Laying Out UNEQUALLY-SLOPED Gables

Find the ridge centerline of a two-slope gable without complicated math

by Carl Hagstrom

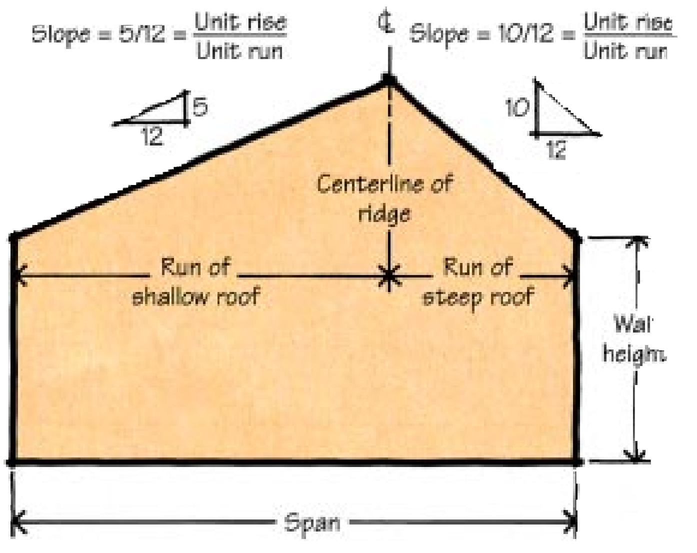
Unequally-sloped gable roofs can be difficult to lay out, but the job is a lot easier if you have a proven method. Complicated mathematical calculations that use "inverse cotangents," "secants," and "adjacent angles" may be accurate, but they're not easy to teach to novice tradespeople. As one carpenter I know put it, "I don't want to learn any 'friggonometry' — I just want to cut rafters that fit."

For a layout method to earn a five-star rating, it must be accurate, fast, and easy to understand. Over the years, I've developed a layout method that works without having to bother with any heavy math. To use my method, you only need to know how to add, subtract, multiply, and divide.

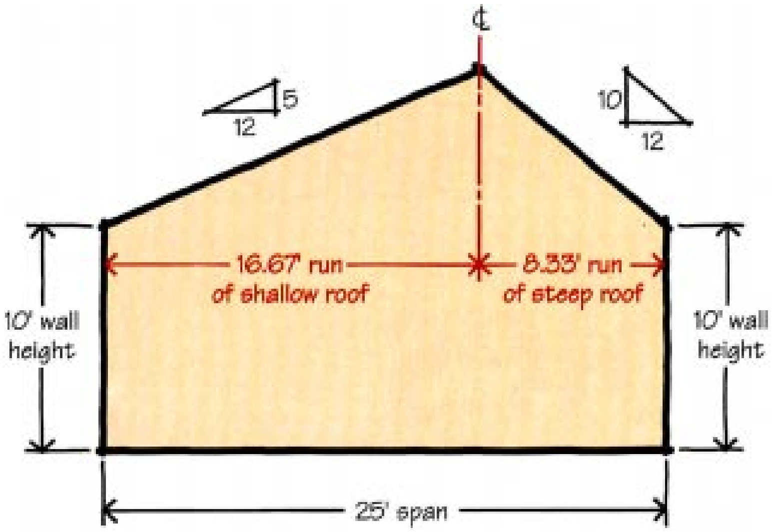
I'll assume that you can lay out a common rafter. You also need to know how to convert feet, inches, and fractions into decimal equivalents — or you can use the simple conversion ruler provided with this article (see "Quick Decimal Conversion," next page).

I treat layout for an unequally-sloped roof as the combination of two common gable roofs. I'm essentially laying out common rafters for two different roofs. The trick is finding where the two different slopes will meet at the ridge. To understand the terms I'll be using, refer to the illustration at right.

Roof Layout Terms



Case 1: Equal Wall Heights



Step 1. Add the rise of the two different roof slopes: 5 + 10 = 15.

