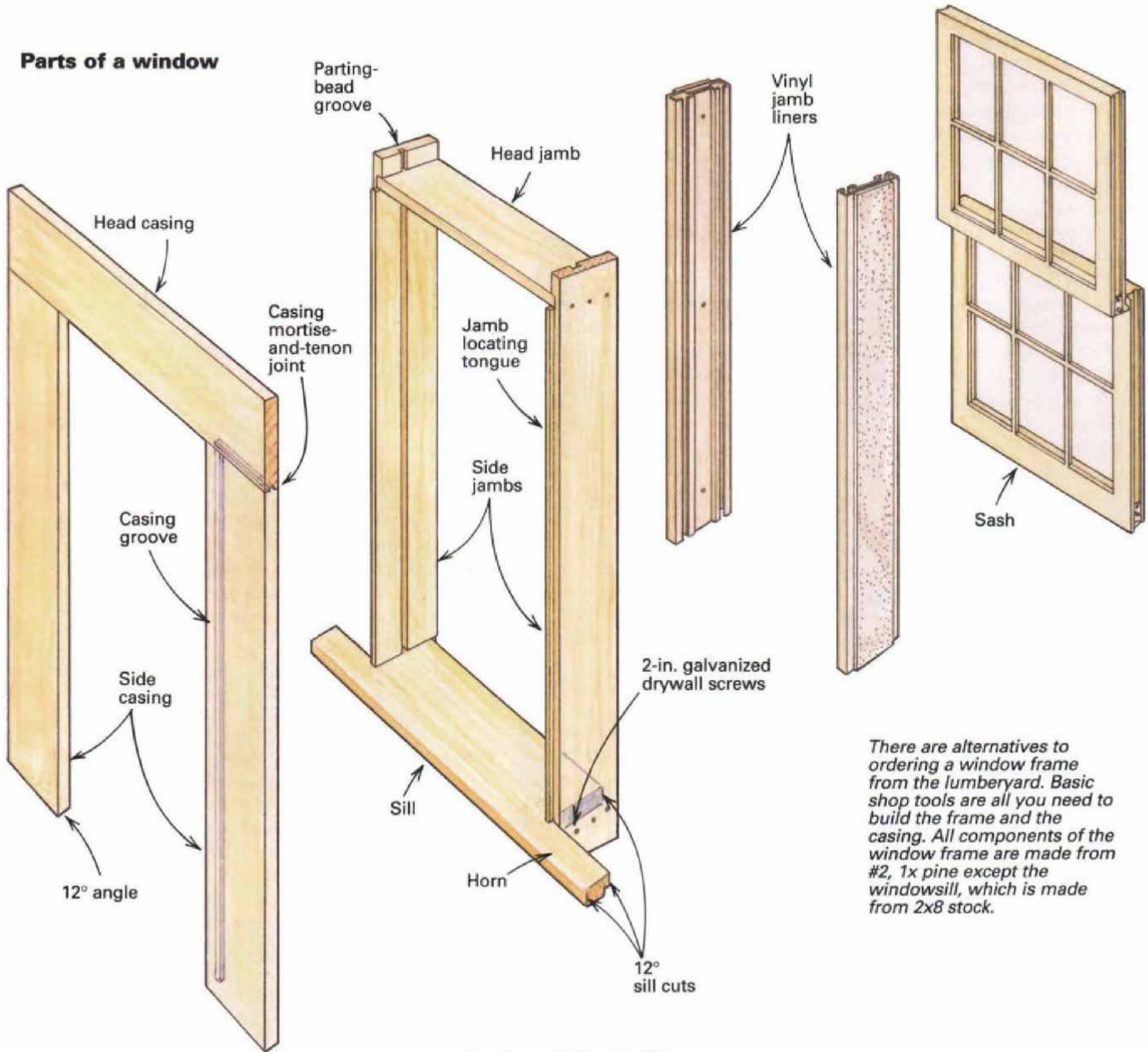
Shop-Built Window Frames

Simple joinery, #2 pine and stock sash make inexpensive custom windows



There are alternatives to ordering a window frame from the lumberyard. Basic shop tools are all you need to build the frame and the casing. All components of the window frame are made from #2, 1x pine except the windowsill, which is made from 2x8 stock.

by Joseph Beals, III

The window frames in my 1855 house were in varying states of disrepair; some of them needed only a little rebuilding, but a lot of the window frames and most all of the sash were beyond hope. A practical renovation demands modern thermal efficiency at a tolerable cost, as well as some sense of original appearance. These goals can be satisfied by the methods 1 used for building new window frames.

