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► 7.0 CLAY TILE

Clay tiles have been used since the days of the Greek and Roman empires in Europe, China and the Middle East. Clay roofing tiles are expensive and laborintensive to install, but have an indefinite life expectancy. Clay tiles are like slate in that the fasteners and flashings are more likely to fail than the tiles.

7.1 HOW THEY ARE MADE

Vitrified Clay

Clay tiles are made with fine clays shaped in molds while wet, and then kiln-baked. Temperatures of roughly 2,000°F bring the clay to a point of **vitrification**. This means the chemicals in the clay, such as silicas and aluminas, lose their individual identity and fuse together to form a dense, glass-like, non-porous structure.

Density

The density, which indicates the quality, is determined by the fineness and purity of the clay, and the duration and temperature of the firing process.

Glazing

Some tiles are glazed to create a particular color or effect. Glazed tiles were historically dipped into the glazing to cover the bottom edges and then the glazing was poured over the face of the tile. Since the 1970s, glazing is more typically sprayed on. The backs of the tiles are not glazed. This saves money and allows moisture and efflorescence to escape through the back of the tile.

Porosity And Permeability

Porosity has to do with how much moisture a material will absorb. Permeability has to do with how much moisture will go through it. For example, a sponge is porous and a screen is permeable.

Good clay tiles are both non-porous and impermeable. Low porosity is important in reducing freeze/thaw susceptibility. Clays must be fired to vitrification to become sufficiently non-porous. A manufacturing defect would be failure to vitrify the clay. Low permeability is important in preventing leakage. Glazing is helpful in reducing permeability, but does not affect porosity.