Step 2. Divide the rise of either roof slope by the sum of the two slopes from Step 1. For example, using the shallower slope, 5 ÷ 15 = .3333. (Use four decimal places for accuracy.)

Step 3. Multiply the span by the answer in Step 2: 25 ft. x .3333 = 8.33 ft.. This represents the total run of the steep roof.

Step 4. To find the run of the shallow roof, subtract this value from the total run: 25 - 8.33 = 16.67 ft. You can check the answer by repeating the process using the steeper slope:
10 ÷ 15 = .6666
25 ft. x .6666 = 16.67 ft.

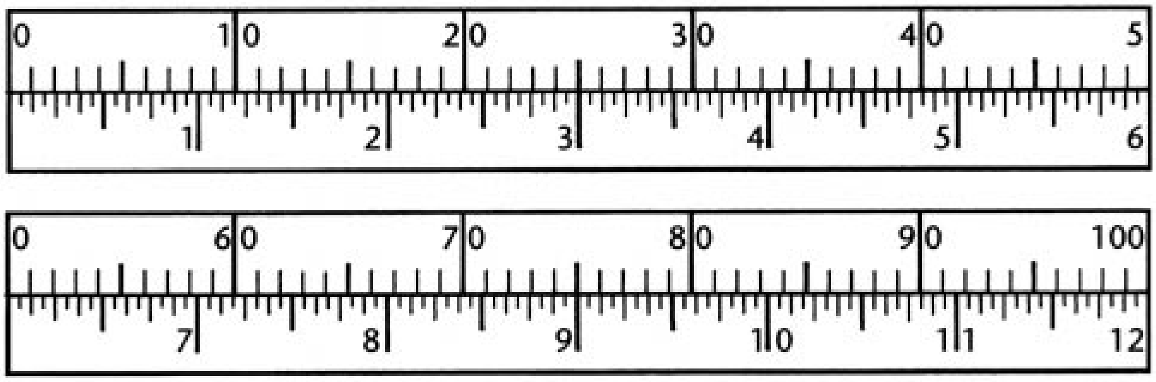
Both rafters can now be laid out as common rafters.

Quick Decimal Conversion

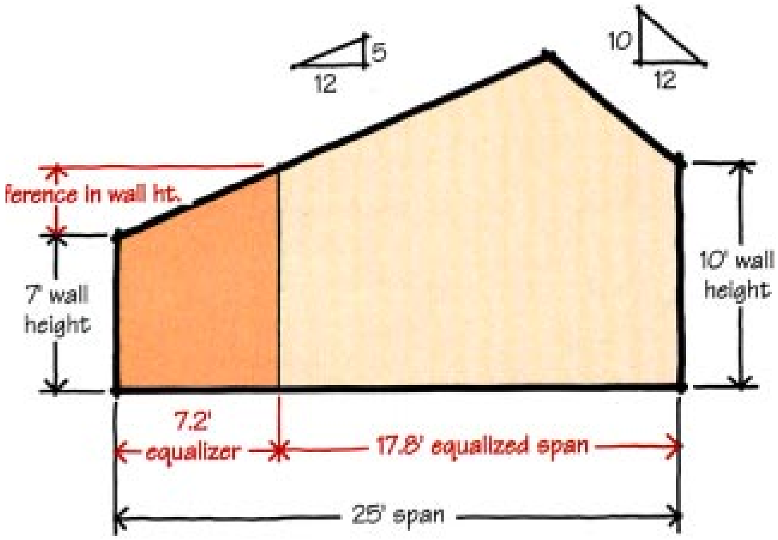
Most of the ways to convert feet, inches, and fractions to their decimal equivalents have one thing in common: too much math. When I was a student at Williamson Trade School in Media, Pa., in the early 1970s B.C. (Before Calculators), I was fortunate to have been taught by Don Zepp, who is a master of the framing square. To eliminate the need for tedious calculations, he taught us how to make a conversion scale that could be glued to a framing square.

