Contents

2 ROOF SURFACE

The **roofing system** generally is comprised of the

- Roof Surface
- Roof Structure
- Roof Ventilation
- Chimney(s)

In this section we will be discussing the **roof surface**.

The function of a roof surface is to **shelter the building** and its contents from the elements. It should also **direct water away** from the structure.

In North America there are countless types of roofing products and each year these existing products are improved and new products are being introduced.

The types of roofing materials installed usually will depend on the slope of the roof. Generally the roof system is applied as:

- Many small overlapping units (slope roof)
- Many continuous membranes (flat roof)
- One continuous membrane (flat roof)

The roof surface also includes **flashing details** that provide the **protective seal** around any **roof penetration, angle** or **connection**.

Flashing details are applied to the:

- Valley
- Chimney
- Parapet walls
- Roof-Wall connections
- Skylight
- Plumbing stack
- Electrical mast

Chimneys can also be a part of the roof system. Generally the types are:

- Masonry
- Stone
- Metal
- Wood chase over metal

2.1 Description

The following describes the **most common types** of roofing materials which divided into description and life expectancy.

2.1.1 Asphalt Shingles – Slope Roof

Asphalt Shingles are one of the **most extensively applied** roofing material because they are economical and relatively simple to install.

The **two most common types** of asphalt shingles are:

1. Organic (typically recycled paper or felt)
2. Fiberglass/Glass Fiber.

A Square (sold as 3 bundles) of shingles implies **100 square-feet** of the roof covered. Roofers will use this form of measurement to determine how much material is required

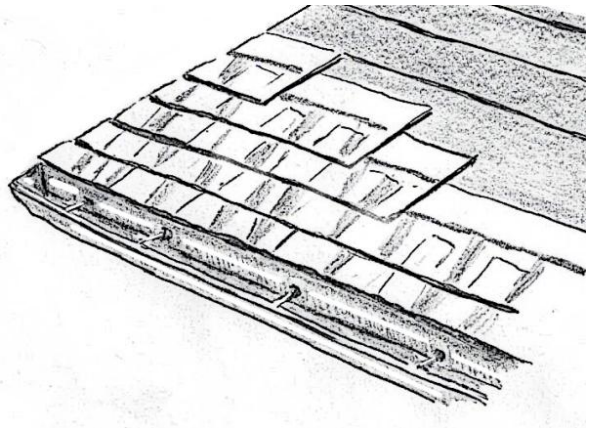
Organic shingles are paper saturated with bitumen (asphalt) to make it water resistant, then a top coating of asphalt is applied and finished with a colored stone or ceramic granules.

Fiberglass shingles have a base layer of glass fiber reinforcing mat. The mat is then coated with asphalt which makes the fibreglass shingle water resistant and finished with a granule surface. Fiberglass has been replacing Organic in Canada and the United States

Life Expectancy warranty can range from approximately **15 to 40 years**. In many cases the warranty can be voided due to improper installation of the product. If possible it is recommended the home owner contact the appropriate manufacturer or installer to determine the type of asphalt shingles.

A more recent fibreglass asphalt shingle is called **Laminated or Architectural** that has a distinct textured look and are tab-less. These shingles are more expensive but have a **greater life expectancy** than traditional shingles due to the extra thickness. The appeal for many is the contoured visual effect similar to a wood shake.

Fig. 2.1 Architectural Shingles (tab-less)



2.1.1 Fiber Cement– Slope Roof

Fiber Cement as its name indicates is a **composite of Portland cement and fibers**. The hard nature of cement reinforced with fibers makes this material ideal for roofing as well as having excellent fire-resistant properties.

Life Expectancy of fiber cement is approximately **30-50-yrs**. Often the fastener will fail before the shingles requires replacement. It is therefore possible if a proper match can be found to continue maintaining this type of roof for a very long time.

2.1.2 Metal Tile – Slope Roof

Metal Tile (shingle) roofs can be described as treated steel or aluminum used **for sloped roofs**. Steel tiles have the disadvantage of corroding over time where as aluminum does not rust relatively. Recently the installation of **aluminum tile has become popular** with a variety of finished styles and colors. Many will have a finish that imitates wood or be shaped to imitate traditional clay tiles. Often you have to observe the tile close up or touch it to determine if it is metal.

Life Expectancy warranty can range from 30-50 years. Many manufacturers of aluminum tiles **may offer life time warranty** though they are typically **very expensive**.

2.1.3 Sheet Metal – Slope Roof

Sheet metal roofing can come in a variety of metals including copper, stainless steel, galvanized steel, aluminum and terne-metal (alloy). Sheet metal can be used for **sloped and flat roofs**. In many cases due to their barn-like appearance this type of system is not popular with homes.

Life Expectancy of sheet metal roofs will vary depending on the type of metal or metal alloy. Assuming the system has been properly installed it may last **over 30 years**. Galvanized steel sheets might last 30-50 years with proper maintenance.

2.1.4 Corrugated Plastic - Slope Roof

Corrugated plastic roof coverings are typically made of high strength plastic fibers bonded with a resin. Although very resilient this type of roofing material is **typically not recommended for homes**.
This type of sheet material is often used for non-essential structures such as porches, decks, carports and sheds. It comes in a variety of corrugated styles and colors. Often transparent sheets are used for greenhouses.

