

# Roofing/Flashings/ Chimneys

## INTRODUCTION

THE PRIMARY PURPOSE OF A ROOF IS TO PROTECT THE BUILDING FROM RAIN, SNOW, SUN AND WIND. ROOFS ALSO AFFECT THE APPEARANCE OF A BUILDING. ROOFS PROVIDE SOME MECHANICAL PROTECTION AGAINST FALLING OBJECTS, ALTHOUGH HAIL DAMAGE FOR EXAMPLE, IS COMMON. ROOF COVERINGS ARE NOT INTENDED TO KEEP OUT THE COLD. MOST ROOFS ARE VERY POOR INSULATORS.

### 1.0 Roofing

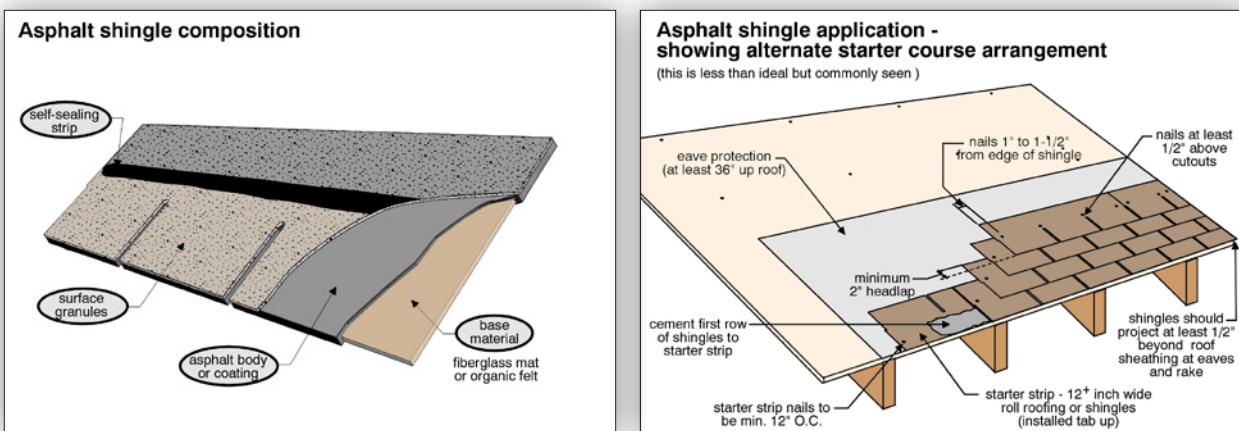
**SLOPED AND FLAT** There are two main categories of roofing systems: sloped roofs and flat roofs. Roofing professionals call these steep roofs and low sloped roofs. Sloped roofing systems are not watertight; they shed water with overlapping shingles or tiles. Flat roofs, on the other hand, are watertight membranes. Flat roof is a bad name, since roofs should never be perfectly flat. They should slope to allow water to drain off them, because water standing on the roof will damage the membrane, and the weight of water can deflect the roof structure.

The difference between sloped roofs and flat roofs is the slope, or pitch, of the roof. The slope is described as a ratio of the vertical rise over a set horizontal run. The run is always defined as 12 feet. Therefore, a 6-in-12 roof would have a vertical rise of 6 feet over a horizontal distance of 12 feet. Roofs with a slope greater than 4-in-12 are considered **sloped**. Roofs with a slope between 4-in-12 and 2-in-12 are considered **low slope**, and roofs with a slope less than 2-in-12 are considered **flat**.

Just to make it confusing, professional roofers describe anything with a slope of more than 2-in-12 as steep roofing. Anything less is low sloped roofing.

#### 1.1 Asphalt Shingles (Composition Shingles)

**DESCRIPTION** Asphalt shingles (also called composition shingles) are the most common roofing material used today. The shingles consist of asphalt-impregnated felt paper or glass fiber mats, coated with a layer of asphalt and covered with granular material.



**LIFE EXPECTANCY** Asphalt shingles were historically classified by weight. Today, asphalt shingles are classified by the manufacturer's warranty. They are known as 15-year, 20-year, 25-year, 30-year or 35-year shingles. Modern shingles are available in various textures and patterns. While shingles with longer warranties will generally last longer than shingles with shorter warranties, the warranty period should not be considered a guarantee of service life.

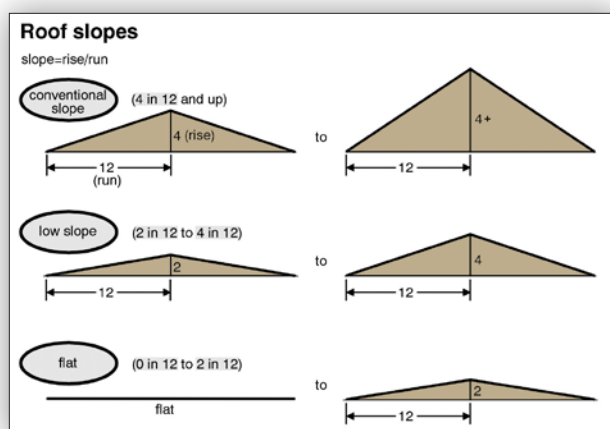
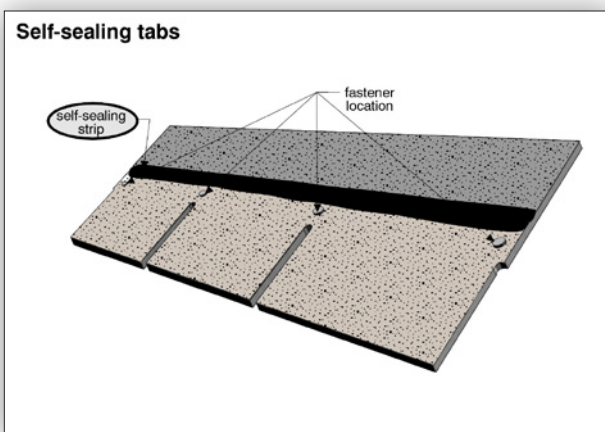
**WEAR FACTORS** Regardless of the type of shingle used, there are two significant factors with regard to wear – exposure and slope. Sunlight is one of the biggest enemies of asphalt roofs and in many areas, the south and west exposures wear out the fastest. The steeper the slope, the longer the shingles will last.

As asphalt shingles wear, they lose their granular covering. The granular material protects the shingles from ultra-violet light. As granules wear off, the shingles dry out and become brittle. They crack, buckle, and curl. Shingles wear out first where the granular material is lost. This may be due to heavy foot traffic, abrasion from tree branches, erosion from downspouts discharging onto the roof surface, or manufacturing defects.

**SELF-SEALING SHINGLES** Most asphalt shingles have self-sealing strips, a strip of asphalt running across the middle of the shingle. The shingle above overlaps the lower shingle, with the bottom edge covering this strip. When the sun warms the roof surface, the two shingles stick together. This protects the shingles from being blown off in a heavy wind. Shingles installed in cold weather do not seal themselves until the weather warms up. They are vulnerable to wind damage during this period.

**SHINGLES AND ROOF SLOPES** Conventional asphalt shingles can be used on a slope as low as 4-in-12. Shingles can also be used down to a slope of 2-in-12 if the roof is first covered with non-perforated, asphalt-saturated felt papers or a waterproof membrane. The felt papers are overlapped by 50% and the section at the eaves (from the bottom edge up to 24 inches beyond the exterior wall) is cemented in place to provide extra protection. After construction, you can't tell whether this was done, especially since the shingles themselves may be cemented down.

In the past, special shingles were made for this application. These are no longer used.



**RE-ROOFING** While it is better to remove old roofing before re-roofing, a second layer of shingles can be installed over one layer of shingles if the layer being covered is relatively smooth and flat. Longer nails must be used. If there are already two layers of shingles on the roof, all shingles should be removed before re-roofing.

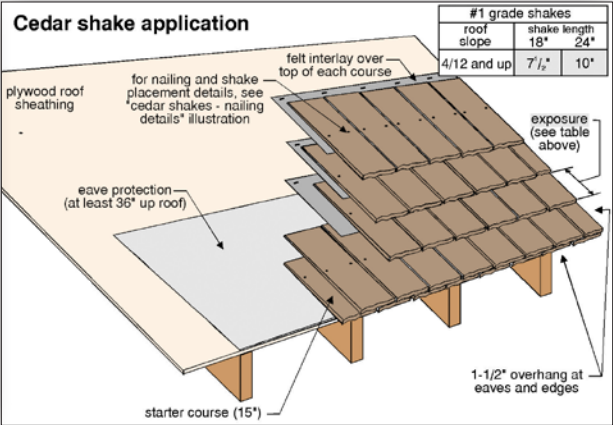
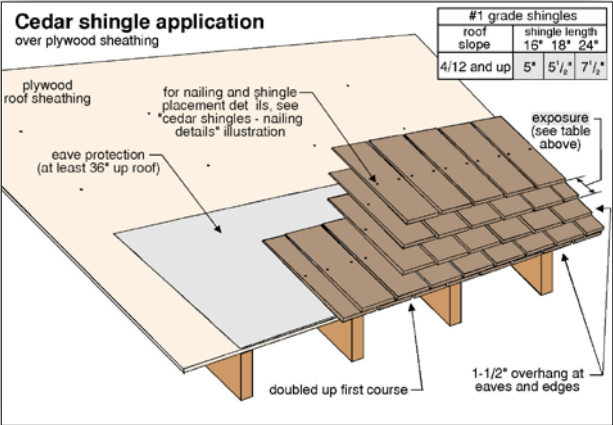
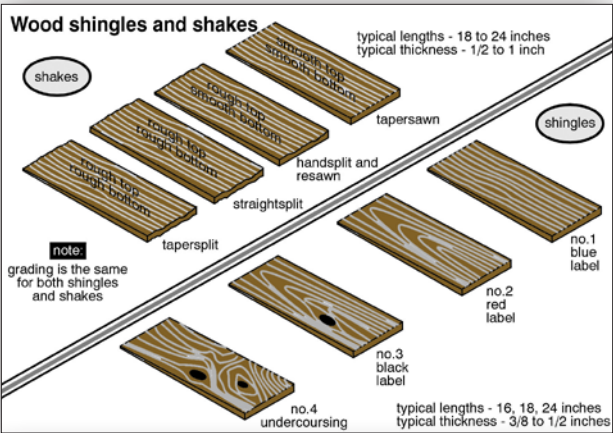
Asphalt shingles are often installed over a single layer of wood shingles or slate shingles; however, the new shingles will perform better and last longer if the old roofing materials are removed.

1.2 Wood Shingles and Shakes

**DESCRIPTION** Wood shingles are machine cut. They are typically smaller, thinner and more uniform than wood shakes. Traditionally, wood shakes were hand split or mechanically split, although machine-sawn shakes are also available. Wood shakes are thicker and split shakes have a much more uneven surface. Most wood shingles are cedar; however, redwood and pine are also used.

Wood shingles can be used on roofs with a slope as low as 3-in-12; however, 6-in-12 or more is recommended. Wood shingles vary in length between 16 inches and 24 inches. On a good quality installation, no more than one-third of each shingle is exposed to the weather.

Shakes may be up to 24 inches long, with no more than half of the shingle exposed. Shakes typically have heavy building paper interwoven with the shakes to prevent wind driven rain and snow getting into the roof between the shakes.



**LIFE EXPECTANCY** The life expectancy of good quality wood shingles is generally 30 to 40 years; however, low quality shingles deteriorate badly in 15 to 20 years. The rate of wear depends largely on exposure (the amount of shingle which is exposed to the weather), the slope (the steeper the better), the grade of shingle (there are four), and the amount of sun and shade they see. Sunlight dehydrates the shingles, resulting in splitting and cupping of the shingles. Some shingles 'burn through', with holes developing as a result of exposure to the sun.

Too much shade and moisture allows moss to grow. This can lead to rot. Wood shingles and shakes may suffer mechanical damage from tree branches, foot traffic, snow shovelling, etc. Another factor affecting the life of wood shingles is their ability to dry quickly. Wood roofing over spaced sheathing boards has lots of air movement on the back of the shingles or shakes, promoting uniform drying. This helps extend the life of the roof. Wood roofing applied over plywood sheathing does not dry as quickly or uniformly. Some experts say the use of plywood will halve the life of wood shingles.

**ROOF TUNE-UP** The shakes or shingles may deteriorate at different rates. The roof's life can be extended by several years by carrying out a roof tune-up. This typically involves spot replacement of damaged shakes or shingles (often located on the hip and ridge caps) as well as the addition of metal shims under any split shakes or shingles where the split is located directly over an adjacent keyway (the vertical joint between individual shakes or shingles). The tune-up should also include a roof cleaning if there is moss and/or algae growth.