The conversion scale is simply a standard 12-inch scale juxtaposed with a 12-inch-long 100ths scale. To use it, just locate the inches and fraction of the measurement you're working with, then read the decimal equivalent directly above. If you're converting a decimal figure back to inches and fractions, find the decimal on the upper scale and the inch-fraction equivalent is directly below. No batteries, no math — it doesn't get any easier.

The conversion table is printed to scale. Make a photocopy, cut the scales out, and glue the two halves together, end-to-end, on the tongue of your framing square. I put clear packing tape over my conversion table to protect it. When it wears out, I just glue another one on. *— C.H.*



Case 2: Different Wall Heights

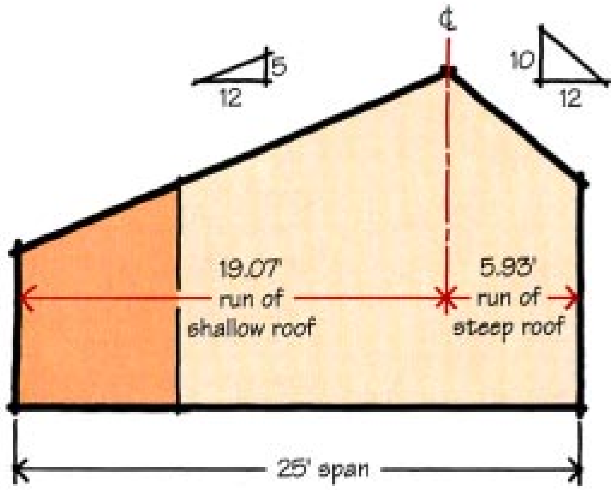


In this scenario, you first have to "equalize" the different plate heights:

Step 1. Divide the unit run of the shallow slope by the unit rise: 12 ÷ 5 = 2.4.

Step 2. Find the "equalizer" by multiplying the difference in plate heights by the value from Step 1. The difference in plate heights: 10 - 7 = 3 ft. Multiply by the value from Step 1:
3 x 2.4 = 7.2 (the equalizer).

Step 3. Subtract the equalizer from the total span of the roof: 25 - 7.2 = 17.8 ft. This smaller, "equalized" span is for a roof with equal plate heights.



Using the "equalized" span, follow the four-step process from Case 1 to find the run of the steep roof:

Step 1. 5 + 10 = 15

Step 2. 5 ÷ 15 = .3333

Step 3. 17.8 ft. x .3333 = 5.93 ft.
This is the run of the steeper roof.

Step 4. To find the total run of the shallow roof, subtract the run of the steep roof from the span of the building: 25 - 5.93 = 19.07 ft.

Case 1: Equal Wall Heights

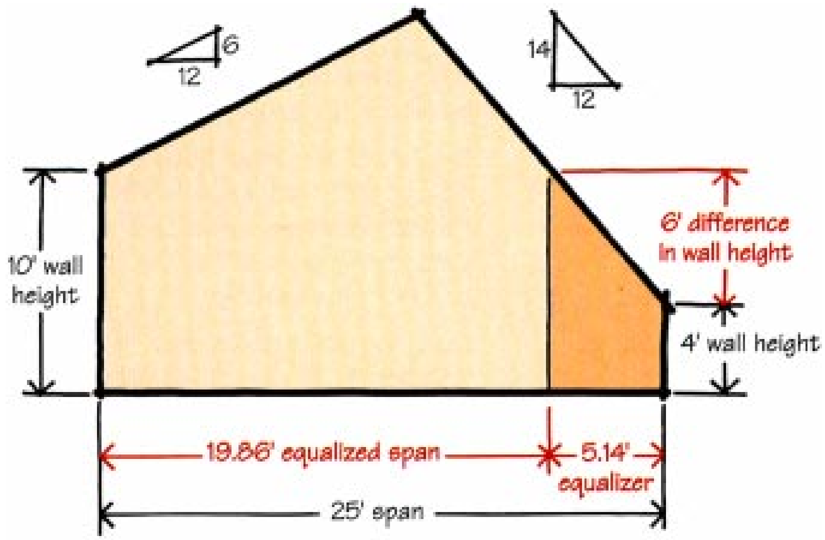
My four-step method results in the run dimension for each slope. In the first example (see Case 1), the bearing walls are both the same height, and I know the roof slopes and the overall span. After plugging the numbers into each of the four steps, I can use the results to lay out common rafters for both slopes.

