Framing a Hipped Tray Ceiling

by Tim Uhler

One of my favorite parts of framing a house is doing the interior-detail pickup framing — elements like arches, barrel vaults, and coffered ceilings. In this article, I'll show a simple method for framing a hipped tray ceiling — a ceiling that looks like the underside of a hip roof except that it's flat on top (Figure 1, page 2).

There's nothing unusual about this shape, but we've gotten the process down to the point where we can lay it out quickly and hand most of the work off to the less experienced carpenters on the crew.

Ceiling as Roof

To help newer framers visualize the ceiling, we use roof-framing terminology to describe the pieces. The members running up from the sides of the opening are called

With this method, all you need to calculate is the length of the hip and the run of a common

"commons" and the ones in the corners are "hips." These "rafters" butt against a lower rim board at the inside face of the soffit and angle up to meet the flat surface at the top of the tray. The flat area is bound by horizontal rim boards that catch the upper ends of the rafters and the tray ceiling joists that span from rim to rim.

The trays we build are small enough that all the framing members except the soffit rim can be made from 2x4s. The soffit rim should be at least as tall as the room's ceiling joists; we often make it from 2x12s.

Sizing rule of thumb. These ceilings typically go in master bedrooms. In rooms of that size, it generally looks good if the commons are about 3 feet long. They could be longer or shorter, but we've found that regardless of the pitch, 3 feet is dramatic enough without overpowering the room. It's also a nice round number to work with.

We also have to determine what slope to use for the sides of the tray. On upper floors, we try to match the pitch of the roof so that the tray rafters near outside walls won't hit the roof rafters or come so close it's hard to insulate.

Framing Calculations

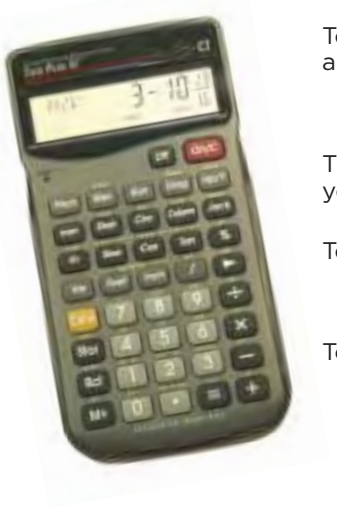
We calculate our cuts and layout based on the 3-foot common-rafter length. The length of our tray rafters corresponds to the line length of a roof rafter — the distance between the head cut at the top and a line projected up from the plumb cut at the birdsmouth. Because the tray rafters butt to rim boards top and bottom, they don't need birdsmouths; instead, they have plumb cuts at both ends.

The photographs in this story come from a house with an 8/12 pitch roof, so that's the pitch we used for the tray ceiling. We knew the rafters would be 3 feet long, so the only thing we had to calculate was the length of a hip and the run of a common. The easiest way to do these calculations is with a Construction Master (Figure 2, page 3). I use a Construction Master Pro Trig Plus III set to round to the nearest 16th inch.

Figure 1. A hipped tray ceiling (above) adds visual interest without a lot of additional framing cost. It's framed like a hip roof except that it's flat on top (right).

The Geometry of a Hipped Tray Ceiling

Figure 2. Laying out a hipped tray ceiling — like the one in the drawing below — is like laying out a hip roof. The author usually starts with a known rafter length of 3 feet and often matches the pitch of the roof above. The calculations shown here are based on an 8/12 pitch. With this method, the only other dimensions the framer needs to know are the length of the hip and the run of the common, information that's easy to get from a Construction Master using the following keystrokes.



To enter the line length of the common and its pitch:

3 Feet Diag 8 Inch Pitch

These values are now stored in the calculator; you can do the next keystrokes in any order.

