With its cross-gabled roof and decorative vergeboards, this cottage complements the Gothic home to which it's appended. Photo by Kevin Ireton.

Framing a Cross-Gable Roof

One good valley rafter supports another

by Scott McBride

In 1851 a German immigrant named Henry Kattenhorn owned a thriving sugar refinery in the riverfront village of Hastings-on-Hudson, New York. Deciding that his four superintendents and their families should share in his prosperity, Kattenhorn built cottages for them on a bluff overlooking the river. Bedecked with finials, decorative chimneys and gaily sawn vergeboards, these small, cozy houses were prime examples of Gothic Revival architecture.

Just a year before the Kattenhorn cottages were built, Andrew Jackson Downing, the leading exponent of the Gothic Revival style, had published *The Architecture of Country Houses.* In his book, Downing had inveighed "an excess of fanciful and flowing ornaments of a cardboard character," but the country carpenters who adapted the style from readily available pattern books were hard to restrain—lumber was cheap, the steam-driven jigsaw had been invented, and the sky was the limit.

Besides gingerbread, another hallmark of the Gothic Revival style was the cross-gable roof. Downing also tried to temper the proliferation of gables, lamenting that "some uneducated builders...have so overdone the matter, that, turn to which side of their houses we will, nothing but gables salutes our eyes." But the "cocked-hat cottage," as Downing called small dwellings with multiple gables, was precisely the form chosen for a recent addition to one of the Kattenhorn cottages (photo above).

When Judy Seixas approached architect Stephen Tilly about adding a semi-detached bedroom suite to the back of her house, she was adamant that the design be strictly in keeping with the Gothic Revival style. Tilly and chief designer Laurel Rech came up with a simple cross-gable rectangle for the addition. An existing flat-roofed screen porch would be enclosed to house a bathroom, the utility room and an entrance foyer. The converted porch would also link the bedroom suite to the existing house. I was hired to build the addition, the trickiest part of which turned out to be framing the cross-gable roof.

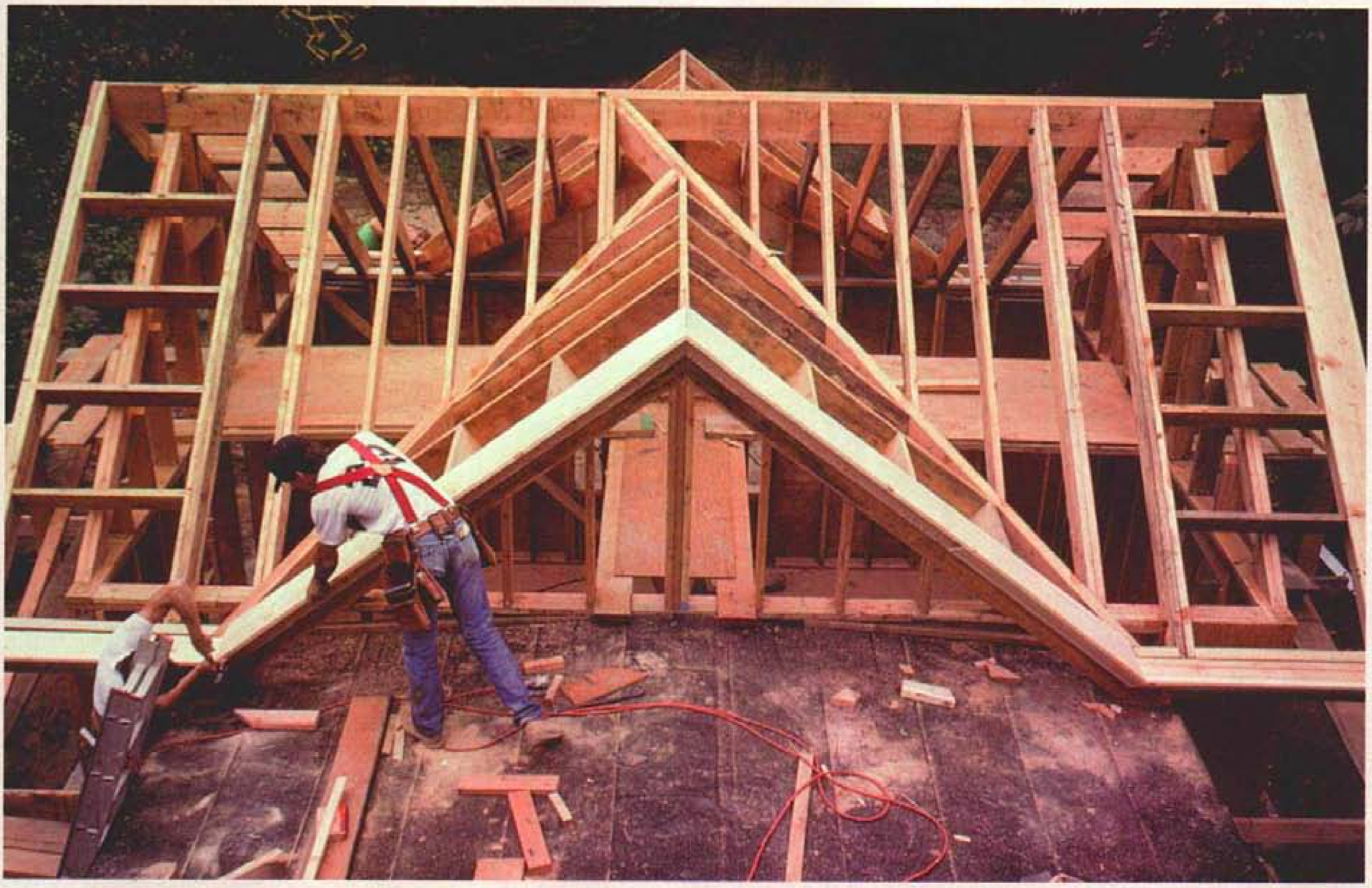
Blind valleys—My crew framed partitions in the former screen porch while the foundation for the new addition was being built. As the blockwork was finished and floor framing began, I retired to a shady spot on the driveway to lay out and cut the principal roof members.

