Valleys for optimum weather protection

Coordinating valley type with the demands of particular roof assemblies

by **Jim Carlson**

Not all valley constructions perform the same, and each has a niche where it is best suited to provide trouble-free, long-term performance.

Background

Typically, not much thought is devoted to designing and constructing valleys for asphalt shingle roof assemblies. And occasionally, the result is a troublesome valley: It leaks, collects leaves and debris, supports moss growth or does not perform as well as the surrounding field of the roof.

With many asphalt shingle roofing projects, the designer specifies the type of shingles desired for the roof's aesthetics, the contractor provides the specified material, and the roofing tradesperson installs the shingles. Many times, the worker ends up acting as the de facto designer of the valley as he builds it. And many roof mechanics build the type of valley with which they are most familiar or the one that can be assembled most quickly. Unfortunately, the designer or contractor often does not confer with the shingle foreman to consider what type of valley is best suited for the project.

Valleys can be designed and built to provide excellent performance with most shingle types in various climates. With the numerous types of shingles and flashing materials available today, and with the knowledge and experience that has been gained as asphalt shingle roofing technology has evolved, roofing professionals can decide which valley type will best serve a particular project's roof system.

Three valley types

There are three industry-accepted valley types commonly used with asphalt shingle roof assemblies: open (see Figures 1 and 2), closed or woven (see Figure 3) and closed-cut (see Figure 4). Variations can be made to each type to make them perform better under certain conditions.

Design criteria

It is not difficult to build successfully performing valleys on most asphalt shingle roofing projects—if the designer considers the relevant design criteria. He also should work with a knowledgeable contractor during the design phase to make decisions based on the overriding criteria. If the roof is suitable for asphalt shingles to act as the watershedding primary roof covering, then, often, a specific type of valley construction will perform best.

First, designers and contractors deciding on the best valley type should know the design criteria relevant to the project. Then, the valley should be designed according to the conditions. Among the most important design criteria for valley selection are:

- Climate.
- Adjacent roof area slopes and the resultant slope of the valley.
- The building's and roof system's desired life expectancies.
- Weather exposure and orientation of the valley.
- Surrounding trees and foliage that will (or could) deposit leaves, needles or organic debris into the valley.
- The level of impact and traffic resistance needed.

Each of these criterion should be considered, as well as what valley flashing materials are best suited for the project. The following further explains the design criteria:

1. *Climate.* The climate to which the roof system will be exposed over the duration of its life should be the designer's first major consideration. If the climate is cold and harsh, where ice may dam the valley during freeze/thaw cycling each winter, then more conservative flashings are needed. (A valley with a more open throat [i.e., the portion that carries the runoff] generally would be more successful.)

In other words, an open-valley design that provides for more free-flowing runoff typically will perform better (in a cold, harsh climate) than a closed valley. At most slopes, closed valleys do not drain as readily as open valleys because the cutouts between individual woven shingles impede drainage as the tab cutouts laterally intersect the valley's center.

In climates where heavy rainfall occurs in relatively short time frames, open valleys can be good performers. On the other hand, in moderately wet climates (i.e., where rainfall occurs regularly but not heavily in short time periods), closed-cut valleys work well.

Closed or woven valleys can be good performers in hot climates where sun loads quickly oxidize, age and deteriorate asphalt-based roofing materials. The closed or woven valley contains many layers of overlapping material that provide for substantial buildup and redundancy.

2. *Actual valley slope.* Roofing professionals need to remember that a valley's actual slope is less than the slope of the intersecting roof areas. For example, if two roof areas with slopes of 4-in-12 (33 percent) intersect at a valley, the resultant slope of that valley will be about 3-in-12 (25 percent).

Slope is essential to any watershedding roofing material's leak-free performance, but actual valley slope should be considered, as well, to ensure the roof system's overall success.

When considering materials and flashing dimensions for a valley on a marginally low-sloped asphalt shingle roof assembly (e.g., 2.75-in-12 [23 percent]), determining the actual valley slope and designing the valley and valley flashings accordingly can be critical to performance. Often, the valley should be designed to include a membrane liner and conservative flashing materials, along with extensive flashing material widths and termination dimensions.

