Framing a Bay-Window Roof

It's only a small hip roof, but its 45° corners befuddle many carpenters. Drawing bay roofs out full scale is key to fast and accurate framing.

BY SCOTT MCBRIDE

A sturdy scaffold makes for efficient bay-reef construction. The walk-board height allows work to be done at waist level. The boards behind serve as a workbench, saving a lot of climbing up and down.

For as long as architects have been drawing bay windows, carpenters have been scratching their heads about framing the roofs. Victorian builders sometimes got around the problem by letting two-story bays die into a projection of the main roof above. Tract builders in the 1950s did likewise by tucking bay windows under overhanging second floors or wide eaves.

When a bay bumps out on its own (photo above), however, it needs a miniature hip roof to keep out the elements. Because the corners of bay windows aren't square, neither is the roof above, and figuring the rafter cuts isn't straightforward. I've built many of these roofs and have worked out a system that does the job without guesswork.

Roofs on manufactured or site-built bays are much the same

The skeleton of a bay roof breaks down into two parts (bottom drawing, facing page). The first part is the cornice, an assembly of horizontal lookouts tied together by subfascias. (A subfascia will receive a finished material, in this case aluminum coil stock. If you're planning to install a painted wood fascia, you can substitute the finished fascia material for the subfascia.) A horizontal ledger carries the lookouts where they attach to the building.

The common rafters for the middle roof, hip rafters and jack rafters comprise the second part of the skeleton. The side roofs also require sloped ledgers to support the sheathing where it meets the building.

Bays can be site-framed or manufactured units. When the walls of a bay are framed on site, the horizontal lookouts double as ceiling joists. In that case, the lookouts bear directly on the wall's top plates.

When I'm installing a manufactured bay, as I did for this article, the bay's plywood headboard provides the ceiling. With the bay installed, I screw through the headboard to affix 2x4 plates above, parallel with the bay's outside edges. I nail a second plate atop the first. This step makes room for a 3-in. frieze above the windows, which I think looks better than having the fascia directly above the glass. Raising the overhang lets in more light and provides room for insulation, which must usually be installed before the roof is sheathed. As a final plus, adding plates to the headboard provides a meatier surface for nailing the lookouts.

There are no rectangles in a hipped bay roof

A frequent mistake is framing the middle roof as a rectangle, using common rafters as hips. This error makes the side roofs steeper than the middle roof. The result looks clunky, and the disparity in pitch complicates the cornice details.

Bisecting the bay angle with the hip shapes the middle roof as a trapezoid and also ensures that the middle roof and the side roofs will be equally pitched.

Photo this page: Scott McBride

Before attaching the plates, I draw the centerline of each hip on the headboard, extending the line all the way to the house. To find the centerlines, it helps to realize that the angle encompassed by a bay window is not its nominal angle, in this case 45°, but rather its supplement. (An angle plus its supplement equals 180°.) So the outer corners of a 45° bay each encompass an angle of 135° (drawing top right). The hips bisect these angles, so the hip centerline angle for a 45° bay is half of 135°, or 67.5°. The other common bay angle is 30°. The techniques in this article work on 30° bays, or bays of any angle for that matter, but you'll have to adjust the angles accordingly.

To lay out the hip centerline accurately, I use a framing square. Conveniently, a 5:12 angle on a framing square is equal to 67.5°, the hip angle of a 45° bay. I place 5 on the apex of the bay's angle, 12 on either the front or side edge of the bay, and mark on the 5 side. Doubling 5:12 to 10:24, provides even greater accuracy.

I pencil plumb lines on the house wall where the hip centerlines intersect it. These plumb lines serve as references for locating the hip lookouts and hip rafters.

Lookouts form a map for the rafters to follow

After plating, I install the 2x6 horizontal ledger. Its ends function as lookouts, supporting the subfascias where they die into the building. I cut the ledger's ends to match the bay's angle and its length to support the subfascia at the proper overhang.