In a pure cross-gable roof, two ridges—both at the same elevation—intersect at 90°. All four valleys formed by the intersection converge at a central peak. Our addition would be a modified version, insofar as there would be a higher continuous ridge and a slightly lower ridge broken by the intervening higher gable. It could be called a gable with two dormers, except that I think of dormers as being subordinate in *size* to a main roof. The similar size of all four gables on this roof makes them more or less equal partners in the deal.

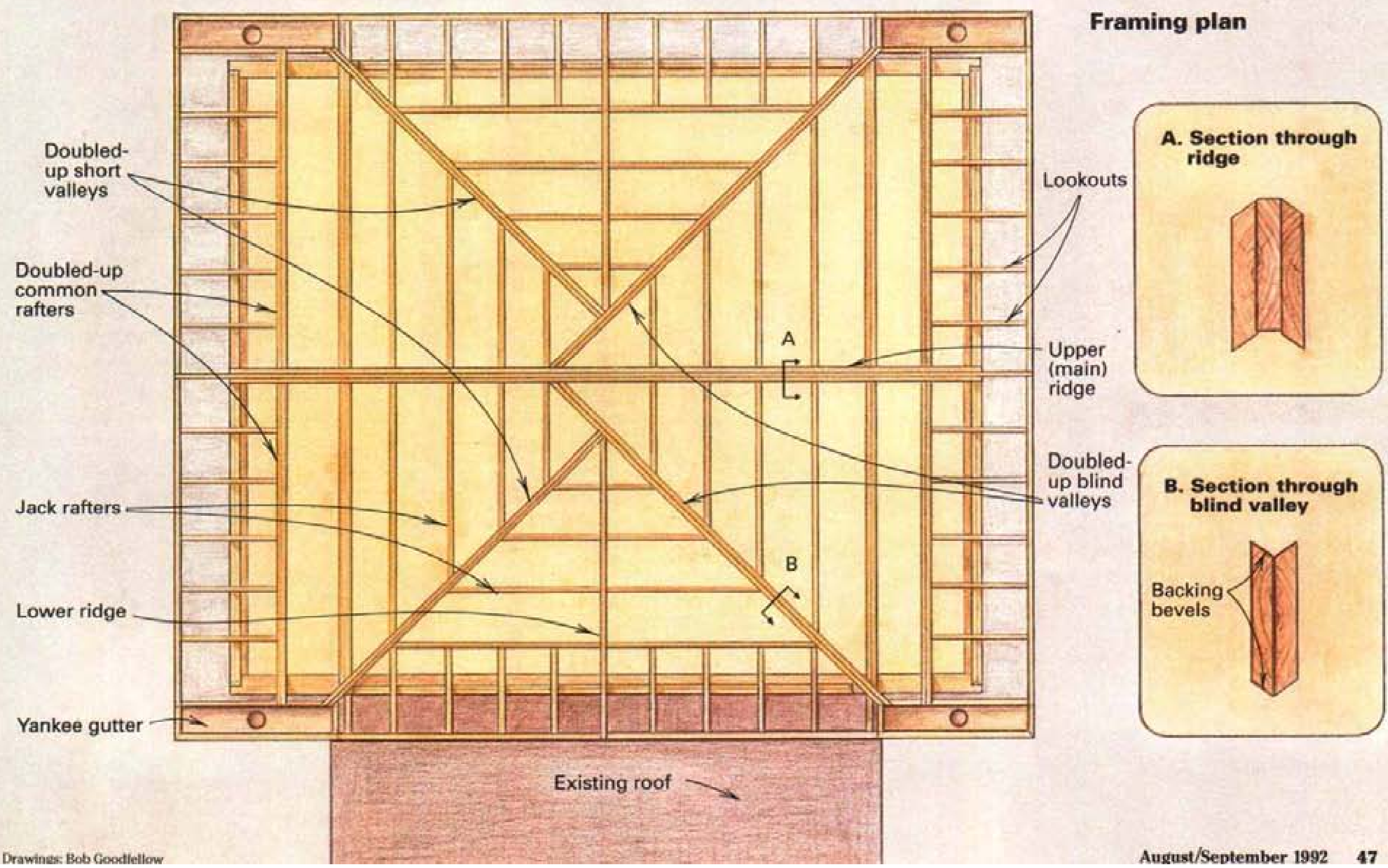
I have seen cross-gable roofs in Victorian houses where a lower ridge flies right through the attic space under a higher ridge. But because our addition was to have a finished cathedral ceiling, I broke the lower ridge into two discontinuous sections. I considered supporting these lower ridges by hanging their inboard ends on headers