Thermal and Moisture Protection: Keeping the Weather Out

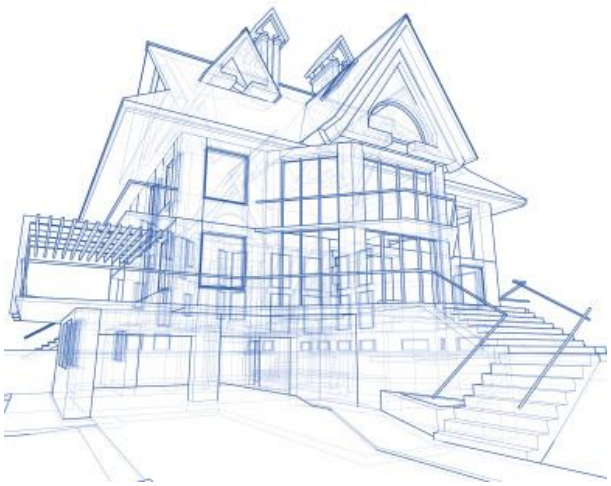
Internet Course

Learning Objectives

- Summarize the key elements (either natural or mechanical) of a properly ventilated structure.
- List and describe at least three specific installation techniques and/or materials that contribute to a properly constructed roof system.
- Outline at least one design strategy based on "best practices" for the construction of buildings in areas with high humidity.
- Identify and implement proven methods that will effectively divert moisture from the foundation of a structure.

Keeping the Weather Out

Protecting buildings from weather and moisture related problems is important for all building professionals. In areas of high humidity, (and ALL Florida counties are considered "warm humid counties" by the Florida Building Code: Energy Conservation 301.2), it is even more important that builders, their employees, and their subcontractors use “Best Practice” procedures to carefully install thermal and weather resistant components. Because of the potential for loss due to consumer complaints and claims, it makes sense for contractors to be trained in moisture control for the homes and buildings they are constructing or renovating.



Major performance objectives.
One objective of a building envelope system is to provide ***moisture control.*** Construction of a building envelope system needs to incorporate methods and materials that prevent or minimize the impact of moisture intrusion. *The photo below shows typical damage caused by poorly installed or maintained building envelope components!*

Too often, exterior shells are simply sealed up without regard for proper installation of house-wraps, flashing and ventilation. Stopping air movement/infiltration and increasing R-values in the attics or walls may only be a temporary solution to high energy costs. *Often, caulking and sealing the outer surface of the envelope traps moisture. This results in future cosmetic and*

structural damage, and potential health problems for the occupants!!!

The building thermal envelope shall be durably sealed to limit infiltration... By properly sealing the envelope, the contractor keeps out weather related moisture and stops uncontrolled movement of energy due to the loss of warmed or cooled, conditioned air.

In order to maintain the ***structural integrity*** of the building foundation, frame and siding components... dampproof, caulk, gasket or weather strip and seal the following:

1. Foundations and crawl spaces
2. Site-built windows, doors and skylights.
3. Utility penetrations.
4. Dropped ceilings or chases.
5. Joints, seams and penetrations.
6. Walls and ceilings separating unconditioned spaces from conditioned.

Temperature control is a real benefit of a properly constructed building exterior shell. Not only will weather borne moisture be kept out of the framing cavities and from behind the shell siding materials, but less energy transfer will be allowed through the properly built shell due to uncontrolled air movement. Properly installed vapor barriers and insulation limit rapid heat transfer within the wall cavity and results in little or no condensation formation.

Foundations

Why should we install vapor barriers and foundation coatings? We need to limit ground water moisture from entering the foundation walls. *It's a common misunderstanding that concrete is waterproof!* Concrete and mortar are not waterproof! Think of masonry products as hard sponges!

The best way to avoid moisture problems below grade is to design and install a system that keeps moisture from saturating the soil around the home. Through the use of proven designs we can effectively divert the rainfall away from the building before it saturates the soil around the structure.

Nothing is more effective in keeping the foundation and crawl space dry than keeping the rain water and ground water from penetrating the perimeter of the foundation. Listed below are examples of how to help ensure a dry crawl space.

► When a high water table exists, install a footer drain around the perimeter of the foundation and drain to daylight if possible.

The *footing drain* needs to be installed as soon as possible after the *foundation waterproofing*. If not done soon, it may require extra hand digging due to collapse of surrounding soil from rain and loose soils around the excavation. This extra work may be ignored or done incorrectly, resulting in incorrect slope or no slope in the footer drains. Or worse, if the drain material is

flexible, workers may allow the line to move up and over the obstruction, resulting in a sediment trap and causing the drain to fail prematurely! ***Remember:*** The surface drains should never be allowed to connect to the floor or footer drains! This means the surface water or gutter drains can only be installed after the footer drains have been covered and backfill operations have begun.

A *daylight drain* means a drain system that discharges to an open and unrestricted environment. The drain flows by gravity and does not need to be pumped. This type of drain is always preferable because it means the basement floor is not the lowest point on the property. Tiling that *drains to daylight* uses gravity to move the water and will work even when electricity needed for pump systems is not available!

R405.1 Concrete or Masonry Foundations. *Drains shall be provided around all concrete or masonry foundations that retain earth and enclose habitable or usable spaces located below grade. Drainage tiles, gravel or crushed stone drains, perforated pipe or other approved systems...shall be installed at or below the area to be protected and shall discharge by gravity or mechanical means into an approved drainage system. Gravel or crushed stone shall extend at least 1 foot beyond the outside edge of the footing and 6 inches above the top of the footing and be covered with an approved filter membrane material. Exception: A drainage system is not required when the foundation is installed on well-drained ground or sand-gravel mixture soils according to the Unified Soil Classification System, Group 1 Soils, as detailed in Table R405.1*

R405.2 Wood foundations. *Wood foundations enclosing habitable or usable spaces located below grade shall be adequately drained in accordance with Sections R405.2.1 through R405.2.3*

R405.2.1 Base. *A porous layer of gravel, crushed stone or coarse sand shall be placed to a minimum thickness of 4 inches (102 mm) under the basement floor. Provision shall be made for automatic draining of this layer and the gravel or crushed stone wall footings.*

R405.2.2 Vapor retarder. *A 6-mil-thick (0.15 mm) polyethylene vapor retarder shall be applied over the porous layer with the basement floor constructed over the polyethylene.*

R405.2.3 Drainage system. *In other than Group I soils, a sump shall be provided to drain the porous layer and footings. The sump shall be at least 24 inches (610 mm) in diameter or 20 inches square (0.0129 m2), shall extend at least 24 inches (610 mm) below the bottom of the basement floor and shall be capable of positive gravity or mechanical drainage to remove any accumulated water. The drainage system shall discharge into an approved sewer system or to daylight.*

► Slope the grade around the home away from the foundation at least 5 %. Code requires a minimum grade slope of 6" of fall in 10' of run around the building's perimeter. Very often, correcting the grade around a building will eliminate the need for other surface water control

measures...look at the grade first!

> ***R401.3 Drainage.*** *Surface drainage shall be diverted to a storm sewer conveyance or other approved point of collection that does not create a hazard. Lots shall be graded to drain surface water away from foundation walls. The grade shall fall a minimum of 6 inches within the first 10 feet.*

► Damp-proof, or water-proof the foundation walls. There is a distinct difference between *dampproofing and waterproofing*. Dampproofing and waterproofing use similar materials, but waterproofing has a greater level of resistance to ground water penetration. Dampproofing is intended to keep out soil moisture while waterproofing keeps out both moisture and liquid water. Buildings have been dampproofed for years, a practice that that is often, mistakenly referred to as waterproofing.

The ***Florida Residential Building Code, R406,*** specifies the conditions that require either dampproofing or waterproofing. Any concrete or masonry foundation walls "that retain earth and enclose interior spaces and floors below grade shall be dampproofed from the top of the footing to the finished grade."

The code provides a list of permissible materials, which include bituminous coating and acrylic-modified cement. *Waterproofing is only required by the code in areas where a high water table or other severe soil-water conditions are known to exist!*

> ***R406.1 Concrete and masonry foundation dampproofing.*** *Except where required by Section R406.2 to be waterproofed, foundation walls that retain earth and enclose interior spaces and floors below grade shall be dampproofed from the top of the footing to the finished grade. Masonry walls shall have not less than 3/8 inch (9.5 mm) Portland cement parging applied to the exterior of the wall.*
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> 1. *Bituminous coating.*
> 2. *Three pounds per square yard of acrylic modified cement*
> 3. *One-eighth inch coat of surface-bonding cement complying with ASTM C 887.*
> 4. *Any material permitted for waterproofing in Section R406.2*
> 5. *Other approved methods or materials.*
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> *Exception: Parging of unit masonry walls is not required where a material is approved for direct application to the masonry. Concrete walls shall be dampproofed by applying any one of the above listed dampproofing materials or any one of the waterproofing materials listed in Section R406.2 to the exterior of the wall.*
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> ***R406.2 Concrete and masonry foundation waterproofing.*** *In areas where a high water table or other severe soil-water conditions are known to exist, exterior foundation walls that retain earth and enclose interior spaces and floors below grade shall be waterproofed from the top of the footing to the finished grade. All joints in membrane waterproofing shall be lapped and sealed with an adhesive compatible with the membrane.*
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> ***R406.3 Dampproofing for wood foundations.*** *Wood foundations enclosing habitable or usable*

spaces located below grade shall be dampproofed in accordance with Sections R406.3.1 through R406.3.4.

