

BY DALE DIAMOND

## Laying Out a Hip Rafter

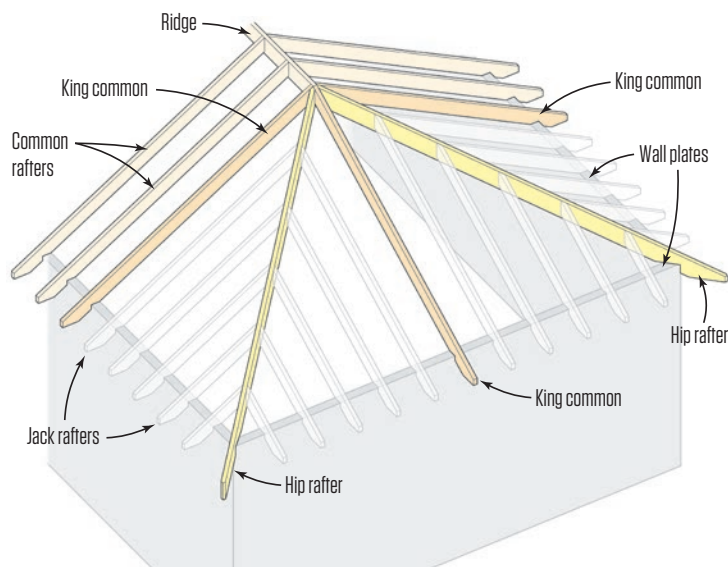
**One of the strongest ways** to frame a roof is using a hip-roof design. The planes of the roof slope up from every side, so the framing braces the roof from all sides. If the building is square and the sides are of equal length, the roof planes will meet at a point, as in a pyramid. On a rectangular-shaped building with a hip roof, the roof planes on the two longer sides meet at a ridge, as shown in the illustration at left.

The key structural member is the hip rafter, which spans from the building corner to the peak or the ridge. Before we explain hip rafters, you need to understand how to lay out and cut common roof rafters; this is covered in “Cutting Common Rafters” (Mar/17). There are many variations on hip roofs and hip-roof construction, but for the purpose of this article, let’s assume that the roof planes are all the same slope (6:12) and that they meet at a ridge, as shown in the illustration at left.

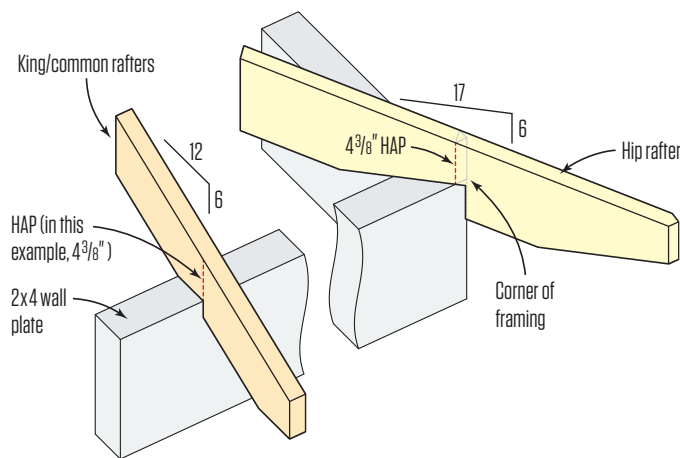
**King commons and ridge.** Start by framing the common rafters along the ridge. The last common rafters that support the ridge are called *king commons* (see illustration, left). An additional common rafter that extends from the end of the ridge down to the plate at the end of the building is also called a king common. The king common at the end of the ridge and the king common on the side of the ridge intersect at a 90° angle. The hip rafter intersects this 90° angle at a 45° angle and runs diagonally down to the building corner.

The king commons at the ends of the ridge are the same length as those at the sides. Each common, including the kings, has an “adjusted run” that equals the run shortened by half the thickness of the ridge (in this case, using 2-by stock, the run is shortened by  $\frac{3}{4}$  inch). If both ends of the building end with a hip, the length of the ridge is the total length of the building minus two times the adjusted run of the common rafters. (For details on calculating ridge length, see “Framing a Hip Roof,” Sep/13.)

