Framing a Gable Roof

Cutting and stacking the way pieceworkers do it

by Larry Haun

The key to production roof framing is to minimize wasted motion. Here, carpenters nail gable studs plumb by eye—there's no need to lay out the top plates. The next step is to snap a line across the rafter tails and cut the tails off with a circular saw.

One of my earliest and fondest memories dates from the 1930s. I remember watching a carpenter laying out rafters, cutting them with a handsaw, and then over the next several days, artfully and precisely constructing a gable roof. His work had a fascinating, almost Zen-like quality to it. In a hundred imperceptible ways, the roof became an extension of the man.

But times change, and the roof that took that carpenter days to build now takes pieceworkers (craftspersons who get paid by the piece and not by the hour) a matter of hours. Since they first appeared on job sites, pieceworkers have given us new tools, ingenious new methods of construction and many efficient shortcuts. But what skilled pieceworkers haven't done is sacrifice sound construction principles for the sake of increased production. Quite the opposite is true; they've developed solid construction procedures that allow them to keep up with demand, yet still construct a well-built home.

The secret to successful piecework, from hanging doors (see *FHB* #53, pp. 38-42) to framing roofs, is to break down a process into a series of simple steps. To demonstrate just how easy roof framing can be (with a little practice), I'll describe how to cut and stack a gable roof the way pieceworkers do it.

The rafter horse—To begin with, pieceworkers try to avoid cutting one piece at a time. They'll build a pair of simple horses out of 2x stock so that they can stack the rafters on edge and mark and cut them all at once. To build the rafter horses, lay four 3-ft. long 2x6s flat and nail a pair of 2x blocks onto each, with a 1½ in. gap between them so that you can slip in a long 2x6 or 2x8 on edge (photo left, following page). An alternate method is to cut a notch 1½ in. wide by about 4 in. deep into four scraps of 4x12. Then you can slip a long 2x6 or 2x8 on edge into these notches. Either of these horses can easily be broken down and carried from job to job. The horses hold the rafters off the ground, providing plenty of clearance for cutting.

Cutting the rafters—Rafters can be cut using a standard 7¼-in. sidewinder or worm-drive circular saw. This isn't the first choice for most pieceworkers, who prefer to use more specialized tools (especially when cutting simple gable roofs). But it is the more affordable choice for most custom-home builders. If you are using a standard circular saw, load rafter stock on the horses with their crowns, or convex edges, facing up—same as the rafters will be oriented in the roof frame. Determine which end of the stack will receive the plumb cuts for the ridge and flush this end. An easy way to do this is to hold a stud against the ends and pull all the rafters up against it. Then measure down from this end on the two outside rafters in the stack and make a mark

Pieceworkers typically build a pair of simple portable rafter horses (photo above). The horses allow them to stack rafters off the ground on edge so that they can mark and cut the rafters all at once.

One way to lay out rafters is with a site-built rafter tee (photo above). The fence on top of the tee allows easy scribing of the ridge cuts and birds' mouths. When laid out this way, rafters are cut one at a time with a circular saw.

corresponding to the heel cut of the bird's mouth (the notch in the rafter that fits over the top plate and consists of a plumb heel cut and a level seat cut). Snap a line across the tops of the rafters to connect the marks.

Next, make a rafter pattern, or layout tee, for scribing the ridge cuts and birds' mouths (right photo above). I usually start with a 2-ft. long 1x the same width as the rafters. Using a triangular square such as a Speed Square (The Swanson Tool Co., 1010 Lambrecht Rd., Frankfort, Il. 60423), scribe the ridge cut at one end of the template. Then move down the template about one foot and scribe the heel cut of the bird's mouth, transferring this line across the top edge of the template. This will serve as your registration mark when laying out the birds' mouths.