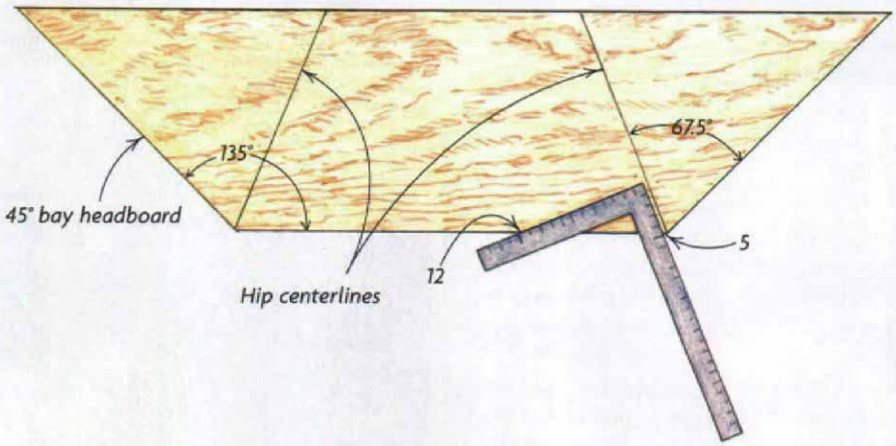
Next come the common lookouts. I usually start the layout in the bay's middle and work outward. By centering either a lookout or the space between two lookouts, I can lay out the cornice so that a common lookout ends up close to each hip. In this way, I can usually avoid having to place a jack lookout between the last common and the hip. Because I position a rafter over each lookout, this consideration also eliminates a jack rafter.

Common lookouts are cut square on both ends, but I miter the side lookouts at 45° where they hit the ledger. In both cases, I find their length by measuring the distance from the ledger to the outside of the plate, then adding the overhang less the subfascia. I nail the common and side lookouts to the ledger before cutting the hip lookouts.

To find the length of the hip lookouts, I cut a 22½° miter on the inboard end of an oversize piece of lookout stock. I tack this stock in position above the hip centerline and use a straightedge to project lines from the ends of the common and side lookouts. These