It is important to keep wood roofing clear of organic debris, moss and algae buildup to extend its life. High pressure washing is not recommended as it may damage the roofing. Low pressure washing may successfully remove loose material without damaging the roof. The roofing can then be sprayed with a combination moss killer and non-toxic detergent to kill any moss, algae or fungus. A heavy rain will usually remove the dead moss.

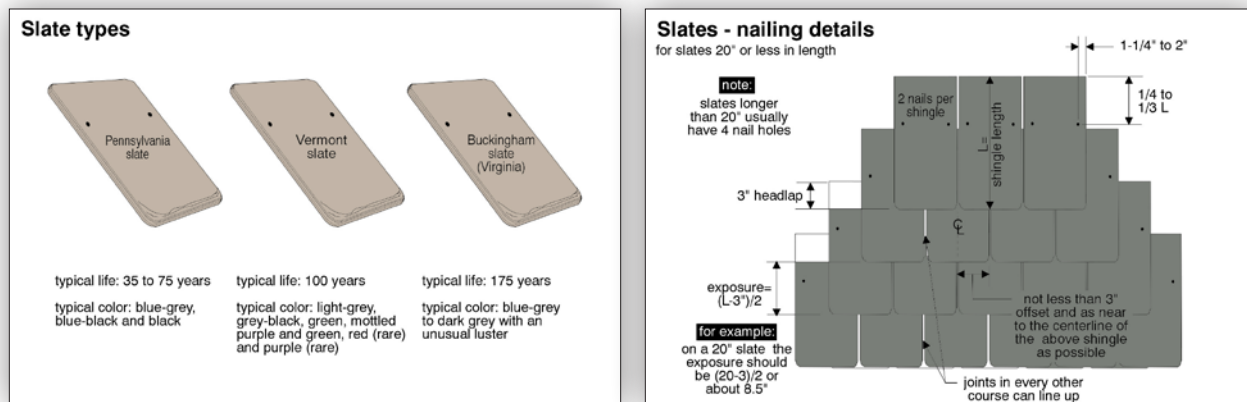
The majority of wood roofing is western red cedar which contains natural oils that resist decay. There are various treatments available that claim to increase this natural decay resistance. These claims and their cost should be carefully evaluated.

**RE-ROOFING** Wood shingles or shakes can be installed over a single layer of asphalt shingles; however, it is better to remove existing shingles to allow the wood roof system to breathe. Wood roofing should never be installed over an old wood roof.

### 1.3 Slate Shingles

**DESCRIPTION** Slate is a natural sedimentary rock that is quarried; the quality can vary. High quality slate roofs can last 200 years. Low-quality roofs may fail in less than 20 years. Slate roofs are heavy, weighing three to five times as much as conventional asphalt shingles. A slope of six-in-twelve or more is recommended and, slates are usually installed with less than 50% of each slate exposed to the weather. The slate above covers more than half of the slate below.

**WEAR FACTORS** While some slates are of low quality and tend to flake and shale, the biggest problem with slate roofs is often the nails holding the slates in place. With time, the nails rust and allow the slates to slide out of position. Copper and stainless steel nails last longer than galvanized nails. Once one slate has come loose, water rusts the nails holding nearby slates in place. Good maintenance is important on an older slate roof. While it is not common practice, slate roofs should be inspected and repaired at least annually. Slates that have slipped are re-secured, and slates that have cracked or split as a result of mechanical damage are replaced. As a general rule, roof replacement makes sense when more than 10% is in need of repair.



**FLASHINGS** The flashing materials do not last as long as the slates themselves. Metal flashings are used wherever the roof changes direction or meets an obstruction such as a chimney. When the flashings rust, a section of the roof may have to be removed to install a new flashing. This is an expensive proposition. Copper and lead flashings are expensive, but last longer than galvanized steel or aluminum flashings.

**REPAIR WORK** Another difficulty with slate roofs is finding qualified people to repair them. Since slate has not been used commonly for the past 50 years, their installation and repair is a vanishing art. Many slate roofs that can be saved are replaced with modern roofing materials, more familiar to the modern roofer.

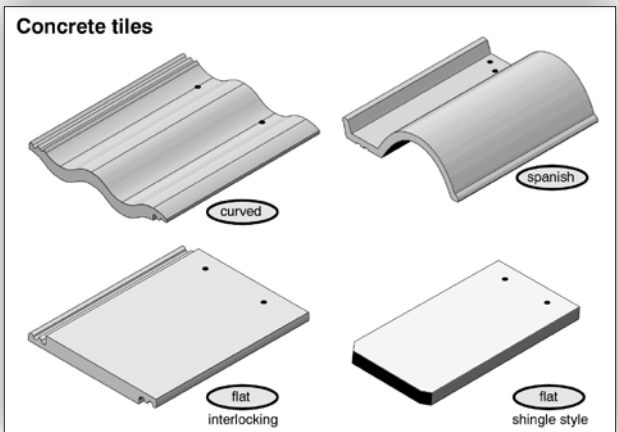
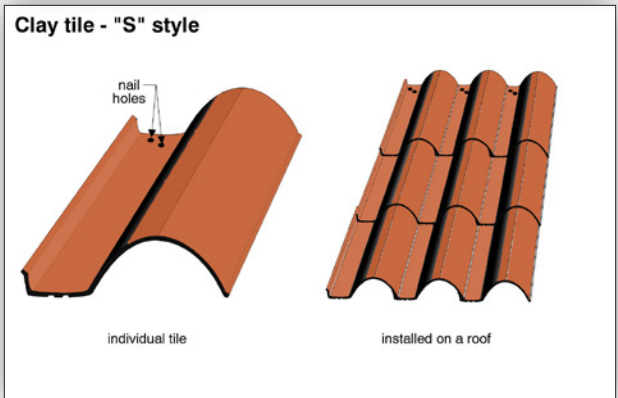
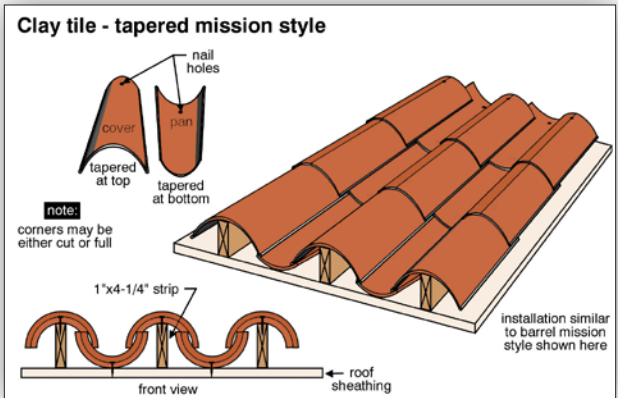
**RE-ROOFING** Slate roofs should never be installed over another layer of roofing. New slate roofs on homes are rare because they are so expensive. Installing slate on a building not designed for slate often requires structural modifications to the roof to carry the weight of the slates.



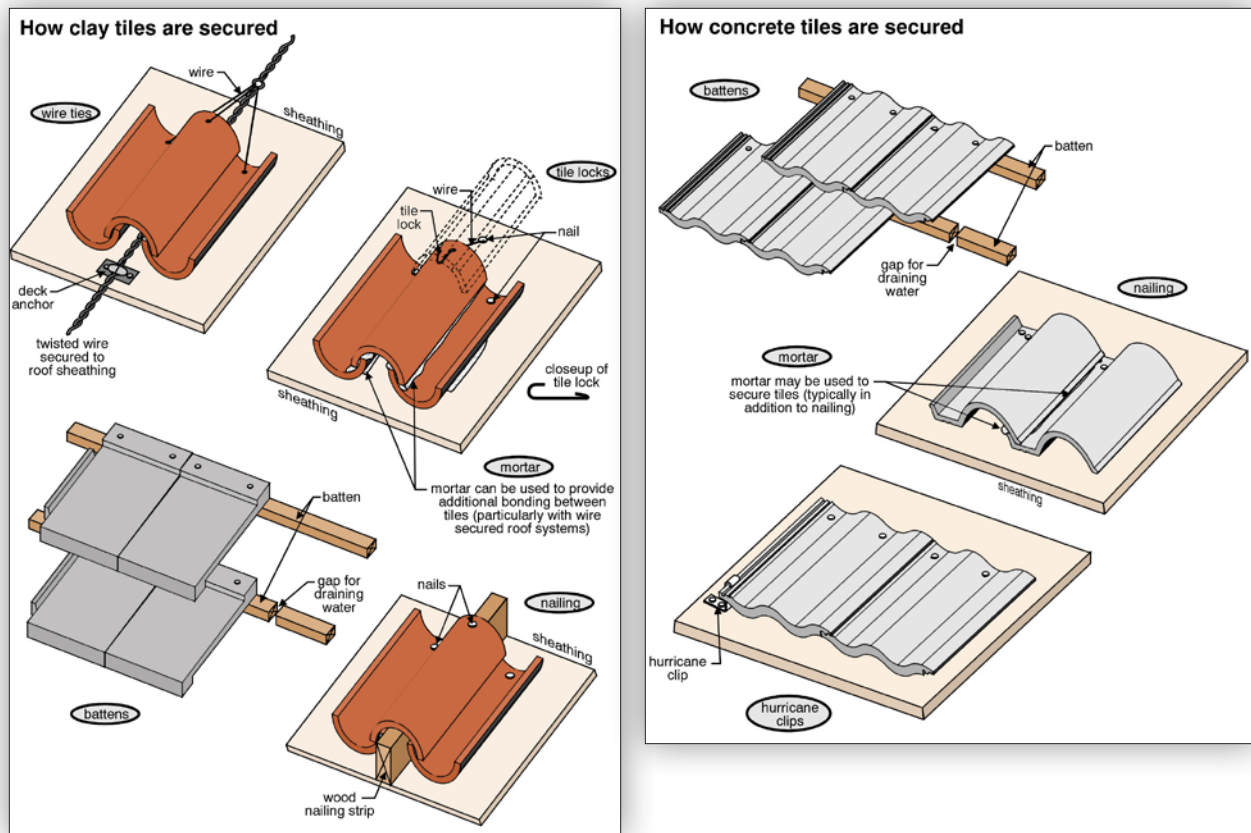
## 1.4 Concrete and Clay Tiles

**DESCRIPTION** These are high quality roofing systems with life expectancies of 50 to 100 years. Like slate, these roofs are heavy, weighing four to five times as much as asphalt shingles. Modifications to the roof structure may be required if replacing asphalt shingles with concrete.

Concrete and clay tiles can be used on a slope as low as 4-in-12 but as with most roofing systems, steeper is better. Many current standards recommend 6-in-12 as a minimum. The amount of overlap (exposure of the tiles) varies depending on the roof system. Systems with a limited overlap are prone to leakage during wind-driven rains. Many loose-fitting concrete and clay tile roofs have a watertight membrane such as built-up roofing below, to act as a backup. The tiles provide protection against fire, ultraviolet light and mechanical damage.



**FASTENING** Some systems are nailed in place while others use special clips or wire ties. In some regions, the tiles are mortared into place. In areas prone to high winds and hurricanes, these heavy tiles can be torn off roofs, becoming dangerous projectiles.



**WEAR FACTORS** Like any brittle roofing system, concrete and clay tiles are subject to mechanical damage, and like any long-lasting roof system, the fasteners may wear out before the tiles. Depending upon the design of the roof system, they can be very difficult to repair.

Concrete and clay tiles that are not flat are more difficult to flash.

**RE-ROOFING** Concrete or clay tiles cannot be installed over another roofing system, with the exception of a single layer of asphalt shingles or over a built-up roof. The roof structure may require modification to handle the additional load.



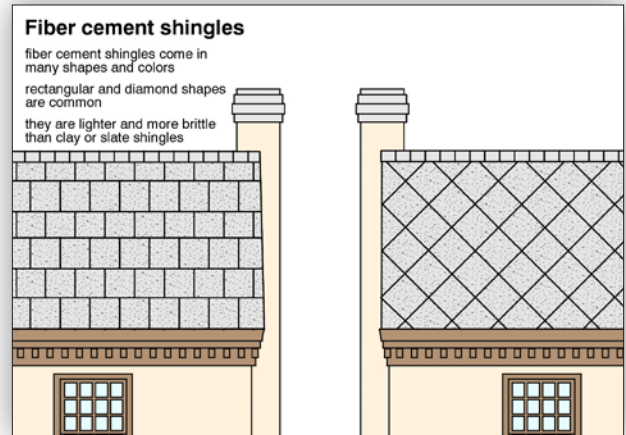
## 1.5 Fiber Cement Shingles

**DESCRIPTION** Fiber cement shingles consist of a mixture of Portland cement, water and fibers. Traditionally, asbestos fibers were used, but since the 1970s asbestos has been replaced by fiberglass or, more commonly, wood fibers. The type of fiber used in shingles is not determined during a home inspection.