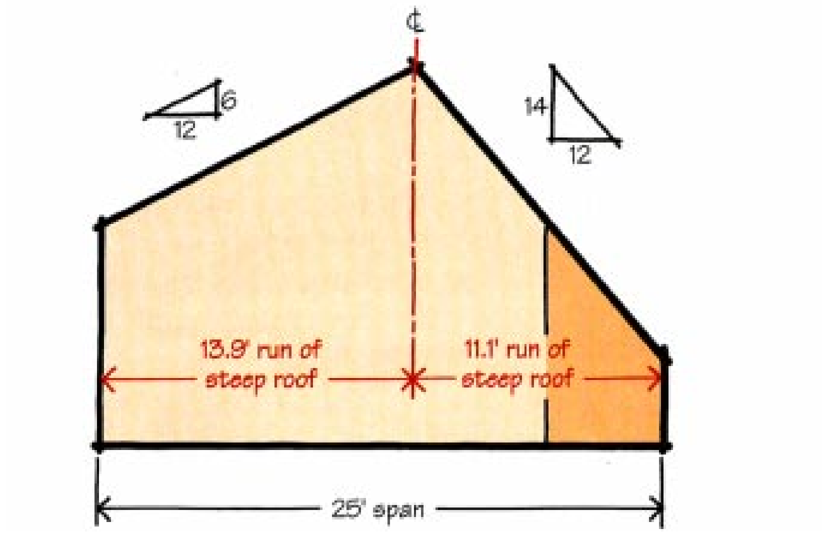
Case 2: Different Wall Heights

Let's consider a more complicated scenario — an unequally-sloped roof with bearing walls at different heights. The slopes are the same as in Case 1, but the wall height on the shallow slope has been changed from 10 feet to 7 feet.

When the walls are different heights, I first create an "equalizer" using three easy steps (see Case 2). When the equalizer is subtracted from the span, I'm left with a roof that once again sits on walls of equal height.

Case 3: Steep Slope on Short Wall





Find the equalizer by following the three steps from Case 2:

Step 1. Divide the unit run of the steeper roof by the unit rise: 12 ÷ 14 = .857.

Step 2. Multiply the difference in plate heights by the value from Step 1: 6 x .857 = 5.14 (the equalizer)

Step 3. Subtract the equalizer from the total span of the roof: 25 - 5.14 = 19.86 ft. This smaller, "equalized" span is for a roof with equal plate heights.

Find the run for common rafters:

Step 1. Add the rise of the two different roof slopes: 6 + 14 = 20.

Step 2. Divide the shallower roof slope by the sum of the rises from Step 1: 6 ÷ 20 = .3

Step 3. Multiply the equalized span by the decimal from Step 2: 19.86 x .3 = 5.96 feet
This is the run of the steep rafter on the shorter, "equalized" building span. To get the true run of the steep rafter, add the equalizer back in: 5.96 + 5.14 = 11.1 feet.

Step 4. To find the run of the shallow rafter, subtract this number from the full span: 25 - 11.1 = 13.9 feet.