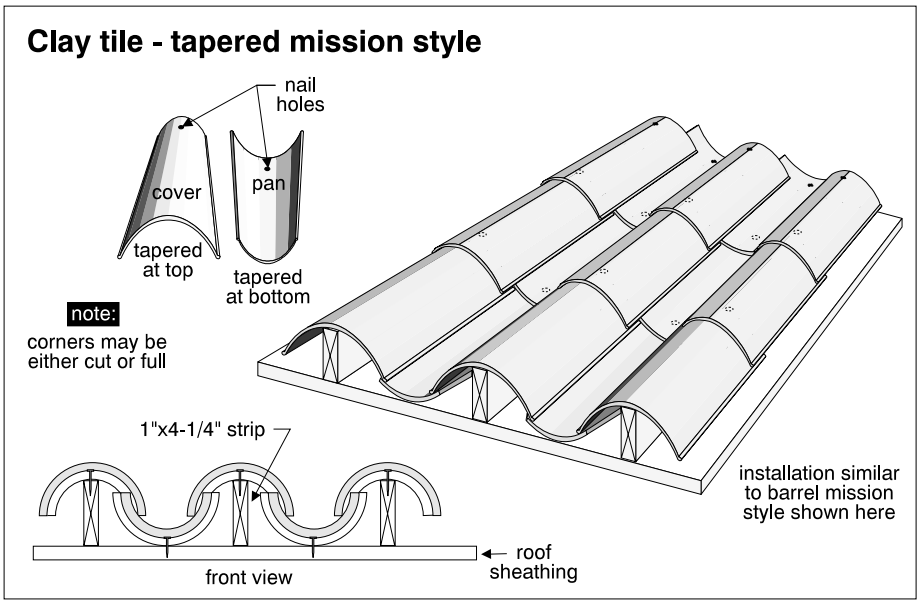
7.2 TILE SHAPES AND INSTALLATION

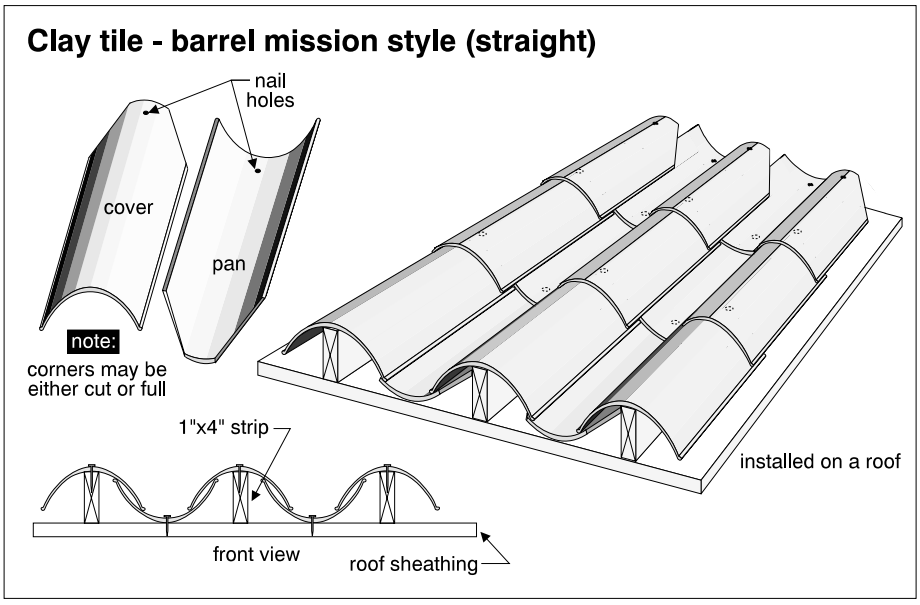
Tile can be many shapes, but can be roughly categorized as flat or curved.

Curved Tiles Mission Tiles

Curved tiles include **Mission** and **Spanish** tile. Mission tile is a two-piece system made up of similarly shaped **pans** and **covers**. The pieces may be tapered from top to bottom. The bottom half is called the **trough**, **pan** or **tegula**. The upper piece is called the **cover**, **cap** or **imbrex**. Mission tile is also known as **barrel** or **two-piece**.

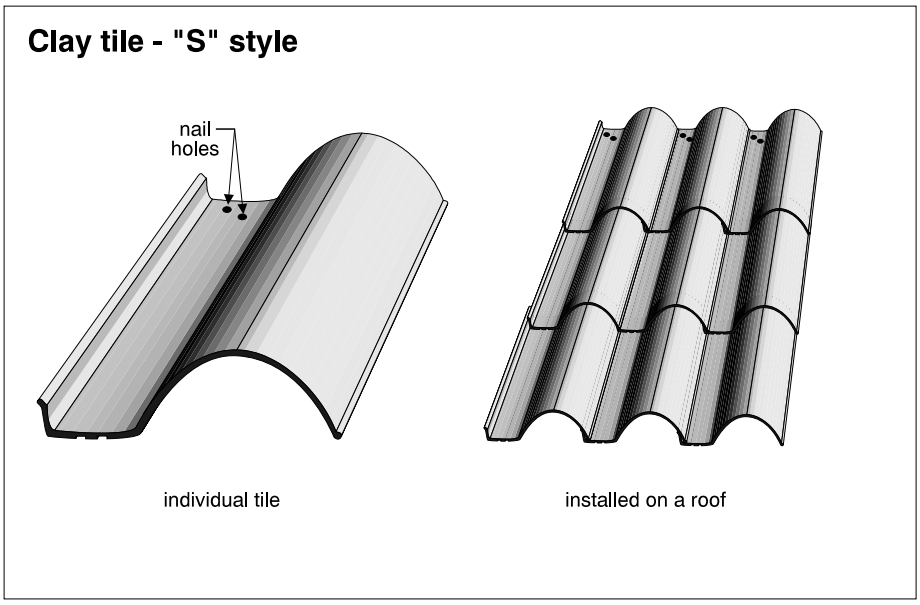
It is understood that early Mission tiles were formed over the thighs of workers, yielding a somewhat irregular, tapered shape. Modern production practices are somewhat less romantic.





