Photos by Sarah Knock

*A little ingenuity can replace a crane when installing roof panels. This 4x16-foot panel is 4 1/2 inches thick and weighs in at about 250 pounds.*

# Installing Stressed-Skin Panels

*by Tedd Benson*

***Recipe for a one-step shell: Plan for minimal waste, measure and cut with precision, and be sure to seal 'em tight.***

In 1976, after building my first few timber-frame houses, I began to search in earnest for a better method of insulation. The built-up system of horizontal 2x4 nailers and foam board we were then using was labor-intensive, suffered from infiltration and thermal breaks, and did not take advantage of the structural characteristics of the timber frame. A decade later, after much experimentation, the stressed-skin panel has become our preferred insulation system.

A stressed-skin panel is nothing more than a sandwich of a thick core material bonded to two thin outer skins. The structural principle is similar to that of an I-beam; the outer skins serve as the flanges of the beam, while the insulation core performs the role of the I-beam web.

The panels we now use have a polyurethane core with an outer face of oriented-strand board (OSB) and an inner face of plaster-base drywall (blueboard). We use OSB because it is stronger than chipboard, has better nail-holding capacity, and costs about the same as regular chipboard. We prefer blueboard rather than regular drywall because it is more durable, and holds up well if it rains before we get the roof on. Blueboard gives our clients the option of either plastering or painting.

If we need extra strength or a nail base on the interior, we sometimes use "doublechips"—panels faced with oriented-strand board on both sides. When we use doublechips, we specify that the interior skin have low formaldehyde-glue content. Otherwise, outgassing into the household air could be a problem.

### Making a Plan

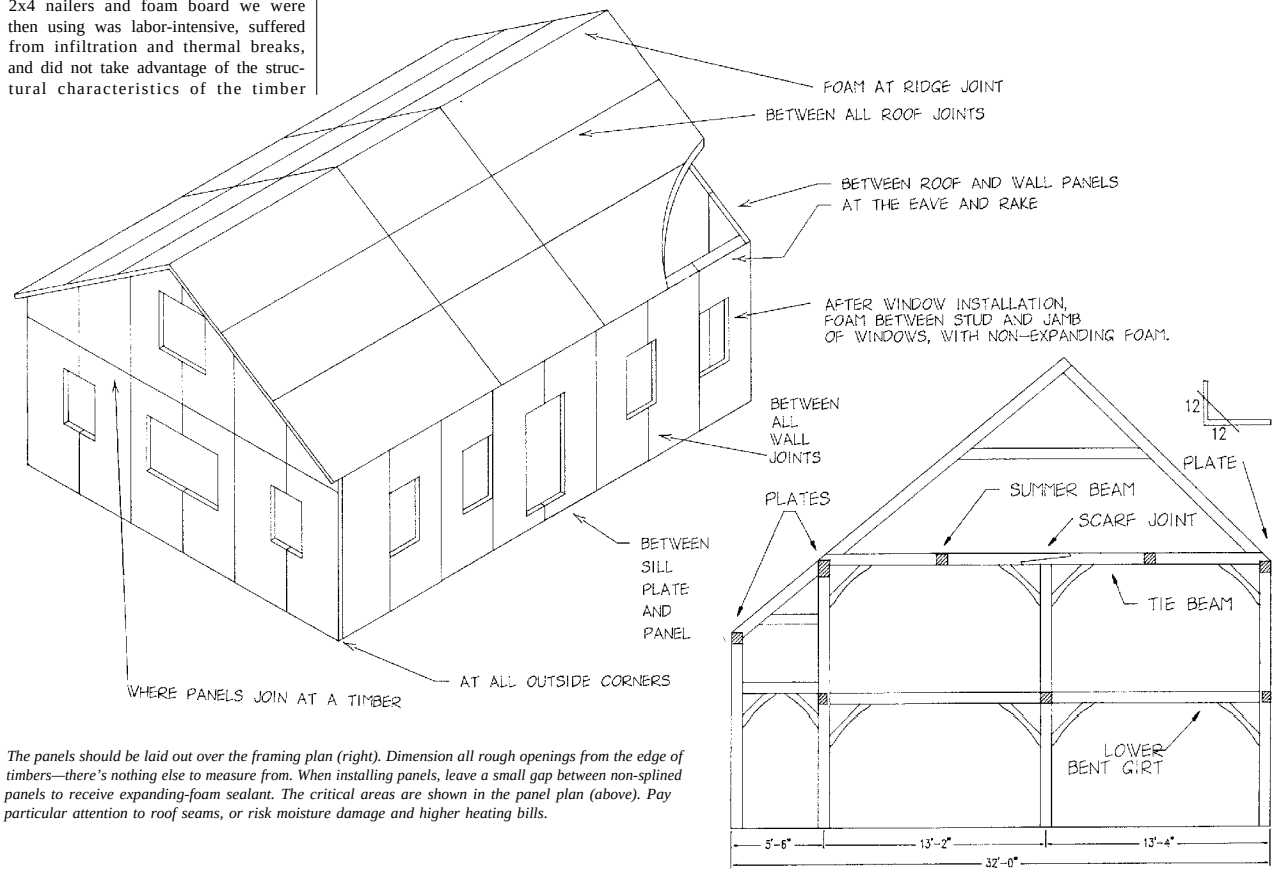
In theory, installing stressed-skin panels is similar to installing other types of sheathing, except that the panels are thicker, heavier, and a lot more expensive. To keep waste down and make installation efficient, it's important to map out a strategy before getting started.