To attain some degree of thermal efficiency in my windows, I decided to use vinyl jamb liners intended for direct retrofit in existing window frames. If the V word makes the hair on your neck stand up, then you share my first reaction. But in a finished window the jamb liners are quite unobtrusive. A jamb liner is a heavy-gauge, cream-colored vinyl extrusion with full weatherstripping and integral spring counterbalances.

Windows have been built to standard sizes for a remarkably long time; I was a little surprised that I could get replacement sash for my house with dimensions the same as the rotted ones I wanted to replace. But stock window frames are another story.

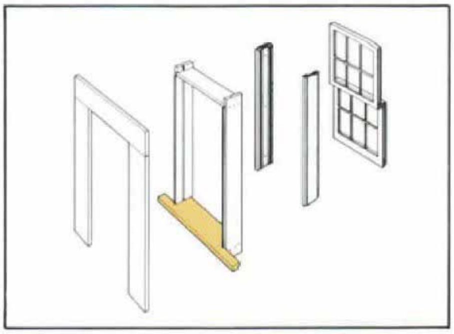
Most stock window frames (the frames on manufactured windows) are built to fit a contemporary 4½-in. wall and require jamb extensions to suit the thicker walls in an old house. Factory-applied jamb extensions are an option, but the thickness of the walls in an old house often vary considerably, which renders the stock jamb extensions a marginal-to-useless convenience.

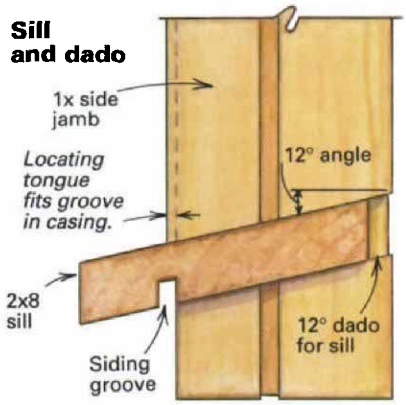
Flat exterior casings are a stock option, but they do not match the width of my original casings. Finally, stock windowsill are usually built of thin material, typically 1 in. to 1¼ in. And on some stock frames the sill sticks past the outside edge of the casing only ½ in., which isn't wide enough to add a ¾-in. backhand to the casing after the window is installed.

To build my own frames, I use #2 pine for the jambs and casings and kiln-dried 2x8s for the sills (drawing above). I picked the stock to avoid loose knots, pitch pockets, checking and wild grain. Clear pine is an option, but it is very expensive, with no advantage of stability or appearance. Remember, the jambs are not exposed in the finished window, and the sill and the casings are painted on all visible surfaces.

Drawings: Bob Goodfellow

Start with the windowsills





Windowsills are set at an angle to shed water (drawing above). I used a 12° pitch to match the average angle of the original windowsills. I cut the sill stock a few inches longer than the final size, ripped one edge at 12°, planed it for a smooth finish, then ripped the inside edge to 12°.

When you duplicate old window dimensions, you may find that the inside edge of the sill is short of the inside edge of the jambs. This is not a mistake or an example of Yankee frugality. The inside of the sill need extend only an inch or less in front of the inside of the bottom sash rail, enough to provide nailing for the window stool (the shelflike piece of interior window trim that most people think of as the inside windowsill).

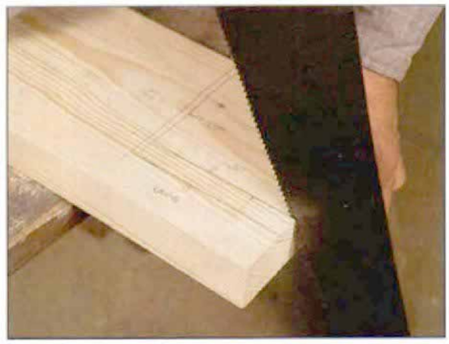
The sill is housed in dadoes angled 12° on the lower ends of the side jambs, with horns that typically are flush with the outside edges of the exterior casings (drawing p. 78).

