# Simple Joinery for Custom Windows

## Time-saving lap joints can save money, too

by David Frane

Few builders enjoy midstream design changes, but most of us have learned to deal with them. There are times, though, when a small change can cause a big problem. An example of this came while we were building a large home outside of Boston, Massachusetts. The roofer had finished about half of the red cedar shingle roof when the architects literally threw us a curve: The client had decided to dress up the front facade with an eyebrow window installed high above the main entry (photo right).

This design change created two problems. First, our window supplier wanted too much money (about $3,000) to custom-build the unit; second, they couldn't deliver it for three months. We didn't want to frame the dormer without the window—the fits would be too exacting and mistakes too expensive to fix—so we decided to build the eyebrow ourselves.

After studying the architects' rough elevations, I told job supervisor Harry Irwin that we could build the unit for about half the quoted price—*if* the client would accept some unconventional and slightly archaic construction details (we actually did it for about one-quarter of the original quote). And we could have the window ready to install in 10 days. The architects and the client, pleased that we'd found an affordable alternative, quickly gave us the go-ahead.

Looking out from an empty attic, the unit (top drawing, facing page) would feature a four-lite hopper (a bottom-hinged window that opens inward). On either side would be two fixed sashes, and the entire assembly would be surmounted by a curved top jamb screwed to a sill beveled to improve drainage. A curved casing applied to the top jamb would serve as a crown molding over which the roof shingles would extend. The operable window was overkill; the owners previously had lived in old houses with hot attics, so they wanted to have plenty of ventilation up there this time. As it turned out, the hopper is rarely opened.

My plan was to build the individual window sashes first, screw them to the sill and then laminate the jamb around them. I could then apply the window stop and casing and haul the unglazed unit to the roof to be framed into place. After the roof was finished, someone would have to go back up and glaze the sash.

**Simplified joinery**—To save time, we decided to use old-fashioned glazing compound instead of curved wooden stops to hold the glass in place. The window would be 35 ft. off the ground, so nobody would notice the substitution. And rather than using standard cope-and-stick joinery, I designed the sashes to incorporate lap joints.

***An unexpected curve.*** **Lap joinery, used by the author to build this eyebrow window, offers an alternative to cope-and-stick joinery. Photo by Charles Wardell.**

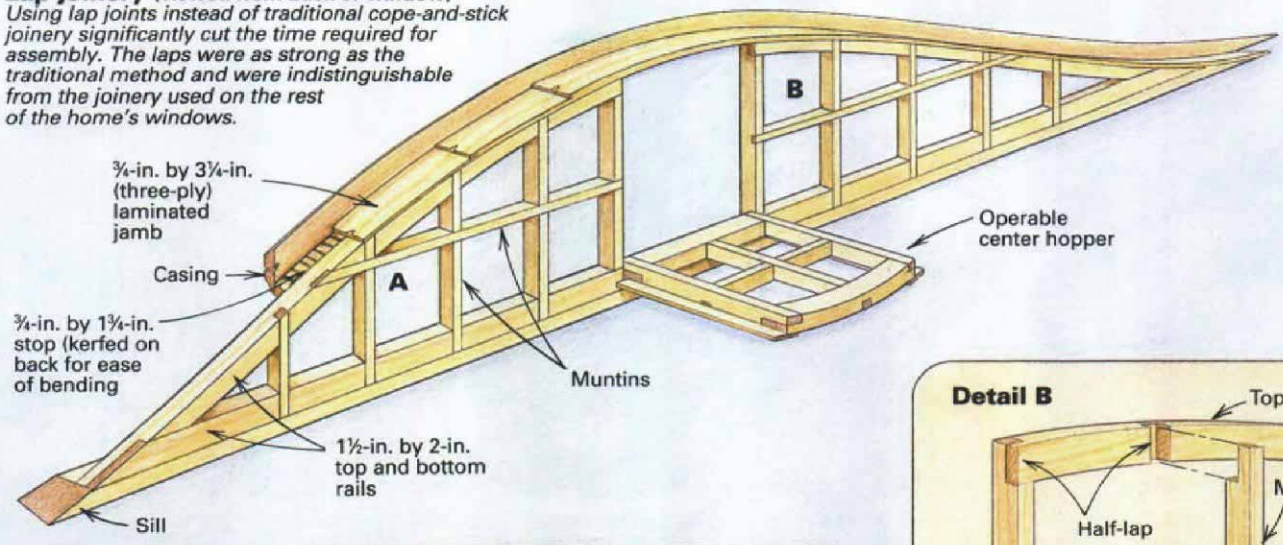
Using lap joints probably saved a lot of time. Also, the multiple shaper setups and the jigging required for coping and sticking curved stock would have busted our budget. Though lap joinery is unconventional for a window, it's as strong as the conventional method. Besides, from the ground it would be indistinguishable from the joinery on the house's other windows.

