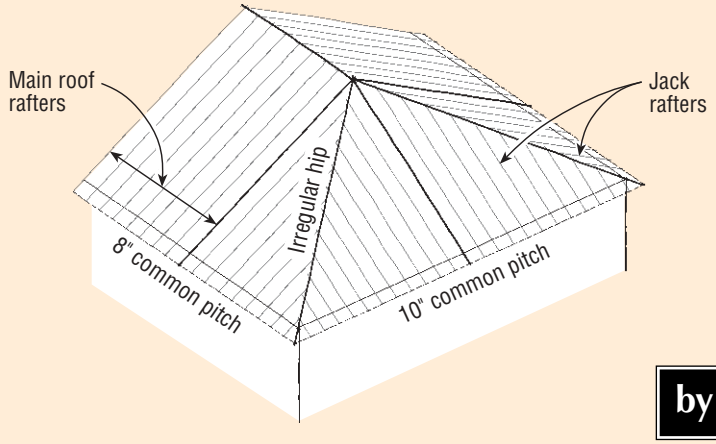
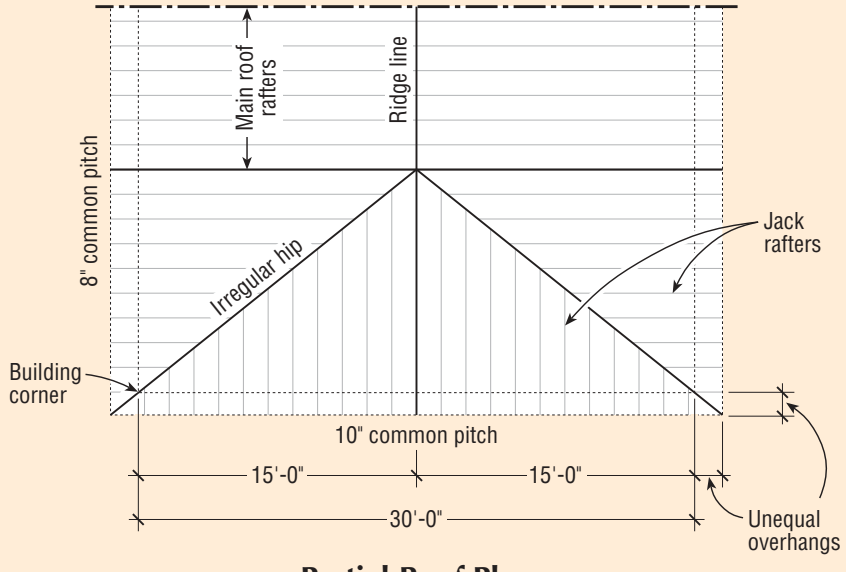
LAYING OUT A Split-Pitch Hip

A series of right triangles provides the numbers you need to make the cuts





Partial Roof Plan

Cutting my first complex roof slowed me to a crawl. Things got especially hairy where two slopes of unequal pitch met in a hip or valley. Although I gradually sorted out the trigonometry that enabled me to move through all the steps and cuts, I'll admit that mastering the calculator keystrokes wasn't a piece of cake. Sometimes on site it's more practical to take a simpler approach. In this article, I'll show how you can lay out and cut a split-pitch, or irregular, hip rafter using a framing square, a tape measure, a bevel gauge, and a series of triangles you can draw on a scrap of plywood.

As an example, I'll use a roof where the main 8/12 pitch ends with a 10/12 hip.

by Joseph Fusco with Dave Holbrook

Because the converging pitches are unequal, the hip doesn't bisect the plan view at 45 degrees, as it would in a regular hip roof. In a regular 8/12 hip roof, you would use 8/17 to step off the hip rafter; 17 is the unit run of the hip per 12 inches of run of the common rafters. With a split-pitch roof, that won't work — as a unit run, 17 applies only to a 45-degree hip.

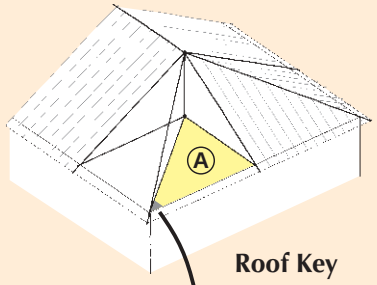
Because the 8/12 pitch in my example is the main roof and establishes the ridge height, I'll do the hip layout in terms of that side of the roof. This will mean finding a new ratio that expresses the 10/12 pitch in terms of an 8-inch rise.

In all the drawings, layout will be done at the centerline of the framing member; you would need to deduct for the thickness of the stock before you cut.