The layout of the bird's mouth on the tee depends on the size of the rafters. For 2x4 rafters, which are still used occasionally around here, measure 2½ in. down the plumb line and scribe the seat cut of the bird's mouth perpendicular to the plumb line. Leaving 2½ in. of stock above the plate ensures a strong rafter tail on 2x4 rafter stock. One drawback to this is that for roof pitches greater than 4-in-12, 2x4 rafters will have less than a 3½-in. long seat cut. Consequently, the rafters won't have full bearing on a 2x4 top plate. However, this presents no problems structurally as long as the rafters are stacked, nailed and blocked properly (the building code in Los Angeles requires a minimum bearing of 1½ in.). For 2x6 or larger rafters, you can make the seat cuts 3½ in. long without weakening the tails.

Once the layout tee is marked and cut, nail a 1x2 fence to the upper edge of the tee. This allows you to place the tee on a rafter and mark it quickly and accurately. Make sure you position the fence so that it won't keep you from seeing the ridge cut or your registration mark. Use the layout tee to mark the ridge cut and bird's mouth on each rafter. Scribe all the ridges first at the flush ends of the stock, sliding the rafters over one at a time. Then do the same for the seat cuts, aligning the registration mark on the template with the chalk marks on the rafters.

Next, with the rafters on edge, cut the ridges with your circular saw, again moving the rafters over one at a time. Then flip the rafters on their sides and make the seat cuts, overcutting just enough to remove the birds' mouths.

Production rafter-cutting—Cutting common rafters with production tools is both faster and easier than the method I've just described. In this case, you'll want to stack the rafters on edge, but with their crowns facing *down*. Flush up the rafters on one end and snap a chalkline across them about 3 in. down from the flush ends (the greater the roof pitch and rafter width, the greater this distance). The chalkline corresponds to the short point of the ridge plumb cut. Snap another line the appropriate distance (the common-rafter length) from this point to mark the heel cuts of the birds' mouths. Then measure back up from this mark about 2½ in. and snap a third line to mark the seat cut of the bird's mouth. This measurement will vary depending on the size of the rafters, the pitch of the roof and the cutting capacity of your saw (more on that later).

Now gang-cut the ridge cuts using a beam saw (top right photo, facing page). Blocks nailed to the top of the rafter horses will help hold the stack upright. My 16-in. Makita beam saw will cut through a 2x4 on edge at more than an 6-in-12 pitch and will saw most of the way through a 2x6 at a 4-in-12 pitch. To determine the angle at which to set your saw, use a calculator with a tangent key or, just as easy, look up the angle in your rafter-table book.

For steeper pitches or wider stock, make a single pass with the beam saw (or a standard circular saw) and then finish each cut with a standard circular saw, moving the rafters over one at a time. This way the only mark needed is the chalkline. The kerf from the first cut will accurately guide the second cut.

To make the process go even faster, apply paraffin to the sawblade and shoe. Also, try to stay close to your power source. If you have to roll out 100 ft. of cord or more, the saw will lose some power and won't operate at its maximum efficiency.

Another method for cutting ridges is to use the Linear Link model VCS-12 saw (Progressive Power Tools Corp., 303 N. Rose St., Suite 304, Kalamazoo, Mich. 49007). The model VCS-12 is a Skil worm-drive saw fitted with a bar and cutting chain that lets the saw cut to a depth of 12 in. at 90° (see *FHB* #39, p. 90). It's adjustable to cut angles up to 45° (top left photo, facing page). You can buy the saw or a conversion kit that will fit any Skil worm drive.

With the right tools, the birds' mouths can also be gang-cut with the rafters on edge. For the heel cuts, set your worm-drive saw to the same angle as the ridge cut and to the proper depth, and then make a single cut across all the rafters (bottom left photo, facing page). Seat cuts are made using a 7¼-in. or, better yet, 8¼-in. worm-drive saw fitted with a swing table. A swing table replaces the saw's standard saw base and allows the saw to be tilted to angles up to 68° (bottom right photo, facing page). I bought mine from Pairis Enterprises and Manufacturing (P. O. Box 436, Walnut, Calif. 91789). Set the swing table to 90° minus the plumb-cut angle (for example, 63½° for a 6-in-12 roof) and make the seat cuts, again in one pass.