Life Expectancy can be 20 years or more. Ultraviolet light from the sun will discolour corrugated plastic over time.

2.1.5 Slate Tile - Slope Roof

Slate tile (shingle) can be described as a **natural stone** that comes in a variety of colors though most often is gray in appearance. It is used for **sloped roofs**. Generally slate is a **high quality expensive** roofing material. Real (natural) slate can be mistaken for composite tiles that are imitations. Often you have to observe the tile close up or touch it to determine if it is real slate.

Life Expectancy for slate tile is generally **over 50 years** often will outlast the fasteners durability. With ongoing maintenance and repair it is possible for slate tile to last indefinitely. However maintenance can be expensive.

2.1.6 Clay Tile - Slope Roof

Clay tile (shingle) has been in use for thousands of years. They come in a variety of colors and shapes though most often terracotta in appearance with a flat or rounded shape. Clay tiles are kiln dried in molds and used for **sloped roofs**. Generally clay tile is a **high quality expensive** roofing material. As with many high quality materials there are imitators so up close visual inspection is often required.

The **structural integrity of the roof** must be considered due to the weight of this system.

Life Expectancy warranties will vary with clay tiles depending on the manufacturing practices. Generally higher quality clay will produce a high quality product. Clay tiles can last **up to 50 years** or more.

2.1.7 Concrete Tile - Slope Roof

Concrete tile (shingle), as the name suggests, is a mixture of portland cement and aggregates similar to other concrete products. It is used for **sloped roofs** and available in many shapes and colors.

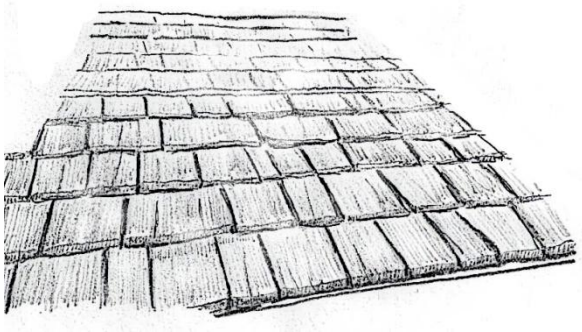
The **structural integrity of the roof** must be considered due to the weight of this system.

Life Expectancy warranties will vary with concrete tiles depending on the manufacturing practices. Generally tiles can last **up to 50 years**.

2.1.8 Wood Shingles - Slope Roof

Wood Shingles, not to be mistaken for wood shakes, are used for **sloped roofs**. The minimum slope is typically 4:12 (vertical:horizontal). Installing wood shingles on lower sloped roofs is possible with special considerations. They are mostly **cedar** wood or occasionally pinewood. The shingles come in various lengths and have a **smooth finish** (shakes will have a rough finish). The quality will depend on which part of the tree the shingle is cut from. Generally the interior part of the tree (heartwood) with no knots and least shrinkage qualities produce the best quality.

Fig. 2.2 Wood Shingles



Life Expectancy of wood shingles can be **20-40 years**. Pressure treated shingles can last longer. Many factors will determine longevity such as shingle quality, local climate, installation practises, roof slope, etc. Often with regular maintenance, such as the use of fungicides and other preservatives, wood shingles can last beyond life expectancies.

2.1.9 Wood Shakes- Slope Roof

Wood Shakes, not to be mistaken for wood shingles, are used for **sloped roofs**. The minimum slope is typically 4:12 (vertical:horizontal). Installing wood shakes on lower sloped roofs is possible with special considerations. They are mostly **cedar** wood or occasionally pinewood. Shakes come in various lengths, are thicker than shingles and have a **rough finish** (wood shingles will have a smooth finish). The quality will depend on which part of the tree the shake is cut from. Generally the interior part of the tree (heartwood) with no knots and least shrinkage qualities produce the best quality.

Installation of wood shakes is typically by two fasteners for each shake. Overlapping will depend on the size and quality of the shake and spaced adequately to allow for expansion. The joints are always staggered. The roof deck is often plywood sheathing although spaced plank sheathing will improve drying potential. Eave protection (tar paper typical) three feet from the edge with additional felt over each course is common for areas where ice-dams are common. This may vary depending on local codes. A drip edge is also a good feature though not always present. A synthetic mesh 'breather' material can also be found on the roof deck to improve drying potential on the underside of the wood shingle.

Life Expectancy of wood shakes can be **20-40 years**. Pressure treated shakes can last longer. Many factors will determine longevity such as shake quality, local climate, installation practises, roof slope, etc. Often with regular maintenance, such as the use of fungicides and other preservatives, wood shakes can last beyond life expectancies.

2.1.10 Modified Bitumen - Flat Roof

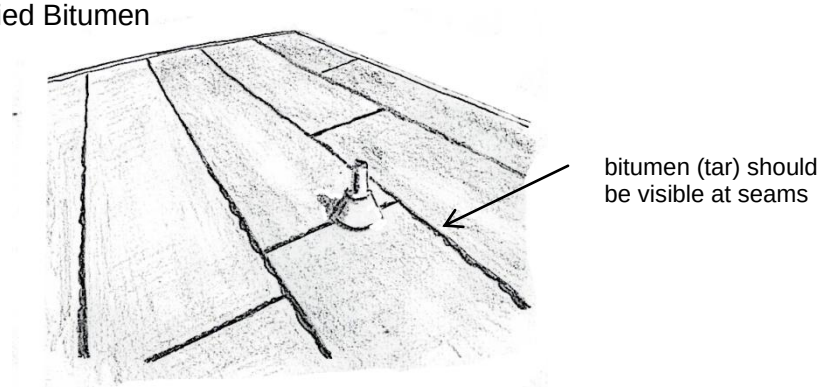
Modified bitumen (also called mod bit for short) roofing membrane can be described as a sheet of rubberized asphalt typically **for flat roofs** though can also be found on low-slope roofs.