R406.3.1 Panel joint sealed. *Plywood panel joints in the foundation walls shall be sealed full length with a caulking compound capable of producing a moisture-proof seal under the conditions of temperature and moisture content at which it will be applied and used.*

R406.3.2 Below-grade moisture barrier. *A 6-mil-thick (0.15 mm) polyethylene film shall be applied over the below-grade portion of exterior foundation walls prior to back filling. Joints in the polyethylene film shall be lapped 6 inches (152 mm) and sealed with adhesive. The top edge of the polyethylene film shall be bonded to the sheathing to form a seal. Film areas at grade level shall be protected from mechanical damage and exposure by a pressure preservative treated lumber or plywood strip attached to the wall several inches above finish grade level and extending approximately 9 inches (229 mm) below grade. The joint between the strip and the wall shall be caulked full length prior to fastening the strip to the wall. Other coverings appropriate to the architectural treatment may also be used. The polyethylene film shall extend down to the bottom of the wood footing plate but shall not overlap or extend into the gravel or crushed stone footing.*

R406.3.3 Porous fill. *The space between the excavation and the foundation wall shall be backfilled with the same material used for footings, up to a height of 1 foot (305 mm) above the footing for well-drained sites, or one-half the total back-fill height for poorly drained sites. The porous fill shall be covered with strips of 30-pound (13.6 kg) asphalt paper or 6-mil (0.15 mm) polyethylene to permit water seepage while avoiding infiltration of fine soils.*

R406.3.4 Backfill. *The remainder of the excavated area shall be backfilled with the same type of soil as was removed during the excavation. Except where required by Section R406.2 to be waterproofed, precast concrete foundation walls enclosing habitable or useable spaces located below grade shall be dampproofed in accordance with Section R406.1.*

► Crawl spaces are notorious for harboring moisture. Homes with a damp musty crawl-space will smell of mildew and mold and the life of the building will be shortened.

Install a vapor barrier over the crawl space soil floor. This will keep the soil from becoming moist due to vapor pressure during humid days. The space will dry much faster on days where ventilation is causing the space to become drier. (There are times when ventilation in the crawl

space can actually add dampness.) If the floor soil is damp due to ground water or wet soil around the building the polyethylene will help prevent the moisture from entering the crawl space.

Code provides somewhat of a remedy for moisture problems in crawl spaces. This includes:

1. Damp-proofing the walls below grade
2. Requiring ventilation at a ratio of 1 square foot per 150 feet of floor area

These two requirements, which are the most commonly used, often provide an insufficient amount of protection in extremely moisture prone regions.

> ***402.2.9 Crawl space walls.*** *(2010 Florida Building Code: Energy Conservation) As an alternative to insulating floors over crawl spaces, crawl space walls shall be permitted to be insulated when the crawl space is not vented to the outside. Crawl space wall insulation shall be permanently fastened to the wall and extend downward from the floor to the finished grade level and then vertically and/or horizontally for at least an additional 24 inches (610 mm). Exposed earth in unvented crawl space foundations shall be covered with a continuous Class I vapor retarder in accordance with the Florida Building Code, Building. All joints of the vapor retarder shall overlap by 6 inches (153 mm) and be sealed or taped. The edges of the vapor retarder shall extend at least 6 inches (153 mm) up the stem wall and shall be attached to the stem wall.*

There are some exceptions to rule #2. Code allows that the ventilation ratio be reduced to 1 square foot of ventilation to 1500 square feet when the ground surface (which should be smooth and level), is covered with 6 mil polyethylene lapped 12 inches. Sealing the lap with tape or silicone caulk keeps the plastic in place and guarantees the vapor barrier's effectiveness.

Additionally, no ventilation openings are required if a continuously operated mechanical ventilation system is installed with an exhaust capacity of 1.0 cfm per each 50 square feet. This 1:50 ratio requires the polyethylene vapor barrier described earlier.

> ***R408.1 Ventilation.*** *The under-floor space between the bottom of the floor joists and the earth under any building (except space occupied by a basement) shall have ventilation openings through foundation walls or exterior walls. The minimum net area of ventilation openings shall not be less than 1 square foot (0.0929 m2) for each 150 square feet (14 m2) of under-floor space area, unless the ground surface is covered by a Class 1 vapor retarder material. When a Class 1 vapor retarder material is used, the minimum net area of ventilation openings shall not be less than 1 square foot (0.0929 m2) for each 1,500 square feet (140 m2) of under-floor space area. One such ventilating opening shall be within 3 feet (914 mm) of each corner of the building. Exception: Crawl*

spaces, designed by a Florida licensed engineer or registered architect to eliminate the venting.

R408.3 Unvented crawl space. *Ventilation openings in under-floor spaces specified in Sections R408.1 and R408.2 shall not be required where:*

1. Exposed earth is covered with a continuous Class I vapor retarder. Joints of the vapor retarder shall overlap by 6 inches (152 mm) and shall be sealed or taped. The edges of the vapor retarder shall extend at least 6 inches (152 mm) up the stem wall and shall be attached and sealed to the stem wall; and

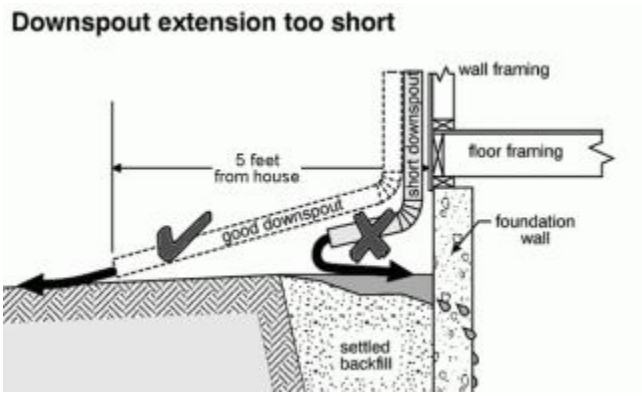
2. One of the following is provided for the under-floor space:

2.1. Continuously operated mechanical exhaust ventilation at a rate equal to 1 cubic foot per minute (0.47 L/s) for each 50 square feet (4.7m2) of crawlspace floor area, including an air pathway to the common area (such as a duct or transfer grille), and perimeter walls insulated in accordance with Section 402.2.9 of the Florida Building Code, Energy Conservation;

2.2. Conditioned air supply sized to deliver at a rate equal to 1 cubic foot per minute (0.47 L/s) for each 50 square feet (4.7 m2) of under-floor area, including a return air pathway to the common area (such as a duct or transfer grille), and perimeter walls insulated in accordance with Section 402.2.9 of the Florida Building Code, Energy Conservation;

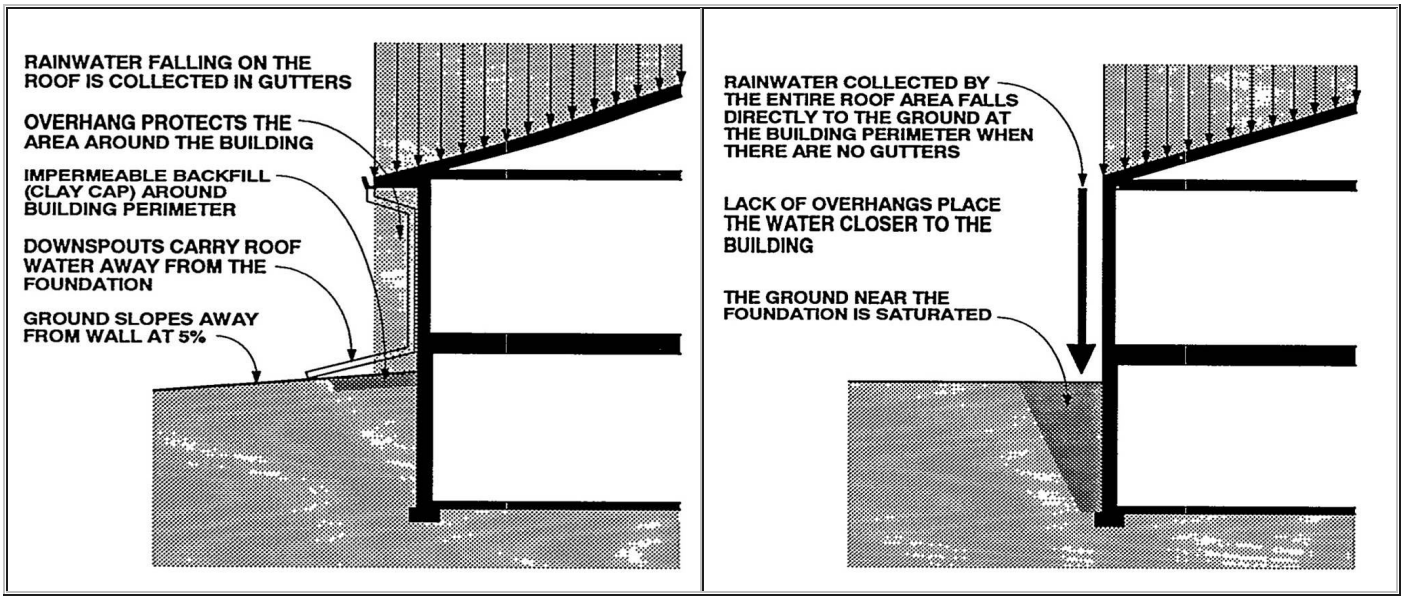
2.3. Plenum in existing structures complying with Section M1601.5, if under-floor space is used as a plenum.

► Install gutters and downspouts that positively remove the rain water away from the building perimeter. Gutters help collect rain water and move it to an area away from the foundation. Roof-eave overhangs prevent rain water from making contact with the soil in close proximity to the foundation. The topsoil at the ***surface*** should be a less permeable soil, helping to increase surface drainage. *(Think of the topsoil as an absorbent membrane that once saturated prevents further absorption).* The grade shall be sloped at least 6" of fall per 10' of run, which is a 5% slope. The grade at inside corners of the foundation should initially be steeper to allow for settlement and guarantee the diversion of the surface waters.



Gutters may help collect and divert the rainwater away from the building's foundation only if it runs into or onto the proper slope or tiling. *NEVER, NEVER, NEVER connect the gutter tiling to the footer drains.* ***Remember:*** The purpose of footer drains and tiling is to act as a conduit to transfer sub-surface water AWAY from the building!!!

► Use a less permeable top-soil or a clay cap at grade so water more effectively moves away from the foundation.



► Insect infestation and rotting framing lumber will likely be a problem, as well as many others.

> ***R318.6 Protection against decay and termites.*** *Condensate lines, irrigation/sprinkler system risers for spray heads and roof downspouts shall discharge at least 1 foot away from the structure sidewall, whether by underground piping, tail extensions or splash blocks. Gutters with downspouts are required on all buildings with eaves of less than 6 inches horizontal projection except for gable end rakes or on a roof above another roof.*

House Wrap and Underlayment

New products and methods help us construct buildings with more energy efficiency. House wrap has helped to reduce the problem of mold and mildew inside the wall cavity. A wall that develops moisture in its cavity, can dry out because house wraps are not vapor barriers. They allow water vapor molecules to pass through, while keeping out liquid rain water.

