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► INTRODUCTION

The primary purpose of a roof is to keep the building and its occupants protected from rain, snow, sun, wind, and all the combinations of these. Roofs may also add to or detract from the appearance of a building. Roofs provide some mechanical protection against falling objects, although anyone who has seen the damage done by a large tree falling on a house, knows their strength is limited. Contrary to what many think, roof coverings are not intended to keep out the cold. The majority of roofs are extremely poor insulators.

► 1.0 ROOFING

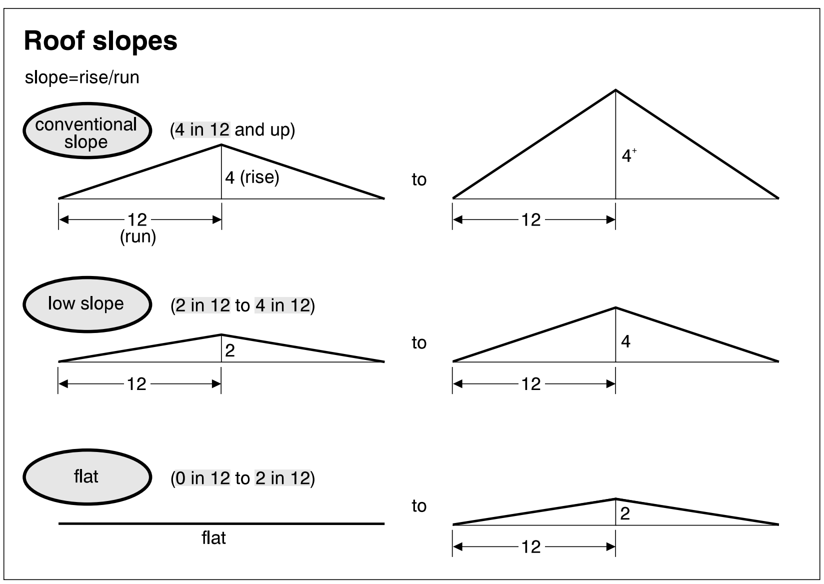
Sloped and Flat

There are two main categories of roofing systems: sloped roofs and flat roofs. Sloped roofing systems are not watertight, per se. They shed water much like a pyramid of umbrellas. Flat roofs, on the other hand, are watertight membranes which are designed to be impervious to water penetration. Flat roofing is actually a misnomer as these roofing systems should never be perfectly flat. They should slope enough to allow water to drain properly, since water standing on the roof for long periods of time will accelerate deterioration of the membrane. Good practice includes a secondary drain for flat roofs.

Drainage

Pitch

Before discussing roofing materials, two common roofing expressions should be defined. The first is "pitch". The pitch of a roof is really the slope of the roof. Convention dictates that the slope is defined as a ratio of rise over run. For uniformity, the run is always defined as twelve feet. Therefore, a six in twelve roof would have a vertical rise of six feet over a horizontal distance of twelve feet.



Roofs with a pitch greater than four in twelve are considered conventional roof systems. Roofs with a slope between four in twelve and two in twelve are considered to be low slope roofs, and roofs with a pitch less than two in twelve are considered to be flat roofs.

Square

Another common roofing term is “square”. A square is a roofer’s expression for the amount of material required to cover one hundred square feet. The pitch of the roof and the number of squares are two major factors that roofers consider when pricing a job. Other considerations are the height of the roof above the ground, the complexity of the roof (the number of dormers, chimneys, changes in direction, etc.) and the number of layers of material that are on the roof.

1.1 Asphalt Shingles: Asphalt shingles are the most common roofing material used at present. The shingles consist of asphalt impregnated felt paper, coated with an additional layer of asphalt and covered with granular material. Some manufacturers use fiber glass matting as an alternative to felt paper.

Shingle Weight

Asphalt shingles were historically classified by weight. The most common type of shingles used today weigh two hundred and ten pounds per square. They have an average life expectancy of twelve to fifteen years. Heavier asphalt shingles such as 225’s (two hundred and twenty-five pounds per square), 235’s and even 320’s are available. 225’s and 235’s have an average life expectancy of fifteen to twenty years, while 320’s have a life expectancy in excess of twenty-five years.

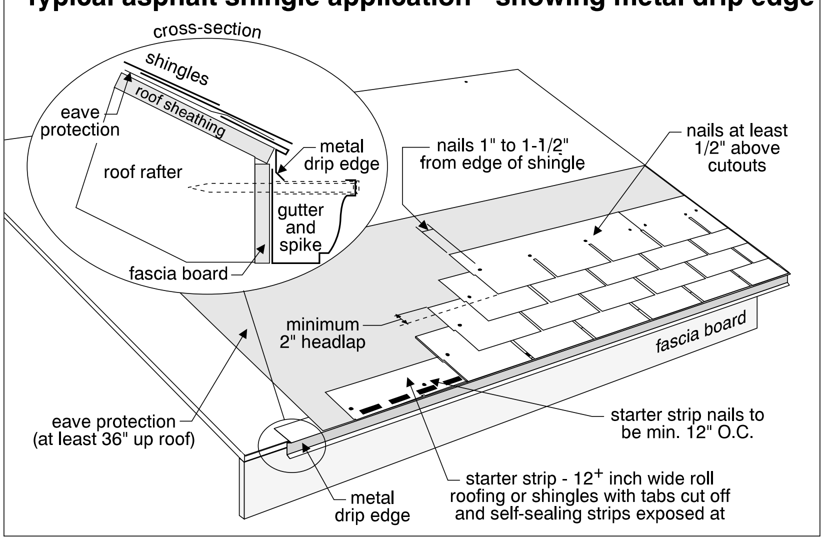
Life Expectancy

Today, asphalt shingles are classified by the warranty offered by the manufacturer. They would now be known as 10 year, 15 year, 20 year, 25 year, 30 year or 35 year shingles. The reason for this change was the use of lighter fiber glass matting. Modern shingles are also available in various textures and edge patterns.

Self Sealing Shingles

Since the mid 1960’s, most asphalt shingles have been of the self sealing type. A strip of tar is put on the surface of the shingles by the manufacturer. This strip is covered by the shingle installed immediately above. When the sun warms the roof surface, the two shingles stick together. This helps prevent the shingles from being blown off in a wind storm. (Shingles installed in the late fall and winter often do not seal themselves until the next spring.) On older, non-sealing asphalt shingles, a wind storm is often the final blow (no pun intended). The shingles, brittle with age, simply tear off and land in the garden.

Typical asphalt shingle application - showing metal drip edge



Conventional Shingles

Conventional asphalt shingles can be used on a slope as low as four in twelve, using normal techniques. Some roofers use these shingles down to a pitch of two in twelve if the roof is first covered with non-perforated, saturated felt papers. The felt papers must be overlapped by fifty percent and the section at the eaves (from the bottom edge up to twenty-four inches beyond the interior of the exterior wall) must be cemented in place to provide extra protection. Unfortunately, it is impossible to determine, during a visual examination, whether this procedure was undertaken. Many roofing experts feel this is not an ideal approach.