The term flat roof is relative since there should always be some gradient towards the drainage arrangement to ensure adequate surface water runoff. The membrane consists of bitumen that has been modified with additives and reinforced to enhance durability. The two most common modifiers are APP (attactic polypropylene) and SBS (styrene-butadiene-styrene). It little resembles traditional asphalt shingles with the exception of being coated with a similar granule surface.

Installation is typically **for low slope or flat roofs**. It can be installed in a single-ply or more **preferably two-ply** applications. Typically it comes in rolls that are heated (or peel and stick) on the underside and rolled on to the roof surface overlapping at the edges. Other installation methods include mopping the roof surface with asphalt and applying the membrane and *peel and stick*.

Life Expectancy warranty can range from approximately **15 to 25 years**.

Fig. 2.3 Modified Bitumen



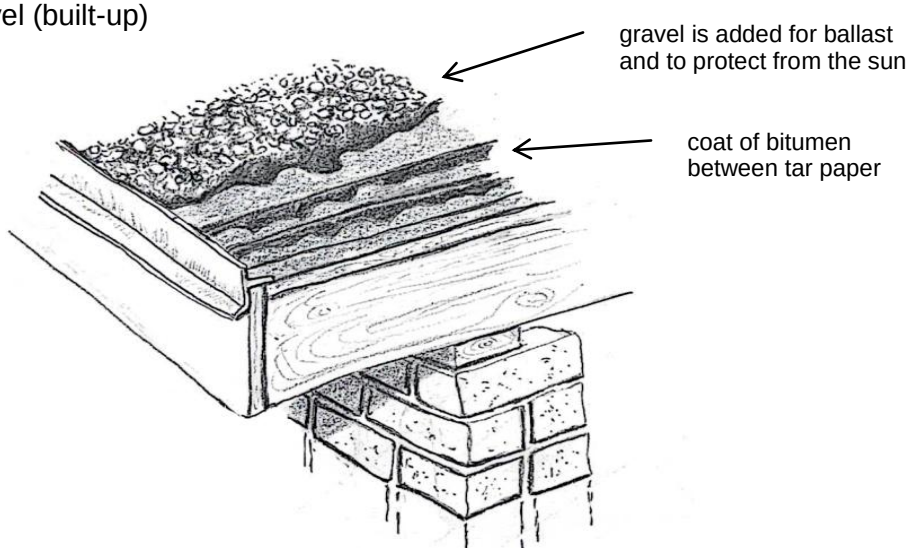
2.1.11 Built-up (Tar & Gravel) - Flat Roof

Built-up (tar & gravel) roofing system can be described as an application of multiple felt and bitumen (asphalt) layers topped with a gravel. This system is mostly **installed on flat roofs** though can also be found on low-slope roofs.

Installation can range from **two to five plies** with **each ply layer coated (mopped) with hot bitumen** typically heated on site and finally **covered with gravel**. The number of plies is determined by how closely the felt ply overlap each other. Determining the number of plies is not possible without intrusive testing i.e. taking core samples. The asphalt acts as the water resistant material and the aggregate provides ballast protecting the asphalt from ultraviolet deterioration.

Life Expectancy warranty can range from approximately **15 to 25 years**.

Fig.2.4 Tar and Gravel (built-up)



2.1.12 Roll Roofing - Flat Roof

Roll Roofing can be described as sheets of bitumen (asphalt) saturated felt coated with a granular surface. It is an inexpensive roofing material and based on the same materials used in asphalt shingles. It is a **low quality material** often mistaken for Modified Bitumen (a higher quality material).

Installation of this membrane is commonly used **for sloped roofs** and although it can be found on flat roofs it is not recommend. It is often used for sheds, porch overhangs, detached garages and other non-essential structures. It is commonly used as a flashing material for valleys or as a starter-strip for sloped roofs.

Life Expectancy of roll roofing is approximately **5 to 10 years.**

2.1.13 Synthetic Rubber - Flat Roof

Synthetic rubber or **e**thylene **p**ropylene **d**iene **m**onomer (EPDM) is a material that typically comes in large sheets or rolls and primarily used for **flat roofs**. Black and white is the most common colours. It is not common for residential buildings.

Installation of synthetic rubber is typically performed by fastening the sheets to the roof deck with compatible adhesives.

Life Expectancy warranties will vary with synthetic rubber and highly dependent on installation and manufacturing practices. Generally it can last **up to 20 years**.

2.1.14 Spray Foam - Flat Roof

Spray foam or **s**pray **p**olyurethane **f**oam (SPF) is a material that is used for **flat roofs**. It is not common for residential buildings.

Installation of spray foam is typically applied with high pressure spray equipment to the roof deck or onto existing roofing materials. This forms a single seamless monolithic membrane.

