Shed-Dormer Retrofit

Turning your attic into living space may be the remedy for your growing pains

by Scott McBride

Growing up amid the post-war baby plantations of central Long Island, 1 got to see a lot of expand-as-you-go housing. One of my earliest memories is the sight of slightly dangerous looking men, with hairy arms and sweaty faces, tearing the roof off of our home. My parents had decided to add onto our modest Cape, and that meant building a shed dormer. The following spring, a neighbor came over to take measurements; his house and ours, you see, were identical, and he wanted to do the same thing to his place. Before long, all the houses in our subdivision had sprouted the same 14-ft. long dormer.

Rivaled only by the finished basement, the enlarged and finished attic endures as the most practical way for the average suburban family to ease its growing pains. The shed dormer makes it possible to enlarge almost any attic space simply by flipping up the plane of the gable roof. Compared to the cost and complexity of a gable dormer, the shed dormer is a good choice where size and budget take precedence over looks.

Design–Shed dormers may be as small as a single window, or may run the entire length of the house (for some interesting examples, see pp. 80-81). In the latter case, it is common to leave a narrow strip of the main roof alongside the rake at each gable end (photo above).

The trickiest part of designing a dormer is getting the profile right. To find the correct position of the inboard header and the dormer face wall, begin by making a scale drawing of the existing roof. Then draw in the dormer that you have in mind. What you're trying to determine here are the height of the dormer's face wall, the pitch of its roof, and where these two planes will intersect the plane of the main roof.

When determining the height of the face wall, consider exterior appearance, interior headroom, and window heights. The roof pitch you choose will affect the kind of roofing. Shingles require at least a 4-in-12 pitch. A flatter pitch should be roofed with 90-lb. roll roofing. This usually isn't a visual problem because you can't see the flatter roof from the ground.

Loading and bearing–Once you're sure that the existing ceiling joists will support live floor loads, you have to consider the other structural aspects of adding a shed dormer. Removing all or part of the rafters on one side of a gable roof upsets its structural equilibrium. You're taking a stable, triangulated structure and turning it into a not-so-stable trapezoid. The downward and outward forces exerted by the remaining rafters are no longer neatly countered by opposing members. The dormer's framing system has to compensate for this lost triangulation. To understand how this happens, let's take a look at a dormer's structural anatomy. As shown in the drawing on the facing page, the *inboard header* transfers loading from the *cripple rafters* out to the *trimmer rafters* on either side of the dormer. The full-length trimmer rafters send this lateral thrust down to the joists. With the main roof load reapportioned around the dormer, the new roof is structurally able to stand on its own.

On low-pitched dormers, the roof sheathing acts as a sort of horizontal beam that reinforces the inboard header and helps transfer the lateral thrust of the main roof out to the trimmer rafters. As you increase the pitch of the dormer, you decrease the ability of the dormer roof to act as a horizontal beam. And the lateral force of the dormer rafters themselves will sometimes threaten to bow out the dormer face wall. The solution is to tie the main-roof rafters and dormer rafters together with ceiling joists. These act as collar ties, creating a modified version of the original gable triangle.

We also have to consider vertical loads. The dormer roof on the outboard side is supported by the dormer face wall, which is built either directly atop the exterior wall or slightly to the inside, where it bears on the attic floor joists. This second option, shown in the drawing, facing page, leaves a small section of the original roof plane (called the apron) intact, and lets you retain the existing cornice and gutter. It also sets the dormer back a bit from the eave line and visually reduces the weight of the addition. Depending on the size of your floor joists, if the setback is more than one or two feet, the load on the attic floor joists can become too great. To lighten this load, you should install a header at the top of the apron to carry the roof load out to the trimmer rafters. In any case, this face wall will support a little more than half the weight of the dormer, depending on the roof pitch.

The other half of the dormer roof load usually rests on a large inboard header, which transmits the load through the trimmer rafters down to the exterior walls. To increase roof pitch and gain more headroom, the inboard header is frequently moved all the way up to the ridge of the main roof. If this ridge beam is made strong enough to carry roughly half the weight of the dormer

Drawings: Chuck Lockhart

Retrofit framing details

roof and half the weight of the main roof, then it won't sag, and the rafters connected to it cannot spread apart at the plates. This allows the attic to have a cathedral ceiling.

