4 Asphalt Shingles

Asphalt roofing materials have been manufactured since the early 1890s. Today, asphalt shingles cover about 70 to 80 percent of all roofs in the United States. Those roofs are attractive, versatile, and fire- and wind-resistant. Asphalt shingle roofs are relatively inexpensive, easy to install, and require little maintenance. The normal life expectancy of an organic asphalt shingle roof is 15 to 20 years. Heavyweight laminated fiberglass shingles will last 20 to 30 years.

Organic Shingles

The base mat of organic-based asphalt shingles (organic shingles) was originally composed of cellulose fibers made from recycled paper or wood chips, and cotton or wool fibers made from rags. Now, it's made of a tough, asphalt-saturated roofing felt, coated on both sides with asphalt, as shown in Figure 4-1.

The base mat gives shingles their strength. The base material is saturated and covered with a high-melting-point flexible asphalt called a *saturant*. The saturant is reinforced with mineral stabilizers such as ground limestone, slate, trap rock (weathered volcanic rock) or other inert materials such as ceramic-coated rock granules. Coarse mineral granules are pressed into the asphalt coating on the exposed face. This gives the shingle its color and helps it resist weather and fire.

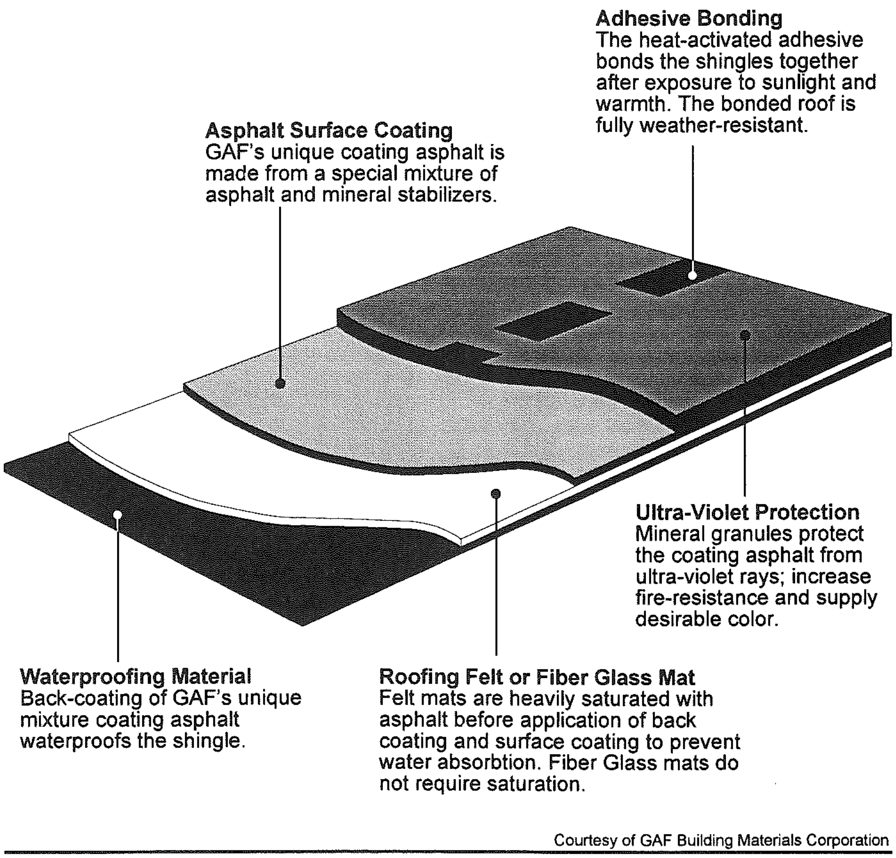


Figure 4-1 Asphalt shingle components

The materials most often used for coarse mineral surfacing are natural-colored slate, natural-colored rock granules, or ceramic-coated rock granules. The back of each shingle is covered with talc, sand or mica to prevent shingles from sticking together in the bundle.

Fiberglass Shingles

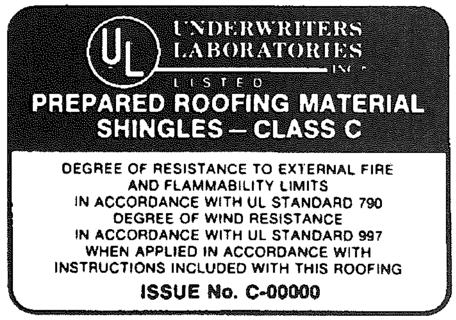
Fiberglass shingles first appeared in the late 1950s. By the late 1970s, they had improved so much they were as good as traditional asphalt shingles. Fiberglass shingles have a fiberglass base mat saturated and covered with flexible asphalt and surfaced with mineral granules. The weight and thickness of a fiberglass mat is usually much less than a cellulose-fiber mat. Fiberglass shingles contain more asphalt than organic-based asphalt shingles.

Nowadays, organic shingles aren't used very often. They soak up water from underneath, which makes the corners at the bottom of the tabs curl up.

Throughout this chapter, the term "asphalt shingle" means an organic- or fiberglass-based shingle saturated with asphalt. I'll distinguish between the two products only when it's necessary for the sake of accuracy.

UL Ratings for Shingles

The Underwriters' Laboratory (UL) is a non-profit organization founded in 1894 under the sponsorship of the National Board of Fire Underwriters. The UL has the most widely-accepted standards for fire resistance of building materials. The UL classifies a fire-resistant shingle as A, B, or C. Class A shingles withstand severe fire exposure. Class B shingles withstand moderate fire exposure and Class C, light fire exposure. With all three ratings, "exposure" means exposure to fire that comes from sources outside the building. To qualify for any UL classification, a shingle must not:



Courtesy of Asphalt Roofing Manufacturers Association (ARMA)

Figure 4-2 Underwriters' Laboratory label

a) disintegrate and fall off the roof as glowing brands (airborne embers)

b) break, slide, warp, or crack, exposing the deck

c) allow the roof deck to fall away as glowing particles

d) allow continued flaming beneath the roof deck.

To bear a UL "wind-resistant" label, a shingle must withstand winds up to 63 miles per hour for two hours without a single tab being uplifted. Figure 4-2 shows a UL shingle label. Look for this label on each bundle of shingles, and be sure to install them according to the manufacturer's instructions.

To increase their wind resistance, many asphalt shingles come with a self-sealing thermoplastic adhesive strip (tar strip) above the cutouts on the face of the shingle. That's shown in Figure 4-3. Heat from the sun makes the strip sticky and helps to bond each shingle to the one above it. The adhesive strip takes longer to bond in cold weather or when the roof is shaded, has a low slope, or faces north or east.

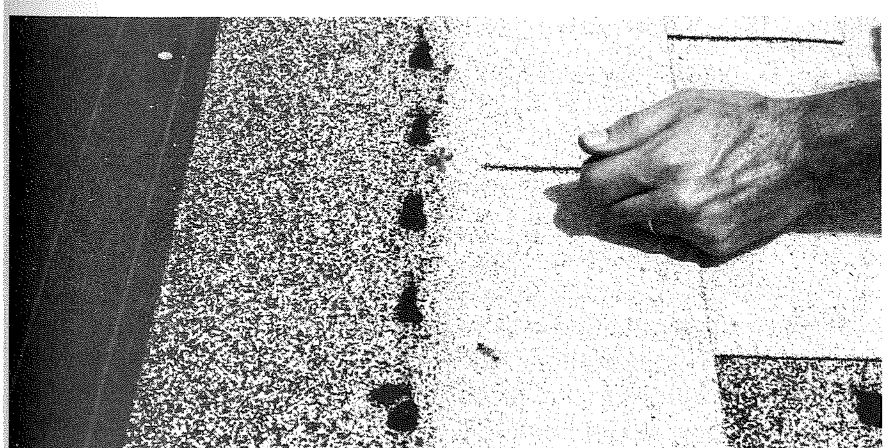


Figure 4-3 Shingle with adhesive strip

The best temperature range for installing asphalt shingles is between 40° F and 85° F. Before you install asphalt shingles during cold weather, store the shingles in a warm location or lay them in the sun until they soften up.

If you will be storing shingles, keep them in a cool dry area in stacks no more than 4 feet high. Your local roofing materials supplier can advise you about how long it's safe to stockpile asphalt shingles. Rotate the bundles so the shingles stored the longest will be the first ones you'll use. That's so the shingles at the bottom of the stacks don't become discolored. Light-colored shingles may darken because oils in the asphalt move. Dark-colored shingles may show light smudges when backing materials (such as talc, which helps keep shingles from sticking together in the bundle) transfer to adjacent shingles.

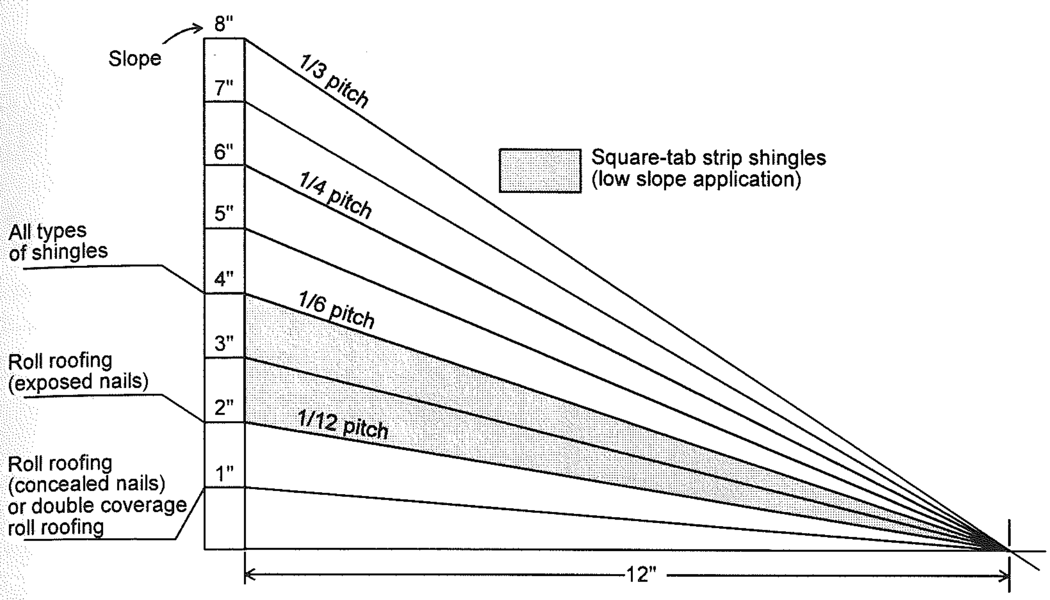
If you store shingles outdoors, place them on a raised platform so they don't touch the ground. Cover the shingles to protect them from wet weather. Don't store shingles in the hot sun because heat makes them stick together.

Deck Requirements

Asphalt shingles require a solid roof deck. As a general rule, you can install asphalt shingles on roof slopes ranging from 4 in 12 through 21 in 12 using standard application methods. You can also install asphalt shingles on slopes as flat as 2 in 12, or steeper than 21 in 12, but you'll have to follow special application procedures. We'll cover this later in this chapter (see Figure 4-27 and related text). Figure 4-4 gives minimum roof slope requirements for various asphalt roofing materials.

Shingle Colors

The color of the shingles you use can dramatically affect the appearance of a building. For example, a light-colored roof directs the eye upward and gives the illusion of spaciousness. Dark colors create the opposite effect. In the case of a large, steep roof, you can use that illusion to scale down the roof structure and make the building look more proportional and attractive. Use Figure 4-5 as a guide for choosing shingle colors that go with various colors of siding, trim, shutters and doors.



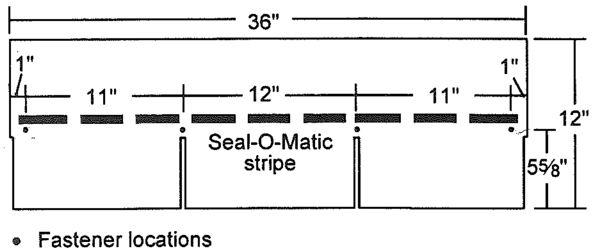
Courtesy of Asphalt Roofing Manufacturers Association (ARMA)

Figure 4-4 Minimum pitch and slope requirements for various asphalt roofing products

Roof Shingles	Siding	Trim	Shutters and Doors	Roof Shingles	Siding	Trim	Shutters and Doors
White	White	White	Deep Gold, Maroon	**Brown**	White	White	Dark Brown, Terra Cotta
	White	Gray	Charcoal		Green	White	Dark Brown, Dark Green
	Green	White	Dark Brown, Dark Green		Yellow	White	Dark Brown, White
Black	White	White	Black, Maroon	**Green**	White	White	Dark Green, Black
	Yellow	White	Black, Deep Olive Green		Yellow	White	Dark Green
	Gold	White	Black, Deep Olive Green		Lt. Green	White	Dark Green, Terra Cotta
Gray	Red	White	Black, White	**Blue**	White	White	Blue
	Yellow	White	Gray, Charcoal, Green		Yellow	White	White
	Coral Pink	Lt. Gray	Charcoal		Lt. Blue	White	Dark Blue, White
Red	White	Gray	Charcoal				
	White	White	Red				
	Beige	White	Dark Brown				

Courtesy of Asphalt Roofing Manufacturers Association (ARMA)

Figure 4-5 Asphalt shingle color guide



Courtesy of Asphalt Roofing Manufacturers Association (ARMA)

Figure 4-6 Three-tab Fire-Glass III fiberglass shingle

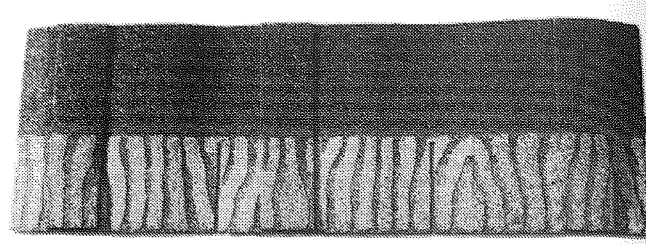


Figure 4-7 Laminated shingle

Asphalt Strip Shingles

The most widely-used type of asphalt shingle is the 3-tab (triple-tab) strip shingle like the one in Figure 4-6. This is also called a square-butt or thick-butt shingle because some manufacturers make a shingle that's thicker at the butt edge. Cutouts (also called keys, water lines, bond lines, tab notches, and water jackets) make a roof look like it's finished with many smaller units.

Shingle type	Approximate weight per square (pounds)
Two-tab strip	300
Three-tab strip	235
Two- or three-tab hexagonal	200
Individual Dutch lap [(1)]	165
Individual American [(1)]	330

[(1)] See Figures 4-97 and 4-98

Figure 4-8 Approximate asphalt shingle weights

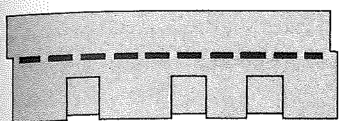
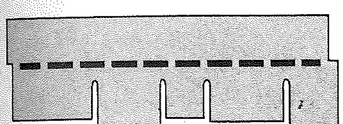
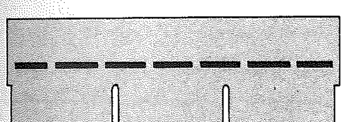
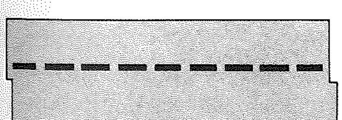
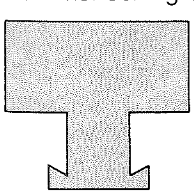
You can also find 2-tab (twin-tab) strip shingles, strip shingles with no cutouts, and shingles with as many as five tabs (random-tab strip shingles). Some shingles have staggered butt lines. Shingles whose tabs are all the same size are called square-tab shingles. Strip shingles with more than one layer of tabs are called laminated, dimensional, or three-dimensional shingles. These shingles create extra thickness and give a three-dimensional effect. See Figure 4-7. Other strip shingles include 2- and 3-tab hexagonal shingles. You can see those at the end of the chapter in Figure 4-99.

Asphalt strip shingles weigh from 135 to 390 pounds per square depending on:

- the shape of the shingle
- the thickness of the base mat
- the amount of asphalt absorbed by the base mat
- the thickness of the asphalt coating
- the amount of surface material pressed into the exposed face.

You can use Figure 4-8 to estimate approximate asphalt shingle weights.

The chart in Figure 4-9 is a quick reference to the specs and coverage for several typical asphalt shingles. Asphalt shingles are from 35$\frac{5}{16}$ to 42 inches long, and from 12 to 14$\frac{1}{8}$ inches wide. They have recommended

PRODUCT	Configuration	Per Square			Size		Exposure	ASTM* fire and wind ratings
		Approximate Shipping Weight	Shingles	Bundles	Width	Length		
Self-sealing random-tab strip shingle  Multi-thickness	Various edge, surface texture and application treatments	240# to 360#	64 to 90	3, 4 or 5	11½" to 14"	36" to 40"	4" to 6"	A or C - Many wind resistant
Self-sealing random-tab strip shingle  Single-thickness	Various edge, surface texture and application treatments	240# to 300#	65 to 80	3 or 4	12" to 13¼"	36" to 40"	4" to 5⅝"	A or C - Many wind resistant
Self-sealing square-tab strip shingle  Three-tab	Three-tab or Four-tab	200# to 300#	65 to 80	3 or 4	12" to 13¼"	36" to 40"	5" to 5⅝"	A or C - All wind resistant
Self-sealing square-tab strip shingle  No-cutout	Various edge and surface texture treatments	200# to 300#	65 to 81	3 or 4	12" to 13¼"	36" to 40"	5" to 5⅝"	A or C - All wind resistant
Individual interlocking shingle  Basic design	Several design variations	180# to 250#	72 to 120	3 or 4	18" to 22¼"	20" to 22½"	—	A or C - Many wind resistant

*American Society for Testing and Materials

Courtesy of Asphalt Roofing Manufacturers Association (ARMA)

Figure 4-9 Typical asphalt shingles

exposures of 4 to 6 inches. (Exposure is the part of the shingle not covered by the next course of shingles.) The most common asphalt strip shingle is 3 feet by 1 foot laid at a 5-inch exposure.

There are also several types of individual asphalt shingles, including hex shingles, interlocking shingles and giant individual shingles. Those are described and shown at the end of this chapter in Figures 4-94, 4-95, and 4-96.

Installing Asphalt Strip Shingles

After you've laid the underlayment, drip edge and valley flashing, you're ready to install a starter course at the eaves of the roof. The starter course protects the eaves of the roof by filling in the spaces under the cutouts and joints of the first course of shingles. Without a starter course, there would only be single coverage at the eaves. Install the starter course with a ¼- to ⅜-inch overhang at the eaves and rakes.

■ Roll Roofing Starter Course You can install a starter course by using a 7-inch-wide (minimum) strip of mineral-surfaced roll roofing whose color matches the shingles (Figure 4-10). Place the starter roll along the eaves with a ¼- to ⅜-inch overhang and nail the strip on 12-inch centers. Drive the nails along a line 3 to 4 inches above the eaves. If you're installing the starter roll over board sheathing, *stagger nail* to prevent splitting a board. That means don't hammer nails in a straight line along the grain of the board.

Roll roofing comes in 36-foot lengths. If you need more than one strip to cover the length of the eaves, lap the end joint at least 2 inches. Nail the underlay, then embed the overlap in roofing cement and nail it in place with three nails.

I recommend you use shingles instead of roll roofing for the starter course. That way you don't have to worry about matching colors, and the laps won't show through the overlying shingles.

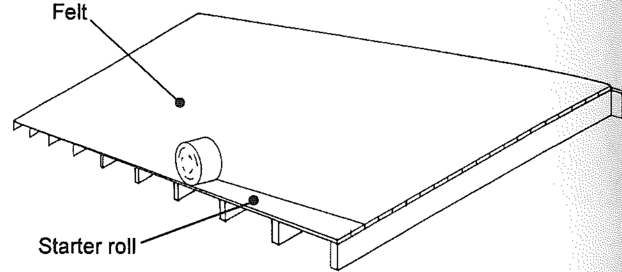


Figure 4-10 Mineral-surfaced starter roll

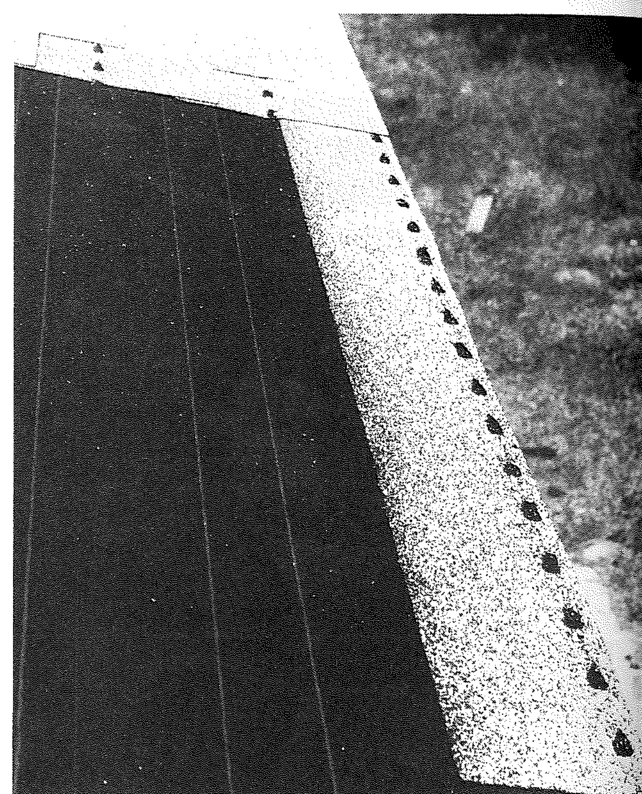
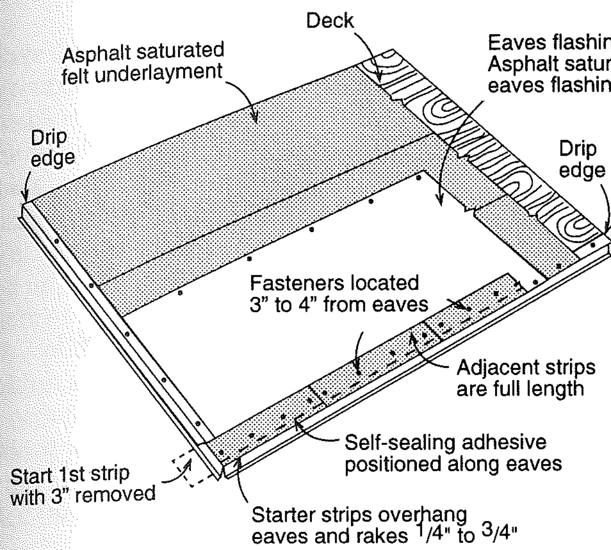


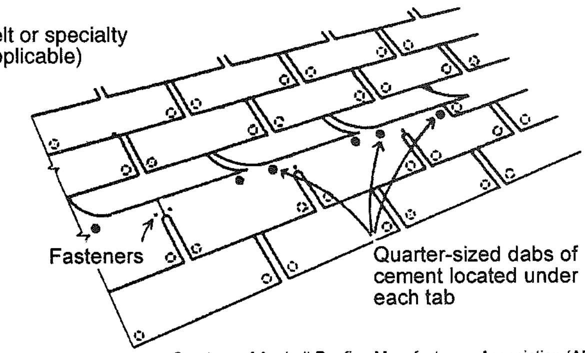
Figure 4-11 Field-fabricated starter course

■ Shingle Starter Course Most strip shingle manufacturers recommend that you make the starter course by cutting off the shingle tabs and installing the shingles with the factory-applied adhesive along the eaves, as shown in Figure 4-11.