framed between the common rafters of the higher gable, which is how I frame gable dormers. But the lower gables in this case were so broad that we would have needed a 13-ft. header to span the distance, which would have been an impractical arrangement.

We resorted to a supporting valley, or a blind valley. For each of the lower gable roofs, one valley rafter would run from the wall plate to the main ridge (photo facing page); this is the blind valley. The other valley would be shorter and would intersect the blind valley. This intersection marks the terminus of the lower ridge.

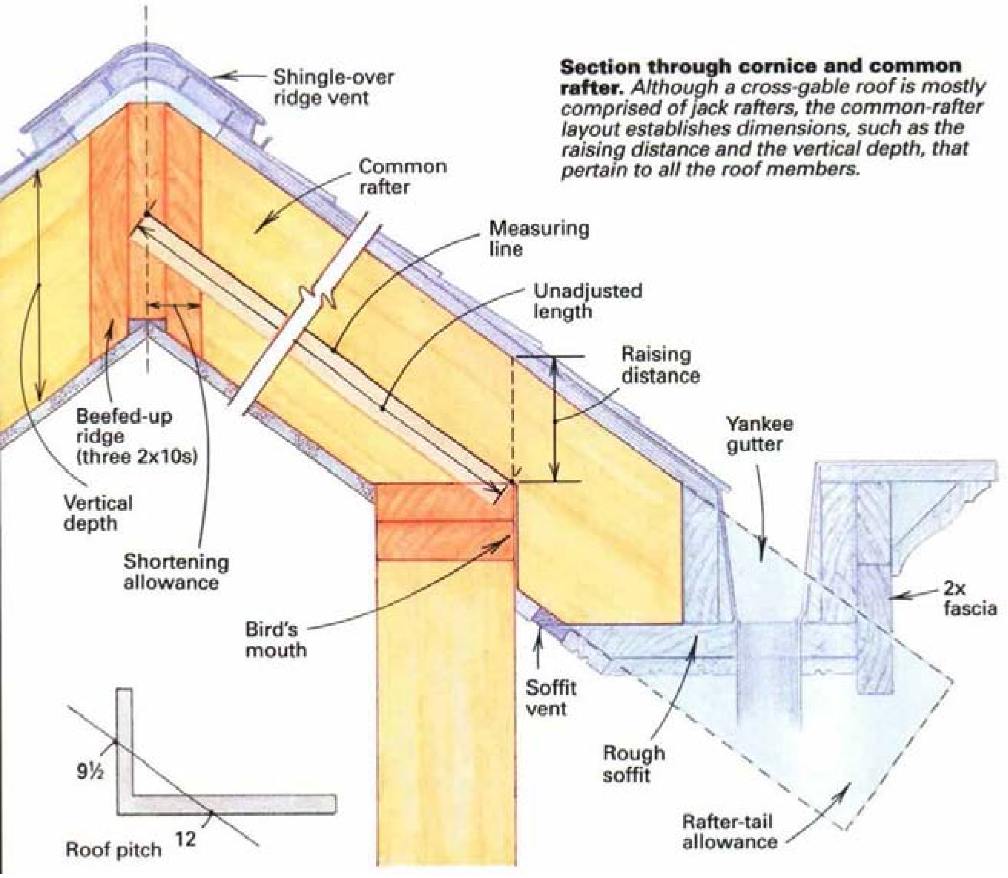
Because the addition's plan was symmetrical, it didn't matter which valley of a pair would run through to the ridge. But I did decide to make the blind valleys from opposing sides of the roof come together at the same point on the ridge. This way, any force exerted on the ridge by one



