the Architectural Committee or the failure or inability of any member to act, the vacancy shall be filled as may be necessary by appointment by the Board of

Directors of the Homeowners' Association. The members of the Architectural Committee shall be appointed for a term of three (3) years, but may be reappointed for additional terms with no limit on the number of additional terms to which they may be reappointed. In all matters, a majority vote shall govern.

Section 2. Submission of Plans. Unless otherwise approved by the Architectural Committee, all units constructed on the Property shall be of the design, size and construction quality required by the Design Guidelines established by the Architectural Committee, as amended from time to time. No improvements of any nature shall be erected, placed, altered or changed on any unit in this development until and unless the building plans and specifications showing the proposed type of construction, the exterior design and the location of such improvement have been approved in writing by the Architectural Committee as to conformity and harmony of design and consistency of the plan with existing residences.

Section 3. Inspection. The Board or the Architectural Committee shall have the right, at their election, to enter upon any unit during construction, erection, or installation of improvements or alterations to inspect the work being undertaken in order to determine that such work is being performed in conformity with the approved plans and specifications and in a good and workmanlike manner, utilizing approved methods and good quality materials.

Section 4. Failure to Approve. In the event that the Architectural Committee fails to approve or disapprove such plans and other requirements within thirty (30) days after they have been submitted to it, or if no suit to enjoin the erection or alteration of such improvement has been commenced before such erection or alteration is substantially completed, approval of the Architectural Committee will be conclusively presumed and this covenant will be deemed to have been fully complied with. The term "improvement" shall be deemed to include the erection, placement or alteration of any wall, fence, deck, driveway, parking area, or recreational amenity.

Section 5. Approval. Upon the approval by the Architectural Committee of any proposed construction or alteration, the Architectural Committee shall issue to the applicant a written approval. No construction or alteration shall be carried on until and unless such written approval is obtained.

Section 6. Minor Violations. The Architectural Committee is authorized by a unanimous vote of all its members to approve or ratify the construction or alteration of any improvement or the minor violation of the set back, location and size provisions of these restrictions, if in the opinion of all the members of the Architectural Committee such shall be necessary to prevent undue hardship. The approval or ratification by the Architectural Committee in accordance with this paragraph shall be binding on the Association and all owners and shall benefit the unit for which the minor violation was approved. Builder and owners shall be responsible for obtaining the approval of any governmental agency necessary for the construction or alteration of any unit and shall be solely responsible for

any violations of any state, federal or local law, ordinance or regulation arising out of any construction undertaken hereunder.

Section 7. Clean premises. All residences must be completed in a workmanship like manner and the construction site at all times must be kept clean and free of debris.

Section 8. Abandoned Work. In the event construction of the exterior of an improvement to a residence is commenced on any lot in this subdivision, and work is abandoned for a period of thirty (30) days or longer, without just cause shown, or should any exterior of an improvement to a residence remain unfinished for a period of one (1) year from the date construction began, without just cause shown, then and in either event the Architectural Committee shall have: (1) the authority to complete the improvements at the expense of the owner and shall have a lien against the lot and all improvements to the extent of any monies expended for said completion, but said lien shall at all times be subordinate to the lien of any prior recorded mortgage or mechanic's lien (but the Architectural Committee shall have the right to contest the validity and amount of such liens); or (2) the authority to remove the improvements from the property and the expense of said removal shall constitute a lien against the lot which lien shall be subordinate to the lien of any prior recorded mortgage or mechanic's lien. Said liens shall be noticed of record and foreclosed in the same manner as the foreclosure of real estate mortgage. No action shall be taken under this paragraph without giving written registered notice to the owner with a registered copy of said notice to any mortgagee or other lien holder of the proposed action to be taken and to give ten (10) days in which to allow owner to show cause, if any, why the Architectural Committee should not take action under this paragraph.

Section 9. Square Footage. The Architectural Committee shall determine the square footage requirements to be contained in each residence. The minimum requirements can vary as to each phase in this subdivision.

Section 10. Exculpation. NEITHER DECLARANT, APPROVED BUILDER, THE BOARD NOR ANY MEMBER OF THE ARCHITECTURAL COMMITTEE, WHILE ACTING IN SUCH OFFICIAL CAPACITY, SHALL BE LIABLE IN DAMAGES TO ANYONE BY REASON OF MISTAKE IN JUDGMENT, NEGLIGENCE, MISFEASANCE, MALFEASANCE OR NONFEASANCE ARISING OUT OF OR IN CONNECTION WITH THE APPROVAL OR DISAPPROVAL OR FAILURE TO APPROVE OR DISAPPROVE ANY SUCH PLANS OR SPECIFICATIONS OR THE EXERCISE OF ANY OTHER POWER OR RIGHT OF THE ARCHITECTURAL COMMITTEE PROVIDED FOR IN THIS DECLARATION. EVERY PERSON WHO SUBMITS PLANS AND SPECIFICATIONS TO THE ARCHITECTURAL COMMITTEE FOR APPROVAL AGREES, BY SUBMISSION OF SUCH PLANS AND SPECIFICATIONS, AND EVERY OWNER OF ANY UNIT AGREES, THAT HE WILL NOT BRING ANY ACTION OR SUIT AGAINST DECLARANT, ASSOCIATION, ITS BOARD MEMBERS OR OFFICERS, OR ANY MEMBER OF THE ARCHITECTURAL COMMITTEE, TO RECOVER ANY SUCH DAMAGES AND HEREBY RELEASES, REMISES, QUITCLAIMS, AND COVENANTS NOT TO SUE FOR ALL CLAIMS, DEMANDS, AND CAUSES OF ACTION ARISING OUT OF OR IN CONNECTION WITH ANY LAW WHICH