Courtesy of Asphalt Roofing Manufacturers Association (ARMA)

Figure 4-12 Application of starter strip



Courtesy of Asphalt Roofing Manufacturers Association (ARMA)

Figure 4-13 Cement application under free-tab shingles

Trim about 3 inches from the end of the first starter-course shingle to keep the joints of the first course of shingles from lining up with the joints of the starter-course shingles. That's shown in Figure 4-12. Position the starter-course shingles along the eaves with a $1/4$- to $3/8$-inch overhang. Drive nails into the shingles along a line 3 to 4 inches above the eaves. Position the nails so that they won't be exposed under the cutouts of the shingles in the first course. Stagger nail the starter-course shingles over board sheathing.

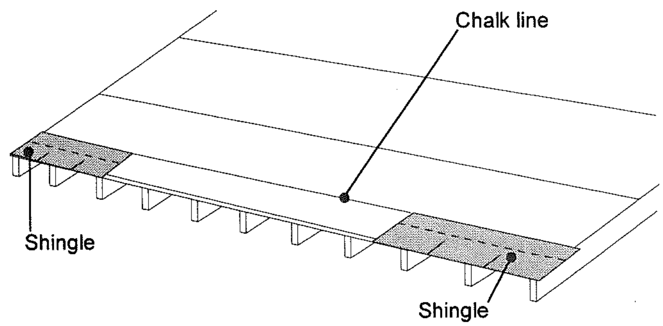


Figure 4-14 Lining up the first course

If you use roll roofing or shingles that don't have a factory-applied adhesive strip (free-tab shingles) for the starter course, bond the tabs of each shingle in the first course to the starter strip. Use a spot of roofing cement about the size of a quarter beneath each shingle tab. Figure 4-13 shows this. Install *all* free-tab shingles this way in high-wind areas. That includes the starter course, even when you use shingles that *do* have factory-applied adhesive strips.

■ **Start with a Straight Line** It's very important that you install the starter course and first course of asphalt shingles straight. To align asphalt shingles, nail down a shingle with the correct overhang on each end of the eaves. Snap a chalk line along the top edges of the shingles as shown in Figure 4-14. Then line up the top edges of intervening shingles along the chalk line. Repeat this alignment every third or fourth course. Measure from the eaves up to the butt position for the next course of shingles at the rakes. Install the end shingles, then snap another chalk line to align that course.

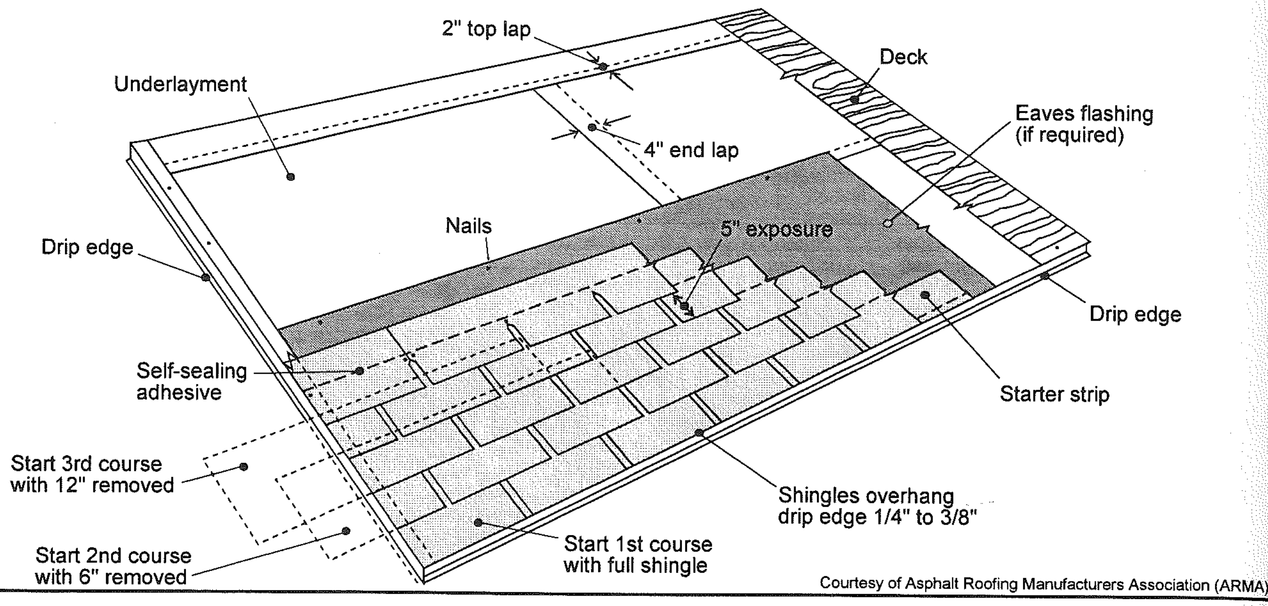


Figure 4-15 Application of shingles using the 6-inch method

You can save time by snapping all the chalk lines before you install any shingles. Snap horizontal chalk lines on 5-inch centers (assuming a 5-inch shingle exposure), allowing for the overhang at the eaves. Then snap vertical chalk lines on 6-, 12- or 36-inch centers, depending on how good you are at eyeballing a straight line. Once you've done this, you can line up shingles at the correct positions with the proper exposure without having to use the exposure gauge on your hatchet. Be sure to allow for the required overhang when you snap your chalk lines.

For example, if your exposure is 5 inches, with a ¼-inch overhang, snap your first horizontal chalk line at 11¾ inches from the edge of the eaves. Snap succeeding chalk lines 5 inches apart.

To maintain the correct exposure for square-tab strip shingles, align the butts with the top of the cutouts in the course below, since the cutouts in these shingles are 5 inches deep.

■ **Shingle Patterns** There are three basic shingling patterns used to install 3-tab asphalt strip shingles:

a) joints broken into halves, or the 6-inch pattern (half pattern)

b) the 5-inch pattern (random pattern)

c) joints broken into thirds, or the 4-inch pattern

To install the 6-inch pattern, start the first course with a full-length shingle. Remove 6 inches from the first shingle of the second course. Then remove 12 inches from the first shingle of the third course. Continue, removing an additional 6 inches from the first shingle of each course until you begin with a full shingle again on the seventh course. You can see how this works in Figure 4-15.

Save the full tabs you cut off and use them for hip and ridge units, filler tabs adjacent to valleys, and at the opposite ends of a gable-framed roof. The 6-inch pattern is the simplest style to install. But, because you align the cutouts every other course and the shingles vary slightly in size, you must snap chalk lines up the roof slope so you can align the edges of the shingles to keep the cutouts lined up vertically. The easiest way to install the 6-inch pattern on a gable roof is to shingle up the rake and install each course only far enough out over the deck to establish a pattern. When you get to the ridge, return to the bottom and finish out each course across the roof, working your way up the slope. This method of shingling up the rakes followed by shingling across the roof is called the *diagonal* method.

If the top of a shingle extends beyond the centerline of the ridge, lap the shingle over the ridge and nail it on both sides of the ridge, as in Figure 4-16.

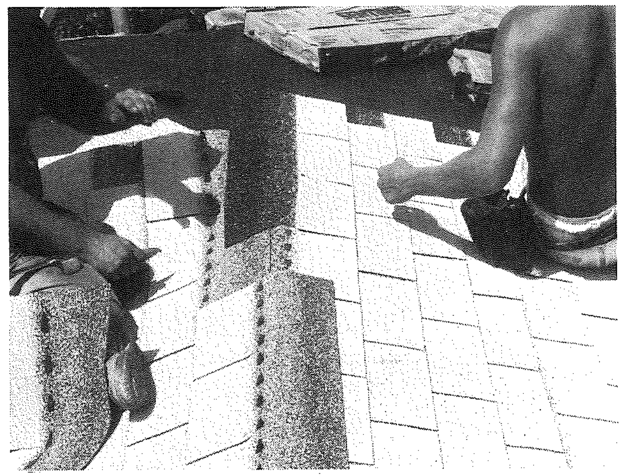
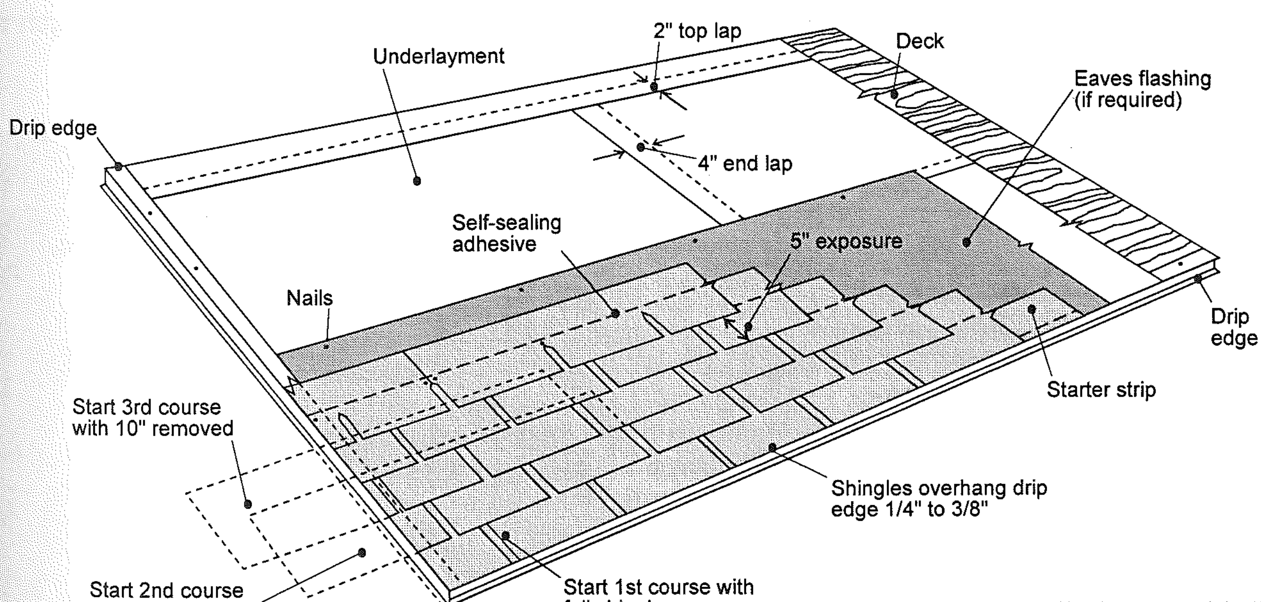


Figure 4-16 Lapping shingles over the ridge

The 5-inch pattern is often called a random pattern. This pattern gives you some flexibility when you align the cutouts up the roof slope. Start the first course with a full-length shingle. Remove 5 inches from the first shingle of the second course. Then remove 10 inches from the first shingle of the third course. Continue, removing an additional 5 inches from the first shingle of each course until you begin with a full shingle again on the eighth course. (You don't start the eighth course with a 1-inch section.) Use the exposure gauge on your hatchet to measure the 5-inch increments. Figure 4-17 shows the shingle pattern this method produces. On gable roofs,



Courtesy of Asphalt Roofing Manufacturers Association (ARMA)

Figure 4-17 Application of shingles using the 5-inch method

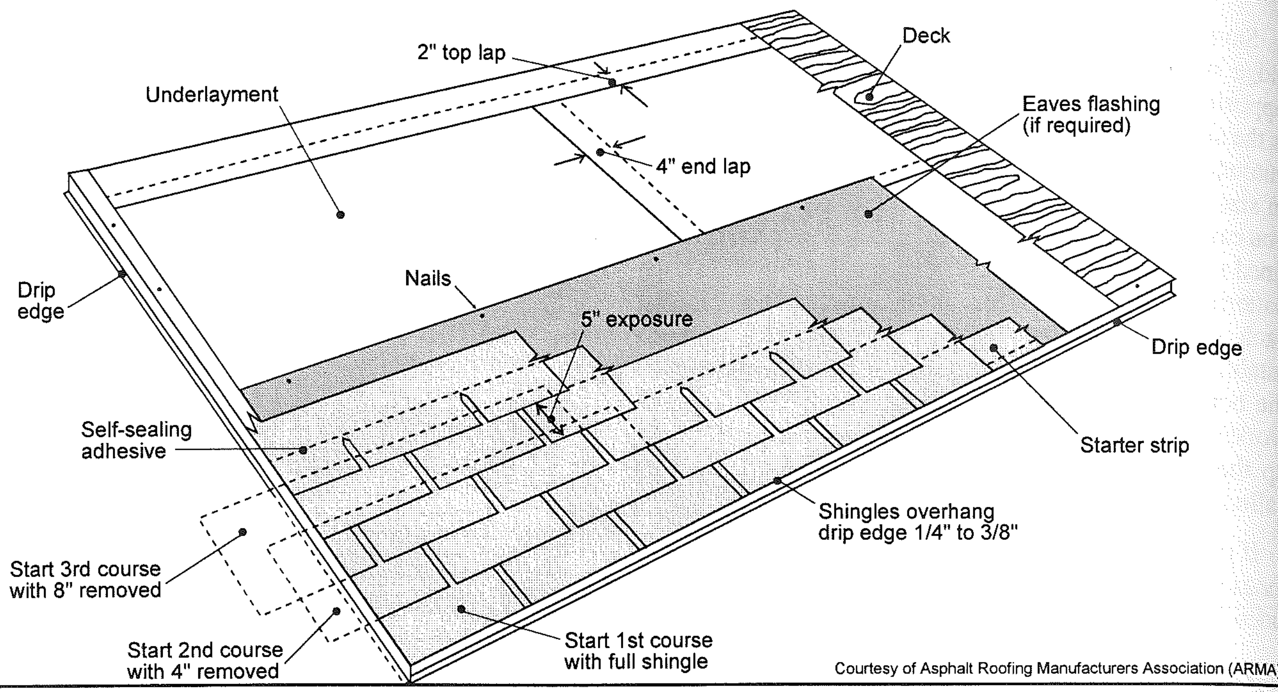


Figure 4-18 Application of shingles using the 4-inch method

shingle up the rake to the ridge, as with the 6-inch pattern, then return to the bottom and finish out each course across the roof, working your way up the slope.

You'd usually use the 4-inch pattern only on low-slope roofs ranging from 2 through 3 in 12. Trim the first shingle of each course in a multiple of 4 inches, beginning again with a full-width shingle at the 10th course. Figure 4-18 shows this pattern.

The 5-inch pattern is sometimes used on hip roofs, while the 6-inch pattern is generally used on gable roofs. Never install a shingle pattern less than 4 inches because the cutouts and joints would be so close on adjacent courses that leaks could occur.

Shingle Application

The order you follow to install shingles depends on the roof style. On gable roofs broken by dormers or valleys, start shingling at the rake and proceed toward the breaks. On simple gable roofs, start shingling at the gable end that's most visible to passers-by. On hip roofs and roofs where both gable ends are equally visible, start shingling at the center of the roof and proceed in both directions. In this case, set all your chalk lines (for the offset pattern you'll use) before you begin shingling.

On hip roofs, lap shingles over the hips from both sides, as shown in Figure 4-19. Then cut the shingle edges of the upper layer in line with the centerline of the hip. See Figures 4-20 and 4-21.

Figure 4-19 Lapping shingles over a hip

Figure 4-20 Trimming the hip

■ Dormers If there's a dormer, shingle the top of it first. Then bring the shingles of the main roof up to and alongside the dormer, all the way to the ridge of the dormer. Extend one shingle course on the main roof on one side of the dormer to a distance at least one shingle beyond the ridge of the dormer roof. Notice the top shingle on the left side of the dormer in Figure 4-22.

Snap vertical chalk lines down from the ridge starting with the edge of the extended shingle, as shown in Figure 4-22. Use those chalk lines as guides to align the shingle courses as you install them on the right side of the dormer. Slip the last shingle course under the course that's in line with the ridge of the dormer. Aligning shingles on both sides of a dormer this

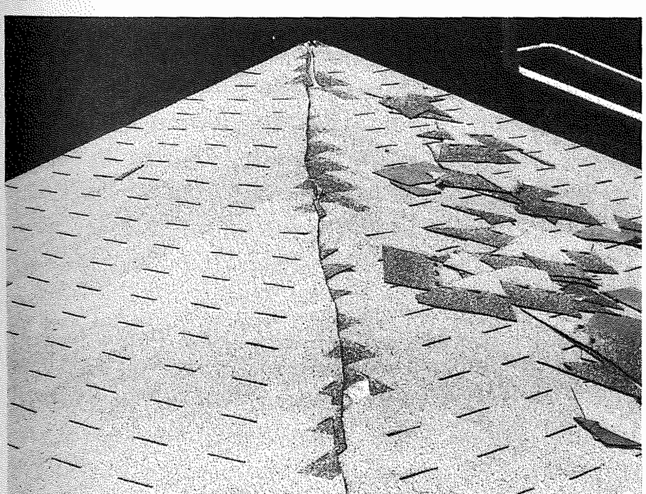
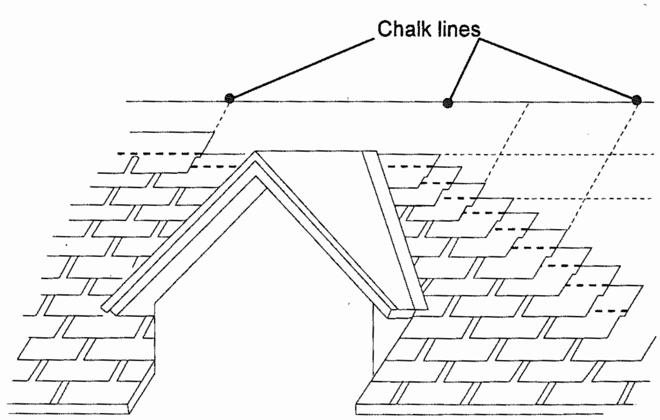


Figure 4-21 A trimmed hip



Courtesy of Asphalt Roofing Manufacturers Association (ARMA)

Figure 4-22 Tying in around a dormer

way is called "tying in." You'll have to shingle the ridge of the dormer before you finish the main roof above the dormer. We'll describe that later in this chapter, on page 92 under the heading, "Ridge and Hip Units, Cap Shingles."

No matter where you begin shingling, roofing material manufacturers recommend you apply the shingles in the diagonal pattern described earlier. Then you'll be sure you've nailed every shingle properly because you can see each one until you cover it with the next course above.

You can also use the straight-up (racking) method shown in Figure 4-23. But then you have to install some shingles under shingles you've already laid in the course above. That's shown in Figure 4-24. Since part of the underlying shingle is hidden, there's a possibility you could miss nailing that part of the shingle.

Some roofing contractors prefer the racking method because it's a more accurate way to align the shingles. You use the horizontal chalk lines and previously-laid shingle edges as guidelines. If you use this method, snap horizontal chalk lines on 5-inch centers starting at the eaves and allowing for an overhang. Then, snap two vertical chalk lines 6 inches apart. Install shingles up the roof offsetting every other course 6 inches, aligning them with the vertical chalk lines. That's shown in Figure 4-25. Then shingle the rest of the roof the same way, using the horizontal chalk lines and previously-installed shingle edges as guidelines.