The only drawback to using a swing table with a worm-drive saw is that it won't allow a substantial depth of cut at sharp angles, so it limits the amount of bearing that the rafters will have on the top plates (about 2½ in. maximum with an 8¼-in. saw). Again, this is of little concern if the roof is framed properly. Nevertheless, for jobs requiring a greater depth of cut, Pairis Enterprises just introduced a swing table to fit 16-in. Makita beam saws.

Gang-cutting birds' mouths works especially well because you needn't overcut the heel or the seat cut, which weakens the tail. Once you get used to working with these production tools, you'll find that it takes longer to stack the rafters than to cut them.

An even faster way to make the seat cuts is to use an 8¼-in. worm-drive saw equipped with a universal dado kit, a rig that has been around the tracts for over 15 years (middle photo, facing page). The dado kit (also manufactured by Pairis Enterprises) consists of an

accessory arbor that fits on the saw, allowing it to accept a stack of carbide blades up to 3¼ in. thick. With this setup, birds' mouths can be gang-cut in a single pass and require just one chalkline for the heel cut.

The rig is surprisingly easy to control as long as it's used for its intended purpose, which is to plow out stock on a horizontal surface. In use, the rig whines like a router and hurls big chunks of stock out the front end. Though the guard effectively prevents wood chips from hitting the operator in the face, it's particularly important to wear safety glasses when operating this tool. The only drawback to this dado saw is its cost—about $750 including the saw. But if you cut a number of roofs a year, it will pay for itself in short order.

With the rafters cut, you can now carry them over to the house and lean them against the walls, ridge-end up. The rafter tails will be cut to length in place later.

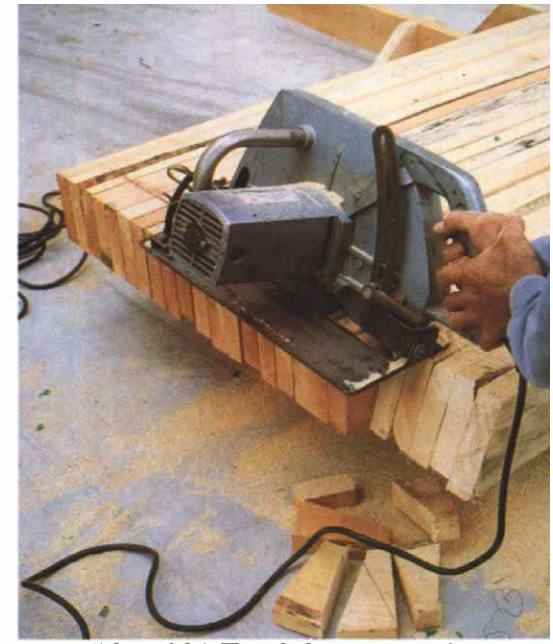
Staging and layout—Now it's time to prepare a sturdy platform from which to frame the roof. The easiest way is to simply tack 1x6s or strips of plywood across the joists below the ridge line to create a catwalk (the joists are usually installed before the roof framing begins). Run this catwalk the full length of the building. If the ridge works out to be higher than about 6 ft., pieceworkers will usually frame and brace the bare bones of the roof off the catwalk and then install the rest of the rafters while walking the ridge.

For added convenience, most roof stackers install a hook on their worm-drive saws that allows them to hang their saw from a joist or rafter. When not in use, the hook folds back against the saw and out of the way (for more on these saw hooks, see *FHB* #55, p. 92).

The next step is to lay out the ridge. Most codes require the ridge to be one size larger than the rafters to ensure proper bearing (2x4 rafters require a 1x6 or 2x6 ridge). Make sure to use straight stock for the ridge. In the likely event that more than one ridge board is required to run the length of the building, cut the boards to length so that each joint falls in the center of a rafter pair. The rafters will then help to hold the ridge together. Let the last ridge board run long—it will be cut to length after the roof is assembled.