Low Slope Shingles

There are also special low slope shingles which are designed for pitches down to two in twelve. With these shingles, only one third of the shingle is exposed to the weather (as opposed to half of the shingle on a conventional installation) and the shingles are individually cemented in place.

Wear Factors

Regardless of the type of asphalt shingle used, there are two general rules with regard to wear. 1) Sunlight is one of the biggest enemies of asphalt roofs and consequently in many areas the south and west exposures wear out the fastest. (Lighter colored shingles reflect more light and, consequently, last slightly longer.) 2) The steeper the pitch of the roof, 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 it is worn off, the shingles dry out and become brittle. They crack, buckle, and curl. Areas where the granular material has eroded the fastest, wear out first. These may be areas where there is heavy foot traffic, abrasion from tree branches, or erosion from downspouts discharging onto the roof surface.

Premature Blisters

Occasionally, shingles will wear out prematurely due to a manufacturer's defect. Blisters, approximately the size of a dime, form underneath the granular surface and cause raised sections in the shingles. While these are not aesthetically pleasing, they do not affect performance until the granular material wears off in these areas.

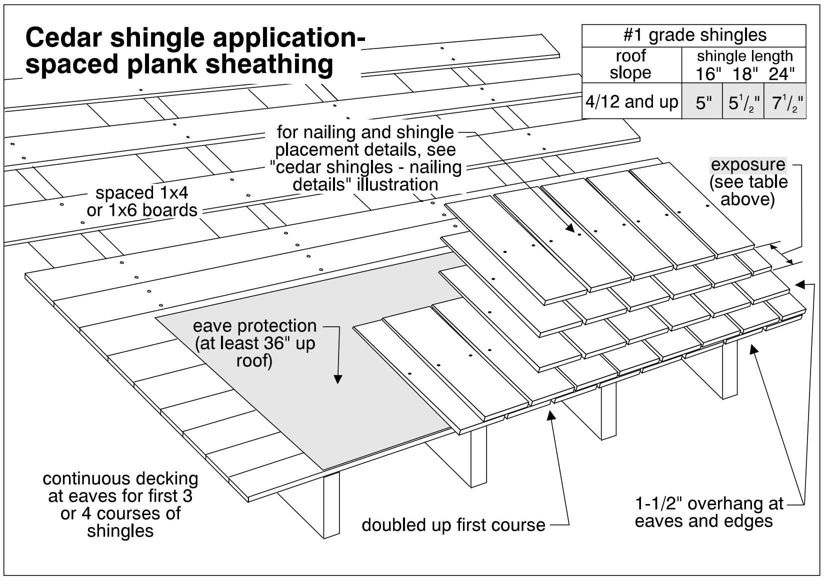
Premature Cracking

In some instances, premature cracking and splitting of fiberglass reinforced shingles occurs. This cracking is sometimes noted as early as 6 months into the shingle life. Cracks on the shingles can be in any direction. Cracks lead to reduced shingle life.

1.2 Wood Shingles and Shakes: Wood shingles are machine cut, while wood shakes are hand split or mechanically split. Wood shakes are thicker and have a much more uneven surface. Most wood shingles are cedar; however, some are redwood. Wood shingles can be used on roofs with a pitch as low as four in twelve; however, six in twelve or more is recommended. Wood shingles vary in length between sixteen inches and twenty-four inches. On a good quality installation, no more than one third of the shingle is exposed to the weather.

Life Expectancy

The life expectancy of wood shingles is generally thirty to forty years; however, low quality shingles have been known to deteriorate badly in fifteen to twenty years. The rate of wear depends largely on exposure (the amount of shingle which is exposed to the weather), the pitch (the steeper the better), the grade of shingle (there are three), and the amount of sun and shade. Too much sunlight dehydrates the shingles, causing them to become brittle. This results



in splitting and cupping of the shingles. Too much shade and moisture causes rot and moss to grow. Wood shingles and shakes can also suffer mechanical damage from tree branches, foot traffic, snow shovelling, etc.

Another factor which affects the life of wood shingles is their ability to dry quickly. It is preferable to put wood shingles over spaced roof sheathing boards rather than plywood sheets. Some experts say the use of plywood will halve the life of the shingles.

As a general rule, when more than ten to fifteen percent of the roof requires repair, it is best to replace the roof covering.

1.3 Slate Shingles: Slate is a natural material. It is sedimentary rock which is quarried; consequently, the quality can vary. High quality slate roofs have an average life expectancy of sixty to two hundred years. Slate roofs are heavy, weighing three to five times as much as conventional asphalt shingles. A pitch of six in twelve or more is recommended and usually, slates are installed with less than fifty percent of the slate to the weather.

Wear Factors

While some slates are of low quality and tend to flake and shale, the biggest problem with slate roofs is not the slates themselves, but the nails holding the slates in place. With time, the nails rust and allow the slates to slide out of position. Once one slate has come loose, water penetration accelerates the rusting of nails holding other slates in the same vicinity. Therefore, it is imperative to be diligent in the maintenance of an older slate roof. While it is not common practice, slate roofs should be inspected and repaired at least twice annually. Slates which have slipped should be resecured, and slates which have cracked or split as a result of mechanical damage should be replaced. As a general rule of thumb, replacement of the entire roof covering makes sense when more than ten percent of the roof is in need of repair.

A slate roof in perfect condition can still leak under some circumstances. Because of the nature of the material, leakage can occur during periods of wind-blown rain, particularly on slate roofs with a low pitch.

Flashings

Another common problem with slate roofs is that the flashing materials do not last as long as the slates themselves. Flashings, typically made of metal, are used wherever the roof changes direction or meets an obstruction such as a chimney. If the flashings rust, a section of the roof may have to be removed to install a new flashing. This is an expensive and difficult proposition.

Repair Work

Another difficulty with slate roofs is finding qualified people to repair them. Since slate has not been used commonly for the past fifty years, their installation and repair is a vanishing art. Those who do not understand slate roof systems tend to do more damage than good when attempting repairs. There also seems to be a tendency to suggest replacement with a more conventional material that the roofer knows and understands.

1.4 Concrete and Clay Tiles: These roofing systems are relatively rare; however, concrete tiles are making a comeback. These are high quality roofing systems with life expectancies in the neighborhood of fifty to one hundred years. Like slate, these roofs are heavy, weighing four to five times as much as asphalt shingles. Often, modifications to the roof structure are required if replacing asphalt shingles with concrete.

Concrete and clay tiles can be used on a pitch as low as four in twelve but as with most roofing systems, steeper is better. The amount of overlap (exposure of the tiles) varies depending on the roof system. Systems with a limited overlap are sometimes prone to leakage during wind-blown rains.

Some parts of the USA use the clay or concrete tiles over a built up roof membrane. The tiles are not water tight but provide protection against fire, ultraviolet light and mechanical damage.