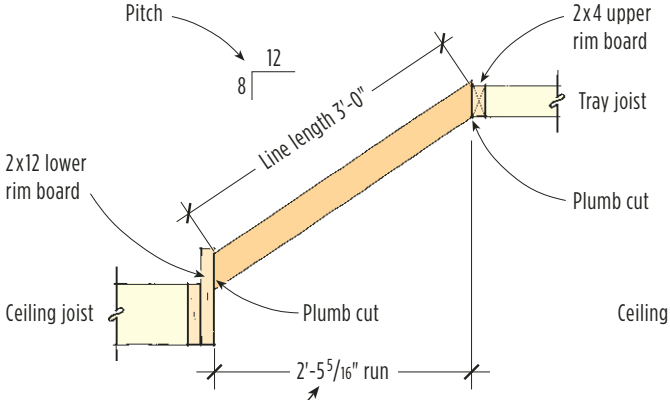
To find the length of the hip, enter

Hip/V and 3′-10 13/16″ is displayed.

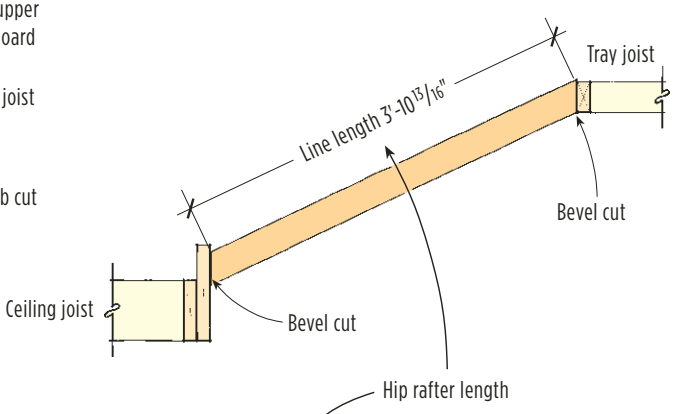
To find the run of a common, press

Run and 2′-5 15/16″ is displayed.

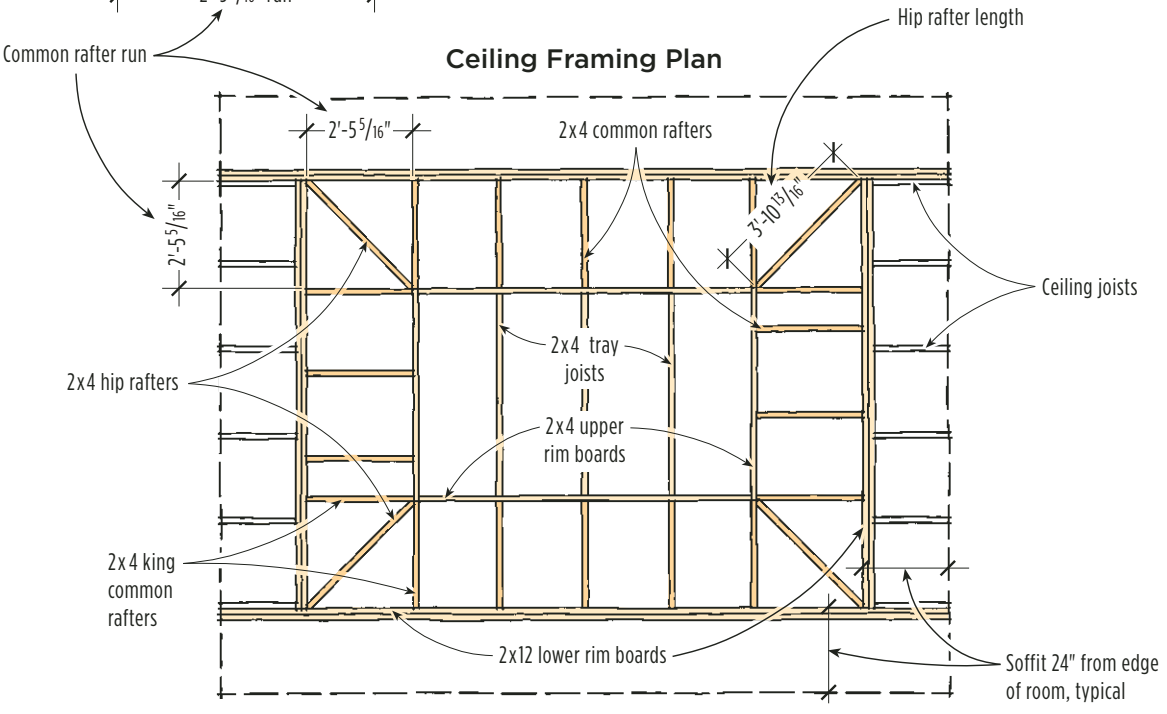
Common Rafter Run



Hip Rafter Length



Ceiling Framing Plan



After entering the pitch (8) and the length of the common (3 feet), the calculator gives us the length of the hip (3 feet $10^{13}/16$ inches) and the run of a common (2 feet $5^{15}/16$ inches). We write both numbers down and put the calculator away; that's it for the math.

