

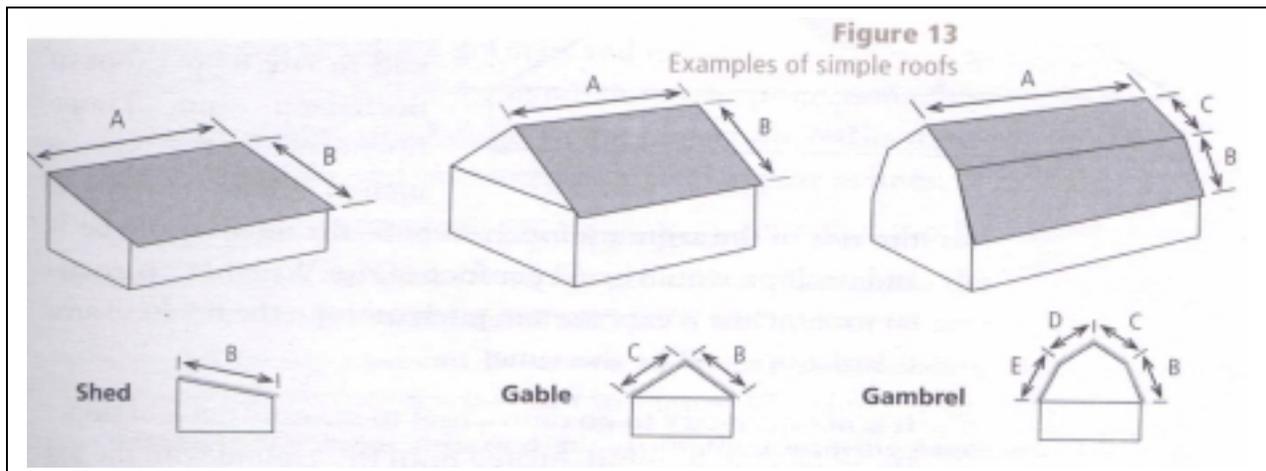
Estimating How Much Roofing Is Required

Various types of asphalt roofing materials, and accessories are required to complete a typical roofing job, including shingles or roll roofing, underlayment, starter strips, drip edges, valley flashing and hip and ridge shingles. Before the job begins, estimates of the required quantities of each material, based on calculations derived from the dimensions of the roof, must be made.

Fairly simple calculations are all that are required. Certain measurement and calculation methods also may be used that simplify the process even further. These are described in the following sections along with suggestions on how to take measurements without getting onto the roof.

Roofs come in a variety of shapes and styles but virtually every kind of roof is comprised of plane surfaces that can be subdivided into simple geometric shapes - squares, rectangles, trapezoids and triangles. Thus, roofing area calculations simplify to area calculations for these basic shapes.

The simplest type of roof is one without any projecting dormers or intersecting wings. Each of the illustrated roofs is comprised of one or more rectangles (See Figure 13.) The area of the entire roof in each case is the sum of the areas of each rectangle.



For the shed roof which has only one rectangle, the area is found by simply multiplying the rake line by the eaves line, or $B \times A$.

A. The gable roof is comprised of two rectangular planes and its area is found by multiplying the sum of the rake lines by the eaves line, or $A(B+C)$. For the gambrel roof, four rake lines are involved and the total area calculation is found by multiplying the sum of the rake line, or $A(B+C+D+E)$.

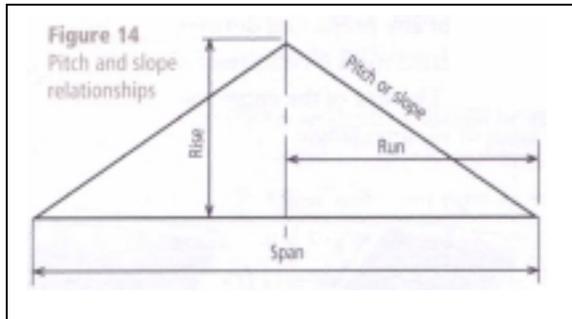
The more complex roofs include those with intersecting wings or dormer projections through the various roof planes. Area calculations for these roofs use the same basic approach taken for simple roofs, but involve a number of subdivisions of the roof surface that are calculated separately, then added together to obtain the total roof area.