Some systems are nailed in place while others use special clips or wire ties. In some regions the tiles are mortared into place.

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 tend to wear out faster than the tiles. Depending upon the design of the roof system, they can be very difficult to repair.

Because most concrete and clay tiles are not flat, they are more difficult to flash.

1.5 Fiber Cement Shingles: Fiber cement shingles consist of a mixture of Portland cement, water and fibers. Traditionally, asbestos fibers were used, but since the 1970's asbestos has been replaced by fiberglass, or more commonly, wood fibers. The type of fiber used in a shingles cannot be determined by visual means and is outside the scope of a home inspection.

These shingles traditionally had a life expectancy of thirty to fifty years, although some newer shingles carry warranties as long as sixty years.

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

1.6 Metal Roofs: There are many types of metal roofs. Copper, galvanized steel, pre-painted or coated steel, terne and tin are some of the most common. Most metal roofs (particularly copper) are very expensive systems. Metal roofs can be installed in sheet form or as shingles. Sheets and shingles can be used on sloped roofs; however, flat roofs are only covered in sheets.

Sheet metal roofs can have many different types of seams. Some are soldered while others are folded and crimped in a variety of ways.

Wear Factors

Like any roofing system there are disadvantages; seams can split, or standing seams can get bent. 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 as moisture trapped below the tar causes accelerated rusting. As a general rule, when one is looking at a tar covered metal roof, one is looking at an inexpensive and short lived repair.

Metal roofs are very difficult to repair, once they have begun to rust and leak. Replacement is the best alternative.

1.7 Corrugated Plastic Roofs: Corrugated plastic is a specialty type of roofing. It is a single ply, translucent roof surface which 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 extremely weak and should never be walked on.

They are generally considered to be low quality roofing systems which are easily damaged, discolor with sunlight and leak at the joints.

1.8 Built-up Roofs: Built-up roofs are commonly called tar and gravel roofs. They are a multi-ply roofing system, consisting of two, three, four or even five plys of roofing felts with a mopping of asphalt (nobody uses coal tar anymore) between layers. A flood coat of asphalt is then applied over the top and covered with gravel to reflect ultra-violet light and protect the roof from mechanical damage. Some roofers use roll roofing rather than gravel to protect the membrane. This is a sacrifice material which may only last five years. Most roofing experts consider this a second choice to gravel.

Pitch

Built-up roofs are designed for flat roof applications and should not be used with a pitch of greater than three in twelve, unless special asphalt is used which will not run when heated by the sun.

Life Expectancy

Two ply built-up roofs have a life expectancy of five to ten years while four-ply roofs normally last fifteen to twenty years. Unfortunately, if the roof has a flood coat of tar and gravel, it is not possible to determine how many plys exist without taking a core sample. It is also difficult to determine the condition of the membrane due to the gravel on top.

Wear Factors

Built-up roofs require a considerable amount of expertise to install properly. If moisture is trapped underneath the membrane or within the layers of 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 dehydrates due to exposure to sunlight.

Drainage

Water ponding on a flat roof can shorten the life expectancy by as much as fifty percent. When reroofing, rigid insulation or wood decking can be used to sculpt the roof surface to promote good drainage. As an alternative, under some circumstances, additional drains can be installed. Good practice includes a secondary drain for flat roofs. Drains may be gutters, central drains or scuppers.

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 plys of a roof before emerging on the interior.

Because of the complexity of built-up roofs, it is imperative that a reputable roofer, offering a meaningful guarantee, be used.

1.9 Roll Roofing: Roll roofing is sometimes known as selvage roofing. It typically comes in eighteen inch or thirty-six inch wide rolls. It consists of the same material as asphalt shingles (asphalt impregnated felts covered with granules). The surface can be completely covered with granules or only fifty percent covered (designed for two-ply application). The material is most often installed as a single ply with very little overlap.

Life Expectancy

It is considered to be a low quality roof covering with 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. Unfortunately, from a visual inspection it is impossible to tell. Modified bitumen roofing (a single ply membrane) can be very similar to roll roofing in appearance. The inspector may not be able to determine the chemical make-up of 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 tends to 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 roof applications. It is sometimes cemented in place but most often it is simply cemented at the seams or nailed at the edges. Often, there is no protection for the nails and leaks occur at these locations.

The material is generally considered to be a handyman type of roof covering.

1.10 Modified Bitumen: 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, or bonded (mopped in) to the roof with hot asphalt. The surface of the membrane may be protected from ultraviolet rays by a coating of granules, foil, or paint. The sheets are approximately thirty-six inches wide and usually overlap each other by three inches. Modified bitumen roofs may be installed as either a single or double layer system. It is usually not possible to tell how many layers exist on a roof

Life Expectancy

Modified bitumen membranes have only been in use for about twenty years, and their life expectancy is not yet well-defined. A lifespan of fifteen to twenty years seems reasonable, but many roofs have failed sooner.

Wear Factors

Many early failures of modified bitumen roofs have been the result of poor installation. Roofs with ultraviolet protection last longer than those without. Two-ply installations are more durable. 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.

Since seam failure and installation problems are most common, it is imperative that a good roofer, providing a meaningful guarantee, be used.

1.11 Other Roof Coverings: There are many types of roof coverings on the market today. There are plastic (primarily PVC) and synthetic rubber (elastoneric, EPDM) membranes for flat roofs, hardboard and rubber shingles for sloped roofs, and many more.

With all roofing systems, some basic principles apply. The roof surface should keep the water out. The life expectancy and guarantee should be reasonable. As a general rule, shedding type roofs should have a slope of four in twelve or more. Any roof system which absorbs water (e.g. wood or hardboard) should be installed to permit quick drying.

Asphalt

1.12 Strip When Reroofing: While it is better to remove old roofing, an asphalt shingle roof can be installed immediately over one other layer of asphalt shingles, if the layer being covered is relatively smooth and flat. Longer nails must be used. If there are two layers of asphalt shingles on the roof at present, they should be removed prior to adding another layer.

Asphalt shingles are often installed over a single layer of wood shingles or slate shingles; however, the preferred practice is to remove these roof coverings prior to installing asphalt.

Wood

Wood shingles or shakes can be installed over a single layer of asphalt shingles; however, it is preferable to remove existing shingles to allow the wood roof system to breathe. Wood shingles or shakes should never be installed over an existing layer of wood shingles or shakes.

Slate

Slate roofs should never be installed over another layer of roofing. New slate roofs are extremely rare. A new slate roof on a building not designed for slate would likely require structural modifications to contemplate the weight of the roof.

Concrete

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

Asbestos Cement

New asbestos cement shingles are rarely installed. Ideally, existing asbestos cement shingles should be removed prior to installing any other form of roofing material. Because of the asbestos content of the shingles, special provisions must be made for handling and disposing of the material.

Metal

Metal roofs should not be installed over other roofing materials.

Built-Up Roofs

While it is common practice to install new built-up roofs over existing built-up roofing systems, the practice is not advisable. Moisture trapped in the old roofing system will cause premature deterioration of the new membrane.