Blind valley. *Two factors complicated the framing of this roof: One pair of gables is lower than the other; and the room below gets a cathedral ceiling. The solution was to run one valley rafter on each side of the roof through to the main ridge. This is called a blind valley, and it carries the shorter valley and the lower ridge. The framing plan below shows a bird's-eye view of these parts.*



Drawings: Bob Goodfellow



Section through cornice and common rafter. *Although a cross-gable roof is mostly comprised of jack rafters, the common-rafter layout establishes dimensions, such as the raising distance and the vertical depth, that pertain to all the roof members.*

blind valley would be canceled out by the force of the opposing blind valley.

Initially, we didn't want collar ties piercing the cathedral ceiling (although we added a pair, which I'll tell you about later). To compensate for the structural loss of the collar ties and to support the weight of the valleys, we beefed up the main ridge. Three 2x10s spiked together became a structural ridge beam. Because of the girth of the ridge, I beveled the top and bottom edges of the two outside 2x10s so that they wouldn't interfere with roof and ceiling planes.

The ridge beam was the first roof member to go up. We supported it on the end walls of the higher gable and put a temporary post under the spot where the blind valleys would meet.

Common-rafter layout—Because the ridges were at right angles to each other, and the roofs were the same pitch (9½-in-12), I was dealing with regular roof framing, meaning that the compound edge bevels on all my valley and jack rafters would be cut with my circular saw set at 45°. Knowing this, I decided to forego the graphic-development method I use to lay out complex, irregular roofs and resorted to more direct numerical methods.

On a clean sheet of plywood, I laid out a full-scale section of the cornice (drawing above). Next I drew in the top edge of the 2x8 common rafter and the measuring line, which is parallel to both edges and originates at the *outside* corner of the plate. The distance along an imaginary plumb line reaching from the measuring line to the top edge of the rafter is the *raising distance—a* key measurement that would remain constant for all the commons, the valleys and the ridges in the roof frame.

To figure the rafter-tail length, I referred to the blueprints. The architect had furnished me with a wall section showing a copper-lined Yankee gutter, which was to be recessed into the roof at the four short sections of eaves located at each corner of the addition. I couldn't envision how this cornice would return into the vergeboard of the higher gable at one end or how the valley flowing into the gutter would be resolved at the other end. I decided to play it safe by letting the valleys and the commons run long by a generous amount, figuring I'd trim them when I could see things in three dimensions.

After drawing the cornice section, I had the information I needed and could then transfer that information to the rafter stock. Laying a piece of rafter stock in front of me, I scribed my measuring line down its length, offset from the rafter's top edge by the raising distance noted earlier. From the end of the 2x8, I measured up 2 ft. for the rafter-tail allowance and drew a plumb line. Then I drew a level seat cut through the intersection of the plumb cut and the measuring line. I now had my bird's mouth. From the comer of the bird's mouth, I measured the unadjusted length of the rafter along the measuring line.