PROVIDES THAT A GENERAL RELEASE DOES NOT EXTEND TO CLAIMS, DEMANDS, AND CAUSES OF ACTION NOT KNOWN AT THE TIME THE RELEASE IS GIVEN.

ARTICLE X.
USE RESTRICTIONS

Section 1. Rules and Regulations. The Board of Directors of the Association shall have the power to formulate, publish, and enforce reasonable rules and regulations concerning the use and enjoyment of the yard space of each unit, the common area and the limited common areas. Such rules and regulations, along with all policy resolutions and policy actions taken by the Board of Directors, shall be recorded in a Book of Resolutions, which shall be maintained in a place convenient to the owners and available to them for inspection during normal business hours and with reasonable notice. Such rules and regulations adopted by the Board may include separate fees and assessments for licensees of the Recreational Parking Facilities and Boat Docks and Boat Slips privilege of using said facilities to the exclusion of other Members.

Section 2. Use of Property. Each unit, building, the residences therein, the common area, the limited common areas and facilities shall be for the following uses and subject to the following restrictions, and, in addition, to those set forth in the By-laws, and the rules and regulations adopted by the Board.

(a) All buildings, the common areas and limited common areas and facilities shall be used for residential and related common purposes. Each residence may not be subdivided and shall be used as a single-family residence and for no other purpose except that the Declarant may use one or more residences for offices and/or model residences for sales purposes.

(b) Nothing shall be kept, and no activity shall be carried on, in any building or residence, the common area or the limited common area which will increase the rate of insurance applicable to residential use of the property or the contents thereof. No owner shall do or keep anything, nor cause or allow anything to be done or kept, in his residence, the common area or the limited common area which will result in the cancellation of insurance on any portion of the property, or the contents thereof, or which will be in violation of any law, ordinance, or regulation. No waste shall be committed on any portion of the common area or the limited common area.

(c) No immoral, improper, offensive or unlawful use shall be made of the property, or any part thereof, and all valid laws, ordinances, and regulations of all governmental agencies having jurisdiction thereof shall be observed. All laws, orders, rules, regulations, or requirements of any governmental agency having jurisdiction relating to any portion of the property shall be complied with, by and at the sole expense of the owner or the Association,

whichever shall have the obligation to maintain or repair such portion of the property.

(d) Nothing shall be done in or to any residence or in, to, or upon any of the common areas or limited common areas which will impair the structural integrity of any building, residence, or portion of the common area or which would impair or alter the exterior of any building or portion thereof, except in the manner provided in this Declaration.

(e) No industry, business, trade, occupation, or profession of any kind, whether commercial or otherwise, shall be conducted, maintained, or permitted on any part of the property, except that (i) the Declarant, Builder or their agents may use any unsold residence or lease up to three (3) residences for sales or display purposes and (ii) a resident-owner may maintain a home office in his residence so long as (a) the existence of said office does not generate pedestrian or vehicular traffic on the property, (b) no signs or advertisements concerning said business are displayed anywhere on the property, and (c) the existence of said office does not in any way affect the rights of the other owners or their enjoyment of the property.

(f) No owner shall display, or cause or allow to be displayed, to public view any sign, placard, poster, billboard, or identifying name or number upon any residence, building or any portion of the common area or limited common area, except as may be allowed by the Association pursuant to its by-laws, provided, however, that the Declarant and any mortgagee who may become the owner of any unit, or their respective agents, may place "For Sale" or "For Rent" signs on any unsold or unoccupied residence in the interior of the window of said residence, which sign shall be no larger than eighteen (18) inches by twenty-four (24) inches or in such other place as the Association may approve.

(g) No person shall undertake, cause, or allow any alteration or construction in or upon any portion of the common area or limited common area except at the direction of, and with the express written consent of, the Association.

(h) The common area and limited common area shall be used only for the purposes for which they are intended and reasonably suited and which are incident to the use and occupancy of the residences, subject to any rules and regulations that may be adopted by the Association pursuant to its by-laws.

(i) No detached storage buildings of any kind will be allowed upon the Property. Any attached storage facilities including storage facilities constructed as a basement to any residence constructed on a lot within the property shall be subject to the prior written approval of the Architectural Committee.

Section 10. Additional Restrictions. This Declaration supplements those certain covenants and restrictions found in Deed recorded in Deed Book 1113, at Page 70, in the office of the Register of Deeds for Oconee County, South Carolina. Reference to said Deed is directed for additional restrictions not listed herein.