Everything else from here on out is a matter of measuring, marking, cutting, and installing.

Rise doesn't matter. If we were framing a roof, we'd want to know the rise of the commons to know how high above the plates to support the ridge while we installed rafters. But with a tray ceiling, the rise matters only if you're installing it in a dropped ceiling and need to fit it beneath the joists.

The ceiling shown here bumped into a large attic space, so we didn't have to worry about its height.

Laying Out Commons

To lay out the commons, we draw a pair of lines 3 feet apart and square across the edge of a 2x4. We then use the Speed Square to mark the two parallel lines, 3 feet apart on the 2x4's face, representing the plumb cuts at each end (Figure 3). We saw through the 2x4 at both lines and use this first common as a pattern to mark the others.

To save time, we stack the material for the commons, trace the plumb cuts onto the top piece, and make the cuts with a saw set deep enough to score the cut on the piece below (Figure 4).

Laying Out Hips

We lay out the hips the same way, again with the Speed Square, but using the hip-valley scale this time.

Bevel cuts. The ends of each hip get beveled with a saw set to 45 degrees so that the top will fit between the king commons and the bottom will fit the inside corner of the opening. Using the Speed Square, we mark the hip plumb cut at one end of the hip, then make a second line parallel to the first and $1^1/2$ inches — the thickness of the stock — away. (If the stock were $1^3/4$ inches thick, the second line would be $1^3/4$ inches away.)

We use these lines to guide

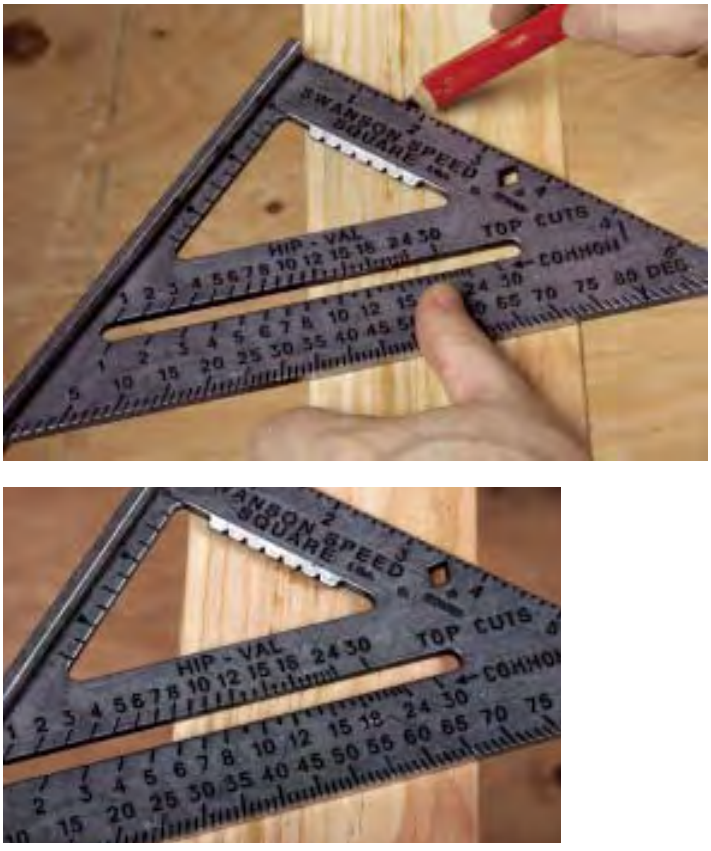


Figure 3. The rafters for a tray ceiling have plumb cuts on both ends. To use a Speed Square to lay out the 8/12 plumb cut on the end of a common, set the pivot point against the edge of the stock and align the number 8 on the "COMMON" scale with the edge of the stock (top). Use the same method to lay out the 8/12 plumb cut on the hip, but index off the "HIP-VAL" scale (above).