Spanish Tile

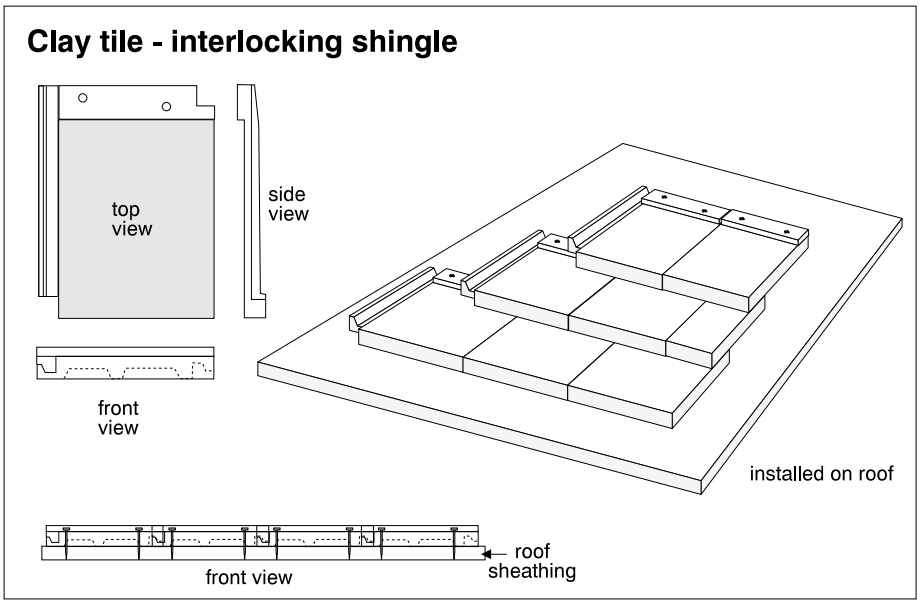
The **Spanish** or **S-shaped** tile is a one-piece system that includes a pan and cover all in each piece, with interlocking sides. Variations of this tile shape include the **Roman** and **Greek** tiles, and the **low-profile** S-shaped tiles.



This shaped tile is commonly imitated by concrete tile. Be careful when looking at them to be sure it's clay before describing it as such.

Flat Tile

The second general category is **flat** tiles. These can be either **shingle** or **interlocking** type. The shingle tiles are installed like slate with double coverage and a 3-inch head lap, typically. Interlocking tiles are installed as essentially a single layer, with a 3- or 4-inch interlocking overlap. The overlap can be even less, depending on the system. Because of its double coverage, the shingle style, will, of course, be a heavier roof system.

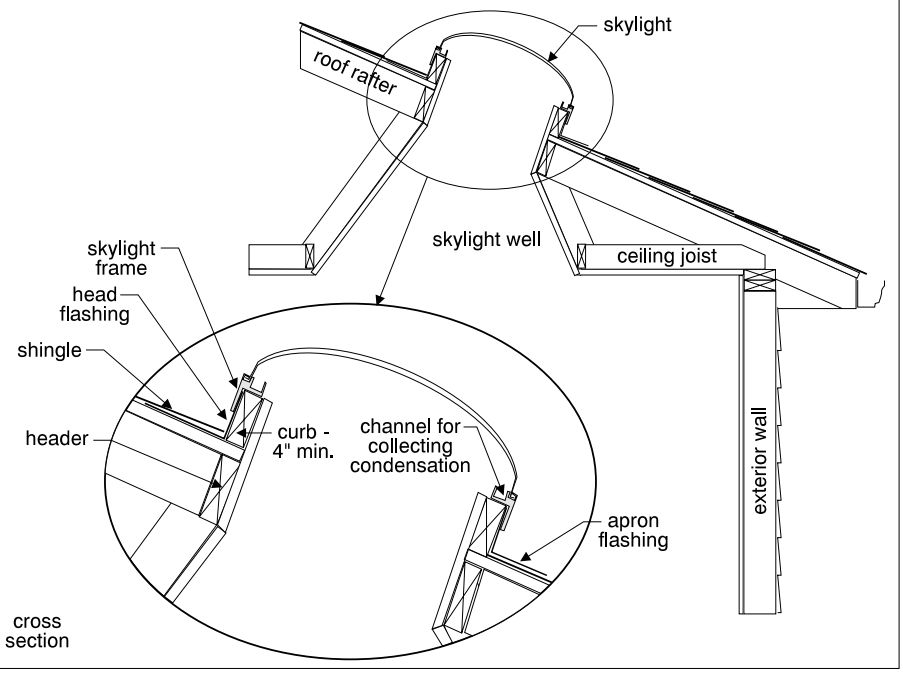


► 9.0 SKYLIGHTS

Skylights are a popular architectural detail. They may be found on flat or steep roofs; they may be single, double or triple glazed; they may have flat or curved glazing; the glazing may be glass or acrylic; the units are typically manufactured, but may also be made on site. They may be installed singly or in groups.