If the rise of the roof had been a whole number, such as 5-in-12,1 could have found the rafter's length in a rafter table such as the one found stamped on the blade of my framing square. But because the pitch was 9½-in-12,1 fell back on my trusty Construction Master calculator (Calculated Industries, 22720 Savi Ranch Pkwy., Yorba Linda, Calif. 92687; 800-854-8075). The Construction Master "speaks" in rise-per-foot rather than in sine/cosine, so you don't have to know trigonometry to use it. I came up with an unadjusted rafter length of 10 ft. 2 7/16 in.

So at a point on the measuring line 10 ft. 2 7/16 in. from the corner of the bird's mouth, I drew a plumb line representing the unadjusted length of the common. To compensate for the 4½-in. thickness of the ridge, I drew another plumb line back from the unadjusted length by a 2¼-in. shortening allowance—half the ridge thickness.

As a result of the cross-gable configuration, only the first rafters in from each corner of the main roof were commons; the rest were jack rafters. These commons would anchor the lookouts for the gable overhang, though, so I doubled them.

Valley layout—Before laying out valleys, I prefer to rip the backing bevel on the upper edge of the valley stock (see sidebar, facing page). I usually bevel two pieces and nail them together later to make a double valley rafter with a V-trough down the middle. The backing bevel helps me orient the compound cheek cuts on both ends of the valley; cheek cuts go either outward or inward in relation to the center face of the valley.

If the ceiling below a valley is a cathedral-type, as was the case here, the lower edges of the valley stock should be beveled as well, with upper and lower edges parallel to each other. This keeps the underside of the valley rafter flush with the underside of the jack rafters and makes it easier to install the drywall. The vertical depth of the valley on both faces should be the same as the vertical depth of the commons and the jacks. (Vertical depth is the width of the rafter as measured along a plumb line.)

After ripping backing bevels on all the valley stock, I started laying out the first blind valley. I designated a top edge and a center face with a lumber crayon. At some arbitrary point on the center face, I drew a plumb line using the numbers 9½ and 17 on the square. I used 17 instead of 12 for the unit run because regular hips and valleys always run 17 in. diagonally for every 12 in. that the corresponding common runs perpendicular to the plate. The rise (in this case 9½) remains the same.

Measuring down from the top edge along the plumb line, I laid off the same raising distance I had found for the common rafters. Through the resulting point, I scribed a measuring line parallel to the rafter's edge. Starting at one end of the rafter, I laid off along the measuring line an allowance for the rafter tail. I had to leave more tail length for the valley rafter than for the common rafter because the valley tail, like the valley rafter, would have a greater run.

Once the tail allowance was established, I drew the bird's mouth with its corner on the measuring line, using 9½ and 17 on the square for plumb and seat cuts. From the corner of the bird's mouth, I laid off the unadjusted length of the blind valley. I got this number by using the HIP/VALLEY key on my Construction Master. With this key, I converted the length of the common rafter to the length of the valley rafter.

From the unadjusted length, I stepped back one half the thickness of the ridge measured at 45°. In this case, the diagonal thickness of the 4½-in. thick ridge was 6⅜ in., so I pulled the actual plumb cut back half that, or 3 3/16 in., from the unadjusted length. This adjustment, like all

Two methods of finding backing bevels

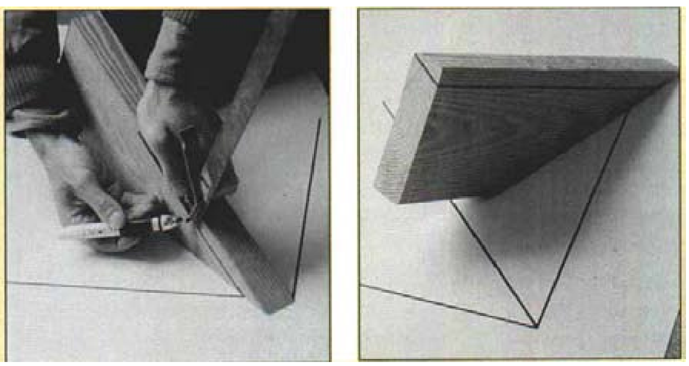
Beveling the top and bottom edges of a valley (or hip) ratter keeps them coplanar with the roof and the ceiling, which simplifies the installation of roof sheathing and drywall. I use two methods to find the backing bevels of hips and valleys: the scrap-block method and the graphic-development method. — *S. M.*