The locations of the timbers determine the final lengths, widths, and cuts for the panels. Therefore, use a blueprint of the framing plan as the basis for the panel plan.

You'll need a plan for each wall of the house and each roof surface. Before you draw in any panels, locate the rough openings for windows and doors. All openings should be dimensioned from the edges of the timbers, because the panel installers will have nothing else to measure from. Use the same rough openings as specified for standard frame construction.

After you've located the rough openings, you're ready to draw in the panels. Laying out the panels is a matter of juggling several considerations: strength, panel waste, rough openings, and roof overhang. Here are a few guidelines:

First, check the requirements of the local building code and the loading characteristics of your panels. Most manufactured panels are engineered to span 8 to 9 feet on the walls and 4 feet on the roof. Be wary of a manufacturer who cannot provide documentation.




*The panels should be laid out over the framing plan (right). Dimension all rough openings from the edge of timbers—there's nothing else to measure from. When installing panels, leave a small gap between non-splined panels to receive expanding-foam sealant. The critical areas are shown in the panel plan (above). Pay particular attention to roof seams, or risk moisture damage and higher heating bills.*

Second, don't waste costly panel material just to make the spans work out perfectly. For example, suppose the distance from the extended sill to the centerline of the girt is larger than your 4x8 panels. You could cut the 4x16 panels to fit, but you'd be creating a lot of waste.

A better solution would be to position the 4x8 panels above the extended sill (see drawing) to span from box sill to girt, keeping in mind that 2 inches is the minimum for good nailing. To do this, you would snap a line along the face of the box sill and nail a temporary ledger to the line to support the panels during nailing. Then you would fill in below the panels to the extended sill with offcuts.

Third, windows wider than 3 1/2 feet must be reinforced with 2x4s on either side of that span from beam to beam. Door openings must be similarly reinforced. Smaller windows can be cut directly into the panels without this reinforcement.

If the window is small enough, try to locate it toward the middle of the panel, leaving 6 inches of panel on either side. But if the window has to be closer than that to a panel edge, try to move the panel edge to the edge of the rough opening. This puts the joint in a place where it can be strengthened with 2x4s and splines.

Fourth, non-supported roof overhangs should be limited to 1 1/2 feet beyond the wall panel at the rakes, and one foot beyond at the eaves. Using doublechip panels here allows you to increase overhangs to 2 1/2 feet on the rakes and 2 feet at the eave. You could run doublechips just, along the roof edges, and use standard panels for the rest of the roof. Some trim details (see box) support the eave panels, making it possible to use greater overhangs with the standard panel.

Some other things to consider when laying out the panels on the plan: Panels should run vertically on the wall, unless the posts are spaced closer together than the horizontal girts and plates. After laying out the full panels on either side of door and window rough openings, plan to fill in above and below the openings with panel pieces. Try to have the tapered factory edges of the drywall meet at all seams.

Use the same procedure on the roof, laying out full panel sections on either side of openings. You will have to juggle all these factors with an attempt to use offcuts efficiently. Dot the panels in over the framing plan, making sure each panel and offcut is clearly marked.

### Cutting the Panels

Once the panel plan is drawn up, you can lay out, cut, and install the panels. We try to install the wall panels before the roof panels, particularly if an overhead winch or crane is used.