Life Expectancy of spray foam will vary depending on the density of the material. It can last **up to 50 years with ongoing maintenance**.

2.2 Probability of Roof Leaking

Leakage Probability as it implies is an overall analysis of the roof condition and the risk associated with leakage. Many factors may determine the level of Leaking Probability that include but not limited to:

- Age of surface
- Flashing details
- Slope
- Eave protection
- Design/Complexity of Roof
- The number of valleys
- Extreme Weather Conditions
- Lack Of Maintenance

Three self explanatory levels of Leakage Probability are described as follows and typically represent the estimated age of the roof or suspect installation:

- Low
- Medium
- High

2.3 Chimneys

Chimneys are used to **safely remove** (vent) **combustion products** produced by fireplaces and heating systems.

The following describes the most common types of chimneys.

Life Expectancy for chimneys generally can be indefinite as long as regular maintenance is performed. The exception is for metal chimneys that might require replacement after 20-years depending the type of climate.

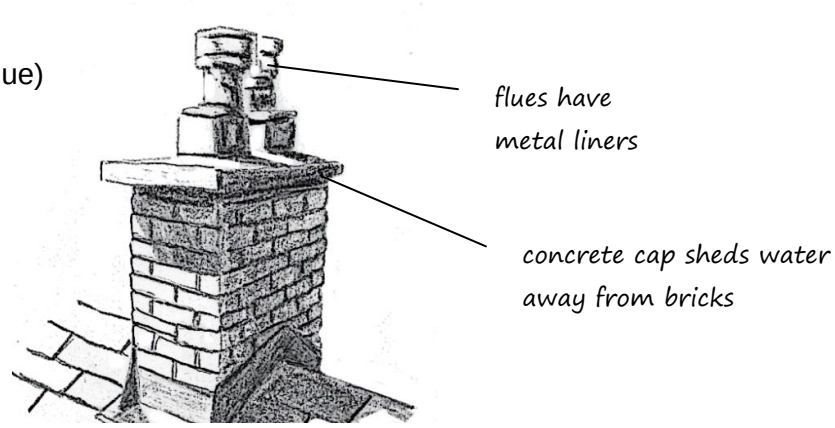
2.3.1 Brick

Brick Chimneys are generally square or rectangular in shape with single or multi flues (openings) that service home heating systems and fireplaces.

Older (circa pre 1960's) brick chimneys were generally built without liners. Depending on the condition of the interior chimney wall a liner may require installation for safety purposes.

Cement (parging) can also be applied to brick chimneys typically for aesthetic purposes and sometimes as a repair.

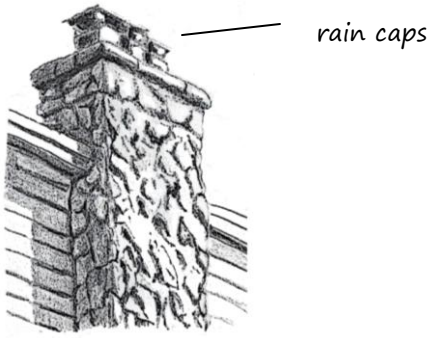
Fig. 2.5 Brick Chimney (double-flue)



2.3.2 Stone

Stone chimneys are generally square or rectangular in shape with single or multi flues (openings). Older brick chimneys were generally built without liners

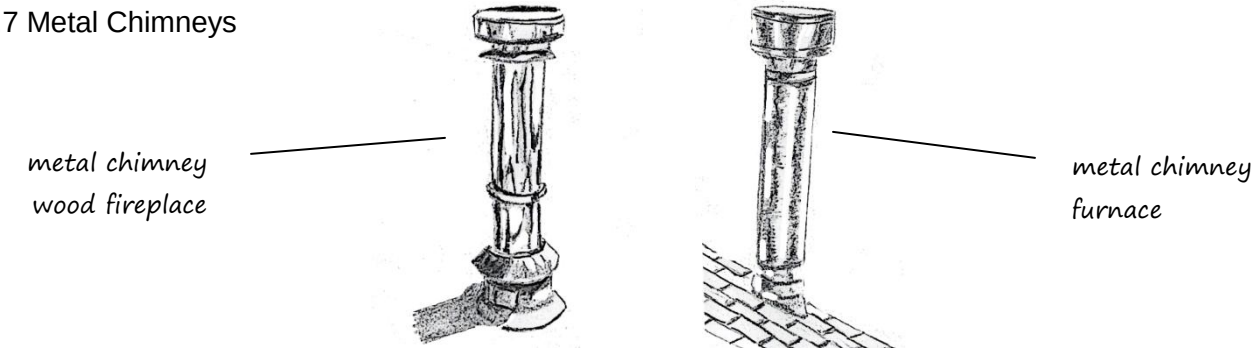
Fig 2.6 Stone Chimney (triple-flue)



2.3.3 Metal

Metal are generally round in shape with a single flue (openings). A metal chimney might also be encased by a wood chase generally for aesthetic purposes.

Fig. 2.7 Metal Chimneys



2.3.4 Masonry Block

Masonry Block are generally square or rectangular in shape with single or multi flues (openings). Older chimneys were generally built without liners.

2.4 LIMITATIONS of Inspecting the Roof Surface and Chimney

Roof surfaces are generally **inspected by**:

- Binoculars from ground
- From eave (ladder is placed along edge)
- Walking on

Generally walking on the roof surface is considered the most effective method to inspect. However this is typically performed at the discretion of the Inspector and safety considerations.