Figure 4. To save time cutting the commons, the carpenters stack the material and score the cut on the second piece while cutting the top piece.

Figure 5. Here, a carpenter lays out the first set of bevel cuts on a hip by drawing parallel lines at the angle of the plumb cut on the hip. The distance between the lines is equal to the thickness of the stock — in this case, 1 1/2 inches (A). It takes two 45-degree bevel cuts to cut the end of the hip. The first cut is made on the outer line with the blade angled toward the other end of the stock (B). The second cut is on the inner line with the blade angled toward the cut end (C). The result is a 90-degree point (D) in plan view that will fit the inside corner of the opening or between the king commons where they meet at the upper rim.

the saw through the two bevel cuts that will produce the desired 90-degree point (Figure 5). With the saw set to a 45-degree bevel, we cut through the 2x4 at the line closest to the end of the board. Then, without flipping the board, we cut along the inner line (that's 1 1/2 inches away), bringing the saw in from the other edge.

The two cuts cross at the center of the stock and give us the diamond-shaped point we're looking for.

Getting the length right. We complete the hip by making a mirror image of this cut at the other end of the stock. The finished piece should be 3 feet 10 13/16 inches point to point, so we measure this distance down the edge from the diamond cut we already made.

We make a mark, then use the Speed Square to draw an 8/12 plumb cut at the mark with the hip-valley scale. This new line represents the long point of the diamond cut we want to make (Figure 6).

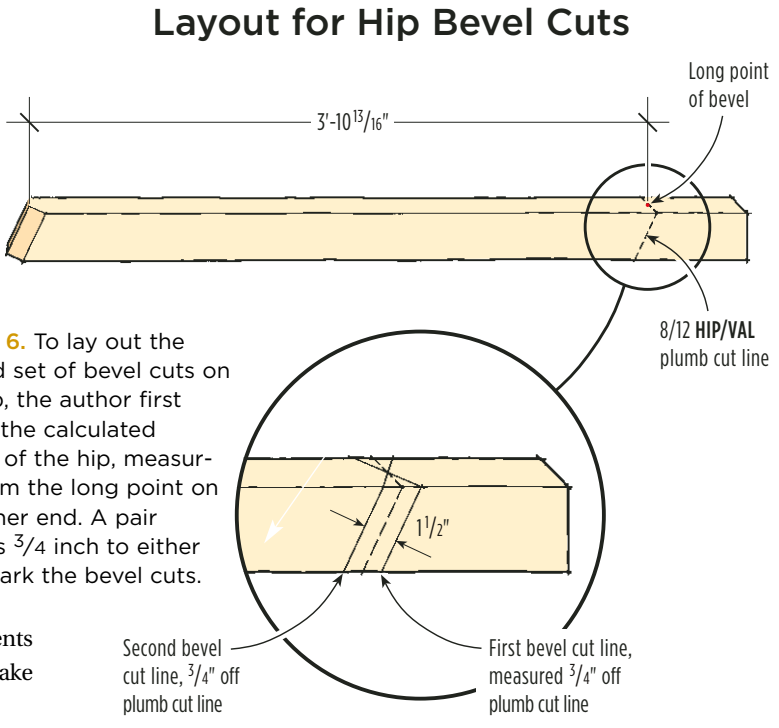


Figure 6. To lay out the second set of bevel cuts on the hip, the author first marks the calculated length of the hip, measuring from the long point on the other end. A pair of lines 3/4 inch to either side mark the bevel cuts.

Next we draw a second and third line parallel to the first and 3/4 inch to either side of it. The first line is now centered between parallel lines that are 1 1/2 inches apart. Our first 45-degree bevel cut is along the outer line with the blade angled back in. Our second bevel cut is along the inner line with the blade angled out. The cuts will cross to form a point at the center line, 3 feet 10 13/16 inches from the cut at the other end.

