Making a Curved Handrail

With the stairs as a form, laminating commercially available bending rail is easier than it appears

BY JOHN GRIFFIN

Store-bought bending rail. Beads and grooves align the laminations, while softwood molds protect the rail from the clamps during glue up.

L-shaped brackets clamped to the stair make up the bending form. Sandpaper stuck to the brackets' bottoms improves their grip. Plywood protects the treads.

Begin with a dress rehearsal. With the unglued laminations bundled, the crew sets the rail in place, choreographing their movements. The rail's center is marked to guide placement once glued, and the clamps are opened to fit the rail.

As an apprentice carpenter, I admired the grace of curved handrails and marveled at the skill necessary to create them (photo facing page). How the stairbuilder bent oak into a rail of the correct shape and floated it so precisely above the stairs that the balusters and newels were plumb and regularly spaced seemed beyond any skills that I might hope to acquire.

Then came the day when two railing installers showed up at a house I was trimming. The skinny, adolescent helper shuttled tools and materials from the van to the house while the boss strolled around chewing an unlit cigar. Three days later, they were gone, leaving behind a couple of soggy cigar butts and a gorgeous balustrade.

Simply seeing the bending rail stock took much of the awe out of curved stair rails. Imagine a standard handrail ripped into thin, flexible strips (inset photo, facing page). Glued and clamped to forms set on the stair, the strips solidify into a rail that follows the stair's curve.

Baluster position determines the centerline of the rail

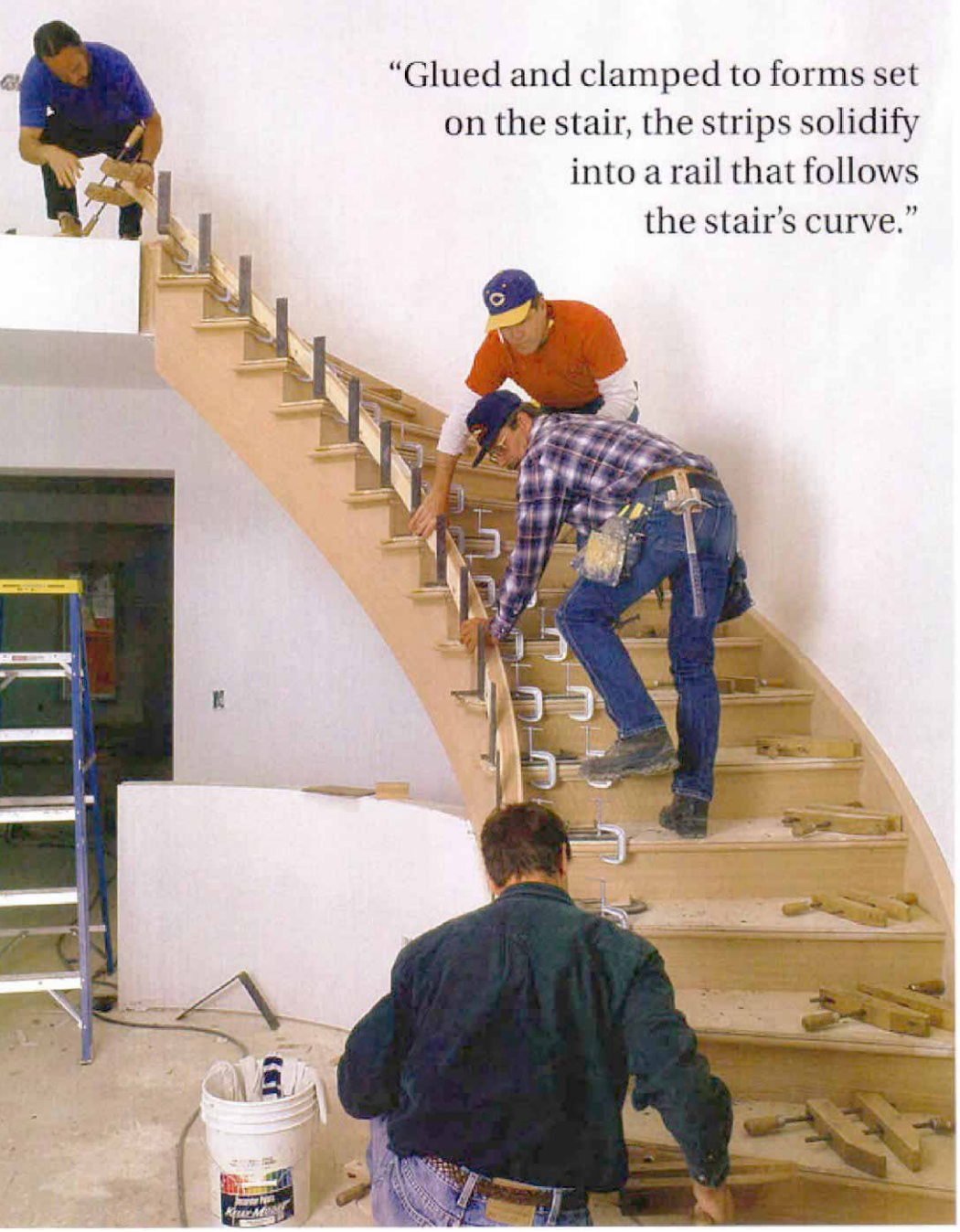
I buy bending rail from a local supplier, R. W. Specialties (800-332-6682), but Coffman (540-783-7251) and L.J. Smith (740-269-2221), both nationally distributed stair-parts manufacturers, also make bending rail. The bending rail that I use comes in several profiles that match standard straight railing. Each lamination has a bead milled in one side and a groove milled in the other. Adjacent strips interlock to keep the laminations in line during glue up. Bending rail is available with varying numbers of laminations. The more laminations, the thinner and more flexible each layer is. So the tighter the stair's radius, the more laminations needed for the rail to bend without breaking. For a 5-ft. radius such as this stair has, I used a 2¼-in. wide rail composed of six laminations. For radii down to 30 in., seven laminations will get a 2¼-in. wide rail around the bend.