3. *The building's and roof assembly's life expectancies.* Just as it is important to consider life expectancies when selecting the type of primary roofing material, it also is imperative when selecting the type of valley and valley materials to use. The overall valley design should be consistent with the life expectancy and performance desired from the field of the roof.

4. *Weather exposure and orientation of the valley.* When deciding which type of valley to use, it is important to consider its location and orientation on the roof, as well as what flashing materials to select. When a

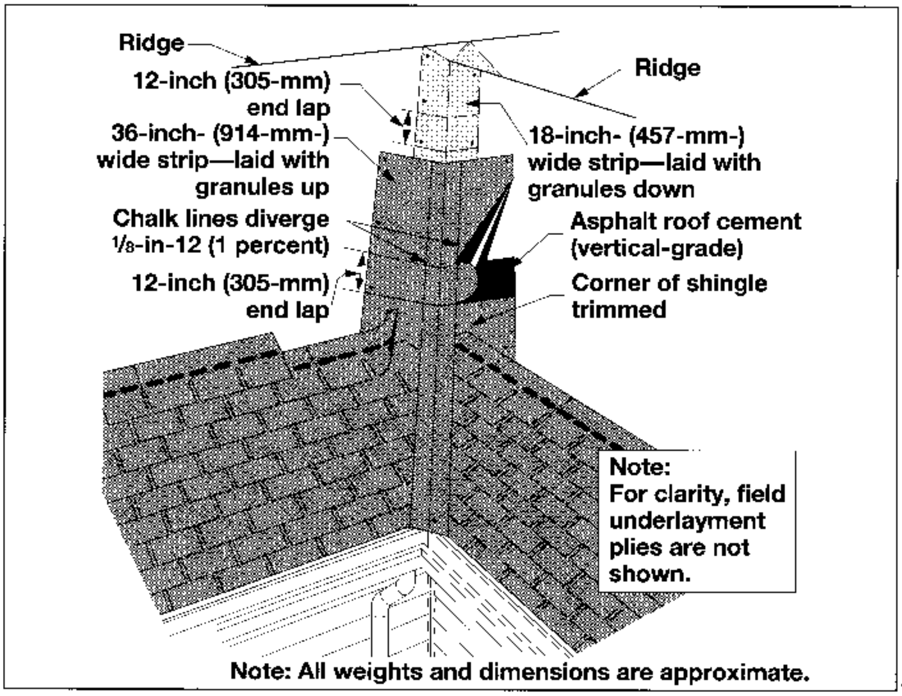


Figure 1: *Open-valley construction with roll roofing as valley material.*

valley is oriented so that it opens directly into prevailing wind and weather, it is more vulnerable to water migration (i.e., lateral water movement between shingle courses) and leakage during wind-driven rain.

Also, valleys located on the sunny side of roof areas should be designed for the anticipated accelerated heat aging of materials, as well as the weathering that results from direct exposure to ultraviolet radiation.

In damp climates, valleys located in shady areas are more prone to moss growth. Moss between shingle tab cutouts (such as in a woven or closed-cut valley) hampers drainage and promotes water migration between shingles. When flashings are not designed to account for the conditions, leaks often result.

5. *Surrounding trees and foliage.* Roof areas surrounded by trees and foliage that deposit leaves, needles or other organic debris in valleys require additional design consideration. Leaf stems and seed pods from foliage fallout are caught easily in the shingle tab cutouts present in woven and closed-cut valleys. As a result, drainage is hampered. However, all valleys on lower-sloped roofs (e.g., slopes of 3-in-12 [25 percent]) can accumulate piles of organic debris. If sweeping and clearing the roof and valleys of debris cannot be performed regularly, then the valleys should be designed conservatively.

Membrane valley liners or flashing sheets (similar to ice-dam protection membranes) should be incorporated into valleys expected to accumulate organic debris. This way, if water backs up in a valley and migrates between shingle courses, it does not leak through the roof system into the interior. Additionally, underlying flashing materials help shed water from within the valley—just as wider valley sides or metal flanges assist valley performance where drainage may be slowed or where large quantities of water must be carried.