Section 11. Supersedes Original Declaration. This Declaration is intended to be in substitution of, the covenants, conditions and restrictions already applicable to the Property by virtue of that certain Amended and Restated Declaration of Covenants, Conditions and Restrictions for Stoneledge at Lake Keowee Phase I, Section 1, dated August 21, 2003, and recorded August 22, 2003, in the Office of the Register of Deeds for Oconee County, South Carolina, in Deed Book 1296, at Page 325, as amended by that certain First Amendment to the Amended and Restated Declaration of Covenants, Conditions and Restrictions for Stoneledge at Lake Keowee, dated August 29, 2003, recorded August 29, 2003, in Deed Book 1298, Page 194, and that certain Supplement to the Amended and Restated Declaration of Covenants, Conditions and Restrictions for Stoneledge at Lake Keowee, Phase I, Section1, dated October 23, 2003, recorded October 24, 2003 in Book 1309, page 12, and that certain Second Amendment to the Amended and Restated Declaration of Covenants, Conditions and Restrictions for Stoneledge at Lake Keowee dated June 30, 2005, recorded July 15, 2005, in Book 1432, at Page 182, in the office of the Register of Deeds for Oconee County, South Carolina (the "Original Declaration"). For purposes thereof, Declarant hereby extinguishes the Original Declaration and declares the same to be void and of no further force and effect.

ARTICLE XI
EASEMENTS, RIGHTS-OF-WAY AND LICENSES

Section 1. Walks, Drives, Parking Areas, and Utilities. Subject to the provisions of those covenants and the rules and regulations of the Association, all of the property, including the portions of lots on which no improvements are constructed, the exterior of units, common area and limited common area, shall be subject to a perpetual non-exclusive easement or easements in favor of all owners of units for their use and the use of their immediate families, guests, invitees, tenants or lessees for all proper and normal purposes and for ingress and egress and regress and to such easements for driveways, walkways, parking areas, water lines, sanitary sewers, storm drainage facilities, gas lines, telephone and electric power lines, cable television lines, and other public utilities as shall be established prior to subjecting the property to this Declaration by the Declarant or its predecessors in title. The Association shall have the power and authority to grant and to establish in, over, upon, and across the common area conveyed to it such further easements as are requisite for the convenient use and enjoyment of the Property.

Section 2. Encroachments. Subject to the provisions of these covenants and the rules and regulations of the Association, all portions of lots on which no improvements are constructed; the exterior of units, common area and limited common area shall be subjected to easements for the encroachment of initial improvements constructed on adjacent units by the Declarant to the extent that such initial improvements actually

encroach, including, without limitation, such items as overhanging eaves, gutters, down spouts, exterior storage rooms, and walls. If any encroachment shall occur subsequent to subjecting the Property to this Declaration as a result of settling or shifting of any building or as a result of any permissible repair, construction, reconstruction, or alteration, there is hereby created and shall exist a valid easement for such encroachment and for the maintenance of the same. Every unit shall be subject to an easement for entry and encroachment by the Declarant for a period not to exceed eighteen (18) months following conveyance of a unit to an owner for the purpose of correcting any problems that may arise regarding grading and drainage. The Declarant, upon making entry for such purpose, shall restore the affected lot or lots to as near the original condition as practicable.

Section 3. Structural Support. Subject to the provisions of these covenants and the rules and regulations of the Association, every portion of a residence which contributes to the structural support of the building shall be burdened with an easement of structural support for the benefit of all other residences within the building.

Section 4. Lake rights, docks, etc. Subject to the provisions of these covenants and the rules and regulations as adopted by the Board and the availability of boat docks and boat slips, the Board shall have the ability, in its discretion to assign Owners within the Subdivision a license to use one boat slip in the boat docks Declarant intends to construct on Lake Keowee. Declarant hereby establishes such rights-of-way over the property and the boat docks as may be reasonably necessary for licensee to enjoy the assigned boat slip. The use of the boat slip shall be subject to reasonable rules and regulations established by the Board, which may provide for, among other things, separate fees and assessments for use of the boat slips, closed seasons or limitations on fishing and which may reasonably restrict the kind and size of boats or motors allowed to be used. Each licensee shall pay an initiation or reservation fee for the assignment of a boat slip and a separate annual assessment for the use and maintenance of its boat slip and the boat dock. No licensee shall undertake, cause or allow the construction in or upon the subdivision, except with the express written permission of the Board, any pier or boat dock other than that to be constructed on Lake Keowee. No licensee shall have the right to sell, convey or exchange boat slips. Once completed, all boat docks shall be owned and maintained by and at the cost of the Association. The Declarant and/or the Board reserve the right to relocate the boat docks and reassign the boat slips which service the Property in their sole discretion. Declarant has only been able to obtain the permits and governmental approvals necessary for the construction of a limited number of boat docks and boat slips, and assignment of licenses for the use of the boat docks and boat slips shall be on a first come first serve basis, subject to the rules and regulations of the Association as adopted by the Board of Directors from time to time.

