Falling Eaves

One carpenter tries five methods of framing a tricky roof

When an angled bay is capped by an extension of the main roof, the rafters that sit on the angled walls require some careful cuts.

by Scott McBride

Roof framing is tricky enough when the walls are plumb, level and square, but when the rafters intersect an eaves wall that's angled, well, it'll drive a person to thinking. The first time I encountered this condition was with a 45° angle bay extending from a single-story exterior wall (photo above). Instead of having its own separate hip roof, broken up into the usual three planes, the roof of this bay was simply to be an extension of the main roof plane, intersecting the diagonal walls of the bay on an angle in both plan and elevation.

The cornice in this situation runs at some oblique angle in plan (usually 45°) while it falls in elevation. I call this condition "falling eaves," as opposed to regular eaves, which run level.

I improvised my way through that job, thankful that only a few rafters were affected. But when the time came on another house to frame a gable roof with all four of its corners lopped off in this fashion, I decided to study the problem carefully. I ended up with five different solutions.

An octagonal room—I was framing a new house that featured an octagonal room extending above the main roof (photo left, facing page). Unlike most octagonal roofs, which have eight roof planes coming to a point at the peak, this roof was essentially a gable, with only two roof planes meeting along a ridge. Falling eaves were located where the angled walls of the octagon intersected this roof.

I began by framing the two gable walls and the two regular eaves walls. To illustrate my method for calculating the heights of these walls, I'll simplify the dimensions a bit. Let's say the level eaves walls were 8 ft. high, and the run of the roof was also 8 ft. (half of a 16-ft, span). Angled walls chop off the four corners of the room (drawing p. 84), extending in 4 ft. from what would have been a square corner. In that 4 ft. of horizontal run, the 9-in-12 roof rises 4 in. x 9 in., or 36 in. total. The height of the gable wall at its outside corners (the lowest points) would therefore measure 8 ft. plus 36 in., or 11 ft. total. Actually, there's an adjustment that I had to make here, which I'll discuss momentarily.

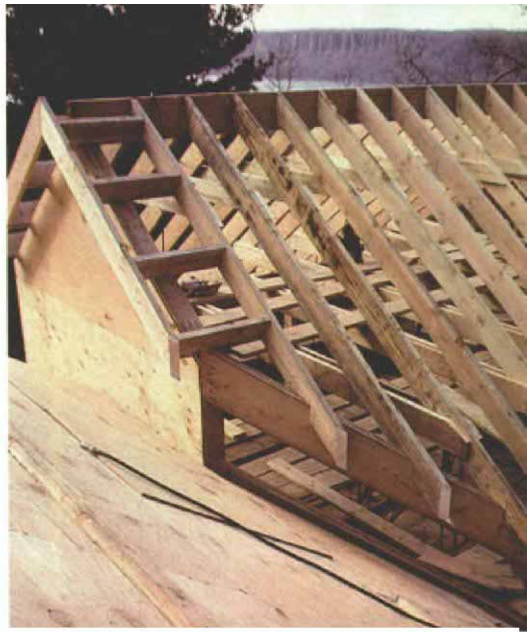
From its outside corners, the gable wall rises 36 in. over the 4 ft. of run. That would make the height of the gable wall at the peak 11 ft. plus 36 in., or 14 ft. total. But there was a further complication in calculating the height of the gable walls. The calculations just given start at the outside comer of the eaves plate. This point lies on the measuring line, which runs somewhere down the middle of the common rafter. But the gable walls needed to support lookouts for a framed rake overhang (photo top right, facing page). The lower edges of these lookouts line up with the lower edges of the common rafters, in a plane below the measuring line. Consequently, the gable-wall top plates had to be lowered by an amount equal to the vertical depth (heel cut) of the common-rafter bird's mouth.

Falling headers—After tipping up the level eaves walls and the gable walls, I connected them with four sloping headers, which I'll call falling headers. Later, I added 2x6 studs under these headers to frame the angled walls. As with the angled walls of the bay described earlier, the top edges of these falling headers are similar to the top edge of a valley rafter. Because the header travels a horizontal distance of 4 ft. perpendicular to the level eaves wall, I knew that its diagonal run in plan would be 17 in. multiplied by four. The hypotenuse on a right triangle with 12-in, sides is 17 in. (actually it's 16.97). The rise in each of those 17-in. diagonal increments of run had to be the same as for each 12 in. of common-rafter run (namely, 9 in.) in order to keep the header aligned with the roof. To find the actual length of the falling header on its long face, therefore, I stepped off 9-in-17 with the square four times. (A shortcut would have been to multiply by four the number listed under 9 in the length-of-hip/valley rafter table on the framing square.)