**LIFE EXPECTANCY** These shingles traditionally had a life expectancy of 30 to 50 years, although some newer shingles carry warranties as long as 60 years. Some fiber cement shingles are made to look like wood shingles.

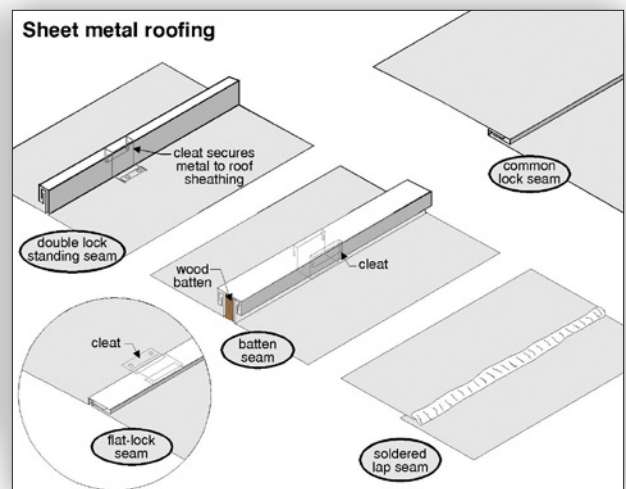
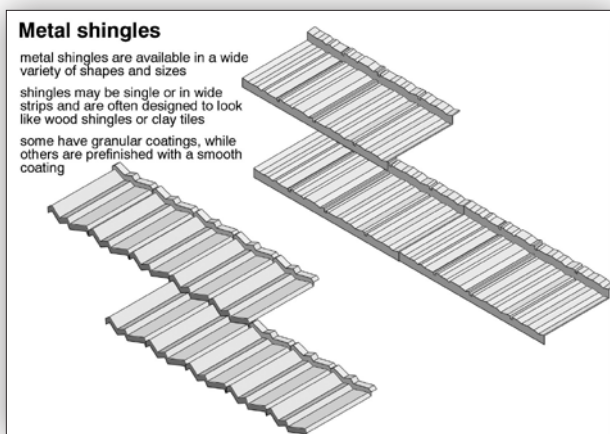
Fiber cement shingles are brittle and are susceptible to mechanical damage. Older shingles often discolor and promote the growth of fungus or moss. They are difficult to repair and replacement shingles may be hard to obtain.

**RE-ROOFING** New fiber cement shingles are rarely installed. Ideally, existing asbestos cement shingles should be removed prior to re-roofing. Because of the asbestos content of old shingles, special provisions should be made for handling and disposing of the material.



## 1.6 Metal Roofing

**DESCRIPTION** There are many types of metal roofs. Copper, galvanized steel, pre-painted or coated steel, terne and tin are common. Some metal roofs have a granular surface embedded in the finish. Most metal roofs (particularly copper) are expensive systems, but they last longer than asphalt shingles. They can be installed as sheets or shingles. Sheets and shingles can be used on sloped roofs; however, flat roofs are only covered in sheets. Sheet metal roofs can have different types of seams including soldered and crimped.



**WEAR FACTORS** Like any roofing system there are disadvantages; seams may split or be damaged. All metal roofs except copper and pre-painted or pre-coated roofs should be painted on a regular basis. Metal roofs should never be covered with tar because moisture trapped below the tar causes rusting. Tar covered metal roofs are usually near the end of their life. Metal roofs are difficult to repair and replacement is often the most practical alternative.

Leaks around the fasteners are common, and failed fasteners may make the roofing vulnerable to blowing off in high winds.

**RE-ROOFING** Moisture trapped in the old roofing system may cause premature deterioration of the new roof or of the sheathing below. Best practice is to remove old metal roofing before reroofing.

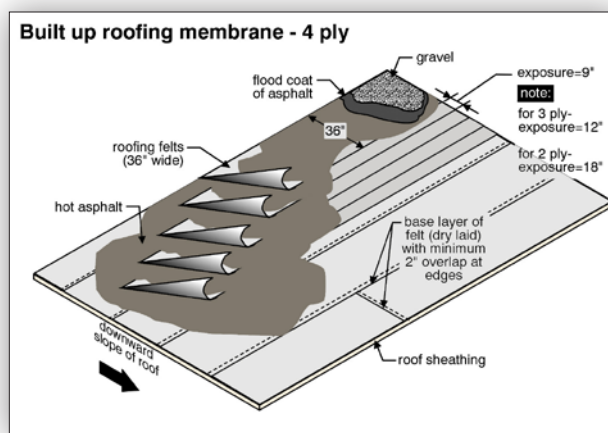
## 1.7 Corrugated Plastic Roofing

**DESCRIPTION** Corrugated plastic is a specialty type of roofing. It is a single ply, translucent roof surface that is generally used over patios and light structures. It should never be used over living areas as it is not considered to be truly watertight. Corrugated plastic roofs are weak and should never be walked on. They are generally considered to be low quality roofing systems that are easily damaged, discolor with sunlight and leak at the joints.

**RE-ROOFING** This roofing has to be removed before applying a new roof.

## 1.8 Built-up Roofing

**DESCRIPTION** Built-up roofs are commonly called tar-and-gravel roofs, even though most modern systems use asphalt instead of tar. They are a multi-ply roofing system, consisting of two, three, four or even five plies of roofing felts with a mopping (coating) of asphalt between layers. A flood coat of asphalt is then applied over the top and covered with gravel to reflect ultraviolet light and protect the roof from mechanical damage. These roofs are still common commercially, but are being replaced residentially with newer systems that are faster and easier to install.



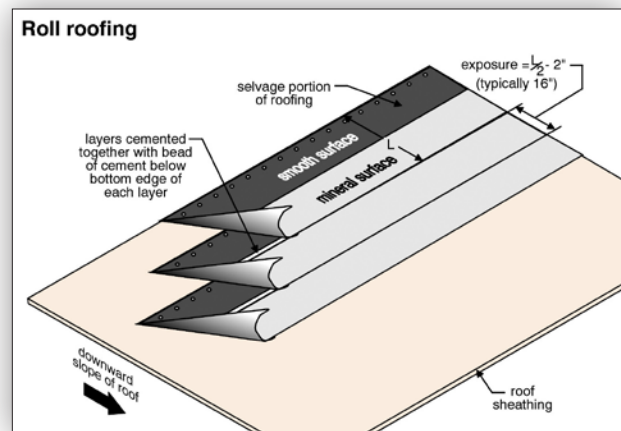
**SLOPE** Built-up roofs are designed for flat (low slope) applications and should not be used with a slope of greater than 3-in-12, unless special asphalt is used.

**LIFE EXPECTANCY** Two-ply built-up roofs have a life expectancy of five to ten years, while four-ply roofs normally last 15 to 20 years. Since the roof typically has a flood coat of tar and gravel, it is not possible to determine how many plies exist. It is also difficult to determine the condition of the membrane due to the gravel on top.

- WEAR FACTORS** Built-up roofs require skill to install properly. If moisture is trapped below or within the membrane, blisters and bubbles will form and reduce the life expectancy of the roof significantly. A lack of gravel causes rapid deterioration of the roof surface. A condition known as alligatoring occurs as the surface breaks down and cracks due to exposure to sunlight.
- DRAINAGE** Water ponding on a flat roof can shorten the life expectancy by as much as 50%. Rigid insulation or wood decking can be used when re-roofing to sculpt the roof surface to promote good drainage. As an alternative, additional drains can be installed. Good practice includes a secondary drain for flat roofs. Drains may be gutters or scuppers at the perimeter, or central drains running down through the building.
- LEAKS** Because of the construction of built-up roofs, leaks are difficult to isolate and repair. A water stain on a ceiling does not necessarily indicate a leak immediately above. Water can travel a significant distance through the plies of a roof before emerging on the interior.
- Because of the complexity of built-up roofs, it is important that a reputable roofer, offering a meaningful guarantee, be used.
- RE-ROOFING** While it is common practice to install new built-up roofs over existing built-up roofing systems, moisture trapped in the old roofing system may cause premature deterioration of the new membrane. Best practice is to remove old roofing before applying a new membrane.

### 1.9 Roll Roofing

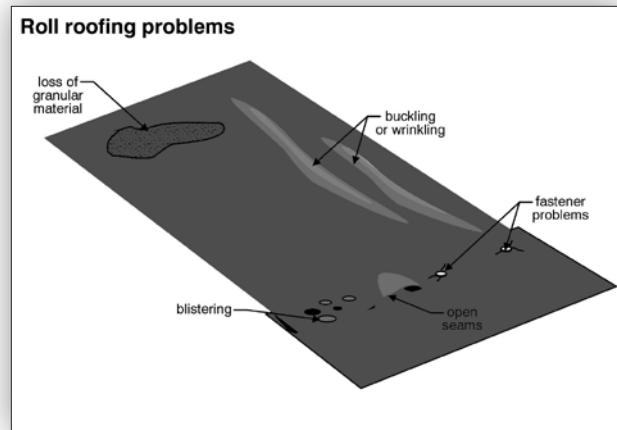
- DESCRIPTION** Roll roofing is sometimes known as selvage roofing. It typically comes in 18 or 36 inch wide rolls. It consists of the same material as asphalt shingles (asphalt impregnated felts covered with granules). The surface may be completely covered with granules or only 50% covered (designed for two-ply application). The material is most often installed as a single ply with very little overlap.
- LIFE EXPECTANCY** This low quality roof covering has a limited life expectancy of five to ten years. There is an exception to this rule. Sometimes, roll roofing is used to protect a built-up roof covering as an alternative to gravel. From a visual inspection it is impossible to tell. Modified bitumen roofing can be very similar to roll roofing in appearance. The home inspector may not be able to determine the roofing material.



**WEAR FACTORS** Because roll roofing material is installed in long strips, and because the material expands and contracts with changes in temperature, it may buckle or wrinkle. The granular covering breaks down quickly in the wrinkled areas, resulting in localized wear and short life.

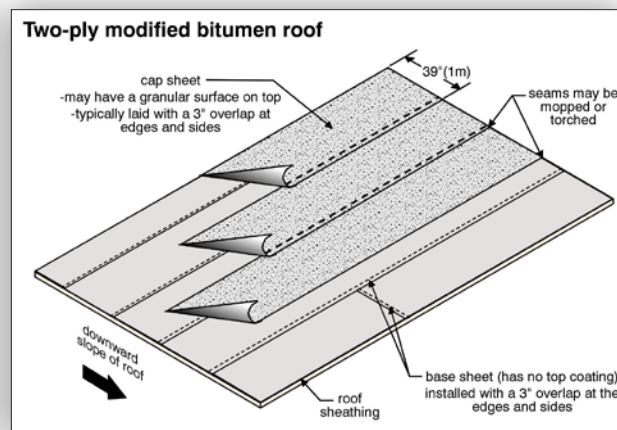
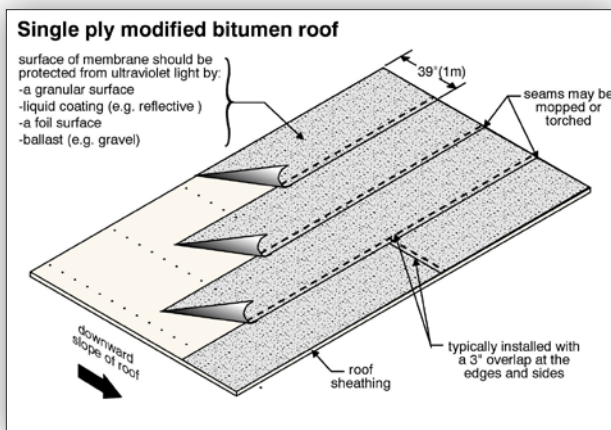
The material is used on both sloped roof and flat roofs. It is sometimes installed with a full layer of roofing cement but is most often simply sealed at the seams or nailed at the edges. Where there is no protection for the nails, leaks often occur around nails.

**RE-ROOFING** Moisture trapped in the old roofing system may cause premature deterioration of the new membrane. Best practice is to remove the old roofing material before applying a new membrane.