In some situations, it is difficult to fit the wall panels under the eave panels and over the extended sill simultaneously. If the eave panels extend over the upper plate or girt, nailing the top edge of the wall panels is difficult, if not impossible. The obvious disadvantage is that the wall has no protection until the roof is on.

Begin by marking panel joints and the rough openings for windows and doors on the outside face of the sill and beams. Then string a line along the eave to accurately represent the eave intersection. Next, using a chalk line or a large T-square, draw the rough openings and all cut lines on the panels. Panel edges that will fall on posts are sawn to allow a 1/4-inch gap at the seam for expanding-foam sealant. Panels that will span the full height from sill to eave should be sawn about 3/8 inch short at the bottom for the foam.

We've had some problems at the eave joint with ants getting into the foam. So now we spread a healthy layer of plastic roofing cement on the extended sill before installing the panels. The roofing cement coats the edge of the panel, and so far appears to keep out the ants.

We usually lay out and cut the wall panels one at a time, but precut all the roof panels at the same time in preparation for crane assistance. The advantage of this system is that you can check your work on the wall as you go. The possibility of making mistakes on the roof is pretty slim, as there are usually few openings.

When you cut, always wear a mask and goggles. Clean up panel dust and chips often. The dust from urethane panels is inorganic and ugly. My most disturbing experience with it was the time a client's beautiful cranberry bog was fouled with a frost of panel dust. The house needed insulating, not the bog.

The panels are heavy, so it's best to make all the cuts in a panel at the same time. If your saw cannot cut through the thickness of the panel, cut from each side and finish with a hand saw, if necessary. Tilt the saw base to cut the roof angle on the upper edge of the wall panels. Then cut a notch in the top outside edge about one inch high and 1 1/2 inches deep to receive an expanding-foam sealant (see drawing).

### Routing for Splines

With a specially adapted grinder, rout all the seams that do not fall on posts to accept double splines (see sidebar). The perimeter of all door and window openings, and the outside edge on each corner, are routed to accept 2x4 nailers. Where the panel edges need additional reinforcement, such as in a vertical joint over a wide window, we rout the panels to receive a solid 2x4 nailer rather than a double spline.

After the panels have been cut, and while they're still on the sawhorses, install and secure the splines to one edge of a pair of mating panels. Attach the splines first on the nail-base side with 1 1/4-inch galvanized drywall-type screws, and use standard drywall screws on the drywall side. Nails and screws should be on 8- or 10-inch centers. Don't install any nailers in door or window openings until the panels are installed, because you want the nailers to span the panel seams for reinforcement.

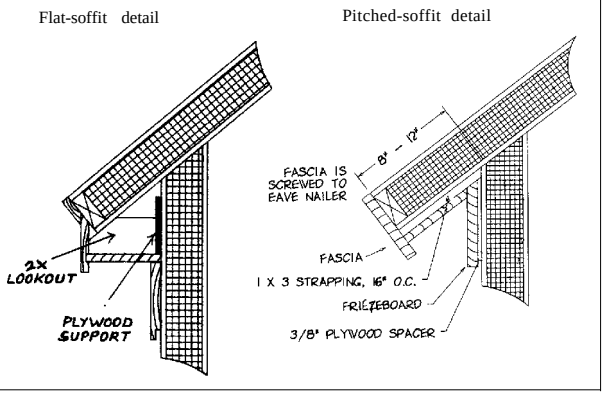
Before bringing the panels into position, start the nails through the exterior sheathing. The nails you use to attach the panels to the frame will depend on the material of the frame. For softwood frames, use an annular ring nail or spiral-shank nail (pole-barn nail) that will penetrate the timbers at least 2 inches. To resist a tannic-acid reaction with metal, use galvanized nails for oak frames. The nails should be long enough to penetrate the wood 1 1/2 inches. These should be on 8- to 10-inch centers around the perimeter.