**Height above plate (HAP).** Before we lay out the hip rafter, we must first figure out the *height above plate* (HAP), or the vertical distance from the seat cut of the birds-mouth (or the top of the wall plates) at the edge of the wall to the top of the rafter. This measurement is taken off the common rafters (see illustration, left). Using the same HAP on the hip rafter and the common rafter



### Height Above Plate (HAP)



Hip rafters support the two sloping planes that make up a hip roof. Depending on the size of the roof, hips can be doubled or made out of different material, such as LVL. To keep the hip roof sections in plane with the main roof, the hip roof rafter must have the same height above plate (HAP) as the regular rafters. Measured at the common rafters, HAP is the vertical distance from the tops of the rafters to the plate at the edge of the wall framing.

Illustrations by Tim Healey

ensures that they will be in the same plane. This measurement is crucial for laying out the hip rafter.

**Hip rafter length.** The conventional way to determine the length of a hip rafter is by using the “Length of Hip per Foot of Run” table on a framing square or by using a construction calculator. But rather than depending on the math, I find it easier on small roofs to physically measure the length as shown on the illustration at right. I start by making a short pattern of the ridge cut for the hip. For this, I need the plumb angle for the hip, which is calculated as the rise-per-foot/17. So for this 6:12 roof, the plumb angle on the hip is based on a 6:17 slope.

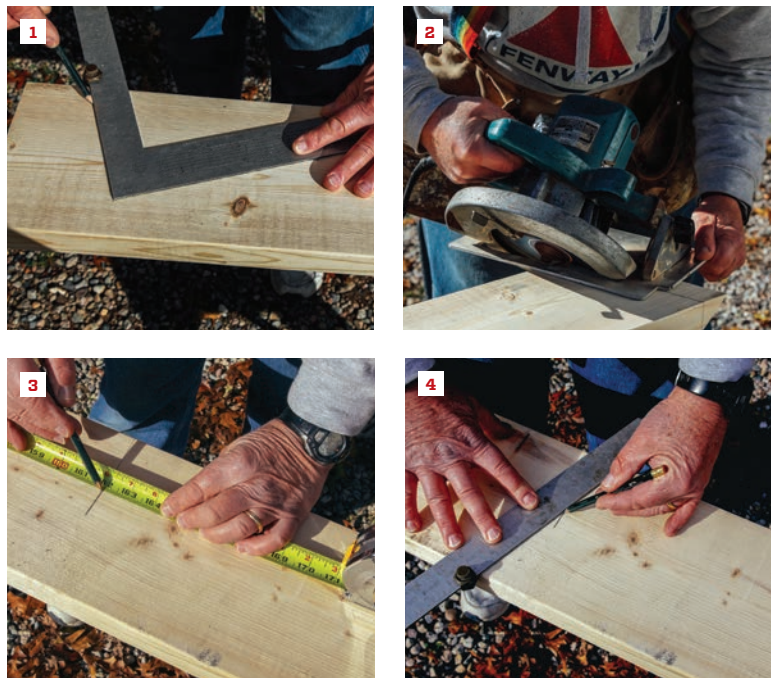
The easiest way to lay out the angle is with stair gauges attached to a framing square. These little hexagonal devices clamp on the edge of the square—one at the 6-inch mark and one at 17. When you slide the square to the edge of the board, the gauges “stop” the square at the proper angle for the hip slope.

Using this angle, I make a *double 45° cheek* cut on my pattern. I then place the pattern in the corner between the two king commons and mark where the shoulder of the cheek cut meets the kings.

Next, I move to the building corner and on the plates, I draw a 45° angle that bisects the corner. I then measure over half the width of the hip rafter— $\frac{3}{4}$  inch for 2-by stock—and draw a parallel 45° line.