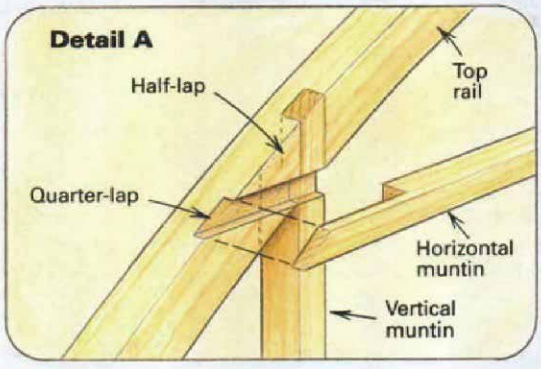
**Laying out the curves**—Lap joints notwithstanding, making an eyebrow window remains technically demanding. The unit must be symmetrical and its curves fair—they must flow smoothly into one another with no visually jarring transitions. The overall shape of this unit would be formed by three tangentially intersecting arcs having identical radii (bottom left drawing, facing page). Two concave curves—the ends of the window—would meet the ends of a single convex curve—the window's center arc. The window would measure 12 ft. end to end and 2 ft. from the sill to the apex of the center arc.

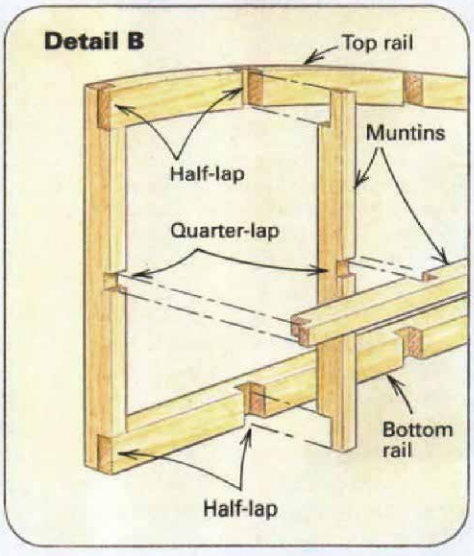
We began by drawing a full-scale pattern of the window's perimeter (representing the entire unit with the casing installed) on ¼-in. lauan plywood. Jim Garry, a member of my crew who has lots of shop experience, laid out the curves with a long trammel. It took some work to find a combination of centerpoint locations that produced the right shape with the proper dimensions.

Next came my turn. I got the profiles of the three sashes by drawing a series of lines parallel to the inside of Carry's pattern. These lines represented the lower edges of the casing, head jamb and window stop, as well as the curved top