I think the best method for laying out a sill is to work off a centerline and measure equally to the right and left sides. I mark the location of the inside faces of the side jambs and add the side-jamb dado depth to each side, typically ¼ in. I mark the back of the horns by copying an old sill. In general, I make the horns 2 in. to 2½ in. deep, which gives a reveal of 1 in. to 1½ in. beyond the outside face of the exterior casing. Because the sill is pitched 12°, the actual reveal will be fractionally smaller, but the difference is not worth a trigonometric calculation.

Because both horn cuts are stopped, it doesn't pay for me to make the cuts by machine. I saw out the waste by hand, using a bevel gauge to guide the angle for the horn back cuts (top photo, right). Remember, the back cuts are not critical because they butt against the wall sheathing and are hidden once the siding is in place.

The horn should be flush with the outside edges of the exterior casing. After marking them accordingly, I cut the sills to length on a radial-arm saw. Some early colonial windows have sill horns that extend past the exterior casings, creating an annoying siding condition whereby a clapboard or a shingle would have to be notched around the sill horn with no aesthetic benefit. If you are duplicating windows with this extended-horn detail, consider eliminating it.

Finally, I cut a groove in the underside of the sill where the siding (clapboards or shingles) is tucked as it runs beneath the sill. The back of the groove is flush with the backside of the horns,

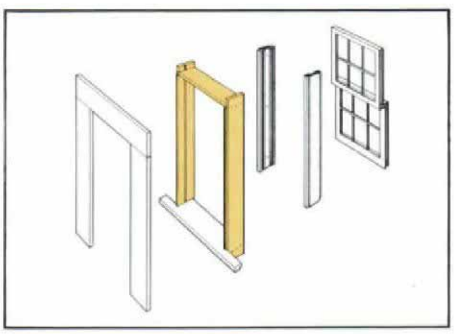


Sill cuts. **Because both of the cuts that make the windowsill horns are stopped, the author uses a handsaw to cut away the waste.**

Cutting the siding groove. **A dado blade cuts a ½-in. by ½-in. groove in the windowsill to accept the siding.**

and the groove dimensions are not critical. I make the groove at least ½ in. by ½ in. Making it too tight is a common mistake, second only to forgetting it entirely. A dado blade on the table saw set for width, depth and sill angle makes the groove in one quick pass (bottom photo, above). If you use a router to cut the groove, you can create the pitch angle by taping a shim to the sill, which will lift one side of the router base.

Side and head jambs



My original windows were built with a rabbet cut on the outside edge of the side jambs. The rabbet leaves a locating tongue that engages a groove on the back of the exterior casings. This is not an essential detail, but it provides positive positioning for the casing and improves the weather-tightness of the joint.

The side-jamb stock is ripped to suit the wall thickness, plus ¼ in. for the rabbet. Add 1⁄16 in. to the actual wall dimension, which will allow the inside of the jambs to stand a fraction proud of the inside finish wall and makes fitting the interior casings much easier. Flush jambs are tolerable if the wall is uniform and dead flat; fractionally recessed jambs are a terrible nuisance.

The length of the side jambs is not critical because the inside frame dimensions are established by the dadoes that house the sill and the head jamb (the top piece in the frame). I always leave an inch or two past the dadoes. Even if it needs to be trimmed later to fit the rough opening, the excess length during construction will protect the short grain between the dadoes and the jamb ends from breaking out. I lay out the dadoes very carefully, working on the left and right side jambs at the same time.

The spacing between the top of the sill and the bottom of the head jamb is defined by the height of the two installed sash (drawing facing page). You can transfer the layout from an old pair of jambs or from a pair of replacement sash.

The width of the dadoes is determined by the stock thickness: For new window frames, that

Angle block. **A scrap of pine cut at 12° acts as a gauge to make the side-jamb sill cut. To cut the opposing jamb, the gauge is switched to the other side of the blade.**

gives 1½ in. at the sill and ¾ in. at the head jamb. A radial-arm saw is ideal for cutting the dadoes because you can see the cut in progress, and a stop block clamped to the fence gives accurate and consistent spacing.