If the ceiling is to be flat, the ceiling joists will prevent the roof from spreading, as mentioned earlier. In this case the ridge is non-structural and can be made of lighter stuff.

If you don't use ceiling joists and go for a cathedral ceiling, the length of your dormer will depend upon the practical length of the inboard header or structural ridge beam. About 12 ft. to 16 ft. is typical. At this length, a triple 2x10 or 2x12 should make an adequate header, capable of carrying Half the dormer roof load, plus the weight of any cripple rafters above it. If the 2xs in the built-up header are slightly offset from one another and the main roof pitch is steep enough, the header will not protrude below the ceiling. Sizes of all members should be checked by an engineer, architect or building inspector.

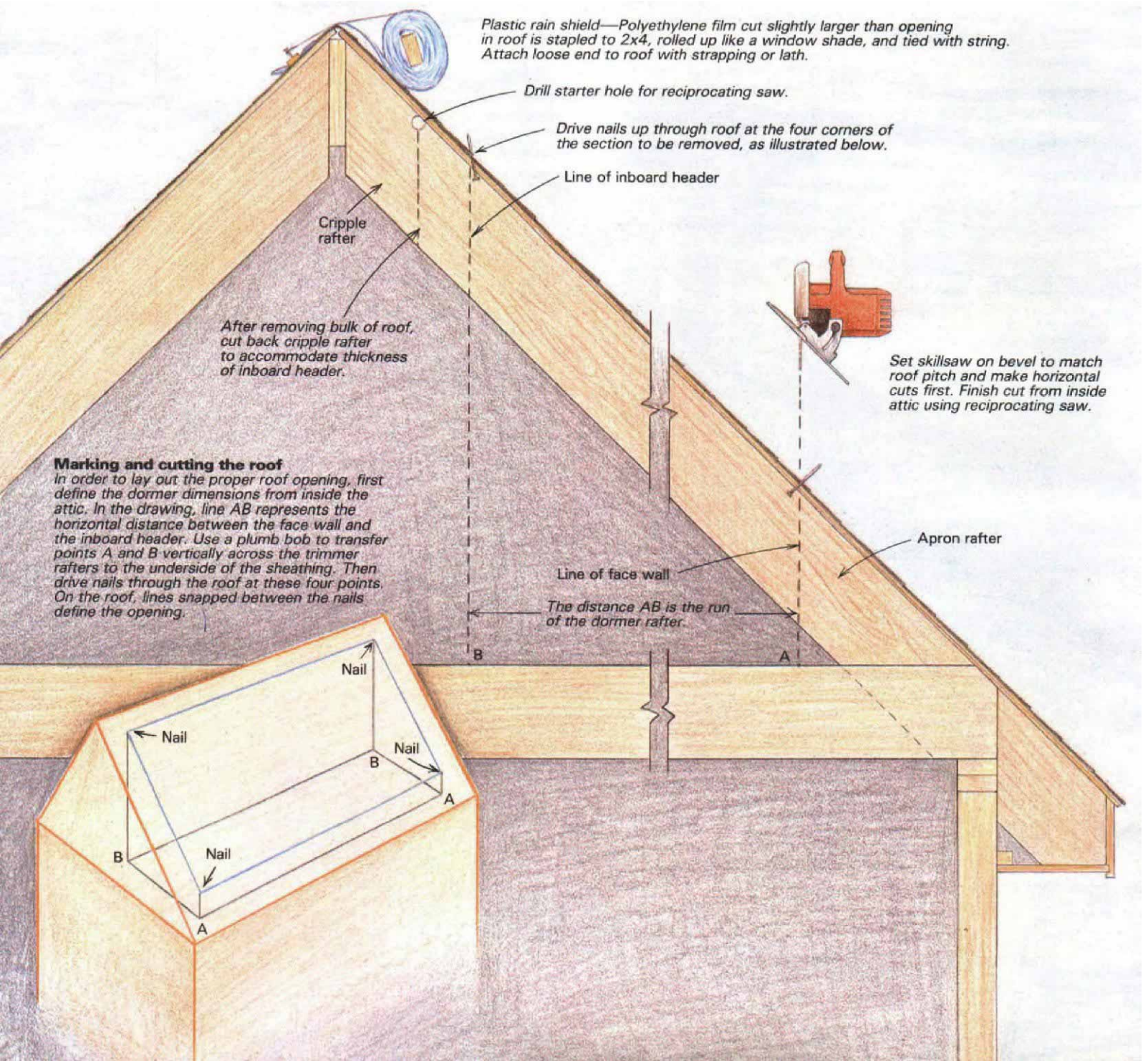
If you're going to build a long dormer, you can support the header between the trimmer rafters with an intermediate rafter. Hidden inside a partition wall that runs perpendicular to the face wall, this rafter picks up the load of the headers, which can then be reduced in size.