This eventually allows the moisture to dissipate through the exterior of the wall. Exterior asphalt felt, acting as a vapor barrier, paired with air sealing and a vapor barrier on the interior walls, creates a sealed space.

House wrap provides protection for the wood sheathing and framing lumber in *two* ways.

1. It provides protection from wind driven rain that gets behind the siding from reaching the sheathing because it won't let water molecules pass through it.

2. It allows moisture that may have formed in or leaked into the framing cavity and insulation materials to escape. This enables the wall cavity to dry because it lets water vapor pass through it.

Housewrap is a generic term used to describe any one of the various brands of wind and water resistant siding underlayment. Tyvek and Typar are common examples. Used as an alternative to felt paper, house wraps are made from *perforated, plastic sheeting or polyethylene fibers* and engineered to allow water vapor to escape the wall cavity while preventing liquid water and wind from entering. HOUSEWRAP IS NOT A VAPOR BARRIER!!!

House wrap acts as an excellent air infiltration barrier helping to reduce heating and cooling costs and damage caused by wind driven rain water or power-washers. Felt paper and housewraps may be installed vertically as long as a lap of at least 6" is observed. If a row of felt is stopped in the span of the wall, restart the row and lap the end of the previous by 6".

> ***R703.2 Weather-resistant sheathing paper.*** *One layer of No. 15 asphalt felt, free from holes and breaks, complying with ASTM D 226 for Type 1 felt or other approved water-resistive barrier shall be applied over studs or sheathing of all exterior walls. Such felt or material shall be applied horizontally, with the upper layer lapped over the lower layer not less than 2 inches (51 mm). Where joints occur, felt shall be lapped not less than 6 inches (152 mm). The felt or other approved material shall be continuous to the top of walls and terminated at penetrations and building appendages in a manner to meet the requirements of the exterior wall envelope as described in Section R703.1. Exception: Omission of the water-resistive barrier is permitted in the following situations:*
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> 1. *In detached accessory buildings.*
> 2. *Under exterior wall finish materials as permitted in Table R703.4.*

Source: Carpentry and Building Construction p. 661

Corrosion and Decay Resistance. Remember, buildings in coastal environments are prone to damage from corrosion, moisture-related decay, and termite damage to building materials. Metal corrosion is *most pronounced on coastal homes within 3,000 feet of the ocean* but moisture-related decay and termite damage are also prevalent throughout coastal areas.

Preservative-treated wood often contains chemical preservatives such as Alkaline Copper Quat (ACQ), Copper Azole (CA-C), Dispersed or Micronized Copper (CA-C), or Copper Naphthenate (CuN-W). The connector plates, straps and fasteners used with these pressure-treated wood products should be selected and verified to be compatible with the wood preservative. Fasteners shall be hot-dipped zinc-coated galvanized steel, stainless steel, silicon bronze, or copper. Corrosion protection for zinc-coated galvanized steel or equivalent is required.
**Exceptions to this rule may be noted in the building code!*

Recommendations

1. Use hot-dip galvanized steel or stainless steel hardware. Stainless steel hardware is acceptable in virtually all locations, but hot-dip galvanized hardware may not be appropriate in every location. Reinforcing steel should be protected from corrosion by adequate cover of sound materials (e.g., masonry, mortar, grout, concrete) and good workmanship. Use galvanized or epoxy-coated reinforcing steel in areas where the potential for corrosion is high.

2. It is important to verify that the connector plate and fastener are of the same type metal. Avoid joining dissimilar metals, especially those with high galvanic potential (e.g., copper and steel) because they are more prone to corrosion.

3. Metal-plate-connected trusses should not be exposed to the weather. Truss joints near vent openings are more susceptible to corrosion and may require increased corrosion protection. Verify the connectors used near any roof vent openings are stainless steel or a minimum of ASTM A 653 type G185 zinc-coated galvanized steel or equivalent.

4. Due to the potential for galvanic corrosion, standard carbon-steel, aluminum, or electroplated fasteners and hardware are not recommended for direct contact with preservative-treated wood.

5. The use of aluminum flashing with most treated wood should be avoided. Aluminum will corrode quickly when in contact with most wood preservatives. Copper flashing may be the best choice although vinyl and butyl rubber flashings are becoming more common.

R703.4 Attachments. *Unless specified otherwise, all wall coverings shall be secured with approved aluminum, stainless steel, zinc-coated or other approved corrosion-resistive fasteners in accordance with the approved manufacturer's installation instructions. Where wind pressures determined in accordance with Table R301.2(2) do not exceed 50 psf, wall coverings are permitted to be installed in accordance with Table R703.4.*

The Building Frame. Framing lumber is kiln dried to a moisture content of not more than 19%. Lumber needs to be protected from moisture during the transportation, storage and construction. If the moisture content is in question at the time of delivery, check it to make sure it is at 19% or less with a moisture meter.

Properly storing the lumber at the jobsite is very important. The lumber needs to be properly supported at least 4 inches off the ground and covered with a tarp. Do not store it at low points on the site where water may pool. If the lumber comes wrapped and sealed, keep it that way until construction starts.

Negative Effects of Lumber with a High Moisture Content

1. Improper seating of floor joists on sill plates, producing more apparent deflection and vibration due to shrinkage.
2. Can increase air leakage in walls due to shrinkage.
3. Fungi will grow on lumber with a moisture content over 19%. In modern construction wet lumber can take several years to dry out. Fungi do not die—they become dormant.

They can become active again upon being re-wetted.

4. Causes excessive nail popping in drywall.

Ideal conditions are when the lumber is delivered dried to 19% or less, there is no rain in the forecast, and the home is dried in with the roofing finished and the windows installed before any rain. But we don't live in a perfect world. We have to be certain that the lumber has dried out sufficiently to at least 19% before we close in the framing with vapor barriers, drywall or other finishes. Code requires the general contractor to notify the building official that all moisture sensitive wood framing is at or below 19% before finishing can begin.

> ***R502.1.1 Identification.*** *Load-bearing dimension lumber for joists, beams and girders shall be identified by a grade mark of a lumber grading or inspection agency that has been approved by an accreditation body that complies with DOC PS 20. In lieu of a grade mark, a certificate of inspection issued by a lumber grading or inspection agency meeting the requirements of this section shall be accepted.*

Foundation to Wall Transition. A capillary break is necessary between the top of the foundation wall and the sill plate. This product is commonly called sill sealer. It is a foam gasket that provides a necessary seal between the imperfections on the surface of the foundation wall and the sill plate. The concrete will likely be green or (not fully cured) when the plates are being installed. This gasket will prevent moisture from wicking up into the plate, If the wall becomes damp in the future, the sill sealer will continue to function as a capillary break.

Siding. Siding is the wall component of a building exposed to the elements. Siding preserves the structural integrity of the wall frame by keeping weather out of the wall cavity. In addition to moisture; dirt, debris and fungus is kept out of the wall cavity when the siding is installed and flashed properly. Proper lapping of siding edges, flashings and caulking is necessary to guarantee the siding will perform as intended.

> ***R703.1 General.*** *Exterior walls shall provide the building with a weather-resistant exterior wall envelope. The exterior wall envelope shall include flashing as described in Section R703.8.*
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> ***R703.1.1 Water resistance.*** *The exterior wall envelope shall be designed and constructed in a manner that prevents the accumulation of water within the wall assembly by providing a water-resistant barrier behind the exterior veneer as required by Section R703.2 and a means of draining to the exterior water that enters the assembly. Protection against condensation in the exterior wall assembly shall be provided in accordance with Section R601.3 of this code. Exceptions:*
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> *1. A weather-resistant exterior wall envelope shall not be required over concrete or masonry walls designed in accordance with Chapter 6 and flashed according to Section R703.7 or R703.8.*

2.

Compliance with the requirements for a means of drainage, and the requirements of Section R703.2 and Section R703.8., shall not be required for an exterior wall envelope that has been demonstrated to resist wind-driven rain through testing of the exterior wall envelope, including joints, penetrations and intersections with dissimilar materials, in accordance with ASTM E 331 under the following conditions:

2.1. Exterior wall envelope test assemblies shall include at least one opening, one control joint, one wall/eave interface and one wall sill. All tested openings and penetrations shall be representative of the intended end-use configuration.

2.2. Exterior wall envelope test assemblies shall be at least 4 feet (1219 mm) by 8 feet (2438 mm) in size.

2.3. Exterior wall assemblies shall be tested at a minimum differential pressure of 6.24 pounds per square foot (299 Pa).

2.4. Exterior wall envelope assemblies shall be subjected to the minimum test exposure for a minimum of 2 hours.

The exterior wall envelope design shall be considered to resist wind-driven rain where the results of testing indicate that water did not penetrate control joints in the exterior wall envelope, joints at the perimeter of openings penetration or intersections of terminations with dissimilar materials.

Siding is the first line of defense against moisture coming in contact with the wall sheathing, framing, insulation and interior wall finishing. Wind driven rain can and will penetrate behind siding materials. Craftsmen need to follow “best practices” in order to prevent moisture from contacting areas where it can cause damage to the structure and threaten the health of the home’s occupants because of mold and mildew.

Wood framed walls, sheathed walls and wood sidings that are less than 6” above finished grade must be made of either naturally durable wood or preservative treated wood. Also, concrete steps, porch and patio slabs require a minimum of 2” to wood siding unless the siding is naturally durable or preservative treated!

R317.1 Location Required. *Protection of wood and wood based products from decay shall be provided in the following locations.....Wood siding, sheathing and wall framing on the exterior of a building having a clearance of less that 6 inches from the ground or less than 2 inches measured vertically from concrete steps, porch slabs, patio slabs, and similar horizontal surfaces exposed to the weather.*

Siding may be as simple as sheet plywood over studs to as complicated as Exterior Insulation Finishing Systems (EIFS). Siding may be vertical or horizontal wood, steel, aluminum, cement panel or vinyl. Stone, brick and stucco, are also, forms of siding.

► **Wood Siding**. Wood siding should have a moisture content of about 12%. With the exception of desert south-west states, most homes will suffer exposure to extreme moisture and temperature changes as the seasons change. Wood siding should be made from naturally durable woods or treated and finished to prevent damage due to exposure to the elements.

