

## Low-slope roofs

The term *flat roofs* is a little misleading in that they are really not flat. They have a very low slope and may look flat to the naked eye. Low-slope roofs typically have a minimum slope of one-fourth inch vertical to twelve inch horizontal ( $\frac{1}{4}$ :12 or 2 percent) depending on the roofing material. Roofs are considered low-slope roofs up to 3:12 pitch.

Low-slope roofs traditionally have been constructed with an asphalt built-up roof covering. This system is a series of multiple layers of asphalt-impregnated sheets of felt paper and hot asphalt. Most built-up roof systems are comprised of three layers of felt and asphalt. The top of the roof system is then covered with a gravel surface to protect the asphalt from ultraviolet (UV) rays of the sun. The UV rays degrade the oils in the asphalt and reduce the effectiveness of the roof system. Built-up roofs are required to be a minimum of one-fourth-inch-per-twelve-inch slope. When coal tar pitch is used in a built-up roof, the roof slope is permitted to be reduced to one-eighth inch per foot. The materials in these systems must comply with several ASTM standards.



FIGURE 13-9 Low-slope roof flashing

Different materials have been introduced into the market for low-slope roofing. All of these systems must be installed in accordance with the manufacturer's installation instructions. Most of these materials are single-ply systems, which means that there is only one layer of membrane material applied as opposed to a built-up roof or multiple-ply system. Modified Bitumen roof coverings are one or more layers of polymer-modified asphalt sheets. These systems can be either fully adhered to the roof sheathing or mechanically fastened. In some cases, these systems are held in place by a ballast of large stones or paver systems. The ballast resists uplift of the membrane from wind passing over the top of the roof and creating a negative pressure on the system (Figure 13-10).



FIGURE 13-10 Ballasted single-ply roof system

Two other single-ply roofing membranes are Thermoset and Thermoplastic single-ply roofing systems. Thermoset single-ply roofing is a synthetic rubber sheet that is adhered together with contact adhesive or tape. These systems can be adhered, mechanically fastened, or held down with a ballast. They are sometimes referred to as *EPDM roofing* (see Figure 13-11). Thermoplastic single-ply roofing systems are plastic sheets (PVC, TPO, CSPE) that are welded together with hot air. This creates a shingle sheet that provides the weather protection for the building. Both the Thermoset and the Thermoplastic must be installed at a minimum one-fourth-inch-per-twelve-inch slope.

## Steep roofs

Roofs with a greater than 3:12 slope or pitch are considered to be steep roofs. Common materials used in steep roofing include asphalt shingles, wood shakes or shingles, and clay or concrete tiles. The IBC provides prescriptive installation requirements for these three systems as well as metal roof panels and shingles. In all of these roof systems, there are five important components: decking/sheathing, underlayment, membrane, fastening, and flashing. Underlayment is one or more layers of asphalt-impregnated felt, sheathing paper, or nonbituminous saturated felt. It is applied over the decking material prior to the installation of a roof membrane. The code outlines the installation requirements for each of these components depending on the type of system being installed.



FIGURE 13-11 Thermoset single-ply adhered roof

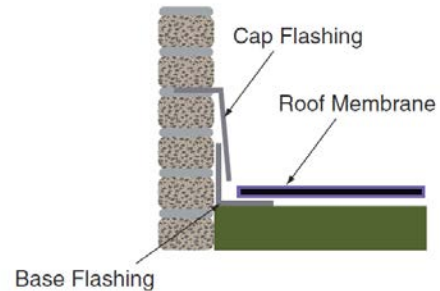
## Asphalt shingles

Asphalt shingles must be installed on solidly sheathed decking. This is typically plywood or some other type of structural sheathing. The shingles must be installed on slopes of two inches per twelve inches or greater. However, if they are installed on roofs with a slope between 2:12 and 4:12, two layers of underlayment are required. The double layer of underlayment must be overlapped a minimum of nineteen inches and fastened to roof sufficiently to hold it in place before the shingles are installed. The single-layer underlayment is required to be lapped a minimum of two inches. In areas of the country where there has been a history of ice-damming along the eaves, additional layers of an ice barrier must be installed along the eave of the roof extending up the roof to a point twenty-four inches inside the exterior wall line of the building.

Flashing is required to be installed along the roof and wall intersections, in valleys, and along the drip edge of the roof. Base flashing is the L-shaped flashing that is attached to the roof itself. It

extends under the roofing membrane with the other leg then extending up the adjacent wall. A cap flashing is then installed over the base flashing (see Figure 3-12). If siding is used, the base flashing is extended up behind the siding and a cap flashing is not installed. Valley flashing is installed where two different roof slopes come together and form a “valley” down the roof. Asphalt shingles have two different types of valleys, closed and open. The code provides specific requirements on how these valleys must be flashed. Drip-edge flashing is provided at the edges of the eaves and gables of asphalt shingle roofs.

The shingles must be fastened to the decking with galvanized, stainless steel, aluminum, or copper roofing nails. They must penetrate through the shingles and a minimum of three-fourths inch into the roof sheathing, or through it if it less than three-fourths-inch thick. A minimum of four nails or the minimum number of fasteners required by the manufacturer must be provided per strip of shingles. In areas with high winds, additional nailing may be required. The asphalt shingles must also comply with specific ASTM standards in high wind areas.



**FIGURE 13-12** Cross section of base and cap flashing

### Clay and concrete tiles

Clay and concrete tiles can be installed over solid sheathing or spaced structural sheathing boards (see Figure 13-13). The minimum slope allowed for tiles is 2½:12. A double underlayment must be provided when the slope is between 2½:12 inches and 4:12. Tile roofs that are steeper than 4:12 only require one layer of underlayment. The underlayment must be a Type II asphalt felt or Class M mineral-surfaced roll roofing.

The ice barrier noted earlier is also required for tile roofs when ice damming is a possibility.

The tile must comply with two ASTM standards. Clay tile must comply with ASTM Standard C1167, and concrete tile must comply with ASTM Standard C1492. Both must be fastened to the roof decking in accordance with IBC Table 1507.3.7, which outlines the fasteners required for each type of roofing tile based on the wind speed, height of the roof, and slope of the roof.



**FIGURE 13-13** Clay tile roof system

The fasteners must be corrosion resistant and penetrate the decking a minimum of three-fourths inch or through the deck if it is less than three-fourths-inch thick.

The roof tile must be installed in accordance with the manufacturer's installation requirements based on the climatic conditions, roof slope, underlayment system, and type of tile. Flashing must be installed at the juncture of the roof and wall surfaces, valleys, and penetrations through the roofing material.

The exterior envelope is the first line of protection for the building from the elements and moisture. Water that is allowed to enter wall and roof cavities can create serious damage to the building and its contents. It is important that exterior wall and roof systems be installed in accordance with the code requirements and the installation instructions from the roof system manufacturer. The proper installation of these systems will protect the building for many years to come.