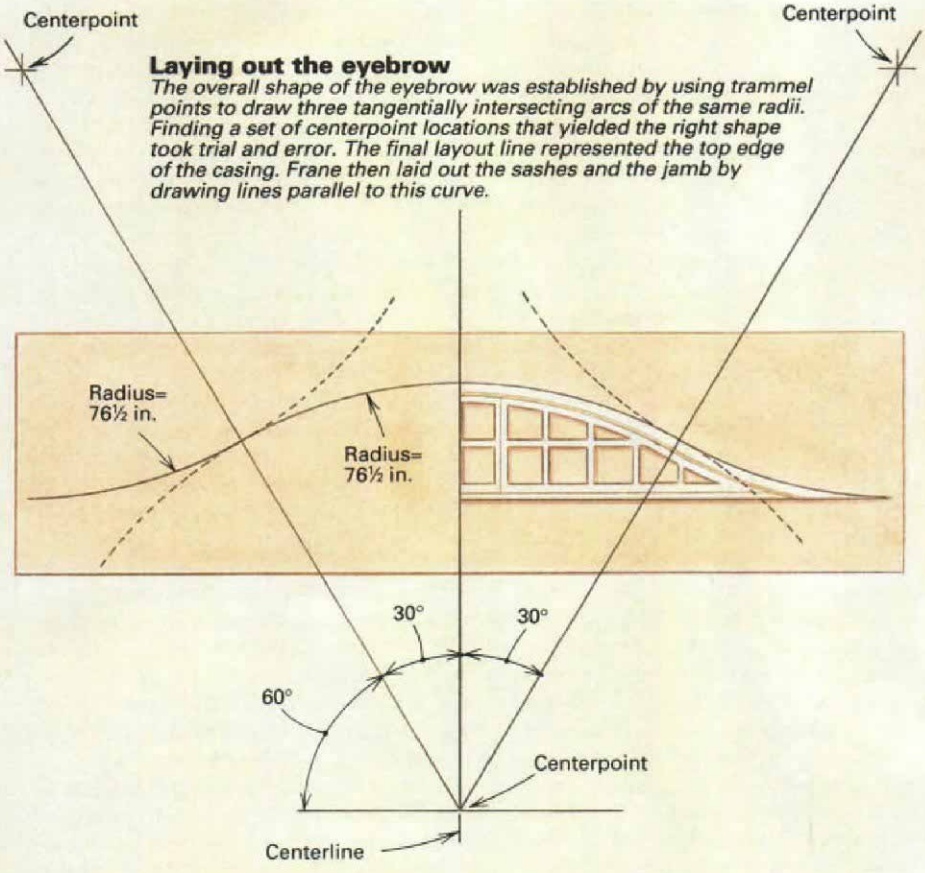
**Lap joinery** (viewed from back of window)
*Using lap joints instead of traditional cope-and-stick joinery significantly cut the time required for assembly. The laps were as strong as the traditional method and were indistinguishable from the joinery used on the rest of the home's windows.*