Finding my calculated length precisely consistent with the field-measured distance from level eaves wall to gable wall (well, close enough), I drew parallel plumb cuts on the header's outside face at both ends. Through these lines I made opposing cheek cuts, with the blade of the circular saw tilted at 45°. I made four of these headers and spiked two of them into their adjoining walls with 16d nails (I had different plans for the other two headers).

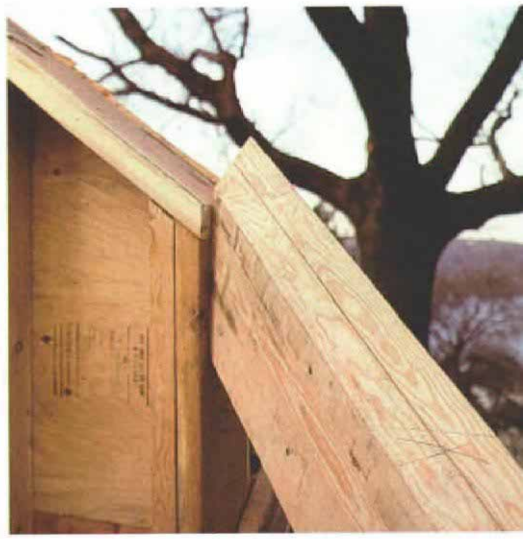
Photo above: Kevin Ireton

Lopping off the corners. **This octagonal room is sheltered by a gable roof that has its four corners lopped off. To find the best way to frame the Intersection of the rafters and the sloping, angled eaves walls, the author framed each of the four corners a different way. Photo by Kevin Ireton.**

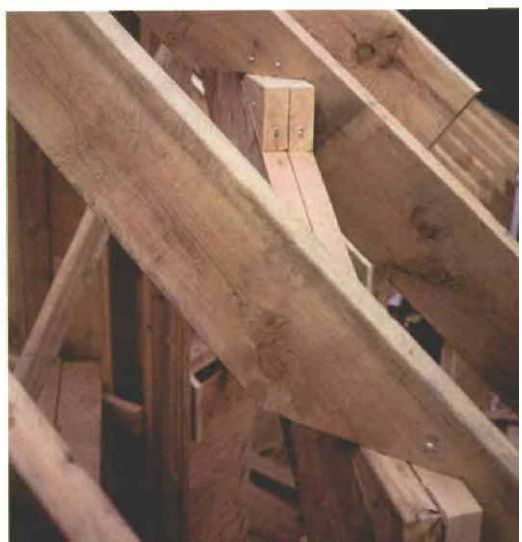


Gable overhang. **The gable walls were shortened an extra few inches to allow for 2x10 lookouts, which cantilever beyond the walls to form the overhang. This framing assembly is called a ladder.**

It's not supposed to line **up. At its lower end, the header in the photo below aligns with the eaves wall. Because the gable wall was lowered to allow for the lookouts, the header protrudes above the gable-wall plate to run parallel with the roof.**



Method #1: raised block. **Nailing triangular blocks on the sloping, angled headers created a level surface to seat the rafters on. But this required a deep heel cut on the bird's mouth and weakened the rafter overhang.**