Preparation—Before you cut a big hole in your roof, you have to determine the location of the dormer from inside the attic. Lay some kind of temporary floor over the open joists to keep boots from going through ceilings and to keep trash out of the attic insulation.

You may want to use one of the existing rafters as a starting point and lay out the dormer from there. In this case the existing rafter becomes a trimmer rafter and will have to be doubled or possibly tripled to carry the load. This can be done before the roof is opened up.

To lay out these extra trimmer rafters, measure the underside of an existing rafter from the heel of the plumb cut at the ridge down to the heel of the level cut at the plate. Transfer the respective angles with your T-bevel. These extra rafters don't support the cornice, so you don't have to cut a bird's mouth; just let the level cut run through. If a ceiling joist prevents the new rafters from reaching the plate, raise the level cut on the bottom of the rafters so they bear snugly on the top edge of the joist.

Now slide the additional rafters into the appropriate bays to make the trimmers. Any roofing nails protruding below the sheathing should



be nipped off. Some persuasion may be necessary to bring the new rafter up tight against the old one. Spike the rafters together generously and toenail the new ones to the ridge and plate.

Now that you've defined the length of the dormer, you need to mark off the width. Begin by measuring from the outside of the exterior wall in to where you want the face wall (drawing, facing page). From here plumb a line up across the trimmer rafter and mark where this line intersects the roof. Now measure horizontally toward the ridge, from the proposed face wall to where you want the inboard header. Plumb another line up to the trimmer from here, and mark where it intersects the roof. This distance is the width of your dormer; it's also the run of the dormer rafter. Where these points (two on each set of trimmer rafters) touch the underside of the sheathing, drive four large nails up through the roof to mark the corners of the rectangular section you'll cut out from above. But before heading up to make the cuts, check for electrical wires, vent stacks and anything else you don't want your skillsaw to run into.

Rigging—Since houses with steep roof pitches make the best candidates for dormers, you'll need good rigging. Set up staging along the eaves, extending a few feet past both sides of the dormer location. If a hoist or pulley can be rigged in conjunction with the scaffold, so much the better. To gain access along the sides of the dormer, a ladder can be hooked over the ridge, or roof brackets can be set up.

"What happens if it rains?" is the question most often asked by clients. If proper precautions are not taken while the house undergoes dormer surgery, a heavy rainstorm could cause thousands of dollars in damage.

Once you get up to the ridge, install an emergency rain shield—a piece of heavy polyethylene film wrapped around a 2x4 somewhat longer than the length of the dormer. On the ground, spread out a piece of the poly several feet longer than the dormer and wide enough to reach from the ridge of the existing roof to the eaves. Staple one of the horizontal edges to the 2x4, and roll the sheet up like a window shade. Tie the roll with string, then carry it up to the roof and fasten its free edge to the ridge with wood lath or strapping. If it rains, cut the string and let the sheet unroll. The weight of the 2x4 hanging over the eaves will keep the poly tight, so it won't flap in the wind and so puddles won't develop.