R703.3 Wood, hardboard and wood structural panel siding.

R703.3.1 Panel siding. *Joints in wood, hardboard or wood structural panel siding shall be made as follows unless otherwise approved. Vertical joints in panel siding shall occur over framing members, unless wood or wood structural panel sheathing is used, and shall be ship lapped or covered with a batten. Horizontal joints in panel siding shall be lapped a minimum of 1 inch (25 mm) or shall be ship lapped or shall be flashed with Z-flashing and occur over solid blocking, wood or wood structural panel sheathing.*

When moisture gets trapped behind wood siding without a drainage plane, capillary suction may drain this water into the building envelope. Generally a space of at least 1/8 inch between the water resistive barrier and the exterior veneer is recommended by the manufacturer. The space is to be provided by the use of a non-corrodible furring strip.

Capillary Action

The ability of liquid to flow against the force of gravity. Liquid will spontaneously rise in narrow spaces.

Capillary Break

1. A space between two surfaces which is purposely made wide enough to prevent the movement of moisture through the space by capillary action.

2. Water will wick up into concrete through capillary action. Capillary breaks such as an elastomeric asphalt coating or a polyethylene sheet placed between two permeable products will stop the rise of moisture between them.

R703.3.2 Horizontal siding. *Horizontal lap siding shall be installed in accordance with the manufacturer's recommendations. Where there are no recommendations the siding shall be lapped a minimum of 1 inch (25 mm), or 1/2 inch (13 mm) if rabbeted, and shall have the ends caulked, covered with a batten or sealed and installed over a strip of flashing.*

R703.3.3 Attachment. *Wood, hardboard and wood structural panel siding shall be attached in accordance with Tables R703.3.3(1) and R703.3.3(2). Specific gravities, G for solid sawn lumber are specified in Table 703.3.3(3).*

A common mistake made when installing horizontal siding is how it is fastened to the wall. Nails shouldn't penetrate the board underneath the board above. Wood siding will swell across its width in the damp, humid seasons and shrink in the drier seasons. This causes the boards to split allowing a space for moisture to enter, The nails should be corrosion resistant—the best choice is ring shank stainless steel.

► **Vinyl Siding.** Code requires that vinyl siding be installed according to manufacturer's instructions. Vinyl siding must be installed on a smooth surface which does not allow for furring strips attached at stud spacing, Vinyl siding sheds water by providing weep holes at the bottom of each panel projection.

> ***R703.11 Vinyl Siding.*** *Shall comply with and be labeled as confroming to ASTM D 3679 and is permitted to be used on exterior wall in accordance with the manufacturer's approved installation instructions and Section R703.11.1 and R703.11.2.*

► **Fiber Cement Siding**. Fiber cement siding (FCS) is intended to mimic traditional wood lap, sheet or shingle siding. Cement board siding is installed similar wood and may be face nailed or blind nailed. *The minimum horizontal lap is 1-1/4".* The butt joints that are in the field of the wall should be flashed. Assembly of FCS siding requires that the vertical butt joints and vertical joints at corners, windows and doors also be gapped and caulked to accommodate movement due to changes in temperature.

> ***R703.10 Fiber cement siding.***
>
> ***R703.10.1 Panel siding.*** *Fiber-cement panels shall comply with the requirements of ASTM C 1186, Type A, minimum Grade II. Panels shall be installed with the long dimension either parallel or perpendicular to framing. Vertical and horizontal joints shall occur over framing members and shall be sealed with caulking, covered with battens or shall be designed to comply with Section R703.1. Panel siding shall be installed with fasteners according to Table R703.4 or approved manufacturer's installation instructions.*
>
> 
>
> ***R703.10.2 Lap siding.*** *Fiber-cement lap siding having a maximum width of 12 inches shall comply with the requirements of ASTM C 1186, Type A, minimum Grade II. Lap siding shall be lapped a minimum of 11/4 inches (32 mm) and lap siding not having tongue-and-groove end joints shall have the ends sealed with caulking, installed with an H-section joint cover, located over a strip of flashing or shall be designed to comply with Section R703.1. Lap siding courses may be installed with the fastener heads exposed or concealed, according to Table R703.4 or approved manufacturers' installation instructions.*

Lap Siding. Lap siding comes in several profiles. Traditionally, horizontal and beveled, lap siding is referred to as clapboard siding. Face nailed horizontal (lap) siding requires a lap of at least 1". However, rabbet edge sidings only require ½" lap.

Wood siding installed vertically is often referred to **"board and batten"**. Traditional square edge siding material (planks), installed vertically, should have battens made from light-weight strips covering the seams. Both the planks and battens should be naturally durable or treated with an exterior grade wood finish.

Shiplapped joints are rabbeted joints on sidings. They may be horizontal or vertical. Sheet plywood siding, with shiplap edge, often has reverse battens while exterior grade square edge plywood needs battens to cover the vertical seams.

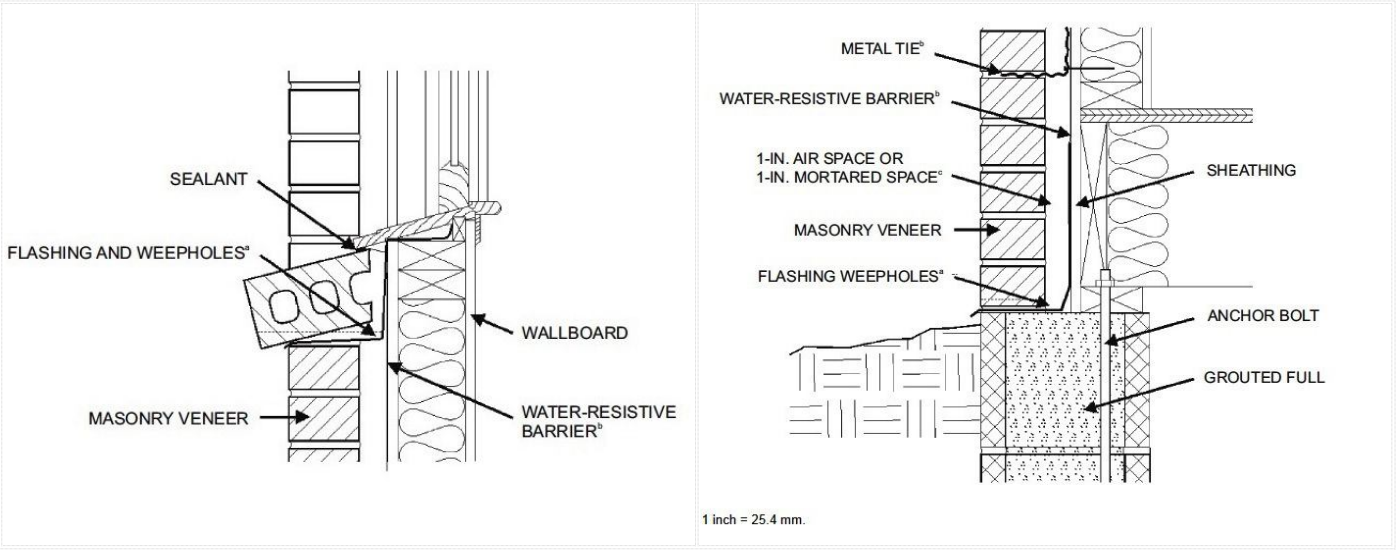
The horizontal seams between plywood panel sidings should be either flashed with "Z" metal flashings or lapped. In order to lap board or plywood sheet siding, the carpenter needs to fur the entire upper wall plane, outward, the thickness of the lower siding before installing the upper layer of siding.

When installing wood siding, and especially plywood panel siding, prime or seal the edges of the material prior to installation. This coating will limit the absorption of water into the material. Also, the horizontal bottom edge, laid into "Z" flashing, is especially prone to delamination and rot caused by water contact. To resist this damage to the plywood edge, keep it above the level surface of the flashing by about ¼". This air-space allows the bottom edge to dry out if it does get wet!

Source: Carpentry and Building Construction p. 658-679

Brick Veneer. It is a common misconception that 4" brick veneer is waterproof. IT IS NOT! Water that gets behind the brick or through the mortar (just like any other wall covering)

needs a place to exit to the exterior. Flashing needs to be installed to help direct the water to drain at weep holes.



Exterior Insulation Finishing System (EIFS) and Stucco. Stucco siding on commercial and residential buildings is as versatile as any other material today. Modern stucco can be applied over building paper, metal mesh and wall sheathing but is likely to be used as part of EIFS. Today's EIFS applications use a modern version of stucco plaster for the permanent, exposed surface. Portland cement and modern materials like latex additives and dyes, make today's stucco water proof, and color-fast. *It's a good idea to use balloon framing methods or steel studs for buildings over one story* when applying stucco siding on commercial and residential buildings. If conventional platform framing is used, there's a possibility, horizontal compression cracks can form at the second story floor-line due to compression or shrinkage at the wall plates or rim joist area of the building frame.

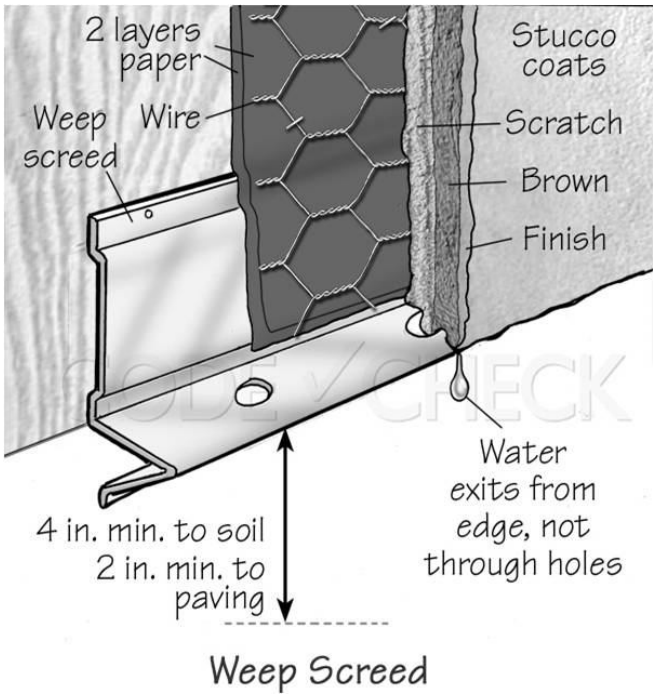
EIFS stands for ***Exterior Insulation Finishing System.***

- EIFS begins with a layer of rigid foam insulation, attached to the wall.
- The next layer is a membrane (house wrap, building paper) to prevent any water that gets behind the stucco from entering the wall cavity.
- Next is a layer of metal or fiber lathe. This lathe, when bonded becomes very strong and durable
- Next comes the first coat of stucco. This is also called the base or scratch coat and bonds the metal mesh or lathe.
- The next layer or *second coat is called the brown coat*. The brown coat is more flexible than the first coat and gives the worker more time to evenly apply the material.
- Finally, the color coat or finish coat is applied. This top coat is colored and modified with polymers to make if extremely resistant to the elements and color-fast.