6. *Impact and traffic resistance.* Roof traffic and the potential for impact on the valleys should be considered. Two-layer-thick open valleys made of lightweight roll roofing are not traffic- or abuse-resistant. Light-gauge metal valleys also are not intended to accommodate maintenance traffic. On the other hand, closed or woven valleys consisting of one layer of underlying roll roofing

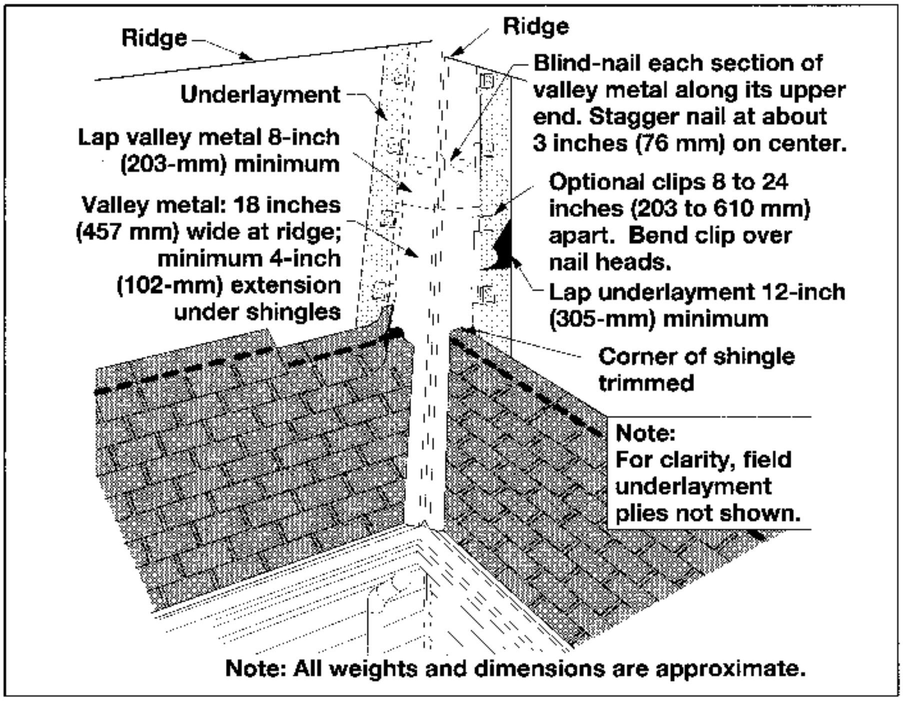


Figure 2: *Typical open valley using metal valley flashing.*

and four layers of shingles woven through the valley are durable and can handle occasional maintenance traffic.

If the roof system is moderately sloped (i.e., 5-in-12 to 8-in-12 [42 to 67 percent]), surrounded by foliage that regularly deposits debris on it (this necessitates frequent maintenance) or is walkable, then the valleys can be problematic if not designed conservatively. Valleys of such moderately sloped roofs often become traffic paths for maintenance workers because they have less slope than the adjacent field of the roof. Therefore, for optimum longevity, valleys should be constructed of durable materials to yield performance commensurate with the type of asphalt shingles used.

Following is a general description of the three common valley types along with the author's opinions regarding their performance attributes. Hands-on tips for improving design and installation also are included.

Open valleys

The type of valley depicted in Figures 1 and 2 is referred to as "open" because its center, or throat, is open to view and exposed to weather. There are two basic open-valley styles used with asphalt shingles.

Until a few years ago, the open-valley style most widely used in the United States was similar to the one shown in Figure 1; this valley historically has been lined with two layers of granule-surfaced roll roofing. However, as polymer-modified, asphalt-roll-good materials have become more available during the past decade, the choices of roll goods for valley liners are changing (this will be discussed further).

The other open-valley style, which currently is popular in many areas of the United States, uses sheet metal to line the valley (see Figure 2).

Following are performance attributes of open valleys:

1. *Drainage.* The open valley is a good choice for regions that experience frequent, heavy rains and accumulate large quantities of water over relatively short time periods. Because the open valley's throat does not have shingle-tab cutouts extending laterally across the valley center line (as do closed or closed-cut valleys), the valley is rapid-draining and not as prone to holding leaves and debris. Essentially, the smoother the valley surface, the more rapid the runoff can exit downslope.