Single Ply Membranes

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

Corrugated Plastic

Corrugated plastic roofing should not be installed over other roofing materials.

Flashings

1.13 Unusually Vulnerable Areas: The typical vulnerable areas of a roof are where the roof changes direction, or where a change in materials occurs (for example, where the roof meets a chimney or a wall). On a properly installed roof, these areas are flashed. Please refer to 2.0 in this section. Particularly vulnerable areas exist where two or more flashings intersect, for example where a chimney occurs in a valley.

Antennas

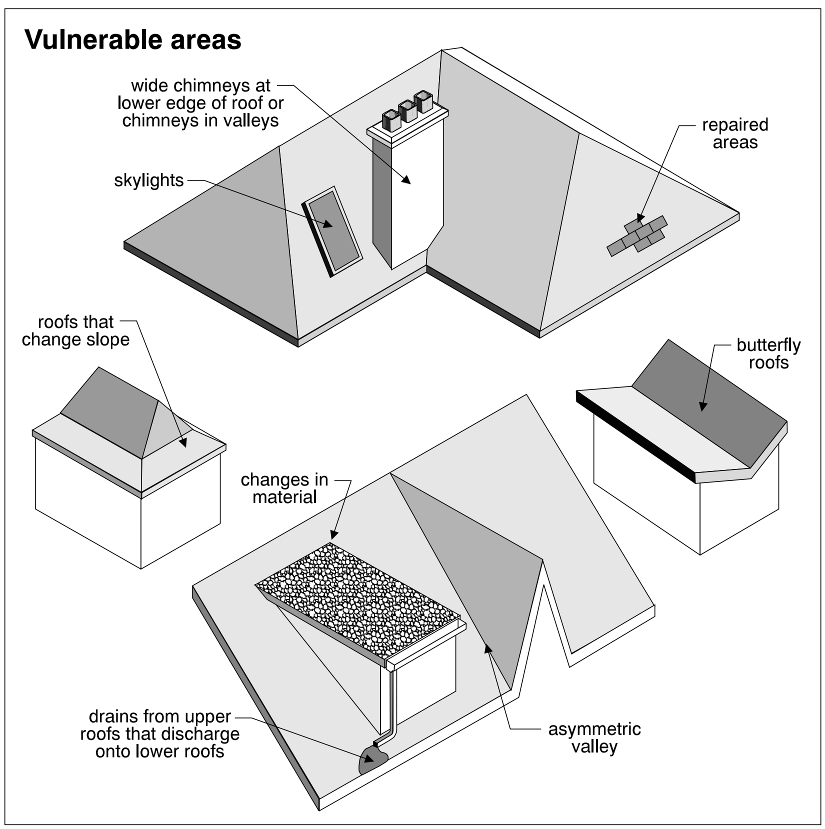
In addition to flashings, areas where television antennas and their supporting wires are attached are potential trouble spots.

Low Slope Roofs

As a rule, areas with a low slope tend to be more vulnerable to wear and leakage. If the low slope portion of the roof is covered with asphalt shingles, refer to 1.1 in this section.

Previous Repairs

Areas that have already been repaired are vulnerable. Previous repairs could have been undertaken for a number of reasons; however, in most cases a repair to a roof indicates one of the following: a design problem, defective materials,



defective installation, mechanical damage or a roofing system nearing the end of its life.

Low Areas

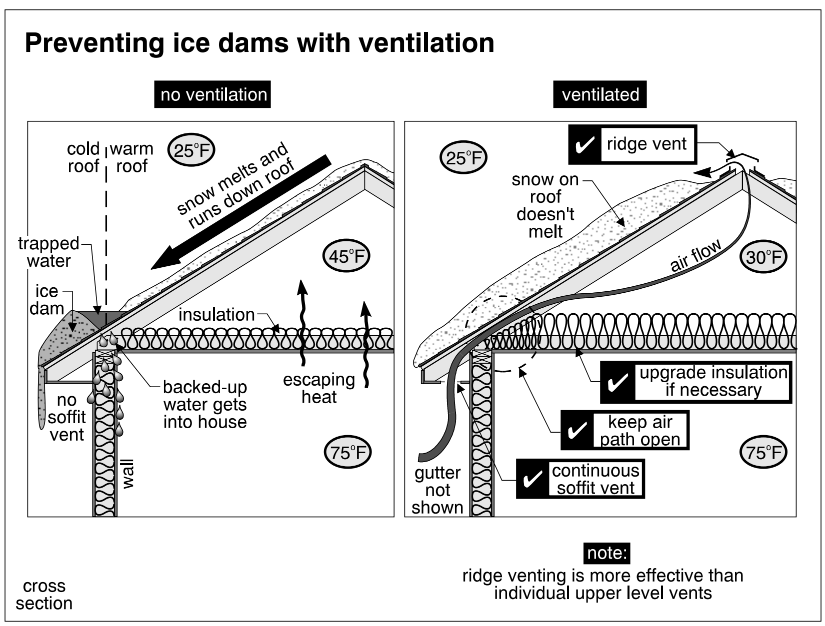
On sloped roofs, valleys are often required. The valley itself, however, should always have some slope. The lower the slope or pitch of the valley, the more prone it is to leakage. Some roofs are poorly designed with valleys where the base of the valley is flat (horizontal) or nearly flat. These roofs are very prone to leakage and ice damming. Refer to 1.14 in this section.

Low areas on flat roofs pond water. Ponding water will reduce the life expectancy of some flat roofing systems by as much as fifty percent. If the roof is in good condition and is relatively new, modifications are not warranted until replacement is necessary.

Unsuitable Materials

Sometimes, roofing materials which are suitable for one application are used for another. Other times, low quality materials which are simply not suitable at all have been employed. In most cases, corrective action should be undertaken or, at the very least, the area should be monitored.

1.14 High Risk of Ice Damming: Some roofing configurations are more prone to ice damming problems than others. Ice damming occurs when snow and ice collect in a certain area of the roof (often the eaves). Melting snow on the upper portion of the roof cannot drain properly as it is trapped behind the ice dam. See Figure 5. If the dam is large enough and sufficient water collects, it will back up under the shingles and leak into the eaves or worse, into the exterior walls or the building interior.



Ice dams are most common on low slope roofs or roofs which 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 snow fall when day time temperatures are at or slightly above freezing while night time temperatures are below freezing.

Solutions

Effective solutions to ice damming problems are increased attic insulation and ventilation. These two measures reduce the air temperature in the attic so that there is less tendency for snow to melt over the heated portions of the house. Also, at the time of reroofing, eave protection should be provided beneath the shingles for a distance of at least 2-1/2 feet beyond the interior of the exterior walls. Eave protection should be a waterproof membrane. Polyethylene sheeting is no longer accepted in many areas for eave protection.