## 1.10 Modified Bitumen Roofing

**DESCRIPTION** Modified bitumen membranes are an alternative to built-up roofs. Polymer-modified asphalt is bonded to fiberglass or polyester reinforcing to form sheets of roofing membrane. Rolls of this rubberized asphalt membrane are typically torched onto the roof, bonded (mopped in) to the roof with hot asphalt, or adhered to the roof using a peel-and-stick backing. The surface of the membrane may be protected from ultraviolet rays by a coating of granules, foil, or paint. The sheets are approximately 40 inches wide and usually overlap each other by four inches. Modified bitumen roofs may be installed as either a single or double layer system.



**LIFE EXPECTANCY** A lifespan of 15 to 20 years is typical.

**WEAR FACTORS** Roofs with ultraviolet protection last longer than those without. Two-ply installations are more durable than single-ply. Some types of membranes perform better in a cold or a warm climate. There is no way to determine the type during a home inspection.

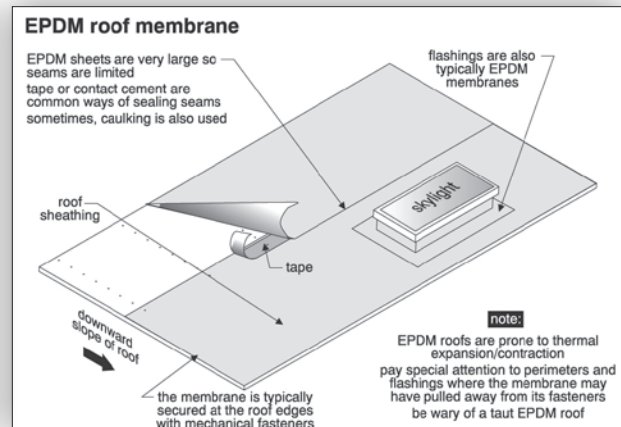
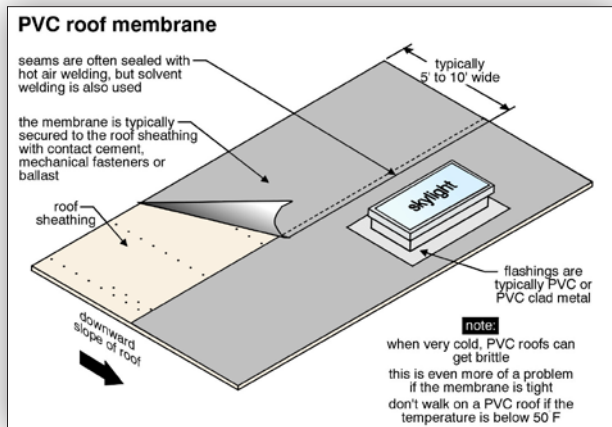
Seam failure and installation problems are the most common issues. Regular foot traffic can shorten the life expectancy significantly.

**RE-ROOFING** Moisture trapped in the old roofing system may cause premature deterioration of the new membrane. Best practice is to remove old roofing before applying a new membrane.

### 1.11 Single-Ply Membranes (Plastic and Rubber)

**DESCRIPTION** Another alternative to built-up roofing is a single-ply membrane. There are a number of these products available, often used for high-end or commercial applications. These can be broken down into plastic-based materials and rubber-based materials.

Plastic, or thermoplastic, membranes include polyvinyl chloride (PVC) and thermoplastic polyolefin (TPO). Rubber or thermoset membranes include ethylene propylene diene monomer (EPDM) and butyl rubber (polyisobutylene – PIB).



**LIFE EXPECTANCY** There are a wide variety of membranes with evolving chemical compounds and a number of installation methods. A lifespan of 15 to 20 years is common.

**LEAKS** Seam, flashing and installation problems are the most common issues. Since many of these membranes shrink, proper attachment is critical. Some systems can be damaged by contact with incompatible materials, including asphalt.

**RE-ROOFING** While some manufacturers of single ply membranes claim their product can be installed over existing materials, most recommend stripping the old roof off. Most plastic and synthetic rubber roof membranes are not compatible with asphalt. These should not be installed over built-up roofs.



## 1.12 Polyurethane Foam (PUF) Roofing

Sprayed-in-place PUF is a two-part foam mixture sprayed onto roof structures to form a single ply roofing membrane. The PUF is protected from mechanical damage, ultra violet light and moisture by an elastomeric rubber coating. PUF systems were first installed in the late 1960s. Numerous problems in the 1970s gave PUF roofing a bad reputation in some areas.

- LIFE EXPECTANCY** Life expectancies of up to 20 years are now projected for PUF systems, although many have had premature problems and failures.
- WEAR FACTORS** Common problems with PUF include deterioration of the PUF, cracking or splitting, delamination or blistering, ponding due to uneven application and coating problems.
- RE-ROOFING** Although PUF roofing is often installed over an old membrane, many do not recommend this approach. Moisture trapped in the old roofing system will cause premature deterioration of the new membrane.

## 1.13 Other Roof Coverings

There are many types of roof coverings on the market today. Examples include composite, hardboard and rubber shingles.

## 1.14 Common Problems with Roofing Systems

### 1.14.1 Problems that Affect All Roofs

- LEAKS** Roofing systems consist of several different types of materials and flashings. Leaks are most common at joints, seams and intersections with other materials. Water leakage may be caused by a number of factors operating together or independently. In some cases, the failure will be significant enough to warrant replacement of the roofing materials. In other cases, minor repairs or improvements are all that are necessary.
- DAMAGE** Worn, cracked, split, loose, or missing components of the roof can result in leakage. Roofing may be damaged by foot traffic, hail, raccoons or other animals. Missing shingles/tiles may be the result of fastener failure. Localized repairs are often an option, but as a general rule, when more than 10 to 15% of the roof requires repair, it is best to replace the roof covering.
- OLD/WORN OUT** As roofing materials grow old, they lose their ability to keep water out. Asphalt and wood roofing cracks, curls and shrinks. Wood roofing rots or burns through from the sun. Shingles or tiles may fall off as the materials or fasteners deteriorate. Built-up roofing dries out and cracks, sometimes referred to as alligatoring, because of the random crack pattern. Membrane roofs often fail at seams. Metal roofs rust. Slate may delaminate, and concrete may spall.
- BLISTERS** Blistering is a common problem with asphalt based roofs, sloped and flat. It is usually caused by moisture trapped in the roof membrane, and roofs often leak as blisters break.



**LOSS OF GRANULAR MATERIAL** Gravel or stone surfacing protects asphalt-based roofs from the sun. Loss of this material can lead to quick deterioration of the asphalt roofing material, and early failure. This may be caused by wind, downspout discharge, foot traffic or a material defect and is an issue on sloped roofs and flat roofs.

**POOR INSTALLATION** When roofing systems are not installed properly, the probability of failure increases. Installation defects include exposed fasteners, poor alignment of materials, incorrect materials, and too many layers of roofing.

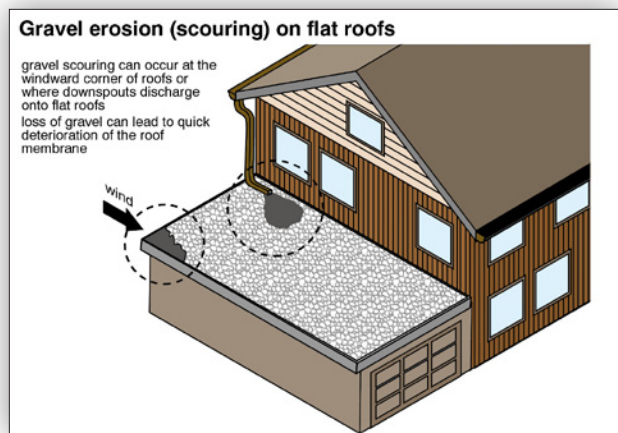
**TOO MANY LAYERS** There are lots of good reasons to strip old roofing before adding new – The new roofing often lasts longer and there is an opportunity to identify and repair damage to the roof sheathing. Stripping old roofing adds to the cost of re-roofing and a second roof is often added over a first. This works better with some materials than others, but a third layer should never be added over second, no matter what roofing material is used.

Asphalt shingles over asphalt or over wood shingles are common double applications. Longer fasteners are needed, and the life expectancy of the new roof may be reduced.

**MANUFACTURING DEFECTS** Defective materials can fail early in their life. These defects include cracking, blistering or premature aging of the roof surface. Some defects, such as color variations, are simply cosmetic in nature.

**VULNERABLE AREAS** The typical vulnerable areas are where the roof changes direction or material (for example, where the roof meets a chimney or a wall). On a properly installed roof, these areas are flashed. Particularly vulnerable areas exist where two or more flashings intersect, for example where a chimney occurs in a valley.

Things that obstruct the flow of water off sloped roofs increase the risk of leaks. Skylights, chimneys and dormers are examples. Roof penetrations for plumbing stacks, electrical masts, etc. are also weak spots.



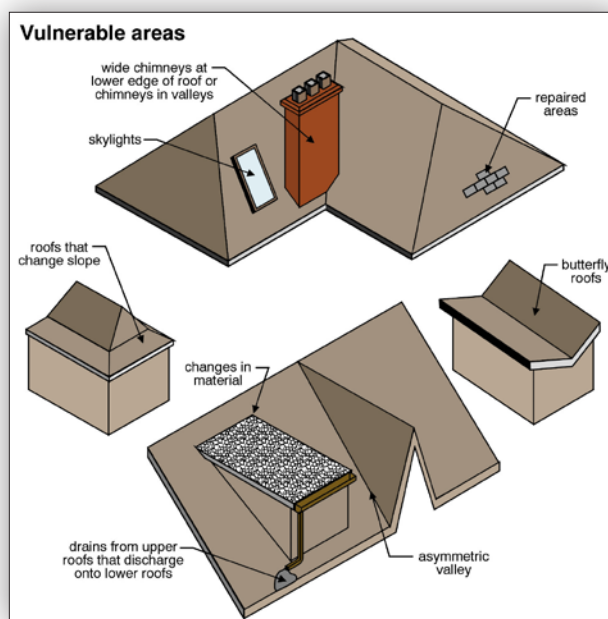
**FLASHINGS** Flashings are perhaps the most vulnerable areas of the roof, as they represent an interruption in the surface of the roof. These are addressed in more detail in Section 2 of this chapter.

**PATCHED/  
PREVIOUS REPAIRS** Areas that have been repaired are vulnerable. Previous repairs indicate prior problems.

**UNSUITABLE  
MATERIALS** Roofing materials that are suitable for one application are sometimes used for another. Metal shingles designed for a slope of at least 3-in-12, are sometimes used on a flat roof. Built-up roofing is sometimes used incorrectly on a slope of 4-in-12. It fails by sliding down the roof surface over time.

**TREE BRANCHES  
CONTACTING  
ROOF** Trees should be kept trimmed away from roof and wall surfaces. The abrasive action of branches rubbing against the roof can damage the roof system. Tree limbs touching buildings also provide easy access to the home for pests.

**SEVERE WEATHER** Weather can cause a new, perfectly-installed roof to leak under the right conditions, including a wind-driven rain from an unusual direction, or a heavy snow followed by warmer temperatures and rain. Strong winds can damage roofs, blowing shingles or tiles off sloped roofs and eroding gravel from built-up roofs. Hail can damage most roof surfaces.



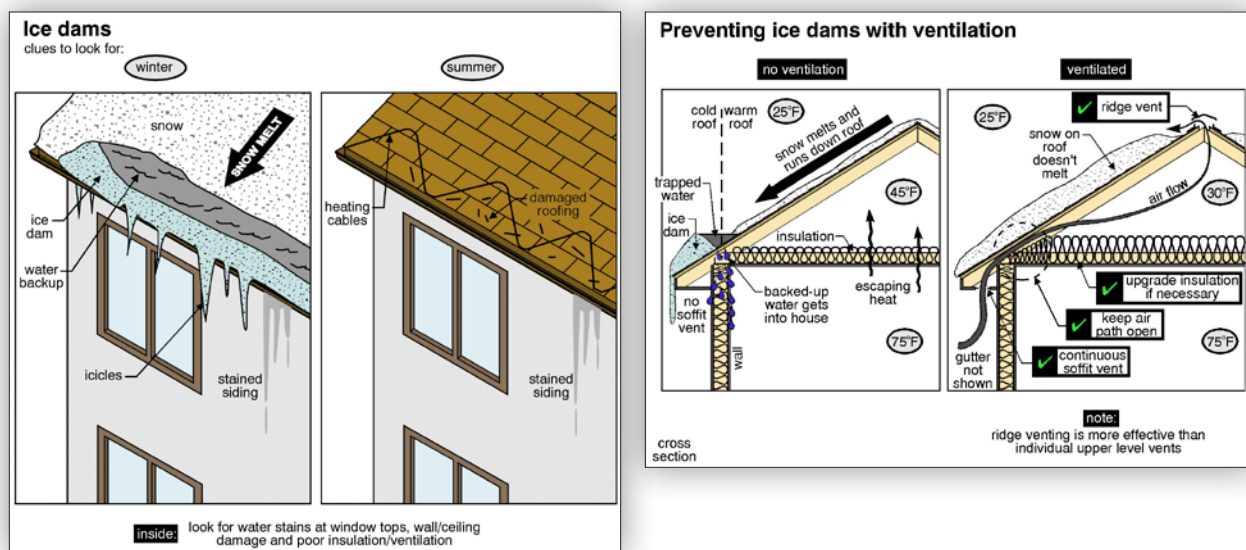
## 1.14.2 Problems Unique to Sloped Roofs

**ICE DAMMING  
IN COLD CLIMATES**

Ice damming occurs when snow and ice collect, often at the eaves. Melting snow on the upper portion of the roof, warmed by the attic, cannot drain properly as it is trapped behind the still-frozen dam at the cold eaves. If the dam is large enough, water will back up under the shingles and leak into the eaves, exterior walls or building interior.