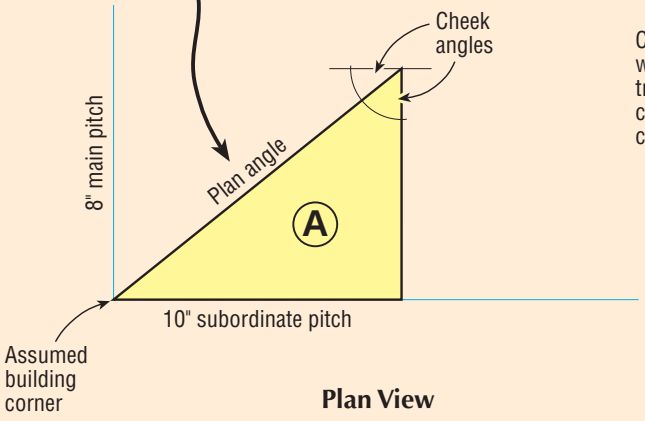
Find the Hip Angle in Plan

The hip doesn't hit the wall at 45 degrees, but finding the angle is easy. Using the framing square, draw a right triangle with a 10-inch and an 8-inch side. Close the right angle with the hypotenuse and you've got the angle of the hip in plan, plus the two cheek-cut angles (triangle A).

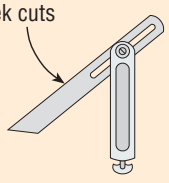
The irregular hip plan angle is a straightforward representation of the relationship between the two roof pitches, in this case 8 and 10 inches, drawn as two sides of a right triangle. The 8-in-12 slope is the "main," or controlling, pitch on this roof; the 10-pitch is subordinate. The resulting angles can be copied with a bevel square and used to set a circular saw for the hip cheek cuts.