Also included with most bending rails are bending molds. These softwood strips are milled with a negative of the railing's profile on their inside. Bending molds go outside the rail during glue up to protect the rail and to give the clamps purchase.

The first step in bending a rail is laying out the baluster locations. Traditionally, the face of the first baluster on each tread aligns with the face of the riser below. The sides of all balusters should line up with the face of the

Once glue up begins, you have 15 minutes to clamp the rail. Rollers spread the glue, and helpers stack the glued-up laminations. Plastic shrink wrap will hold the laminations together.

Photo facing page: Ron Ruscio



Clamping proceeds from the middle to the ends. Clamps hold the rail to the forms and keep the rail's bottom flat to the tread nosings. The crew watches for voids and adds clamps as needed.

After 24 hours, the rail is unclamped from its forms. The rail is placed on horses for preliminary smoothing. Scraping and belt-sanding remove most of the glue squeeze out.

finished stringer. This step keeps the holes drilled in the stair to fasten the balusters solidly in the treads. I typically space the balusters on centers equal to half the tread depth at the baluster line.

After placing protective pieces of plywood on the treads, I clamp L-shaped brackets to the nosing overhangs (photo top left, p. 75). Once secured in place, these brackets make up the form to which I'll clamp the rail during glue up. I bent my brackets from Win. by 2-in. steel bar stock, but they can also be made from wood. However they're made, they must be rigid enough to resist the tension of bending the rail.

To establish the correct curve, it's critical that the brackets be clamped to the tread tangent to the inside edge of the handrail's bending mold. This line is half the combined thickness of the rail and the bending mold from the baluster centerline.

With all the brackets in place, it's time for glue up

I use Titebond Supreme glue, which is said to be better for ring-porous woods such as oak (Franklin International; 800-669-4583). It has an open time of 12 minutes to 15 minutes, not long, so I like to have at least three helpers for this stage. Franklin makes other glues with longer working times that may be easier to use with bending rails. I haven't tried them because I know Supreme works well and because I hesitate to experiment on a job as involved as a bent rail.

I begin with a dry run (photo top right, p. 75). This step synchronizes everyone, and it allows me to make some index marks on the rail to position it at the top and bottom of the staircase. During glue up, I begin clamping in the stair's middle. Without these index marks, it's possible to end up with one end of the rail too short and the other end beyond the forms. If that happens, there is no convenient way to continue curving the rail, and you have a fine mess. When bent, the rail stock should extend about 6 in. beyond each end of the stair to allow for trimming.

During the dry run, I lay all the necessary clamps on the treads and open them up to the proper width so that they're ready to go once the glue is spread. After the dry run, I take the bending rail from the forms and lay it on sawhorses, bead side up, with the two outside laminations good side down (photo bottom right, p. 75). I pour the glue into a paint tray, and using small disposable rollers, I paint one side of all but the last outside lamination with glue. I use plenty of glue and don't worry about squeeze out; a glue-starved area spells disaster. Then I stack the

Temporary posts hold the rail in its correct position. The range of acceptable rail height is marked on the posts' top. Once the posts are plumb, hand screws act as ledgers to register the rail's height, allowing it to be removed and replaced as needed.