Some roofs are more prone to ice damming problems than others. Ice dams are most common on low slope roofs or roofs that change from a high slope to a low slope. The largest dams tend to form over unheated areas, such as eaves, porches, and attached garages. Ice dams are also common above party walls in attached houses.

Ice damming problems do not necessarily occur every winter. They normally occur after periods of heavy snowfall when daytime temperatures are at or slightly above freezing while nighttime temperatures are below freezing.

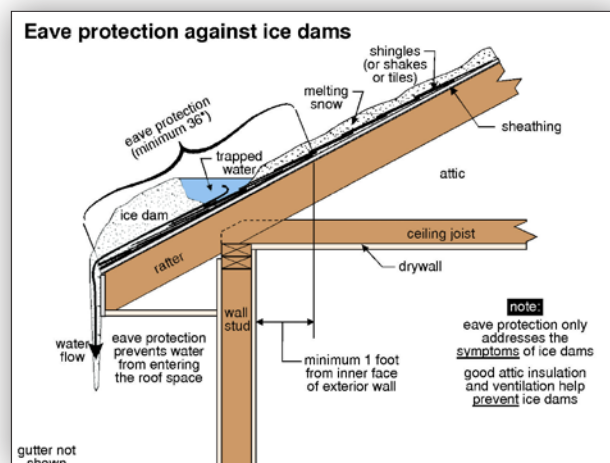


**SOLUTIONS** Effective solutions to ice damming problems are increased attic insulation and ventilation. These two measures reduce the attic temperature so snow over the heated portions of the house does not melt so quickly.

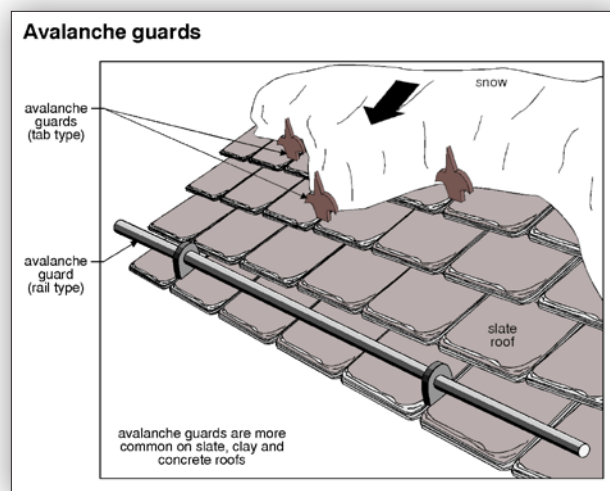
Heat may also leak into the attic through openings in the attic floor. Pot lights, exhaust fans, plumbing stacks, chimneys and attic access hatches can allow heated air into the attic unless they are well sealed. This is a key element in controlling ice dams.

Heating ducts in the attic should also be well sealed and insulated to avoid warming the attic and melting the snow above.

**EAVE PROTECTION** When re-roofing, eave protection should be provided along the lower part of the roof, from the edge up to roughly two feet beyond the exterior wall. Eave protection is often a waterproof rubberized asphalt membrane. In extreme climates, metal roofing is sometimes used on the lower part of the roof. The metal is watertight and allows snow and ice to slide off the roof. A metal or vinyl drip edge flashing will help protect the lower edge of the roof sheathing and direct water into the gutter.

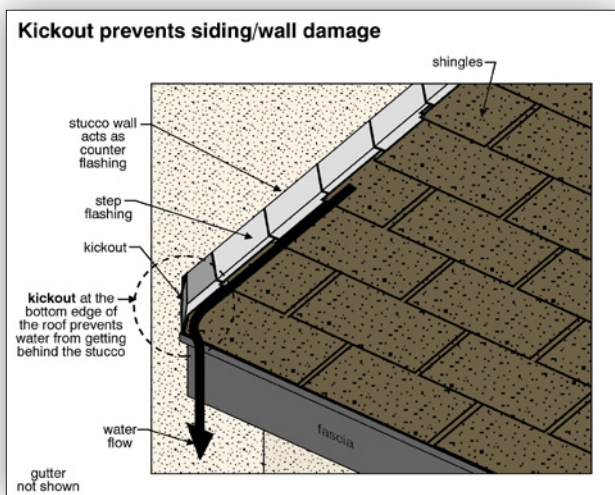


**AVALANCHE GUARDS** Small metal devices that protrude above roof surfaces (usually on the lower section of roof) are designed to hold snow on the roof and prevent avalanches. These are common on slate roofs and larger homes and commercial buildings. Some say these may worsen ice-damming conditions.



**HEATING CABLES** Electric heating cables along roof edges may be used to prevent ice dams. They have to be turned on before snow and ice accumulate to be effective. In some cases, they can aggravate rather than improve a situation if they are turned on after the ice dam has formed. Heating cables are not tested during an inspection.

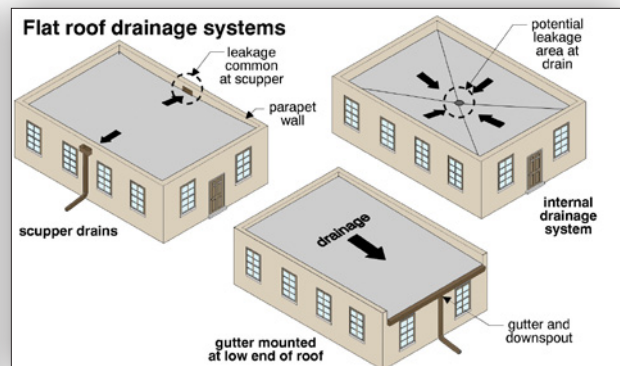
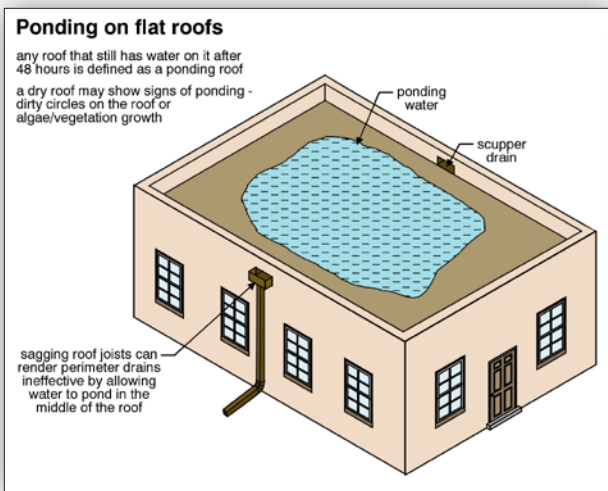
**NO KICKOUT FLASHING** This flashing should be provided at the bottom of the roof that is against the side wall. Where the flashing is omitted, water may get in behind the siding and cause damage to the wall around and below the bottom of the roof.



### 1.14.3 Problems Unique to Flat Roofs

**PONDING ON FLAT ROOFS** Ponding water on flat roofs reduces the life expectancy by as much as 50%. Flat roofs should not really be flat; they should have enough slope to drain water, usually described as 1 in 50 or 2%. We think that is cutting it pretty fine, and recommend more slope where possible.

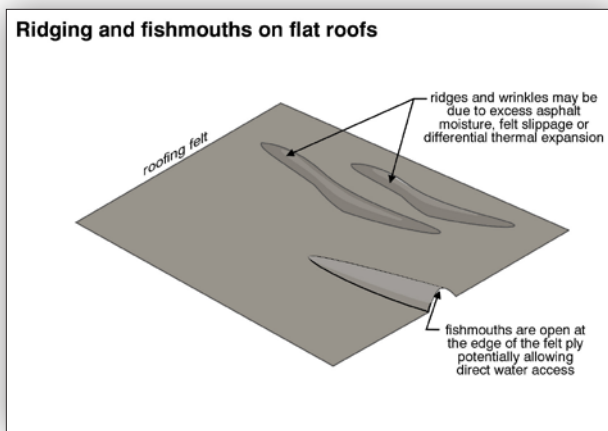
While ponding is most often caused by inadequate roof slope, it may also be the result of missing or clogged roof drains. When leaks do occur, they do more damage if there is a large volume of water ponded on the roof.





**BUCKLING, WRINKLING, OPEN SEAMS** Buckling, wrinkling and open seams in membranes may be caused by poor installation, membrane slippage, thermal expansion or contraction, and moisture trapped in the roof. These conditions can lead to leaks as the membrane opens up or develops holes.

Wrinkles or ridges that create openings at seams are sometimes called fishmouths.



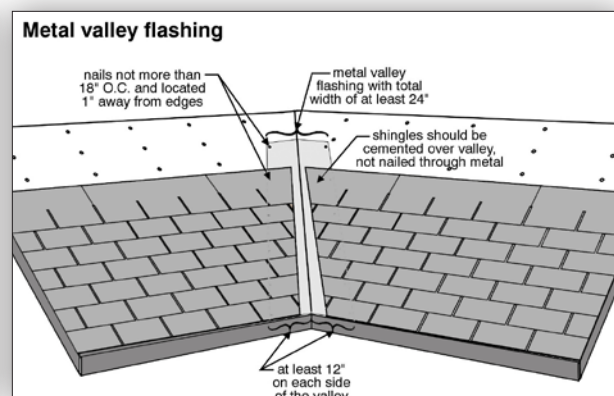
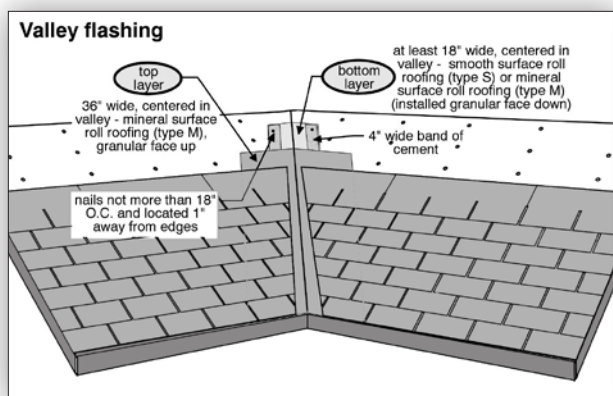
## 2.0 Flashings

**DESCRIPTION** Flashings are designed to keep water out. They are used where dissimilar materials meet, where a material changes direction, at roof penetrations and at joints in materials. Flashings are often galvanized steel; however, they can also be tin, terne (steel containing copper, coated with a lead-tin alloy), aluminum, lead or copper. In valleys, roll roofing material may be used as a flashing. Roll roofing is similar to asphalt shingles, except that it comes in rolls, roughly 18 or 36 inches wide.

**LOCATION** When a roofline changes direction, a ridge, a valley, or a hip is created. Ridges are horizontal and are found at the peak. Hips and valleys are high spots and low spots respectively.

### 2.1 Valley Flashings

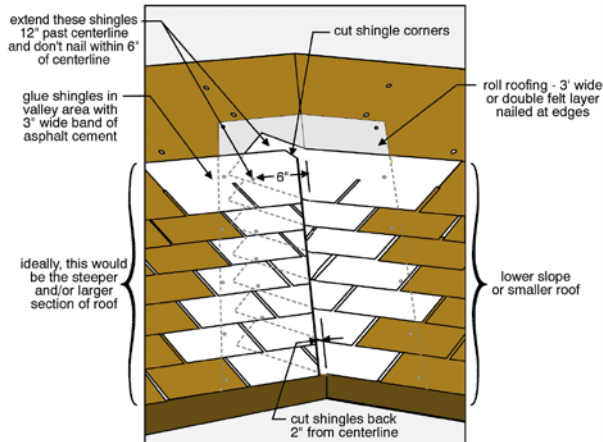
**DESCRIPTION** All valleys should have flashings. Metal valley flashings are better but more expensive than roll roofing. Where the flashing is visible, it is known as an open valley. Metal valley flashings are typically 24 inches wide; however, much of the material is hidden by the shingles. When roll roofing is used, two layers are installed; one being 18 inches wide, and the top one 36 inches wide.