Roof Key

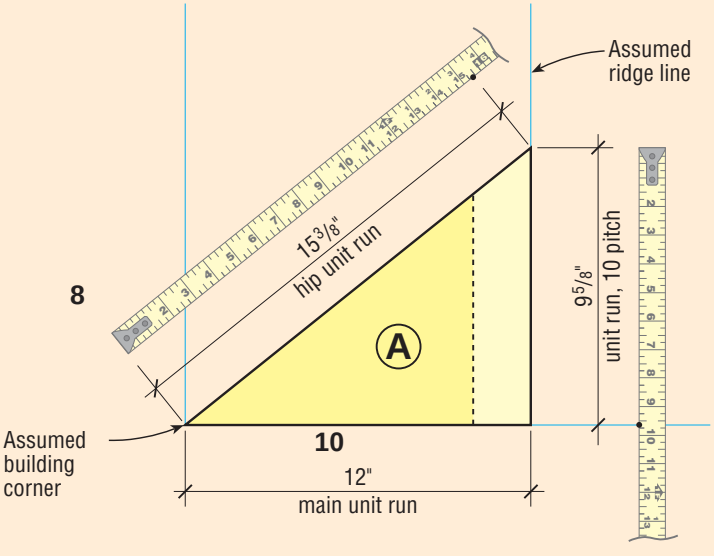


Plan View



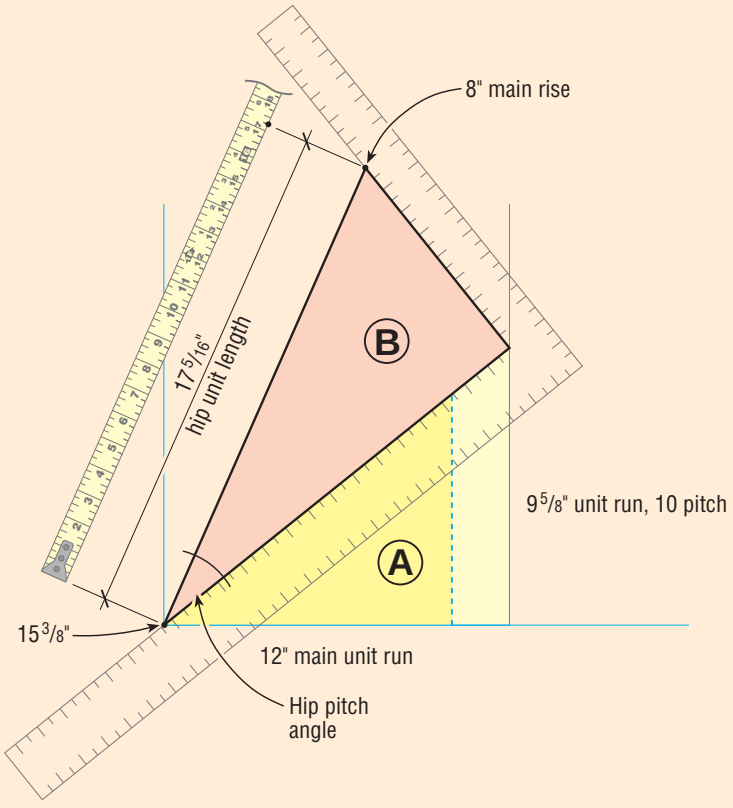
Hip Unit Run

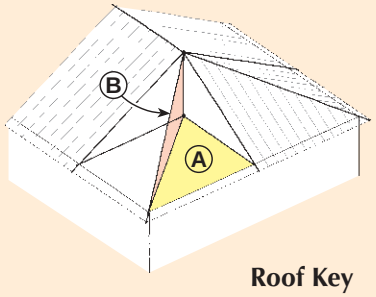
To determine the hip unit run (the hip run per 12 inches of common run), extend the 10-inch baseline of triangle A to 12 inches. Draw a new line perpendicular to the endpoint of the base extension. Extend the adjacent hypotenuse to meet it: The 12-inch baseline is the unit run for the common, 8-pitch rafter; its opposite side represents the 10-pitch unit run as a ratio of the controlling 8-inch pitch.



Hip Unit Length

The next step is to find the unit length for the hip. Draw an 8-inch line — the controlling unit rise — perpendicular to the hip unit run line and return it to the 12-inch baseline endpoint (triangle B). The length of this new hypotenuse is the hip unit length. All unit dimensions will be multiplied by the run (1/2 span) of the main pitch to determine total run and total length of the hip and each common rafter.

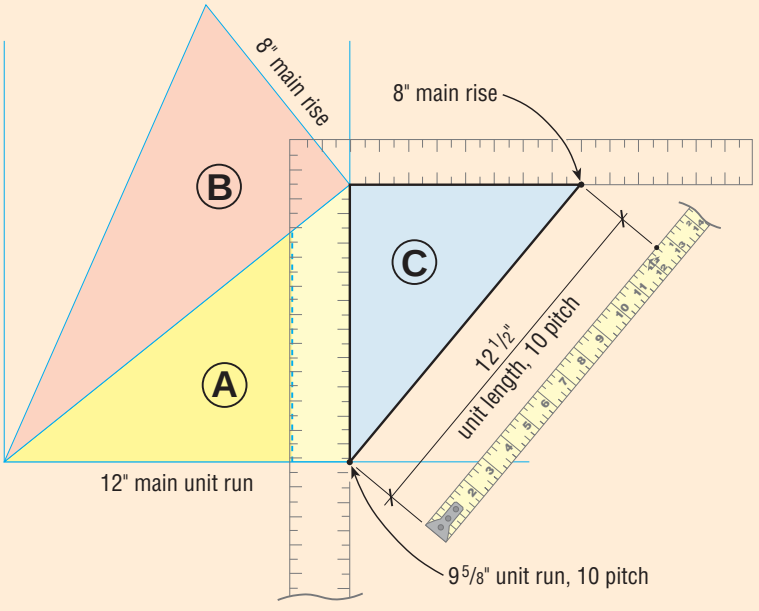


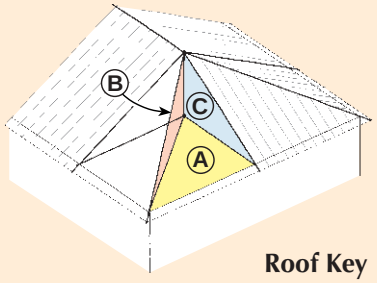


Roof Key

10-Pitch Unit Length

To determine the unit length for the subordinate 10-pitch king common rafter, draw the 8-inch main unit rise perpendicular to one end of the 10-pitch unit run line, and draw a hypotenuse back to the opposite point (triangle C). Measure the hypotenuse to find the unit length for the 10-pitch rafter. Because the 8-pitch determines the ridge height, the 10-pitch is seen as a ratio of the 8-inch pitch — the wireframe roof key illustrates how these unit triangles relate to the controlling rise unit.