Section 5. Recreational Parking Facilities. Subject to the provisions of these covenants and the rules and regulations of the Association as adopted by the Board of Directors, the Declarant shall have the right, but not the obligation, to assign each purchaser of a license to use a recreational parking space within the development one parking space in an area designated a recreational parking facility if any such areas are

developed by Declarant as part of the Subdivision. Declarant hereby establishes such rights-of-way over the property and the recreational parking facilities as may be reasonably necessary for each licensee of a recreational parking space to enjoy the assigned recreational parking space. The use of the recreational parking space shall be subject to reasonable rules and regulations established by the Association as adopted by the Board of Directors. Once completed, all recreational parking facilities shall be owned and maintained by and at the cost of the Association. The Declarant or Association, as the case may be, reserves the right to relocate the recreational parking facility and reassign the licenses to use certain designated parking spaces in their sole discretion. Each licensee shall pay a separate annual assessment for the use and maintenance of its parking space.

Section 6. Emergencies. Every lot and residence shall be subject to an easement for entry by the Association for the purpose of correcting, repairing or alleviating any emergency condition which arises upon any lot or within any residence and which endangers any building or portion of the common area or limited common area.

ARTICLE XII.
COVENANTS OF OWNER TO KEEP UNITS INSURED AGAINST LOSS, TO REBUILD AND TO KEEP IN GOOD REPAIR

Section 1. The Declarant covenants with the Association, on behalf of itself and on behalf of each subsequent owner of a unit within the properties, and each owner of any unit within the Property, by acceptance of a deed therefor, whether or not it shall be so expressed in said deed, or be exercise of any act or ownership, is deemed to covenant:

(1) The Association shall obtain a group or blanket insurance policy equal to the full replacement value of the project. Said policy shall contain a Replacement Cost Endorsement providing for replacement of a unit from insurance loss proceeds.

(2) The full amount of any insurance proceeds shall be applied to the rebuilding or repair of any unit (subject to the provisions and covenants contained in any mortgage or mortgages creating a lien against any unit).

(3) The dwelling shall be rebuilt or repaired in the event of damage thereto provided the dwelling is insured under a group or blanket hazard insurance policy which contains a replacement cost endorsement providing for replacement of a dwelling from insurance proceeds.

(4) The owner shall keep the dwelling in good repair except for repairs required of the Association.

(5) Premiums for the group or blanket hazard insurance policy shall be a common expense and shall be collectible in the same manner and to the same extent as provided for annual and special assessments in Article V. The lien for assessments for insurance premiums shall be subordinate to the lien of any first mortgage in the same

manner provided for annual and special assessments.

(6) Such policies shall provide that insurance proceeds payable on account of loss of, or damage to, the real property shall be adjusted with the carrier by Homeowners' Association and shall be payable solely to the Homeowners' mortgagee, if any, and the Homeowners' Association as Insurance Trustee for the owner(s). Such insurance proceeds shall be applied to repair or restoration of the property as hereinafter provided. All such insurance policies shall provide that coverage may not be canceled by the carrier without first giving the Homeowners' Association and unit mortgagee, if any, ten (10) days written notice of cancellation. All such policies shall contain, if obtainable, a waiver of the right of subrogation against any unit owner, member of the unit owner's family, the Homeowners' Association, its officers, agents and employees, as well as a waiver of the "pro rata" clause.

(7) The Association shall also obtain a broad form public liability policy covering all common area and all damage or injury caused by the negligence of the Association or any of its agents, officer or employees in an amount of not less than one million dollars for each occurrence and such policies shall contain a waiver of the right of subrogation against members of the Homeowners' Association, its officers, agents and employees.

(8) Contents and personal property insurance will not be covered by the insurance policy maintained by the Association. Any owner may, if (s)he wishes, at his/her own expense, carry any and all other insurance (s)he deems advisable beyond that included in the homeowners policy required by the Association.

(9) In the event of damage or destruction by fire or other casualty to any property covered by insurance payable to the Association as trustee for the homeowners, the Board of Directors shall, with the concurrence of mortgagees, if any, upon receipt of the insurance proceeds, contract to rebuild or repair such damaged or destroyed portions of the property to as good condition as formerly existed. All such insurance proceeds shall be deposited in a bank or other financial institution, the accounts of which bank or institution are insured by a Federal governmental agency, with the provision agreed to by said bank or institution that such funds may be withdrawn only by signature of at least one-third (1/3) of the members of the Board of Directors, or by an agent duly authorized by the Board of Directors. The Board of Directors shall obtain bids from at least two reputable contractors, and then may negotiate with any such contractor, who may be required to provide a full performance bond for the repair, reconstruction or rebuilding of such building or buildings.

(10) Also, the Association may levy in any calendar year, a special assessment for the purpose of defraying the cost of construction, reconstruction, repair or replacement of a building or buildings containing single family residential units, to the extent that insurance proceeds under a group insurance policy containing a Replacement Cost Endorsement are insufficient to pay all costs of said construction, reconstruction, repair or replacement to as good condition as existed prior to damage or destruction by fire or other casualty covered by said insurance.