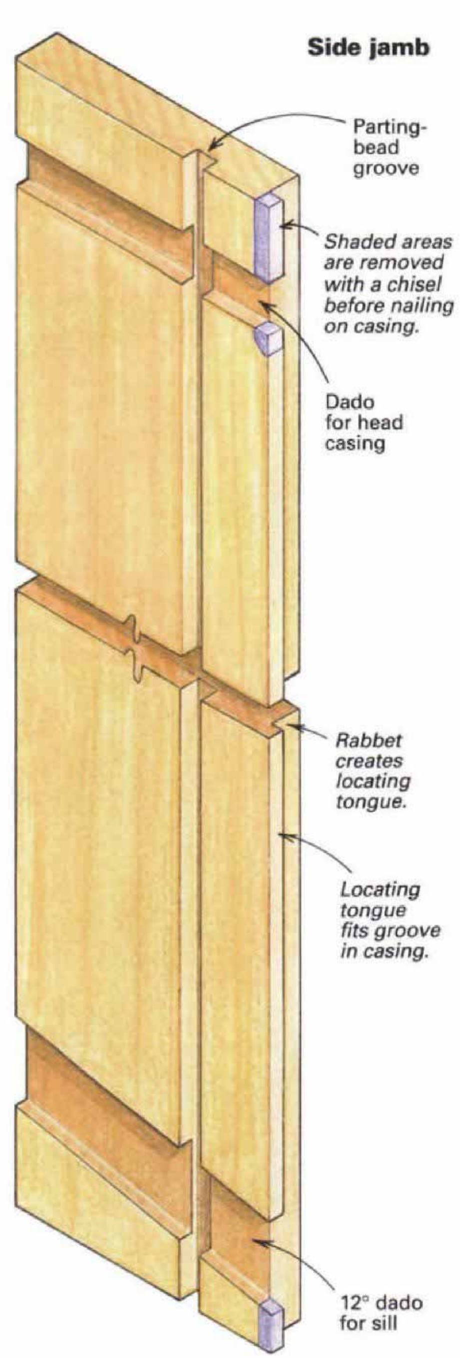
Like most woodworkers, I prefer to leave my radial-arm saw set at 90° rather than setting the left and right angle cuts independently, which increases the possibility for error. To cut the 12° dado for the sill, I make a gauge out of scrap pine. By holding the jamb stock against the gauge, I cut the exact same angle every time (bottom photo, p. 77). To cut an opposing jamb, I simply switch the gauge to the other side of the sawblade. When all the dadoes are cut, I clean out any waste left with a chisel (photo below).

After cutting the dadoes, I plow a parting-bead groove in each side jamb (drawing below). A parting bead is a thin strip of wood that's inserted into the jamb to create separate tracks for the upper and lower sash. A parting-bead groove is unnecessary for a replacement sash that includes a jamb liner, but it ensures the option of historic reversibility. 1 include the parting-bead groove as a matter of conscience. It is a quick, easy cut, and it will soothe the temper of some future renovator who may already be annoyed by the absence of sash-weight pockets and pulley mortises. I take the groove dimensions and position from an original jamb and plow it with a dado blade on the table saw.

Finally, 1 cut the rabbet on the outside edge of each side jamb, which creates the locating tongue. The rabbet can be made in one pass with a dado blade on the table saw or with two intersecting cuts to slice off a slender ribbon of waste. The double-cut method is fastest for one window, but a number of windows will justify the time necessary for setting up the dado blade.

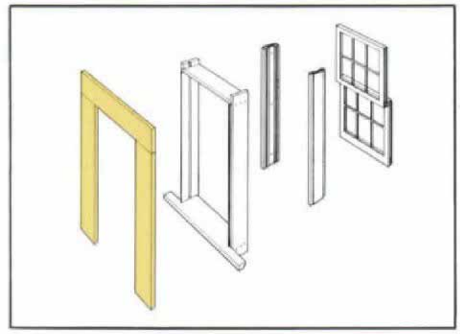
In my original windows the head jamb did not have a locating tongue, so I didn't include one. I simply ripped the head jamb to the width of the side jambs, excluding the tongue. The head jamb is the same length as the sill, excluding the horns. It is important that the head-jamb length be accurate; if it isn't, the frame will not be square.

I assemble the frame with galvanized drywall-type screws and construction adhesive. The adhesive is more for waterproofing than for strength, and priming the joints would certainly work as well. 1 use long screws, at least 2 in., to give adequate grip in the end grain of the sill and the head casing. I also make sure that the sill horns are drawn tight against the outside edge of the side jambs and that the head jamb is flush on both sides. I don't worry about keeping the frame square; even after assembly it will be quite limber and can be squared up as the casings are installed. The final squaring takes place when the frame is installed in the wall.