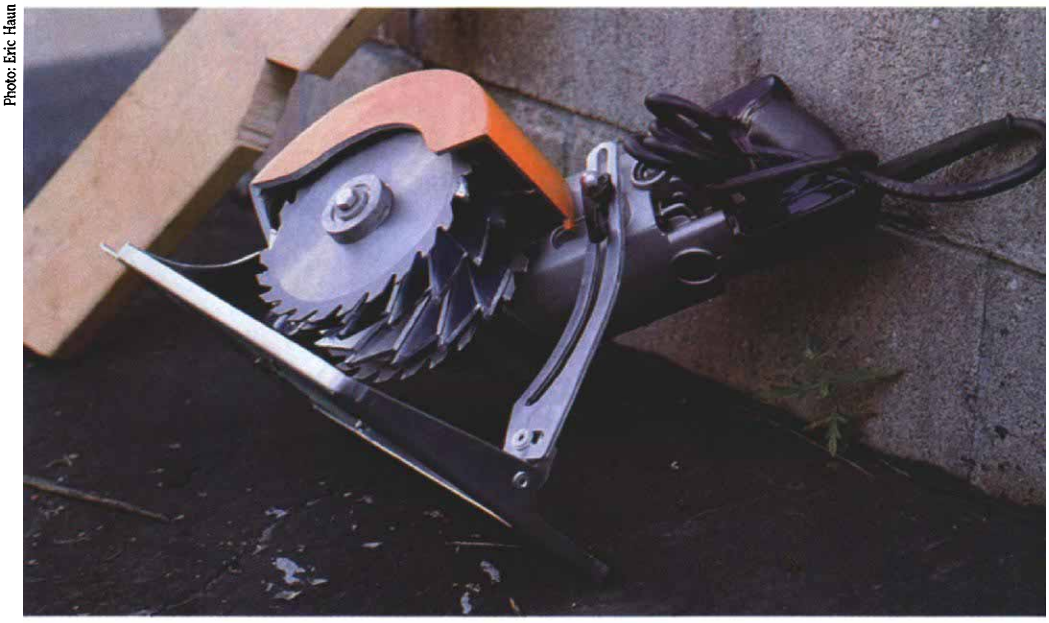
Be sure to align the layout of the ridge to that of the joists so that the rafters and joists will tie together at the plate line. If the rafters and joists are both spaced 16 in. o. c., each rafter will tie into a joist. If the joists are spaced 16 in. o. c. and the rafters 24 in. o. c., then a rafter will tie into every fourth joist. Regardless, no layout is necessary on the top plates for the rafters. Rafters will either fall next to a joist or be spaced the proper distance apart by frieze blocks installed between them. Once the ridge is marked and cut, lay the boards end to end on top of the catwalk.

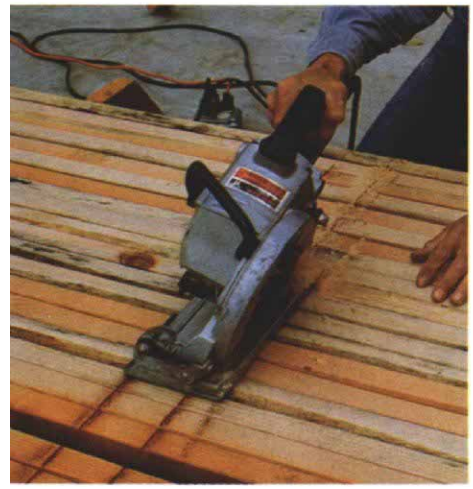
Nailing it up—Installation of the roof can be accomplished easily by two carpenters. The first step is to pull up a rafter at the gable end.



To save time, ridges can be gang-cut with a 16-in. beam saw (photo right). Though these saws won't cut all the way through anything wider than a 2x4 at a 4-in-12 pitch, where necessary each cut can be completed using a standard circular saw. For these finish cuts, the kerfs guide the saw. The only layout required is a single chalkline across the top edge of the rafters. An alternate method is to use a Linear Link saw (photo left), a Skil worm-drive saw fitted with a bar and chain.