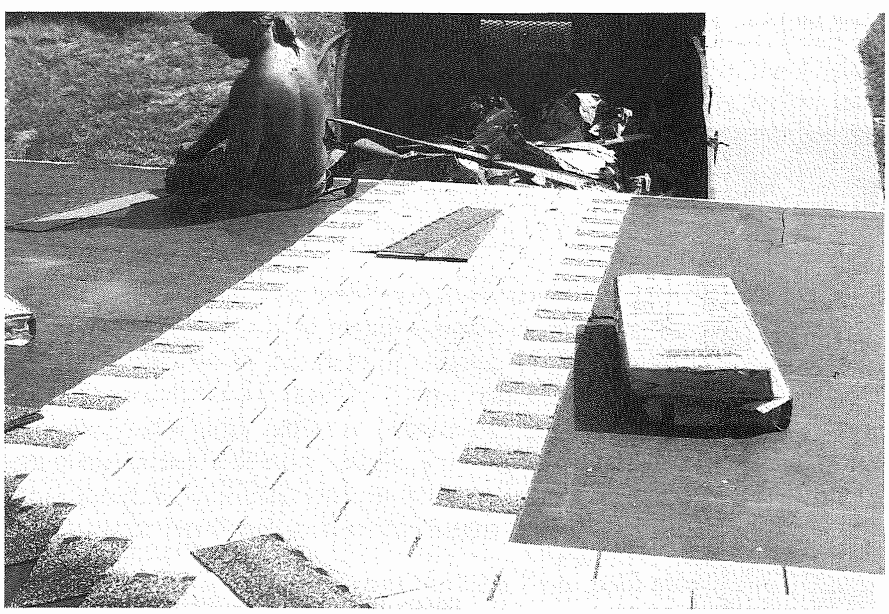


Figure 4-23 The straight-up (racking) method

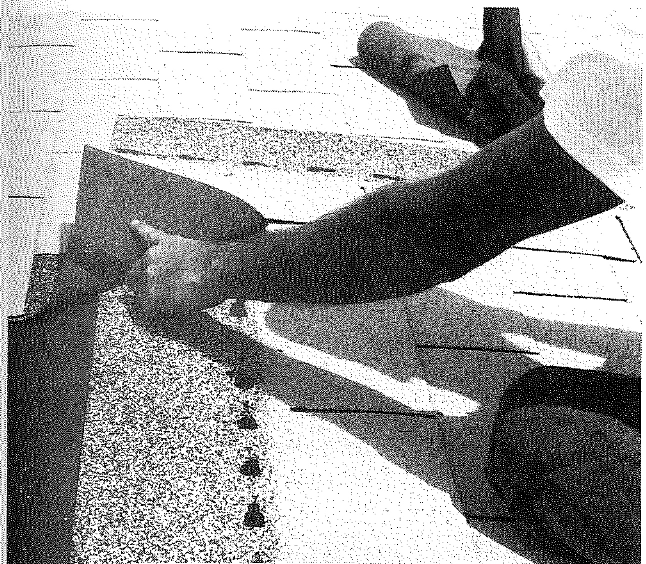


Figure 4-24 Installing a shingle beneath one previously installed

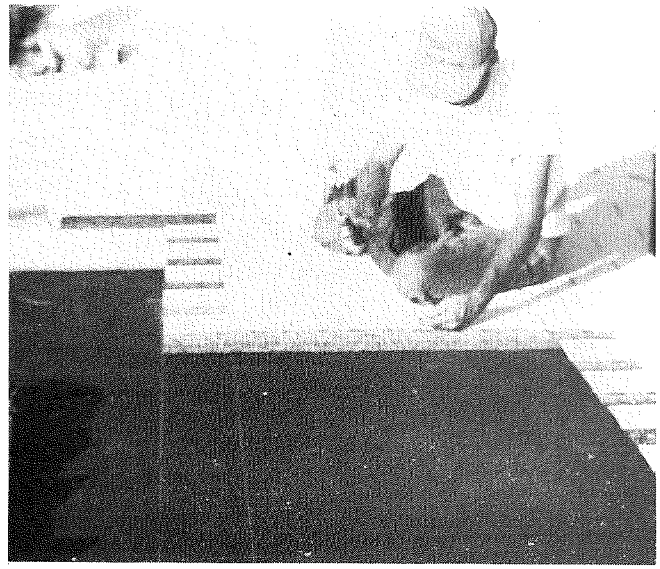


Figure 4-25 Vertical chalk lines used with the racking method

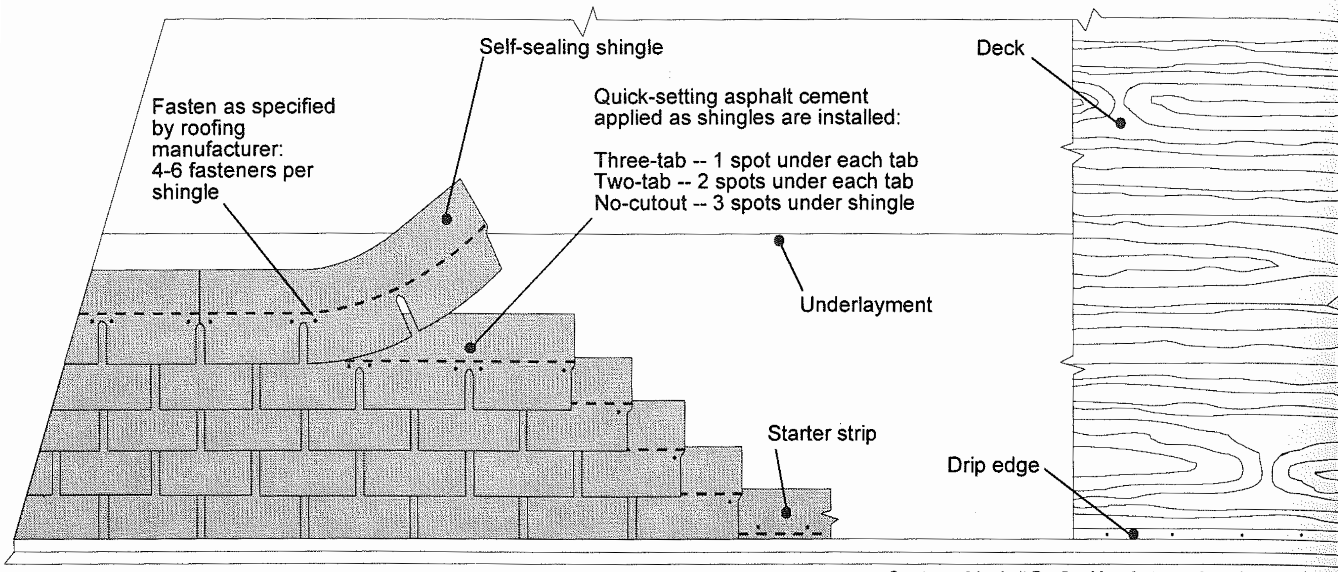
■ **Patterning** Offset the joints in adjacent courses of 3-tab shingles to keep water from being channeled through the joints, where it can get under the shingles. Offset the joints of laminated shingles for the same reason.

To form a random pattern, start the first course at the rake with a full-length dimensional shingle. Then remove 4 inches from the first shingle of the second course, and 11 inches from the first shingle of the third course. Start the fourth course with a full-length shingle and repeat the pattern every third course. Finish the remainder of each course with full-length shingles.

By using this method, you won't get an obvious and unattractive repeated pattern throughout the roof. If you install dimensional shingles using the 6-inch pattern, you'll get repeated diagonal trails like the ones in Figure 4-26. If you install dimensional shingles using the racking method you'll get repeated vertical trails.

Figure 4-26 Repeated diagonal pattern

■ **Shading** Asphalt shingles sold as one color won't match perfectly. Some will look lighter or darker than others. This is called "shading" and it's due to the way they were made. It can also happen if the shingles have been stored too long, or in stacks so tall that backing material of one shingle rubs off onto the face of another. If you use the racking method, (straight-up application) you'll accent the shading. Use the diagonal method of application to help blend the shingles.



Courtesy of Asphalt Roofing Manufacturers Association (ARMA)

Figure 4-27 Application of shingles on steep slopes

Low or High Slopes

In general, install asphalt strip shingles only on roof slopes of 4 in 12 and steeper. You can install square-tab shingles on slopes as low as 2 in 12 (but never lower) if you follow special application procedures. The primary requirement is that you install the proper underlayment and eaves flashing (if required) to prevent damage caused by ice dams. Refer back to Chapter 3 for details on ice dams. Also, for added wind resistance, use shingles with self-sealing factory-applied adhesive strips or apply a spot of roofing cement about the size of a quarter under every shingle tab. Use cement sparingly. Too much cement can cause blisters.

Normally, you don't install asphalt strip shingles on roof slopes steeper than 21 in 12. The main problem is that the factory-applied self-sealing adhesive strip isn't very effective, especially on colder or shaded portions of the roof. However, you can install asphalt strip shingles on steeper slopes if you follow modified application procedures. Depending on the manufacturer's specifications, install each shingle with 4 to 6 fasteners.

Use roofing cement to attach shingle tabs to underlying shingles. Apply the cement in spots about the size of a quarter.

- For shingles with three or more tabs, apply a spot of cement under each tab.
- For two-tab shingles, apply two spots of cement under each tab.
- For no-cutout shingles, apply three spots of cement under the exposed portion of each shingle.

Figure 4-27 shows this.

Installing Asphalt Strip Shingles in Valleys

The three main types of valley are:

1) open (Figure 4-28)

2) closed-cut (half-lace) (look ahead to Figures 4-32 and 4-34)

3) woven (full-lace) (look ahead to Figures 4-38 and 4-39)

The valleys of aggregate-surfaced roofs are usually made of underlayment covered with aggregate embedded in bitumen. Turn back to Chapter 3 for information on valley flashing requirements. Never install a vent pipe or any other roof penetration in a valley.

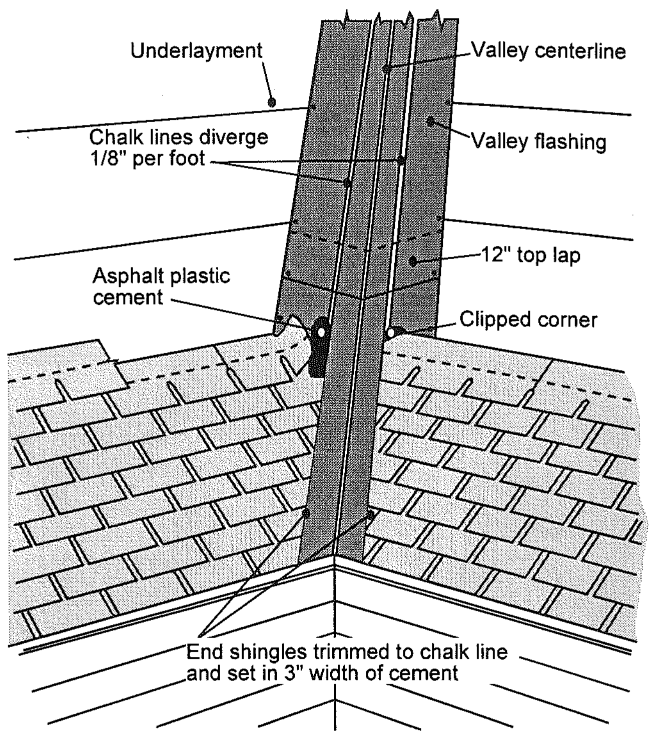


Figure 4-28 Application of shingles in an open valley

■ Open Valleys Although Figure 4-28 shows it, I don't recommend you use open-valley construction on roofs with 3-tab asphalt shingles. Open valleys are more likely to leak than other types of valleys. The valley can get clogged by leaves, twigs, pine needles or other debris and cause a backup. Or water may be forced up under shingles adjacent to the valley during a heavy rain.

To construct an open valley, install shingles at the upper end of an open valley up to within 3 inches on each side of the centerline of the valley. Widen this distance by about 1/8-inch per foot going down the valley. You need to make this area wider because, as a stream of water flows down a valley, the stream will get wider. This widening is helpful because it lets ice free itself and slide down the valley as it melts.

Trim 1 to 2 inches from the upper corner of the last shingle in each course in the valley at a 45-degree angle. This is to direct water into the valley and not between the shingle courses. That's called "dubbing," and it's shown in Figure 4-28. In addition, you should cement the end of the shingle to the valley flashing with a 3-inch width of roofing cement. Don't allow exposed nails along the valley flashing. I also recommend dubbing-off and cementing shingle corners in closed-cut and woven valleys.

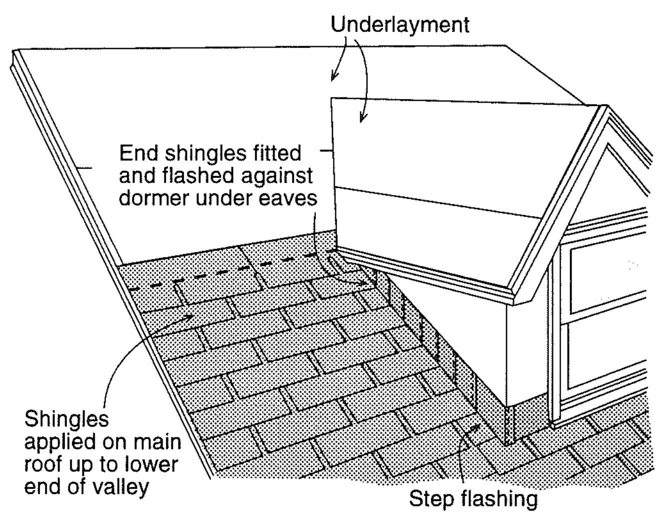


Figure 4-29 Point at which installation of open valley at dormer roof begins

■ Open Valleys at Dormer Roofs Install dormer valley flashing after you've installed the shingles on the main roof deck up to a point just above the lower end of the dormer valley. Figure 4-29 shows this. Then install the valley flashing. Trim the lower part of the flashing so that it goes at least 2 inches below

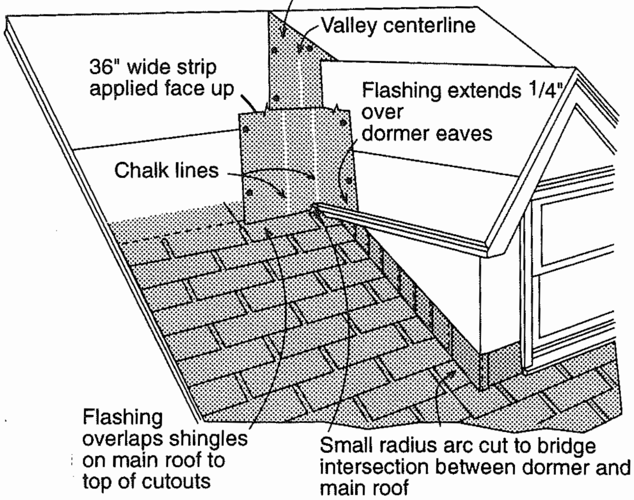


Figure 4-30 Application of roll roofing as flashing for an open valley at a dormer roof

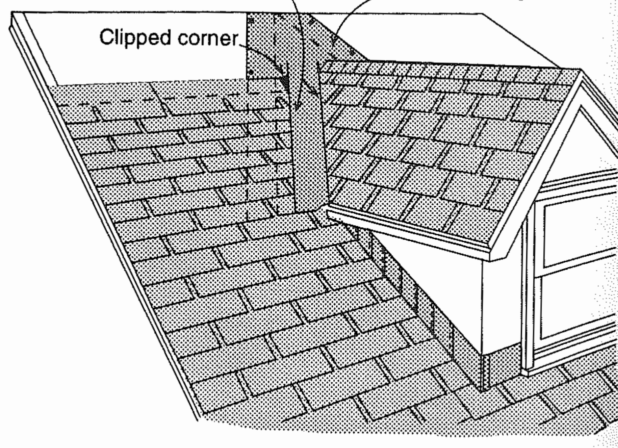


Figure 4-31 Application of shingles in open valley at dormer roof

where the two roof decks meet. Also, trim the flashing so it overlaps the uppermost shingles (the ones you installed before) down to the top of the cutouts. In addition, cut a small arc in the flashing where the dormer and main roof decks meet, as shown in Figure 4-30. Overlap, trim, cement, and nail down the upper part of the flashing above the dormer ridge. Then install shingles over the main roof deck and dormer roof as shown in Figure 4-31.

■ **Closed-Cut Valleys** I prefer the closed-cut (half-lace) valley construction shown in Figure 4-32 over woven (full-lace) valley construction because it looks neater and more professional. And, you can usually install this type of valley faster because you can shingle each side of the valley independently.

Figure 4-32 A closed-cut valley has a neat appearance

Install each shingle course along the eaves of one side of the valley and at least 12 inches across to the other side (Figures 4-33 and 4-34). Make sure the shingle end joints are at least 10 inches from the centerline of a closed-cut or woven valley. To keep a joint from ending up in a valley, insert an individual 12-inch-wide tab within a shingle course on either side of the valley. That's shown in Figures 4-35 and 4-36. Use two fasteners to secure the end of each shingle you install across the valley.

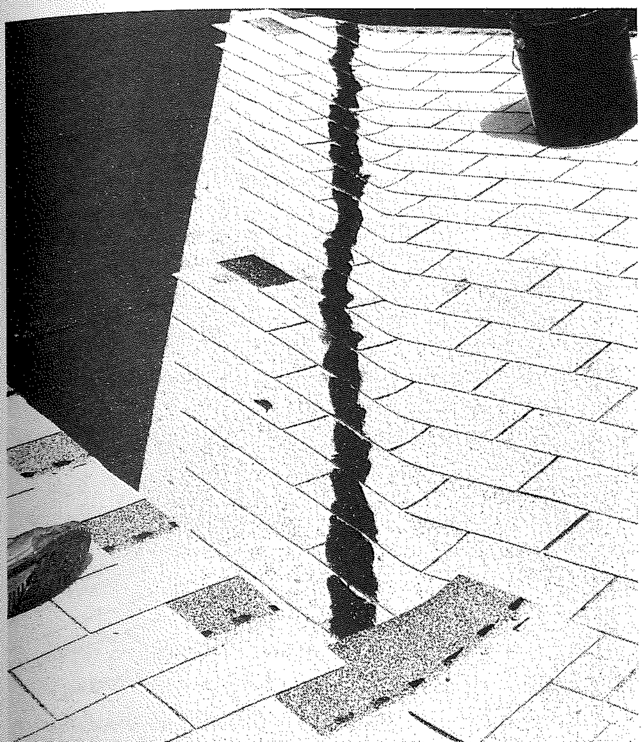
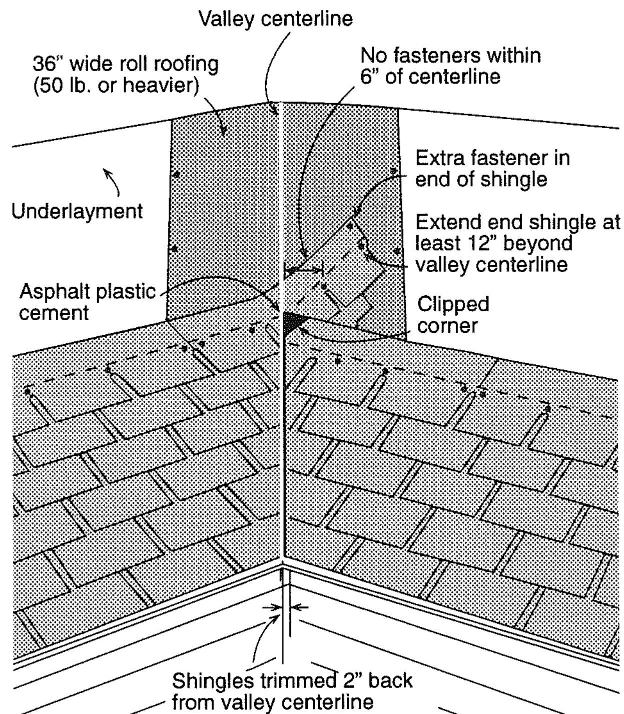


Figure 4-33 Shingle at least 12 inches onto the adjoining roof plane. Note the roofing cement.



Courtesy of Asphalt Roofing Manufacturers Association (ARMA)

Figure 4-34 Application of shingles in a closed-cut valley

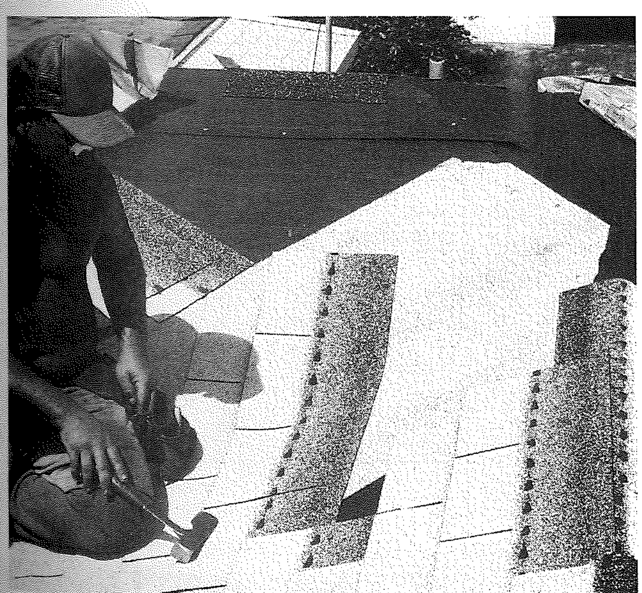


Figure 4-35 An inserted single tab prevents a joint from falling within the valley

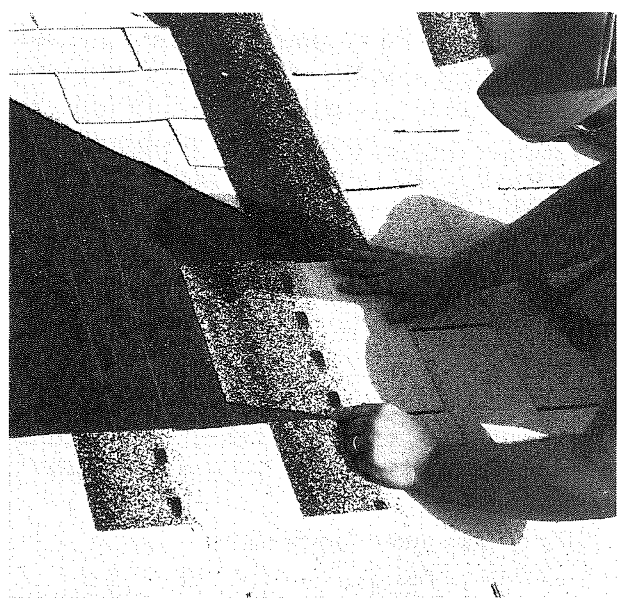


Figure 4-36 Single 12-inch tab inserted within the shingle course

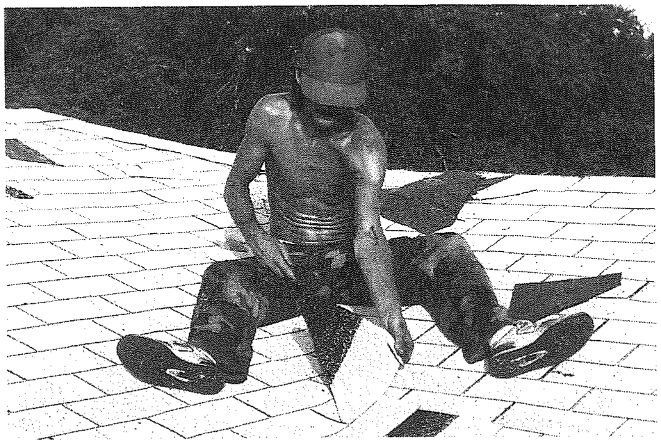


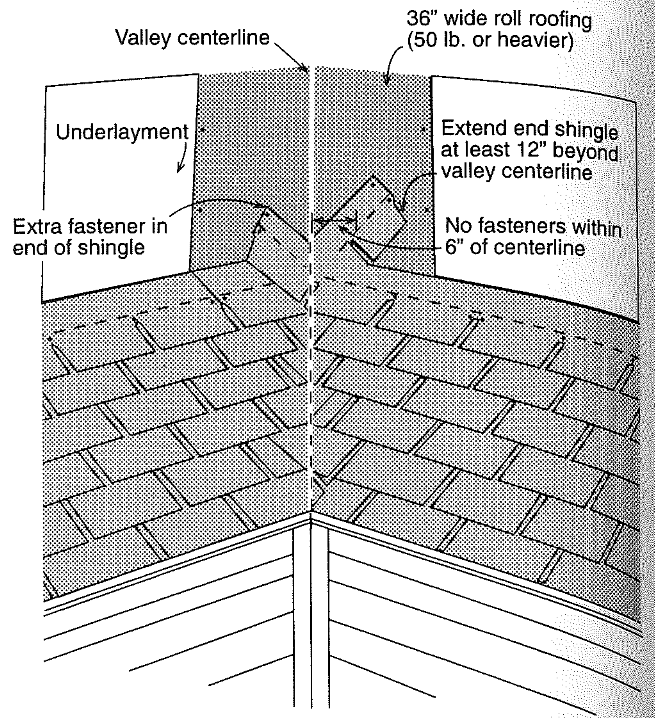
Figure 4-37 Trimming overlying shingles in a closed-cut valley

Next, apply shingles to the other side of the valley, extending them beyond the valley and over the shingles you just laid. Then, trim the overlying shingles back 2 inches from the centerline of the valley, as shown in Figure 4-37. Snap a chalk line and use it for a cutting guide. Also, trim 1 inch from the upper corner of the last shingle in each course at a 45-degree angle to direct water into the valley and not between the shingle courses. In addition, cement the end of the shingle with a 3-inch width of roofing cement. Refer back to Figure 4-33.