### Raising the Panels

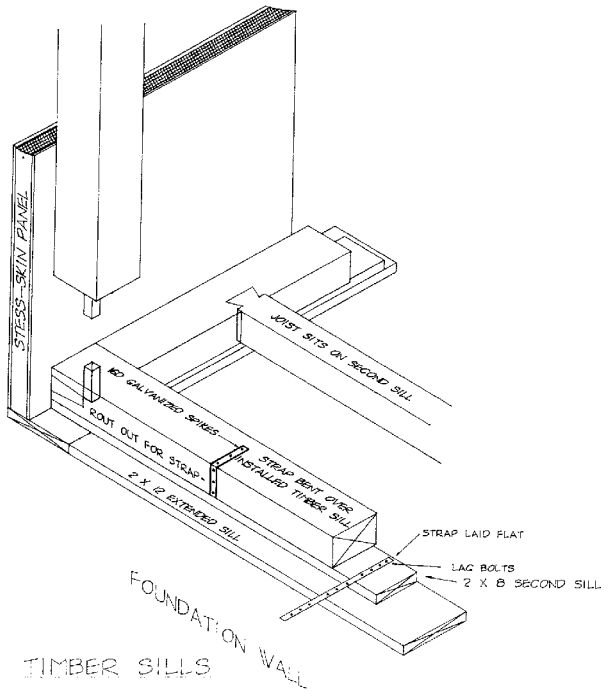
After starting the nails, apply a bead of construction adhesive to the faces of the posts, beams, and box sill where the panels will attach. Starting with an outside corner, lift each panel into place, resting its base on the extended sill (or on a ledger on the face of the box sill). Slide the panels together horizontally. When installing the top panels in the wall, lift them to the eave string by pry-

## *Trimming the Eaves*

**A** *wide variety of roof details can be used with stressed-skin panels. All basically fall into two categories—the flat soffit (left) and the open soffit (right): Trim is generally connected to the roof by using a nailer let-in to the edge of the roof panel. Generally, the overhung should be held to 8 to 12 inches fur a regular panel (drywall one side) and 16 to 24 inches for a doublechip. In the open soffit, because there is no nailing on the bottom of the panel, 1x3 strapping is wedged in place by the frieze board.*




*The lower sill, shown in the detail below, is extended out to support the wall panels. The upper sill and deck can be made of timbers, or can be conventionally framed, as in the photo above, where the box sill is being drilled for wiring.*



ing with a flat bar. Drive in the nails.

After the first panel on each wall is in position, you will need to drive subsequent panels together to engage the splines—often using a mallet or sledge. Protect the edge of the panel from the mallet with a block of wood. If the panel is no longer than 10 feet, it is sometimes easier to drive the splines from above than to pre-install the splines and mate them edgewise. This is another reason to put the wall panels on first.

In places where panel edges meet at a timber and there's no reason for a spline, use 1/4-inch-thick plywood pieces to temporarily space the panels apart while nailing. The gap is later filled with foam. Make sure the bottoms of the stacked panels have at least 2 inches of nailing in the timbers. Gable-end panels should also be shy of the roof panels by 1/4 inch for foaming.

Before installing the roof panels, snap a line across the roof where the first panel seam will be, to ensure that the eave and rake will be straight for the rim. Put a bead of construction adhesive on the roof timbers and on the beveled edge of the eave panel prior to placing the roof panels.

With the nails already in position, attach the panel when it is aligned with the chalk line. Most roofs require few spline joints because the timbers are on 4-foot centers. Space the panels 1/4 inch from each other with plywood spacers, creating a cavity for foam.

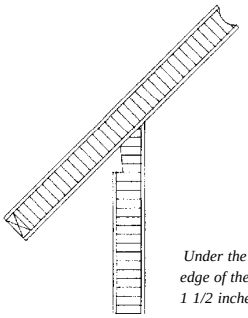
## Finishing Up

If you choose to ignore my instructions about foaming the wall seams, don't carry the illogical thinking up to the roof. You'd be disappointed with the results. Not only is more heat lost through air leaks in the roof, but there is also a greater likelihood of moisture migration through the roof seams, which can cause rot in the timbers or damage the panels. I have even seen unfoamed roof joints that built up so much moisture that in the wintertime ice formed in the joint and lifted the shingles.

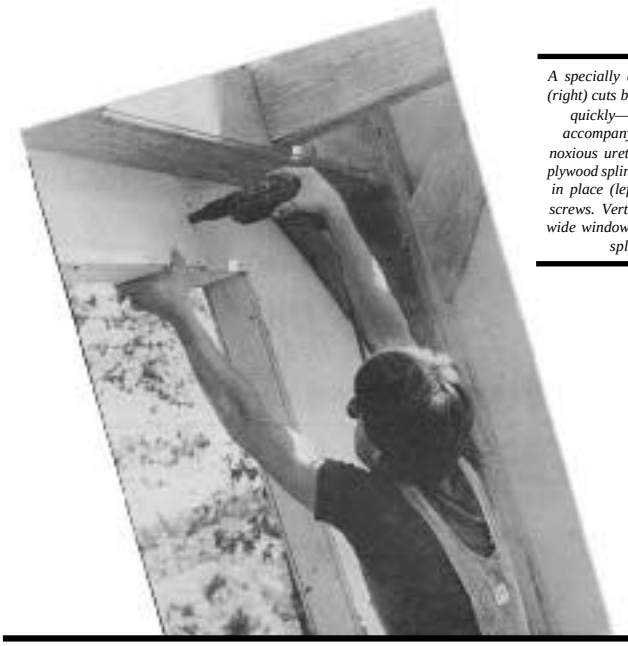
When all the panels are completely nailed to the frame, install the nailers in all the rough openings. Nail them with 8d galvanized nails from the outside skin, and screw with drywall screws from the inside skin. Also make sure all the spline joints have been properly screwed and nailed. Now you are ready to fill the roof and wall seams with expanding-foam sealant.