Photo: Eric Haun





One method for gang-cutting birds' mouths is to cut the heels with a worm-drive saw (photo left) and the seats with a worm-drive saw fitted with a swing table, an accessory base that adjusts from -5° to 68° (photo right). By equipping a saw with a universal dado kit (photo above), birds' mouths up to 3¼ in. wide can be plowed out in a single pass.

Top left photo courtesy of Progressive Power Tools Corp.

While one carpenter holds up the rafter at the ridge, the other toenails the bottom end of the rafter to the plate with two 16d nails on one side and one 16d nail (or backnail) on the other. The process is repeated with the opposing rafter. The two rafters meet in the middle and hold each other up temporarily, unless, of course, you're framing in a Wyoming wind. If that's the case, nail a temporary 1x brace diagonally from the rafters to a joist.

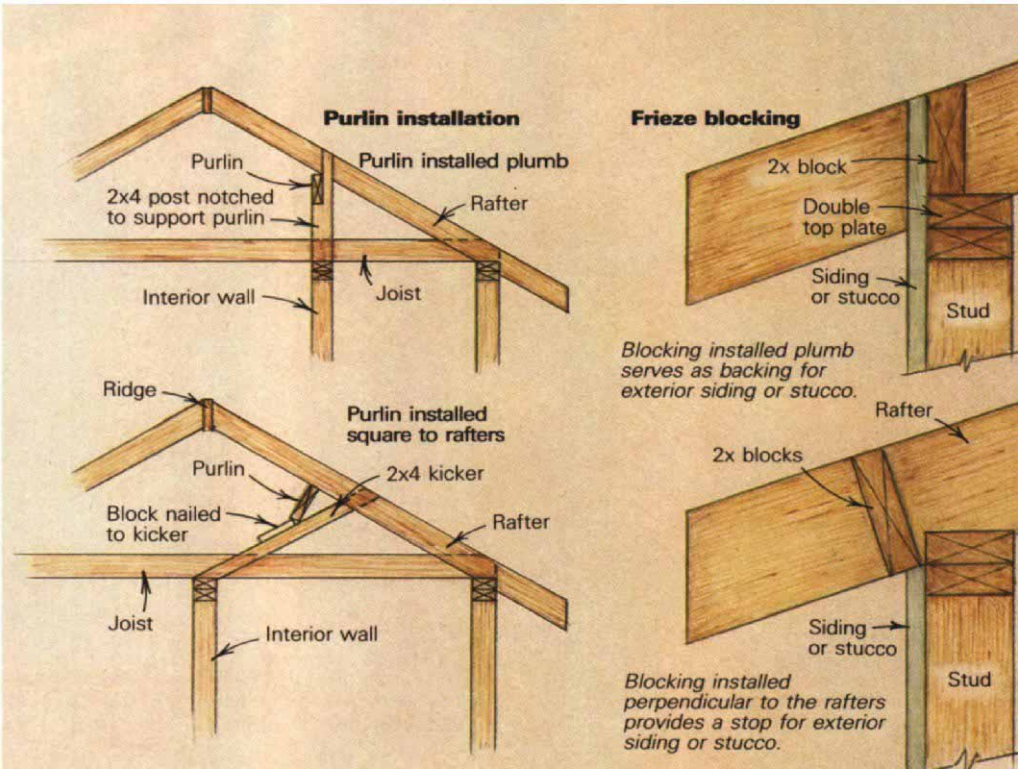
Next, move to the opposite end of the first ridge section and toenail another rafter pair in the same way. Now reach down and pull up the ridge between the two rafter pairs. There is no need to predetermine the ridge height (photo facing page). Drive two nails straight through the ridge and into the end of the first rafter, then angle two more through the ridge into the opposing rafter. To keep from dulling a sawblade when you're sheathing the roof, avoid nailing into the top edge of a rafter. At this point, nail a 2x4 leg to the ridge board at both ends to give it extra support. If these legs need to be cut to two different lengths to fit beneath the ridge, it means that the walls probably aren't parallel and, consequently, that the ridge board isn't level. In this case yank the nails out of the rafter pair at the top plate on the high end of the ridge and slide out the rafters until the ridge is level. The key to avoiding all this hassle is, of course, to make sure the walls are framed accurately in the first place.