■ **Woven Valleys** To install shingles into a woven (full-lace) valley, apply them alternately to both sides of the valley. Extend the shingles across the valley, and at least 12 inches on each side. As with a closed-cut valley, be sure the shingle end joints are at least 10 inches from the centerline of the valley. Also, secure the end of each shingle that goes across the valley with two fasteners. See Figure 4-38.

It's best to use woven valleys only when the roof slope is 3 in 12 or steeper. Even though you don't have to trim the shingles when you make a woven valley, it'll still take you longer to install it. That's because you have to work both sides of the valley at the same time. I don't like this type of valley because it doesn't look clean and professional. See Figure 4-39. What do you think?

■ **Ridge and Hip Units (Cap Shingles)** Some asphalt shingles come with a prefabricated ridge roll or prefabricated individual 12" x 12" units. The advantage of the prefab units is that they save you time — all you have to do is install them. Sometimes, when you use lami-



Courtesy of Asphalt Roofing Manufacturers Association (ARMA)

Figure 4-38 Application of shingles in a woven valley

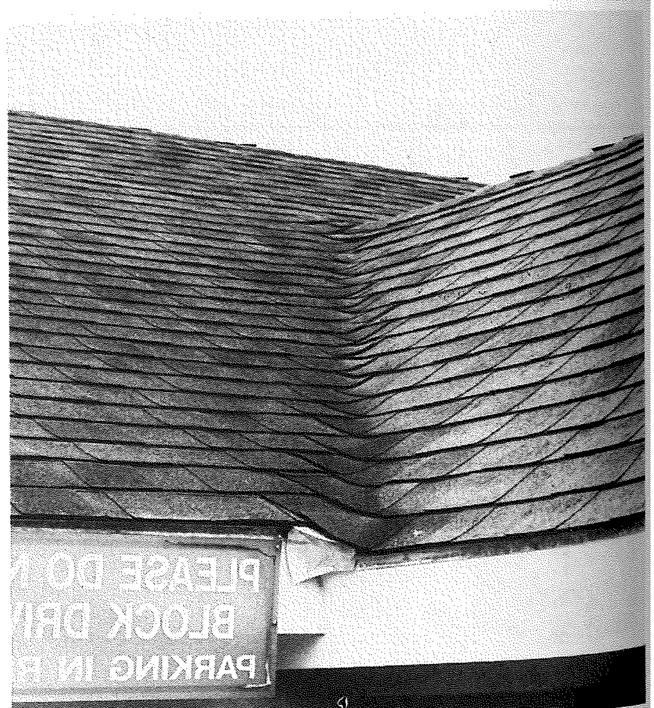


Figure 4-39 A woven valley

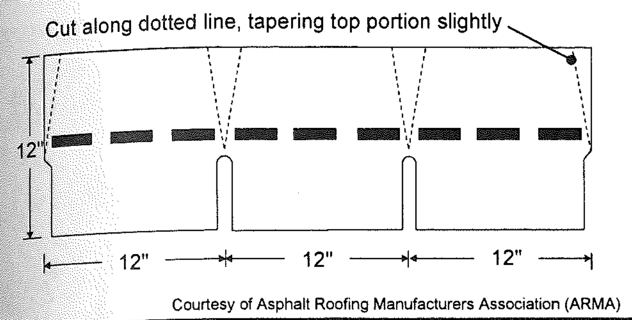


Figure 4-40 Fabrication of hip and ridge shingles from 3-tab strip shingles

nated 4-tab and 6-tab shingles, you also need to use special hip and ridge shingles. You can field-fabricate the cap shingles from the same material as the rest of the roof, but as above, the factory-supplied units save time.

With 2- and 3-tab shingles, or shingles with no tabs, you can cut hip and ridge units from standard shingles. Cut a 3-tab shingle down to three 12" x 12" units as in Figure 4-40. To get a neat, professional look, taper the lap portion of each unit so it's slightly narrower than the exposed part, as shown in Figure 4-41. To make cap shingles from 2-tab or no-tab shingles, trim units to a minimum of 9" x 12". Salvage parts of shingles left over from the rakes, hips, and valleys, and make them into cap shingles.

Install the hip units before you install the ridge units. Start shingling the hips at the eaves and work up slope toward the ridge. In high-wind areas, use roofing cement to secure the first hip unit. Trim the first hip unit so its edges overhang the eaves by ¼ to ⅜ inch, depending on the overhang you allowed for the starter course. Then temporarily tack another hip unit at the top of the hip. Snap a chalk line down the hip aligned with one or both edges of the two units as a guide for intervening hip units. That's shown in Figure 4-42. Trim the top hip units where they meet at the ridge, as shown in Figure 4-43.

To cap the end of a ridge above the hips, nail down the end ridge shingle as shown in Figure 4-44 and cut about 6 inches through the center of the shingle tab. Then nail down one flap, as shown in Figure 4-45 and fold the opposite flap down into a bed of roofing cement to cover the nail and seal the hip-ridge junction. See Figure 4-46.

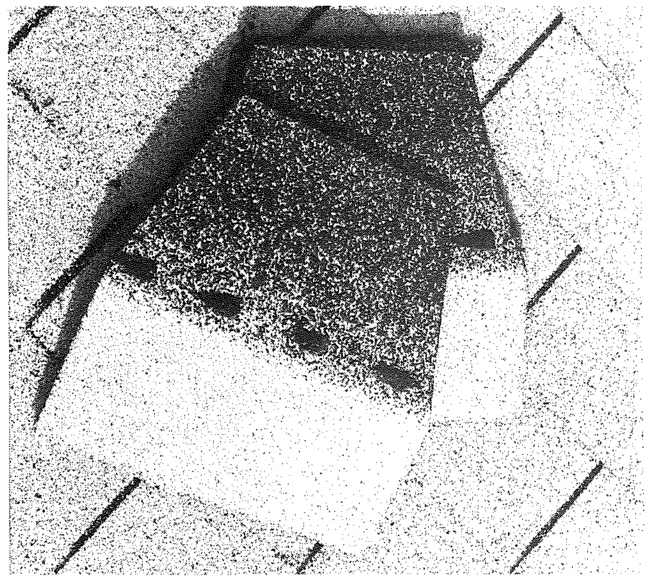


Figure 4-41 Cap shingles with tapered lap portions

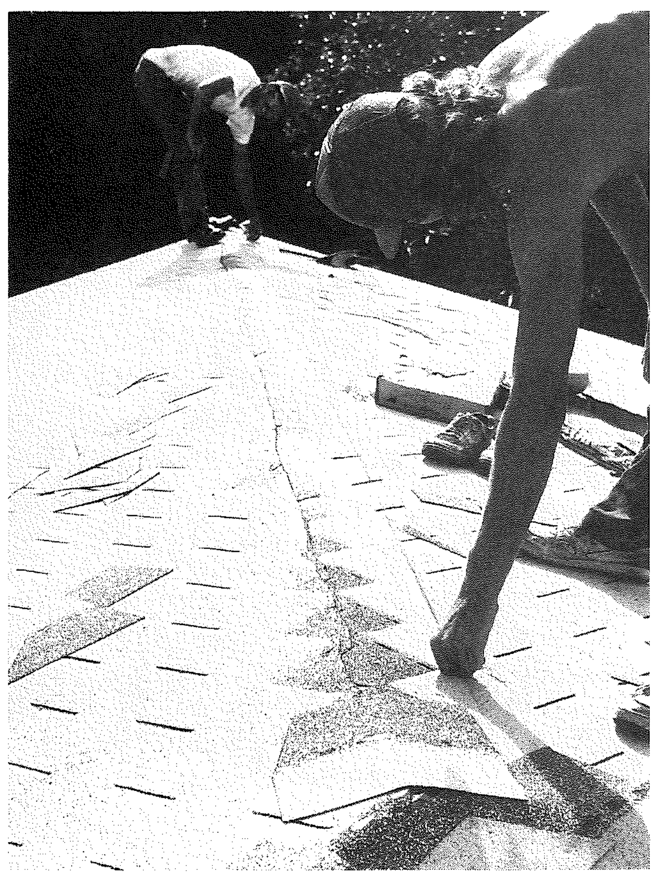


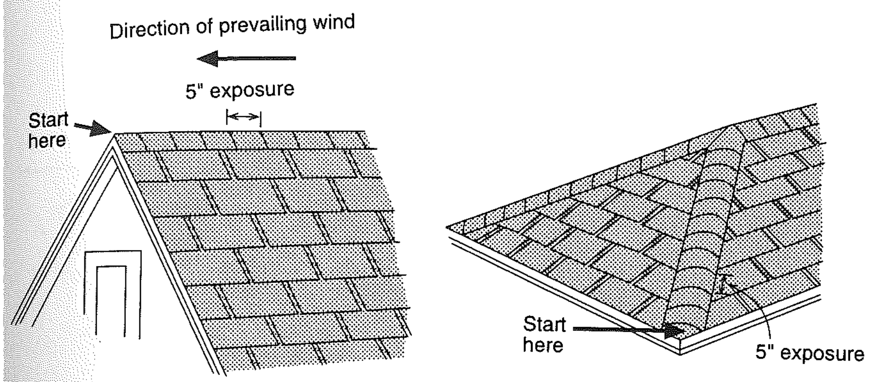
Figure 4-42 Snap a chalk line to line up hip units

Figure 4-43 Trim the uppermost hip units at the ridge

Figure 4-44 Install the first ridge unit above the hips

Figure 4-45 Cut the ridge unit and nail down one flap

Figure 4-46 Seal the hip-ridge juncture



Courtesy of Asphalt Roofing Manufacturers Association (ARMA)

Figure 4-47 Application of hip and ridge units

On a gable or hip roof, install ridge units at opposite ends and snap a chalk line along one or both edges to align the intervening ridge units. Install ridge shingles over a gable roof beginning at the end of the roof facing into the wind, as shown in Figure 4-47. Install ridge shingles on a hip roof starting at both ends and working toward the center of the ridge. You can also follow this procedure on a gable roof. When you reach the center of the ridge, trim a shingle to use as a cap over the last ridge units. Nail the cap and cover the nails with roofing cement, as in Figure 4-48.

Install hip and ridge units at a 5-inch exposure. Secure each unit with two fasteners, one on each side. Drive the fasteners 5½ inches back from the exposed end and 1 inch up from the edge of the shingle. See Figure 4-49.

On dormers, install the ridge units starting at the front of the dormer and working toward the main roof. Extend the last unit you install at least 4 inches onto the main roof. Split the part of the shingle that extends over the main roof down the center, and nail it into place as shown in Figure

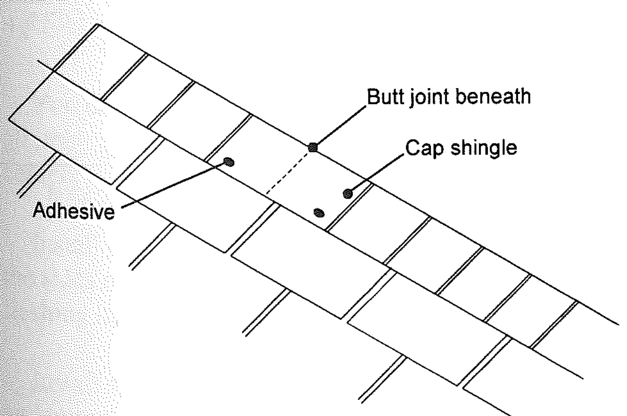
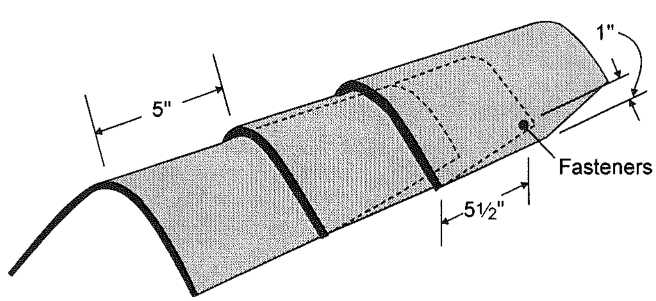


Figure 4-48 Capping the ridge units



Courtesy of Asphalt Roofing Manufacturers Association (ARMA)

Figure 4-49 Nail location for hip and ridge shingles

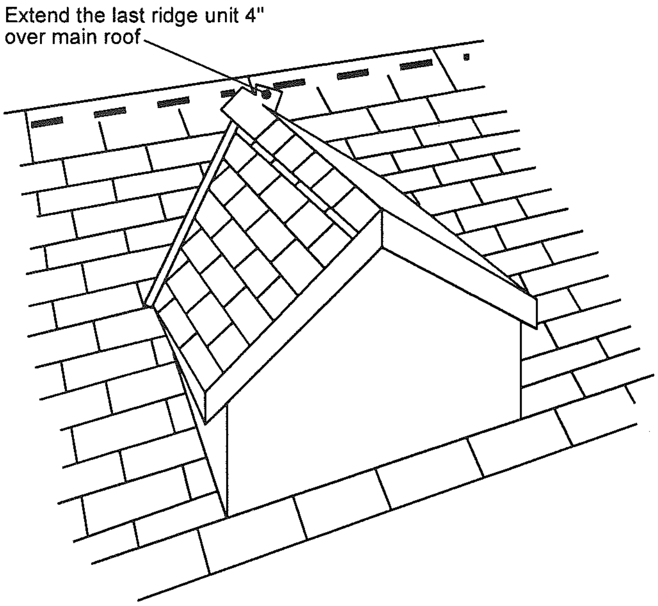


Figure 4-50 Application of ridge units over a dormer

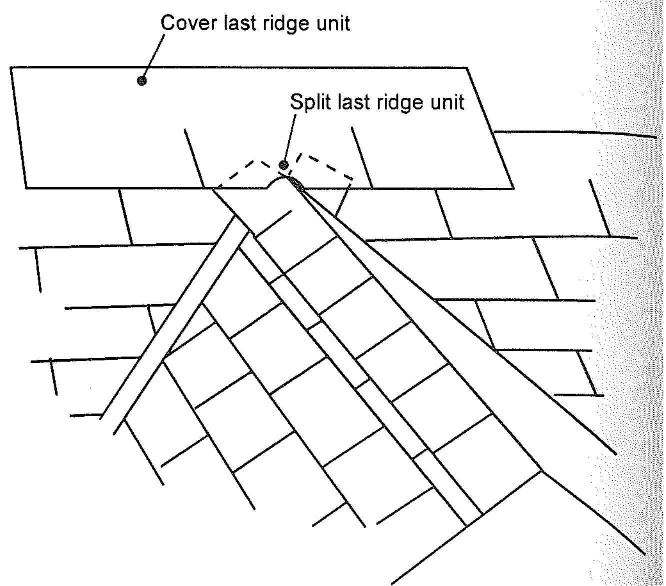
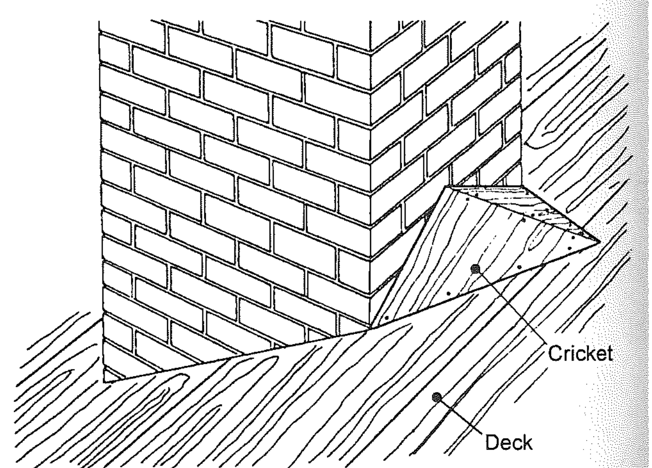


Figure 4-51 Covering the last dormer ridge unit

4-50. Then cover this last dormer shingle with shingles you apply to the main roof, as shown in Figure 4-51. If a cutout in a main roof shingle falls over the dormer ridge shingle, coat the dormer shingle with roofing cement under the main roof shingle. To provide extra waterproofing at the place where the dormer ridge and the main roof meet, install 6-inch-wide strips of water shield material between the last dormer ridge unit and the shingle beneath it.

Flashing at Chimneys and Other Vertical Structures

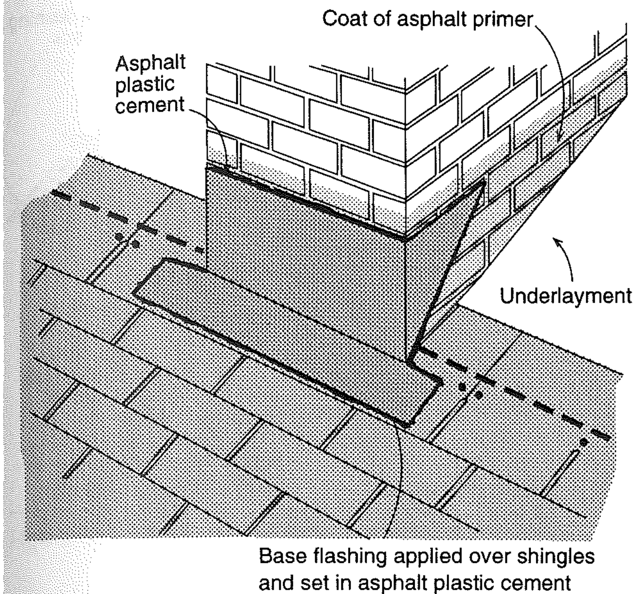
Any flashing turned up on a vertical surface is called a *base flashing*. Flashing built into the vertical surface and bent down over the base flashing is called *counter-flashing* or *cap flashing*.



Courtesy of Asphalt Roofing Manufacturers Association (ARMA)

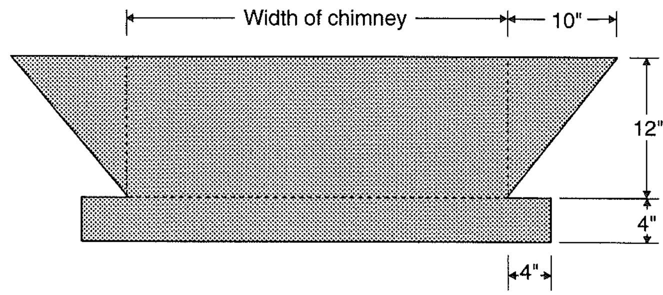
Figure 4-52 Location and configuration of chimney cricket

If the horizontal width of a chimney is greater than 2 feet, install a fabricated galvanized metal saddle flashing, or a wooden cricket, above the chimney, as in Figure 4-52. The cricket or saddle helps keep ice and snow from building up at the upper side of the chimney, and diverts rainwater around it. Build the saddle flashing or cricket with the same slope as the main roof.



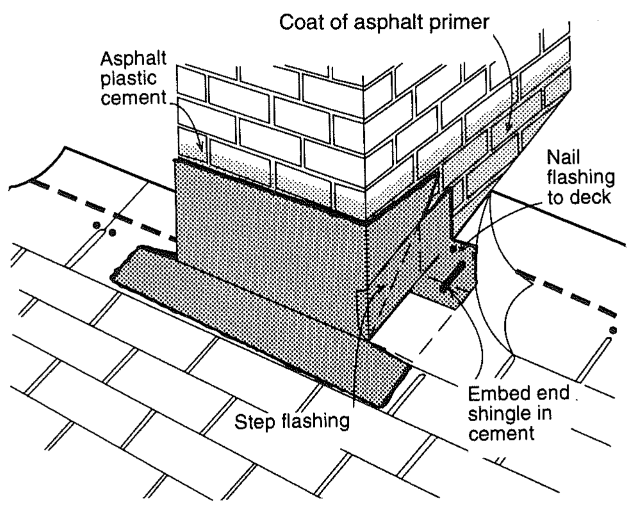
Courtesy of Asphalt Roofing Manufacturers Association (ARMA)

Figure 4-53 Application of base flashing at front of chimney



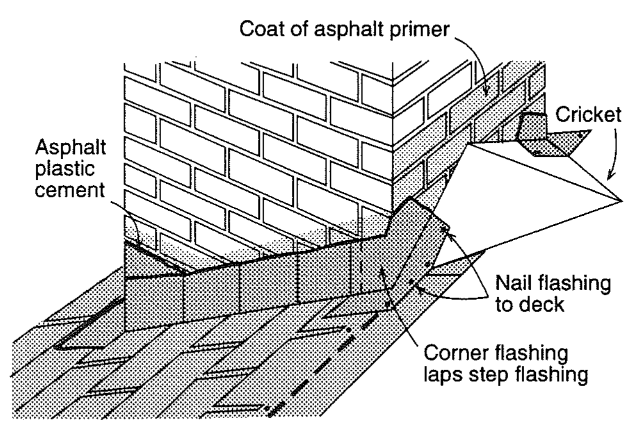
Courtesy of Asphalt Roofing Manufacturers Association (ARMA)

Figure 4-54 Pattern for cutting front base flashing



Courtesy of Asphalt Roofing Manufacturers Association (ARMA)

Figure 4-55 Application of base flashing at side of chimney



Courtesy of Asphalt Roofing Manufacturers Association (ARMA)

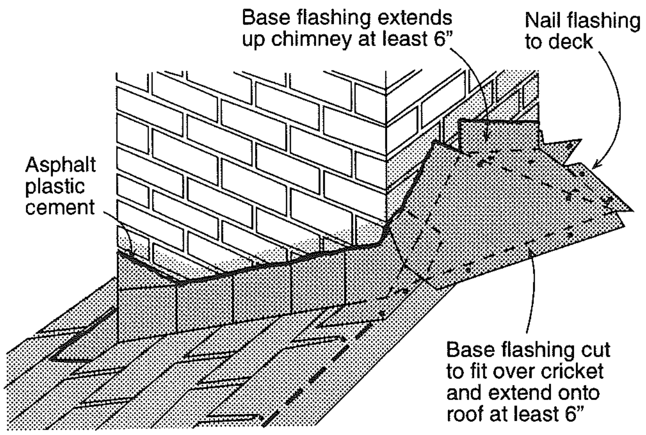
Figure 4-56 Application of corner base flashing at rear of chimney

Apply asphalt shingles up to the lower edge of a chimney before you install any metal flashing material. Then install the base flashing on the down-slope face of the chimney (Figure 4-53). Make this piece so the lower part goes at least 4 inches over the shingles and the upper section goes at least 12 inches up the chimney face. See Figure 4-54. Apply a bed of asphalt plastic cement over the shingles and masonry and set the entire flashing in it. Drive only enough nails through the flashing into mortar joints to keep the flashing in place until the cement sets. Apply a coat of asphalt primer to any masonry surface before you apply roofing cement. That seals the masonry and provides good adhesion between the cement and the masonry.