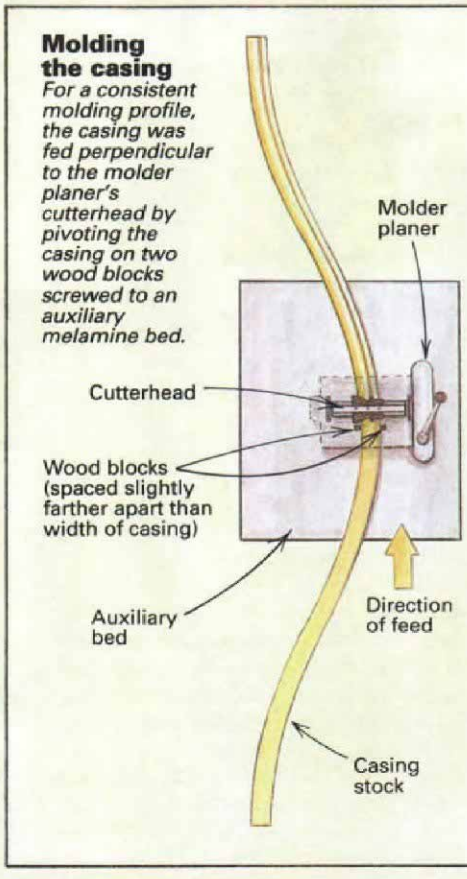



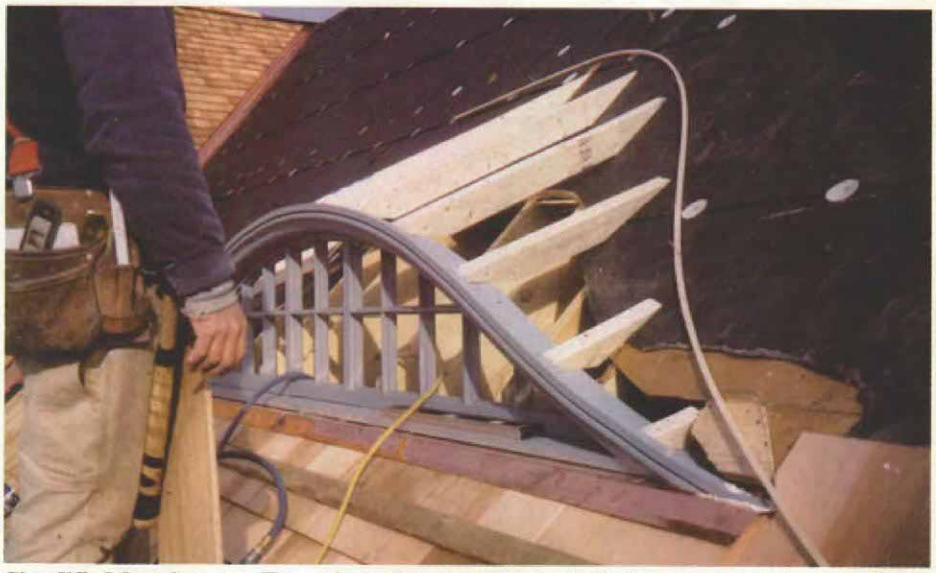

**Laying out the eyebrow**
*The overall shape of the eyebrow was established by using trammel points to draw three tangentially intersecting arcs of the same radii. Finding a set of centerpoint locations that yielded the right shape took trial and error. The final layout line represented the top edge of the casing. Frane then laid out the sashes and the jamb by drawing lines parallel to this curve.*



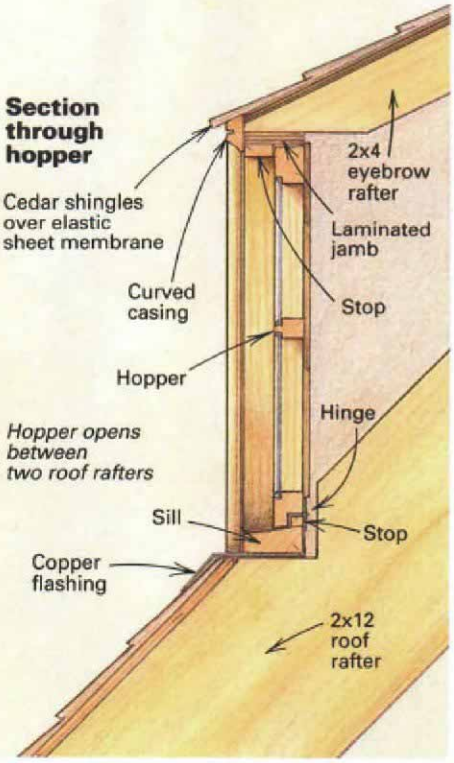

**Molding the casing**
*For a consistent molding profile, the casing was fed perpendicular to the molder planer's cutterhead by pivoting the casing on two wood blocks screwed to an auxiliary melamine bed.*