Next, plumb this ridge section. This can be accomplished in a couple of ways. One way is to nail a 2x4 upright to the gable end ahead of time so that it extends up to the height of the ridge. This allows you to push the end rafters against the upright and to install a 2x4 sway brace extending from the top plate to the ridge at a 45° angle. This is a permanent brace. Nail it in between the layout lines at the ridge.

A second method is to use your eye as a gauge. Sighting down from the end of the ridge, align the outboard face of the end rafters with the outside edges of the top and bottom plates, and then nail up a sway brace. Either way, the ridge can be plumbed without using a level. This means carrying one less tool up with you when you stack the roof.

With the bare bones of the first ridge section completed, raise the remaining ridge sections in the same way, installing the minimum number of rafter pairs and support legs to hold them in place. When you reach the opposite end of the building, eyeball the last rafter pair plumb, scribe the end cut on the ridge (if the ridge is to be cut at the plate line), slide the rafters over a bit and cut the ridge to length with a circular saw. Then reposition the rafters and nail them to the ridge. Install another sway brace to stabilize the entire structure.

Now stack the remaining rafters, installing the frieze blocks as you go. Nail through the sides of the rafters into the blocks, using two 16d nails for up to 2x12 stock and three 16d nails for wider stock. Where a rafter falls next to a joist, drive three 16d nails through the rafter into the joist. This forms a rigid triangle that helps to tie the roof system together.



Roof-framing tips

Check your blueprints for the roof pitch, lengths of overhangs, rafter spacing and size of the framing members. But don't rely on the blueprints to determine the span. Instead, measure the span at the top plates. Measure both ends of the building to make sure the walls are parallel; accurate wall framing is crucial to the success of production roof framing.

Once you've determined the length of the rafters, compensate for the thickness of the ridge by subtracting one half the ridge thickness from the length of the rafters. Though theoretically this reduction should be measured perpendicular to the ridge cut, in practice for roofs pitched 6-in-12 and under with 2x or smaller ridges, measuring along the edge of the rafters is close enough. For 2x ridge stock, that means subtracting ¾ in. from the rafter length. An alternative is to subtract the total thickness of the ridge from the span of the building before consulting your rafter book.

Once you've figured the common-rafter length, determine the number of common rafters you need. If the rafters are spaced 16 in. o. c., divide the length of the building in feet by four, multiply that figure by three and then add one more. That will give you the number of rafters on each side of the roof. If there are barge rafters, add four more rafters. If the rafters are spaced 24 in. o. c., simply take the length of the building in feet and add two, again adding four more to the total if barge rafters are called for. ***—L. H.***