Skylights installed in cathedral ceilings or flat roofs don't usually need **light wells** to get to the ceiling level. Skylights installed on steep roofs often have large wells around the skylight extending down through the attic to the ceiling level. These wells often widen as they get closer to the ceiling to allow better light disbursement.

Skylight in sloped roof - curb mount



Although we're focusing on flashings in this section, we'll talk about a number of skylight issues while we're on the topic. We talk about them in the Interior Module, but since they are so troublesome, it doesn't hurt to address them a couple of times.

Let's look at some of the problems that you might encounter.

9.1 CONDITIONS

Common problems include –

1. leakage
2. rot
3. mechanical damage
4. patching
5. cracked or broken glazing
6. loss of seal on double-glazed units
7. installation problems, including
   a. no curb
   b. low curb
   c. improper or incomplete flashings
   d. wrong application (e.g., a system designed for steep roofing is installed on a flat roof or vice-versa; a system designed for asphalt shingles is installed on a tile roof)
   e. a window is used as a skylight
   f. the skylight is poorly secured to the roof

Implications There are structural implications to rot around skylights, if the rot is progressive. Most of the other implications of skylight problems are damage to interior finishes as a result of leakage.

9.1.1 LEAKAGE

Causes Common causes of leakage include –

1. poor installation
2. low quality skylights
3. mechanical damage
4. cracked glass or acrylic
5. condensate drainage backup

9.1.2 ROT

Cause Rot is usually caused by minor leaks that have not been serious enough to demand attention. Sometimes the water will be trapped within the roof system, keeping the wood damp enough to support rot.

9.1.3 MECHANICAL DAMAGE

Cause Common causes include –

1. animals
2. re-roofing activities
3. snow and ice removal activities
4. overhanging trees

9.1.4 PATCHING

Cause Patching typically indicates efforts to control leaks.

9.1.5 CRACKED OR BROKEN GLAZING

Cause This is commonly a result of –

1. mechanical impact
2. manufacturing defects
3. building settlement or deflection under load
4. thermal stresses (heating/cooling causing excessive expansion/contraction)

9.1.6 LOSS OF SEAL ON DOUBLE-GLAZED UNITS (CONDENSATION)

Cause A loss of seal is caused by a failed gasket at the perimeter of hermetically sealed units.

Strategy It should be understood that on double-glazed skylights, some have sealed glazing where there should be no leakage (in or out) of the air between the two panes. Other skylights are vented, and are intended to have air changes in the space between the glazing units. Most modern skylights are vented, rather than hermetically sealed, and condensation will be only temporary on vented skylights.

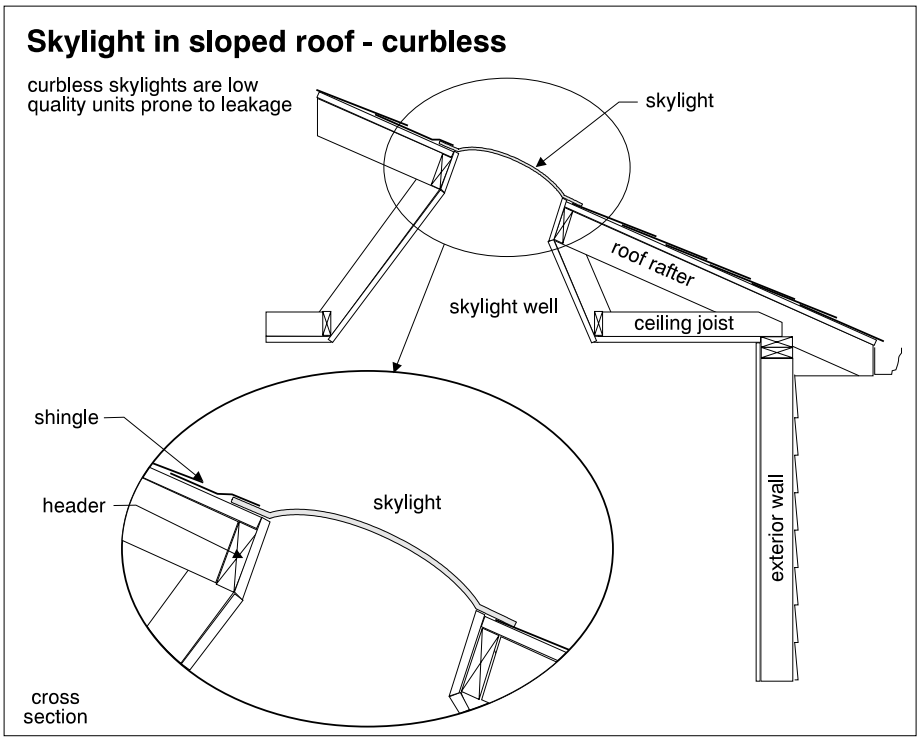
If you see condensation or evidence of it (streaks on the glazing surfaces, for example), you should check to see whether the unit is sealed or vented around the perimeter before describing condensation as a problem.