Drawings: Bob Goodfellow

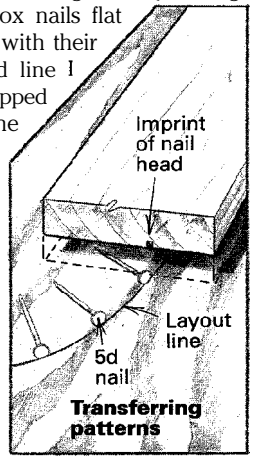


***Simplified framing, too.*** **The eyebrow dormer was framed with 2x4 rafters, and the curved jamb was used as a header. Because the window looked out from an unfinished attic, the roof rafters behind it could be left intact. A pine batten is being used here to lay out a fair curve on the main roof.**




rails of the sashes. I generated each line by making a series of pencil marks the proper distance down from Garry's curve, bending a thin wooden batten so that one of its edges touched all the marks, then connecting the marks with a pencil line scribed along the batten. At the bottom of the pattern, I drew straight lines for the sill and the lower sash rails, then drew in the muntins.

**Making curved sashes**—The first step in making the curved top rails of the three sashes was to transfer our curves from the lauan pattern to the solid white-pine sash stock. To do this, I borrowed an old boat-building trick (drawing below). I laid 5d box nails flat on the pattern stock with their heads on the curved line I wanted to transfer. I tapped the nail heads into the lauan so that they wouldn't move, then carefully lowered the sash blanks onto the pattern and tapped down on them to make an imprint of the nail heads on the blank. Then I drew lines through these marks, roughed out the blanks on the bandsaw and smoothed them with a spokeshave.




**Transferring patterns**

Assembling the blanks into sash frames was straightforward. I simply laid the blanks on the pattern, ticked off the intersections of the stiles and the rails on the sashes and cut my half-laps with a dado head on the radial-arm saw. On curving cuts, I roughed out the rabbets with the dado head and finished them with a chisel. Routing would have been more precise, but it also would have required more setup time and would have given me a better job than I needed in this case.

I glued all the pieces together with an epoxy adhesive. For this job I used Chem-Tech's T-88 (P. O. Box 70148, Seattle, Wash. 98107; 206-783-2243). This product is as thick as honey and harder to use than many other epoxies. But we were working in an unheated shop and T-88 is the only epoxy I know of that will set at temperatures down to 35 ° F.

I glued the half-lapped stiles and rails together on top of the full-size pattern. Clear plastic sheeting placed between the sash and the pattern kept the two from being glued together. The sashes were to be paint grade, so instead of clamping the joints, I simply drove long drywall screws with washers through the joints and the lauan pattern and into the underlying wooden table.

When the epoxy set, I removed the screws and cleaned up the excess epoxy (the screw holes would be puttied later). Then I transferred the muntin locations from the pattern to the new sash frames. My preferred tool for dadoing the half-laps would have been the radial-arm saw, but our saw didn't have enough throw to reach across the sashes. Instead, I made multiple cuts with a Porter-Cable trim saw, then cleaned out the dadoes with a chisel. Dropping the vertical muntin bar stock into these dadoes, I then marked the locations where the horizontal muntins would intersect vertical muntins, stiles and rails. Because the horizontal muntin at each end of the window would intersect a half-lap on the top rail (detail A, previous page), I decided to install all of the horizontal muntins using quarter-laps instead of half-laps. I cut these quarter-laps by running the entire sash frame through the table saw, keeping the bottom of the sill against the rip fence. After testing for fit, I glued the muntins to the sash frames. Using a rabbeting bit in a laminate trimmer, I then cut rabbets on the exterior of the window to accept the glazing and the putty. The rabbets were squared with a chisel. On the interior, I used the router to cut an ovolo profile around each lite opening (hardly anyone will ever see this, but it made me feel better). Now it was time to make the sill and the jamb.

**Beveled sill, curved jamb**—Making the sill and the jamb was the simplest part of the job. The sill is a single piece of 1½-in. thick pine ripped and beveled on the table saw. Because the sill would butt against the head jamb at both ends, I marked the end cuts of the sill by tacking the sashes to the sill and projecting the curvature of the jamb across the edges of the sill. Then I removed the sashes, cut the sill on the bandsaw, reattached the sashes and turned my attention to the jamb.