***Scrap-block method*—To use the scrap-block method, begin by bisecting the angle formed by the adjoining walls where the rafter will sit. h the case of regular roof framing, that means bisecting a 90° comer at 45°. You can do this on the actual plates, but I usually just draw on a sheet of plywood or a piece of paper a 90° corner with a 45° line running through it.**

Next, I cut a scrap block with the level seat cut of the valley at the lower end and a square cut at the upper end. The block doesn't have to be the same width as the actual valley, but it must be the same thickness. Set the block on the drawing, with its point on the vertex (photo below left). If the valley is a single 2x, the block should straddle the bisecting line, with its two faces offset ¾ in. to either side. If the valley is to be doubled, set one face of the block on the bisecting line.

From the point where the outside face of the block crosses the plate line, scribe a line on the face of the block parallel to the block's edge. This line indicates the downhill side of the backing bevel. The uphill side of the bevel will be either a center line drawn down the top edge of the block (in the case of a single 2x valley rafter) or the upper corner on the opposite face of the block (in the case of a double valley rafter). The angle is the same in either case.

On the end grain of the square cut, connect the downhill side of the backing to the uphill side (photo below right). This is the ripping angle for your circular saw.

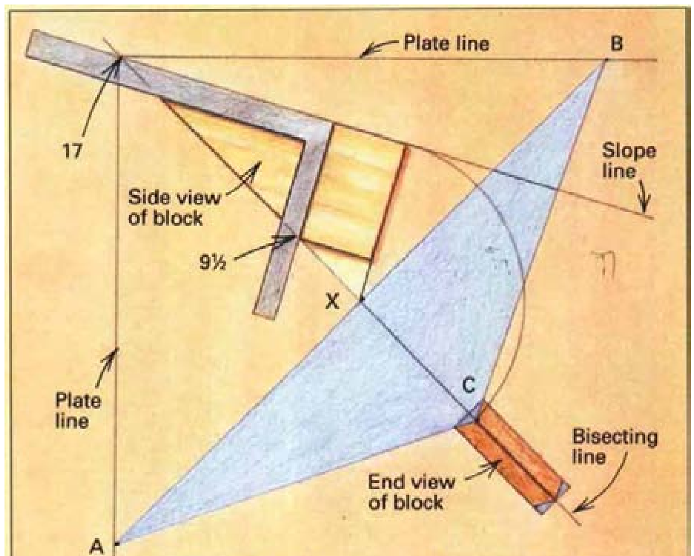


***The scrap-block method.* Beveling the edges of a valley rafter makes it easier to nail on plywood and drywall. Here, a scrap block cut with the seat cut of the roof pitch is used to find the correct angle.**

***Graphic-development method*—The graphic-development method is the same process as the scrap-block method, but it's performed in two dimensions. Suppose the pitch of the valley is 9½-in-17. Starting with the same plan—a 90° angle bisected by a 45° line—apply a framing square with 17 at the vertex and 9½ on the bisecting line (drawing below). Scribe along the 17 side. This is the slope line and is essentially a view of the scrap block pushed over on its side. Next, draw a perpendicular line at any point along the slope line, until it hits the bisecting line. This is a side view of the square cut you made on the scrap block.**

Where the perpendicular line hits the bisecting line-point X-extend lines perpendicular to the bisecting line in both directions until they hit the plate lutes at points A and B. The distance from A to B is analogous to the thickness of the valley. With a compass at point X, swing the original perpendicular line down h an arc to hit the bisecting line and connect the resulting point C with A and B. Now imagine you're looking at the end gram of the square cut you made on the scrap block; lines BC and AC represent the lines you drew connecting the downhill side of the backing bevel to the uphill side. Angle ACX is the circular-saw tilt angle.

For an irregular plan, when the walls intersect at some angle other than 90°, the bisecting line will not be 45°. Otherwise, the procedure for finding the backing bevels is the same.