9.1.7 INSTALLATION PROBLEMS

Cause Installation problems are workmanship issues.

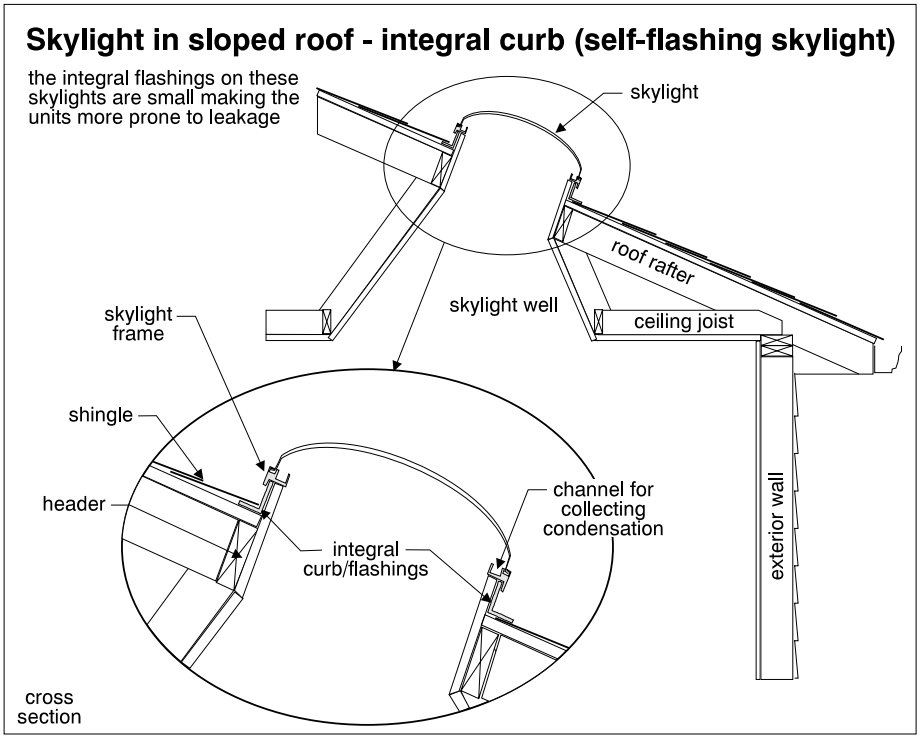
Strategy Skylights are one of the most troublesome roofing details. This is true of skylights on steep roofs and flat roofs. Most problems are associated with poor quality installation, although in some cases, it is a problem associated with the quality of the skylight.

Curbs Look for skylights that are mounted on curbs. These are more likely to be successful than curbless skylights or skylights with integral manufactured curbs. Skylights with integral manufactured curbs usually have very small curbs and very small integral flashings. These skylights are more prone to leakage. Some flush-mounted skylights are particularly prone to leakage.



Think Of Skylights As Short Chimneys

If you imagine that a skylight mounted on a curb is a very short chimney, it's easy to understand how the flashing details can be done correctly. Base and cap flashing strategies can be used and step flashings along the sides are employed. In some cases, a counter flashing is provided; in other cases the skylight curb itself forms the counter flashing.