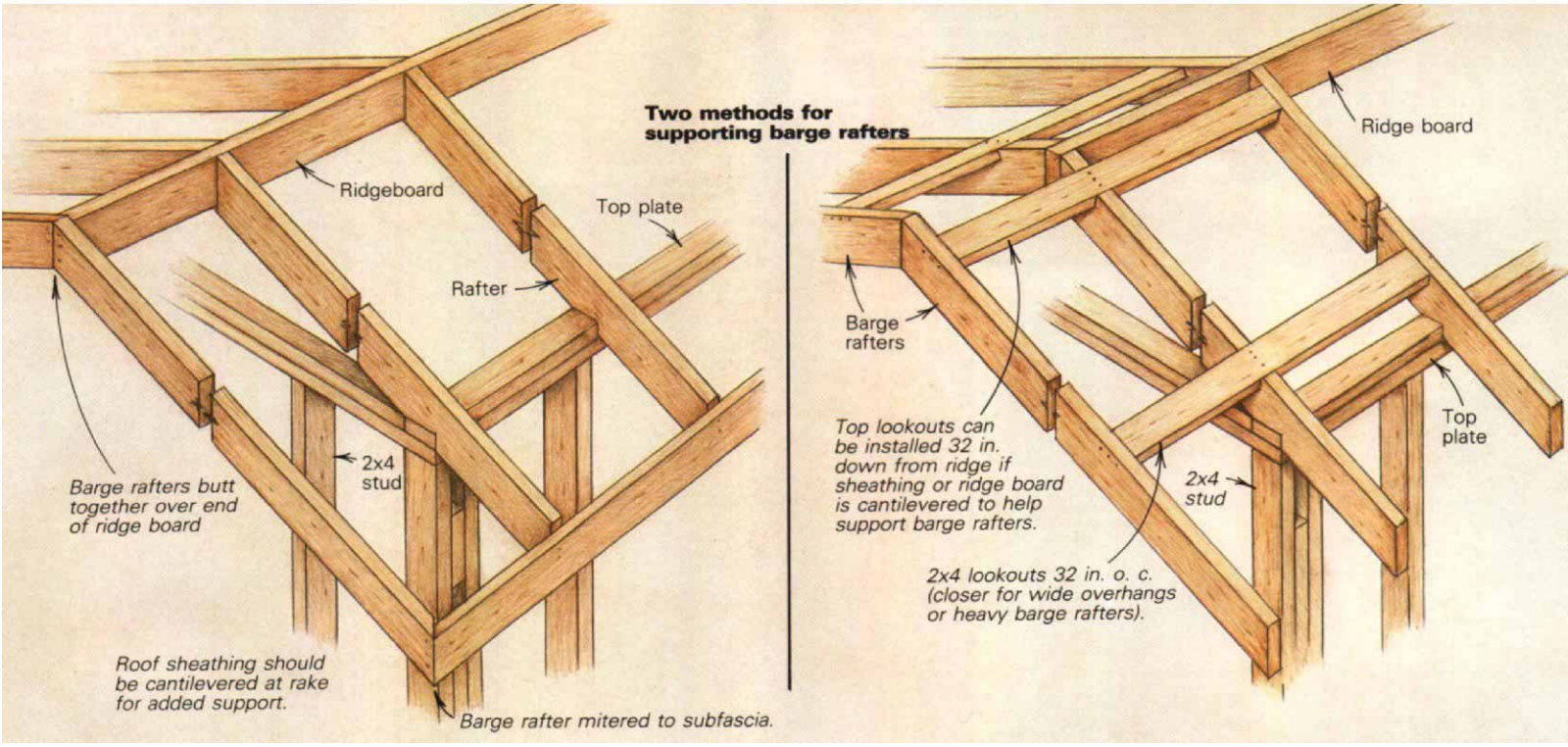
In some parts of the country, blocking is not installed between the rafters at the plate. But in many areas, building codes require blocks. I think they're important. They stabilize the rafters, provide perimeter nailing for roof sheathing and tie the whole roof system together. They also provide backing or act as a stop for siding or stucco. If necessary, they can easily be drilled and screened for attic vents.

There are two methods for blocking a gable roof (drawings above right). The first is to install the blocking plumb so that it lines up with the outside edge of the top plate, allowing the blocks to serve as backing for the exterior siding or stucco. This requires the blocking to be ripped narrower than the rafters. The other method is to install the blocking perpendicular to the rafters just outside the plate line. The blocking provides a stop for the siding or stucco, eliminating the need to fit either up between the rafters. Also, there's no need to rip the blocking with this method, which saves time. Either way, blocks are installed as the rafters are nailed up. Sometimes blocks need to be cut a bit short to fit right. Rafter thickness can vary from region to region (usually it's related to moisture content), so check your rafter stock carefully.

Collar ties and purlins—In some cases building codes require the use of collar ties to reinforce the roof structure or purlins to reduce the rafter span (drawings above left). Collar ties should be installed horizontally on the upper third of the rafter span. They're usually made of 1x4 or wider stock, placed every 4 ft. and secured with five 8d nails on each end so that they tie the opposing rafters together.