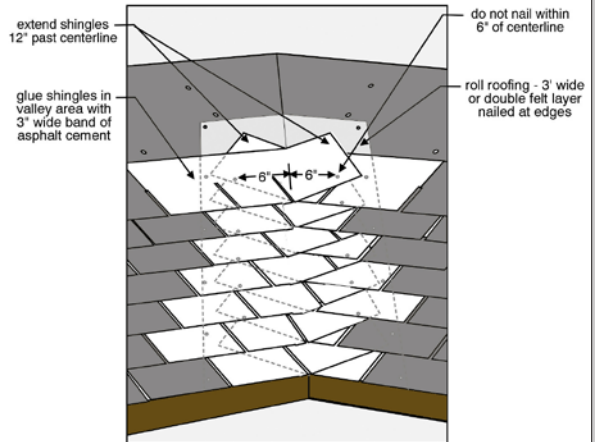


Sometimes a valley flashing is installed and then covered with shingles. This is called a closed valley. These may be closed cut or fully woven.

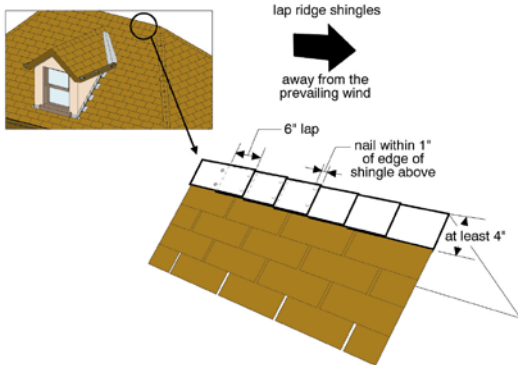
#### Closed cut (or half-woven) valley



#### Fully woven closed valley



#### Ridge shingle application

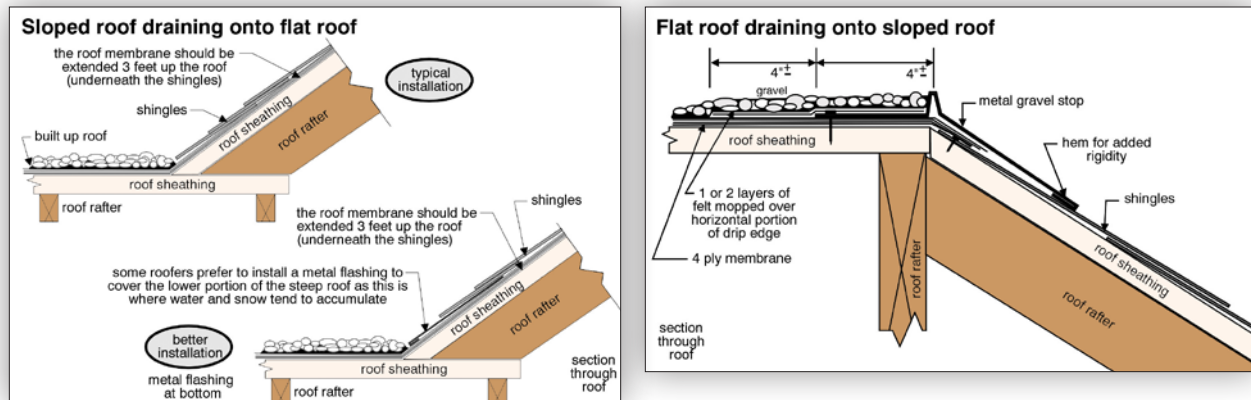


## 2.2 Hip and Ridge Flashings

Flexible shingles (such as asphalt) are simply cut and bent over hips and ridges to make them watertight. Metal flashings are often used with brittle roofing materials (wood shingles, slate, and asbestos cement) at the ridges and hips. Flashings may also be made from the roofing material. On some roofs, the flashing is covered by a layer of shingles.

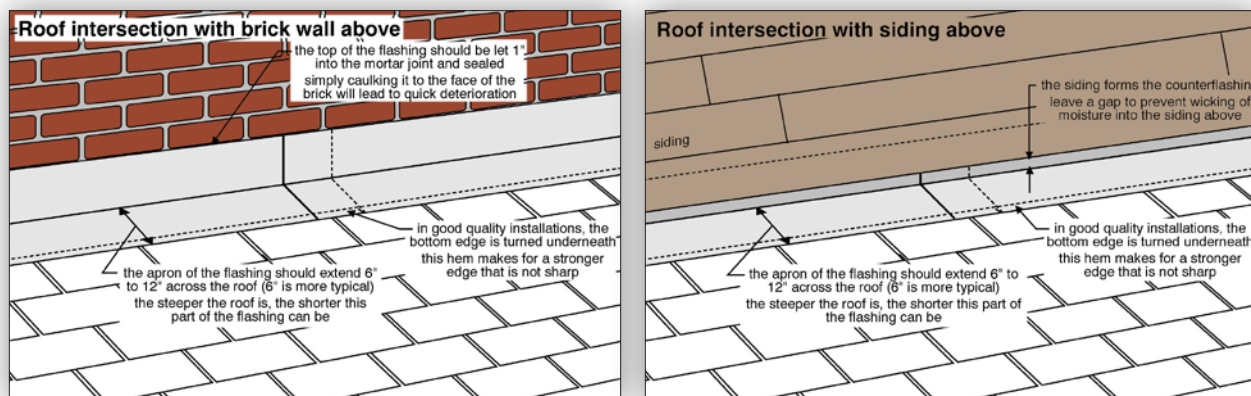
## 2.3 Sloped Roof to Flat Roof Flashings

When the flat roof is below the sloped one, the flat roofing material is typically applied first and extended up the slope. The sloped roofing covers the flat membrane. There may be metal flashing used at the change in direction. When the flat roof is above the sloped roof, a metal flashing protects the top of the sloped roofing material. The metal flashing extends onto the flat roof and is covered by the flat roof membrane.



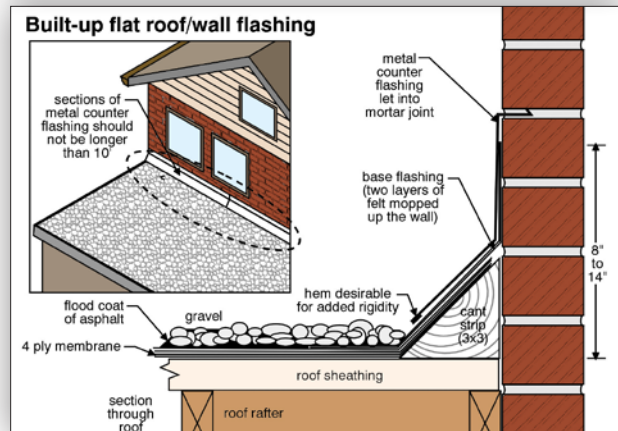
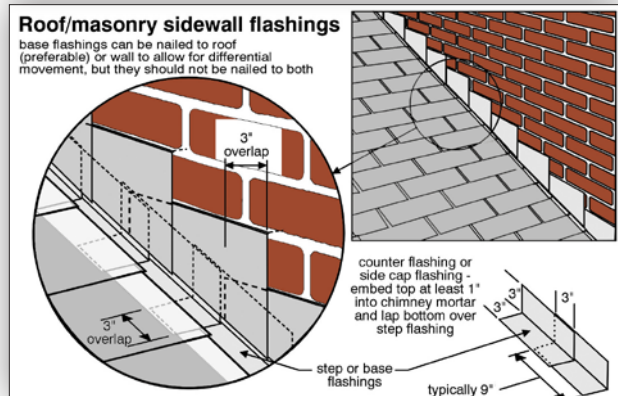
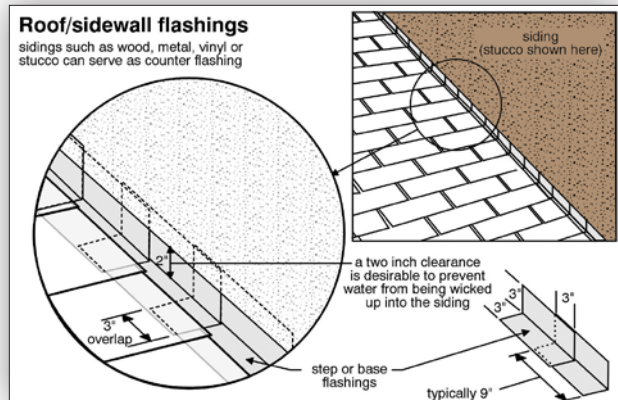
## 2.4 Roof to Wall Flashings

**DESCRIPTION** Special flashing is used when a roof intersects a wall. The flashing depends on the configuration and the roofing material. If the top of the roof meets a wall, a counter flashing can be installed over the roofing material. This metal skirt covers the top of the roofing material and extends up the wall behind the siding. On masonry walls, the metal flashing is let (embedded) into a mortar joint or sealed to the masonry surface with caulking (the less desirable approach).



When the side of a roof ends at a wall, two sets of flashings are used. L-shaped step flashings are installed between each layer of shingles. The vertical part extends up the wall and is covered by siding or a metal counter flashing. Counter flashings are used on masonry walls, and the top may be let into mortar joints or sealed to the face of the masonry with caulking (a less permanent approach).

We looked at kickout flashings on Page 19.

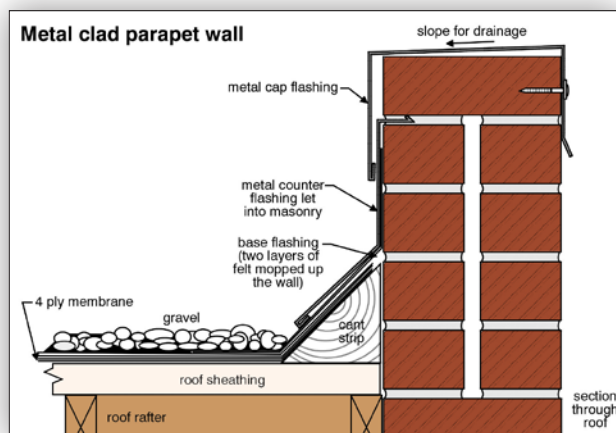
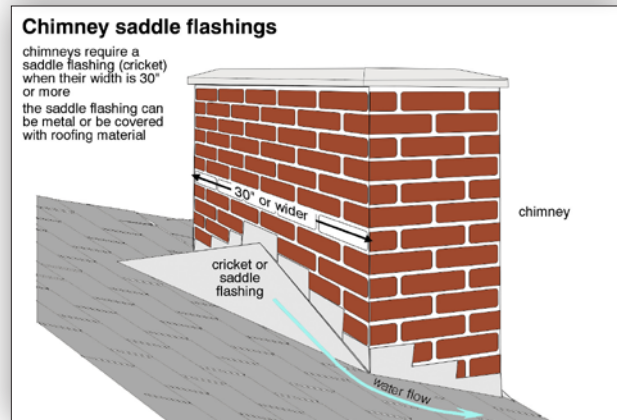
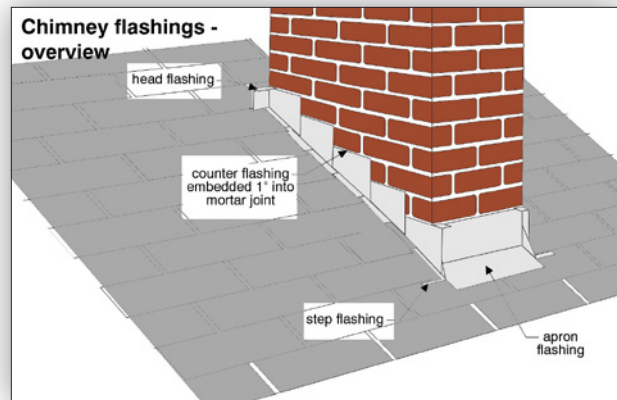


## 2.5 Chimney Flashings

**DESCRIPTION** The flashings used on the sides and downhill portion of the chimney are similar to the wall flashings described above. The weakest part of a chimney flashing is the high side, facing up the roof. Water running down the roof must be diverted around the chimney. The flashings on the high side typically extend up at least six inches or one-sixth of the width of the chimney, whichever is greater. The flashing should continue up under the roofing to an equal height.