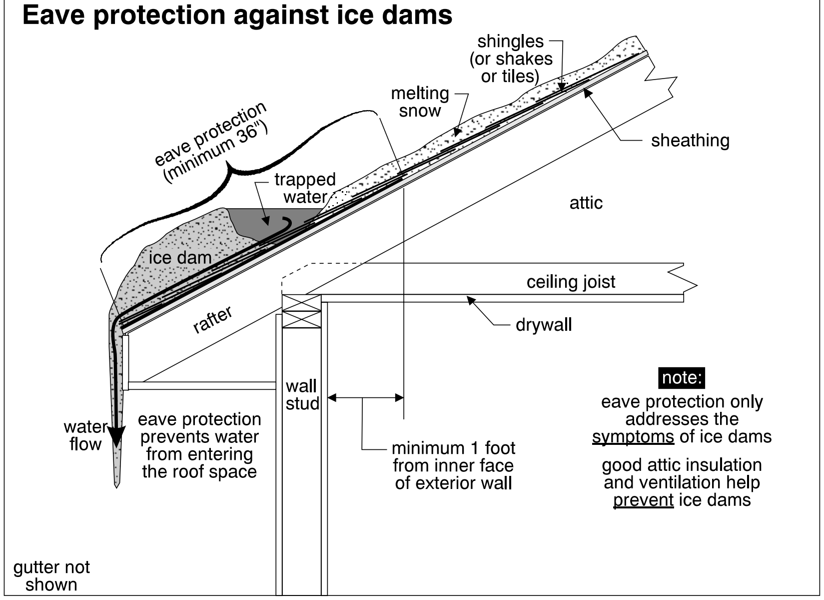
In extreme climates, eave protection is visible and usually takes the form of metal roofing at the eaves. It is impervious to water penetration and tends to allow snow and ice to slide off the roof. A metal or vinyl drip edge flashing will help protect the lower edge of the roof sheathing and direct water into the gutter.

Avalanche Guards

Metal devices which protrude above roof surfaces (usually on the lower section of roof) are designed to hold snow on the roof and prevent avalanches. These may worsen ice damming conditions.

Heating cables can also be used, however, they are considered to be a less desirable approach. Heating cables must be turned on prior to to the accumulation of snow and ice. In some cases, they can aggravate a situation rather than improve it if they are turned on after the ice dam has formed. Heating cables are not tested during an inspection.

Eave protection against ice dams



1.15 Tree branches Touching 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 and shorten its life expectancy.

Tree limbs touching buildings also provide easy access to the home for pests such as squirrels and raccoons.

► 2.0 FLASHINGS

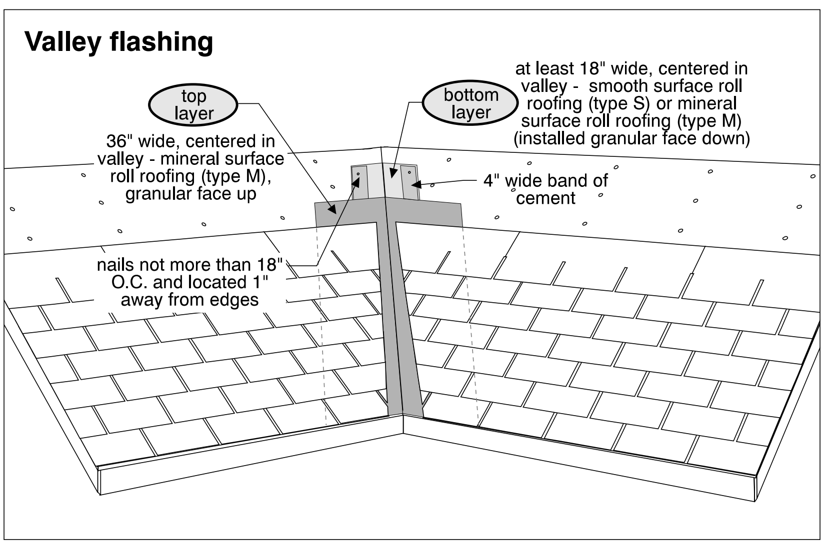
Material

Flashings are designed to keep water out. They are used where dissimilar materials meet, where a material changes direction, or at joints in materials. Most flashings are galvanized steel; however, they can also be tin, terne (steel containing copper, coated with a lead-tin alloy), aluminum, or copper. In some cases, lead is used. In specific applications, roll roofing material is used as a flashing. Roll roofing is a material similar to asphalt shingles, except that it comes in rolls, which are either eighteen inches or thirty-six inches wide.

Location

Most flashings are associated with roofs.When a roof line changes direction, a ridge, a valley, or a hip is created. Ridges are horizontal and are found at the highest portion of any given section of a roof. When a roof changes direction in such a way that water will be directed towards that change in direction, a valley is created. When the opposite is true, a hip is created.

2.1 Valley Flashings: Ideally, valley flashings should be constructed of metal; however, most are constructed of roll roofing. In some cases, valley flashings are omitted altogether and the roofing material is bent around the corner. This is not a wise practice. Sometimes a proper valley flashing is installed and then covered with shingles. This is called a closed valley. These may be interwoven or closed cut.Where the flashing is visible, it is known as an open valley. Metal valley flashings are typically twenty-four inches wide; however, the majority of the material cannot be seen, as it is hidden under the shingles. When roll roofing is used, two layers are installed; one being eighteen inches wide, and the other thirty-six inches.



Problems

Valleys are particularly weak spots on roofs, as they channel a significant amount of water; therefore, even a small leak can cause considerable damage. The slope of the valley is less than the slope on either side. This causes increased wear on the valley. Sometimes valley flashings stop short of the edge of the roof and allow water to pour into the eaves. Also, the inexperienced tend to walk up valleys when traversing a roof. This damages valley flashings, particularly if they are constructed of roll roofing. If the flashings are not lying flat, they are more prone to damage. Valley flashings are difficult to replace when not replacing the entire roof surface and, consequently, they are often repaired. Even when reroofing, some roofers shingle up to existing valleys and do not replace them. This is not considered good practice.

Low slope

As a general rule, valley flashings on low pitched roofs are more prone to leakage than on steeply pitched roofs. There is also a greater tendency for snow and ice accumulation in low pitched valleys which can result in water backup under the shingles.

Problems can also occur at a valley between a steeply pitched roof and a low pitched roof. Water cascading down the steeply pitched roof can sometimes overshoot the valley and run under the shingles on the lower pitched side. Under some circumstances, special valley flashings have to be created to prevent water from overshooting the valley.

2.2 Hip and Ridge Flashings: When pliable shingles (such as asphalt) are used on the roof, shingles are simply cut and bent over hips and ridges to make them watertight. When the roof shingles are brittle and non-pliable (such as wood shingles, slate, and asbestos cement), metal flashings are often used at the ridges and hips. On some of these roofing systems, the flashing is buried beneath a decorative layer of shingles. In most cases, the condition of hip and ridge flashings is not a major concern, since water is always shed away from these flashings, due to the configuration of the roof. On older roofs such as slate, however, metal flashings rust away and require replacement.