You can buy special flashing cements you can use at all temperatures and on wet or dry surfaces. This cement comes in one-gallon cans or five-gallon pails.

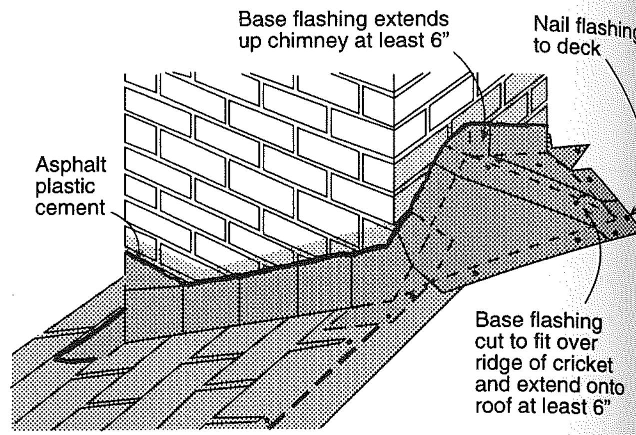
Install metal step flashing (baby tins) and shingles at the sides of the chimney, as shown in Figure 4-55. Step flashing installation is discussed in greater detail below.

Install the base flashing at the rear of the chimney and over the cricket, as in Figures 4-56, 4-57, and 4-58. Extend the flashing at least 6 inches onto the roof sheathing and 6 inches up the chimney.



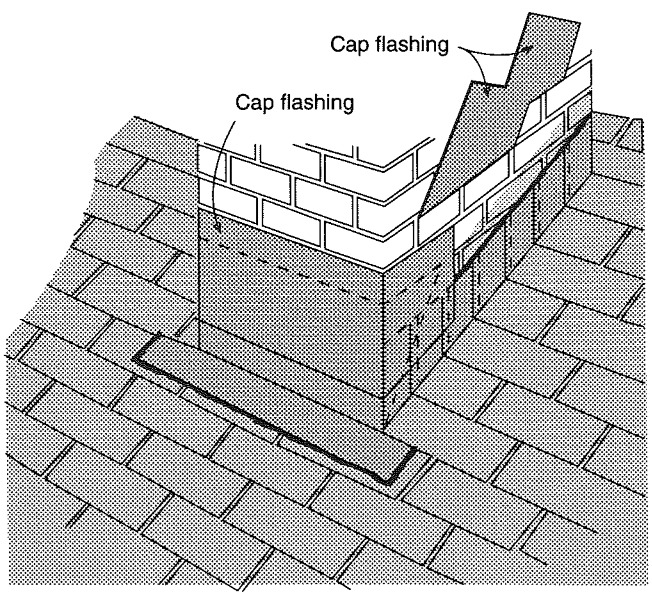
Courtesy of Asphalt Roofing Manufacturers Association (ARMA)

Figure 4-57 Application of base flashing over cricket



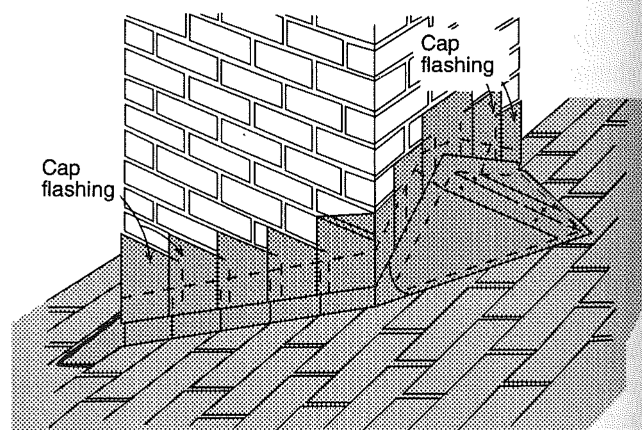
Courtesy of Asphalt Roofing Manufacturers Association (ARMA)

Figure 4-58 Application of base flashing over ridge of cricket



Courtesy of Asphalt Roofing Manufacturers Association (ARMA)

Figure 4-59 Application of cap flashing at front and side of chimney

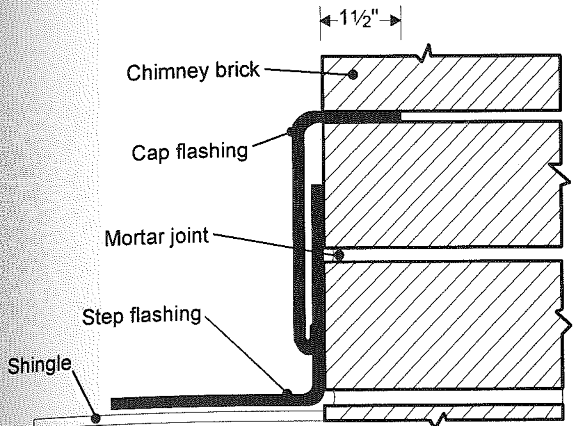


Courtesy of Asphalt Roofing Manufacturers Association (ARMA)

Figure 4-60 Application of cap flashing at side and rear of chimney

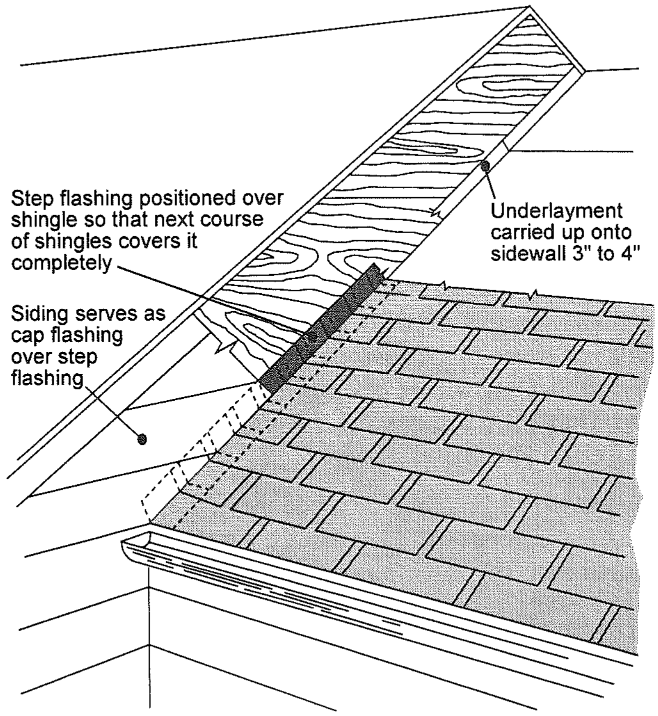
Install shingles over the cricket, or up to the cricket valleys. Install any shingles you apply over the cricket in a bed of asphalt plastic cement. You don't have to install shingles over a metal cricket if you can't see it from the ground or surrounding viewpoints.

Install metal cap flashing (Figures 4-59, 4-60 and 4-61) not more than 3 bricks high. Chisel and rake clean the mortar joints to a depth of $1^1/_2$ inches before you install the cap flashing. Make some mortar that's 1 part portland cement and 3 parts fine mortar sand, and refill the joints with it. Wet the joints before you apply the fresh mortar.



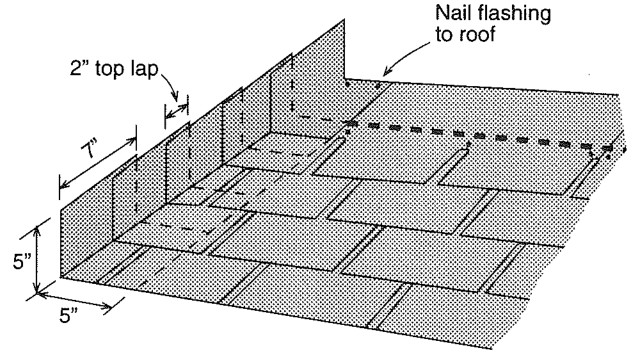
Courtesy of Asphalt Roofing Manufacturers Association (ARMA)

Figure 4-61 Application of cap flashing



Courtesy of Asphalt Roofing Manufacturers Association (ARMA)

Figure 4-62 Application of step flashing against vertical side



Courtesy of Asphalt Roofing Manufacturers Association (ARMA)

Figure 4-63 Application of step flashing

Or, you can caulk the joints after you install the flashing pieces. Install the cap flashing at the front of the chimney in one piece, as shown in Figure 4-59. Install the cap flashing at the sides and back of the chimney as individual units, beginning at the lowest point. Install each piece into mortar joints so each cap flashing unit overlaps the base flashing by at least 3 inches, as in Figure 4-60. Bend the last piece of cap flashing around the upper corners of the chimney. Use a good grade of butyl rubber sealant to seal the flashing joints at the chimney corners.

Make all exposed flashing (such as cap flashing) with its bottom edge turned under ½ inch, as in Figure 4-61. This adds stiffness against the wind and prevents snow from packing in under the flashing.

Use galvanized metal step flashing where a sloping roof meets a vertical surface such as the chimney shown in Figures 4-55 through 4-61, or the vertical side wall in Figure 4-62. The step flashing is later protected by cap flashing installed in the masonry, or by siding. The cap flashing makes a good water seal even when the roof and chimney (or wall) move independently due to expansion or settlement. You can see cap flashing in Figures 4-59 through 4-61. There is no cap flashing in Figure 4-62 because the siding takes the place of cap flashing. Overlap the step flashing joints at least 2 inches, and extend the metal under the shingles and up the chimney about 4 to 5 inches. See Figure 4-63. Lap the cap flashing down over the base flashing at least 3 inches and extend it down to within 1 inch of the finished roof. See Figure 4-61.

Step Flashing

Install step flashing as an individual piece for each course of shingles you lay by starting at the bottom and ending at the top of the chimney or side wall. Place the first piece of step flashing over the unexposed area of the shingle next to the lower edge of the chimney (refer back to Figure 4-55), or over the starter-course shingle at a side wall, as shown in Figure 4-62. Install a shingle over the step flashing so its butt is flush with the lower edge of the flashing. Install the next piece of step flashing over the shingle 5 inches above the butt. Install the next shingle so its butt is in line with the step flashing. Then, the horizontal leg of each piece of step flashing will cover the unexposed part of the underlying shingle. And, each piece of step flashing will be covered by the exposed part of the overlying shingle. See Figure 4-63. Continue this way until you've flashed and shingled the entire roof-wall intersection.

Use roofing cement to embed the end of each shingle which extends over the step flashing. Cut each piece of step flashing 10 inches wide and 2 inches longer than the shingle exposure. With 3-tab shingles, make each piece 7 inches long, providing a 2-inch lap.

Where a sloping roof and vertical wall meet, extend each piece of step flashing you install at least 5 inches up the wall and at least 5 inches under the shingles, as in Figure 4-63. Embed the horizontal leg of each piece of step flashing into roofing cement and secure it with two nails. Since the roof could eventually settle, don't nail the flashing to the wall. Cover the vertical leg of each piece of step flashing later with siding or cap flashing (in brick or stucco walls). In either case, extend the underlayment at least 3 inches up the wall, as in Figure 4-62.

These rules also apply when you install T-lock shingles (shown in Figure 4-96 near the end of the chapter), except that the length of flashing required will vary, depending on the type and size of shingle. If you install siding material correctly, it will serve as cap flashing material as in Figure 4-62.

Install continuous flashing like the one in Figure 4-64, where a sloping roof and a vertical side wall meet to form a horizontal line. One example of this is the intersection of a sloping roof and the front of a dormer. Another is a shed roof intersecting a wall, as in Figure 4-65.

To install continuous flashing, embed it into roofing cement and nail it over the last course of shingles you apply to the roof deck. Nail it above the cutouts of the shingles below it, as shown in Figure 4-65. Don't nail the flashing to the wall. This way, the roof and wall can move independently. Instead, install the flashing before the siding. If the siding's already installed, pry up the lowest siding board enough to slip the flashing beneath it.

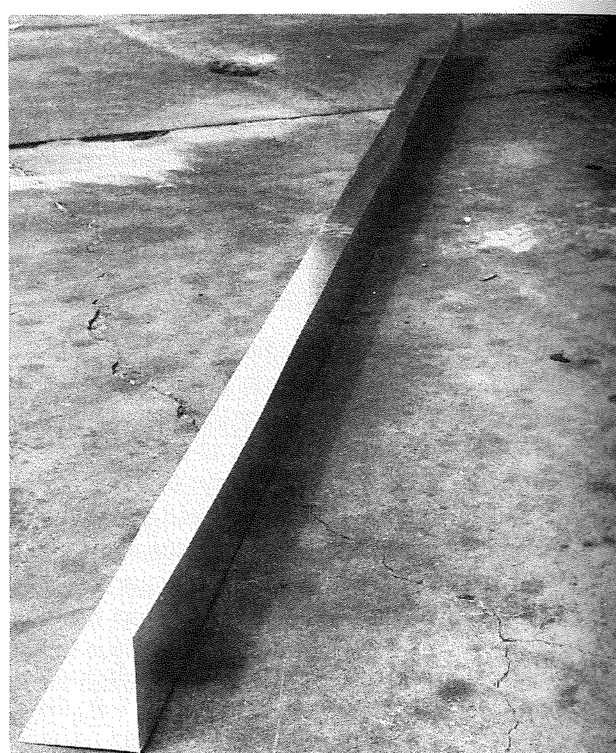


Figure 4-64 Continuous flashing

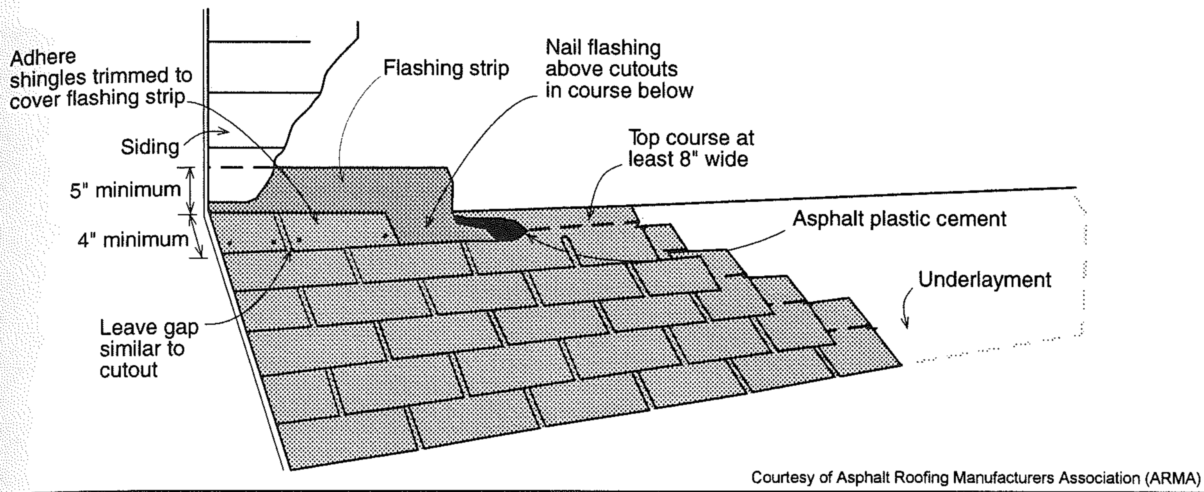


Figure 4-65 Application of flashing against vertical front wall

If the side wall is brick, use a masonry saw to remove 1½ inches of mortar from a joint at a point about 5 inches above the roof-wall intersection. Bend the top of the flashing strip so you can insert it into the joint. Close the joint with mortar or caulking compound.

If the wall finish is stucco, saw out a joint and re-pack it with mortar or caulk. After you get the flashing in, cover it with one course of shingles trimmed to fit over the flashing. Nail the shingles into place and cover each nail head with roofing cement. Use 26-gauge galvanized metal flashing and extend it at least 5 inches up the wall and 4 inches over the last shingle course, as in Figure 4-65. Where front-wall flashing turns a corner (at a dormer, for example), extend the flashing at least 7 inches around the corner. From there on, install step flashing up the slope.

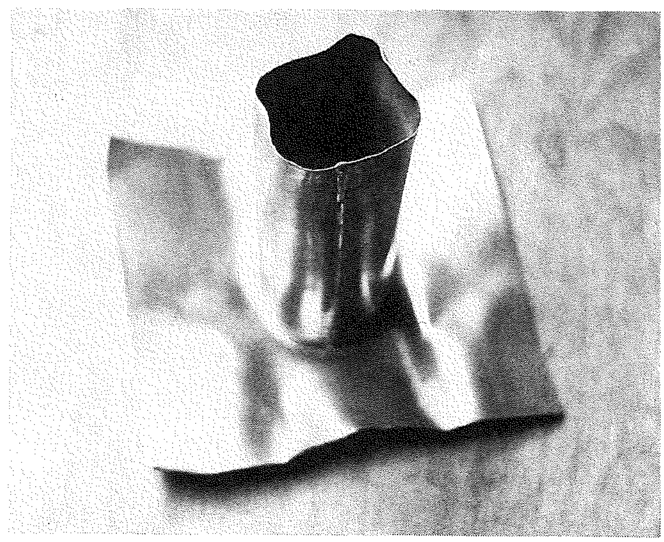


Figure 4-66 Lead vent flashing

Flashing Soil Stacks and Vents

Normally, you flash vent pipes with a one-piece lead flange and sleeve (collar) as in Figure 4-66. Turn the top of the sleeve down into the stack. Look ahead to Figure 4-73. Or you can cut a lead sleeve flush with the top of the vent pipe and counterflash it with lead extending 4 inches down the outside of the pipe and 2 inches down the inside of the pipe, as shown in Figure 4-67.

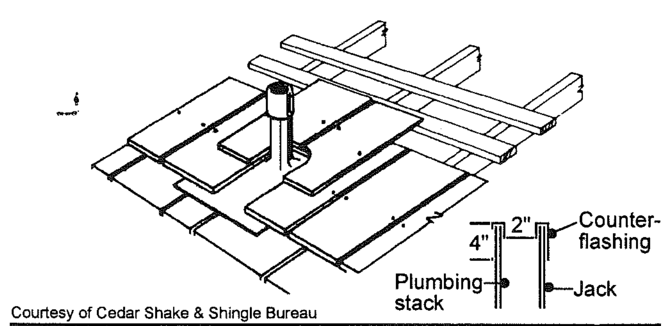


Figure 4-67 Counterflashed vent flashing

Another popular type of vent flashing is a rubber flange, which you slip down over the pipe, as in Figure 4-68. This type of flashing is often installed on metal roof decks. Vent pipes are normally 1½ to 3 inches in diameter.

When you come to a vent pipe, install shingles up to the bottom edge of the pipe, as in Figure 4-69. If the top edge of a shingle hits the pipe, notch it so it fits around the pipe, as shown in the figure. If a shingle ends up over the pipe, cut a hole in the shingle and slip it over the pipe, as in Figure 4-70.

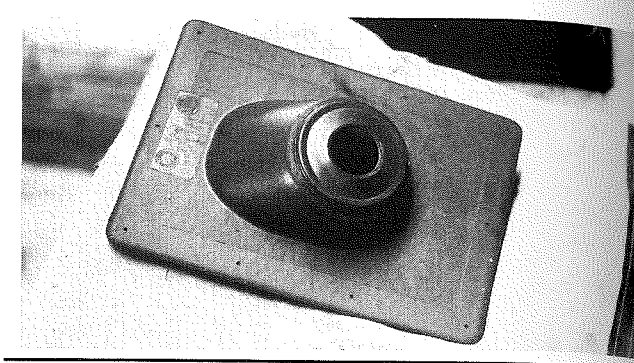
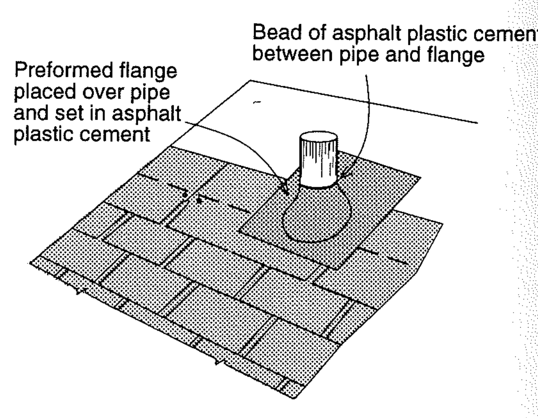


Figure 4-68 Rubber vent pipe flange

Figure 4-69 Shingle up to the bottom of vent pipe

Slip the flange over the pipe and underlying shingle, as shown in Figure 4-71. Embed the flange and overlying shingle in roofing cement. See Figures 4-72 and Figure 4-73. Always install a full-width shingle over the pipe (Figure 4-74). Insert a single tab along the shingle course to rearrange and offset the joints so there won't be a joint above the pipe.