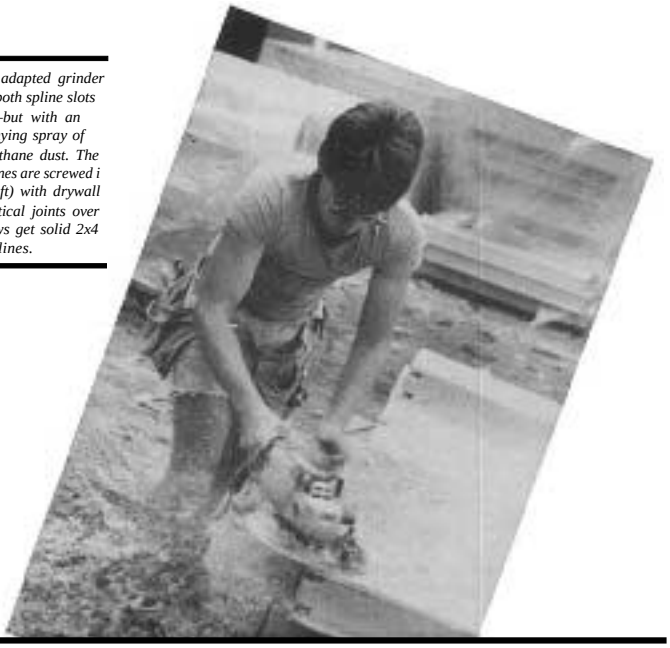
You've just completed the exterior sheathing, interior wallboard, and insulation in one step—saving labor and time. Using this system, the panels take the beating from the elements. If necessary, they could be replaced in time, but the frame should survive the ages intact.

*Tedd Benson is a timber framer in Alstead, N.H. He is the author of the forthcoming book* The Timber-Frame Home: A Practical Design and Construction Guide *to be published this fall by The Taunton Press, Newtown, Conn.*




*Under the eave, cut a notch in the top outside edge of the wall panel about one inch high and 1 1/2 inches deep to receive expanding-foam sealant.*





*A specially adapted grinder (right) cuts both spline slots quickly—but with an accompanying spray of noxious urethane dust. The plywood splines are screwed i in place (left) with drywall screws. Vertical joints over wide windows get solid 2x4 splines.*

# MAKING CONNECTIONS

Panel-to-panel connection is just as important as the way a panel is made, because it's the connection at the seams that is really the weak link in a panel system. There are a number of manufacturer-suggested connecting systems, but we've found they don't offer the thermal performance we're looking for. Instead, we use the double-spline system shown in the drawing.

The panels come with square edges, which we then rout out to accept two 5/8x3-inch plywood splines. Our spline router (actually a grinder) is designed to take out 1/8 inch of insulation at each edge between the splines to create a 1/4-inch cavity into which we spray expandable foam.

**The wrinkling wasn't caused by moisture getting through the panel joint, but by the panels being pulled together as the frame shrank.**