I laminated the jamb out of three 4-in, wide by ¼-in. thick strips of pine. Instead of building a separate laminating form, though, I used the tops of the sashes themselves. With the help of Don Pascucci (who would frame the unit onto the roof), I nailed the first lamination to the tops of the fixed sashes, then epoxied and nailed the successive laminations over it. After the glue set, I planed the rough edges of the jamb with a portable power plane, then trimmed its ends flush with the bottom of the sill.

Finally, I nailed a curved 1x1 pine stop to the top jamb. Because the stop would show a mere ¼-in. reveal beneath the top casing, I bent the stop by cutting a series of cross-grain 7/16-in. deep kerfs in its backside. Epoxy secured it to the jamb, and putty filled the kerfs.

**Milling reverse curves**—Carry made the casing from 5/4 stock. After transferring the curves from the pattern to the stock, he cut his pieces and joined them into a single casing blank using long scarf joints and epoxy. The pitch of the scarf must be 1-in-12 or less; otherwise you're just gluing end grain, and the joint won't hold.

Of course, the main challenge posed by the casing was that, unlike the rest of the window, there was no way to escape having to mold a profile on it. We had run plenty of curved stock

## *Where to buy eyebrow windows*

**The following companies offer either stock or custom windows that can be used for eyebrows. This is not a complete list, however. You should also check with your local suppliers or contact the following trade associations: The National Wood Window and Door Association (708-299-5200) consists of window and door manufacturers. The National Sash and Door Jobbers Association (708-299-3400) consists of window and door distributors.**
**— *Mark Feirer, editor of* Fine Homebuilding.**

**Andersen Windows, Inc.**
100 Fourth Ave., North Bayport, Minn. 55003-1096
(800) 426-4261
Low-e, argon-filled round-top and elliptical units. Wood or vinyl-clad. Extension jambs available. Laminated and curved trim available.

**Atrium Door & Window Co.**
P. O. Box 226957, Dallas, Texas 75222-6957
(800) 527-5249
Half-rounds, pre-finished (primed line will soon be available), true divided lite or snap-in grills. High-performance glazing (HPG).

**Caradco**
P. O. Box 920, Rantoul, III. 61866
(217) 893-4444
Half-round, elliptical and quarter-round windows. Custom windows also available. Aluminum-clad or primed wood exteriors. Natural wood interiors. HPG.

**Crestline**
One Wausau Center, P. O. Box 8007, Wausau, Wis. 54402-8007
(800)552-4111
Stock and custom. HPG. Wood and clad.

**Dash Wood Industries, Ltd.**
Box 10, Centralia, Ont., Canada NOM 1KO
(519) 228-6624
Aluminum-clad, vinyl-clad, encapsulated. Bare wood and primed.

**DF Windows**
Donat Flamand, Inc., 90, Industrielle St., Saint-Apollinaire, Que., Canada GOS 2EO
(418) 881-3974
Wood round-tops and half-rounds.

**Hurd Millwork Co., Inc.**
575 S. Whelen Ave., Medford, Wis. 54451
(800) 2BE-HURD
Standard sizes in half-round, quarter-round and ellipse. Custom sizes and shapes available (aluminum-clad or primed wood). HPG.

**JJJ Specialty Co.**
113 27th Ave., N. E., Minneapolis, Minn. 55418
(612) 788-9688 or (800) 445-6736
Wood and aluminum-clad windows. Elliptical and round-top windows. True divided lite or single lite with grill. Custom sizes only.

**Kolbe & Kolbe Millwork Co., Inc.**
1323 South 11th Ave., Wausau, Wis. 54401
(715) 842-5666
Round-top, half-round windows. Laminated jambs. Stock and custom. True divided lite and single lite with grill. Any wood species available in custom line.

**Lincoln Wood Products, Inc.**
P. O. Box 375, Merrill, Wis. 54452-0375
(715) 536-2461
All units are custom. Aluminum-clad (four colors) or unfinished. Round-top or quarter-round. HPG. Tinted or tempered glazing available.