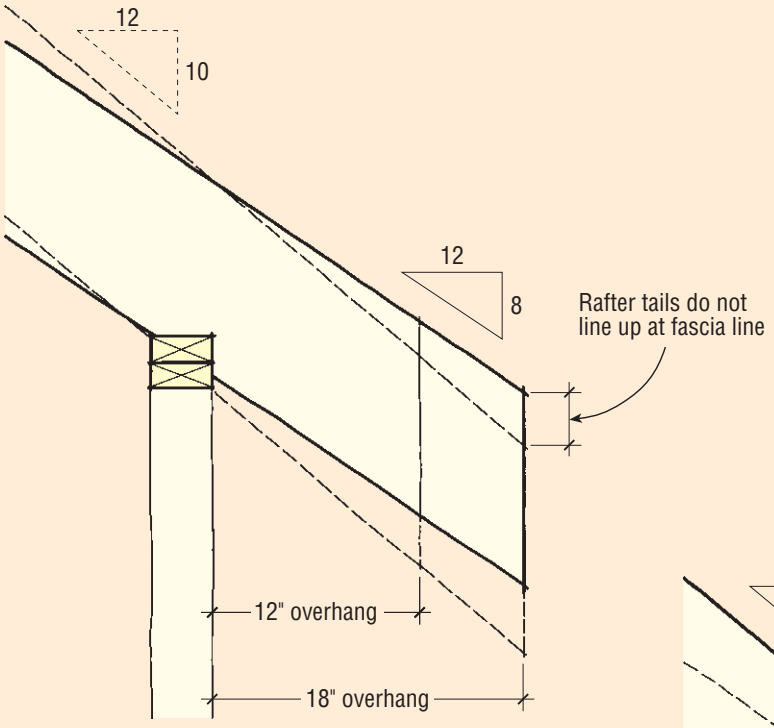




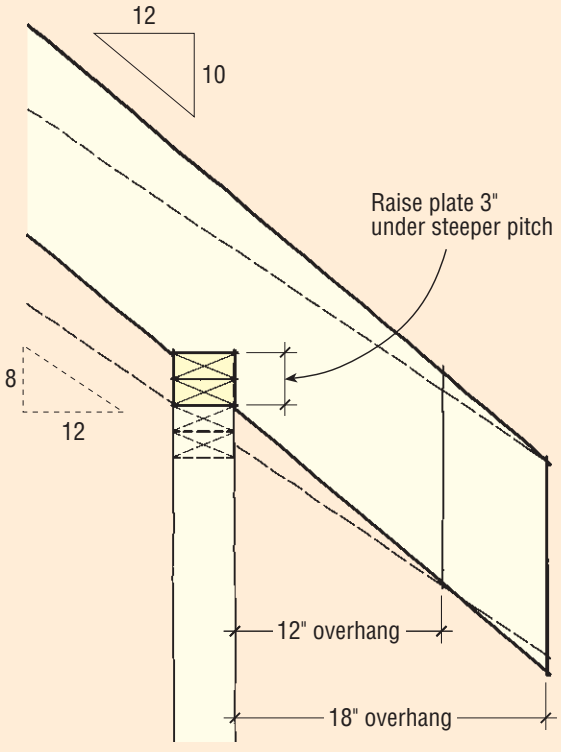
Roof Key

Creating an Equal Fascia Line

To equalize the height of the differently pitched rafter tails at the fascia line, the plate under the steeper roof pitch must be raised for each foot of overhang by the difference between the two pitches. In this case, the plate rise unit is 2 inches (10 minus 8). To calculate the plate rise for an 18-inch (1½-foot) overhang, multiply 2 x 1.5 = 3 inches.