Roof **access/visibility** and therefore accurate analysis might be limited by:

- Height of roof – may restrict visibility or close up analysis
- High Slope -not safe to walk on
- Low Slope – not visible from ground
- Snow/ice cover – surface not visible
- Deck obstructs visibility
- Gravel/Stone finish limits visibility – flat roof systems
- Another building obstructing view or access to surface
- Trees obstructing view or access to surface
- Wet surfaces will be more difficult to inspect
- Fragile surface are not be walked to avoid damage
- Solar panels obstruct visibility

Chimney access/visibility:

- The same limitations apply as listed above

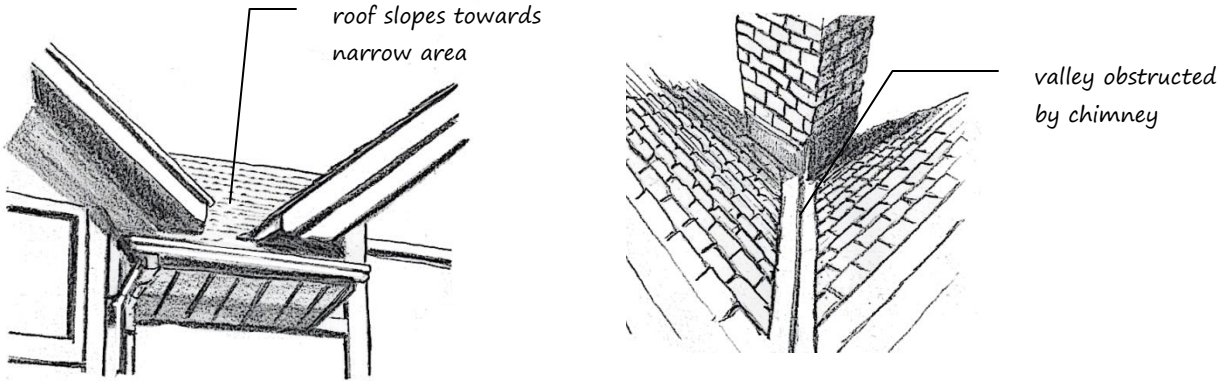
2.5 Recommendations/Observations

The most obvious implication of a failed roof surface is leaking. Water entering the house can damage interior finishes, storage and furnishings. If continuous over the long term leaking can damage the roof structure and contribute to mould which is a health concern.

2.5.1 Vulnerable Areas

A roof surface can be a simple gable shape with some penetrations or comprise of numerous slopes, angles, dormers and chimneys. Generally, as the complexity of the roof increases the vulnerable areas and leaking potential increase.

Fig 2.8



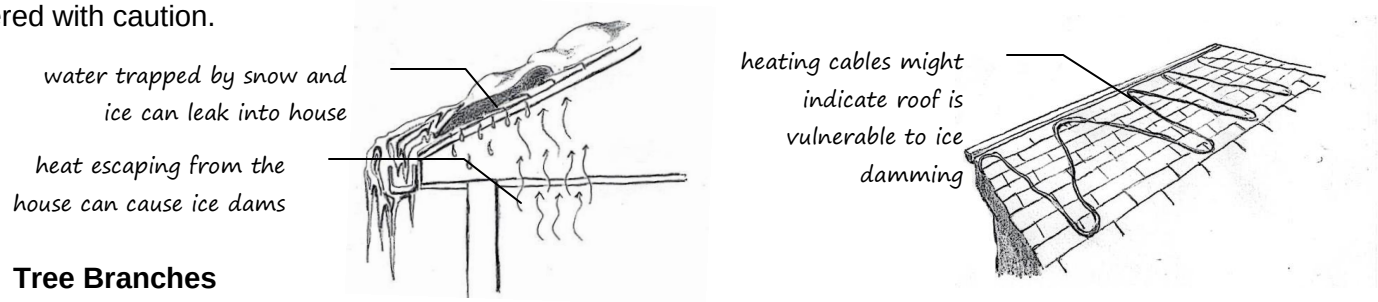
2.5.2 Ice Dams

Ice dams generally occur at the eaves (edge) of roof surfaces. They are caused by a combination of the accumulation of snow/ice and by heat escaping from the house. Ice dams can also occur around flashing details such as chimneys, valleys, dormers and skylights.

It should be understood that ice damming is not necessarily a result of the roof condition but more often caused by inadequate ventilation, lack of vapour barrier and low insulation in the roof space.

The presence of heating cables may indicate ice dam problems. The use of heating cables should be considered with caution.

Fig. 2.9



2.5.3 Tree Branches

The canopy of trees should be monitored for loose or damaged branches and trimmed as required to avoid damage to the roof surface.

Under windy conditions branches may brush up against the roof and damage the surface.

Tree trimming can be expensive and should be performed by an experienced and licensed specialist.

Municipal regulations may govern the proper maintenance of trees.

2.5.4 Sloped Surface

A sloped roof surface typically implies a **slope of 2:12 (17%) and greater**.

Shingles or Tiles are installed on wood sheathing (plywood) decks or wood plank decks.

For older homes that have a wood plank type of roofing deck installing of plywood is typically recommended to adhere to warranty requirements and improve the longevity of the shingles. However this is not usually done due to the extra cost of installation.