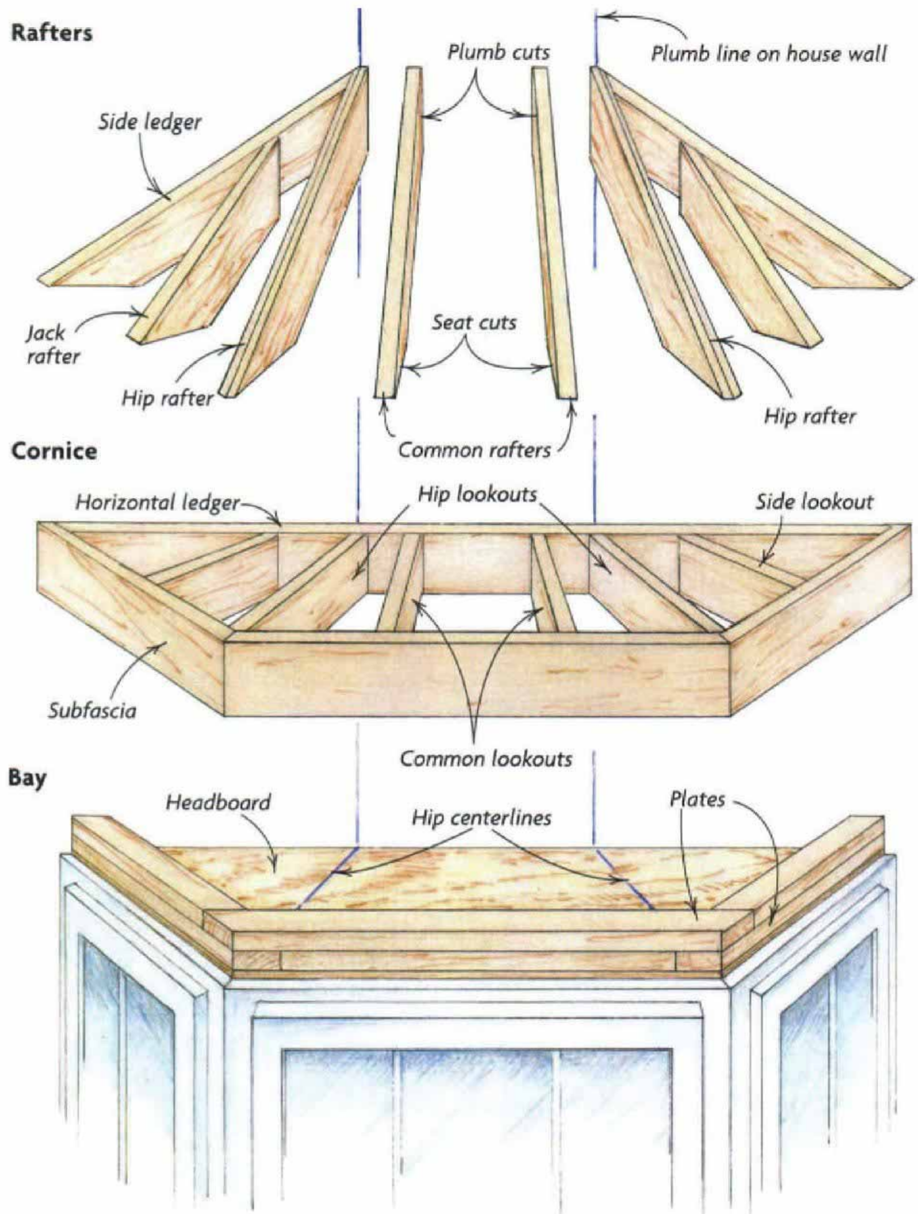
Lay out the hips with a framing square

The hip's centerlines bisect the bay's 135° outside corners, so their angle is 67.5°. A 5-in-12 pitch on a framing square also yields 67.5°.



Two distinct assemblies comprise a bay roof

The lower portion, or cornice, rests on the bay's walls, or on 2x4 plates fastened to the headboard if it's a manufactured unit The rafters that form the roof's upper portion fasten to the cornice members and to the house wall.



Drawings: Christopher Clapp

lines should cross the end of the hip to form a 22½° miter. I trim and permanently install the hip lookouts. Hanging the subfascias completes the cornice frame,

Drawing the roof first takes the guesswork from the rafter angles

The rafters of a bay roof contain a surprising variety of angles. To understand these angles and make a more accurate job, I sometimes draw them on a sheet of plywood. This process is called graphic development. Bay roofs are generally small enough to draw full scale, but the same process can be used to develop angles for larger roofs by drawing at a reduced scale.

Geometric drawings may seem beyond the call of duty for the average carpenter, but the alternative was described to me succinctly by one of my backwoods buddies: "We just cut on 'er till she fits."

I start the graphic development by drawing a half-plan that shows the outside of the bay's cornice (top drawing, right). The first line to be added to the half-plan is the run of the hip, AB, drawn as it was on the headboard. Next, I draw the run of a common rafter, BC, perpendicular to the house wall.

The next move is establishing the slope of the common rafters. Sometimes I know the pitch, such as the 8-in-12 pitch shown here. In that case, I lay out the common-rafter slope with a framing square (line CD in center drawing, right).

Other times, I want the roof of the bay to top out at a particular elevation, such as the bottom of a window or the bottom of a clapboard. To find the slope of the common rafters in these cases, I measure the rise from the top of the lookouts to the desired elevation. On the drawing, I place D this distance from B.