As with any other masonry material, keep stucco from drying out and losing its strength. If possible, keep newly applied stucco shaded and moist for 3 days. This allows the *Portland cement to properly hydrate* and achieve the desired strength.

Also, as with other masonry products, don't allow the material to freeze until adequately cured. Don't install stucco if the temperature may drop below 40 degrees Fahrenheit. If necessary, tent the wall and create a controlled environment if the temperature will get too, cold. ***Source: Carpentry and Building Construction p. 681-2***

Condensing water vapor within a building envelope is always going to be an issue that needs to be addressed. Breathable waterproof membranes on the outside of a wall frame and vapor barriers on the warm-side-in-winter are all used to prevent moisture from condensing inside the wall cavity.



R703.6.3 *Where cement plaster (stucco) is to be applied to lath over frame construction, measures shall be taken to prevent bonding between the cement plaster and the water-resistive barrier. A bond break shall be provided between the water-resistive barrier and the cement plaster (stucco) consisting of one of the following:*

1. Two layers of an approved water-resistant barrier material; or

2. One layer of an approved water-resistant barrier over an approved plastic house wrap; or

3. Other approved methods or materials applied in accordance with the manufacturer's installation instructions.

Since stucco is applied as a coating component of EIFS, it's possible, without a weep screed, to trap water behind the material. EXTERIOR INSULATION FINISHING SYSTEMS THAT ARE NON-DRAINABLE ARE NOT PERMITTED!

R703.9 Exterior insulation and finish system (EIFS)/EIFS with drainage. *Exterior Insulation and Finish System (EIFS) shall be designed or tested to meet the wind pressures specified in Table R301.2(2) and shall comply with this chapter and Sections R703.9.1 and R703.9.3. EIFS with drainage shall comply with this chapter and Sections R703.9.2, R703.9.3 and R703.9.4. Exterior insulation and finish system (EIFS). EIFS shall comply with ASTM E 2568.*

R703.9.2 Exterior insulation and finish system (EIFS) with drainage. *EIFS with drainage shall comply with ASTM E 2568 and shall have an average minimum drainage efficiency of 90 percent when tested in accordance with ASTM E 2273.*

R703.9.2.1 Water-resistive barrier. *The water-resistive barrier shall comply with Section R703.2 or ASTM E 2570.*

R703.9.2.2 Installation. *The water-resistive barrier shall be applied between the EIFS and the wall sheathing.*

R703.9.3 Flashing, general. *Flashing of EIFS shall be provided in accordance with the requirements of Section R703.8.*

R703.9.4 EIFS/EIFS with drainage installation. *All EIFS shall be installed in accordance with the manufacturer's installation instructions and the requirements of this section.*

R703.9.4.1 Terminations. *The EIFS shall terminate not less than 6 inches (152 mm) above the finished ground level.*

R703.9.4.2 Decorative trim. *Decorative trim shall not be face nailed though the EIFS.*

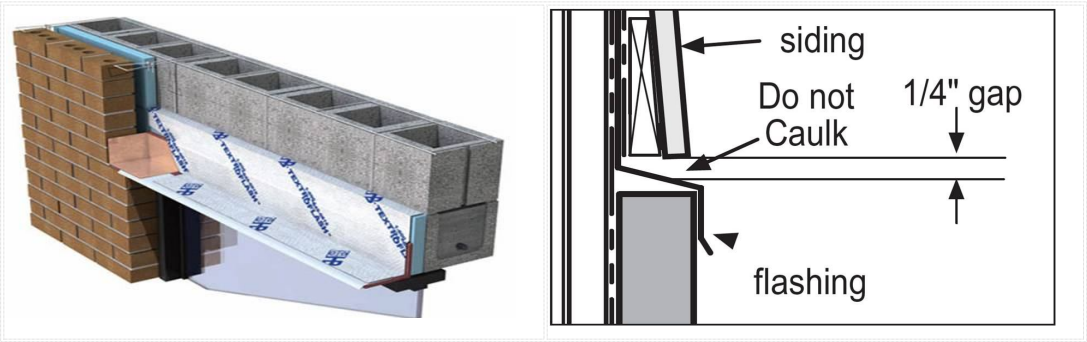
Windows and Doors

Improperly flashed window and door openings are one of the most common mistakes made by contractors. This causes moisture to get into the wall, causing mold, mildew, and eventually, rot. A major reason for the mistakes made while installing windows and doors is that *not every situation is the same.*

Such as:

- Is the house wrap installed yet?
- Does the unit recess into the wall?
- Does the unit install with a flange?

Proper window and door installation preserves the integrity of the building envelope. Window and door rough opening sides should have the house wrap folded around and into the opening. The side flanges or brick molding will counter flash the sides of opening and can be sealed with caulking or butyl tape. The top edge of the house wrap should be cut even with the rough opening and temporarily pinned or held up and out of the way of the window or door top flange. *If the window or door has a integral or well sealed top flange, it can serve as the window or door head flashing!*



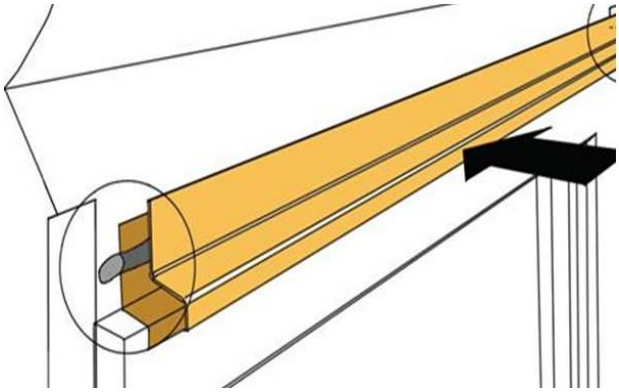
Windows with molded or integral top flanges don't usually need additional head flashings. *However, windows and doors NEED HEAD FLASHING!!!* A metal or vinyl flashing (z-metal) installed on the top edge of the unit serves to positively divert any water to the exterior of the unit. The loose layer of house wrap can then be spot tacked with tape or fasteners over the head flashing. ***Remember:*** Before installing the trims around the window or door apply

enough caulk at the ends of the z-metal flashing to create a “dam”, which will keep water from running off the ends of the flashing and down the sides of the unit behind the side trims.

****DO NOT CAULK OR SEAL THE HOUSE WRAP TO THE HEAD FLASHING EXCEPT AT THE ENDS WHERE YOU CREATED THE DAM!!!*

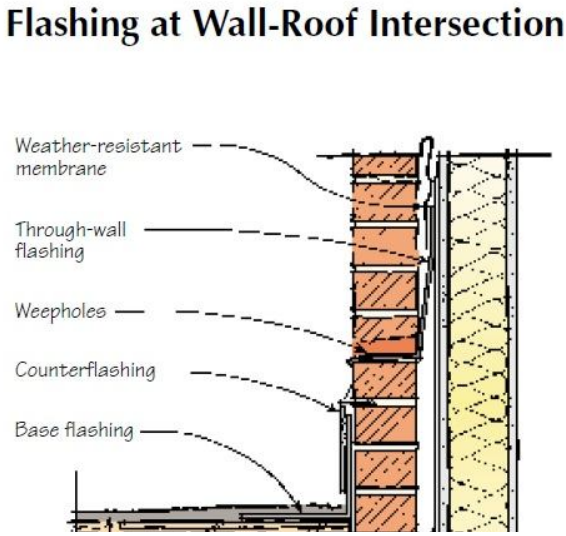
Flashing. Properly installed flashing provides a path and outlet for trapped water moisture to escape the surface of the siding. Every subsequent layer should be installed over and above the previous in order to shed moisture to the lower outer layer.

Flashings can be made from corrosion resistant steel, aluminum, rubbers or plastic. It’s important that the installer use material that will not be adversely affected by the material being flashed. Certain metals may react with others. Chemicals used in pressure treated wood are too caustic to be allowed near aluminum flashings.



Flashing is required above all window and door openings as well as above all horizontal projecting trims that do not have ship lap or built-in flashing edges. Flashings can be “Z” metal, drip cap or even proprietary flashings produced by the manufacturer of the window and door. ***Never caulk the exposed part of the flashing. Dams hold water!!!***

> ***R703.8 Flashing.*** *Approved corrosion-resistant flashing shall be applied shingle-fashion in a manner to prevent entry of water into the wall cavity or penetration of water to the building structural framing components. Self-adhered membranes used as flashing shall comply with AAMA 711. The flashing shall extend to the surface of the exterior wall finish. Approved corrosion-resistant flashings shall be installed at all of the following locations:*
>
> > ***1. Exterior window and door openings.*** *Flashing at exterior window and door openings shall extend to the surface of the exterior wall finish or to the water-resistive barrier for subsequent drainage. Flashing at exterior window and door openings shall be installed in accordance with one or more of the following or other approved method:*
> >
> > *1.1 The fenestration manufacturer’s written flashing instructions.*
> >
> > *1.2 The flashing manufacturer’s written installation instructions.*
> >
> > *1.3 In accordance with FMA/AAMA 100, FMA/AAMA 200, or FMA/WDMA 250.*
> >
> > *1.4 In accordance with*



the flashing method of a registered design professional.