Purlins should be placed near the middle of the rafter span. They can be toenailed to the rafters either plumb or square. If there's an interior wall beneath the center of the rafter span, install the purlin plumb and directly over the wall. This makes it easy to support

Drawings: Michael Mandarano



the purlin with several 2x4 posts that bear on the top plate of the interior wall. The 2x4s are notched so that they both support the purlin and are nailed to the sides of the rafters.

If there isn't a wall beneath the center of the rafter span, toenail the purlin square to the rafters and install 2x4 kickers up from the nearest parallel wall at an angle not exceeding 45°. A block nailed to each kicker below the purlin will hold the purlin in place. Kickers are typically installed every 4 ft. Large purlins such as 2x12s require fewer kickers.

In some parts of the country, rafters have to be tied to the top plates or blocking with framing anchors or hurricane ties for added security against earthquakes or high winds. Check your local codes.

Framing the gable ends—Gable ends are filled in with gable studs spaced 16 in. o. c. Place the two center studs (on either side of the ridge) 14 in. apart. This leaves enough room for a gable vent, which allows air to circulate in the attic. Measure the lengths of these two studs, then calculate the *common difference* of the gable studs, or the difference in length between successive studs. Then you can quickly determine the lengths of the remaining studs. A pocket calculator makes it easy.

For a 4-in-12 roof pitch, the equation goes like this: 4 ÷ 12 x 16 = 5.33. Four equals the rise, 12 the run and 16 the on-center spacing. The answer to the problem, 5.33, or 5⅜ in., is the common difference. Another way to calculate this is to divide the unit rise by three and add the answer and the unit rise together. For a 4-in-12 pitch, 4 ÷ 3 = 1.33 + 4 = 5.33. For the angle cuts, set your saw to the same angle as that of the plumb cut on the rafters. Cut four gable studs at each length, and you'll have all the gable studs you'll need for both gable ends.

Once the gable studs are cut, nail them plumb using your eye as a gauge. There is no need to lay out the top plates or to align the gable studs with the studs below. Be careful not to put a crown in the end rafters when you're nailing the gable studs in place.

Finishing the overhangs—The next step is to install the *barge rafters* if the plans call for them; these are rafters that hang outside the building and help support the rake. Sometimes barge rafters are supported by the ridge, fascia and roof sheathing. In this case, the ridge board extends beyond the building line so that the opposing barge rafters butt together over its end and are face nailed to it. At the bottoms the barge rafters are mitered to the sub fascia boards, which also extend beyond the building line. The roof sheathing cantilevers out and is nailed to the tops of the barge rafters.

Another way to support barge rafters is with lookouts. A lookout is a 2x4 laid flat that butts against the first inboard rafter, passes through a notch cut in the end rafter and cantilevers out to support the barge rafter (drawing above right). Lookouts are usually installed at the ridge, at the plate line and 32 in. o. c. in between (closer for wide overhangs or heavy barge rafters). If the roof sheathing cantilevers out over the eaves (adding extra support for the barge rafters), then the top lookouts can be placed 32 in. down from the ridge.

The notches in the rake rafters are most easily cut when you're working at the rafter horses. Pick out four straight rafters and lay out the notches while you're laying out for the birds' mouths and ridge cuts. Cut these notches by first making two square crosscuts with a circular saw 1½ in. deep across the top edges of the rafters. Then turn the rafters on their sides and plunge cut the bottom of the notch.

Lookouts are cut to length after they're nailed up. Snap a line and cut them off with a circular saw. That done, the barge rafters are face nailed to the ends of the lookouts with 16d nails.

Pieceworkers don't waste time predetermining the ridge height. Instead, they toenail a pair of rafters to the top plates at either end of the ridgeboard, then raise the ridgeboard between the rafters and nail the rafters to it with 16d nails. A 2x4 sway brace is installed before the intermediate rafters are nailed up.

The final step in framing a gable roof is to snap a line across the rafter tails and cut them to length. Cutting the rafters in place ensures that the fascia will be straight. Use the layout tee or a bevel square to mark the plumb cut. If the rafters are cut square, use a triangular square. Then, while walking the plate or a temporary catwalk nailed to the rafter tails, lean over and cut off the tails with a circular saw, ❑

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