**Loewen Windows**
1397 Barclay Blvd., Buffalo Grove, Ill. 60089
(800) 245-2295 or (708) 215-8200
Stock and custom. Wood and clad. HPG.

**Marvin Windows**
P. O. Box 100, Warroad, Minn. 56763
(800) 346-5128
Custom and standard round-tops. Aluminum-clad or unfinished. True divided lites or single lite with grill. Pre-finished in standard colors.

**New Morning Windows, Inc.**
11921 Portland Ave. South, Burnsville, Minn. 55337
(612) 895-6175
Custom with any glazing. Wood and clad.

**Norco Windows, Inc.**
P. O. Box 140,811 Factory St., Hawkins, Wis. 54530-0140
(800) 526-3532 or (800) 826-6793 (Wis.)
Half-round, custom and stock windows. Unfinished or primed wood exterior.

**Peachtree Doors and Windows, Inc.**
Box 5700, Norcross, Ga. 30091
(800) 477-6544
Custom. Aluminum or wood. HPG.

**Pella Windows & Doors/Rolscreen Co.**
102 Main St., Pella, Iowa 50219
(515) 628-1000 or (800) 524-3700
Stock round-tops. Aluminum-clad and finished or unfinished wood. Standard and custom colors.

**Pozzi Window Co.**
P. O. Box 5249, Bend, Ore. 97708
(800) 821-1016
Custom and stock half-rounds. Wood (single lite or true divided lites) or wood-clad. HPG.

**Wenco**
P. O. Box 259, W. Main St., Ringtown, Pa. 17967
(800) 255-7743
Stock and custom units. Aluminum-clad or unfinished wood. HPG and tempered glass available.

**Zeluck, Inc.**
5300 Kings Highway, Brooklyn, N. Y. 11234
(718) 251-8060, ext. 89
Custom windows only. Various woods, including mahogany, teak, walnut and cherry. HPG.

through our Williams & Hussey molder/planer in the past, but this casing was different. Making molding requires that the stock be fed straight into the cutterhead. With simple, curved pieces, the usual technique is to register the stock against curved guides. But the curves on the eyebrow casing reversed direction twice. Carry's low-tech solution was to free-hand the blank through the molder/planer by pivoting it on two wood blocks that he had screwed to an auxiliary melamine bed (bottom right drawing, p. 73). Carry positioned the blocks on the infeed side of the cutterhead, letting him use the blocks as he would the guide pins on a shaper table. The result wasn't furniture grade, but it was up to snuff as exterior architectural millwork. The casing was applied to the window, everything was sanded and primed, and the hardware was affixed to the operating sash. We were ready for installation.

**Framing the dormer**—At this point, Pascucci took over. Because the window would look out from an empty attic, the only headered opening needed was behind the operable hopper sash; full rafters would run behind the rest of the unit (for more on framing a full eyebrow dormer, see *FHB* #65, pp. 8084). All the rafters above the window were painted black so that they wouldn't be visible from the street. Pascucci's framing technique let him support the window on seat cuts made in the top edge of the existing rafters (top drawing, facing page). Using a pine batten, Pascucci then drew in a fair curve corresponding to the intersection of the eyebrow's rafters with the main roof deck (photo facing page).

The dormer framing consisted of short 2x4 rafters that were screwed to the window's head jamb at one end and to the main roof at the other end. Sheathing this was a bit tricky. Because the -in. plywood we used elsewhere wouldn't make the necessary bends, Pascucci used three layers of ¼-in. lauan instead. The lauan was applied in overlapping strips because full sheets could not easily conform to a compound curve. Fortunately, our roofer was able to blend the eyebrow dormer's cedar shingles into those of the main roof. The shingles were applied over an elastic-sheet membrane to keep any water that backed up under the shingles from leaking into the attic. At the junction of the two roofs, copper step flashing was hidden between courses in what was, in essence, a woven valley. This meant carefully choosing pliable shingles and, when that wasn't enough, boiling them. □

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