Locating the starting newel. The volute is lined up on the rail by eye. With the newel plumb and with the volute eyed up, the newel location is then scribed to the tread.

pieces—bending mold, laminations and bending mold—finally shrink-wrapping the stacked rail in several places. This step helps to hold the rail together while it's being carried to the stair and clamped.

With the glued-up rail on the stair, two people clamp it to the forms, starting from the middle, while another two pull and twist the ends of the rail into alignment (top photo, facing page). It's important to press the railing tightly to each tread as you clamp. The rail's bottom should make full contact with the tread nosings. If only one point on the rail touches the nosings, the rail is twisting, and the bottom of the rail won't be level when it's installed. Joining a twisted rail to fittings such as volutes or goosenecks is much harder.

I check for voids between the laminations both top and bottom, and add clamps wherever necessary.

After 24 hours' drying time, the rail can be undamped. I move it back to the sawhorses (bottom photo, facing page) and remove most of the dried-glue squeeze out with a sharp scraper and 80-grit sandpaper in a belt sander. Final profile and joint sanding happen later, after the fittings are attached.

Support the rail in its final position to find the cuts for the fittings

The stair rail on this project intersects a balcony rail at the top, so the height of the top newel was determined by the height of the balcony guardrail (36 in.). Just as it would have done with a straight rail, the balcony rail passes over the newel higher than the stair rail. A standard two-riser gooseneck makes up the difference. At the bottom, this stair had a bullnose step, so the rail begins with a volute.

Setting the starting newel for a curved rail is a bit different than for a straight rail, as is my approach to marking the volute and gooseneck fittings for their cuts (for more on setting newels, see *FHB* #121, pp. 94-99). Unlike straight rail, where all cuts are square to the rail's side, cuts made to join curved rails and fittings are square to the radius's tangent. Because the rail parts curve in from the tangent, the cuts are made at a slight angle. A compound-angle cut on a helical-shaped rail is difficult to lay out exactly the first time, and some fussing is called for. Al-

SNEAKING UP ON A PERFECT CUT

1. Eyeballing where rail is tangent to volute. The author marks these points on the volute's top and bottom.

2. Steady help is critical. The volute is blocked up so that the tangent points align with the chopsaw blade.

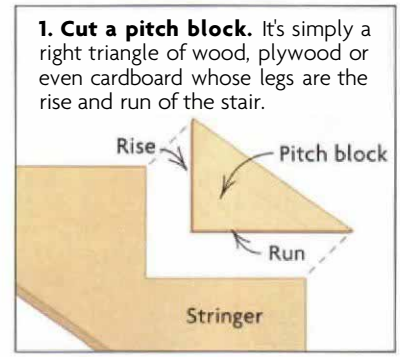
3. Transferring the cut to the rail. With the volute set atop the newel, the cut angle is transferred to the rail.

4. The author plumbs the rail while his helper checks the fit. It can take several trimmings to get it perfect.

Marking a volute on the bench

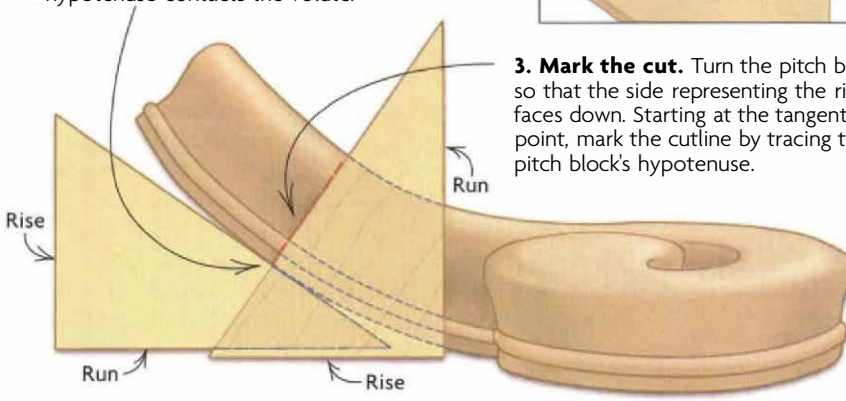
If you're not comfortable eyeballing the cuts on a $100 volute, as discussed in the text, here's an alternative. These techniques also work on goosenecks, but the positions of the pitch block are reversed.