Courtesy of Asphalt Roofing Manufacturers Association (ARMA)

Figure 4-70 Application of shingle over vent pipe

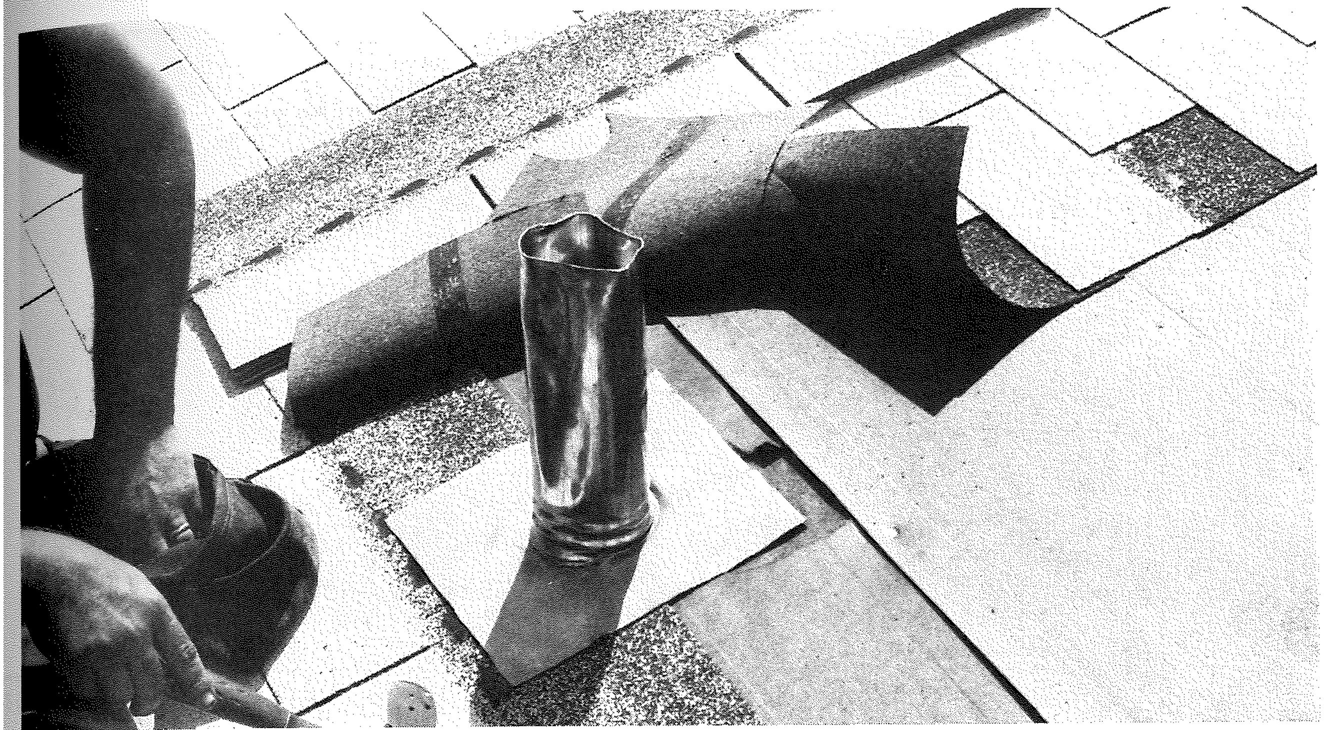
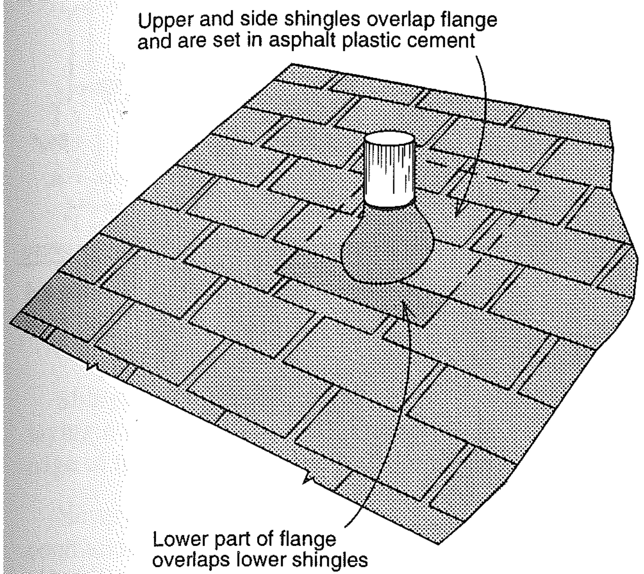


Figure 4-71 Slip the flange over the vent pipe and underlying shingle

Figure 4-72 Embed the flange in roofing cement

Figure 4-73 Embed the overlying shingle in roofing cement

Figure 4-74 Arrange to install a full shingle over the vent pipe



Courtesy of Asphalt Roofing Manufacturers Association (ARMA)

Figure 4-75 Bottom portion of vent flange exposed

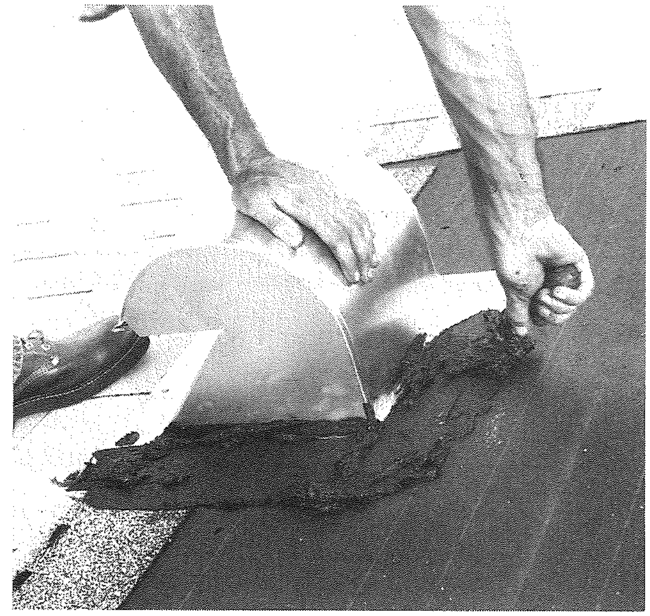


Figure 4-76 Applying roofing cement over the flange of a heater vent

Continue shingling around and above the pipe, trimming successive shingle courses to fit around the pipe. Nail shingles over the vent pipe so the nails don't go into the metal flashing flange. Allow a ½-inch space between the vent sleeve and the overlying shingle so debris won't get caught between the shingle and the vent stack. Most of the debris there will be dislodged mineral granules which won't wash away easily if there's no gap. You don't need to cover the down-slope part of the flange with shingles. In fact, I recommend that you leave the bottom third of any vent flashing flange exposed, as shown in Figure 4-75. An exposed flange isn't as likely to trap debris, but it doesn't look as neat. Let your customer have the final word on this.

For added leak protection on low-sloped roofs, embed a strip of mineral-surfaced roll roofing into roofing cement under the vent pipe flange.

When you come to a larger roof penetration such as a heater vent, nail down the flange of the vent and install shingles up to the lower edge of the vent. Apply roofing cement over the flange, as in Figure 4-76. Cut shingles to fit around and above the vent as in Figure 4-77. Don't drive shingle nails through the vent flange.

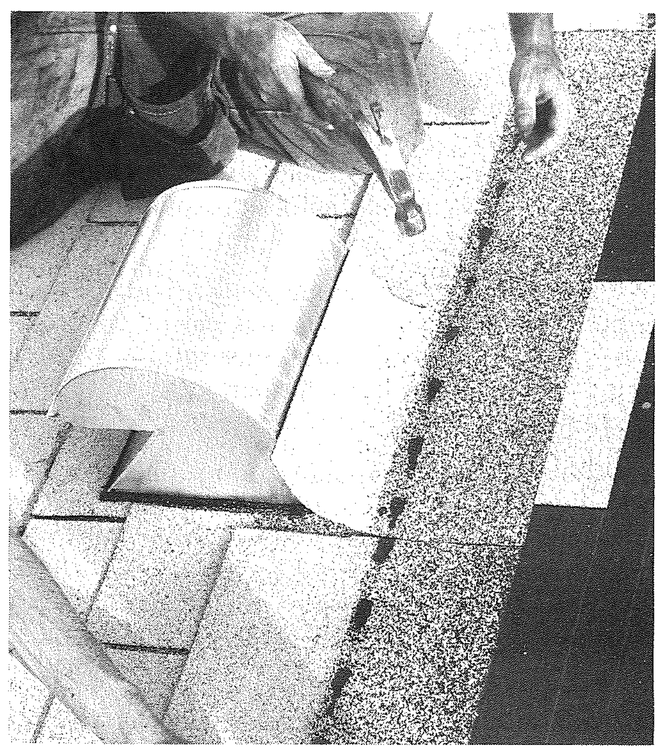


Figure 4-77 Installing a course above the vent

Application	Nail length (inches)
Roll roofing on new deck	1
Strip or individual shingles on new deck	1¼
Roofing over old asphalt roofing	1½ to 2
Roofing over old wood shingles	2

Figure 4-78 Recommended nail lengths

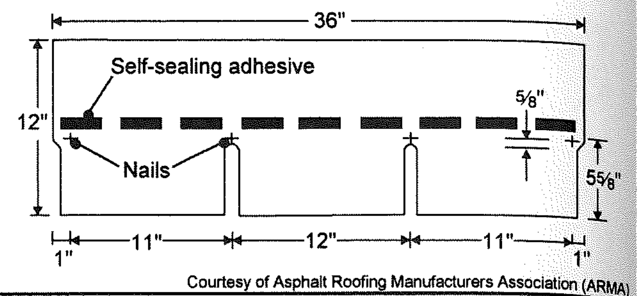


Figure 4-79 Nail locations for 3-tab strip shingle

Fasteners

Install asphalt roofing materials over solid roof sheathing. Use 11- or 12-gauge hot-dipped galvanized or aluminum roofing nails with heads that are at least 3/8 inch in diameter and barbed or deformed shanks that are 1 to 2 inches long. Recommended lengths are shown in Figure 4-78. When re-roofing with asphalt shingles, use nails that are long enough to go at least 3/4 inch into the sheathing. You can make sure the nails you use are long enough by checking the underside of the sheathing to see if they come through it. Allow for about 2½ pounds of nails per square when you install asphalt shingles.

When you install shingles across a roof, start nailing from the end nearest the shingle you just laid and proceed across. This will prevent buckling. Drive nails straight so the nail head doesn't damage the surface of the shingle. Don't drive nails into knotholes or cracks in the sheathing. If you have to remove a nail, seal the hole with roofing cement or remove and replace the entire shingle.

Drive nails into the shingle along a line just below the factory-applied adhesive strip. Depending on what part of the country you're building in, use at least four nails for each 3-tab shingle. When you're laying a shingle at a 5-inch exposure, drive the nails along a line 5⅝ inches above the butt edge of the shingle.

Earlier you recall we said not to nail in a straight line, in order to avoid splitting the sheathing boards. But in this case, nail placement is very important so the adhesive strip will do its job. That's not a problem with starter-course material, so stagger-nail when you can. But in this case, nail in a straight line. Drive the two outermost nails 1 inch from each end of the shingle. Center the innermost nails over each cutout, as in Figure 4-79.

Two-tab shingles also need at least four nails. When you're laying a shingle at a 5-inch exposure, drive the nails along a line 5⅝ inches above the butt edge of the shingle, and at 1 and 13 inches from each end of the shingle, as in Figure 4-80.

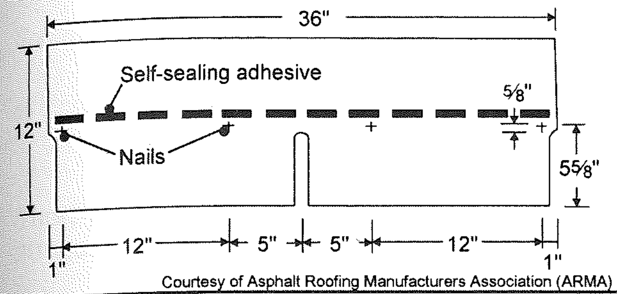


Figure 4-80 Nail locations for 2-tab strip shingle

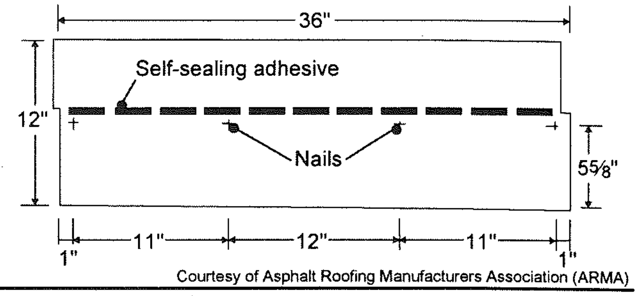


Figure 4-81 Nail locations for no-cutout strip shingle

Shingles with no cutouts also require at least four nails. When you're laying a shingle at a 5-inch exposure, drive nails 5⁵/₈ inches above the butt edge of the shingle, and 1 and 12 inches from each end, as in Figure 4-81.

Never use fewer than four nails to install each strip shingle. Some roofing contractors don't drive the fourth nail because it's hidden under the overlapping shingle above. This is called "three-nailing" and I don't recommend it.

Many building codes, especially in high wind and hurricane areas, require six nails. Check with your building inspector beforehand, and make the necessary material and labor cost adjustments to your estimate.

Stapling

I also don't recommend you use staples because they tend to come loose eventually. Roofing contractors who hand-nail shingles (and explain to their clients why they do so) have more work than they can handle, at a price that yields high profit. Many have a waiting list of customers which includes general contractors. That's because the quality and durability of their work is consistently above that of their competitors.

If you decide to use staples, use them only on new construction to fasten wind-resistant asphalt shingles with factory-applied adhesives. If the old roofing has been removed, you can use staples for re-roofing. Use galvanized staples that are at least 16 gauge with a minimum crown of $^{15}/_{16}$ inch. Make sure the staples are long enough to go at least $^{3}/_{4}$ inch into the sheathing. Locate staples the same way as roofing nails.

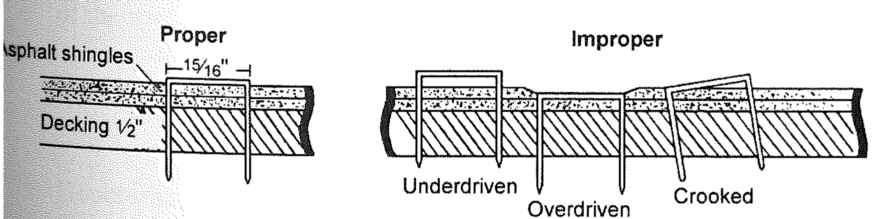


Figure 4-82 Driving staples

It's very important to hold the staple gun so the staples go in at the correct angle so the crown is practically flush with the shingle surface. And be sure to adjust the air gun so the staples go far enough into the sheathing. Figure 4-82 shows good and bad stapling.

Be aware that a pneumatic stapler has no "feel" to it. It won't be obvious when you're stapling into a joint or knothole. In warm weather, it's easy to drive a staple all the way through a soft asphalt shingle. Wind will also tear off a shingle unless you drive the crown of the staple parallel to the long shingle edge.

Number of Shingles Required per Square

Asphalt strip shingles are usually 3′ x 1′ and come in 3-bundle squares (for lighter-weight shingles), or 4-bundle squares (for heavier shingles). That means you need three or four bundles of asphalt strip shingles (whichever the case), laid at the recommended exposure (usually 5 inches) to cover a square of roofing surface.

Whatever the size or exposure a strip shingle is, you can figure out how many shingles you need for each square of roof surface by:

$$\textbf{Shingles/Square} = \frac{\textbf{100 SF}}{\textbf{Shingle Length (in.) x Exposure (in.)}} \textbf{ x 144 sq. in./SF}$$

Equation 4-1

▼ **Example 4-1:** Assume you're using 3′ x 1′ asphalt strip shingles at a 5-inch exposure. Find the number of shingles you need to cover one square of roof area.

$$\text{Shingles/Square} = \frac{\text{100 SF}}{\text{36 in. x 5 in.}} \text{ x 144 sq. in./SF}$$

$$= \text{80 shingles per square}$$

You shouldn't "stretch" the exposure, but you can install shingles at an exposure *less* than what's recommended. In this case, the extra shingles you need per square, in terms of a percentage-of-increase factor, are:

$$\textbf{Percentage-of-Increase Factor} = \frac{\textbf{Recommeded Exposure}}{\textbf{Actual Exposure}}$$

Equation 4-2

▼ **Example 4-2:** An area of 20 squares is to be covered with 3-tab strip shingles. Assume the recommended exposure is 5 inches, then find the number of shingles required to install shingles at:

a) 4½ inches, or

b) 4 inches

Solution:

a) Percentage-of-Increase Factor, 4½" exposure $= \dfrac{5 \text{ in.}}{4\frac{1}{2} \text{ in.}}$

$= 1.10$

Thus, you increase the shingle quantity by 10 percent:
20 squares x 1.1 = 22 squares

b) Percentage-of-Increase Factor, 4" exposure $= \dfrac{5 \text{ in.}}{4 \text{ in.}}$

$= 1.20$

Thus, you increase the shingle quantity by 20 percent:
20 squares x 1.2 = 24 squares

Number of Shingle Courses

You can determine the number of shingle courses required to cover a wall or roof by:

$$\textbf{Courses} = \frac{\textbf{Dimension of Structure}}{\textbf{Exposure}}$$

Equation 4-3

where the Dimension of Structure is the wall height, or the width of a roof section, measured from the eaves to the ridge, along the top of a common rafter.

You can also use Equation 4-3 to determine the number of hip and ridge units required (if you know the lengths of the hips and ridge).

▼ **Example 4-3:** Assume an exposure of 5 inches, then find the number of courses of 12-inch-wide asphalt shingles required to cover the roof of the building diagrammed in Figure 4-83. The roof slope is 5 in 12.

Solution: From Column 2 of Appendix A, the actual width of each side of the roof, measured along any rafter from eaves to ridge is:

Length = 13' x 1.083 = 14.1 linear feet

From Equation 4-3, the number of shingle courses required on one side of the roof is:

$$\text{Courses} = \frac{14.1 \text{ ft.} \times 12 \text{ in.} / \text{LF}}{5 \text{ in.}}$$

= 33.84, rounded to 34 courses.

Double that for a total of 68 courses for both sides of the roof. Remember, this formula produces the number of courses for a *section* of roof. In this case, you multiply by 2 because both sides of the roof are the same.

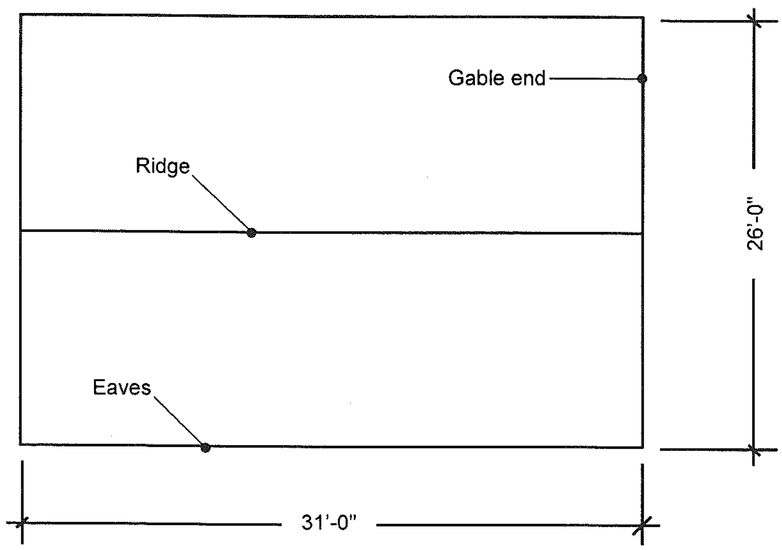


Figure 4-83 Gable roof example

Notice that the calculated answer in the previous example didn't come out to an even number of courses. Since it's impractical to install 0.84 of a course, we changed the answer to an even 34 courses, which will result in slightly less exposure throughout. We also could have used 33 courses, with slightly more exposure. Either way, use the following equation to find the exact exposure for this example.

$$\textbf{Exposure} = \frac{\textbf{Dimension of Structure}}{\textbf{Number of Courses}}$$

Equation 4-4

▼ **Example 4-4:** Determine the consistent exposure required to install:

a) 33 courses, or

b) 34 courses of shingles on the roof described in Example 4-3.

Solution: The consistent exposures are:

a) For 33 courses:

$$\text{Exposure} = \frac{14.1 \text{ ft. x } 12 \text{ in./LF}}{33}$$

= 5.127 inches, or 5⅛ inches (rounded off)

Since you shouldn't "stretch" the exposure, use 34 courses in this case, with a decreased exposure.

b) For 34 courses:

$$\text{Exposure} = \frac{14.1 \text{ ft. x } 12 \text{ in./LF}}{34}$$

= 4.98 inches, which rounds to 5 inches

There's another way you can install shingles on roofs or walls whose dimensions aren't evenly divisible by the shingle exposure. To do this, apply courses at the recommended exposure and decrease the exposure near the ridge so you finish with a full shingle width at the ridge. It's better to shorten than to stretch the exposure of the shingle near the ridge. This method for shortening an exposure is called "stacking" the shingles.

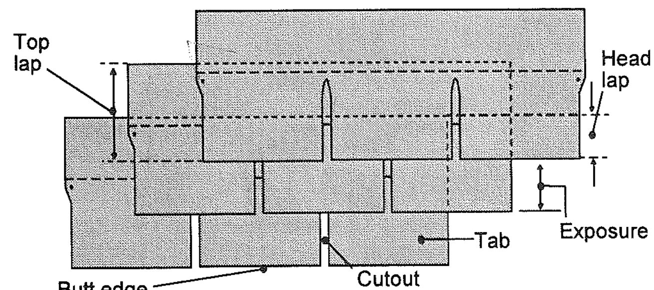


Figure 4-84 Exposure diagram

Head Lap, Top Lap and Exposure

Head lap is where shingles (or other roof coverings) are three layers thick. Top lap is where shingles (or other roof coverings) are at least two layers thick. See Figures 4-84 and 4-85. Thus, the 7-inch lap on a 12-inch-wide shingle, where the shingles are two layers thick, is the top lap. The 2-inch lap where the shingles are three layers thick is the head lap, as shown in Figure 4-84. Exposure is the part of the shingle not covered by the next course of shingles. The relationships between head lap, top lap and exposure are given in the following equations, where TL = top lap, W = width of shingle, E = exposure, and HL = head lap.

$$\text{Top Lap} = W - E, \text{ or} \qquad \text{Equation 4-5}$$

$$\text{Top Lap} = E + HL \qquad \text{Equation 4-6}$$

$$\text{Head Lap} = TL - E, \text{ or} \qquad \text{Equation 4-7}$$

$$\text{Head Lap} = W - 2E \qquad \text{Equation 4-8}$$

$$\text{Exposure} = \frac{W - HL}{2} \qquad \text{Equation 4-9}$$

Coverage Based on Number of Shingle Plies

Shingle coverage is often designated as single, double or triple, depending on the number of plies or layers of shingles. The number of plies is defined as the number of shingle layers at the head lap. Figure 4-85 shows 3-ply construction.

If the number of plies isn't the same throughout the roof, coverage is generally considered as the number of layers installed over a majority of the roof area. Most strip shingles and T-lock shingles are designed for double coverage. To get two layers of shingles over an entire roof, overlap shingles by a bit more than half. Overlap by slightly more than two-thirds to get triple coverage.