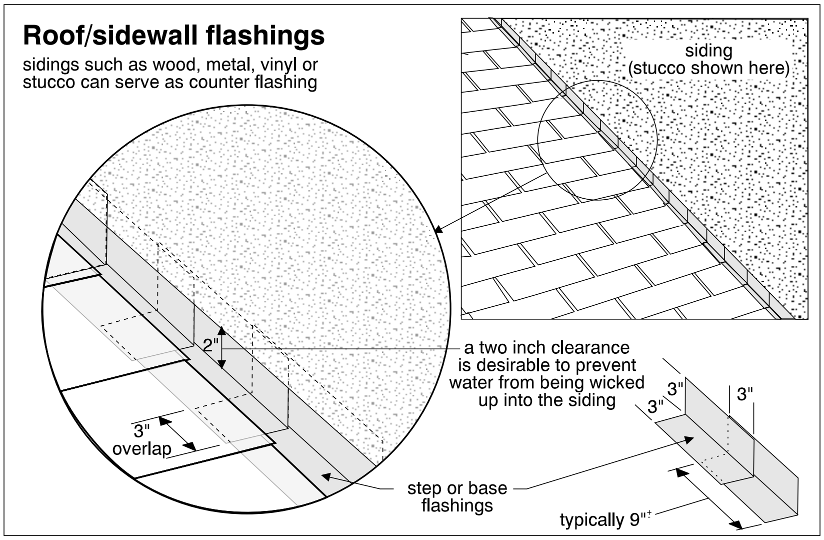
Older metal flashings are often poorly secured and can be blown off in high winds.

2.3 Sloped Roof To Flat Roof Flashings: Many methods are used to flash between sloped and flat roofs (assuming the flat roof is at the bottom of the sloped roof). The principle is always the same - to prevent simple water penetration and to prevent water backing up underneath the shingles, as snow tends to accumulate in this area. Since flat roofs and shingle roofs are often not replaced at the same time, many flashings in this area are poorly installed. The flat roof membrane should extend at least three feet up the sloped roof. Minor building settlement also tends to tear flashings in this location. This is an area which should be carefully monitored.

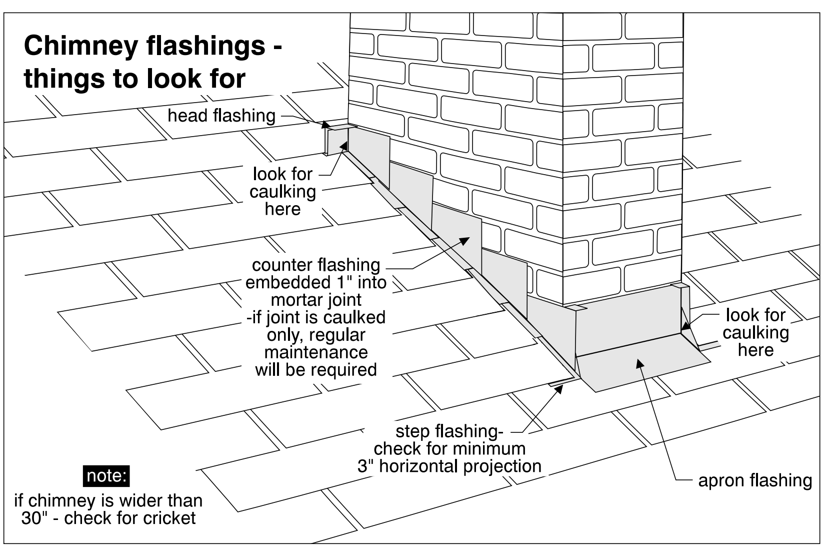
2.4 Roof To Wall Flashings: Many different flashing configurations are used when a roof intersects a wall. The type of flashing arrangement depends on whether the roof is flat or sloped, and whether the slope is away from the wall, or parallel to the wall. The slope should never be toward the wall. If the roof is flat or slopes away from the wall surface, a simple counter flashing can be installed over the roofing material. A counter flashing is simply a metal skirt which covers the top six inches (roughly) of the roofing material and which is turned up the wall surface. A tight connection between the top of the flashing and the wall is important. This is the most common area of failure.

When a roof slope is parallel to a wall, two sets of flashings are required. Step flashings are installed between each layer of shingles and covered with a counter flashing. Unfortunately during a visual inspection, it is often difficult to determine the presence of step flashings. Sometimes, the siding material acts as a counter flashing.

Counter flashings often pull away from the wall and allow water penetration.



2.5 Chimney Flashings: The flashings used on the sides and downhill portion of the chimney are similar to the wall flashings described above. The portion of a chimney flashing which is most prone to leakage is the portion facing the high section of roofing. (No such section exists if a chimney protrudes through the ridge of a roof.) Water running off a roof hits the high side and must be diverted around the chimney. Therefore, flashings on the high side should be a minimum of six inches in height or one-sixth of the width of



the chimney, whichever is greater. The flashing should continue up under the shingles to an equal height. When a chimney is more than thirty inches in width, a saddle (or cricket) should be installed behind the chimney to divert water around the chimney. This device is simply a miniature peak roof directing water away from the chimney. They are often missing. There are alternative approaches.

Location The location of a chimney will dictate how prone it is to flashing leaks. A chimney near the peak of a roof is less prone to water penetration problems than a chimney in a valley or at the bottom of a long section of sloped roof.

Problems Flashings are often torn, loose, missing, incomplete, rusted, or mechanically damaged by animals.

Roofing cement is often used to correct chimney flashing leaks. This should be considered a short term solution; however, it is sometimes viable if reroofing is to be undertaken within the next few years. At the time, proper chimney flashings can be installed.

2.6 Parapet Wall Flashings: On some houses, the exterior wall of the house protrudes above the roof line. Where the roof meets the wall, flashings are required. These are typical wall/roof flashings (see 2.4) and their design will depend upon whether the roof is sloped or flat. In addition to the wall/roof flashing, a cap flashing should be provided over the top of the parapet wall to prevent water penetration into the wall system.

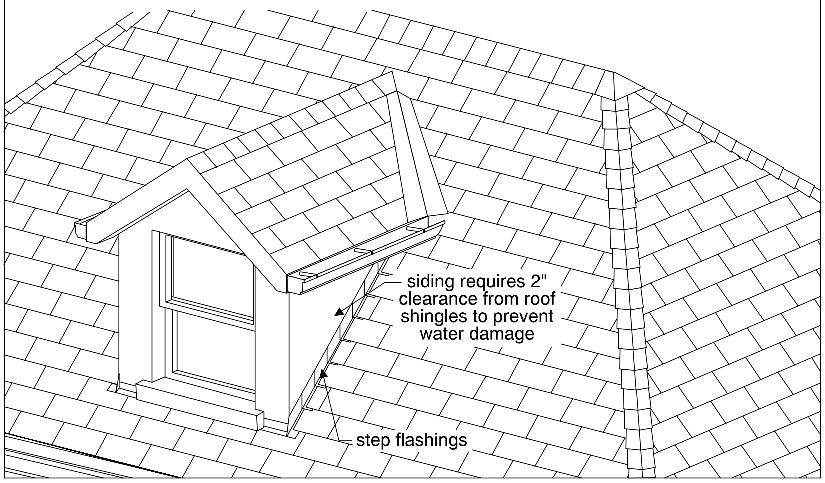
Parapet wall flashings are often loose, deteriorated or missing altogether.