1. Cut a pitch block. It's simply a right triangle of wood, plywood or even cardboard whose legs are the rise and run of the stair.



2. Mark the tangent point on the volute. Working on a flat surface, mark the point where the pitch block's hypotenuse contacts the volute.

3. Mark the cut. Turn the pitch block so that the side representing the rise faces down. Starting at the tangent point, mark the cutline by tracing the pitch block's hypotenuse.



though I might simply lay a straight rail on the tread nosings to mark the fitting cuts, I temporarily suspend a curved rail in its final position to locate the newel and to find the correct cut angle for the fittings.

To suspend the rail, I leave at least three brackets on the stairs, one top, one bottom and one center, I clamp some scrap-wood posts, with the range of allowable handrail height marked on them, plumb to these brackets (photos left, p. 77). (Where I work, the Uniform Building Code requires a handrail height between 34 in. and 38 in. from the tread nosings.) The bent rail is clamped to the posts in the middle of the rail-height range.

Because the curve of the glued-up handrail relaxes a bit after it's undamped, I brace the posts plumb to keep the rail true. The rail will be clamped and undamped several times for cutting and test-fitting. Once I've established the height, I affix hand screws to the temporary posts to support the rail at the correct height as it's removed and replaced.

I use square-bottom starting newels long enough to penetrate the bullnose step and reach the floor. Normally, I use the template provided with the volute. In this case, however, the starting step narrowed so that this template wouldn't work. To locate this starting newel, I set the volute on it temporarily. Then I rested the newel plumb on the starting step. This process placed the volute above the rail, and I lined up the volute on the rail by eye (photo right, p. 77). When I got this right, I scribed the newel location to the tread and jigsawed the hole for the newel.

Using a bull's-eye level to check for level, I again set the volute atop the newel and the newel on the tread, but behind its hole. I rotate the volute so that its up-easing parallels the rail. With the rail and volute lined up, I can eyeball them from the side and mark where their tops and bottoms intersect (photo top left). These marks establish the cut on the volute. I then cut the volute on a chopsaw (photo top right). For another method of marking volutes, see the drawing (left).

At this point, the newel is still too long and will need trimming for its final height. I set the newel temporarily in its hole, with the volute on top. By measuring the difference in height between the volute and the rail, I can now see if the newel requires trimming. Sometimes, I can adjust the rail height up or down to meet the volute fairly; other times, I must trim the newel's height. If raising the rail, I'm careful to check that the balusters I have are not now too short. Also, if I change the rail height here, I do so on the other posts as well to keep things uniform.

Drawings: Dan Thornton

With the newel set, I again put the volute in place. Using a combination square, I transfer the cut angle from the volute to the rail (photo bottom left, facing page). With a helper, I remove the rail to the chopsaw and make the cut. Then I return the cut rail to its place and check the joint's alignment (photo bottom right, facing page). Odds are it's not perfect yet, and I'll mark the needed adjustments, disassemble the rail and recut. This way, I sneak up on a perfect fit a hair at a time.

Temporarily assemble the volute-to-rail joint

Once I've mated volute to rail, I take them down to drill them for rail bolts. I don't glue the joint yet, however, because it may be necessary to realign these components later.

I install the gooseneck at the balcony newel the same way as the volute (photo below left). Marking the cuts involves setting the horizontal surface of the gooseneck on the newel dead level while holding the up-easing (the curved portion) alongside the rail. Again, I like to sneak up on the cuts. Patience making these cuts beats replacing a miscut fitting.

Once I'm sure the gooseneck fits as it should, I mark index lines across the joints and disassemble them. The joints are then glued and the rail bolts tightened. I also install all the plugs to cover the bolt holes in the bottom of the rail. Working with the rail on sawhorses, I smooth the joints in preparation for final installation.

When fastening this assembly to the newels, I coat the inside of the holes on the bottom of the fittings with glue rather than coating the dowel pins on top of the newels. This step keeps glue from smearing the bottom of the fittings or dripping down the newels. Once the rail is glued to the newels and reclamped to the center brace halfway up the stair, it's time to work on the balusters.

Double-ended lags hold balusters to treads

Baluster installation is the same as with a straight rail. I plumb up from points marked on the treads, using an L.J. Smith Telescoping Baluster Marking Tool, and mark the rail.