Graphic development of backing bevel. *You can use a form of descriptive geometry called graphic development to find backing bevels while you're sitting at the drawing table.*

shortening adjustments, was made in a horizontal direction, not along the measuring line.

I now had the valley rafter's true length, but I still needed to ascertain the direction of the bevels for the rafter's two compound plumb cuts—the first one located at the back of the bird's mouth where it would fit up against the edge of the plate, and the other at the top of the valley where it would bear against the ridge. After checking the plan, I looked down on the edge of the valley rafter and visualized its position in the completed frame. I then made crayon marks to indicate whether the bevels would go inward or outward from the center face. I cut one half of the double valley and used it as a template for the other half, being careful to orient the bevels in their correct relationship to the center face; the two halves were opposite in this regard.

I cut another pair of rafter halves for the blind valley on the other side of the roof. This pair was the mirror image of the first, with the bevels going in the opposite direction. When both pairs of blind valleys were cut and nailed together, we hauled them up to the roof for the acid test. I got a lot of grief from the crew for all my ciphering, so I was relieved when both valley rafters dropped perfectly into place.

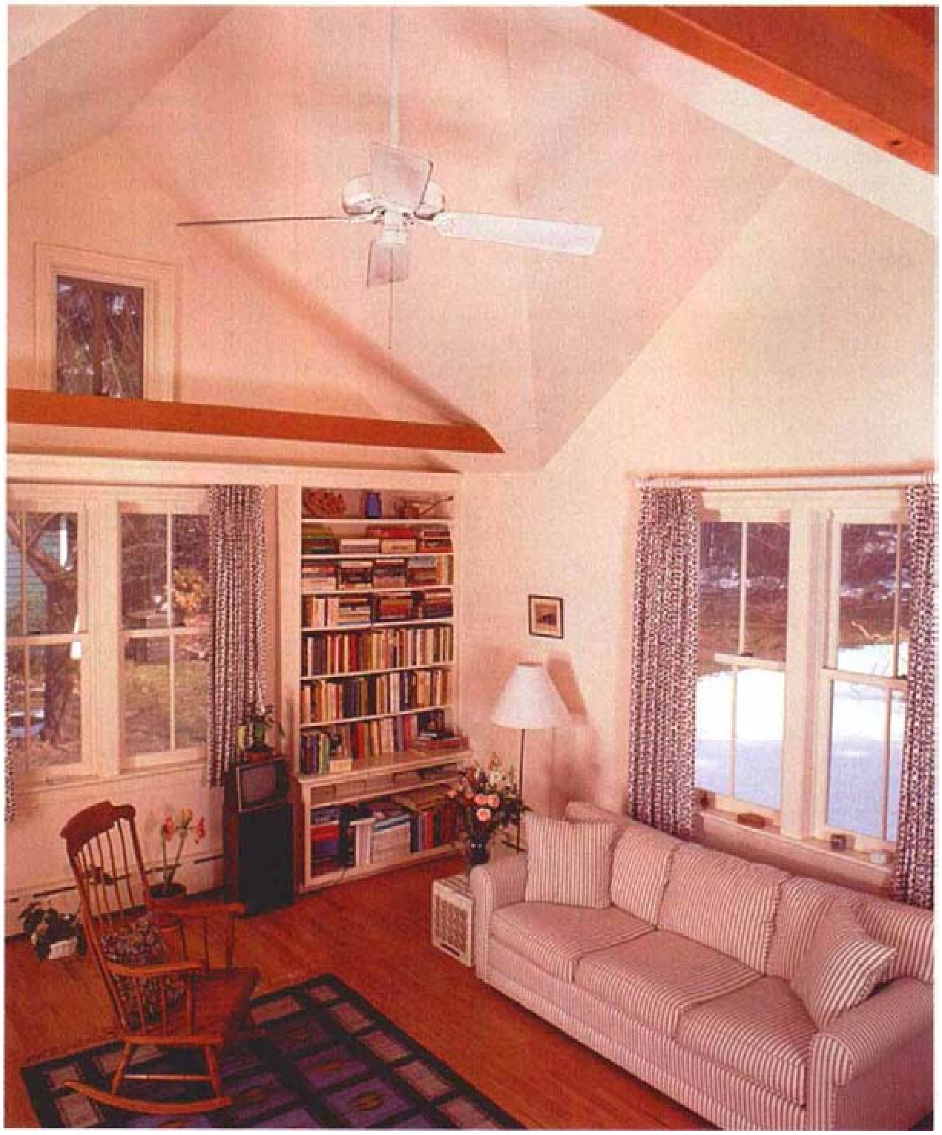
Short valleys, low ridges and jacks—The short valleys were laid out in much the same way as the blind valleys into which they would butt, though with a few differences. Their length was extrapolated via calculator (the HIP/VALLEY key again) from the length of the lower-gable common rafter instead of from the upper-gable common rafter. This relationship is evident in the framing plan on p. 47.