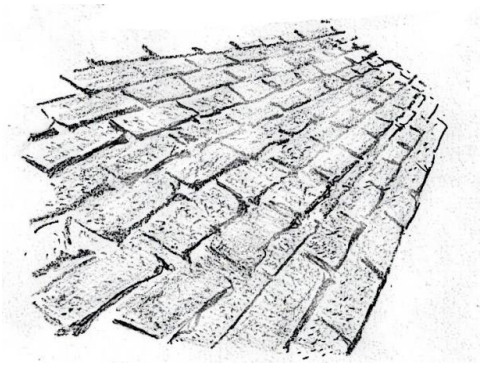
Before the shingles are installed **eave protection** (tar paper typical) three feet from the edge is recommended for the lower sloped roofs and often will be installed over the entire area of roof deck. This will vary depending on local codes.

Installation of a **drip edge** (along edge of the roof) is also considered good building practise though not always present.

Aging shingles will typically have the following appearance

- Cracking surface
- Cupping or curling edges
- Worn granules and exposed felt or mat
- Fasteners (nail heads) exposed
- Areas patched with bitumen or newer looking areas
- Missing tabs

Fig. 2.10



Tiles (clay, fiber cement, etc.) are fastened to wood sheathing (plywood) decks or wood plank decks. They are secured to the roof deck by nailing through factory made holes.

Aging tiles will typically have the following appearance:

- Cracked/broken
- Missing/loose (often due to failing fasteners)
- Moss growth (also due to low sunlight exposure)
- Rust streaks might indicate rusting fasteners
- Worn/'dirty' looking surface

Metal roof surfaces: For metal surfaces **ice guards are required** since ice sheets or snow could suddenly come loose and fall onto areas where someone might be standing. This is a **safety concern** that must be evaluated on a case by case basis.

Heavy tiles: Clay, slate and concrete tiles are heavy. The **structural integrity of the roof** must be evaluated before installation. A sagging roof might indicate undue stress to the roof structure. Often the roof structure is reinforced to accommodate the extra weight. This can only be observed from the roof access hatch.

Wood Shingles and Shakes: Installation of wood shingles is typically by two fasteners for each shingle. Overlapping will depend on the size and quality of the shingle and spaced adequately to allow for expansion. The joints are always staggered. A synthetic mesh 'breather' material might be found on the deck to improve drying potential on the underside of the wood shingle.

2.5.5 Flat Surface

A flat roof surface typically implies a **slope of 2:12 (17%) and less**. However there should always be some sloping for proper drainage. Drainage can be along the roof edge or internally.

Ponding: This refers to water that remains on a flat roof due to poor drainage. Standing water will contribute to aging the surface and makes the roof for prone to leaking. Under extreme conditions the ponding may cause the roof to sag which may accumulate more water. The weight of the water may affect the structure.

Shingles or tiles are not adequate for flat roof surfaces. Various systems have been developed over the years of which the most common was a built-up surface (tar and gravel).

More recently built-up surfaces are now being replaced with a sheet-ply type of systems. Generally it is easier to install and often less costly. Ease of maintenance and repair is also an advantage.

Other installation methods include mopping the roof surface with asphalt or a peel and stick type of system.

Aging flat surfaces will typically have the following appearance:

- Worn/cracking surface
- Loose seams
- Missing/worn gravel (only built-system)
- Exposed tar paper plies (only built-system)
- Blistering (may also be due to poor installation)
- Patched areas

Built-up (tar & gravel): Installation can range from **two to five plies** with **each ply layer coated (mopped) with hot bitumen (tar)** typically heated on site and finally **covered with gravel**. The number of plies is determined by how closely the felt ply overlap each other. Determining the number of plies is not possible without intrusive testing i.e. taking core samples. The bitumen acts as the water resistant material and the aggregate provides ballast protecting the asphalt from ultraviolet deterioration.

Modified Bitumen: Installed in a single-ply or more **preferably two-ply** applications. Typically it comes in rolls that are heated on the underside and rolled on to the roof surface overlapping at the joints. Tar should be visible at the joints to ensure a good seal. The top ply should have a granule (mineral) surface to protect the material from the elements especially ultra violet light from the sun.

Roll Roofing: This is a low quality material that is typically used for flat roofs and sometimes sloped roofs. It is often used for sheds, porch overhangs, detached garages and other non-essential structures. It is commonly used as a flashing material for valleys or as a starter-strip for sloped roofs. It can be mistaken for modified bitumen because it looks similar.

2.5.6 Flashing

The roof surface also includes **flashing details** that provide the **protective seal** around any **roof penetration, angle** or **connection**.