► 4.0 MODIFIED BITUMEN

Modified bitumens or **polymer modified bitumens** or **mod bit**, as it is frequently called, has been used for both low-sloped (flat) and steep roofing since about 1975. This is an asphalt-based product with additives to enhance its strength and flexibility, and to reduce the tendency of the asphalt to flow at high temperatures.

Rubberized Asphalt

The product is sometimes referred to as **rubberized asphalt** and can be applied in liquid form or in sheets. We will restrict our discussion to the sheet form, which is almost exclusively limited to residential applications.

SBS And APP

There are two types of mod bit roofing. The **APP (Atactic Polypropylene)** modified bitumen is a plasticized asphalt product which has been found to perform better in warmer climates. The **SBS (Styrene Butadiene Styrene)** modified bitumen is often referred to as a rubberized asphalt, which has been found to perform better in cold weather. Both types will be found in both climates. You will typically not be able to identify which of the modified bitumen products you are looking at in the field.

Asphalt Compatible

Modified bitumen products are asphalt compatible. Some of the other single-ply membranes are not.

Reinforcement

Most of the modified bitumen products are reinforced with fiberglass or polyester fabric. The reinforcing can be imbedded in the modified asphalt or laminated to it.

Protection From Ultraviolet Light

Many of the early applications were done with no ultraviolet protection and, in some areas, this is still a common installation technique. It has become more common recently to provide ultraviolet protection in the form of –

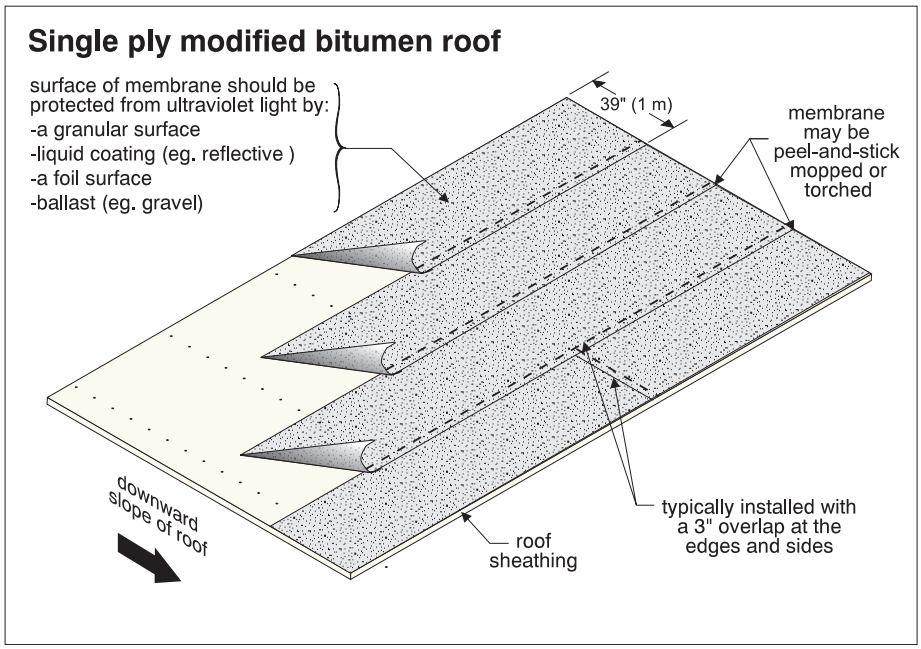
1. a granular surface (like the one on asphalt shingles)
2. liquid applied latex coatings (e.g., latex, or reflective asphalt)
3. foil surfaces (typically aluminum or copper)
4. ballasted (not common residentially)

Many people believe that the ultraviolet protection helps to extend the life of the membrane. The protective materials, in some cases, may also help to protect against high heat and mechanical damage. Incidentally, surface temperatures of uncoated modified bitumens (which are black) can be approximately 170°F when outdoor temperatures are 91°F! It's not unusual to have the surface temperature of uncoated modified bitumens be roughly 70°F warmer than the ambient temperature.