The tray has four hips, so we cut three more that are exactly the same as the first. The number of commons will vary with the size of the opening, but they all must be accurately cut because the way we install them leaves no room to fudge.

Soffit Framing

While a more experienced carpenter is calculating and cutting the hips and commons, I'll have two less-experienced carpenters frame the soffit around the opening in the ceiling. We typically bring the soffit in 24 inches from the edge of the room. We usually know in advance that we're going to install a tray ceiling, so when we roll the joists we use pieces that run partway into the opening and stop. (We use bearing ridges on most of the houses we build, so it doesn't matter that the joists don't reach from plate to plate.)

If we're framing a 24-inch soffit and using a single rim board, we snap a line across the joists 22 1/2 inches in from the wall and trim the joists back to that line, making sure the cuts are plumb (Figure 7).

Lower rim board. Although the joists are usually 2x8s, we use 2x12s for the rim because the added height allows us to install rafters several inches up from the bottom of the opening. This leaves a vertical surface below the slope large enough to install a crown with cove lighting.

If we chose to, we could make the rim the same height as the joists and install the rafters flush to the ceiling.

We start by cutting rims and nailing them (crown side up) onto the ends of the joists. We then install a second pair of rim boards perpendicular to the first, 24 inches out from the walls at the ends of the opening.

We check to make sure the entire opening is plumb, square, and straight. If it's not, the precut hips and