*2. At the **intersection** of chimneys or other masonry construction with frame or stucco walls, with projecting lips on both sides under stucco copings.*

*3. **Under and at the ends** of masonry, wood or metal copings and sills.*

*4. Continuously **above all projecting** wood trim.*

*5. Where exterior porches, decks or stairs **attach to a wall or floor assembly of wood-frame** construction.*

*6. At wall and roof **intersections**.*

*7. At built-in **gutters**.*

Caulking. NEVER CAULK A HORIZONTAL LAP JOINT!!! Lap joints of beveled siding, window and door flanges, flashings, etc. are lapped to allow moisture to *shed to the exterior* surface of the wall. For example, if a carpenter or painter mistakenly caulks the head of a window, he defeats the *"Z" flashing* or flange's ability to divert the moisture to the outer surface of the window. Horizontal caulk is an effective dam. DAMS BLOCK WATER MOVEMENT!!!

Most window and door manufacturers require the exterior, outer edge of their window or door frame to be caulked to the siding or exterior trims. An adequate amount of caulk is necessary to preserve the integrity of the caulk. Too little caulk, on the surface only, will likely result premature failure of the caulk.

For example, if the window manufacturer requires a fully filled 3/16" gap, it's because they understand that over the course of several years of movement, *caused by expansion and contraction of the siding material*, too little caulk on the surface only, will not maintain its bond and likely separate from the surface of the siding and edge of their window frame!

Source: Carpentry and Building Construction p. 637

Windows. The IECC defines U-Factor as: The rate at which a window, door, or skylight conducts non-solar heat flow. It's usually expressed in units of Btu/hr-ft2-oF. For windows, skylights, and glass doors, a U-factor may refer to just the glass or glazing alone. However, *NFRC U-factor ratings represent the entire window performance, including frame and spacer*

material. (lower U-factor = more energy-efficient window, door, or skylight)

> ***303.1.3 Fenestration product rating.*** *(2010 Florida Building Code : Energy Conservation) U-factors of fenestration products (windows, doors and skylights) shall be determined in accordance with NFRC 100 by an accredited, independent laboratory, and labeled and certified by the manufacturer. Products lacking such a labeled U-factor shall be assigned a default U-factor from Table 303.1.3(1) or 303.1.3(2). The solar heat gain coefficient (SHGC) of glazed fenestration products (windows, glazed doors and skylights) shall be determined in accordance with NFRC 200 by an accredited, independent laboratory, and labeled and certified by the manufacturer. Products lacking such a labeled SHGC shall be assigned a default SHGC from Table 303.1.3(3).*

Each pane of glazing installed in hazardous locations shall be provided with a manufacturer's designation, indicating the type of glass and the safety glazing standard with which it complies, which is visible in the final installation. The designation shall be acid etched, sandblasted, ceramic-fired, laser etched, embossed, or be of a type which once applied cannot be removed without being destroyed. *A label shall be permitted in lieu of the manufacturer's designation.* ***SECTION 2403 GENERAL REQUIREMENTS FOR GLASS***

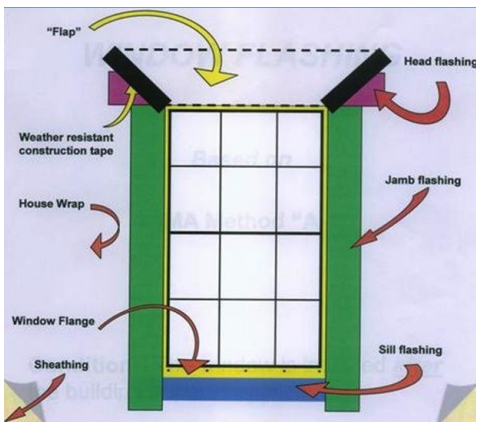
Window Installation

Installation methods and flashing of any window will depend on type and manufacture. Always follow the window manufacturer's instructions!

1. Prepare the window
2. Prepare the rough opening. Trim any plywood and cut the housewrap
3. Insert the window; lap the bottom and side flange over the housewrap and the housewrap over the head flange!
4. Level the window (plumb-level-square)
5. Nail (fasten) the window
6. From inside, seal/insulate the space between the window frame and the rough opening

**Don't forget to tape the side flanges to the house wrap!*

Remember: In order to maintain the warranty, follow the window manufacturer's instructions!



Doors. By definition a door is a movable, usually solid, barrier for opening and closing an entranceway, cupboard or cabinet; a *door commonly operates on hinges or slides in grooves or on a track.*

When installing an exterior door, many of the same steps must be takes as when installing windows. However, care should be taken to level the sub-floor and fully support the pan-flashing at the door location (with shims or by any other means). *While most windows are supported at only a couple points on the rough sill, door thresholds need to be continuously supported because of the constant loads imposed by heavy foot traffic.*

Door Installation. Installation and flashing methods will depend on type and manufacture. Proper installation includes but is not limited to:

1. Prepare the door and rough opening. Trim any plywood, flash and level the rough sill and properly house wrap the opening...head wrap should be loose and out of the way of head flashing yet to be installed.
2. Run a bead of caulk under the threshold (be sure not to create a dam to the exterior of any weep holes!!!)
3. Insert the door; Nail (fasten) the door's bottom two corners first.
4. Remember plumb-level-square...
5. Install the head flashing, tack the head wrap with tape or fasteners.

When installing the new door, determine if the threshold has weep holes on the underside. If there are weep holes or slots on the underside of the threshold, make sure any caulk, applied to the underside of the threshold or the pan flashing is installed slightly to the interior of the weep holes. *If the caulk line is to the exterior of the weep holes, the caulk acts as a continuous dam, stopping the flow of accumulated water to the exterior of the wall. BAD! BAD! BAD!*

A bead of caulk at the outer edge of the flashing pan almost always results in rotten jambs, floor framing, joists, bond, sill or siding immediately below the door!!!

As with windows, if the door has integral side and head flanges, install, tape and layer properly. If, however, the door has brick mold applied or solid exterior casings to be applied, it's a good idea to pre-caulk the moldings and then add a head flashing made from Z-metal or vinyl, then lay the loose house wrap over the head flashing and tack in place with tape or fasteners. ***Remember:*** Before installing the trims around the window or door apply enough caulk at the ends of the z-metal flashing to create a "dam", which will keep water from running off the ends of the flashing and down the sides of the unit behind the side trims. *As a final precaution, don't forget to spot-tape any cuts or tears remaining in the house wrap!!!*

Source: Carpentry and Building Construction p. 606

Skylights

. By definition a skylight is: Glass or other transparent or translucent glazing material installed at a slope of 15 degrees or more from vertical. Glazing materials in skylights, including unit skylights, solariums, sunrooms, roofs and sloped walls are included in this definition.

Sloped glazing shall be any of the following materials, subject to the listed limitations.

1. For monolithic glazing systems, the glazing material of the single light or layer shall be laminated glass with a minimum 30-mil polyvinyl butyral (or equivalent) interlayer, wired glass, light-transmitting plastic materials meeting the requirements of Section 2607, heat-strengthened glass or fully tempered glass.

2. For multiple-layer glazing systems, each light or layer shall consist of any of the glazing materials specified in Item 1 above. Annealed glass is permitted to be used as specified within Exceptions 2 and 3 of Section 2405.3.

Source: Florida Building Code 2405.2 Allowable glazing materials and limitations

Most skylights will have proprietary installation instructions according to the manufacturer. However, almost all skylights, unless one-piece-molded units, will have flashing kits. *Flashing kits include base flashing (bottom), step flashing or pan flashing and head (top) flashing (sometimes with gutter).*

Also, any location within a few feet of a valley or behind or below a chimney should be avoided!

Roofs

How Moisture Penetrates the Roof/Ceiling

When a roof has leaks, look at anything “out-of-plane”. Valleys, flashings, skylights and chimneys all break the plane of the roof. Valleys are usually the first place to look when trouble shooting roof problems! When you look for a leak on an asphalt shingle roof, start by looking for *worn shingles with dark patches on them.*

SECTION R903 WEATHER PROTECTION

R903.1 General. *Roof decks shall be covered with approved roof coverings secured to the building or structure in accordance with the provisions of this chapter. Roof assemblies shall be designed and installed in accordance with this code and the approved manufacturer’s installation instructions such that the roof assembly shall*

serve to protect the building or structure.

R903.2 Flashing. *Flashings shall be installed in a manner that prevents moisture from entering the wall and roof through joints in copings, through moisture permeable materials and at intersections with parapet walls and other penetrations through the roof plane.*

R903.2.1 Locations. *Flashings shall be installed at wall and roof intersections, wherever there is a change in roof slope or direction and around roof openings. Where flashing is of metal, the metal shall be corrosion resistant with a thickness of not less than provided in Table R903.2.1. Exception: Flashing is not required at hip and ridge junction.*

TABLE R903.2.1
METAL FLASHING MATERIAL

MATERIAL	GAGE MINIMUM THICKNESS (INCHES)	GAGE	WEIGHT (lbs per sq ft)
Copper	0.024		1 (16 oz)
Aluminum	0.024		
Stainless steel		28	
Galvanized steel	0.0179	26 (zinc coated G90)	26 (zinc coated G90)
Aluminum zinc coated steel	0.0179	26 (AZ50 alum zinc)	26 (AZ50 alum zinc)
Zinc alloy	0.027		
Lead			2.5 (40 oz)
Painted terne			1.25 (20 oz)

R903.2.2 Crickets and saddles. *A cricket or saddle shall be installed on the ridge side of any chimney or penetration more than 30 inches (762 mm) wide. Cricket or saddle coverings shall be sheet metal or of the same material as the roof covering.*

R903.2.3 Membrane flashings. *All membrane flashing shall be installed according to the roof assembly manufacturer's published literature.*

R903.3 Coping. *Parapet walls shall be properly coped with noncombustible, weatherproof materials of a width no less than the cross section of the parapet wall. Metal coping shall comply with ANSI/SPRI/ ES-1 or RAS 111.*

R903.4 Roof drainage. *Unless roofs are sloped to drain over roof edges, roof drains shall be installed at each low point of the roof. Where required for roof drainage, scuppers shall be placed level with the roof surface in a wall or parapet. The scupper shall be located as determined by the roof slope and contributing roof area.*

R903.4.1 Overflow drains and scuppers. *When other means of drainage of overflow water is not provided, overflow scuppers shall be placed in walls or parapets not less than 2 inches (51 mm) nor more than 4 inches (102 mm) above the finished roof covering and shall be located as close as practical to required vertical leaders or downspouts or wall and parapet scuppers. An overflow scupper shall be sized in accordance with the Florida Building Code, Plumbing.*

R903.4.2 One and two family dwellings, and private garages. *When gutters and leaders are placed on the outside of buildings, the gutters and leaders shall be constructed of metal or approved plastic for outdoor exposure with lapped, soldered or caulked joints and shall be securely fastened to the building with a corrosion resistant fastening device of similar or compatible material to the gutters and downspouts.*

Roof Valleys. Avoid using "open valleys" where the two roofs forming the valley have considerably different slopes. For example, if an upper slope is a 4/12 pitch and falls toward a

lower roof with a 12/12 pitch, the lower sloped roof acts like a dam, backing up water, snow and ice in the valley!