If the valley is designed correctly, so the width of the opening increases as the valley continues downslope, the open valley also can perform well in climates that experience regular snow and ice conditions. Such valleys can free themselves of lodged snow and ice, which may slide downslope as temperatures warm. It is recommended that the open valley's throat widen a minimum of ⅛ of an inch (1 percent) per lineal foot (0.3 m).

2. *Durability.* Unfortunately, open valleys constructed of modern, lightweight roll roofing or relatively thin-gauge (e.g., 26-gauge [0.45-mm]) valley metal are not extremely durable. Particularly with lower-sloped roofs, where valleys may be subject to traffic, and on roof systems using higher-quality shingles, the author recommends that open valleys be constructed of materials that are of conservative strength.

In some areas of the United States, a majority of asphalt shingle manufacturers no longer produce heavyweight roll roofing. In its place, lighter-weight, glass-fiber-reinforced roll roofing is offered for lining open valleys. And unless the designer specifies the more durable products, lighter-weight, somewhat less durable roll roofing is what the distributor usually offers the contractor.

Therefore, some of the products, such as No. 72 granule-surfaced cap sheets, sometimes are used incorrectly as valley materials. Such cap sheets are intended to be set in hot asphalt or solvent-based asphalt adhesive as part of built-up roof systems; most are not waterproof without a layer of asphalt under them, so they should not be used for open-valley material when installed dry. Instead, the 83-pound, granule-surfaced, glass-fiber-reinforced cap sheets are offered as valley material. They are more durable, but some reports indicate that, under foot traffic, they are not as tough as heavier-weight, organic roll roofing (typically referred to in the past as 90-pound).

Granule-surfaced, polymer-modified asphalt sheets can be good valley material. Both APP and SBS polymer-modified asphalt, granule-surfaced roll goods are being used successfully as valley materials. The only problem is obtaining granule colors that match or resemble the granule color of the shingles that the designer or owner wants.

A similar durability concern exists with open valleys constructed with metal. The roof system's location and proximity to surrounding foliage should be considered along with other relevant factors, such as climate, roof slope and weather orientation. If the open valleys will collect debris, need to be swept out regularly and have to withstand foot traffic during maintenance, then relatively heavy-gauge sheet metal, such as 24-gauge (0.61-mm), galvanized or other coated, prepainted steel—or a metal of comparable longevity—should be used as the valley metal.

3. *Valley flange width.* The flanges on either side of the valley metal center line should be of sufficient dimensions to carry runoff that may migrate under the overlying shingles' tabs. It is the author's opinion that valley metal used in most climates, on roofs with 4-in-12 to 10-in-12 (33 to 83 percent) slopes, should be about 24 inches (610 mm) wide. Twenty-four-inch- (610-mm-) wide valley metal allows for at least a 10-inch (254-mm) flange dimension on either side of the valley center line. A 10-inch (254-mm) flange allows for 4 to 6 inches (102 to 153 mm) of shingle overlap onto the flange and still provides 4 to 6 inches (102 to 153 mm) of open flange on either side of the valley center line for clear drainage.

Roofs with slopes greater than 10-in-12 (83 percent), in most U.S. climatic regions, usually can be successful with narrower-width valley metal. However, roofs with slopes less than 4-in-12 (33 percent) often need additional membrane waterproofing