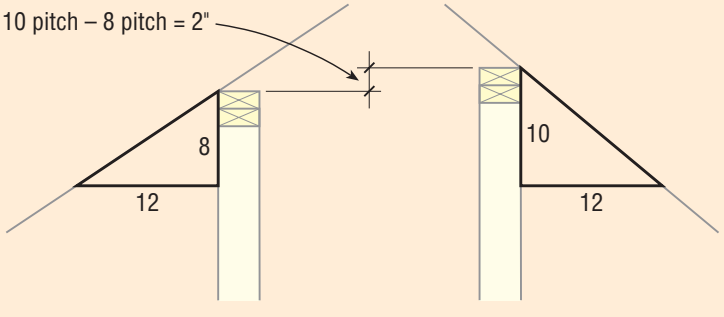


Problem

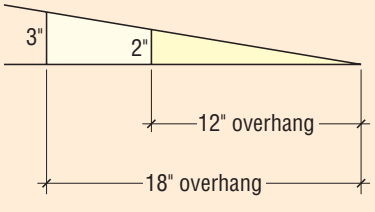


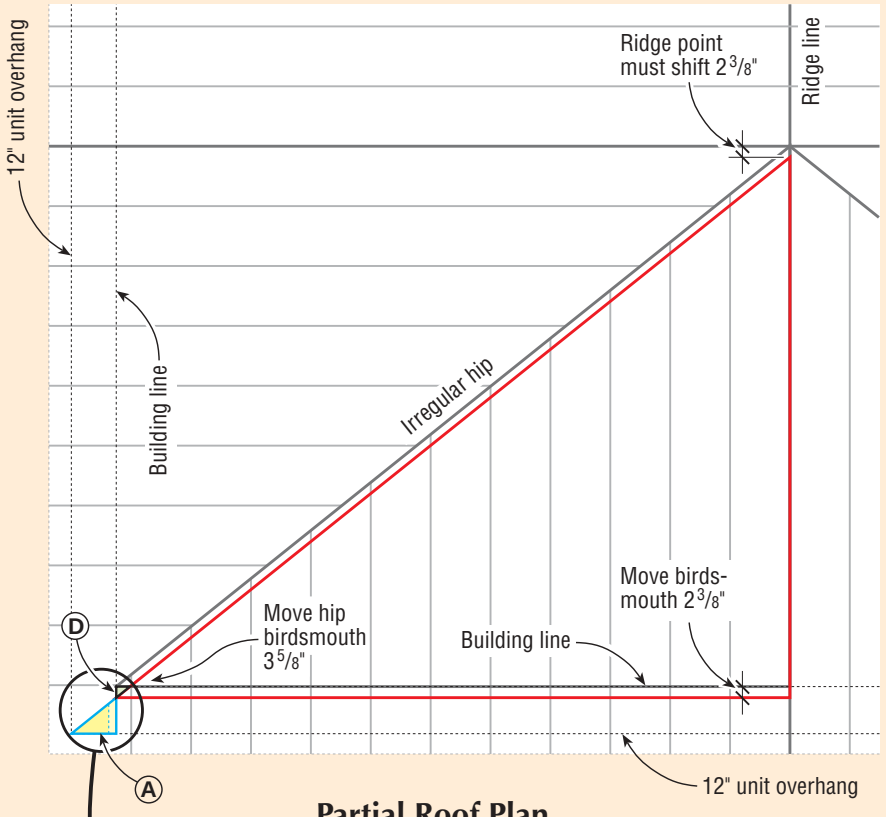
Solution

Raising the Plate

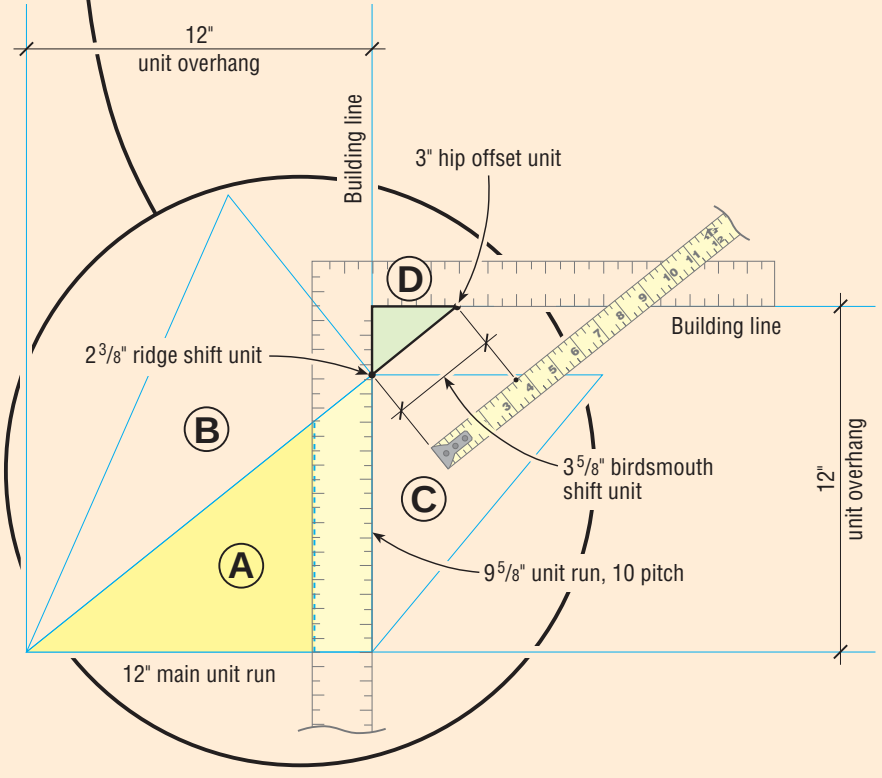


2" x 1.5 (plate rise to overhang ratio) = 3"





Partial Roof Plan



Creating Equal Overhangs

Although the differently pitched rafter tails now meet at a common fascia line, the overhangs will be unequal because the two roofs have different slopes; therefore, the steeper pitch resolves closer to the building line than the shallower main pitch. The solution is to shift the entire plane of the steeper roof off the plate by the difference between the two unit runs. As a result, the hip moves off the building corner, onto the plate of the steeper roof (red triangle). And the location of the birdsmouth shifts back onto the plate.