When a chimney is more than 30 inches wide, a saddle (or cricket) should be used to divert water around the chimney. This is a small peaked roof that directs water around the chimney.

**LOCATION** The location of a chimney affects how prone it is to flashing leaks. A chimney near the peak of a roof is better than a chimney at the bottom of a roof, which is better than chimney in a valley.

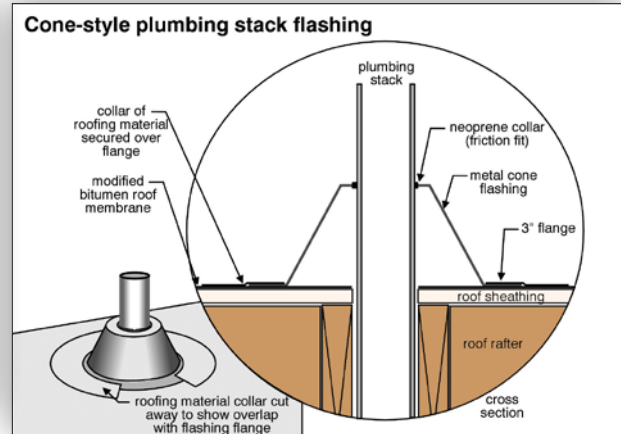
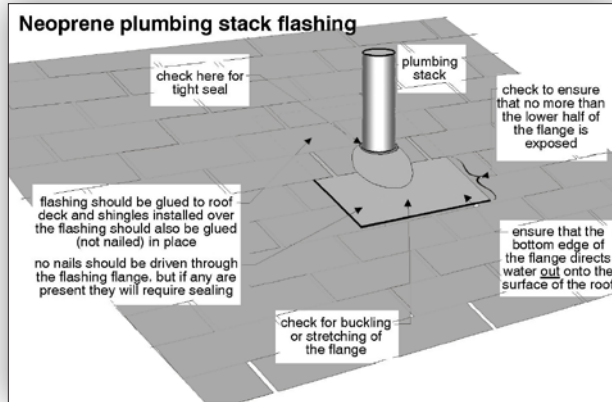


## 2.6 Parapet Wall Flashings

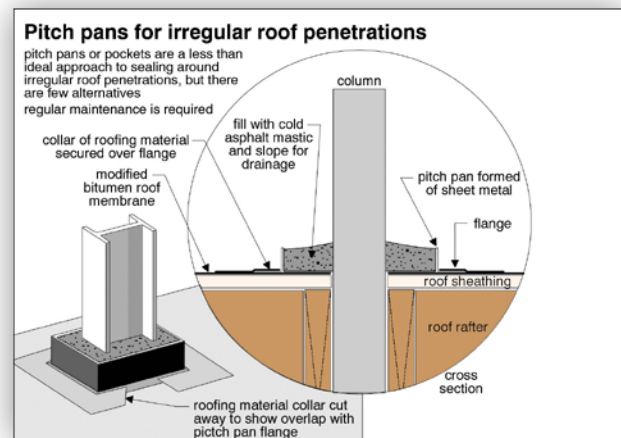
The exterior house wall may protrude above the roofline, forming a parapet wall. Where the roof meets the wall, typical wall/roof flashings are used. A cap flashing should also be provided over the top of the wall to prevent water penetration into the wall system.

## 2.7 Plumbing Stack/Electrical Mast/Exhaust Flue Flashings

A metal or rubber flashing is provided where anything penetrates the roof.



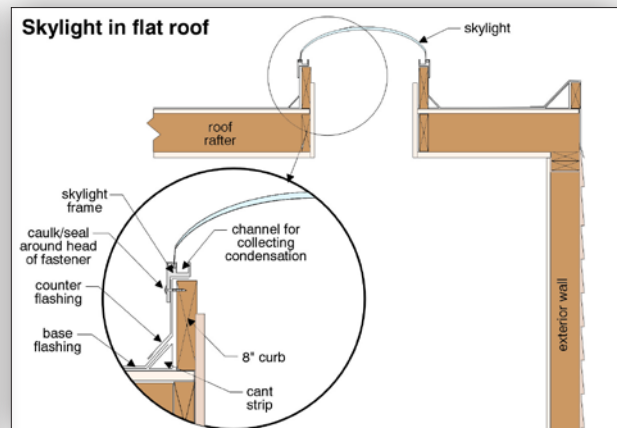
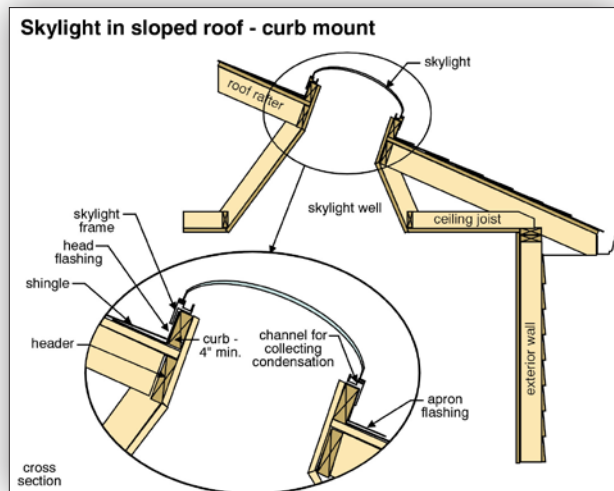
**PITCH PANS (PITCH POCKETS)** On flat asphalt roofs, pitch pans are sometimes used. A sheet metal pan around the stack or mast is filled with pitch or tar to a depth of one or two inches. Some experts consider this a poor flashing.





## 2.8 Skylight Flashings

Skylights should be flashed much like chimneys. A skylight should be installed on a curb or box that protrudes above the roof surface (unless the skylight comes with a pre-manufactured flashing assembly). This allows for the installation of proper flashings and limits snow accumulation on the skylight in cold climates.

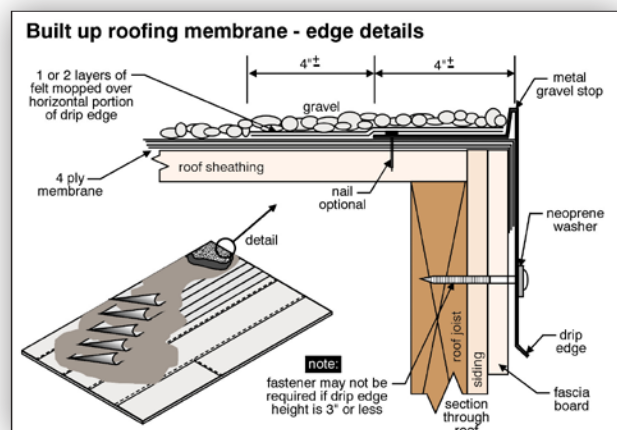


## 2.9 Drip Edge Flashings

This metal flashing is provided along the lower edge of some sloped roofs. It is intended to protect the roof sheathing and fascia from water damage.

## 2.10 Gravel Stop Flashings

On most built-up flat roofs, a gravel stop flashing made of metal is used at the perimeters. This metal flashing typically has a low profile and performs several functions, including securing and protecting the roof membrane at the edge of the roof, preventing the gravel from sliding off the roof, and forming a drip edge to keep water run-off from damaging the wood fascia.





## 2.11 Roof Vent Flashings

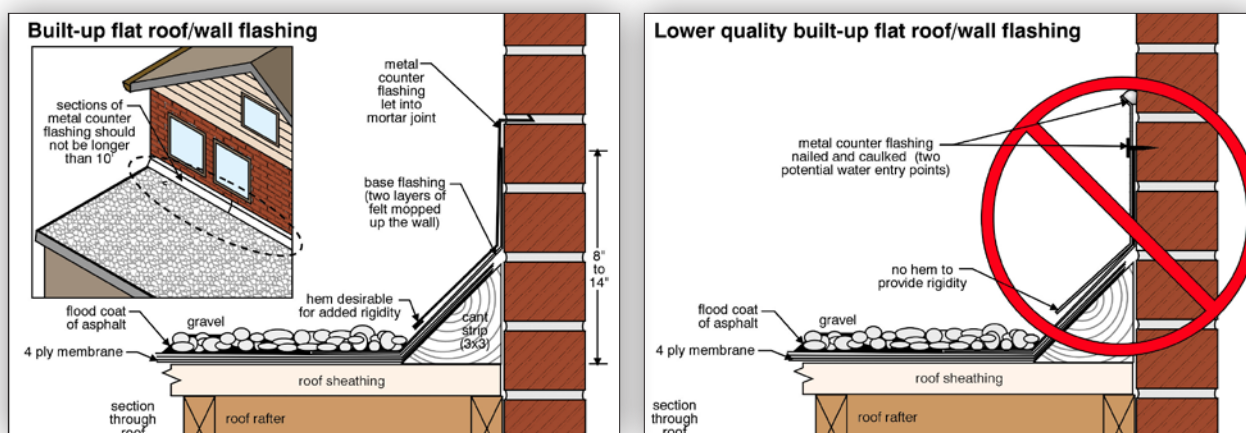
Flashings are built into most roof vents. The flashing slides under the shingle material on the sides and uphill portion of the vent. On the downhill side, the flashing is exposed, overlapping the roofing material. The amount of overlap of shingles and flashing, as well as the quality of the installation determines the effectiveness.

### Common Problems with Roof Flashings

Roofs leak when flashings don't do their job properly. Flashing problems are one of the most common sources of roof leaks. When re-roofing, we recommend flashings be replaced even if they are not worn out. It is expensive to replace flashings part way through the life of a roof.

#### MISSING, POORLY INSTALLED

The most common problems with flashings are that they are missing or not properly installed. Poor installation includes loose or missing components, poor fastening, inadequate height or length and poor sealing at the top. The illustrations below show a good way and an inferior way to attach a flashing to a brick wall.



#### DAMAGED/ DETERIORATED/ PATCHED

Flashings deteriorate over time – rusted metal and torn membrane flashings are common. Patches indicate previous issues and may suggest future problems.

#### VALLEY FLASHING ISSUES

Valley flashings are often damaged by foot traffic or obstructed with leaves, twigs and pine needles, for example. Valleys may suffer ice dam problems in cold climates. Valleys that are too long at the bottom may allow water to overshoot the gutter. This allows water to collect against the foundation wall, and may lead to wet basements or crawlspaces.

#### ROOF-TO- SIDEWALL FLASHINGS – INADEQUATE CLEARANCE

Where wood siding is used as a counter flashing, it should stop roughly two inches above the roof surface so that the wood is not constantly wet. Wood close to the roof surface is prone to rot.

**SADDLE MISSING** Saddles (or crickets) should be provided for chimneys wider than 30 inches to divert water around the chimney. A missing saddle may result in roof leaks at the chimney.

**PITCH PANS (PITCH POCKETS)** Pitch pans should be kept full of pitch or asphalt to avoid collecting water, which causes leakage. These high maintenance flashings are often neglected.

## ON FLAT ROOFS

**PARAPET FLASHINGS – PONDING** Parapet flashings should drain water quickly. When water accumulates on the top surface, premature rusting and leakage may occur.

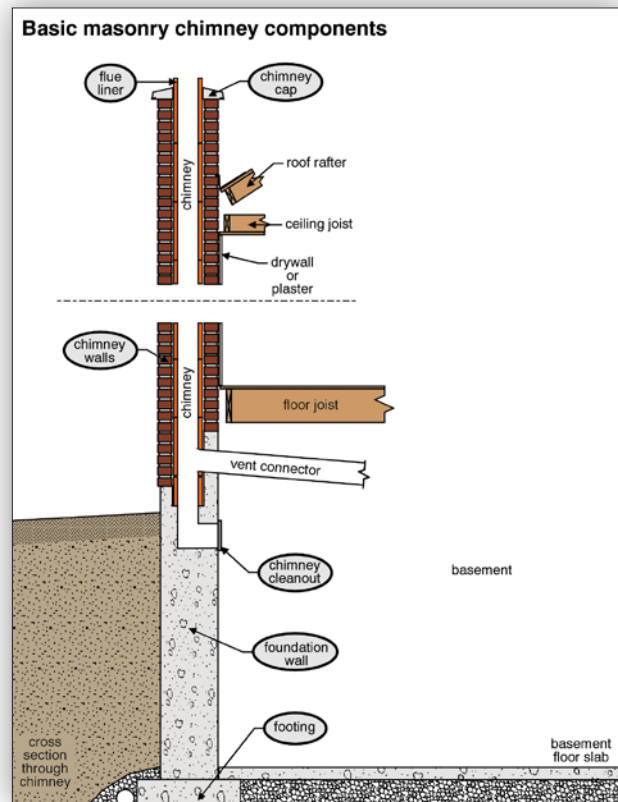
**SKYLIGHT FLASHINGS** Leaks are common where there are no curbs or very short curbs. Other common problems include incomplete or improper flashing details around the skylight.