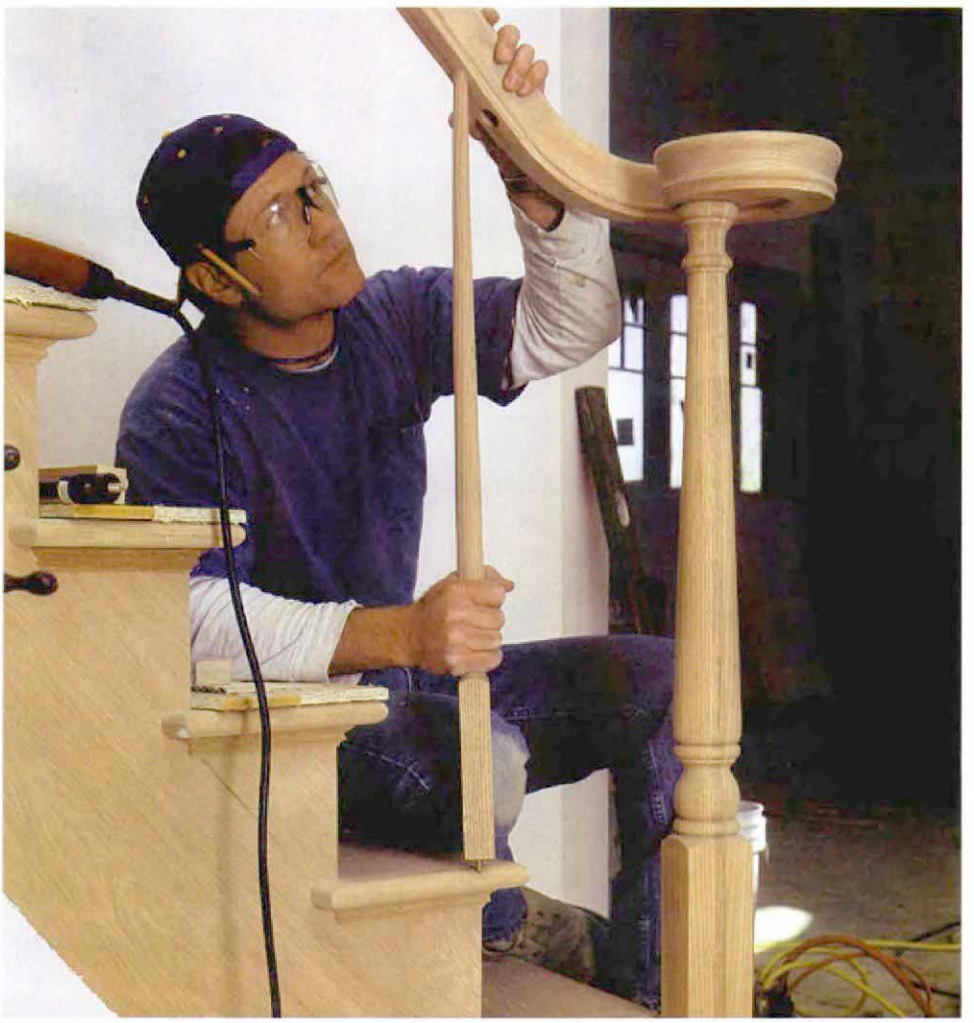
I used to drill holes in the treads to receive the pins on the balusters' bottoms. No more. I cut off the pins and drill a pilot hole in each baluster for a 5/16-in. by 2½-in. lag that's threaded on both ends (photo below right). L.J. Smith also makes the Centaur Drill Guide, which quickly centers a drill over the bottom of standard-size balusters. Corresponding holes are drilled in the treads.

The holes drilled in the underside of the rail must be deep. This way, I can slide the untapered baluster tops far up into the rail so that the lags in their bottoms can swing into place over the hole in the tread. Once a baluster is threaded tight to the tread, I shoot a 1¼-in. brad through its top into the handrail to prevent any movement or raiding.

Final sanding and detailing are done with chisels and progressively finer grits of sandpaper. A professional finish requires running your hand up and down the handrail to check for flaws. As every finish carpenter knows, elbow grease and patience are absolute necessities if the finished product is to be a pleasure both to see and to feel. ☐

John Griffin is a finish carpenter in Louisville, Colorado. Photos by Andy Engel, except where noted.

The gooseneck at the balcony is marked much like the volute. With the author holding the fitting level, his helper marks the cut where the rail and fitting meet.



Double-ended lag joins baluster and tread. With the holes in the rail drilled extra deep, the author inserts the balusters, positions the lag over the tread and twists the baluster home. Pneumatic nails will secure balusters to the rails.