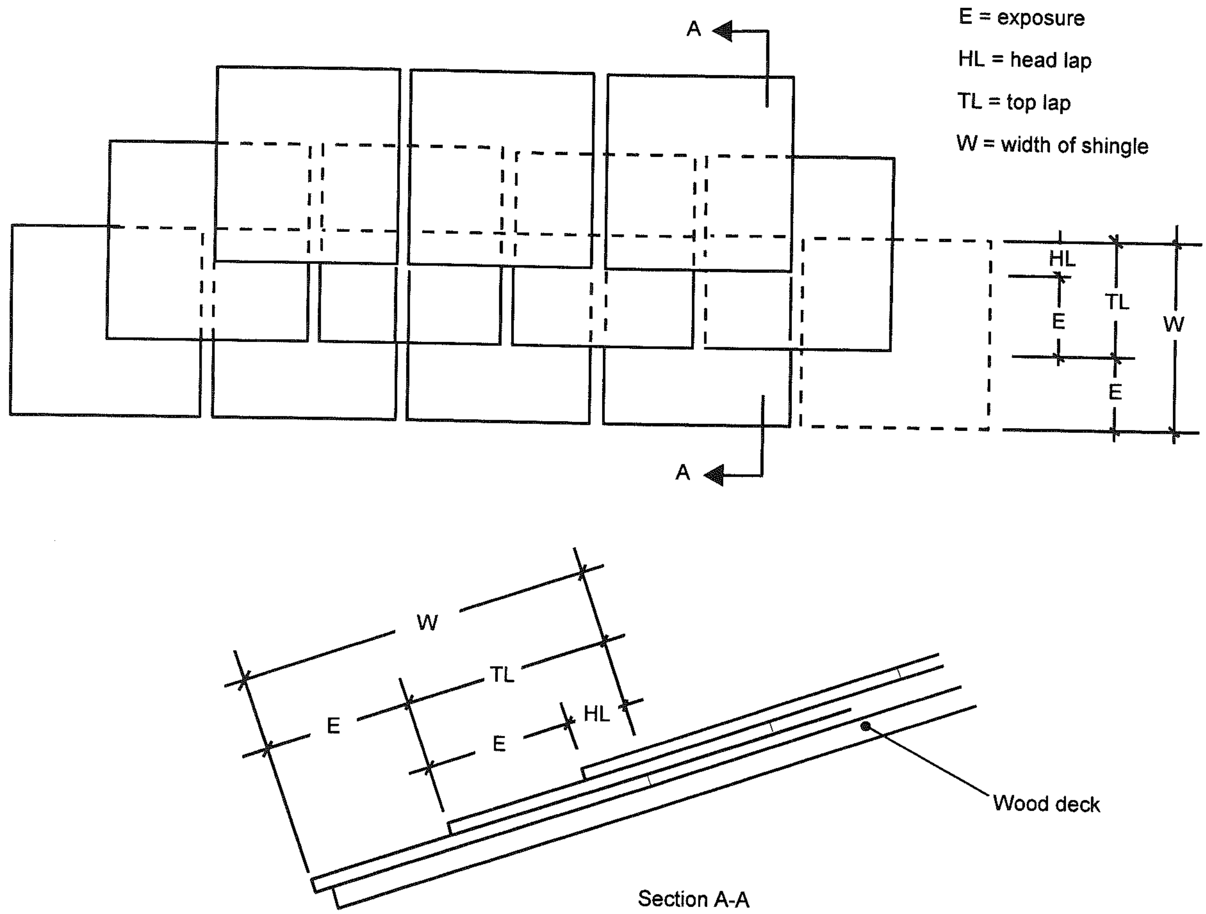


Figure 4-85 Head lap, top lap and exposure

Sometimes roof coverage specifications call for the acceptable minimum number of shingle plies.

▼ **Example 4-5:** Assume that 3-ply coverage is specified, then find the maximum exposure allowed to apply 12-inch-wide asphalt shingles with a minimum of a 2-inch head lap.

Solution: From Equation 4-9, the maximum allowable exposure is:

$$E = \frac{12\text{ in.} - 2\text{ in.}}{2}$$

$$= 5\text{ inches}$$

Estimating Asphalt Strip Shingle Quantities

First, take off quantities for asphalt strip shingles in square feet. Then, convert these quantities into the number of bundles of shingles required. The total quantity of shingles required must include material for the starter course, hip and ridge units, cutting waste at the rakes, hips and valleys, and waste due to crew errors.

Starter Course

You can find the amount of field-fabricated starter-course material required by:

Starter Course (SF) =Eaves (LF) x Exposed Area (SF/LF) **Equation 4-10**

You can find the coverage per linear foot of shingle, by:

$$\textbf{Area (SF/LF)} = \frac{\textbf{Exposure (in.)}}{\textbf{12}}$$ **Equation 4-11**

▼ **Example 4-6:** Assume a 5-inch exposure, then find the coverage of starter-course material in square feet per linear foot of eaves.

Solution: The coverage is:

$$\text{Area} = \frac{5}{12} = 0.42 \text{ square feet per linear foot}$$

As a convenience, use Figure 4-86 to quickly determine the area-per-linear-foot values for shingles installed at various exposures along the eaves.

Sometimes you need to know the *number* of starter-course units. The number of eaves shingles required at any given eaves is:

$$\textbf{Number of Eaves Shingles} = \frac{\textbf{Eaves Length (ft.)}}{\textbf{Shingle Length (ft.)}}$$ **Equation 4-12**

Estimate eaves units carefully, section by section. The high cost of some materials, and the inconvenience and delay caused when you're short of materials, makes underestimating eaves materials very expensive.

▼ **Example 4-7:** Assume application of 10-inch-long shingles, then find the number of eaves shingles required for the roof of the building diagrammed in Figure 4-83.

Solution: The number of eaves shingles required along each eaves is:

$$\text{Number of Eaves Shingles (each eaves)} = \frac{31 \text{ feet}}{.83 \text{ feet}} = 38 \text{ (rounded up)}$$

Because there are two eaves in this example, you need to order 76 shingle units.

Exposure (inches)	Area covered (SF) per LF of shingle	Exposure (inches)	Area covered (SF) per LF of shingle
3	0.25	9	0.75
3½	0.29	9½	0.79
3¾	0.31	10	0.84*
4	0.34*	10½	0.88
4¼	0.35	11	0.92
4½	0.38	11½	0.96
4¾	0.40	12	1.00
5	0.42	12½	1.04
5⅛	0.43	13	1.08
5¼	0.44	13½	1.13
5½	0.46	14	1.17
5⅝	0.47	14½	1.21
5¾	0.48	15	1.25
6	0.50	15½	1.29
6½	0.54	16	1.34*
7	0.58	16½	1.38
7½	0.63	18	1.50
8	0.67	20	1.67
8½	0.71	22	1.84*

*For the sake of cautious estimating, I round up the answer for 4, 10, 16 and 22 inches of exposure, respectively. This results in quantities that are a bit long, but safe.

Figure 4-86 Area of coverage per linear foot of eaves

Asphalt shingle manufacturers recommend that the starter course and first course overhang the eaves and rake by ¼ to ⅜ inch. However, you don't have to increase your order to account for that since the added area is so small.

Cutting Waste at Rakes, Hips and Valleys

Don't forget to allow for shingles lost due to cutting waste at rakes, hips and valleys. Use Figure 4-87 to account for wasted material. The table doesn't include material wasted due to crew error. The table assumes 3′ x 1′ strip shingles laid at a 5-inch exposure.

Ridge and Hip Units

Using a 12-inch-wide shingle, you'll need 1 square foot of shingles for each linear foot of hip and ridge. Assuming a conscientious and prudent crew that uses every salvageable single-tab shingle available from material

Waste (SF per linear foot)					
Shingle type	Rake	Hip	Open valley	Closed-cut (half-lace) valley	Woven (full-lace) valley
3-tab	0.25	0.64	1.41	2.12	2.83
Other than 3-tab	negligible	0.30	0.30	1.00	1.71

Figure 4-87 Asphalt strip shingle cutting waste

Shingles salvaged (SF per linear foot)					
Shingle type	Rake	Hip	Open valley	Closed-cut (half-lace) valley	Woven (full-lace) valley
3-tab	1.00	0.50	2.00	1.00	0

Figure 4-88 Asphalt hip and ridge shingles salvaged from cutting waste

cut at the rakes, hips and valleys, you can use Figure 4-88 to determine the quantity of shingles salvaged. The table assumes 3′ x 1′ three-tab shingles laid at a 5-inch exposure.

The formula for allowance in hip and ridge units is the difference between the square feet required and the square feet salvaged:

Net Allowance (ridge and hip units) = SF Required - SF Salvaged **Equation 4-13**

On hip roofs, you'll require more units than you've salvaged. On gable roofs, you'll salvage more units than you need. Unless you can use the excess on another roof, the salvaged units will be wasted.

A "Shortcut" Method for Determining Asphalt Strip Shingle Waste

As a "rule of thumb," some contractors add 10 percent waste on small- to average-sized gable roofs, and 15 percent on hip roofs (3-tab shingles). They add 2 percent on gable roofs and 3 percent on hip roofs for laminated shingles with prefabricated ridge and hip units. This allows for additional material required for the starter course and site-fabricated ridge and hip units (in the case of 3-tab strip shingles), cutting waste at rakes, hips and valleys, and waste due to crew error. They add a larger percentage for more complex roofs.

Cutting waste and overruns (gable roof)			
Building dimensions (LxW)	Roof slope		
	3 in 12	6 in 12	12 in 12
30 x 20	8[(1)] (4)[(2)]	8 (4)	8 (3)
40 x 30	6 (3)	6 (3)	6 (2)
45 x 30	5 (3)	6 (3)	5 (2)
50 x 30	5 (3)	5 (3)	5 (2)
60 x 30	4 (3)	4 (3)	4 (2)
70 x 30	4 (2)	4 (3)	4 (2)
80 x 30	5 (2)	5 (3)	3 (2)
50 x 40	5 (2)	5 (2)	5 (2)
60 x 40	4 (2)	4 (2)	5 (2)
70 x 40	4 (2)	4 (2)	4 (2)
80 x 40	3 (2)	3 (2)	4 (2)
90 x 40	3 (2)	3 (2)	4 (2)
60 x 50	4 (2)	5 (2)	4 (1)
70 x 50	4 (2)	4 (2)	3 (1)
80 x 50	4 (2)	4 (2)	3 (1)
90 x 50	3 (2)	3 (2)	3 (1)

(1) 3-tab shingles using site-fabricated hip and ridge units.
(2) Laminated strip shingles using a prefabricated ridge and hip roll. The roll must be taken off separately.

Figure 4-89 Cutting waste and overruns (gable roof)

I don't rely on this method of estimating waste. Remember that exclusive of crew-error waste (which varies from crew to crew and from job to job), actual waste depends on the roof type, the ratio of roof length to roof width, the roof slope, the shingle exposure, the type of shingle installed, and whether the hip and ridge units are prefabricated or site-constructed.

Waste on asphalt strip-shingle roofs varies from 1 to 8 percent on average-sized gable roofs, and from 3 to 18 percent on hip roofs. You can use Figure 4-89 and 4-90 to quickly get a "ball-park" percentage of asphalt strip shingle waste. Waste due to crew error isn't included in these figures.

Figure 4-89 lists the total percentage you add to net roof area of a *gable roof* for the starter course, cutting waste at rakes, and site-fabricated ridge units (if applicable).

This table assumes 3′ x 1′ strip shingles laid at a 5-inch exposure.

Cutting waste and overruns (hip roof)			
Building dimensions (LxW)	Roof slope		
	3 in 12	6 in 12	12 in 12
30 x 20	18[1] (10)[2]	17 (9)	14 (8)
40 x 30	14 (7)	13 (6)	12 (6)
45 x 30	13 (7)	12 (6)	10 (5)
50 x 30	12 (6)	11 (6)	9 (5)
60 x 30	11 (6)	11 (5)	9 (4)
70 x 30	11 (5)	11 (5)	9 (4)
80 x 30	10 (5)	9 (4)	8 (4)
50 x 40	11 (6)	9 (4)	9 (5)
60 x 40	9 (5)	9 (4)	9 (4)
70 x 40	9 (4)	9 (4)	8 (3)
80 x 40	9 (4)	8 (4)	6 (3)
90 x 40	8 (4)	8 (4)	6 (3)
60 x 50	9 (5)	9 (4)	7 (3)
70 x 50	9 (4)	8 (4)	7 (3)
80 x 50	9 (4)	6 (4)	6 (3)
90 x 50	7 (4)	6 (4)	6 (3)

(1) 3-tab shingles using site-fabricated hip and ridge units.
(2) Laminated strip shingles using a prefabricated ridge and hip roll. The roll must be taken off separately.

Figure 4-90 Cutting waste and overruns (hip roof)

Figure 4-90 shows the total percentage you add to net roof area of a *hip roof*, including the starter course, cutting waste at hips, and site-fabricated ridge units (if applicable). The table assumes 3′ x 1′ strip shingles laid at a 5-inch exposure. The table doesn't include crew-error waste.

▼ **Example 4-8:** Assume a roof slope of 5 in 12 and 3-bundle squares installed at a 5-inch exposure. How many bundles of 3′ x 1′ 3-tab shingles are required for the roof diagrammed in Figure 4-83? Assume also that you'll use field-fabricated 3-tab shingles for the starter course at the eaves and 12" x 12" tabs salvaged at the rakes for ridge units.

Solution: First, remember the formula for net roof area to be covered (from Chapter 1):

Actual (Net) Roof Area = Roof Plan Area x Roof-Slope Factor

Thus, Net Roof Area = 31′ x 26′ x 1.083
(from Column 2 of Appendix A)
= 873 square feet ÷ 100
= 8.73 squares (use this quantity to estimate labor costs)

The total eaves length is 2 x 31, or 62 linear feet.

The total area of starter-course material required is:

Area (Starter Course) = 62′ x 0.42 SF/LF
(Equation 4-10 or Figure 4-86)
= 26 square feet

The total rake length is:

LF (Rake) = 4 ea. x 13′ x 1.083 (Column 2, Appendix A)
= 56 linear feet

Cutting waste at the rakes is:

Waste (Rake) = 56′ x 0.25 SF/LF (from Figure 4-87)
= 14 square feet

Remember, you need 1 square foot of single-tab shingles per linear foot of ridge, or 31 square feet.

From Figure 4-88, the amount of salvaged tabs at the rakes is 56 square feet. That's more single-tab units than needed, so from Equation 4-13, the net allowance for ridge units is:

Net Allowance (Ridge Units) = 56 SF - 31 SF
= 25 square feet

Thus, the gross roof area = 873 SF + 26 SF + 14 SF + 25 SF
= 938 square feet ÷ 100
= 9.38 squares

From Chapter 1, the waste factor (excluding crew-error waste) is:

$$\text{Waste Factor} = \frac{\text{Area Covered (including waste)}}{\text{Net Roof Area}}$$

Therefore,

$$\text{Waste Factor} = \frac{9.38 \text{ Squares}}{8.73 \text{ Squares}}$$

$$= 1.08$$

As you can see, that answer agrees with the information from Figure 4-89. In that table, the nearest size to our example is a 30′ x 20′ roof with a 6 in 12 slope, and the table shows a waste factor of 8 percent for 3-tab shingles.

Total material required: 9.38 squares x 3 bundles/square = 29 bundles.

▼ **Example 4-9:** Work the same problem assuming use of 3′ x 1′ laminated strip shingles with field-fabricated shingles used for the starter course at the eaves. Also, assume using 3-bundle squares and a prefabricated ridge roll.

Solution: First, you need 31 linear feet of ridge roll to cover the length of the ridge. We already know the net roof area is 8.73 squares (from the last example). We also know there's 26 square feet of starter course material required. From Figure 4-87 we see that cutting waste at the rakes is negligible for this type roof.

Thus, the gross roof area = 873 SF + 26 SF
= 899 square feet ÷ 100, or 8.99 squares

The waste factor is 3 percent (8.99 ÷ 8.73), close enough to the 4 percent waste predicted in Figure 4-89. At 3 bundles per square, this job requires 27 bundles.

The following examples show you how to estimate roofs of any size, with any slope. If you calculate the waste factors for each example, you'll see that you can use the tables (Figures 4-89 and 4-90) with confidence.

▼ **Example 4-10:** Assume a roof slope of 5 in 12 and the use of 3-bundle squares installed at a 5-inch exposure, then find how many bundles of 3′ x 1′ 3-tab shingles are required for the roof of the building diagrammed in Figure 4-91. Also, assume using field-fabricated 3-tab shingles for the starter course at the eaves and 12" x 12" tabs salvaged at the hips for hip and ridge units.

Solution: The net roof area to be covered is:

Actual (Net) Roof Area = Roof Plan Area x Roof-Slope Factor

Net Roof Area = 40′ x 20′ x 1.083 (from Column 2 of Appendix A)
= 866 square feet ÷ 100
= 8.66 squares (use this quantity to determine labor costs)

The total eaves length is:

Perimeter = 2(L+W)

LF (Eaves) = 2 x (40′ + 20′)
= 120 linear feet

The total area of starter-course material required is:

Area (Starter Course) = 120′ x 0.42 SF/LF
(from Equation 4-10, or Figure 4-86)
= 50 square feet

From Column 3 of the Slope Factor table, each hip length is:

Length (Hip) = 10′ x 1.474
= 14.74 linear feet

The total hip length is 4 x 14.74, or 59 linear feet.

From Figure 4-87, calculate cutting waste at the hips:

Waste (Hips) = 59′ x 0.64 SF/LF
= 38 square feet

You need 1 square foot of single-tab shingles for each linear foot of ridge and hips, therefore:

Hips and Ridge = (59′ + 20′) x 1 SF/LF
= 79 square feet

From Figure 4-88, calculate the number of tabs salvaged at the hips for use on ridge and hips:

59′ x 0.5 SF/LF = 30 square feet

You need more shingles than you salvaged, so you have to allow for additional shingles:

Net Waste (Hip and Ridge Units) = 79 SF - 30 SF
= 49 square feet

The total of the above calculations produces the gross roof area to be covered:

Gross Roof Area = 866 SF + 50 SF + 38 SF + 49 SF
= 1,003 square feet ÷ 100
= 10.03 squares

The waste factor (excluding crew-error waste) is:

$$\text{Waste Factor} = \frac{\text{Area Covered (including waste)}}{\text{Net Roof Area}}$$

$$= \frac{10.03 \text{ Squares}}{8.66 \text{ Squares}}$$

$$= 1.158$$

This job requires 31 bundles of shingles:

Bundles = 10.03 Squares x 3 Bundles/Square
= 31 bundles (10.33 squares)

▼ **Example 4-11:** Using the same dimensions as those in Example 4-10 (Figure 4-91), assume the application of 3′ x 1′ laminated strip shingles using field-fabricated shingles for the starter course at the eaves. Also, assume 3-bundle squares and a prefabricated hip and ridge roll. Now calculate how many bundles of 3′ x 1′ laminated strip shingles you need to roof the building.

Solution: The total hip and ridge length is the same as in the previous example, 79 linear feet. The net roof area is also the same, 8.66 squares, as is the total area for the starter course, 50 square feet.

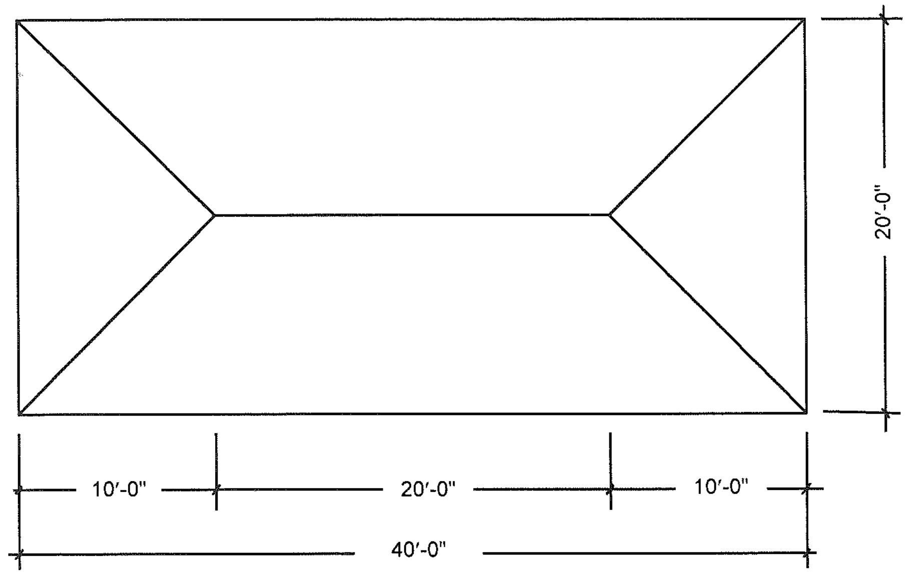


Figure 4-91 Hip roof example

From Figure 4-87 cutting waste at the hips is:

Waste (Hips) = 59′ x 0.30 SF/LF
= 18 square feet

The gross roof area in this case is 866 SF + 50 SF + 18 SF
= 934 square feet ÷ 100
= 9.34 squares

This job requires 29 bundles of shingles:

Bundles = 9.34 Squares x 3 Bundles/Square
= 29 bundles (9.67 squares)

Example 4-12: Assuming a roof slope of 4 in 12 and the use of 3-bundle squares installed at a 5-inch exposure, determine the number of bundles of 3′ x 1′ three-tab shingles required for the roof of the building diagrammed in Figure 4-92. Also assume using field-fabricated 3-tab shingles for a starter course at the eaves and 12" x 12" tabs salvaged at the hips and valleys for ridge and hip units. Also assume the closed-cut valley method of construction.

Solution: The formula for net roof area is:

Actual (Net) Roof Area = Roof Plan Area x Roof-Slope Factor

Net Roof Area = [(50′ x 22′) + (22′ x 11′)] x 1.054
(Column 2, Appendix A)
= 1,415 square feet ÷ 100
= 14.15 squares (Use this figure to estimate labor costs.)