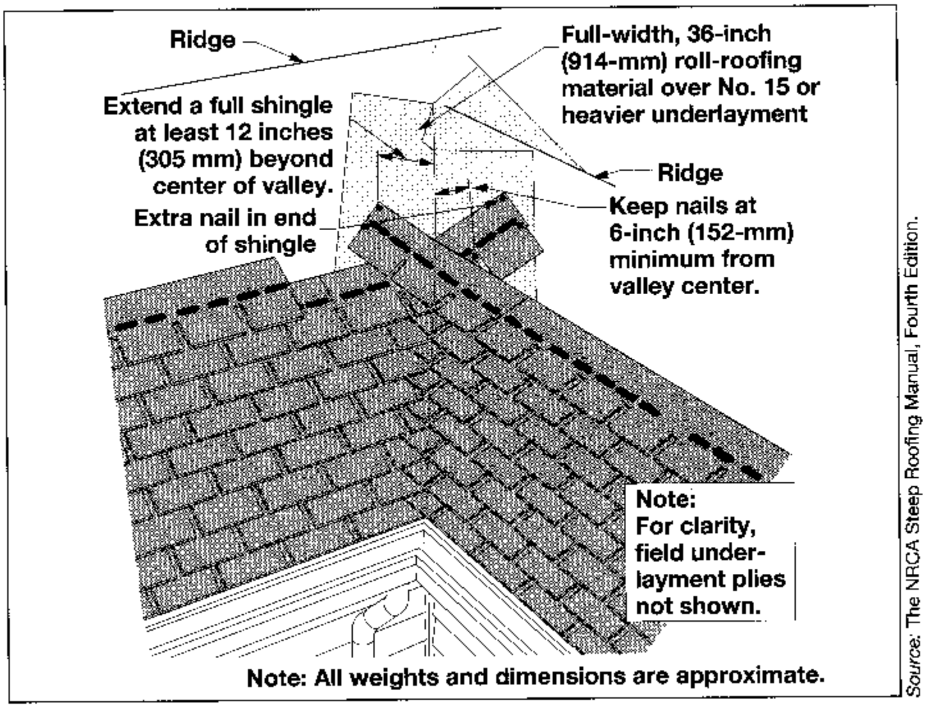


Figure 3: *Woven or closed valley.*

along the outsides of the valley flanges to perform well over time. This particularly applies if the valley is oriented into the prevailing wind and weather or is located under trees or heavy foliage.

4. *Attachment.* Valley materials should not be nailed close to the center of the valley. Roof mechanics should keep nails a minimum of 6 inches (153 mm) away from the valley center line. (The author prefers not to nail valley material closer than 8 inches [203 mm].) Especially on lower slopes, fasteners should be kept back from valley centers.

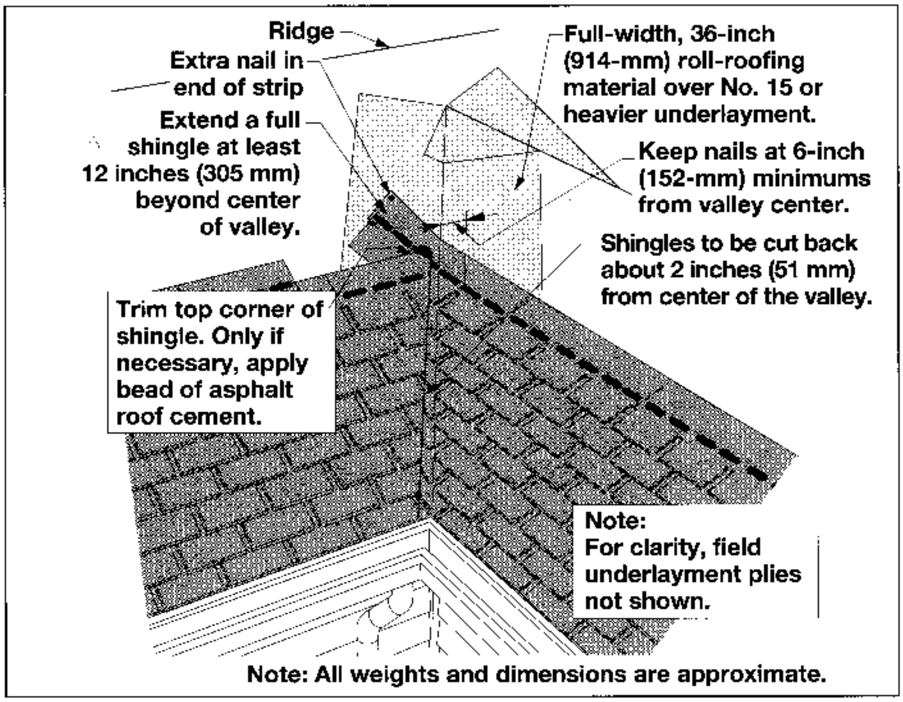
However, sufficient attachment of valley materials is important. Besides intermittently securing the materials' sides, the upslope end of each overlapped, downslope section should be stagger-fastened.

5. *Adhesion of shingles.* With most valley constructions, it usually is not a good idea to adhere shingle tabs to the sides or flanges of the valleys. There are design specifications that call for fully adhering tabs with asphalt roof cement, and there are regional practices where this is done. But in most climates, the adhered tabs simply create a dam in the valley.