Demolition—For cutting through the roof, you need a powerful skillsaw equipped with a nail-cutting blade. The heavy carbide tips on these blades are ground almost square, giving them the toughness needed to plow through asphalt, plywood and miscellaneous nails all at once. Some manufacturers coat this type of blade with Teflon to reduce friction. Eye protection is a must during this operation.

After snapping lines between the four nails you drove up through the roof, make the horizontal cuts first (there are only two of them and they're a little tougher to do). Set the skillsaw as deep as it will go, and set the saw's shoe to the plumb-cut angle of the main roof. Since you cannot safely plunge-cut with a skillsaw when it's set on an angle, start the cut with your drill and reciprocating saw. Then use a slow, steady feed on the skillsaw. Keep moving, because the weight of the saw will tend to push the downhill side of the sawblade against the work, generating extra friction. Be particularly alert to the possibility of kickback; your blade will be crashing into 8d sheathing nails now and then. And remember, you're up on a roof.

To make the vertical cuts, set the skillsaw back to 90° and start the cut on the uphill end. These cuts are easier because the weight of the saw helps pull it through the cut. All you have to do is slide down the roof behind it. If you have had experience plunge-cutting, then begin this way. Otherwise, start the cut with the reciprocating saw, and finish with the skillsaw.

After the four outline cuts are done, make longitudinal cuts down the middle of each bay in the area to be removed. This divides the roof into manageable chunks. Before freeing these chunks by completing the cuts through the rafters, determine whether the remaining roof frame (the apron rafters below, and the cripple rafters above) need temporary support. If these pieces are short and well-nailed to the plate and ridge, they will stay up by themselves. If not, shore them up temporarily with 2x4 braces.

Now use your reciprocating saw inside the attic to complete the cuts through the rafters. Have a couple of burly helpers hold up each section while you're working on it. A 10-ft. 2x8 rafter, 14 sq. ft. of sheathing, and several layers of roofing make these chunks very heavy. The safest way to lower them to the ground is with a strong rope that's wrapped around a sturdy mast.

After removing the bulk of the roof, the bottom ends of the cripple rafters must be cut back to accommodate the thickness of the inboard header, without cutting through the sheathing. Drill a ¾-in. starter hole at the top of the mark with a right-angle drill. Then cut straight down with the reciprocating saw.

To finish up the demolition, you'll need to cut back the roofing material to make way for the dormer sidewalls. Set the depth of the skillsaw so that it will cut through all the roof shingles, but will just graze the sheathing. Snap longitudinal lines on the roofing, located back from the inside faces of the trimmers a distance equal to the width of the dormer sidewall framing plus sheathing thickness, plus ½ in. for clearance. Slice through the roof shingles along these lines, and peel back the roofing to expose strips of decking above the trimmer rafters. The dormer sidewalls will be built up from these, with the inside edges of the studs flush with the inside faces of the trimmer rafters.

Wall framing—Your next step will be to cut and lay out the plates for the face wall. In most situations, the bottom plate for the face wall will bear directly on the attic floor. You should lay out the face-wall framing so that the apron rafters will bear directly on the wall studs (aligning the framing in this way is called stacking).

In order to bring concentrated roof loads down safely onto the floor framing, window king studs also should be in line with the apron rafters or else be located over a joist. You can then frame inward to get the necessary rough-opening width. Or you can forget all this and just double the bottom plate to distribute the load safely.

Taking the scaled measurements from your drawings, transfer the header and sill lengths onto the plates. The various stud lengths will also come from your drawings. Be sure to locate the rough sill for the windows at least several inches above the apron to keep rain and melted snow from creeping in underneath.

Cut all the face-wall components and assemble them on the attic floor. Then raise and plumb the wall, bracing it temporarily if necessary.

Next you have to fill out the corners of the face wall with a combination of beveled sidewall studs and blocking, as shown in the drawing on p. 47. The tops of these studs will be flush with the top of the face wall, and will give bearing to the dormer end rafters. Begin by cutting oversized pieces with the pitch of the main roof cut on one end. Stand these in place and mark their tops flush with the top of the face wall. Cut and nail. This completes the face wall.