2.7 Plumbing Stack/Electrical Mast/Exhaust Flue Flashings: A flashing must be provided where a plumbing stack, mast or flue protrudes through a roofing system. These flashings are typically constructed of metal or rubber. On flat roofs, pitch pans are often used. A sheet metal pan around the stack or mast is filled with pitch or tar to a depth of one or two inches. Many experts consider this a poor flashing. Sometimes, condensation forming on the plumbing stack is mistaken for a flashing problem.

Plumbing stack and electrical mast flashings are sometimes torn and often missing (particularly on flat roofs where roofing cement is used as a poor alternative).

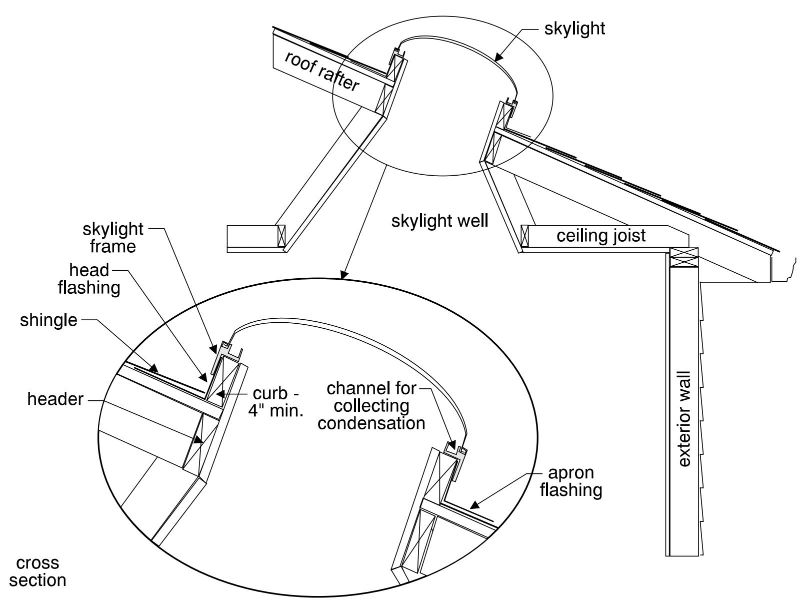
2.8 Dormer Flashings: Many types of flashing arrangements are used where dormers intersect the main roof. The type of flashing depends largely upon the dormer shape. The most common flashings are step flashing, which fit between each layer of shingles and extend up the wall surface, and counter flashings which cover the portion of the stepped flashing on the wall surface. Depending upon the configuration of the roof, step flashings are not usually visible. Sometimes, siding material fulfills the role of the counter flashing. If wood siding material is used on a dormer, it should stop approximately two inches above the main roof surface so that rot does not occur.

Dormer siding flashings



2.9 Skylight Flashings: Skylights should be flashed in a similar method to chimneys. Unfortunately, many skylights are not installed at the same time as the roof and consequently, proper flashing details are omitted. Ideally, a skylight should sit on a curb or box which protrudes at least six inches above the roof surface (unless the skylight comes with a premanufactured flashing assembly). This allows for the installation of proper flashings and limits snow accumulation on the skylight.

Skylight in sloped roof - curb mount



Flush Skylights

Some skylights are simply a bubble which is intended to have no flashings. The bubble simply slides under the shingle material on the sides and uphill portion of the skylight. On the downhill side, the skylight overlaps the roofing material. The pitch of the roof, and the distance the skylight projects under the shingles, determines the effectiveness of this arrangement. Generally, this type of skylight is prone to leakage. Replacement with a better quality skylight and flashing system is the best solution.

It is not uncommon for condensation to form on the interior of skylights. This is often mistaken for flashing leakage problems.

2.10 Solarium Flashings: Leakage from solariums often occurs where the glass roof meets the conventional roof or original wall of the house. It is imperative that this area be properly flashed. Leakage also tends to occur where the glass roof meets the glass wall at the eaves of the solarium. Many solarium designs allow water to collect at a moulding or frame at the lower edge of the windows creating the roof. If these components are wood, they invariably rot.

Regardless of the material used, the puddle of water created in this location inevitably leaks through to the interior. Often, design modifications are required to correct a chronic problem. Caulking will work as a short term solution but rebuilding, in whole or in part, is often the only viable long term repair.

As with skylights, water stains from condensation may be difficult to differentiate from water penetration stains.

2.11 Drip Edge: This metal flashing is provided along the lower edge of some sloped roofs. It is intended to direct water from the roof edge into the gutters without damaging the fascia or roof sheathing edges. If it is not installed properly, it can cause water damage to the eaves.

2.12 Gravel Stop Flashing: On most flat roofs, a gravel stop flashing is used to terminate the roof membrane 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 a built-up roof, and forming a drip edge to keep water run off from damaging the wood fascia.

Gravel stop flashings are sometimes loose, rusted or missing altogether. It is common to find the roof membrane lifting from the gravel stop. This can occur due to a poor installation or not properly preparing the metal prior to roofing.

2.13 Roof Vent(s): Flashings are an integral part of 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 dictates the effectiveness.

3.0 CHIMNEYS

Material

Flues

The most common materials used in chimney construction are masonry and steel. Masonry chimneys can be brick, block or stone and are sometimes stuccoed or parged. In some areas, cement asbestos chimneys are found. Chimneys often have more than one flue. A flue is a separate and distinct channel for the smoke on the inside of the chimney. Each appliance within the house must have 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. Some codes allow wood stoves to share flues with gas or oil furnaces, if at the same floor level.

Flue Liners

Some flues are unlined in that there is masonry exposed on the inside of the flue. Unlined chimney flues are most common in houses built before the Second World War. These unlined masonry flues have performed reasonably well for fireplaces and oil-fired furnaces. Gas-fired furnaces, on the other hand, usually require a liner.

Flues can be lined with one of several materials: clay tile, metal, or asbestos cement pipe. For more information on chimney liners, refer to Heating.

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, it is both courteous and prudent to discuss the work with the neighbor first, as often the costs and benefits of the improvements can be shared. Shared flues present a safety concern. This is discussed in Section 8.9 of the Interior chapter.

Removed

Many chimneys which are no longer needed, are removed down to a point below roof level during re-roofing. This eliminates the need to maintain the upper section and eliminates the risk of water leakage through the chimney flashing, a common source of problems. Removal is appropriate as long as nothing which could be used inadvertently is connected to the chimney below.