When an open valley is unavoidable and the roofs forming the valley have considerably different slopes, use metal valley flashing with a center splash diverter and water guards.

Asphalt shingles have a base mat of tough asphalt-saturated felt or fiberglass. A typical 3-tab shingle is made from a single mat. Laminated shingles use two lengthwise mats cemented together. While laminated shingles are easily packaged and lay nicely on an even roof plane, *do not use them in woven valleys.*

> ***R905.2.8.2 Valleys.*** *Valley linings shall be installed in accordance with the manufacturer's installation instructions before applying shingles. Valley linings of the following types shall be permitted:*
>
> *1. For open valleys lined with metal, the valley lining shall be at least 16 inches (406 mm) wide and of any of the corrosion-resistant metals in Table R903.21.*
>
> *2. For open valleys, valley lining of two plies of mineral surface roll roofing, complying with ASTM D 3909 or ASTM D 6380 Class M, shall be permitted. The bottom layer shall be 18 inches (457 mm) and the top layer a minimum of 36 inches (914 mm) wide.*
>
> *3. For closed valleys, valley lining of one ply of smooth roll roofing complying with ASTM D 6380 Class S and at least 36 inches (914 mm) wide or valley lining as described in Item 1 or 2 above shall be permitted. Self-adhering polymer modified bitumen underlayment complying with ASTM D 1970 shall be permitted in lieu of the lining material.*

Closed-cut valleys can be used with all types of strip shingles. However, the woven-closed valley is only recommended with three-tab strip shingles.

In an open valley, when flashing a valley with two layers of rolled roofing, where a lap joint is needed, lap the upper section over the lower section by at least 12 inches and be sure to cement the layers together with the bottom layer mineral surface down! When flashing a valley with two layers of metal, lap the lower section of valley metal at least 6" by the upper metal.

Source: Roofing Construction & Estimation, by Daniel Atcheson

Flashing

Continuous flashing is used when a roof dies out or ends against a skylight, valley or vertical wall. Continuous wall flashing is bent at about 90° centered longitudinally, creating two full length flanges. The upper edge is fastened against the wall sheathing, behind the

siding and counter flashed by the house wrap. The roof edge is continuously tarred or sealed with roof cement to each shingle row.

Step Flashing is installed by overlapping each shingle with a piece of flashing and so on. Step flashing is an extension of each shingle up the side wall. The first piece of flashing closest to the eave of the house should have a kicker made of flashing material to positively divert water away from the sidewall and eave.

Result of an improperly flashed valley!!!

Wood shingles and shakes should hang over the eaves farther than asphalt shingles. The drip edge for wood shingles and shakes, at the eave, should extend out beyond the fascia 1-1/2". Because, shakes are thicker and rougher than shingles, they can absorb more water. Thus, they expand and contract more as they absorb or lose water. *Space shakes 3/8" to 5/8" apart.*

Shingles are thinner and more likely to split lengthwise than shakes. Because of this, *shingles should be between 3" and 8" wide and nailed twice*. If the shingle or shake is too wide, it can split when it shrinks and if not nailed properly, the newly split portion can become loose and dislodge from the roof. Wood shingles and shakes require a minimum side-lap of at least 1-1/2".

Valley flashing for wood **shingles** shall be a minimum 26 gauge corrosion resistant sheet metal and shall extend from the centerline of the valley, on roof slopes less than 12/12, at least 10".

> ***R905.7.8.1 Valley flashing.*** *Roof flashing shall be not less than No. 26 gage [0.017 inches (0.48 mm)] corrosion-resistant sheet metal and shall extend 10 inches (254 mm) from the centerline each way for roofs having slopes less than 12 units vertical in 12 units horizontal (100-percent slope), and 7 inches (178 mm) from the centerline each way for slopes of 12 units vertical in 12 units horizontal and greater. Sections of flashing shall have an end lap of not less than 4 inches (102 mm).*

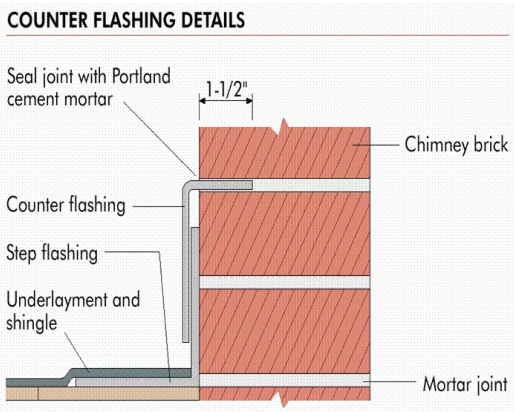
Valley flashing for wood **shakes** shall be a minimum 26 gauge corrosion resistant sheet metal and shall extend from the centerline of the valley at least 11".

> ***R905.8.10.1 Valley flashing.*** *Valley flashing shall extend at least 11 inches (279 mm) from the centerline each way and have a splash diverter rib not less than 1 inch (25 mm) high at the flow line formed as part of the flashing. Sections of flashing shall have an end lap of not less than 4 inches (102 mm). For roof slopes of four (4) units vertical in twelve (12) units horizontal (33-percent slope) and over, the valley flashing shall have a 36-inch-wide (914 mm) underlayment of one layer of ASTM D 226 Type I underlayment running the full length of the valley, in addition to*

other required underlayment per Table R903.2.1 Valley flashing and flashing metal shall be a minimum thickness as provided in Table R903.2.1 for nonferrous metal or stainless steel.

Source: International Residential Code R905

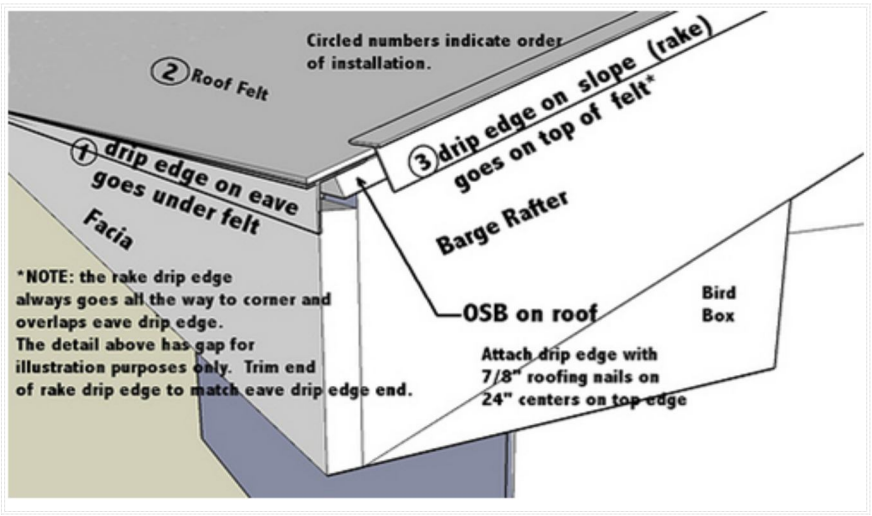
The Florida Residential Code requires a cricket or saddle built immediately upslope and behind any chimney wider than 30". ***(R1003.20)*** However, good framing and roofing practices suggest building the cricket/saddle anytime the chimney's width is greater than 24".



Remember, *step flashing should be counter flashed*. Since the step flashing is applied against the wall or brick first, it's considered *base flashing*. Base flashing is always counter flashed by cap flashing, housewrap, siding, etc. If base flashing is not counter flashed, its upper edge will collect rain and debris, rendering it useless!

A drip edge should be *installed under the felt at the eaves*. If the drip edge is installed under the felt along the rakes, wind water can penetrate between the felt and the drip edge.

R905.2.8.5 Drip edge. *Provide drip edge at eaves and gables of shingle roofs. Overlap to be a minimum of 3 inches (76 mm). Eave drip edges shall extend 1/2 inch (13 mm) below sheathing and extend back on the roof a minimum of 2 inches (51 mm). Drip edge at eaves shall be permitted to be installed either over or under the underlayment. If installed over the underlayment, there shall be a minimum 4 inch (51 mm) width of roof cement installed over the drip edge flange. Drip edge shall be mechanically fastened a maximum of 12 inches (305 mm) on center. Where the Vasd as determined in accordance with Section R301.2.1.3 is 110 mph (177 km/h) or greater or the mean roof height exceeds 33 feet (10 058 mm), drip edges shall be mechanically fastened a maximum of 4 inches (102 mm) on center.*



Sheathing and Built up Roofs

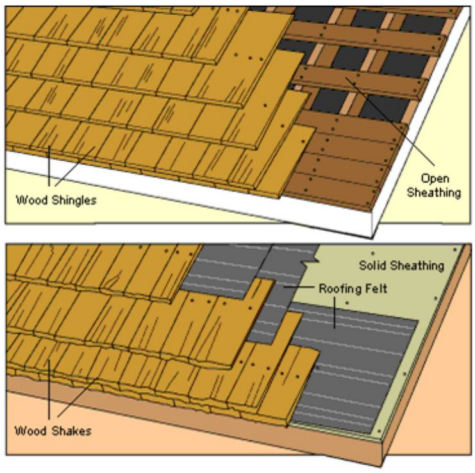
R905.9 Built-up roofs. *The installation of built-up roofs shall comply with the provisions of this*

section.

R905.9.1 Slope. *Built-up roofs shall have a design slope of a minimum of one-fourth unit vertical in 12 units horizontal (2-percent slope) for drainage, except for coal-tar built-up roofs, which shall have a design slope of a minimum one-eighth unit vertical in 12 units horizontal (1-percent slope).*

Solid Roof Sheathing. It's recommended that you install shakes or wood shingles over solid sheathing where:

1.The outside design temperature (the average expected low temperature) is 0° F or colder.
2.The January mean temperature is 25 ° F or less.