(11) The reconstructed or repaired residence shall be substantially identical to the destroyed residence, unless a change shall be approved by the Board, and shall be constructed in conformity with plans submitted to and approved by the Board prior to construction.

(12) If a dwelling is not habitable by reason of damage, the obligation of the owner to pay annual assessment installments shall continue to be assessed against the unit owner. In the event a dwelling is damaged or destroyed, the owner, at his expense, shall remove all personal debris from the unit within thirty (30) days, so that it shall be placed in a neat, clean, and safe condition; and if he fails to do so, the Association may cause the debris to be removed, and the cost of removal shall constitute a lien upon the dwelling until paid by the owner, unless the dwelling is thereafter acquired by the Association.

(13) Any dwelling which has been destroyed, in whole or in part, by fire or other casualty, and is substantially restored or reconstructed, shall be subject to the provisions of this Declaration and to the By-Laws of the Association.

(14) The Association shall maintain adequate fidelity coverage against dishonest acts by officers, directors, trustees and employees, and all others who are responsible for handling funds of the Association. Such fidelity bonds shall:

(1) Name the Association as an obligee.

(2) Be written in an amount equal to at least 150% of the estimated annual operation expenses of the planned unit development project, including reserves.

(3) Contain waivers of any defense based on the exclusion of persons who serve without compensation from any definition of "employee" or similar expression.

ARTICLE XIII.
GENERAL PROVISIONS

Section 1. Enforcement. The Association, or any owner, shall have the right to enforce, by any proceeding at law or in equity, all restrictions, conditions, covenants, reservations, liens, and charges now or hereafter imposed by the provisions of this Declaration. Failure by the Association or by an owner to enforce any covenant or restriction herein contained shall in no event be deemed a waiver of the right to do so thereafter.

Section 2. Severability. Invalidation of any one of these covenants or restrictions by judgment or court order shall in no wise affect any other provisions, which shall remain in full force and effect.

Section 3. Amendment. The covenants, conditions, and restrictions of this Declaration shall run with the land and bind the land for a term of twenty (20) years from the date this Declaration is recorded, after which time they shall be automatically extended for successive periods of ten (10) years. This Declaration may be amended by an instrument signed by the owners of not less than seventy-five percent (75%) of the units; provided, however, that the Board of Directors may amend this Declaration, without the consent of owners, to correct any obvious error or inconsistency in drafting, typing or reproduction. All amendments shall be certified as an official act of the Association and shall forthwith be recorded in the Office of the Register of Deeds for Oconee County, South Carolina. All amendments shall become effective upon recordation.

Section 4. Conflicts. In the event of any irreconcilable conflict between this Declaration, the By-Laws of the Association, or the Rules and Regulations of the association as adopted by the Board of Directors, the provisions of this Declaration shall control. In the event of any irreconcilable conflict between this Declaration or the By-Laws of the Association and the Articles of Incorporation of the Association, the provision of the Articles shall control.

Section 5. Contracts. The Homeowners' Association, prior to passage of control to it, is not bound either directly or indirectly to contracts or leases (including a management contract) unless there is a right of termination of any such contract or lease, without cause, which is exercisable without penalty at any time after transfer of control, upon not more than ninety (90) days notice to the other party.

Section 6. Mortgage. The constituent documents do not restrict the unit owner's right to mortgage his or her unit. In addition, they do not limit the unit owners financing options requiring the use of a specific lending institution or a particular type of lender. Lenders being referred to include Federal National Mortgage Association (FNMA).

ARTICLE XIV.
RIGHTS OF FIRST MORTGAGEES

The following provisions, in addition to provisions set forth elsewhere in this Declaration, shall be applicable to the holders of first mortgages (and other parties as may be indicated) upon the individual unit subject to this Declaration and any amendments thereto.

Section 1. This Declaration and other constituent documents create a Planned Unit Development, hereinafter referred to as "PUD."

Section 2. Any first mortgagee who obtains title to a PUD unit (residence) pursuant to the remedies provided in the mortgage or foreclosure of the mortgage will not be liable for such unit's unpaid dues or charges which accrue prior to the acquisition of title to such unit by the mortgagee.

Section 3. Unless at least two-thirds (2/3) of the first mortgagees (based upon one vote for each first mortgage owned) [provided they request the right and inform the Association of their addresses in writing] or owners (other than the sponsor, developer or builder) of the individual units in the PUD have given their prior written approval, the PUD Homeowners' association, corporation or trust shall not be entitled to:

(a) by act or omission seek to abandon, partition, subdivide, encumber, sell or transfer the common property owned, directly or indirectly, by such Homeowners' association, corporation or trust for the benefit of the units in the PUD (the granting of easements for other public purposes consistent with the intended use of such common property by the PUD shall not be deemed a transfer within the meaning of this clause);

(b) change the method of determining the obligations, assessments, dues or other charges which may be levied against a PUD unit owner;

(c) by act or omission change, waive or abandon any scheme of regulations, or enforcement thereof, pertaining to the architectural design or the exterior appearance of units, the exterior maintenance of units, the maintenance of the common property, party walls or common fences and driveways, or the upkeep of lawns and plantings in the PUD;

(d) fail to maintain fire and extended coverage on insurable PUD common property on a current replacement cost basis in an amount not less than one hundred percent (100%) of the insurable value (based on current replacement cost);

(e) use hazard insurance proceeds for losses to any PUD common property for other than the repair, replacement or reconstruction of such common property.