Experience has proved that adhering shingles to valley material can be problematic. If water migrates into a shingle roof system and runs between courses, it should be able to run out again. If shingles are fully adhered onto the valley metal flange (creating a dam), then leakage can occur during times of hard, wind-driven rain.

A small dab of vertical-grade roof cement, applied under shingle tab corners, can help the factory-applied, self-sealing strip keep the tabs from lifting and flapping in the wind. But the author suggests that, in most regions away from wind-exposed coastal areas or other high-wind locations, shingles not be adhered to valley materials. Then, the watershedding roof covering can function as intended.

Fully adhered tabs, and even adhered corners of tabs, also can be detrimental to long-term, trouble-free roof system performance. Shingles adhered to valley material tend to catch leaf stems, promote moss growth and collect debris that become difficult to remove without



Source: The NRCA Steep Roofing Manual, Fourth Edition.

Figure 4: *Closed-cut valley.*

separating the shingles from the valley. And when attempting to separate the adhered tab, the shingle or valley material (if it is roll roofing) often tears.

Closed valleys

A closed valley, depicted in Figure 3, also is referred to as "woven"; the shingles from both roof areas that intersect the valley are overlapped and woven together. The valley's underlying throat is closed from view and not exposed to the weather.

Following are some attributes of closed valleys:

1. *Durability.* Woven or closed valleys can be extremely durable because the roof covering is at least four layers thick through the valley center. This provides for a durable, abuse-resistant valley.

2. *Wind resistance.* A woven or closed valley can be a good choice for steep-slope roof systems that are oriented into prevailing winds. Also, many roof systems exposed to high winds can benefit from woven valleys because the courses of shingles, woven together in the valley, create a heavy covering that is rigid and difficult to lift. This covering is especially difficult to lift and separate when seal-strip adhesive bonds the courses together.

3. *Drainage.* The woven or closed valley drains more slowly than an open or closed-cut one. The shingle tab cutouts that laterally intersect the valley center line impede drainage. However, if the roof is steep and the tributary area is not great, woven or closed valley drainage usually is not a concern.

4. *Debris collection.* The woven or closed valley is the most likely of all valley types to collect leaves and organic debris. Thus, roof systems located directly under trees are not always good candidates for woven valleys.

5. *Compatibility with laminates.* Woven or closed valleys work well with cut-tabbed and no-cutout strip shingles. However, laminate shingles sometimes are difficult, and occasionally impossible, to use with woven valleys. The laminate shingle style must be examined closely when valley design is being considered because laminated tabs often further complicate valley construction and drainage. The humps created by the laminated strip or tab also can make the valley more prone to holding debris; therefore, open valleys usually are used with most laminate shingle styles.

Closed-cut valleys

A closed-cut valley, depicted in Figure 4, has regional nicknames, but, essentially, it is a combination of an open valley (lined with roll roofing) and a closed one. The shingles from one roof area are extended through the valley center line.

Following are some opinions about closed-cut valleys:

1. *Durability.* Closed-cut valleys can be quite durable; they have two layers of underlying roll roofing and two layers of shingles that extend through the valley. A closed-cut valley is somewhat abuse-resistant, and some maintenance traffic usually can be tolerated.

2. *Drainage.* A closed-cut valley drains faster than a woven valley but does not drain as readily as an open valley. The shingle tab cutouts that laterally intersect the valley center line slightly impede drainage. Nevertheless, the cut edge of the opposing roof area provides a good edge to guide runoff down the valley's throat.

3. *Debris collection.* The closed-cut valley can hold some debris but is not as prone to collecting organic matter as the closed valley.

4. *Overall performance.* For overall aesthetics and general performance, the closed-cut valley is the author's choice. It can perform well in most climates and works well with cut-tabbed and no-cutout strip shingles.

Conclusions

For most asphalt shingle roof assemblies, there is a valley type well-suited to the climate, roof layout and slope, and type of shingles to be used. With the materials available today, and the experience that has been gained in asphalt shingle roofing technology, these three accepted valley types are improving all the time. PR

Jim Carlson is an NRCA deputy director of technical services.