If plans of the building are available, use them to obtain the required roof dimensions from which area calculations can be made. Otherwise, direct measurements may have to be taken on the roof.

However, another alternative exists that enables the estimator to indirectly measure the areas. It involves calculating the projected horizontal areas of the roof, then combining these areas with the roof slope or slopes to obtain the true areas. Both the roof slope and the horizontal projection of the various roof surfaces are determined directly as described in this chapter. Tables are also included in the following sections for converting the indirect measurement and calculations to actual lengths and actual roof areas.

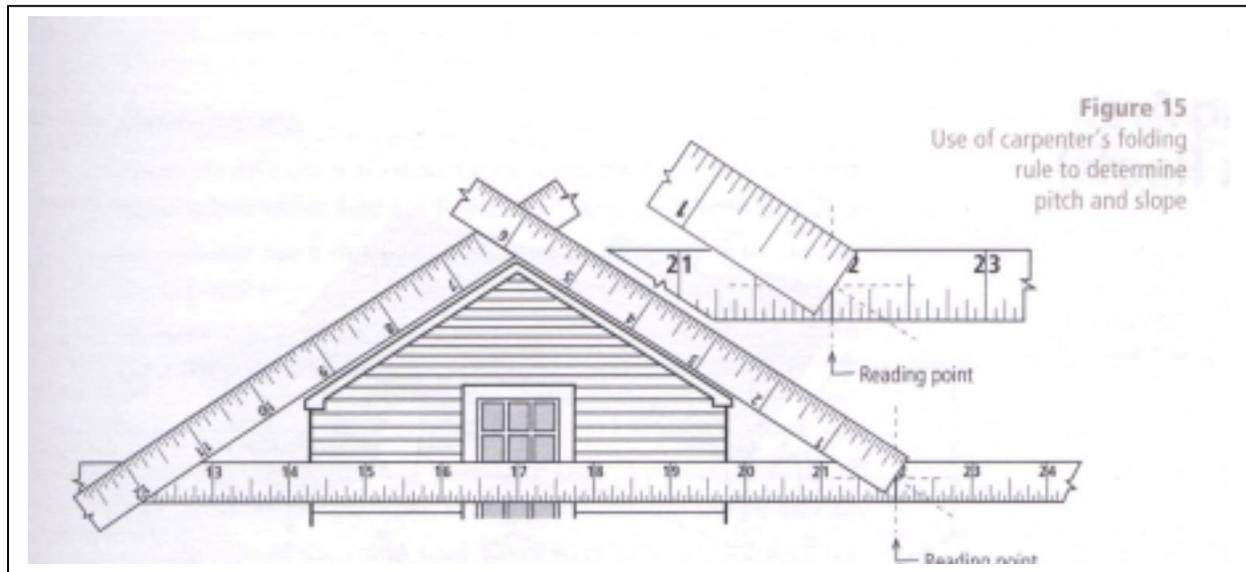
(A) Roof Pitch and Slope

The degree of incline a roof possesses is usually expressed as its "pitch" or "slope." Pitch is the ratio of the rise of the roof to the span of the roof. (See Figure 14.) Slope is the ratio of rise in inches to horizontal run in feet (run equals half the span). For example, if the span of a roof is 24' and the rise is 8', the pitch is 8/24 or 1/3. Expressed as a slope, the same roof is said to rise 8" per foot of horizontal run [Slope (inches per foot) = Rise (in inches) / Run (in feet)]. If the rise of the same roof span were 6', the pitch would be 1/4 and its slope would be 6" per foot of run. Whether a particular roof incline is expressed in pitch or slope, the results of area calculations will be the same.