Section 4. First mortgagees of PUD units may, jointly or singlely, pay taxes or other charges which are in default and which may or have become a charge against any PUD common property, may pay overdue premiums on hazard insurance policies, or secure new hazard insurance coverage on the lapse of a policy for such common property. First mortgagees making such payments shall be owed immediate reimbursement therefor from the PUD Homeowners' association, corporation or trust. Entitlement to such reimbursement is hereby reflected in this Declaration as an agreement in favor of all first mortgagees of units in said PUD duly executed by the PUD Homeowners' Association, corporation or trust, and an original or certified copy of such agreement is possessed by Seller.

Section 5. No provision of the PUD constituent documents gives a PUD unit owner, or any other party, priority over any rights of the first mortgagee of a unit in a PUD.

pursuant to its mortgage in the case of a distribution to such PUD unit owner of insurance proceeds or condemnation awards for losses to, or taking of, PUD common property.

Section 6. The Homeowners' Association is required to make available to unit owners and lenders, and to holders, insurers or guarantors of any first mortgage, current copies of the Declaration, By-Laws, or other rules concerning the project, and the books, records and financial statements of the Association. "Available" means available for inspection, upon request, during normal business hours or under other reasonable circumstances.

Section 7. Any holder of a first mortgage is entitled, upon written request, to a financial statement of the Association for the immediately preceding fiscal year.

Section 8. Upon written request to the Homeowners' Association, identifying the name and address of the holder, insurer or guarantor and the unit number or address, any mortgage holder, insurer, or guarantor will be entitled to timely written notice of:

a. Any condemnation or casualty loss that affects either a material portion of the project or the unit securing its mortgage.

b. Any 60-day delinquency in the payment of assessments or charges owed by the owner of any unit on which it holds the mortgage.

c. A lapse, cancellation, or material modification of any insurance policy or fidelity bond maintained by the Homeowners' Association.

d. Any proposed action that requires the consent of a specified percentage of mortgage holders.

ARTICLE XV
DECLARANT'S RIGHTS

Any or all of the special rights and obligations of the Declarant set forth in this Declaration or the By-Laws may be transferred to other Persons, provided that the transfer shall not reduce an obligation nor enlarge a right beyond that contained in this Declaration or in the By-Laws, as applicable. Furthermore, no such transfer shall be effective unless it is in a written instrument signed by the Declarant and successor and duly recorded in the public records of Oconee County, South Carolina. Nothing in this Declaration shall be construed to require the Declarant or any successor to develop any of the property adjacent to or contiguous with the Property.

Notwithstanding any provisions contained in this Declaration to the contrary, so long as construction and initial sales of units shall continue, it shall be expressly permissible for the Declarant and Builder to maintain and carry on upon portions of the common area such facilities and activities as, in the sole option of the Declarant, may be reasonably required,

convenient, or incidental to the construction or sale of such units, including, but not limited to business offices, signs, model units, sales offices, and rental units. The Declarant and Builders authorized by Declarant shall have easements for access to and use of such facilities. The right to maintain and carry on such facilities and activities shall include specifically, without limitation, the right to units owned by the Declarant and any common area or other facilities which may be owned by the Association, as models, sales offices, or rental units.

In addition, notwithstanding any contrary provision of this Declaration, the By-Laws, or any Association rules, the Declarant shall have the right to replat or revise the recorded plats relating to any portion of the Property without the consent of any owner other than the owner(s) of the lots in which the boundaries are altered, including revisions that change the location and configuration of the private roadways, boat docks, boat slips, recreational parking facilities and utilities that serve the subdivision.

So long as Declarant owns property within the development, Declarant may, without the express written consent of any owner, the Board, the Association or the Architectural Committee, include in any contract or deed hereafter executed covering all of any portion of the development, any additional covenants or restrictions applicable to such lands, so long as they are consistent with and do not lower the standards set forth in this Declaration and do not violate any covenants or restrictions then in effect and recorded against the development. Further, the Declarant may make any amendment necessary to the Declaration to comply with the guidelines established by, or the requirements of, any governmental authority, title insurer or institutional lender without, the express written consent of any owner, the Board, the Association or the Architectural Committee.

So long as the Declarant continues to have rights under this Article, no Person shall record any declaration of covenants, conditions and restrictions, or similar instrument affecting any portion of the Properties without Declarant's review and written consent. Any attempted recordation without compliance herewith shall result in such declaration of covenants, conditions and restrictions, or similar instrument being void and of no force and effect unless subsequently approved by written consent signed by the Declarant and recorded in the public records.