You can also see from the plan that the short valley butts squarely into the blind valley, which seems peculiar if you're used to the oblique orientation of most valleys. Consequently, the plumb cut at the top of the rafter was made with the saw set square, as for a common, and the shortening allowance was half the thickness of the blind valley rafter measured at 90° (not the 45° thickness).

The inboard ends of the short lower ridges, where they nuzzle into the intersection of the

A slight adjustment. **Where the blind valley extends above the lower ridge, the backing bevel had to be reversed on one side (the left side in the photo above) so that it wouldn't break the plane of the roof. The author scored this section of the rafter with a saw and used an ax to hew it flush with the roof.**

A little insurance. **To strengthen the connection between roof and walls, steel brackets were added between the top plates and the longest jack rafters, which were doubled up and were the only rafters with collar ties.**



Cathedral ceiling. **The careful framing of the roof makes possible the crisp lines of a cathedral ceiling. Exposed collar ties keep the walls from spreading. Photo by Kevin Ireton.**

blind valley and the short valley, got a double 45° bevel cut made square across their faces. Once the short valley rafters and lower ridges were nailed in place, I had to make an adjustment to the blind valleys. Where the blind valleys extend above the lower ridge, the backing bevel had to be reversed on the side closest to the short valley. I scored it with a saw and used an ax to hew it flush with the main roof (top left photo, above).

A cross-gable roof is mostly jack rafters, or "fil as they're referred to on the West Coast. Although methods exist for cutting sets of jacks in diminishing progression, I find that the accumulation of error produced by this system makes it more trouble than it's worth. I just lay off the positions of the jacks on the ridge and on the valley, then measure in between. With a lumber crayon, I scribble the measurements on the ridge beam large enough to read them from the ground.

If the addition's plan had been a square, the outward thrust of the valley at each corner would have been resisted by a pair of walls perpendicular to each other. If the walls were adequately tied together, neither collar ties nor structural ridges would have been necessary. But the plan was rectangular, and we worried about the valleys pushing against the long walls a couple of feet in from the comers. A stronger ridge was one alternative, but strengthening the ridge would have been difficult without making it deeper and bringing it below the ceiling planes. So to tie the opposing long walls together, we bolted clear fir collar ties between the longest pair of jack rafters at each end (photo above right). We used steel angle brackets, cut from heavy angle stock, to strengthen the connection between the jacks and the walls (bottom left photo, above).

Vents and vergeboards—Venting a cross-gable roof that has a cathedral ceiling is problematic because there's little or no eaves soffit to provide cool-air intake. We had only one bay at each end vented at the eaves, but by taking a notch out of the top edge of each jack rafter toward its lower end, we managed to get at least a little draft in the bay's bordering valleys. I also could have recessed the top edge of the valley in relation to the jacks, as I sometimes do with hips, but this would have reduced its strength.

We vented the ridges with a concealed shingle-over type ridge vent. We vented the framed rake overhang by replacing one course of the yellow-pine wainscoting used as soffiting material with a strip of aluminum soffit vent.

The pierced and sawn vergeboards (photo p. 46) are the dominant features of the exterior (for more on vergeboards, see Finishing Touches, pp. 86-87). We made the vergeboards from clear kiln-dried redwood 2x12 because any knots or checks would likely cause the delicate, short-grained pendants to break off. We laid out the design using a single-repeat template traced from the existing house, adjusting the spacing to get an even number of pendants. Sawing them out was a chore, even with a heavy-duty jigsaw.

Instead of a finial, the vergeboards meet at a simple square shaft, turned catty-corner and suspended from the peak. I wanted to go wild with an ornate spire, but the architects held me back. Some things haven't changed in 140 years. □

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