Installation Method

The three common installation methods are –

1. torched-on (sometimes called heat welding)
2. mopped-in with hot asphalt
3. peel and stick



Torching

The SBS mod bits can be applied with any of the three methods. The APP mod bit is most commonly torched in. Materials intended to be torched in typically have a thin polyethylene sheeting on the back of the roll to prevent the material from sticking to itself. This polyethylene film is burned off with the torch when applying.

Mopping

Peel And Stick

Material intended to be mopped in has a sand backing that prevents the material from sticking to itself in the roll. The peel and stick product has a removable plastic film that exposes the adhesive on the back of the material.

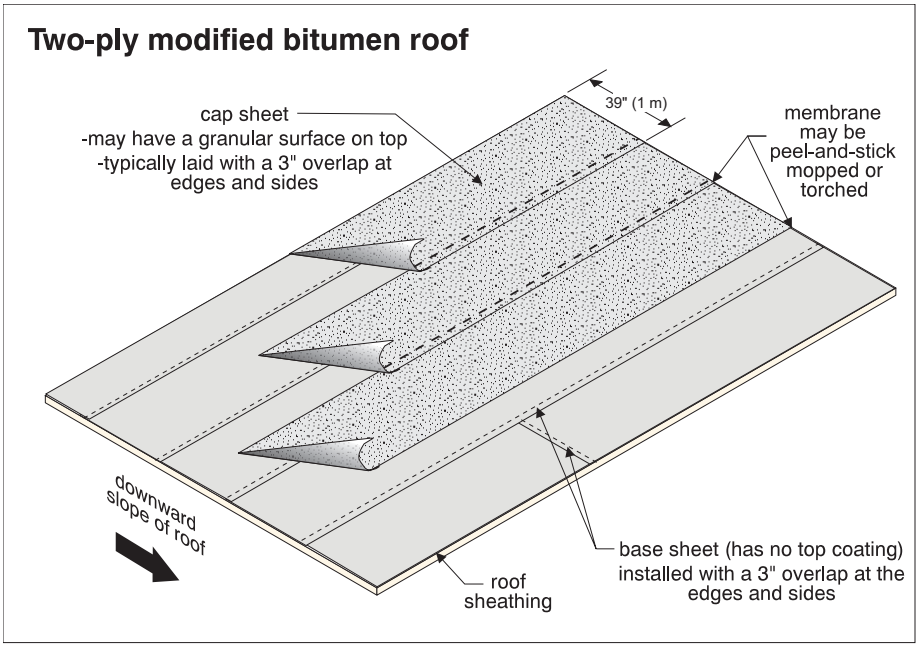
Securing The Membrane

The roofing membrane is typically fully adhered to the roof deck. It is common to use a base sheet, 2 layers of felt paper, rigid insulation or a separation board when torching or mopping, to reduce the risk of fire.

Although it's not common to find a ballasted system held down with loose rock or pavers in houses, these installations have no adhering of the membrane to the substrate.

Number Of Plies

Mod bits may be installed as a single-ply system although higher quality installations are two-ply. Occasionally, a single-ply mod bit sheet will be laid over two or three plies of felts impregnated with asphalt. This, however, is rare.



Base And Cap Sheet

In a two-ply application, it's common to have a base sheet that has no coating on the top surface, and a cap sheet that may have a granular surface on the top.

Thickness

The material thickness ranges from roughly 2mm to 5mm (40 to 160 mils). When applied as a single-ply, the material is usually 3mm to 4mm. The rolls are typically

Roll Size

39 inches (1 meter) wide and 25 to 50 feet long. Many manufacturers recommend that the sheets be cut into lengths of 15 to 25 feet and allowed to lay flat and relax before they are installed.

Seams

Seams may be torched together or mopped together with hot asphalt. If the membrane is torched to the substrate, the seams are usually torched. If the sheets are mopped to the substrate, the seams are typically mopped. There is usually a 3-inch overlap at the sides and ends.

Flashing Materials

The flashing material is most often the modified bitumen material itself.

4.1 CONDITIONS

Problems to watch for on mod bit roofs include –

1. old/worn out
2. openings at seams and flashings
3. surface cracking
4. loss of granules
5. slippage of the membrane
6. blisters
7. punctures or tears