Removing the waste. **The author quickly pares away waste with a sharp chisel. Because the orientation of the 12° cuts defines the handedness, left and right jambs are needed for each window.**

Making casing



The casings extend ½ in. past the inside face of the jambs. In the original windows this extension served as a stop for the upper sash. For my purposes the stop is a reference edge for the installation of the vinyl jamb liners. It also conceals the edge of the liners. The casing width is equal to the distance from the inside edge of this ½-in. reveal to the outer end of the sill horn.

With the casing stock ripped and planed to its filial width, I choose the better face of the board and mark that face with a soft pencil. If there is no clear choice, I orient the heart side toward the weather. Plain-sawn wood tends to cup toward the bark side: With the heart side out, any cupping will be concave in, convex out, which is visually less obtrusive than the other way around.

A groove plowed on the back of the side casings engages the locating tongue on the front edge of the side jambs. You can use a router to cut this groove, but a dado blade on the table saw is fast, accurate and easily adjusted for fit. The tongue should enter the groove easily. Don't try to finesse the joint; this isn't furniture, and a tight spot at the time of assembly will be extremely frustrating.

When all the grooves are cut, I separate the casings into stacks of left and right sides because the remaining operations will define the specific handedness of each piece.

The beveled sill cut on the casing bottoms is best made on a radial-arm saw, but a table saw is fine if you exercise care in controlling the stock to ensure a square crosscut. I use a scrap piece to set up and test the angle, preferably one with the groove on the backside so that it can be set in place on the frame to check the angle. The bottom should sit flat on the sill, but it helps to relieve the back of the angle by a fraction of a degree to keep the front tight. If I can, I make the angle cut with the face side up because both the radial-arm saw and the table saw will tend to chip the bottom of the cut.

A stub tenon on top of each side casing mates with a corresponding mortise on the bottom edge of the head casing (drawing facing page). This joint is perhaps the most tedious part of the frame construction, and although it may appear gratuitous, it actually is quite important. Structurally, it ties the outside top corners of the side casings to the head, which would otherwise float free of each other. But its primary function is to prevent water from working behind the casings.

To lay out the joint, I fit a piece of casing on a frame. I make sure that the casing is well seated on the jamb tongue and that the bottom is tight to the sill. Then I mark a line square across the side casing, ½ in. below the bottom edge of the head jamb. This is the shoulder of the joint, where the bottom edge of the head casing will rest. I mark a second line ¼ in. above the shoulder: This is the end of the stub tenon and the cutoff line for the overall length of the casing pattern (left photo, below).

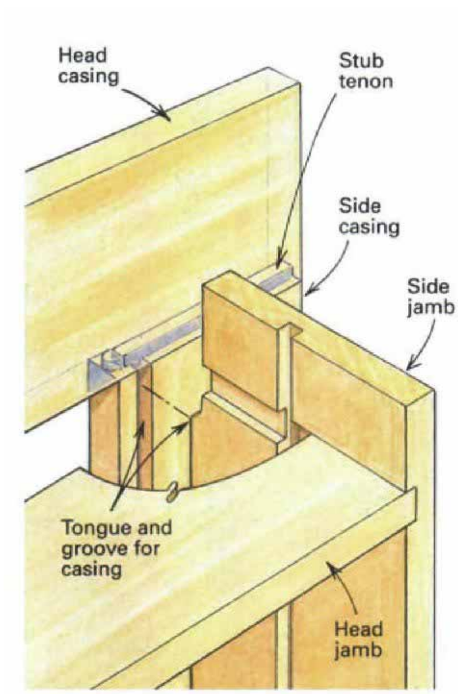
I cut all casings to length according to the marks. A radial-arm saw makes this easy: I fasten a stop block to an extension fence, butt the bottom of the casing against it and make the cut.

The head casing is the same length as the sill, from horn to horn. After cutting it to length, I mark a line on each end of the bottom edge to show the inside edge of each side casing. I clamp the head casing in a vise, bottom edge up, and use a router with a fence and a ¼-in. carbide spiral bit to cut the two mortises (middle photo, below). The mortises should be a touch deeper than the stub-tenon length to ensure that the head casing sits tight on the side-casing shoulders. To center the mortise, I set the router fence so that the cutter is approximately in the center of the casing edge, then make each cut twice, once from each side and stopping at the line I've drawn on the casing. The first cut removes the bulk of material, and the second shaves off a whisper of waste, leaving a mortise slightly more than ¼ in. wide.