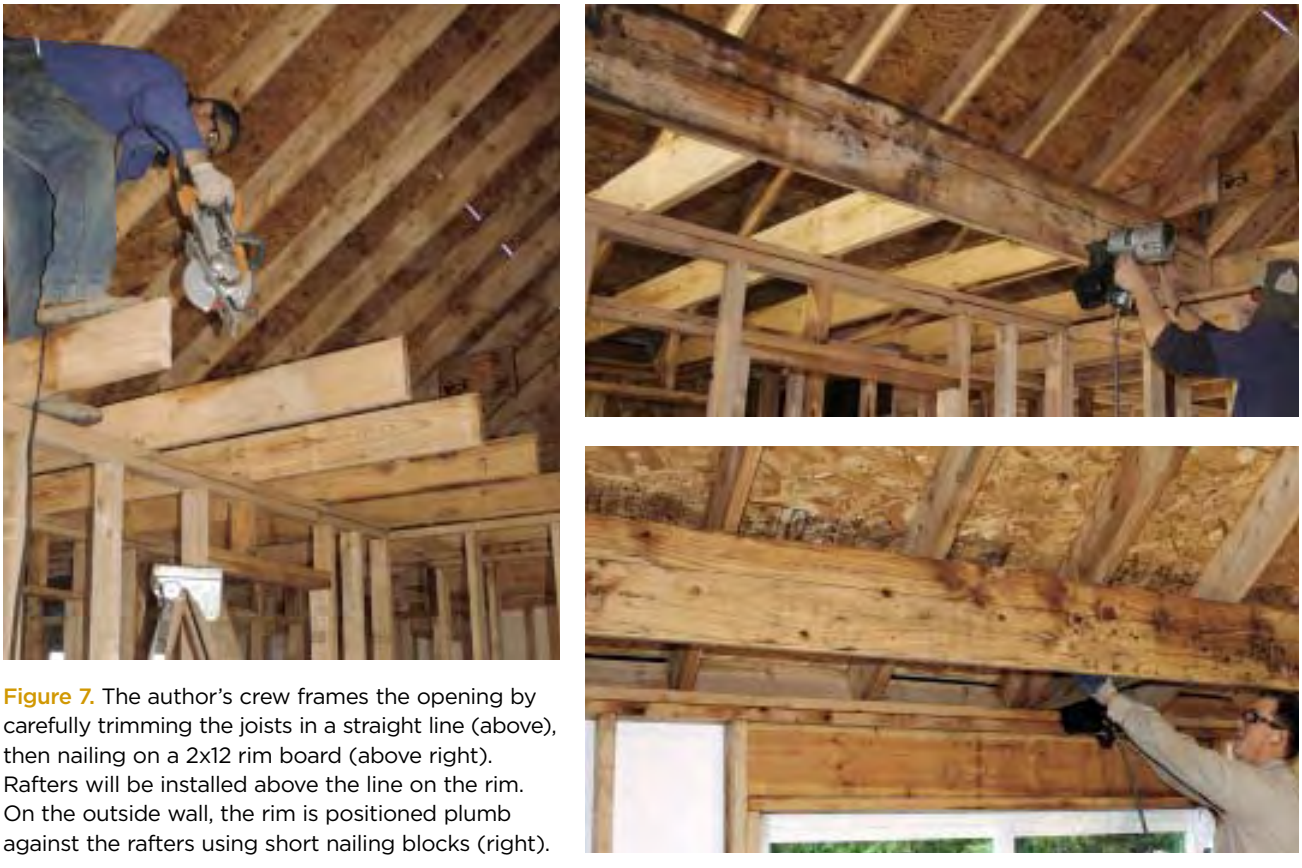


Figure 7. The author's crew frames the opening by carefully trimming the joists in a straight line (above), then nailing on a 2x12 rim board (above right). Rafters will be installed above the line on the rim. On the outside wall, the rim is positioned plumb against the rafters using short nailing blocks (right).

Figure 8. King commons, which flank the hips, are positioned the same distance out from the corner as the run of a common — in this project, 2 feet $5^{15}/_{16}$ inches (above). The rafters install fast because toenailing holds them in place until the upper rim is installed. After the hips are nailed up (above right), the king commons and hips get nailed together at the top (right).

commons won't fit properly and it will show in the finished ceiling.

Installing the Tray Ceiling

With the soffit framed and the hips and commons cut, it's time to install the rafters. But first we have to mark their layout. We like to install rafters 5 to 7 inches up from the bottom of the opening, so we snap a line at the right height on all four sides.

The hips land at the inside corners and the commons are spaced 24 inches on-center along the rims. But the commons on either side of each hip (the king commons) have to be a specific distance out from the corner, equal to the run of a common — in this case, 2 feet $5^{15}/_{16}$ inches. This ensures that the hip and king commons converge at the same point.

King commons and hips. Unlike roof rafters, which need immediate support at the ridge, tray ceiling rafters can be installed by toenailing them to the lower rim. They're so short and light that toenails will hold them until we get around to installing the upper rim (Figure 8).

Again, this is why we didn't bother to calculate the rise of the commons: If our cuts are accurate and we nail the hips and king commons tight to the rim, all the rafters automatically top out at the same elevation.

We measure out from the corners of the rim and nail the king commons in place. Next, we toenail the hips in the corners. The hips and king commons will converge, and we nail them all together where they meet. (Be careful when positioning these pieces for nailing: If you hold on at the wrong spot, you could easily shoot a nail into your hand.)

Upper rims. Once all the hips are nailed to the king commons, it's time to install the upper rim pieces.

Figure 9. While it's possible to calculate the lengths of the upper rim pieces, the author finds it quicker and easier to install the hips and king commons (A), measure between them (B), and then cut the rim pieces to fit (C). Once the upper rims are in place (D), it's a simple matter to install the commons and run ceiling joists across the top.

There's no need to calculate their lengths; all we have to do is measure from corner to corner where the hips and king commons meet. We cut the pieces from 2x4s and nail them at the corners (Figure 9).

At this point, the upper rim goes all the way around the opening and is supported at the proper height. Next we install the commons 24 inches on-center between the king commons.

Commons and joists. The only framing left is to install 2x4 ceiling joists between the upper rims. Once more, we install these pieces 24 inches on-center. If there's going to be a light or fan in the tray, we avoid running a joist across the center. There's no need to install hip jacks because the drywall will be able to span from hip to king common without any added support.

Cost to Frame

A while back I timed how long it took me to frame a tray ceiling by myself. It took about two hours, but I was going all out. If I do the math and make a pattern for the hips and commons, the less experienced guys on our crew can frame a tray ceiling in about three man-hours.

Compared with the value that a tray ceiling adds to a new home, the material cost to frame one is almost negligible. The only things we have to go out of our way to get are the long 2x12s used for the lower rim. None of the 2x4s are very long, so we can usually get them from scrap.

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