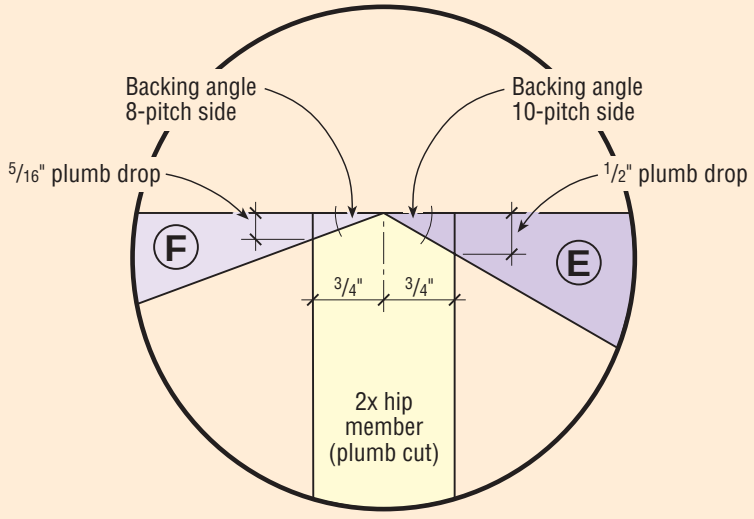
To figure all this out, return to triangle A and extend the 10-pitch unit run line to 12 inches. Draw a line perpendicular to the endpoint of the 12-inch line, then extend the hypotenuse to meet this line.

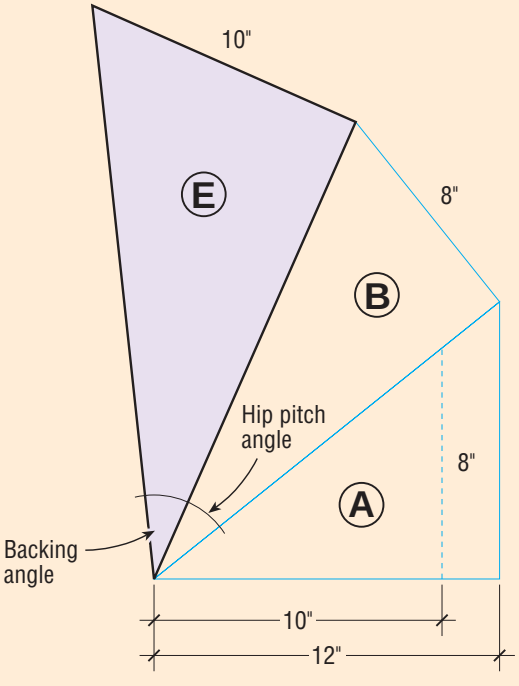
Each side of the resulting, smaller triangle D gives an important unit dimension. Since the entire plane of the steeper roof has shifted, the difference between the common unit run and the 10-pitch ratio unit run (2 3/8 inches) must be added to the ridge endpoint. The length of the opposing side gives the hip offset distance from the building corner onto the steeper roof's plate. And the hypotenuse gives the distance to shift the birdsmouth back onto the plate. These dimensions are all factors per 12 inches of overhang.

Backing the Hip

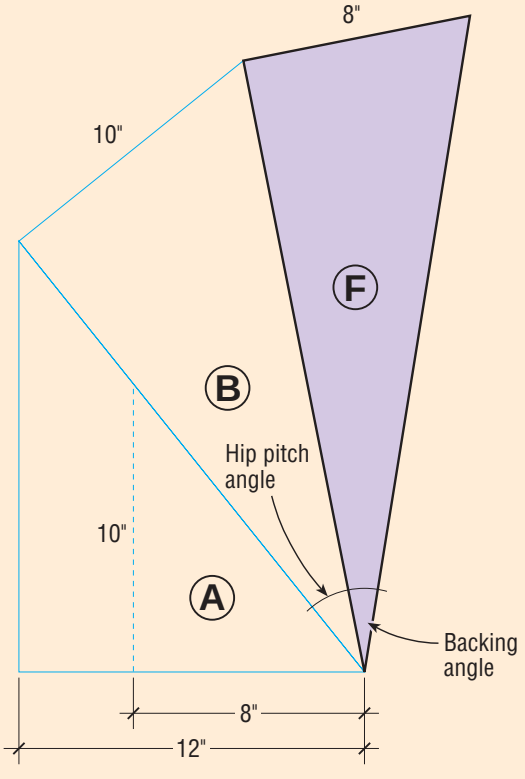
The hip rafter shares the same height above the plate as the common rafters, but its corners project above the planes of both roofs. Backing angles on an irregular hip are unique to each side but can be found by redrawing triangle A in two perspectives: one with an 8-inch baseline and a 10-inch opposing angle, and the other with a 10-inch baseline and an 8-inch opposing angle. In both triangles, extend the baseline to a common unit length of 12 inches. Next, draw the hip angle on top of each base angle as it relates to the opposite side of the hip. So, for the 8-inch baseline triangle, the hip rise line is 10 inches; for the 10-inch baseline triangle, the hip rise is 8 inches. If you check the angles on these two secondary triangles, you'll find that they match perfectly — the hip angle is constant.