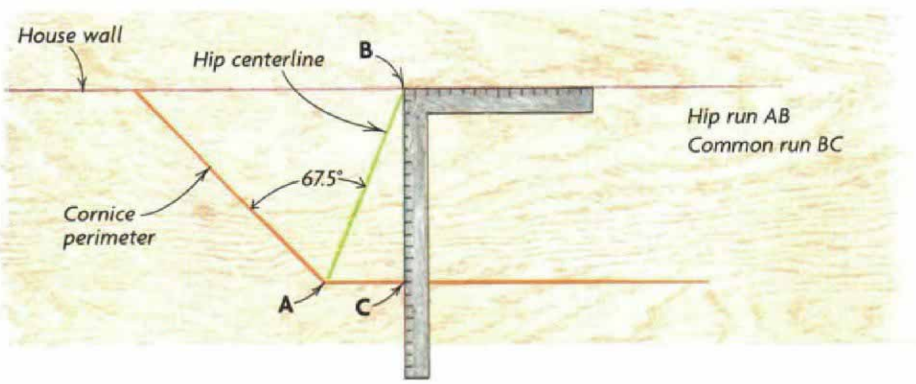
To find the slope of the hip, I swing an arc from D and centered on B until it crosses a line raised perpendicular to AB. The point of intersection is E, and BE represents the rise of the hip. The idea behind swinging an arc is to transfer the rise of the common, BD, to the rise of the hip, BE, because the common and the hip rise the same distance.

The side ledger also rises the same distance as the common and the hip. To find it, extend line BC until it intersects the arc at F. BF is the rise of the ledger, and it corresponds to the plumb line drawn on the house's wall. FG is the ledger's slope (bottom drawing, right).

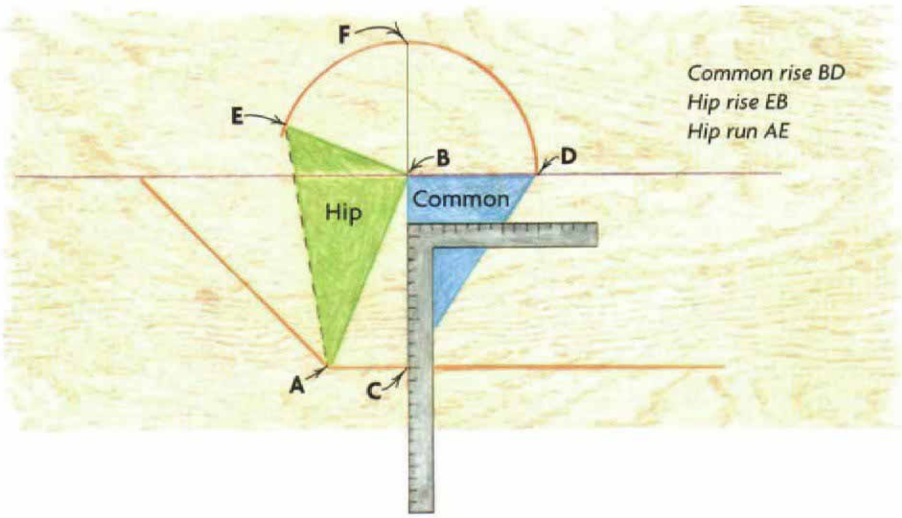
Full-scale graphic development provides all the information you need to make the plumb and seat cuts as well as lengths of the rafters. Bird's mouths aren't required for any of the

FULL-SCALE GRAPHIC DEVELOPMENT CREATES TEMPLATES FOR ALL THE RAFTER CUTS

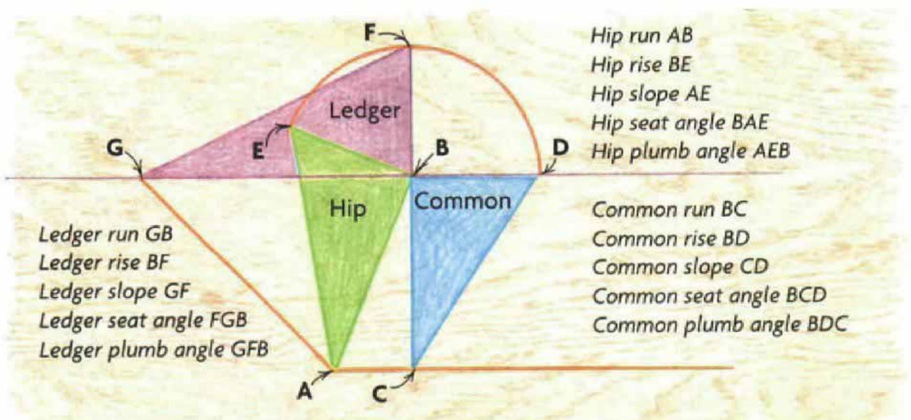
Draw a half-plan of the house wall and the cornice perimeter. Next, the hip centerline, AB, which bisects the bay's corner, is drawn. The outside corners of a 45° bay encompass 135°, so the hip centerline angle is half that, or 67.5°. Line BC, which represents the common rafter run, is drawn next.