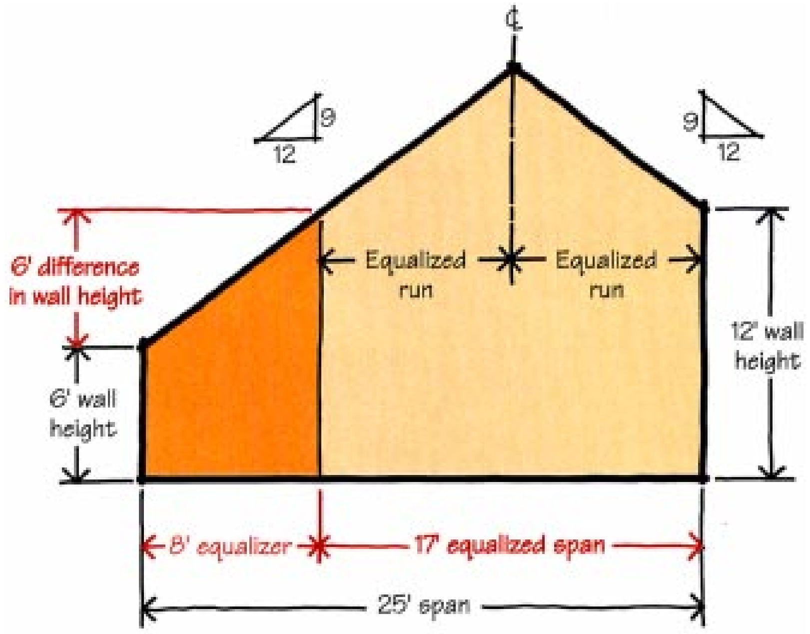
Then I can follow the four original steps to find the run for the common rafter of the steep slope. When laying out the common rafter for the shallow slope, remember to subtract from the original span (25 feet in the examples), not the "equalized" span.

Case 3: Short Wall, Steep Slope

Sometimes the steeper slope bears on the shorter wall (Case 3). Again, the trick is to find the equalizer — the point on the steep roof plane where a wall equal in height to the taller wall would meet the rafter. Follow the three-step process just described, but this time use the slope of the steep roof, because that's the side of the building with the short wall. The result is an equalized span for a building with walls of equal height.

Now use the four-step process described in Case 1. Remember, how-

Case 4: Saltbox

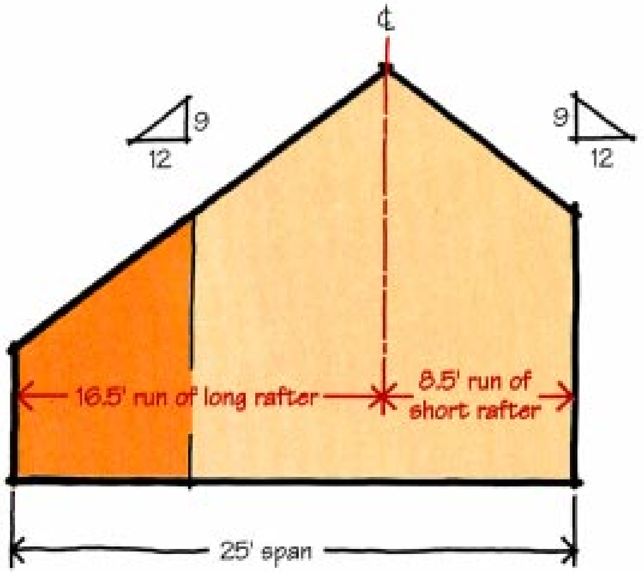


A Saltbox is a standard gable roof set on walls of unequal height. To lay out the rafters, first follow the three-step process in Case 2 to "equalize" the span.

Step 1. 12 ÷ 9 = 1.3333

Step 2. Difference in wall heights:
6 ft. x 1.3333 = 8 ft. (the equalizer)

Step 3. 25 ft. - 8 ft. = 17 ft. (equalized span)



Divide by 2 to get the run of the short rafter: 17 ÷ 2 = 8.5 ft. Add the equalizer back in to get the run of the long rafter: 8.5 + 8 = 16.5 ft.

ever, that in this case, you need to add the equalizer back in to get the run of the common rafter on the steep slope. Then subtract this number from the original span to find the run of the shallow common rafter.

Case 4. Saltbox Layout

A Saltbox is not a true unequally-sloped roof — it's really a standard gable roof set on a building with unequal wall heights. You don't need the four-step method described earlier, but you still have to "equalize" the span. To lay out the common rafters, find the run for the short rafter first by dividing the equalized span in half. To find the run for the long rafter, add the equalizer to the run of the short rafter.

Carl Hagstrom *cuts rafters in Montrose, Pa.*