Partly Removed

Occasionally, abandoned chimneys are knocked down part way, but still protrude above the roof line. In some cases the flue is sealed, with concrete for example. When re-roofing, it is wise to remove the section of the chimney above the roof line to eliminate the necessity of future maintenance and the risk of roof flashing leakage.

Problems Chimney deterioration is a very common problem. In most cases, water is the culprit. Metal chimneys corrode, and masonry chimneys suffer deterioration to mortar, brick, stucco, et cetera. The source of the water can sometimes be wind driven rain. In many cases, however, the water is 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 droplets are absorbed into masonry chimneys and sit on the interior of metal chimneys. The water droplets are somewhat acidic from products of combustion. This causes corrosion in metal flues and deterioration within masonry flues. Condensation can also damage cement asbestos chimneys over several years. In severe cases, the chimney can be obstructed.

Freeze/Thaw The problem is compounded in masonry chimneys because of cyclical heating. Chimneys are forever heating up and cooling down, as furnaces, boilers, hot water heaters and fireplaces are only on intermittently. The moisture which has been absorbed into masonry chimneys freezes as the temperature drops. This causes mortar to deteriorate, bricks to spall and parging or stucco to loosen. This is a natural phenomenon with all chimneys, and deterioration over time should be anticipated.

Gap in Liner Some masonry chimneys are lined with clay tile. 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, some brick masons simply raised the top tile, leaving a gap between the top two tiles in the flue. A ring of more rapid deterioration normally shows up on the exterior of the chimney, corresponding to the gap in the clay tile liner.

Scaffolding The amount of deterioration dictates whether chimneys require repair or rebuilding. On tall chimneys or chimneys situated on steeply pitched roofs, it is often necessary to build scaffolding to facilitate proper repairs. This adds to the cost.

3.1 Chimney Cap: The purpose of a chimney cap is to prevent water from penetrating the top of a masonry chimney. The chimney cap should not be confused with the rain caps which sometimes cover the tops of chimney flues to prevent rain water from running down the flues. A chimney cap is usually constructed of concrete; however, some are stone or metal. A good quality cap normally overhangs the sides of the chimney at least one inch to provide some protection for the chimney from water which is dripping off the cap.

Missing In many cases, a proper cap is not provided. Bricklayers often put a thin coat of mortar over the top of the chimney (exclusive of the flues, of course). With time, this thin layer of mortar cracks and eventually becomes loose. The rate of deterioration to the top of the chimney which does not have a cap depends largely upon the type of masonry used to build the chimney and the quality of the mortar. There are many chimneys that have no cap that do not show signs of deterioration.

Cracked A cracked cap allows water to penetrate the chimney causing premature deterioration and in northern climates, freeze/thaw damage.

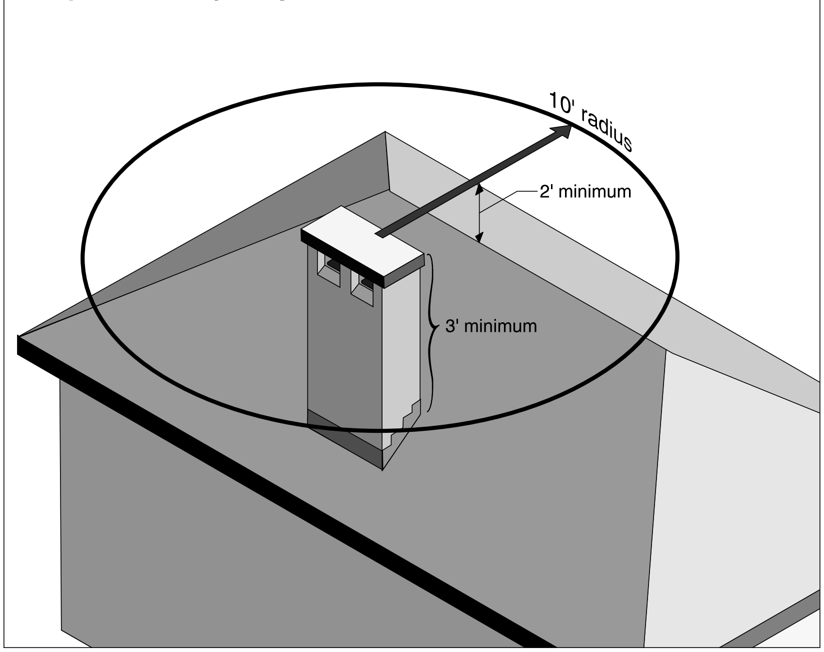
3.2 Brace: Tall chimneys, whether they be masonry or metal, should be braced. The requirements for bracing are not only based on the height of the chimney but also on the width and depth of the chimney.

3.3 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. Minor liberties can be taken with this rule when considering single flue metal chimneys for furnaces.

Draft Problems

Chimneys of insufficient height are prone to downdraft problems. Consider a chimney on the leeward side which does not extend above the peak of the roof. On windy days, wind blowing across the roof will tend to follow the roof line. This would result in wind pressure on the top of the chimney. This can cause fireplaces to smoke and products of combustion from furnaces to back up.

Proper chimney height



The best solution is to extend the chimney upwards. Alternative solutions such as a wind cap or adding glass doors on a fireplace are effective in some cases.

3.4 Vermin Screens: In some neighborhoods, particularly those near park lands or wooded areas, problems are encountered with vermin. Raccoons, birds and squirrels sometimes nest in chimneys to take advantage of their warmth. In these neighborhoods, vermin screens on the top of the chimney flues are advisable.

► 4.0 PROBABILITY OF LEAKAGE

Roofing systems often consist of several different types of flashings and materials. Water leakage may be caused by a number of different factors operating either together or independently. The probability of leakage refers to the chance of leakage occurring within the next year. A low probability does not mean that a roof will not leak within the next year, just that it is less likely to do so than a roof with a high probability of leakage. 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.

Age

As roofing materials grow old, they lose their ability to create a weather-tight system. Asphalt shingles can curl and shrink. Built-up roofing dries out and cracks. Wood shingles can do all of these things. Refer to individual material descriptions in Section 1.0 for more information. It is important to note that a new roof is less likely to leak than an old one, but it is still possible.

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.

Manufacturing Defects

Defective materials can cause problems with the performance of the roofing system. These defects include cracking or premature aging of the materials. Some defects, such as color variations, are simply cosmetic in nature.

Flashings

Flashings are perhaps the most vulnerable areas of the roof, as they represent a seam, or interruption, in the surface of the roof. Refer to Section 2.0.

Design

Steep, simple roofs are less likely to develop problems than roofs with a variety of slopes, angles and penetrations. A low-slope design combined with a large roof overhang will make the roof more prone to ice damming, for example.

Weather

The most unpredictable factor in predicting leakage is the weather. Often, even a new, perfectly-installed roof will leak under just the right conditions, such as a wind-driven rain from an unusual direction, or a heavy snow following by warmer temperatures and rain.

► NOTES