The common rise, BD, is marked on the house-wall line. D can be found by using a framing square to plot a desired slope, such as 8-in-12, or by positioning D the desired rise of the roof from B. An arc whose radius is the rise of the roof is centered on B and swung from D to E. BE is the hip rise and is perpendicular to AB. CB is extended to F, and BF represents the plumb line drawn on the actual house wall.



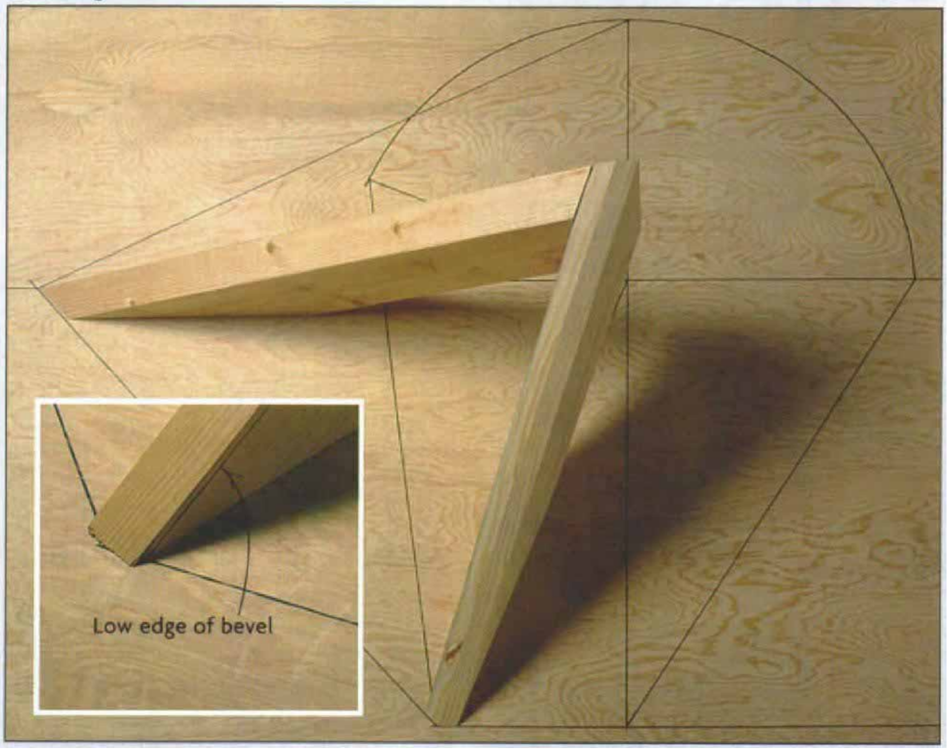
Connecting A and E develops the hip slope. FG is the ledger slope, and all the rafter angles are now there for the taking. To visualize the roof, try this mental origami. Imagine folding the drawing along the house-wall line so that BF, the ledger rise, is plumb. Now imagine raising BD, the common rise, and BE, the hip rise, to plumb.