SIGNATURES ARE ON THE FOLLOWING PAGES.

IN WITNESS WHEREOF, the Declarant has caused this instrument to be executed this 1st day of November, 2005.

IN THE PRESENCE OF:

Witness (1)

Notary Public

IMK DEVELOPMENT CO., LLC
a South Carolina limited liability company

By:
Print Name: Tim W Roberson
Its: Member

STATE OF SOUTH CAROLINA)
) PROBATE
COUNTY OF GREENVILLE)

PERSONALLY appeared the undersigned witness and made oath that (s) he saw the within named IMK Development Co., LLC, by its Manager, sign, seal and as its act and deed, deliver the within written Amended and Restated Declaration of Covenants, Conditions and Restrictions for Stoneledge at Lake Keowee, and that (s) he with the other witness subscribed above witnessed the execution thereof.

Witness (1)

SWORN to before me this
1ST day of November, 2005.

(SEAL)
Notary Public for South Carolina
My Commission Expires: 6-8-15

IN THE PRESENCE OF:

STONELEDGE AT LAKE KEOWEE OWNERS' ASSOCIATION, INC.,
a South Carolina non-profit corporation

Witness (1)

Notary Public

By: _____
Tim Roberson
President

STATE OF SOUTH CAROLINA)
) PROBATE
COUNTY OF GREENVILLE)

PERSONALLY appeared the undersigned witness and made oath that (s) he saw the within named Stoneledge at lake Keowee Owners' Association, Inc., by its President, sign, seal and as its act and deed, deliver the within written Amended and Restated Declaration of Covenants, Conditions and Restrictions for Stoneledge at Lake Keowee, and that (s) he with the other witness subscribed above witnessed the execution thereof.

Witness (1)

SWORN to before me this
1st day of November, 2005.

_____ (SEAL)
Notary Public for South Carolina
My Commission Expires: 6-8-15

STATE OF SOUTH CAROLINA)
) CONSENT AND SUBORDINATION
COUNTY OF OCONEE)
) MORTGAGE BOOK 2053, PAGE 001
) MORTGAGE BOOK 2053, PAGE 010
) MORTGAGE BOOK 2120, PAGE 037

For and in consideration of Ten and 00/100 Dollars ($10.00) and other good and valuable consideration, the receipt and adequacy of which are hereby acknowledged, the undersigned, the holder of those certain Mortgages from IMK DEVELOPMENT CO, LLC (the "Mortgagor"), recorded in the land records for Oconee County, South Carolina in Mortgage Book 2053, Page 001, Mortgage Book 2053, Page 010 and Mortgage Book 2120, Page 037 (the "Mortgages"), hereby consents to the terms, covenants, conditions, easements and restrictions set forth in this Amended and Restated Declaration of Covenants, Conditions and Restrictions For Stoneledge at Lake Keowee (the "Declaration") recorded in Book 1296, at Page 345 in the aforementioned land records, and hereby subordinates the liens and security interests created by the Mortgages to the Declaration.

In Witness Whereof, this Consent and Subornation has been signed, sealed and delivered this day of November, 2005.

THE PALMETTO BANK

Witness (1)

By:
Print Name: EARLE HARDING
Its: EVP

Notary Public

FILED FOR RECORD
OCONEE COUNTY, S.C.
REGISTER OF DEEDS
2005 NOV 30 A 9:

STATE OF SOUTH CAROLINA)
) PROBATE
COUNTY OF GREENVILLE)

PERSONALLY APPEARED before me, the undersigned, who, first being duly sworn deposes and says that (s)he saw the within named The Palmetto Bank, by EARLE HARDING, its EVP, as its act and deed sign, seal and deliver the within Consent and Subordination and that (s)he with the other witness witnessed the execution thereof.

Sworn to before me this 17 day of November, 2005.

Notary Public for South Carolina
My Commission Expires: 1-2-11

Witness (1)

LYLES & LYLES, LLC
ATTORNEYS AT LAW
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Member

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November 25, 2013

VIA EMAIL & US MAIL DELIVERY

The Honorable Alexander Stephens Macaulay
Oconee County Courthouse
Post Office Drawer 428
Walhalla, S.C. 29691-0428
amacaulayj@sccourts.org
amacaulaylc@sccourts.org

Re: *Stoneledge at Lake Keowee Owners' Association, Inc., et al. vs. IMK, et al.*
Case Number: 2009-CP-37-652

Dear Judge Macaulay:

In response to the post-trial motions that have been filed, I wanted to write and clarify, for everyone's benefit, the amounts that are the subject of settlement agreements between the Stoneledge HOA and the parties relative to Phase I. After reviewing my records, the settlement agreements relative to Phase I total the sum of $2,855,911.77. The settlement agreements are as follows:

1) Eason Construction (Bostic subcontractor) - $1,000,000.00;
2) KMAC (Bostic subcontractor) - $725,000.00;
3) Morales (Bostic subcontractor) - $334,000.00;
4) Jose Nino (Bostic subcontractor) - $225,000.00;
5) Everado Jarmamillo (Bostic subcontractor) - $90,000.00;
6) Eufacio Garcia / Parra Insulation (Bostic subcontractor) - $15,000.00;
7) Jeff & Joe Bostic / Mel Morris - $45,000.00;
8) Miller Player (project architect) - $275,000.00 (one-half of a total settlement of $550,000.00);
9) M Group (successor to Marick Home Builders) - $37,500.00 (one-half of a total settlement of $75,000.00);
10) Ludwig / SDI (developer) - $109,411.77 (a portion of a total settlement of $620,000.00, allocated by number of units sold by Ludwig/SDI in Phase I).