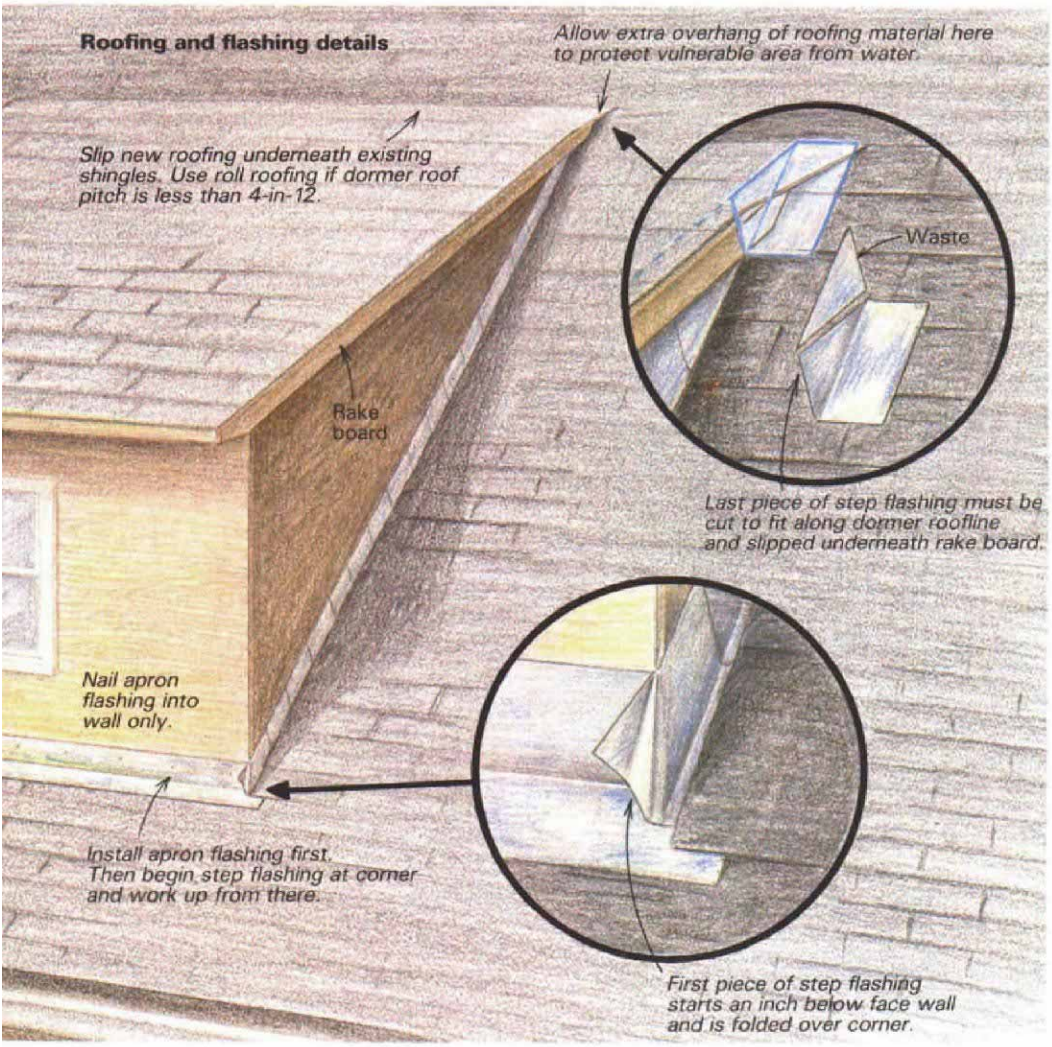
Roof framing—The shed-dormer rafter is laid out just like any common rafter. The only differences are the generally lower pitch, and the fact that its plumb cut bears against a header instead of a ridge board. There are several ways to determine rafter length. I lay out the bird's mouth first, then step off the rafter length with a large pair of dividers, using the method described in my article on roof framing *(FHB* #28, pp. 31-37). After marking the plumb cut at the ridge, lay out the rafter tail according to the soffit and fascia details from your elevation drawings. Then carefully cut out the rafter pattern. (For more on rafter layout see *FHB* #10, pp. 56-63.)