ALIGNING THE HIPS AND LEDGERS WITH THE ROOF PLANE

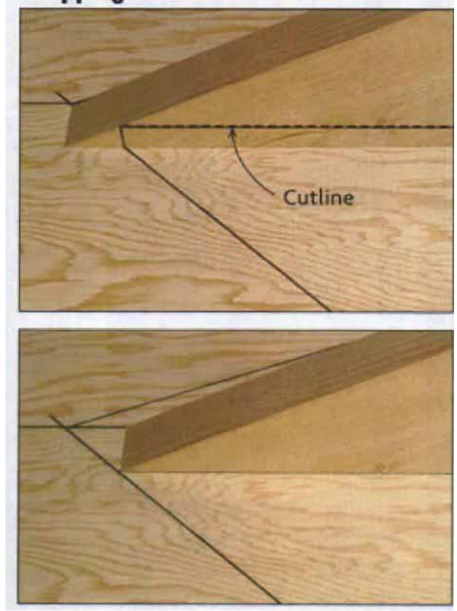
Full-scale graphic development generates two-dimensional templates for all the rafters of a bay roof. When cut, however, edges of the three-dimensional hips and ledgers will protrude above the roof plane unless the rafters are dropped or beveled.

Beveling



With the rafter stock held in place on the graphic development, the low edge of the bevel is easily marked (inset). The high point of the hip's bevel is the center of the rafter. The ledger's high point is the upper edge that contacts the house.

Dropping



Cutting a bit extra from the seat of a hip or ledger will align it with the roof plane. A plumb line raised where the held-in-place rafter intersects the bay's perimeter (top) shows how much to cut off the rafter (bottom). Unlike beveled rafters, sheathing contacts only the dropped rafters' edge.

seat cuts; the rafters simply sit on top of the lookouts and are nailed in place.

Dropping or beveling the hip and side ledgers

Graphic development outlines the entire top surface of the common rafters, but the hips and side ledgers are more complex. The slope lines from the graphic development are one-dimensional representations of the centerline at the top of the hip and of the top edge of the side ledger that hits the house. The actual rafters are, of course, three-dimensional. The corners of a hip rafter or side ledger will protrude above the adjoining roof planes unless some adjustment is made (photos above).

One way to make the adjustment is to drop the hip or ledger so that just the corners align with the roof plane. Cutting a little extra from the seat cut does this alignment. An alternative is to bevel, or *back,* the top edge of the rafter so that the edge is in plane with the roof. Backing is nice if you've got a table saw handy, but dropping works just as well.

To find the drops, I cut scrap blocks with the same seat cut as the hip and the ledger. I place the blocks in position on the developed drawing, straddling the hip centerline or, for the side ledger, on the wall line. The hip line on the drawing represents the rafter's center, so the center of the scrap block must align with the apex of the cornice angle. For the ledger, the line represents its inward edge, so the inner corner of the scrap must land on the intersection of the house and the cornice. I then draw plumb lines on the scraps, starting from where the blocks intersect the cornice's edges. The height of these lines is the drop to be deducted from the seat cut of the hip or of the side ledger.

If you want to bevel the rafters, you need to go one step farther. From where the block touches the edge of the bay, draw a line on the block parallel to its top edge. This line is the low side of the backing bevel. The center of the hip or the opposing corner of the ledger represents the high side.

Raising the roof

If a band or rim joist backs up the sheathing where the commons top out, as is often the case, the common rafters can be nailed directly to the sheathing. If not, it's a good idea to shorten the hips and commons by a horizontal distance of 1½ in., and hang them on a 2x ledger. The ledger ends line up on the plumb lines I raised earlier from the hip centerlines drawn atop the bay. The ledger's top will have to be dropped or beveled so that it's in plane with the rafters.

If there is to be a horizontal ledger for the common rafters, I install it and the side ledgers now. If there is no horizontal ledger, I install the hip first, centering it on the plumb line I raised earlier from the bay. In either event, the hip's plumb cut is compound, with a 22½° bevel for a 45° bay.

Once the ledgers are installed, I plumb up from the lookouts below to locate any jack rafters. The jacks can then be measured directly. They have the same seat and plumb cut as the commons, except that the plumb cut is made with a 45° bevel.

Laying out the sheathing cuts is a matter of transferring measurements from the rafters. I usually add overhang to the sheathing to pick up the top edge of a crown molding. ❑

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Photos by Judi Rutz, except where noted.