Spaced Board Sheathing. There are two acceptable ways to install spaced sheathing under wood shingles. The best is to…….Install 1 x 4s spaced on centers equal to the shingle exposure.

Installing Mineral-Surfaced Roll Roofing. Try to install rolls when the weather is above 45° F.

Base Sheets (Vapor Retarders)

BUR (Built UP Roof). Use a coated sheet as a vapor-retarding base sheet, or as the top ply on a smooth-surfaced built-up roof.

Coated sheets:

- 36 inches wide
- 36 to 144 feet long.
- 45 to 80 pounds per square.

Roofing Felts. Apply *25 pounds of asphalt or pitch per square* between felts with an application tolerance of plus or minus 15 percent.

Hot Bitumens

Type 1 asphalt • Install over roof slopes up to ¼ in 12 • self-healing • soften at 135° to 151°F
Type 2 asphalt • softens at 158° to 176°F • use it on slopes up to ½ in 12.

Type 3 asphalt

- most common
- softens at 180° to 205°
- apply on roof slopes up to 3 in 12

Most asphalts have a flash point ranging from 437° to 500°F. you can safely heat dead level asphalt or pitch to 400° and flat and steep asphalts to 450° and 475°F. Don't heat asphalt to within 25°F of the flash point.

Cold-applied Bitumens. Use emulsions for surfacing bitumen on slopes up to 6 in 12. Apply surface emulsions at the rate of 3 gallons per square. Since emulsions contain water, don't let them freeze.

Surface Aggregate. A properly installed aggregate-surface BUR system has a life expectance of 20 years or more.

Cant Strips. Run the *cant strip over the roof at least 3 inches and up the vertical surface at least 5 inches.* A cant strip coves the roof parapet interface.

Repairs

Asphalt Shingle Repair. You can spot repair minor cracks or worn area on asphalt shingles by *applying roofing cement and then sprinkling on loose granules and rubbing them into the cement.* Either buy granules from a roofing supplier, or make your own by rubbing two shingles together.

You can also *install galvanized sheet metal below the shingle* and nail the metal into a bed of roofing cement. Cover the nail heads with plastic cement.

The *best time to repair asphalt shingles is in warm weather.* When they're warm, asphalt shingles become pliable, so you're less likely to damage them.

Repairing Wood Shingles and Shakes. The most common leak on a wood shingle roof occurs where joints or *splints line up in three adjacent courses.*

Slate Repairs. To replace a broken slate, *insert the new slate underneath the two overlying courses and nail it into place.*

Repairing Wood Roofs. When the repair cost *exceeds* replacement cost, a roof simply needs to be replaced.

- repair costs exceeding 80% of the replacement cost
- 30 hail-caused splits per square for cedar shingles
- 25 hail-caused splits per square for cedar shakes

Ventilation

SECTION R806 ROOF VENTILATION

R806.1 Ventilation required. *Enclosed attics and enclosed rafter spaces formed where ceilings are applied directly to the underside of roof rafters shall have cross ventilation for each separate space by ventilating openings protected against the entrance of rain. Ventilation openings shall have a least dimension of 1/16 inch (1.6 mm) minimum and 1/4 inch (6.4 mm) maximum. Ventilation openings having a least dimension larger than 1/4 inch (6.4 mm) shall be provided with corrosion-resistant wire cloth screening, hardware cloth, or similar material with openings having a least dimension of 1/16 inch (1.6 mm) minimum and 1/4 inch (6.4 mm) maximum. Openings in roof framing members shall conform to the requirements of Section R802.7. Exception: Attic spaces, designed by a professional engineer or architect licensed to practice in the state, designed to eliminate the attic venting.*

R806.2 Minimum area. *The total net free ventilating area shall not be less than 1/150 of the area of the space ventilated except that reduction of the total area to 1/300 is permitted provided that at least 50 percent and not more than 80 percent of the required ventilating area is provided by ventilators located in the upper portion of the space to be ventilated at least 3 feet (914 mm) above the eave or cornice vents with the balance of the required ventilation provided by eave or cornice vents. As an alternative, the net free cross-ventilation area may be reduced to 1/300 when a Class I or II vapor retarder is installed on the warm-in-winter side of the ceiling.*

R806.3 Vent and insulation clearance. *Where eave or cornice vents are installed, insulation shall not block the free flow of air. A minimum of a 1-inch (25 mm) space shall be provided between the insulation and the roof sheathing and at the location of the vent.*

R806.4 Unvented attic assemblies. *Unvented attic assemblies (spaces between the ceiling joists of the top story and the roof rafters) shall be permitted if all the following conditions are met:*

1. The unvented attic space is completely contained within the building thermal envelope.

2. No interior vapor retarders are installed on the ceiling side (attic floor) of the unvented attic assembly.

3. Where wood shingles or shakes are used, a minimum 1/4 inch (6 mm) vented air space separates the shingles or shakes and the roofing underlayment above the structural sheathing.

4. Either Items 4.1, 4.2 or 4.3 shall be met, depending on the air permeability of the insulation directly under the structural roof sheathing.

4.1 Air-impermeable insulation only. Insulation shall be applied in direct contact with the underside of the structural roof sheathing.

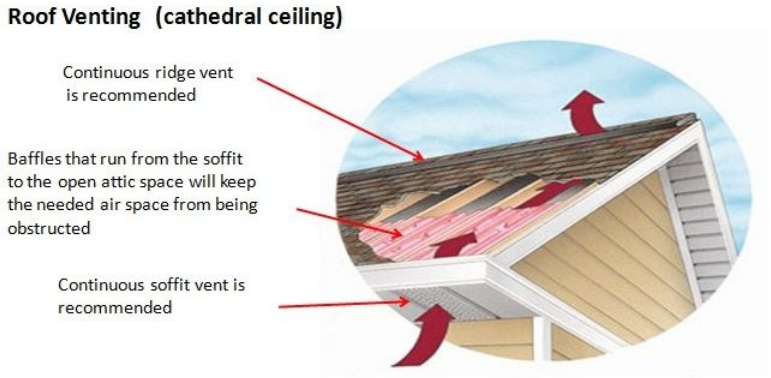
4.2 Air-permeable insulation only. In addition to the air-permeable installed directly below the structural sheathing, rigid board or sheet insulation shall be installed directly above the structural roof sheathing as specified in Table R806.4 for condensation control.

4.3 Air-impermeable and air-permeable insulation. The air-impermeable insulation shall be applied in direct contact with the underside of the structural roof sheathing as

specified in Table R806.4 for condensation control. The air-permeable insulation shall be installed directly under the air-impermeable insulation.

Natural Attic Ventilation. At first it may seem odd to add insulation and then purposely allow cold air to enter the attic through vents, but this combination is the key to a durable and energy-efficient home. Here's why: in the winter, allowing a natural flow of outdoor air to ventilate the attic helps keep it cold, which reduces the potential for ice dams. Ice dams form when snow melts off a roof from an attic that is too warm and then re-freezes at the eaves. As the melt-off continually re-freezes, the ice dam increases in size, eventually causing water to flow backward under the shingles, causing damage to the building.

In the summer, *natural air flow in a well-vented attic* moves super-heated air out of the attic, protecting roof shingles and removing moisture. The insulation will resist heat transfer into the house.

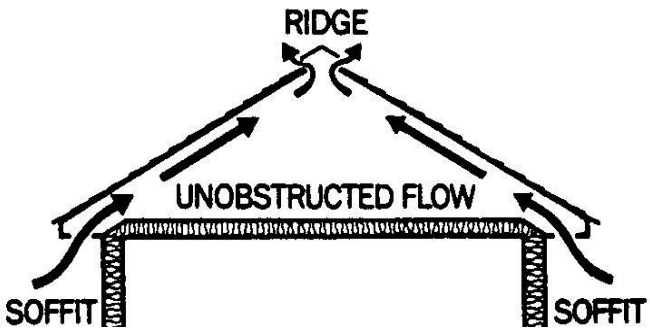


The most common mistake homeowners make when installing insulation is to block the flow of air at the eaves. NEVER COVER SOFFIT VENTS WITH INSULATION — use rafter-space baffles called **proper-vent** to maintain airflow.

Attic fans are intended to cool hot attics by drawing in cooler outside air from attic vents (soffit and gable) and pushing hot air to the outside. However, if your attic has blocked soffit vents and is not well-sealed from the rest of the house, attic fans will suck cool conditioned air up out of the house and into the attic. This will use more energy and make your air conditioner work harder, which will increase your summer utility bill.

You don't want your unfinished attic cooled by your air conditioner. To prevent this, follow the air sealing and insulation strategies to make sure the attic is well-ventilated using passive vents and natural air flow.

Doing the Job. Laying fiberglass rolls in a level attic is easiest. After the first layer of insulation is installed between the ceiling joists or truss' bottom chords, install the second layer over and perpendicular to the first (the second layer of roll insulation should be *un-faced — with no vapor retarder*). This will help cover the tops of the joists and reduce heat loss or gain through



the frame. Also, when laying down additional insulation, work from the perimeter toward the attic opening. Lay insulation carefully over recessed lights fixtures and never over soffit vents. Make a special box or barrier-cover to keep all insulation at least 3 inches away from "can" lights, unless they are rated IC (Insulation Contact). If you are using loose fill insulation, use sheet metal to create barriers around the openings. If using fiberglass, wire mesh can be used to create a barrier.

Installing Rafter Vents. To completely cover your attic floor with insulation out to the eaves you need to install rafter vents (also called insulation baffles or proper vents). Complete coverage of the attic floor along with sealing air leaks will ensure you get the best performance from your insulation. Rafter vents ensure the path for air movement from soffit to ridge (or gable vent)is kept clear by keeping the channel for outside air movement open directly under the roof-deck sheathing.

To install the rafter vents, staple them directly to the roof decking. Rafter vents may be cardboard or foam products that come in varying rafter spacing widths. Rafter vents should be placed in the attic ceiling in between the rafters at the point where your attic ceiling meets your attic floor.

Once in place, the batts, blankets, or blown insulation, may be placed to the very edge of the attic floor. Note: Blown insulation may require an additional block to prevent insulation from being blown into the soffit. A piece of rigid foam board placed on the outer edge of the top plate works very well for this.

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