Turning to the roof, first nail the inboard header to the trimmers. Joist hangers won't work in this situation because you'll want to offset the 2xs like stair steps, starting each one slightly above or below the next in order to fit the slope of the roof. Instead, just toenail each piece in place with plenty of 16d commons, and then spike them to each other.

Now try the rafter pattern at several different locations along the top plate of the face wall. If all is well, use the pattern to cut the rest of the rafters and nail them in place. The spacing of the rafters should align with the face-wall studs in the same way the studs align with the floor joists. The end rafters will have to be retrimmed on a sharp angle at the top, because they bear directly on the roof instead of on the header. Place one of the pattern-cut rafters in position, up against the trimmer rafter, and mark the roofline. After cutting, double the end rafters to provide nailing for drywall, or spike a 2x on the flat with its bottom face flush with the bottom edge of the end rafter.

The dormer sidewall studs are framed directly from the main roof up to the dormer's end rafters, without any plates. As with the corners of the face wall, begin by cutting oversized pieces with the pitch of the main roof cut on one end. Then stand the pieces in place and mark where they meet the dormer end rafter,

Piggyback shed dormers. **Shed dormers are often part of the original design on houses that have a gambrel roof. Here a second dormer was added on top of the first, probably to let more light into the room. For more examples of atypical shed dormers, see pp. 80-81.**



cut along the mark and nail them up. These studs diminish in a regular progression, like gable studs, as they approach the ridge. If you don't want to mark each one in place, just mark the first two and measure the difference between them. This measurement is their common difference, and you can use it to calculate the diminishing lengths of the remaining studs.

Closing up—A few points on exterior finish are worth mentioning. Before decking the dormer roof, use a shingle ripper to remove nails in the first course of roof shingles above the dormer. This allows the dormer roofing material to be slipped underneath the existing shingles. If you install the sheathing first, the lower pitch of the dormer roof will interfere with the handle of the shingle ripper.

Flashing a shed dormer is relatively simple. As shown in the drawing below left, the apron is flashed first, then the dormer sidewalls are step-flashed. Use a 6-in. wide length of flashing along the apron, creased in half so that 3 in. of flashing runs up the dormer face wall and 3 in. extends over the apron shingles. Nail the face-wall side only. At the corners of the face wall, let the apron flashing run a few inches past the dormer sidewall. Slit the flashing vertically along the corner of the dormer, and push the overhanging vertical fin down flat on the main roof.

Overlap the apron flashing with the first piece of step flashing, where the dormer sidewall meets the main roof. Extend the step flashing down at least an inch past the face wall, and fold the vertical fin down and back on an angle. This will carry rainwater safely past the corner. You'll have to relieve the back of the corner board to fit over this first piece of step flashing.

Continue the step flashing all the way up the sidewall, slipping one piece of bent step flashing under the end of each roof shingle course, and pressing the other side up against the wall sheathing. Don't nail the step flashing into the roof; nail it to the sidewall only.

The rake board is usually furred out with a piece of 5/4 spruce so the siding can be slipped underneath. Where the dormer rake board dies into the main roof, the uppermost piece of step flashing is trimmed on an angle so that it can fit up behind the rake board and tight against the furring. Give the dormer roofing a little extra overhang here to help divert water from this sensitive spot.

Vents in the dormer soffit are a good idea. They prevent condensation in the dormer roof insulation as well as ice damming at the eaves. Since the inboard header blocks the flow of warm air at the tops of the roof bays, cut some notches across the top of the header in each bay or recess the top edge of the header slightly below the tops of the dormer rafters. If you're insulating between the rafters (instead of the ceiling joists), you'll need some spacers to create an airflow channel between the roof sheathing and the insulation (see *FHB* #33, p. 12). This allows some air flow from the dormer soffit vent to the ridge vent or gable-end louvers. □

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Photos: Scott McBride