Flashing details are applied to the:

Fig. 2.11

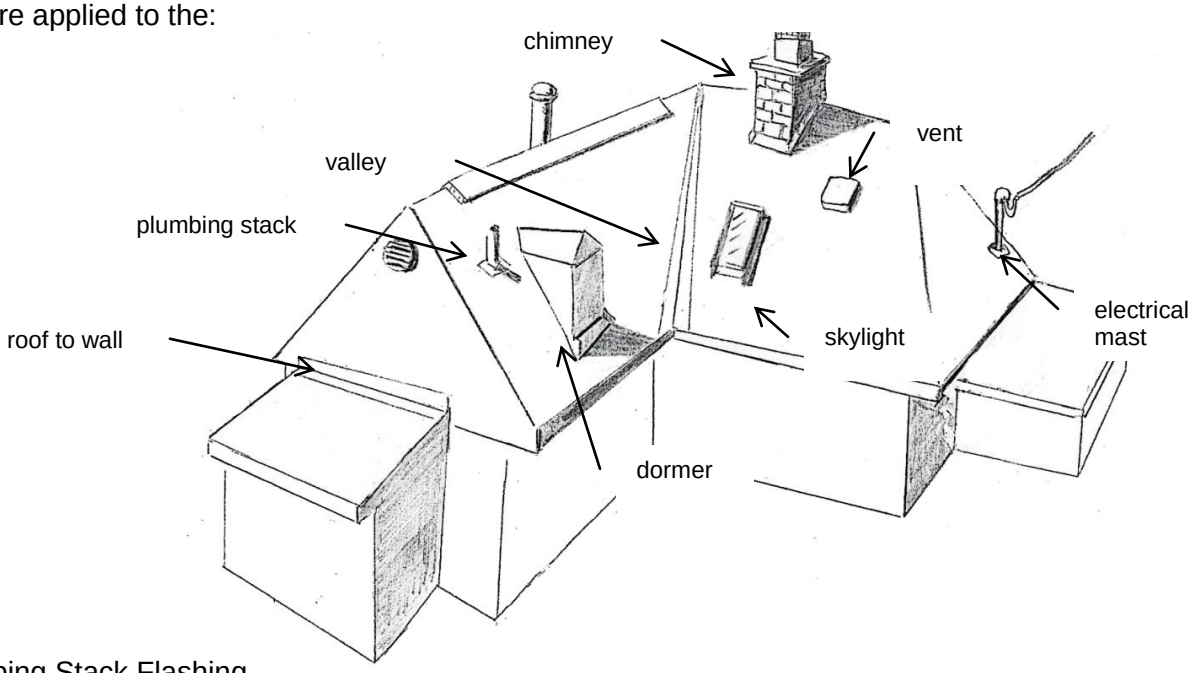


Fig. 2.11.1 Plumbing Stack Flashing

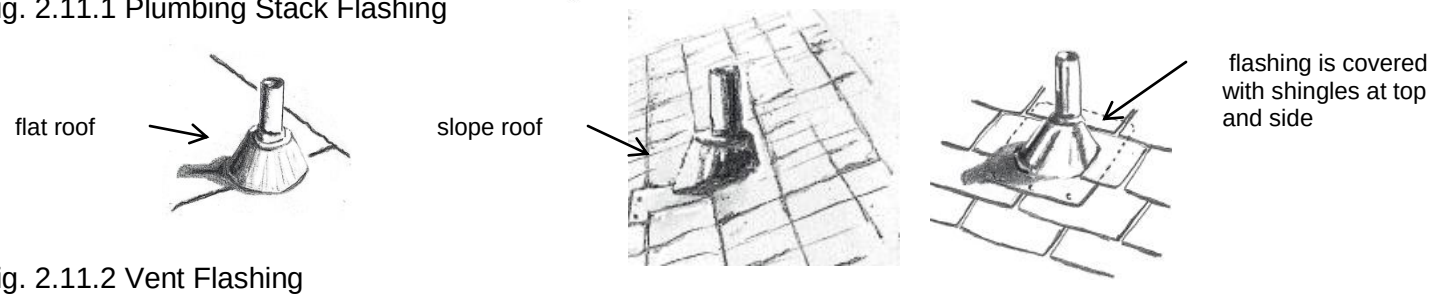


Fig. 2.11.2 Vent Flashing

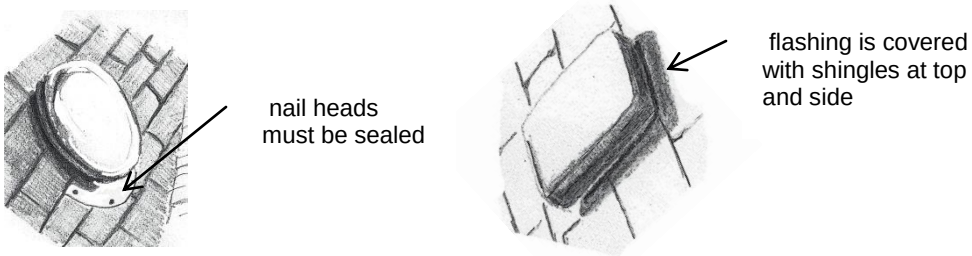


Fig. 2.11.3 Skylight Flashing

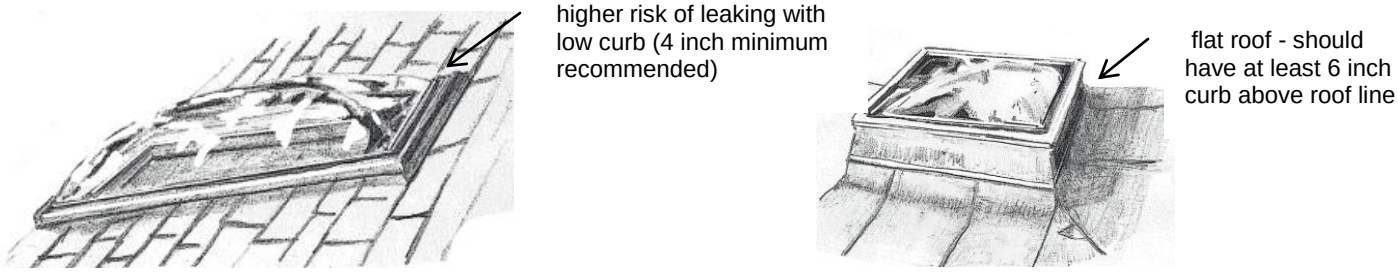
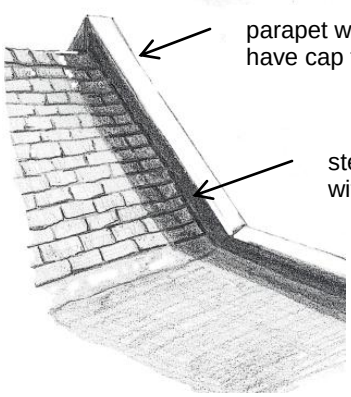


Fig. 2.11.4 Parapet Wall Flashing



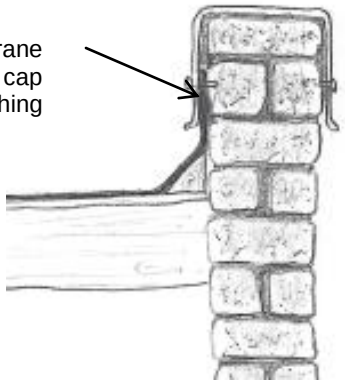