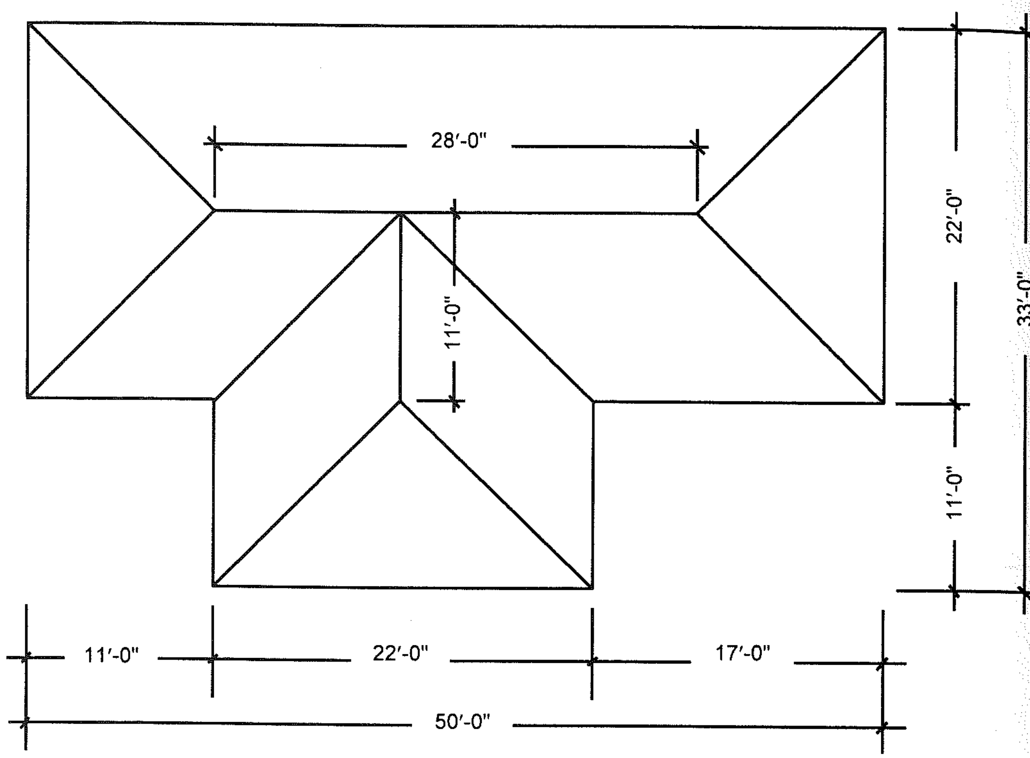


Figure 4-92 Hip and valley roof example

The total length of eaves is:

Perimeter = 2(L+W)

LF (Eaves) = 2 x (50′ + 33′)
= 166 linear feet

From Equation 4-10 or Figure 4-86, the total area of starter-course material required is:

Area (Starter Course) = 166′ x 0.42 SF/LF
= 69 square feet

From Column 3 of the Slope Factor table in Appendix A, the length of each hip or valley is:

Length (Hip or Valley) = 11′ x 1.453
= 16 linear feet

There are 6 hips and 2 valleys. Use Figure 4-87 to calculate the waste allowance:

Waste (Hips) = (6 ea. x 16′ x 0.64 SF/LF)

Waste (Valleys) = (2 ea. x 16′ x 2.12 SF/LF)

Add the two together:

= (96′ x 0.64) + (32′ x 2.12)
= 129 square feet

Now, calculate the total length of ridge and hips to find the number of single-tab shingles required:

LF (Ridge and Hips) = 39′ + 96′
= 135 linear feet
= 135 square feet (at 1 SF/LF)

From Figure 4-88, the quantity of tabs salvaged at the hips and valleys for hip and ridge units is:

SF salvaged at hips = (96′ x 0.50 SF/LF)

SF salvaged at valleys = (32′ x 1.00 SF/LF) (closed-cut valley)
= 80 square feet

Use Equation 4-13 to calculate the net waste allowance. Since we can expect to salvage 80 square feet, and need 135 square feet, we need an additional 55 square feet of single-tab shingles for the hips and ridges.

Thus, Gross Roof Area = 1,415 SF + 69 SF + 129 SF + 55 SF
= 1,668 square feet ÷ 100
= 16.68 squares

At 3 bundles per square, this job requires 50 bundles of shingles.

▼ **Example 4-13:** Work the last example, using 3-bundle, 3' x 1' laminated strip shingles with field-fabricated shingles used for the starter course at the eaves. Assume closed-cut valley construction, and a prefabricated hip and ridge roll.

Solution: The total hip and ridge length is the same as the example above, 135 linear feet. The net roof area is also the same, 1,415 square feet, as is the total area of starter-course material required, 69 square feet.

The total length of hips is 96 linear feet, so from Figure 4-87, calculate the waste allowance:

Waste (Hips) = 96′ x 0.30 SF/LF
= 29 square feet

The total length of valleys is 32 linear feet, so from Figure 4-87, calculate the waste allowance:

Waste (Valleys) = 32′ x 1 SF/LF
= 32 square feet

Thus, Gross Roof Area = 1,415 SF + 69 SF + 29 SF + 32 SF
= 1,545 square feet ÷ 100
= 15.45 squares

This job requires a total of 47 bundles (15.45 x 3).

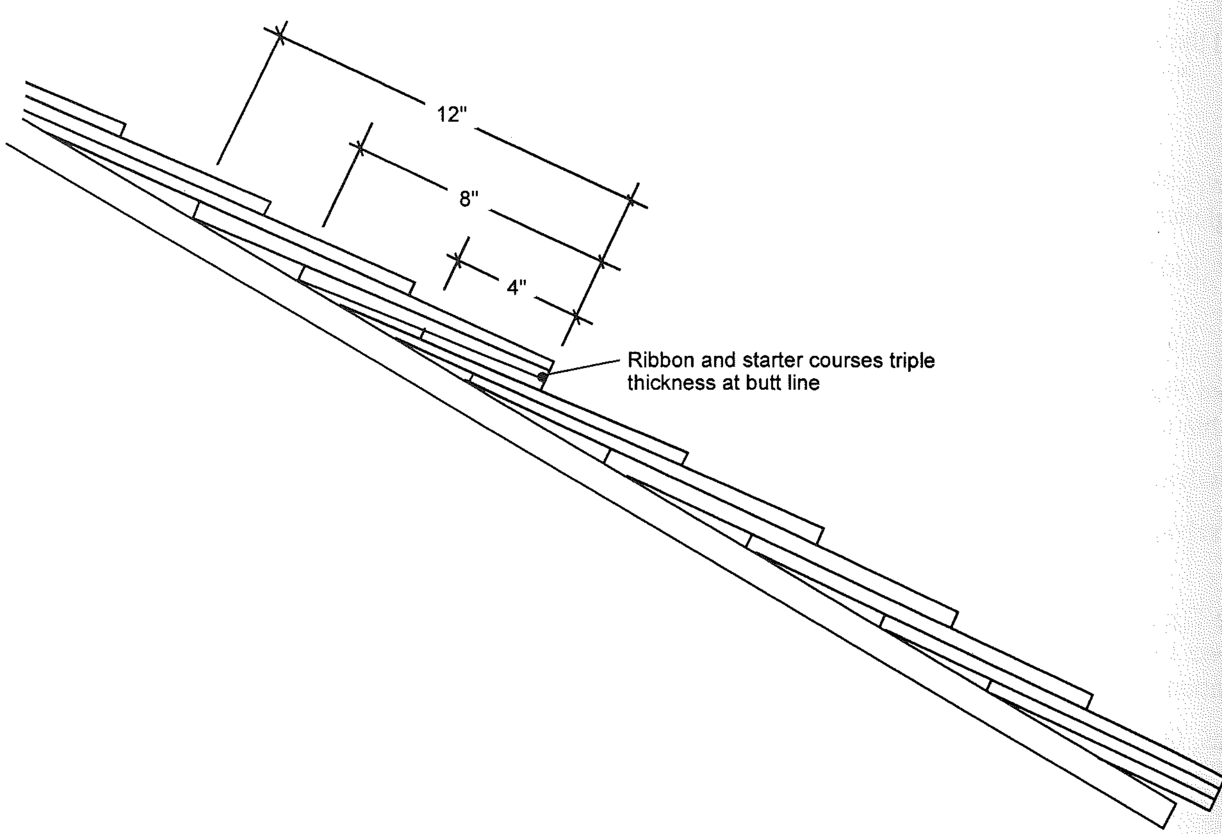


Figure 4-93 Ribbon coursing

Notice that if you calculate the waste factors for the previous two examples, you'll see that the rule of thumb for estimating waste we discussed on page 115 ("shortcut") isn't accurate. The calculated waste factors are 18 percent (16.68 ÷ 14.15) and 9 percent (15.45 ÷ 14.15). The rule of thumb method would have produced waste factors of 15 percent and 18 percent, respectively. That's probably not close enough on a large job in a competitive market.

Estimating Ribbon-Course Quantities

A popular shingle pattern, where every fifth course beginning at the eaves has a triple thickness of shingles, is called ribbon (shadow) coursing. You use a single 3-tab shingle to make the first two layers (4 and 8 inches wide, respectively). The third (top) layer is a full shingle, as shown in Figure 4-93.

Since you make the first two layers of a ribbon course from one shingle and the top layer is a full-width shingle, we must only add one layer of shingles at each ribbon course to our estimate.

Install the first ribbon course along the eaves. It's not necessary to add to the material estimate for this course however, because you can alter the shingles you use for the double starter course to serve as a ribbon course.

Use Equation 4-14 to find the total number of ribbon courses (N) required for a *gable roof*:

$$N\ (\text{Gable}) = \frac{2 \times \text{Roof Dimension}}{\text{Ribbon Spacing}} - 2$$

Equation 4-14

where: Roof Dimension is the actual length of roof measured from eaves to ridge. Remember, that's the plan length times the Roof-Slope Factor (Column 1) from Appendix A.

Use Equation 4-15 to find the total number of ribbon courses (N) required for a *hip roof* :

$$N\ (\text{Hip}) = \frac{\text{Roof Dimension}}{\text{Ribbon Spacing}} - 1$$

Equation 4-15

where: Roof Dimension is the actual length of roof measured from eaves to ridge.

If your result in Equation 4-14 or 4-15 isn't a whole number, round the answer up to the next whole number.

Use Equation 4-16 to find the total length of ribbon courses required for a *gable roof*:

$$\text{Total Length (Gable)} = N \times L$$

Equation 4-16

where: L equals the length of the roof.

Use Equation 4-17 to find the total length of ribbon courses required for a *hip roof*:

$$\text{Total Length (Hip)} = 2N\ [(L + W) - 2(N + 1) \times \frac{\text{Ribbon Spacing}}{\text{Roof–Slope Factor}}]$$

Equation 4-17

where: W is the width of the roof and the Roof-Slope Factor is from Column 1 of Appendix A.

▼ **Example 4-14:** Assume a ribbon course is installed at every fifth course, then find the total number of squares of shingles required for the gable roof described back in Example 4-8, Figure 4-83.

Solution: From Example 4-8, we know the gross roof area of that building is 938 square feet. At a 5-inch exposure, the ribbon spacing is 25 inches, or 2.083 linear feet (5 courses at 5-inch exposure).

Use Equation 4-14 to find the number of ribbon courses:

$$N = \frac{2 \text{ x } 13 \text{ ft. x } 1.083}{2.083 \text{ ft.}} - 2$$
$$= 11.5, \text{ rounded up}$$
$$= 12 \text{ ribbon courses}$$

Use Equation 4-16 to find the total length of ribbon courses required:

LF (Ribbons) = 12 ea. x 31′
= 372 linear feet

The formula to calculate the square feet of ribbons is similar to Equation 4-10, using Figure 4-86:

Area (SF) = Ribbons (LF) x Exposure Area (SF/LF)

Area (Ribbons) = 372′ x 0.42 SF/LF
= 156 square feet

Thus, Gross Roof Area = 938 SF + 156 SF
= 1,094 square feet ÷ 100
= 10.94 squares

▼ **Example 4-15:** Assume a ribbon course at every fifth course, then find the total squares of shingles for the hip roof described back in Example 4-10, Figure 4-91.

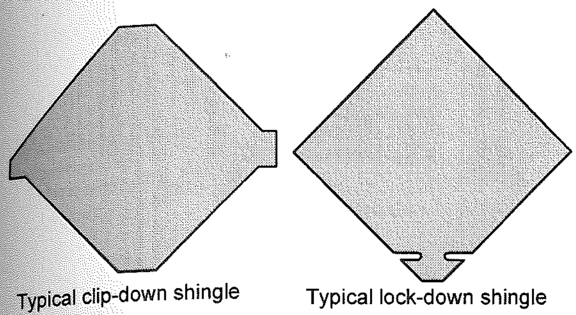
Solution: From Example 4-10, we know the Gross Roof Area is 1,003 square feet. At a 5-inch exposure, the ribbon spacing is 25 inches, or 2.083 linear feet (5 courses at 5-inch exposure).

Use Equation 4-15 to calculate the number of ribbon courses:

$$N = \frac{10 \text{ ft. x } 1.083}{2.083 \text{ ft.}} - 1$$
$$= 4.19$$
$$= 5 \text{ courses}$$

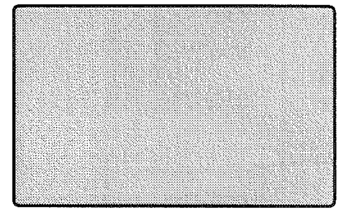
Use Equation 4-17 to find the total length of ribbon courses:

$$\text{LF (Ribbons)} = 2 \text{ x } 5 \text{ x } [(40' + 20') - 2 \text{ x } (5 + 1) \text{ x } \frac{2.083 \text{ ft.}}{1.083}]$$
$$= 10 \text{ x } [60' - 12 \text{ x } \frac{2.083 \text{ ft.}}{1.083}]$$
$$= 369 \text{ linear feet}$$



Courtesy of Asphalt Roofing Manufacturers Association (ARMA)

Figure 4-94 Individual "hex" shingles



Courtesy of Asphalt Roofing Manufacturers Association (ARMA)

Figure 4-95 Giant individual shingle

Use Figure 4-86 to find the additional square feet of shingles required for the ribbon courses:

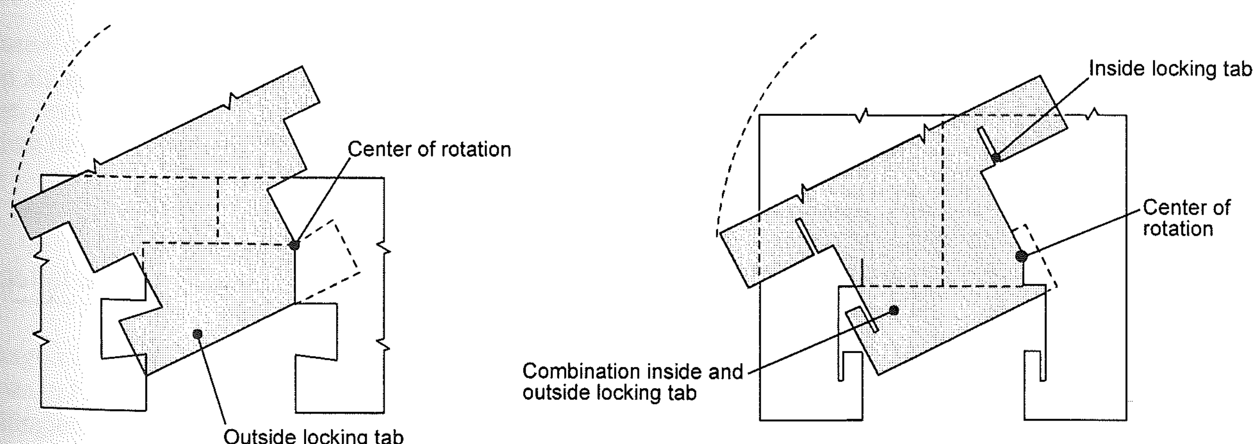
Area (Ribbons) = 369′ x 0.42 SF/LF
= 155 square feet

Thus, Gross Roof Area = 1003 SF + 155 SF
= 1,158 square feet ÷ 100
= 11.58 squares

Individual Shingles

The three most common types of individual shingles are:

1) Hexagonal, as in Figure 4-94
2) Giant, as in Figure 4-95
3) Interlocking, as in Figure 4-96



Courtesy of Asphalt Roofing Manufacturers Association (ARMA)

Figure 4-96 Common interlocking shingles and their locking methods

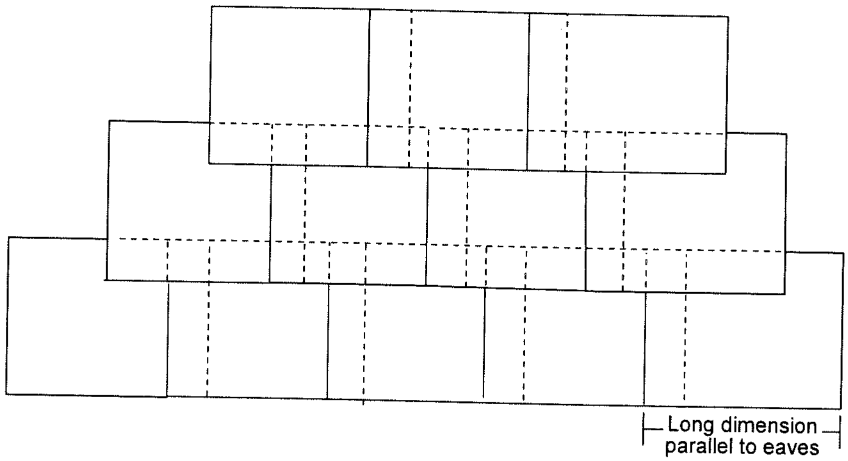


Figure 4-97 Dutch lap method

Individual clip-down and lock-down shingles are designed to withstand strong winds. You don't have to use any adhesives with these shingles, except where you've removed the locking devices, for example, at the rakes and eaves. Normally, you finish hips and ridges of individual shingle roofs with single tabs you cut from 3-tab shingles (laid at a 5-inch exposure), or a prefabricated ridge roll.

Two types of individual and hexagonal (hex) shingles are available: those locked together with a clip and those locked together via a built-in locking tab, as shown in Figure 4-94. Both types are lightweight and intended primarily for re-roofing over old roofing. They also work well on a new roof. For either application, install the shingles on roof slopes of 4 in 12 and steeper.

Use the giant individual shingles shown in Figure 4-95 for new construction or re-roofing. There are two ways to apply them: the Dutch lap method (like Figure 4-97) or the American method (Figure 4-98). For either application, install the shingles over roof slopes of 4 in 12 and steeper.

With the Dutch lap method, you install giant individual shingles with the long dimension parallel to the eaves. Apply the shingles so they overlap adjacent shingles in each course as well as the course below. See Figure 4-97.

Normally, you use the Dutch lap method to re-roof over a smooth deck that holds nails well. You can use it over new decks where single-coverage roofing will do. Install the shingles over roof slopes of 4 in 12 and steeper.

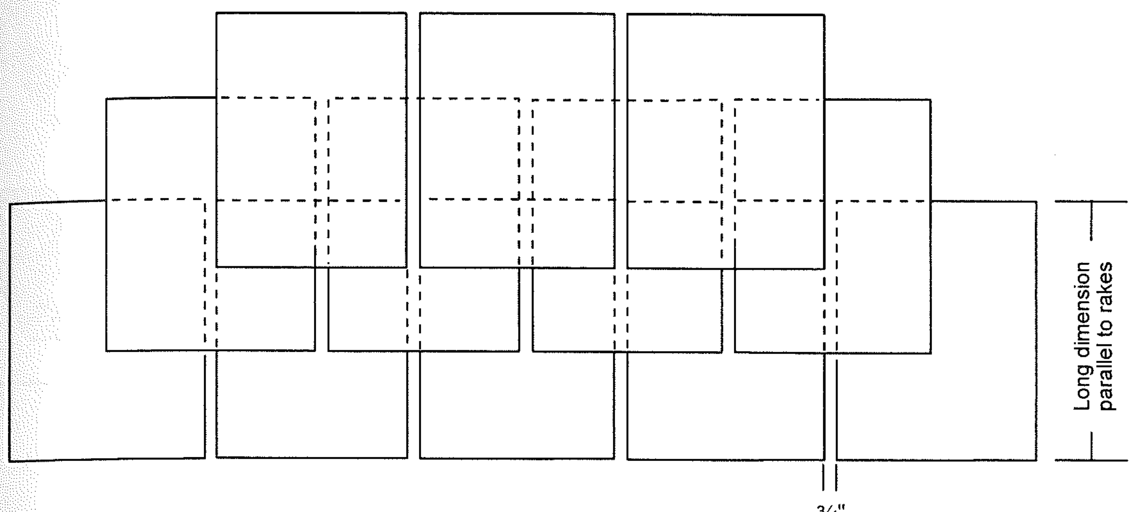


Figure 4-98 American method

With the American method, you install giant individual shingles with the long dimension parallel to the rakes. Center the shingles over the shingles of the underlying course, with ¾-inch-wide joints, as shown in Figure 4-98. You can use the American method for new construction or for re-roofing. Install the shingles on roof slopes of 4 in 12 and steeper.

Interlocking shingles (T-locks) have sets of locking tabs to make them more wind resistant. See Figure 4-96. Use them primarily for re-roofing over existing roofing. They provide single coverage and aren't recommended for new construction.

Because of their irregular shape, you may have to remove the locking tabs on shingles you install along the rakes and eaves. To prevent wind damage, cement these altered shingles to the sheathing or nail them down according to the manufacturer's recommendations.

Hexagonal Strip Shingles

Hexagonal strip shingles come most commonly in two- or three-tab units, as shown in Figure 4-99. These shingles cover the same area as 3-foot 3-tab strip shingles. Hips and ridges are usually finished with single tabs cut from 3-tab strip shingles (laid at a 5-inch exposure) or a prefabricated ridge roll, because the narrow hex tabs don't make good hip and ridge units.

The shingles described in this section are not widely used, but their varied sizes and unusual shapes make them an attractive alternative to the more traditional shingle patterns. Follow the manufacturers' guidelines for coverage requirements and installation procedures.

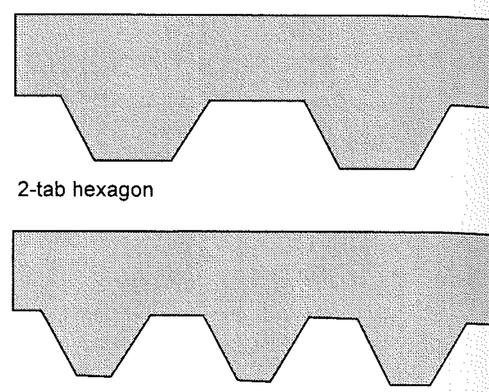


Figure 4-99 Hexagonal strip shingles

Estimating Asphalt Shingle Roofing Costs

Let's say you've got to cover the roof shown in Figure 4-91 under the conditions given in Example 4-10. Assume that each square of shingles costs $50.00, including sales tax. From Example 4-10, we must purchase 31 bundles of shingles, or 10.33 squares (31 ÷ 3 =10.33). So the total material cost is 10.33 squares x $50.00/square = $517.00 (rounded off).

We have a roof deck area of 8.66 squares and a total of 79 linear feet of hips and ridge. According to the NCE, an R-1 crew consisting of one roofer and one laborer can install composition shingles at the rate of 1 square per 2.05 manhours, and hip and ridge units at the rate of 1 linear foot per 0.02 manhours. Assuming the roofer makes $20.00 per hour and the laborer makes $15.00 per hour, including labor burden, the average cost per manhour is: ($20 + $15) ÷ 2 = $17.50. So the labor cost will be:

Labor (installing shingles) = 8.66 squares x 2.05 manhours/square x $17.50/manhour = $311.00

Labor (installing hip and ridge units) = 79 LF x 0.02 manhours/LF x $17.50 = $28.00

The total labor cost is $311.00 + $28.00 = $339.00.

The total cost is $517.00 + $339.00 = $856.00.

Now that you know how to install asphalt shingles and estimate their quantities, let's move on to another asphalt roof covering material, mineral-surfaced roll roofing. That's the topic of the next chapter.