It is not necessary to go onto a roof to measure pitch or slope. It can be closely approximated from the ground with the aid of a pitch card (available from many manufacturers) or a carpenter's folding rule as follows: Stand away from the building and form the rule into a triangle with the 6" joint at the apex and the 12" joint at one side of the horizontal base line. Holding the rule at arm's length, line up the sides of the triangle with the roof as shown in Figure 15, being sure to keep the base of the triangle horizontal. Then, with the zero point of

the rule aligned with the center of the base, read the intersection of the zero point with the base. In the example shown in Figure 15, this occurs at the 22" mark. Next, locate the "rule reading" in Figure 16 nearest to the one read in the field and directly under it read the pitch and slope of the roof. For the example, the pitch is read as 1/3, the slope as 8" per foot.



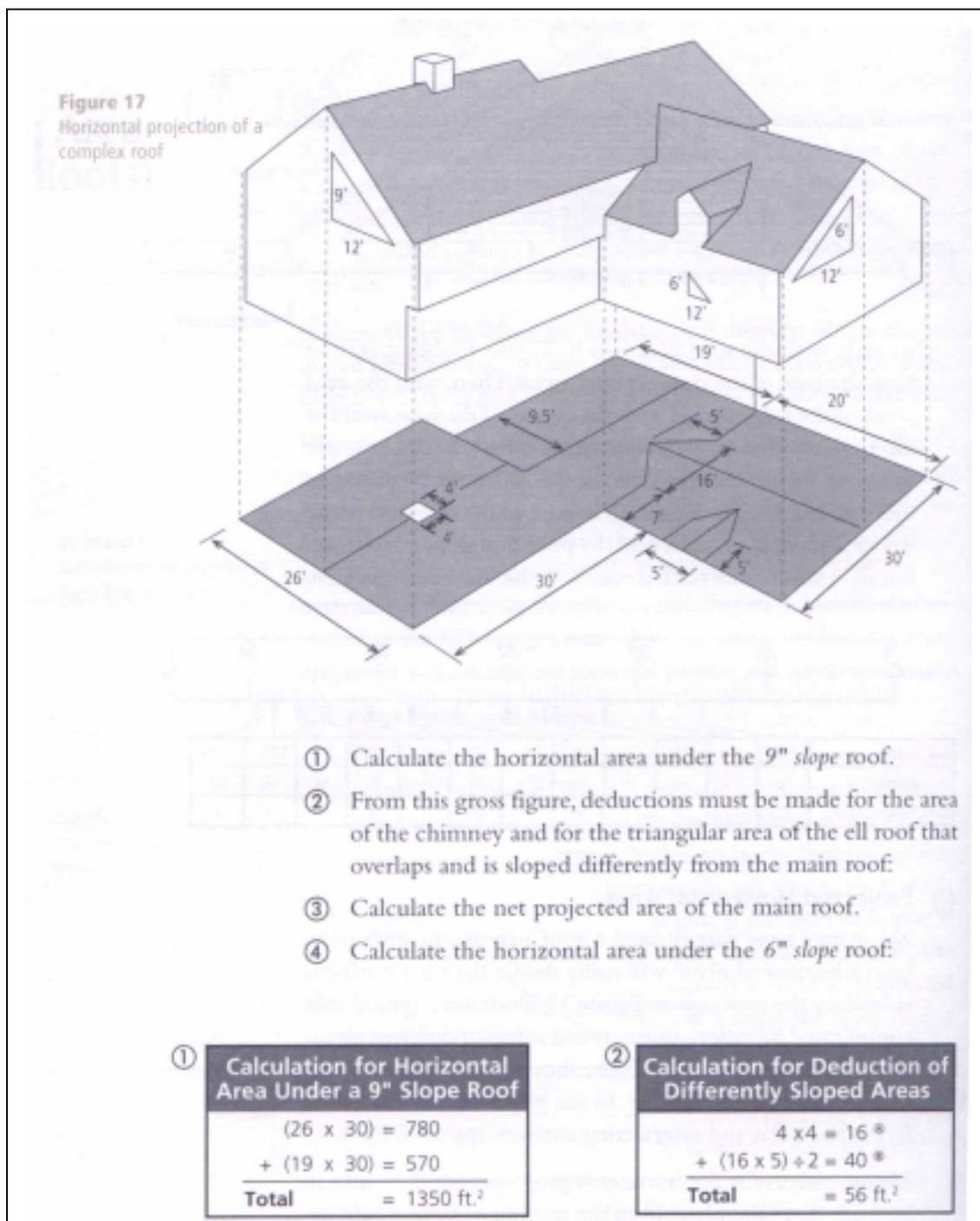
| Rule reading | 20 1/2 | 20 5/8 | 21 1/4 | 21 3/8 | 22 | 22 1/4 | 22 3/4 | 23 1/8 | 23 3/8 | 23 5/8 | 23 3/4 | 23 7/8 |
|-------------------------|--------|--------|--------|--------|-----|--------|--------|--------|--------|--------|--------|--------|
| Pitch (fraction) | 1/2 | 11/24 | 1/2 | 5/8 | 1/2 | 7/24 | 1/4 | 1/24 | 1/6 | 1/8 | 1/12 | 1/24 |
| Slope (inches per foot) | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |

(B) Projected Horizontal Area

No matter, how complicated a roof may be, its projection onto a horizontal plane will easily define the total horizontal surface the roof covers. Figure 17 illustrates a typical roof complicated by valleys, dormers and ridges at different elevations. The lower half of the figure shows the projection of the roof onto a horizontal plane. In the projection, inclined surfaces appear flat and intersecting surfaces appear as lines.

Measurements for the horizontal projection of the roof can be made from the plans, from the ground or from inside the attic. Once the measurements are made, the horizontal area covered by the roof can be drawn to scale and calculated. Sample calculations for the roof in Figure 17, using the dimensions and slopes indicated, appear on the following page.

Because the actual area is a function of the slope, calculations must be grouped in terms of roof slope and those of different slopes are not combined until the true roof areas have been determined.



(C) Duplications

Portions of the higher roof surfaces often project over roof surfaces below them but the horizontal projections do not show the overlap. Such duplicated areas should be added to the total horizontal area. Thus, one final correction must be made to account for these overlapped or duplicated areas before the total projected horizontal is obtained.

In the example, there is an overlap: (1) on the 6" slope roof where the dormer eaves overhang the ell roof; (2) on the 9" slope roof where the main roof eaves overhang the ell section; and (3) where the main roof eaves overhang the smaller section of the main roof in the rear of the building. In each case, if the eaves extend 4" beyond the structure, the duplication calculations are:

- (1) Two eaves overhangs:
 $2(5 \times 4/12) = 3 \frac{1}{3} \text{ ft.}^2$
- (2) Two eaves overhangs:
 $2(7 \times 4/12) = 4 \frac{2}{3} \text{ ft.}^2$
- (3) Overhang covers only half of the 19' wide section:
 $9.5 \times 4/12 = 3 \frac{1}{16} \text{ ft.}^2$

Item (1) should be added to the area of the 6" slope roof and items (2) and (3) to the 9" slope roof. Thus, for the 6" slope roof, the adjusted total is $640 + 3 = 643 \text{ ft.}^2$ and for the 9" slope roof, $1,294 + 8 = 1,302 \text{ ft.}^2$ (fractions are rounded off to the nearest foot).

(D) Conversion to Actual Area

Now that the total projected horizontal areas for each roof slope have been calculated, the results can be converted to actual areas with the aid of Table 3. (To calculate the Actual Area, multiply the Horizontal Area by the Area/Rake Factor.)

- (1) For the 9" slope roof:
 $1,302 \text{ ft.}^2 \times 1.250 = 1,627.5 \text{ ft.}^2$
- (2) For the 6" slope roof:
 $643 \text{ ft.}^2 \times 1.118 = 718.8 \text{ ft.}^2$

After the horizontal areas have been converted to actual areas, the results added to obtain the total area of roof to be covered:
 $1,628 \text{ ft.}^2 + 719 \text{ ft.}^2 = 2,347 \text{ ft.}^2$

For an actual job estimate, an allowance should be made for waste. In this case, assume a 10% waste allowance. Thus, the total area of roofing material required is:
 $2,347 \text{ ft.}^2 + 235 \text{ ft.}^2 = 2,582 \text{ ft.}^2$