Finally, draw a third triangle on top of the respective hip angles, with a rise line equal to that for its side of the hip. For the 8-pitch side, draw an 8-inch line perpendicular to the hip angle hypotenuse (triangle F). For the 10-pitch side, draw a 10-inch line (triangle E). Complete both triangles with a hypotenuse. The resulting angles, at the long points of the triangles, are the backing angles for each side of the hip. To determine the drop amount for each side, superimpose the angles on the plumb cut of the hip, working from the center of the hip stock out. Remember, drop is measured in plumb, not parallel, and don't get your sides confused.





Backing Angle 10-Pitch Side



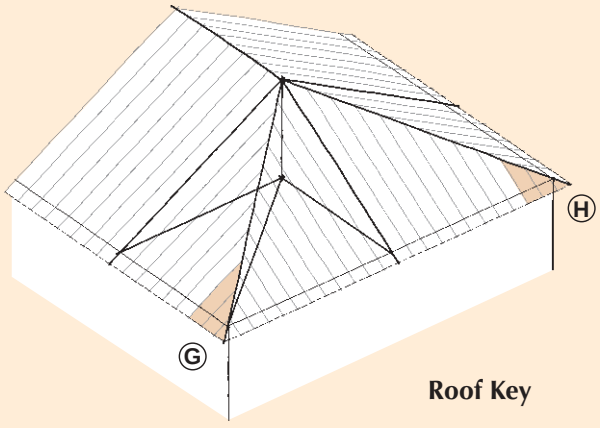
Backing Angle 8-Pitch Side

Cutting Plywood Angles

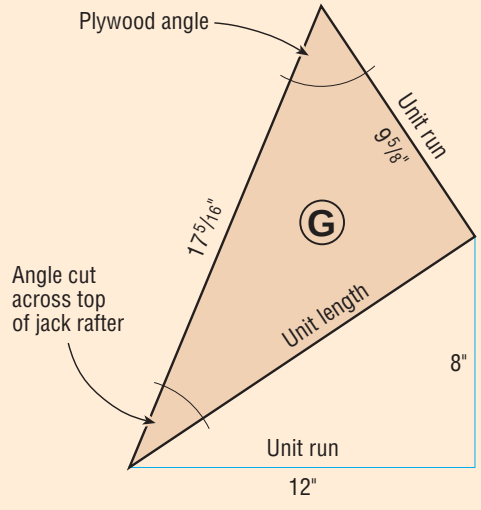
The easy way to cut roof ply is on the ground. You can't cut the plywood at the plan angle to fit the hip — it's not the same at pitch. To find the two angles needed, draw two separate rise/run triangles: a common 8-over-12 triangle for the main side of the hip, and 8-over-$9\frac{5}{8}$ inches for the 10-pitch side.

On each of these triangles, draw the opposing unit run — $9\frac{5}{8}$ inches over the 12-inch run (triangle G) and 12 inches over the $9\frac{5}{8}$-inch run (triangle H) — perpendicular to the hypotenuse and draw a second hypotenuse from the run line back to the baseline. Notice that the length of each secondary hypotenuse is equal to the hip unit length.

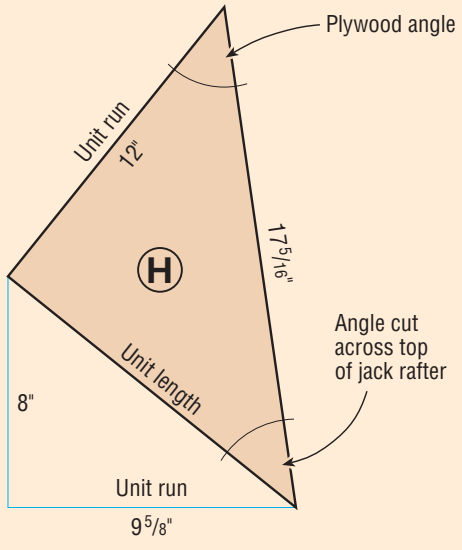
The plywood cut angle is adjacent to the run line. The more acute angle at the opposite end is the angle of cut across the top of the jack rafter, useful for marking cheek cuts steeper than a circular saw can accommodate.