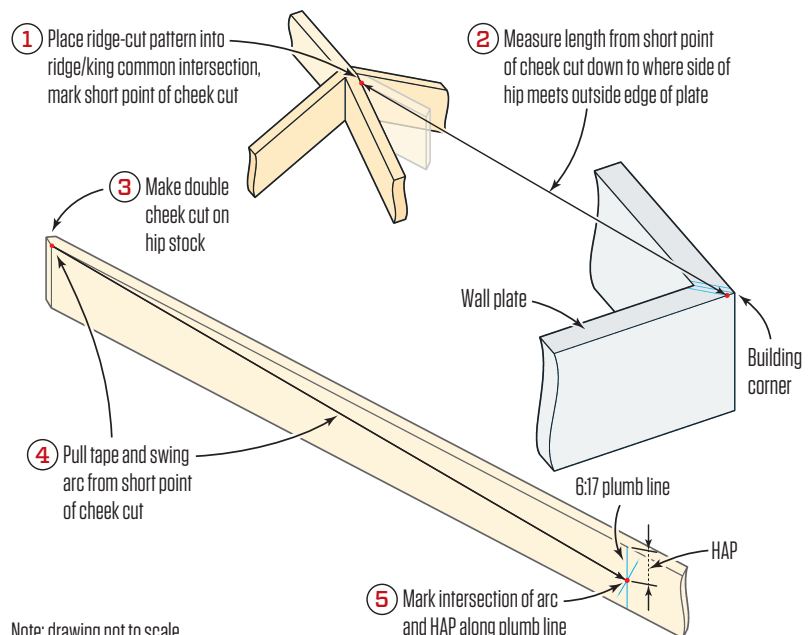
Holding the tape on the shoulder mark that I made on the king common using my ridge-cut pattern, I measure down to where the line for the side of the hip meets the outside edge of the plate, and I record that measurement. (Note: This is *not* the same length as the hip rafter “line length,” which is the figure you would find using a calculator or the table on a rafter square to determine the hip rafter length.)

**Hip rafter layout.** For the hip rafter, I choose a lumber dimension one increment up from the size of the common rafters. In this case, I used 2x6 stock for the commons, so I went with 2x8 stock for the hip. (If the commons were 2x10, I would have used 2x12 stock for the hip). Be sure to mark the direction of the crown on the hip board and keep this as the top edge of your hip rafter.



Lay out plumb cuts for the top of the hip rafter (1), and make the cuts with the saw blade set at 45° (2). Swing an arc at the measured length of the rafter (3), and then mark the HAP along an intersecting plumb line (4). Using the ruler on the framing square, the  $4\frac{3}{8}$ -inch HAP is marked at  $10\frac{3}{8}$  inches. These steps are also shown in the illustration below.

### Measuring Hip Rafter Length



Note: drawing not to scale





On one end of the stock, I cut a double 45° cheek cut along a plumb line for a 6:17 roof. To lay out this double cheek cut, I draw a plumb line on one side (1), square this line across the edge, flip the board over, and draw another plumb line on the opposite side. These define the short points of each cheek cut. After setting the blade angle on the saw to 45°, I cut all the way through the board from one side. (Because I am cutting the short point line, I keep the saw blade angled towards my off-cut.) Then I flip the board over and cut from the other side (2). The cheek cuts should meet in the middle of the hip stock.

Next, a crew member holds the end of the tape on the short point of the cheek cut (at the top edge of the hip rafter) while I hold a pencil at my length measurement and trace a shallow arc across the width of the board (3). With the framing square set at the 6:17 angle, I slide the square up to the arc and mark the point where the HAP distance along the plumb side of the square intersects with the arc (4). That point is where the seat cut of the hip rafter starts, so I slide the square down and draw a level line to the edge of hip stock, using the “level” side of the square. (Note: The plumb cut for the birdsmouth has to be moved out to clear the plates and sheathing.)

**Install the hip rafter.** To put the hip rafter in, I have a crew member hold the top end of the hip rafter so that the shoulders of the cheek cuts are flush with the tops of the king commons (5). When the top is set, I align the seat cut on the line that I drew for the side of the hip and drive toenails to secure the hip to the plates on both sides (6). To secure the top of the hip in place, I drive nails through the king commons. If that isn’t possible, I drive a nail through the top of the hip and into the ridge (7).

Next, I cut and install the jacks (see “Fast Jack Rafter Layout and Cutting,” Sep/17). When the jacks are in place, I extend a line from the tails out to the hip rafter from both directions and make plumb cuts at a 45° angle. I then project a line from the bottoms of the jack rafter tails to the hip and make a level cut to catch the corner of the soffit.

To install the hip rafter, set the top end into the corner between the two king commons and tap it down until the shoulders are flush with the tops of the adjacent rafters (5). Align the edge of the seat cut with the layout line on the plates and toenail it from both sides (6). Fasten the top through the king commons if accessible or directly through the top (7).

For a more detailed discussion on hip rafters, go to [www.jlconline.com/training-the-trades/laying-out-a-hip-rafter](http://www.jlconline.com/training-the-trades/laying-out-a-hip-rafter)

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