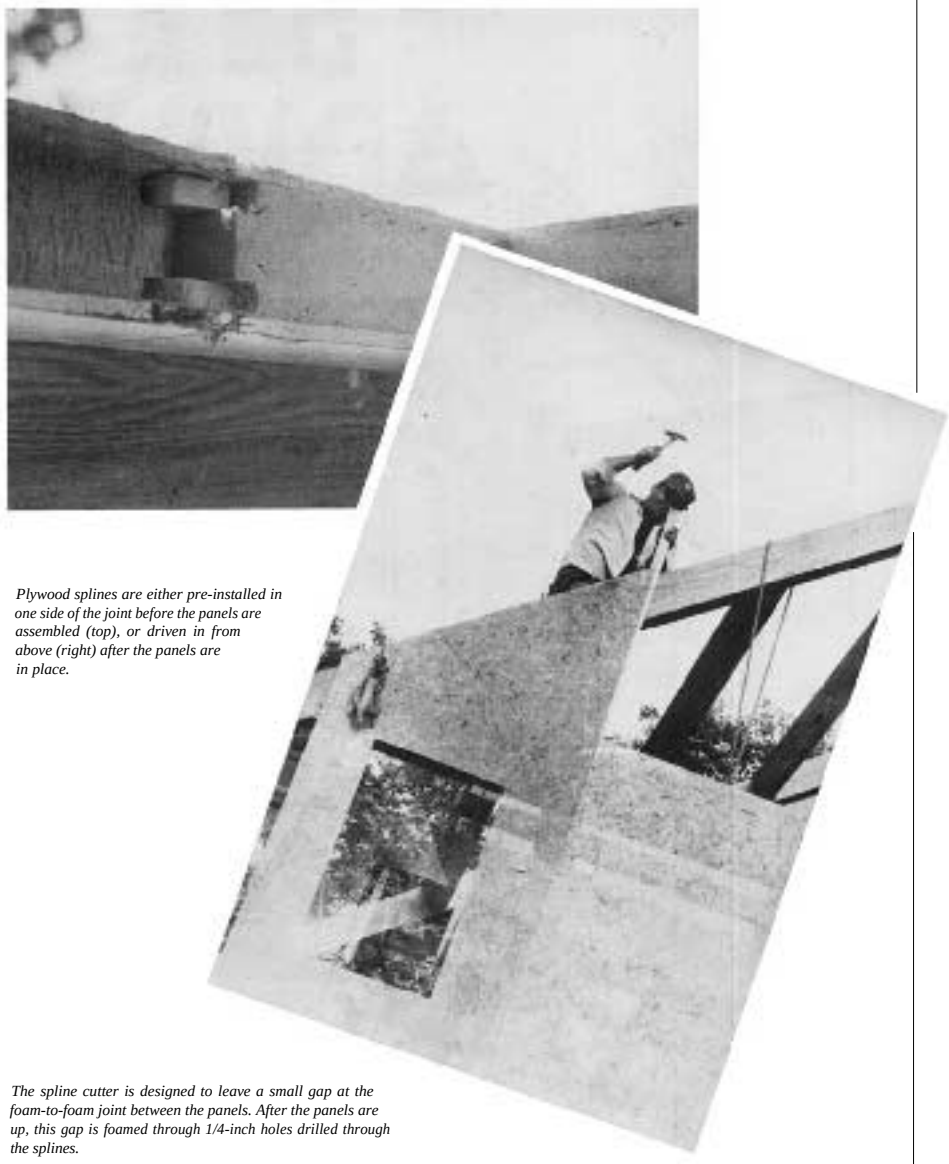
The foaming is done after the panels have been installed by drilling a 1/4-inch hole every 14 inches through the splines to accept the nozzle of the foam can. We fill all roof joints as well as the wall joints, and work our way up the joints, not down, because the foam tends to rise as it expands.

Experiment on some scraps before you start, because climatic conditions affect foam expansion. We have found a two-second count generally fills to the next level quite nicely. After the foam has completely expanded and hardened, scrape the excess from the surface.

At this point we also foam the 1/4-inch-wide gaps deliberately left where panels join, without splines, over a timber. We also foam the gaps left between the extended sill and the panels, at all outside corners, between wall and roof at the eave and rake seams, and at the ridge.

We treat the roof joints a little differently. On a couple of houses, despite a thoroughly sealed roof joint (foam in the joint and roofing cement on the exterior surface), we had trouble with the shingles wrinkling over the rafters. After poking around, we discovered that the wrinkling wasn't caused by moisture getting through the panel joints, but by the panels being pulled together as the frame shrank. For that reason, we now use a single 5/8x3-inch spline in vertical roof joints.

All this foaming may seem like a lot of bother, but if you want to achieve the best thermal value, these extra steps are the cat's pajamas. ■



*Plywood splines are either pre-installed in one side of the joint before the panels are assembled (top), or driven in from above (right) after the panels are in place.*

*The spline cutter is designed to leave a small gap at the foam-to-foam joint between the panels. After the panels are up, this gap is foamed through 1/4-inch holes drilled through the splines.*

SPLINE DETAIL