(E) Additional Material Estimates

To complete the estimate, the required quantity of starter strips, drip edges, hip and ridge shingles and valley strips must be determined. Each of these estimates depends on the length of the eaves, rakes, hips, ridges and valleys at which the material will be applied.

| Slope (inches per foot) | Area/Rake Factor |
|----------------------------|---------------------|
| 4 | 1.054 |
| 5 | 1.083 |
| 6 | 1.118 |
| 7 | 1.157 |
| 8 | 1.202 |
| 9 | 1.250 |
| 10 | 1.302 |
| 11 | 1.356 |
| 12 | 1.414 |

*To use the table, simply multiply the projected horizontal area by the conversion factor for the appropriate roof slope. The result is the actual area of the roof.

Because eaves and ridges are horizontal, their lengths may be determined directly from the horizontal projection drawing. Rakes, hips and valleys are sloped. Thus, their lengths must be calculated following a procedure similar to that for calculating sloped areas.

To determine the actual length of a rake, measure its projected horizontal distance. Then use Table 3, previously used for *horizontal-to-actual area* conversions, to convert *horizontal-to-actual lengths* by multiplying the rake's projected horizontal distance by the Area/Rake Factor for the appropriate roof slope. The result is the actual length of the rake.

For the house in Figure 17, the rakes at the ends of the main house have horizontal distances of 26' and 19'. There is another rake in the middle of the main house where tile higher roof section meets the lower. Its horizontal distance is: $13' + 3.5' = 16.5'$. Combine these horizontal distances and multiply by the Area/Rake Factor for the 9" slope roof (from Table 3) to find the Total Actual Length of the rakes.

$$26' + 19' + 16.5' = 61.5'$$

$$61.5' \times 1.250 = 76.9'$$

Following the same procedure for the ell section with its 6" slope roof dormer, the total length of rakes is found to be 39.1'. These rakes can now be added to the total length of eaves (actual horizontal distances, no conversion necessary) to estimate the quantity of drip edge required for the job.

The quantity of ridge shingles required is estimated directly from the drawing since ridgelines are true horizontal distances.

Hips and valleys again involve sloped distances. As a result, their projected horizontal lengths must be converted to actual lengths with the aid of Table 4.

In the following calculations, the total length of valleys for the house in Figure 17 will be determined from which the estimate for valley flashing material can be made.

There is a valley formed on both sides of the ell roof intersection with the main roof. The total measured distance of these valleys on the horizontal projection is 16'.

The fact that two different slopes are involved complicates the procedure somewhat.

If there were only one roof slope, the true length could be calculated directly from Table 4. But in this case, calculations for each slope must be made and then averaged to obtain a close approximation of the true length of the valleys. Using the formula [Horizontal Length x Conversion Factor = Actual Length], the calculation would be:

$$16' \times 1.600 \text{ (9" slope)} = 25.6'$$

$$16' \times 1.500 \text{ (6" slope)} = 24.0'$$

$$\text{Average: } (24.0 + 25.6) / 2 = 24.8'$$

The approximate length of the two valleys is 24.8' or 12.4' each.

The total projected horizontal length of the dormer valleys in Figure 17 is 5'. From Table 4, with a 6" slope for both the ell roof and the dormer, the actual length of the valleys is calculated to be 7.5'.

The total length of valleys for the house is: $25' + 7' = 32'$. Based on this true length, the amount of valley flashing material can now be estimated.

| Slope (inches per foot) | Hip/Valley Factor |
|----------------------------|----------------------|
| 4 | 1.452 |
| 5 | 1.474 |
| 6 | 1.500 |
| 7 | 1.524 |
| 8 | 1.564 |
| 9 | 1.600 |
| 10 | 1.642 |
| 11 | 1.684 |
| 12 | 1.732 |

*To use the table, simply multiply the projected horizontal distance of the hip/valley by the conversion factor for the appropriate roof slope. The result is the actual length of the hip/valley.