**GRAVEL STOP FLASHINGS** Gravel stop flashings are sometimes loose, rusted or missing altogether. It is common to find the roof membrane pulling away from the gravel stop. This can lead to leaks at the roof edge.

## 3.0 Chimneys

**MATERIAL** Chimneys are typically masonry or metal. Masonry chimneys can be brick, block or stone and are sometimes stuccoed or parged. In some areas, asbestos cement chimneys are common.

**FLUES** Chimneys often have more than one flue. Each flue is a separate channel for the smoke. Each appliance has a separate flue, with a few exceptions. Two gas furnaces on the same floor within a house can share a common flue, as can a gas furnace and a gas hot water heater on the same level.



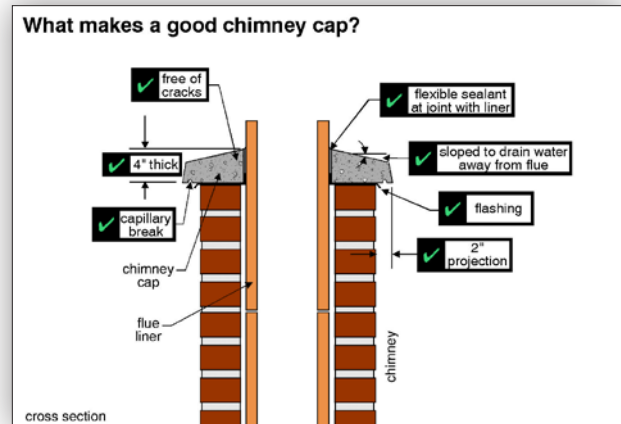
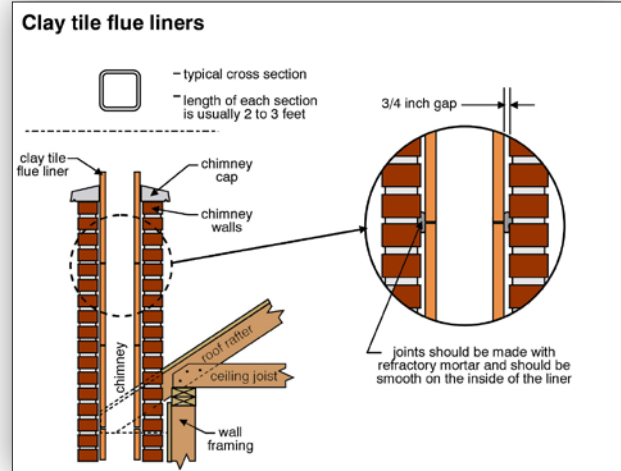
**FLUE LINERS** Some flues have masonry exposed on the inside. Unlined chimney flues are common in houses built before 1940. These unlined masonry flues often work well for fireplaces and oil-fired furnaces. Gas-fired furnaces usually require a liner because the cooler exhaust condenses, producing slightly acidic water that can damage unlined flues.

Flues are typically lined with clay tile, metal, or asbestos cement pipe. For more information on chimney liners, refer to the Heating chapter.

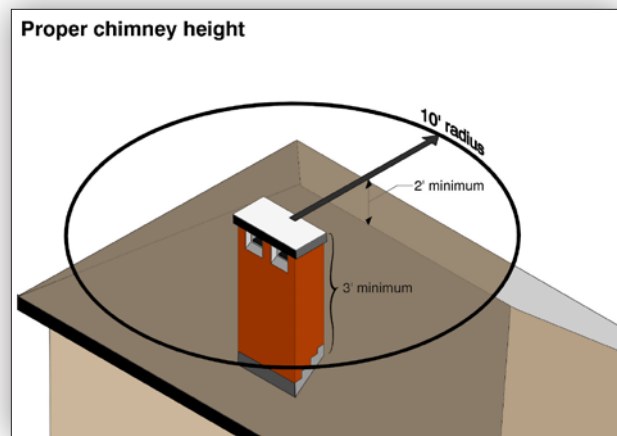
**VERMIN SCREENS** Raccoons, birds and squirrels may nest in chimneys. Vermin screens on the top of the chimney flues can be used to prevent this.

**CHIMNEY CAP – MASONRY** The purpose of a chimney cap is to protect the top surface of a masonry chimney from water. The chimney cap should not be confused with the rain caps that cover chimney flues to prevent water from entering the flues. Chimney caps are usually concrete; however, some are stone or metal. A cap normally overhangs the chimney sides at least one inch to protect the chimney from water dripping off the cap.

**CHIMNEY CAP – METAL** Caps on metal chimneys are designed to keep rain out and help promote good draw by preventing downdrafts. Caps for wood burning appliances often include a screen to prevent sparks and embers escaping from the chimney top.

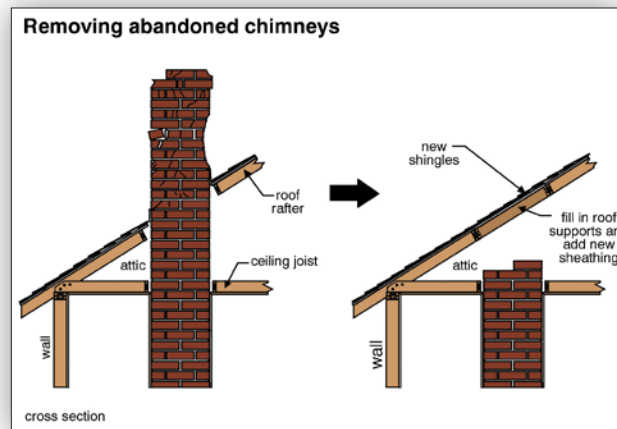


**HEIGHT** Chimneys should be a minimum of three feet above the point of penetration through the roof and two feet higher than anything within ten feet of them to help ensure good draft. Minor liberties can be taken with this rule when considering single flue metal chimneys for furnaces. A common solution for fireplaces that draw poorly is to extend the chimney or divert down drafts.



**MUTUAL CHIMNEYS** Many attached and row houses share chimneys. One chimney may have one or more flues for each house. Prior to working on a mutual chimney, co-ordination with the neighbor makes sense. Shared flues present a safety concern. This is discussed in the Interior chapter.

**REMOVED** Many idle chimneys are removed down to below roof level during re-roofing. This eliminates the need for flashing, a common source of problems.



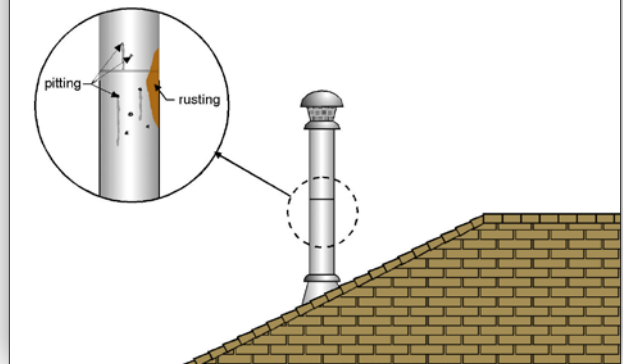
## Common Problems with Chimneys

**WATER DAMAGE** Chimneys often deteriorate as a result of water. Metal chimneys rust, and masonry chimneys suffer damage to mortar, brick, stucco, etc. The source of the water can sometimes be wind-driven rain or condensation within the chimney.

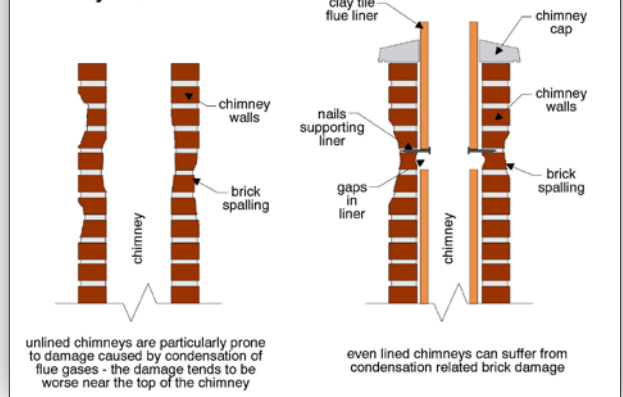
One of the by-products of burning fossil fuels is water vapor. As exhaust gases travel up the chimney, they cool, sometimes reaching the dew point, forming condensation. The water is absorbed into masonry chimneys and sits on the interior of metal chimneys. The somewhat acidic water droplets cause corrosion in metal flues and deterioration within masonry flues.

**FREEZE/THAW** Damage may occur in masonry chimneys because of cyclical heating in cold climates. The moisture absorbed into the masonry freezes and expands as the temperature drops. This causes mortar to deteriorate, bricks to spall and stucco to loosen. Small amounts of loose mortar can be replaced, but extensive damage to the mortar or the masonry usually requires re-building of the affected portion of the chimney.

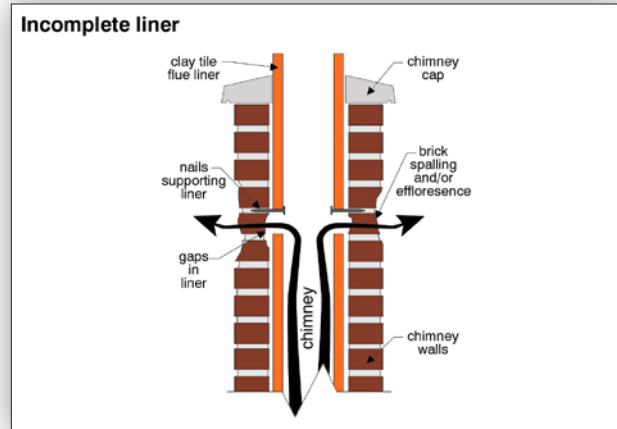
**Rusting and/or pitting metal chimneys**



**Chimney deterioration**



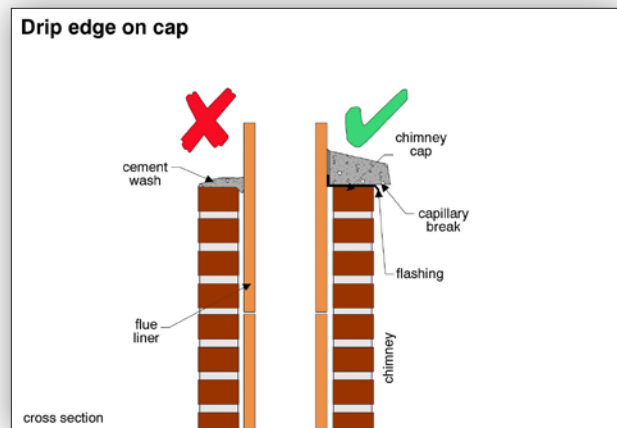
**GAP IN LINER** Some masonry chimneys lined with clay tile have a gap in the liner. The top flue tile should protrude two to four inches beyond the top of the chimney. If the top section of clay tile was too short to protrude (two-foot lengths are common), some masons simply raised the top tile, leaving a gap between the top two tiles. A ring of deterioration may show up on the exterior of the chimney, corresponding to the gap in the clay tile liner.



**MISSING CHIMNEY CAP – MASONRY** In many cases, a proper cap is not provided. Bricklayers often put a thin coat of mortar over the top surface of the chimney around the flue. This cement wash has no overhang to keep water away from the chimney. Over time, this cracks and eventually becomes loose. The rate of deterioration to the top of a chimney that does not have a cap depends largely upon the type of masonry used to build the chimney and the quality of the mortar.

**CRACKED CHIMNEY CAP – MASONRY** A cracked cap allows water to penetrate the chimney causing premature deterioration and in cold climates, freeze/thaw damage.

**DEBRIS** Debris can accumulate in the bottom of the chimney and may block off the appliance vent if not cleared. Many chimneys have a clean-out door to allow removal of accumulated debris.





**MISSING CHIMNEY CAP – METAL** A missing cap on a metal chimney can lead to water damage to the chimney interior. It may also lead to downdraft problems.

**DRAFT PROBLEMS** Short chimneys are prone to downdraft problems, depending on the chimney location, roof shape and prevailing winds.

**BRACING** Tall chimneys, masonry or metal, should be braced to stabilize them. The requirements for bracing are not only based on the height of the chimney but also on the width and depth of the chimney.