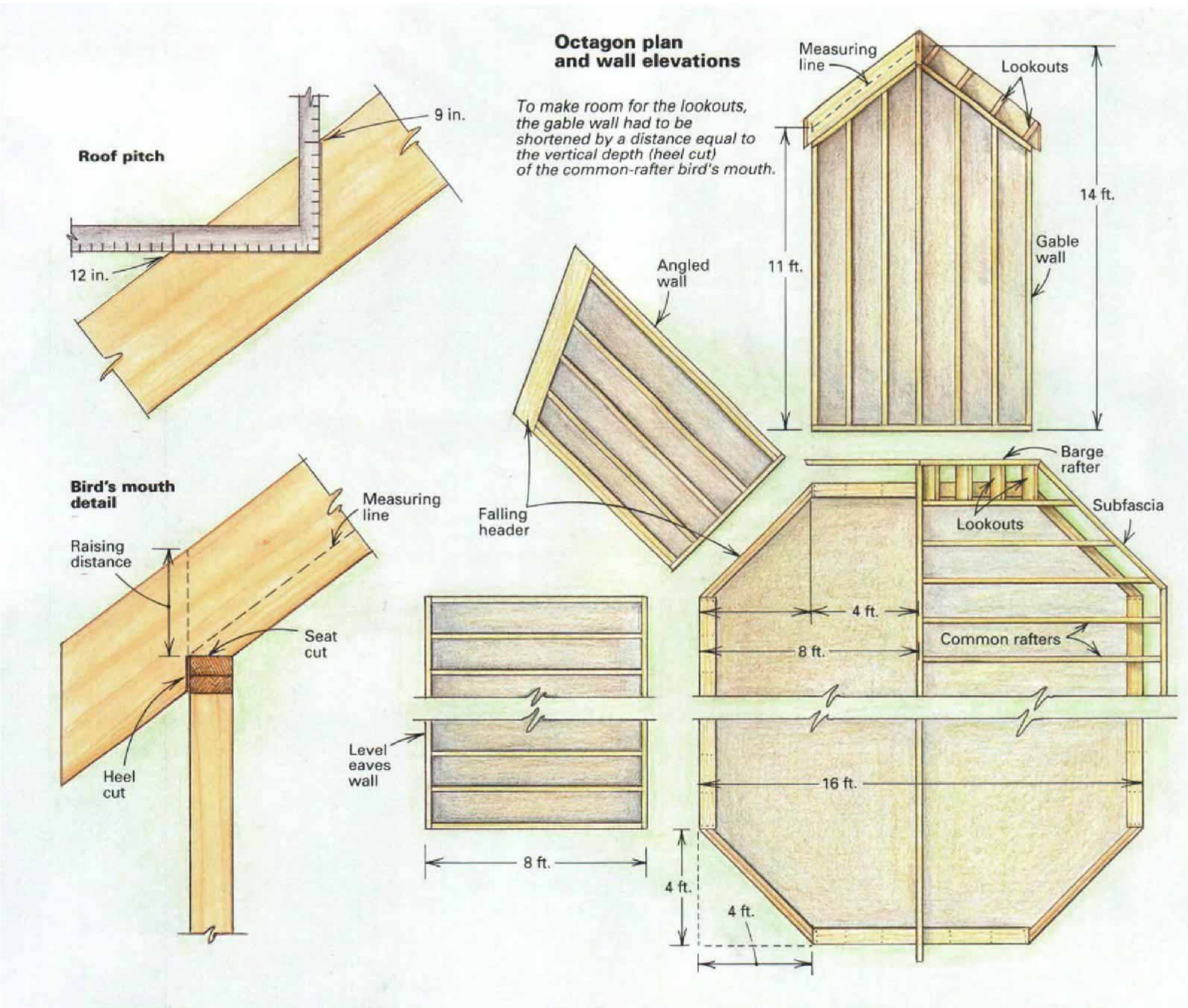
Because the outside corners of the falling headers were aligned with the level eaves plates at their lower ends, they could not align with the gable-wall top plates at their upper ends and remain parallel to the roof surface. This is because the gable-wall top plates were recessed below the roof surface by the full vertical depth of the rafters (to make room for the lookouts). However, the eaves-wall plates were recessed below the roof surface by the raising distance (the vertical depth of the rafter above the plate). The raising distance takes up only part of the vertical depth of the rafter, with the heel cut of the bird's mouth taking up the remainder (drawing detail next page). Therefore, the top ends of the falling headers protrude above the gable-wall top plates (middle photo, right). The height of the protrusion is a vertical distance equal to the heel cut of the common-rafter bird's mouth.

I had several ideas about how I might frame rafters into these falling headers. To find out which was best, I decided to frame each of the four corners of the room in a different way.

The raised-block method—Because I'm used to seating the lower ends of rafters onto a level surface, I first tried building up level bearing on one of the falling headers by adding triangular blocks (bottom photo, right). To lay out the spacing for the jack rafters, I pulled 16-in, centers from

Method #2: the notch. **Another way to create level bearing for the rafters was to cut a notch in the header with a handsaw. Although it worked, this method did not provide much bearing surface for the rafters.**

Method #3: beveled header/level seat cut. **Here the falling header is beveled, as is the seat cut of the rafter's bird's mouth. The intersection between the rafter and the header is a level line (above left). The bevel angle of the header was determined by the top of the eaves-wall plate where the two intersect (above right). The author scribed a scrap block in place to determine the angle. This method provided good bearing and was the easiest to nail.**



Method #4: beveled header/no bird's mouth. **Here the header is beveled in plane with the bottom of the rafters. There is no need for bird's mouths; the rafters simply bear on the headers (above left) and are held in place by toenails. The bevel angle for this header was determined by the top of the gable-wall plate where the two intersect (above right). The bottom end of the header is recessed below the level eaves-wall plate.**

Method **#5? From this view, you can't tell whether the header is notched for the rafter or vice versa. The author tried the former but thinks the latter method, which he tested on a model, might be the best**

the nearest common rafter, first making sure the common was straight. The blocks themselves were laid out using the numbers 9 and 17 on the rafter square. With the top of the block presenting a level surface, I could put an ordinary 9-in-12 square seat cut on the jack rafter (cutting on 12). The heel cut of the bird's mouth for these rafters, as well as for the rafters on the other three corners, was made by laying out the standard 9-in-12 plumb cut (cut on 9) on the face of the rafter but cutting it with the circular saw tilted 45°.