I cut the mortises first because setting up the router cut for a specific width can be very tedious, whereas the stub tenons are easily made to fit a finished mortise.

I cut the stub tenons on the top of each side casing with a radial-arm saw. First I fit a stop block on the fence, using the top of the casing as a reference. Then I set the blade depth on a scrap piece and cut a test tenon. I aim for a snug fit that can be dressed with a sharp chisel if necessary. The stub tenons generally do not justify setting up a dado blade: 1 just make one or two passes with a standard combination blade, flip the stock over and repeat the cut. Because the typical alternate top bevel (ATB) carbide-tipped blade doesn't make a flat-bottomed cut, a tight fit can be tuned by paring off the peaks of the kerfs.

How it all fits



Because the head-casing mortises are rounded, rather than square at the stopped ends, the inboard ends of each stub tenon need to be relieved. I use a sharp chisel to score the shoulder line across the inboard edge and pop out a little chunk of waste with a quick twist of the wrist.

With chisel in hand, I study the assembled window jambs and sill to see how the jamb rabbets run out to the ends. At the bottom, the rabbets will interfere with the siding installation and should be removed. At the top, the rabbets will interfere with the head casing. I pare off the tongues with a chisel (drawing facing page).

Before installing the casings, I prime the angled bottom cuts and both mortises and tenons at the top. I don't wait for the primer to dry; I place the side casings on the frame, seating the casings fully on the jamb rabbets and making sure the bottom bevel is tight to the sill. For a neat job 1 drill pilot holes before nailing. 1 use galvanized 6d common nails to fasten the casings to the jambs, spaced 8 in. to 10 in. o. c. (right photo, below).

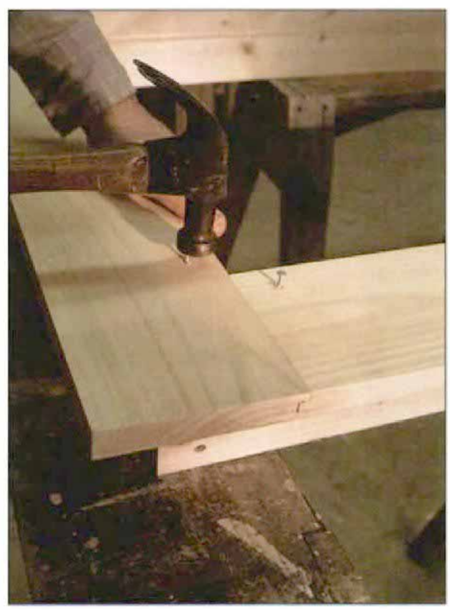
When the window frames are finished, they're installed in the usual manner. 1 tip the frame into the rough opening in the wall and then level the windowsill by shimming under the side jambs on one side or the other. I then use a level to plumb one of the side casings. When the sill is level, and the side casing is plumb, the window will be square. I use 8d galvanized commons to nail through the casings into the sheathing.

Replacement jamb liners are typically sized to suit the stock window and replacement sash, but the jamb liners may not match the sill angle in an old window. To obtain a tight fit at this cosmetically important joint, I ordered jamb liners in the next longer length from Caldwell Manufacturing Company (P. O. Box 92891, Rochester, N. Y. 14692-8991; 716-352-3790) and trimmed them to match the sill with a power miter box. The vinyl saws easily, and the power miter box leaves a clean, accurate cut. The liners attach easily to the jambs with screws provided by the manufacturer. Once the jamb liners are installed, the sash tilt easily into place. □

Joseph Beals, III, is a designer and builder in Marshfield Hills, Mass. Photos by Jefferson Kolle.

Tenon layout. **Side casings are laid out for the joint that connects the head and side casings. The left line is the total length of the casing. The other line is the shoulder of the tenon.**

Cutting the mortise. **The mortise in the head casing is cut with a fence-guided router and a ¼-in. carbide spiral bit. The first pass is made on one side; the second, on the oilier.**



Nailing on the casing. **Pilot holes are drilled for 6d galvanized nails. The mortise-and-tenon joint that joins the head and side casings provides weather resistance at the joint.**