Roof Key



Plywood Cut and Jack Angles
8-Pitch Side

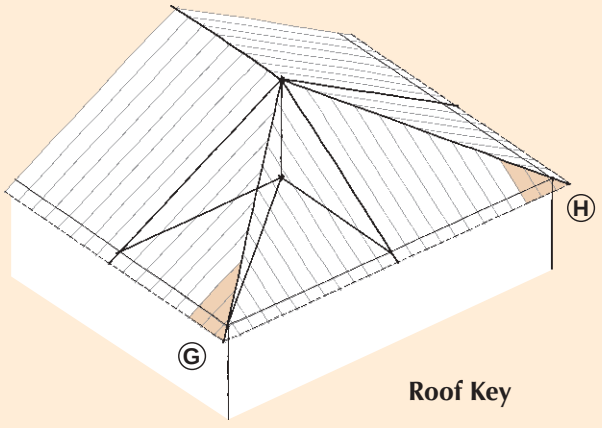


Plywood Cut and Jack Angles
10-Pitch Side

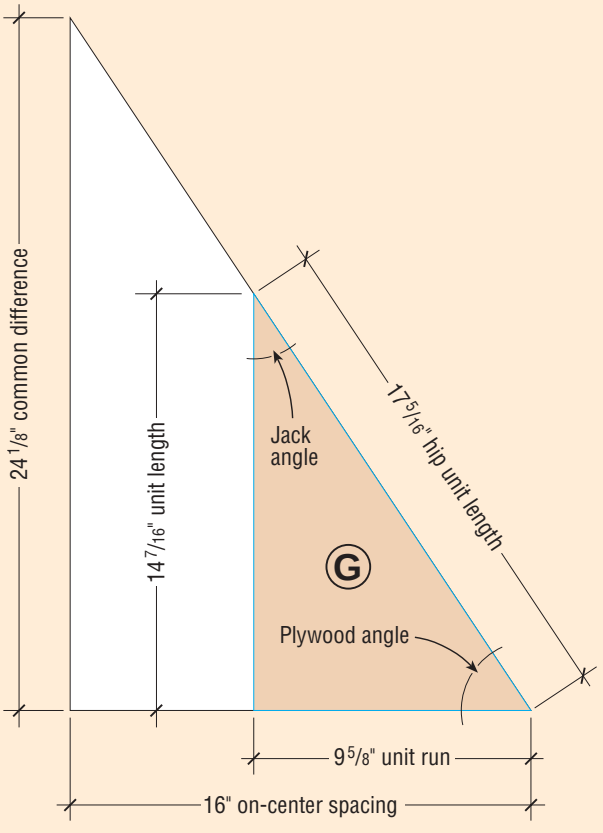
Finding the Jack Rafter Common Difference

Jack rafter lengths, and the common difference between them, are easily developed from the plywood angle drawings. Extend the respective baselines to equal common rafter spacing — we'll assume 16 inches — then draw a perpendicular line at the endpoint to intersect the hypotenuse. The point of intersection is the length of the first jack rafter as well as the length of the common difference.

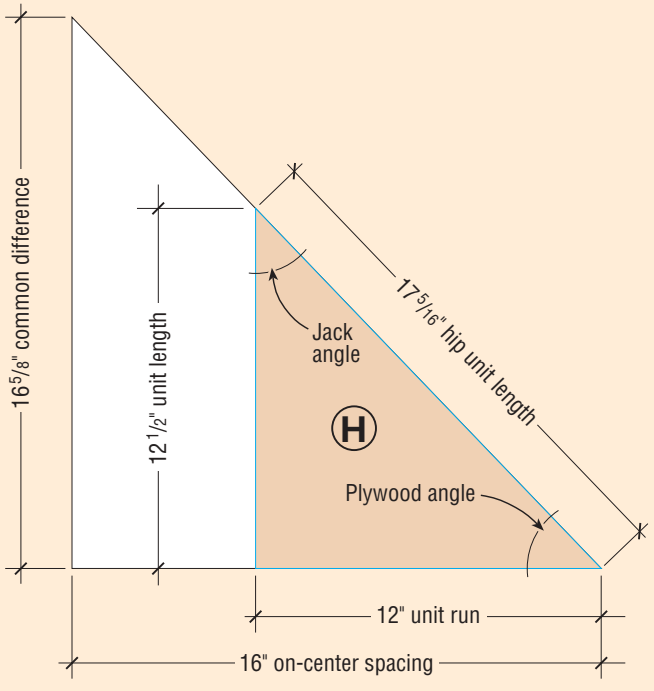
Jack rafter cheek cuts can exceed the angle setting of conventioinal circular saws, and the cut may have to be completed with a handsaw or saber saw. To guide the cut, lift the appropriate angle from the drawing with a bevel gauge and trace it across the top of the jack rafter. Don't make the mistake of using the plan angle for this purpose — it's not the same and can be used only as a saw setting for making 45-degree or shallower compound plumb cuts.



Roof Key



8-Pitch Side



10-Pitch Side

Joe Fusco is a carpenter and cabinetmaker in Staten Island, N.Y.
Dave Holbrook is an associate editor at JLC.