As you can see in the photo, the bird's mouths for the blocked-up rafters had to be cut quite deep. This was necessary because the triangular blocks protruded above the top edge of the falling header, which reduced the raising distance and increased the vertical depth of the bird's mouth. Structurally, this weakened the overhang.

The notch method—Another way of producing a level surface on which to seat the rafters was by notching the header. First I reasoned that any line drawn square across the edge of the unbacked header would be a level line. After squaring such a line across the header's edge, I extended a level line on the inside face of the header from the point where the squared-across line hit the header's inside face (photo left, facing page). Along this line, I measured off the 45° thickness of a double 2x—about 4¼ in. From that terminus, I plumbed up to the top inside edge of the. header. From where the plumb line struck the corner, I connected back to where I started from on the outside face of the header. These three lines described the two handsaw cuts—one plumb, the other level—that I needed to make the notch.

The bird's mouth to fit these notches was essentially the same one used for the raised-block method, except that it didn't need to be cut extra deep. Because the outside corner of the notch lines up with the outside corner of the level eaves plate, I used the standard raising distance.

Although leaving the strength of the rafter uncompromised, the notch method offers a small bearing surface, which could be a problem with long or heavily loaded rafters.

Beveled header/level seat cut—On one side of the octagon, I used a header backed (meaning that its top edge was beveled) so that its intersection with the seat cut of the rafter was a level line (middle photo, facing page). To find the correct backing bevel, I took a 2x scrap and put a 9-in-17 plumb cut on it sawn at a 45° blade tilt. The scrap mimicked the cheek cut on the end of the header. Holding the cheek cut of the scrap vertically against the end of the level eaves-wall top plate, I scribed a level line across the plate onto the end grain of the scrap. This showed me how much to take off the inside edge of the header (right photo, facing page). Using a worm-drive saw equipped with a rip fence, I beveled one of the headers that I hadn't already installed and then spiked it in place.

To fit the rafters to this header, I laid out the standard common-rafter bird's mouth and made the heel cut (plumb cut) of the bird's mouth with the saw blade tilted at 45°. The seat cut was also made with the blade tilted, but not at 45°. For this I had to use the plumb-cut angle of the common rafter. This method provided good bearing and was the easiest to nail. The backing operation, however, took some time.

Beveled header/no bird's mouth—To round out my experiment, I backed the last header so that its top edge would lie parallel to the roof plane. The big advantage of this method was that the rafters required no bird's mouth whatsoever, so there was no need to calculate precise rafter length (I cut the rafter tails in place later). I was able just to lay the rafter stock down on the mark and toenail (photo above left). I once saw ordinary rafters framed the same way, sitting on walls with tilted top plates, but I suspect that this connection might slip over time (if used with ordinary stud walls) because of the thrust of the roof. In this case, however, I felt that plenty of spikes driven into a beefy header (doubled 2x10s) would adequately resist the lateral load.

To determine the header's bevel, I used the same scrap-block trick I had used for the preceding method, except that I scribed it against the gable-wall top plate rather than against the level eaves-wall top plate (middle photo, above). Unlike the other three falling headers, which are aligned with the level eaves plate and protrude above the gable-wall plate, this header aligns with the gable-wall plate at the top and is recessed below the level plate at the bottom. It's offset from the roof surface by the rafter's full depth rather than by just the raising distance.

And the winnner is—You may be wondering which method I like the best. Well, the beveled-header/no-bird's-mouth method was the easiest. But given my concerns about the rafter-to-plate connection slipping overtime, the beveled-header/level-seat-cut method is probably the best of the four I tried.

Since completing the project, however, I have thought of another method. As I looked at a photo of rafters installed using the header-notch method (photo above right), I realized it's impossible to tell from the uphill side whether the rafters are let into the header or vice versa. Instead of notching the header, I could have made a sloping beveled seat cut on the jack rafter's bird's mouth that would mate directly with the edge of the unbacked header. I developed the angles for this method on paper and tested them on a scale model. It works.

Then there was that guy from California who told me he just uses metal framing anchors... □

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Drawing: Bob Goodfellow