Total: $2,855,911.77

Very little of these settlement sums have actually been received, though there are settlement agreements, either in writing or on the record, in the referenced amounts. If any of the opposing counsel has a disagreement about these sums, I invite them to bring that to my attention.

Additionally, in our post-trial motions we have requested that, in conformance with the Court of Appeals' decision in *Keeter v. Alpine Towers*, the full amount of the cumulative jury award, $5,000,000.00, be assigned to each of the three causes of action (negligence, breach of warranty, and breach of fiduciary duty). While in the post-trial motion we asked for the set-off to be equally divided between those three causes of action, in the amount of approximately $933,000.00 per, after reflection, it seems appropriate that if the Court follows *Keeter*, and awards the cumulative verdict for each cause of action, then the full set-off should also apply to each cause of action. That would reduce the amount awarded for each cause of action to a total of $2,144,088.23.

Applying the Apportionment Act would result in the following judgments, after the set-off is applied:

Negligence:

Bostic:	$2,144,088.23 (more than 50% responsible);
Marick:	$857,635.29 (40% apportionment).

Breach of Warranty[1]:

Bostic:	$643,226.47 (30% apportionment);
Marick/IMK:	$2,144,088.23 (more than 50% responsible).

Breach of Fiduciary Duty[2]:

IMK:	$2,144,088.23;
IK:	$2,144,088.23;
Cox:	$2,144,088.23;
Lollis:	$2,144,088.23;
Thoennes:	$2,144,088.23.

[1]The allocation if the Court finds the Apportionment Act applies. In post-trial motions we have asked that the Act not be applied to the warranty cause of action.

[2]No one requested apportionment of the fiduciary duty award and no apportionment was decided by the jury. That award is joint and several.

As always, I appreciate your attention and consideration in advance.

Very truly yours,

LYLES & LYLES, LLC

Robert T. Lyles, Jr.

RTL/hch
cc: Jason M. Imhoff, Esquire *(Via Email)*
Alan Belcher, Esquire *(Via Email)*
Cynthia Buck Brown, Esquire *(Via Email)*
Stoneledge Litigation Committee *(Via Email)*

RECEIVED
AUG 02 2016
SC Court of Appeals

THE STATE OF SOUTH CAROLINA
In the Court of Appeals

APPEAL FROM OCONEE COUNTY
Court of Common Pleas

The Honorable Alexander S. Macaulay, Circuit Court Judge

Lower Court Case No. 2009-CP-37-00652
Court of Appeals Case No. 2015-000417

Stoneledge at Lake Keowee Owners' Association, Inc., C. Dan Carson, Jeffrey J. Dauler, Joan W. Davenport, Michael Furnari, Donna Furnari, Jessy B. Grasso, Nancy E. Grasso, Robert P. Hayes, Lucy H. Hayes, Ty Hix, Jennifer D. Hix, Paul W. Hund, III, Ruth E. Isaac, Michael D. Plourde, Mary Lou Plourde, Carol C. Pope, Steven B. Taylor, Bette J. Taylor, and Robert White, Individually, and on Behalf of All others similarly situated,

Respondents,

v.

IMK Development Co., LLC, Larry D. Lollis, William C. Cox, Integrys Keowee Development, LLC, Marick Home Builders, LLC, Bostic Brothers Construction, Inc., Rick Theonnes,

Defendants.

(Of Whom Bostic Brothers Construction, Inc., is the Appellant)

PROOF OF SERVICE

I certify that I have served the Appellant's Record on Appeal upon the Respondents by depositing a copy of same in the United States Mail, First Class postage prepaid, on July _____, 2016, addressed to Respondents' attorneys of record, Robert T. Lyles, Jr., Esquire, Lyles & Lyles, LLC, PO Box 773, Charleston, SC 29402.

Also served by the same means are the following: Cynthia Buck Brown, Esquire and R. Patrick Smith, Esquire of Harper Lambert & Brown, PA, P.O. Box 908, Greenville, SC 29602 (attorneys for IMK Development Co., LLC, Integrys Keowee Development, LLC, William C. Cox, and Larry Lollis), Jason M. Imhoff, Esquire and Chad M. Graham,

Esquire of The Ward Law Firm, P.A., P.O. Box 5663, Spartanburg, SC 29304 (attorneys for Marick Home Builders, LLC and Rick Thoennes).

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