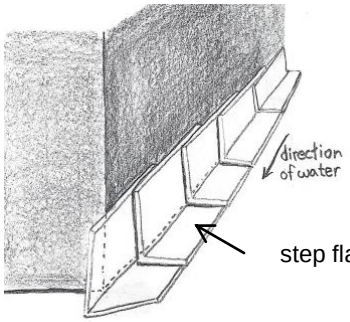
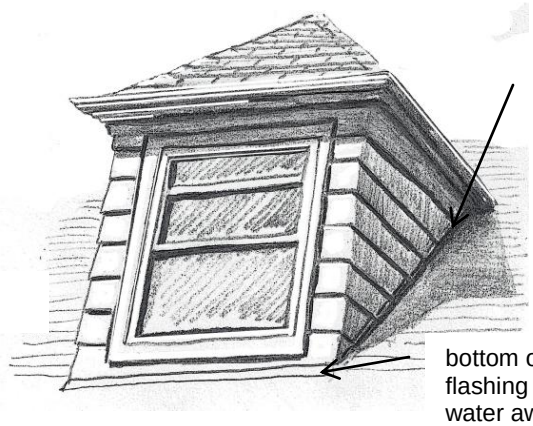


Fig. 2.11.5 Dormer Flashing





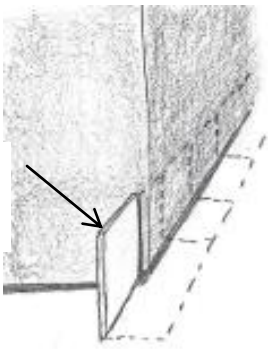
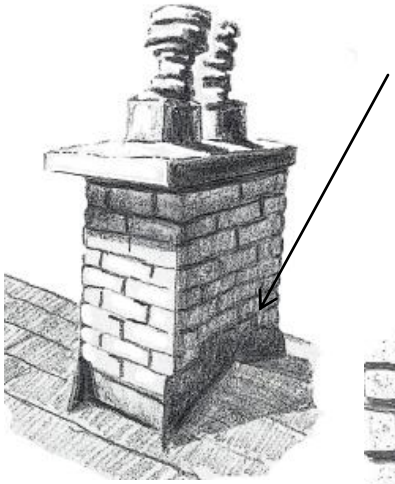
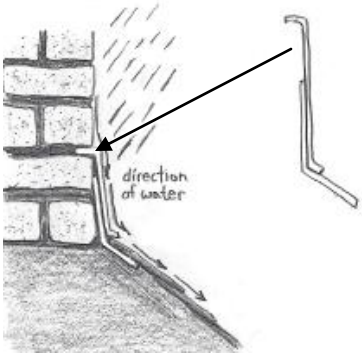
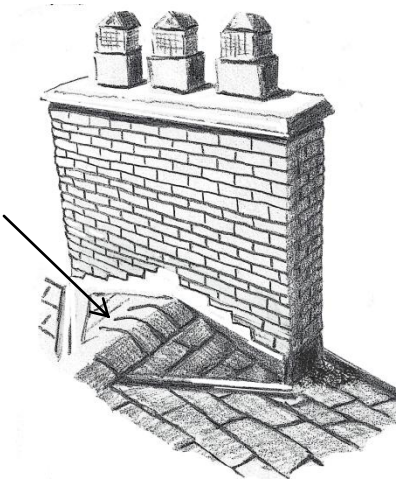
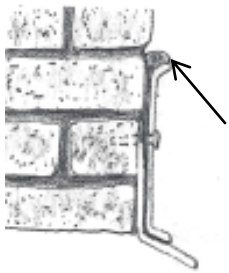


Fig. 2.11.5 Chimney Flashing









2.5.7 Chimney(s)

Various chimney conditions are illustrated below.

Fig. 2.12