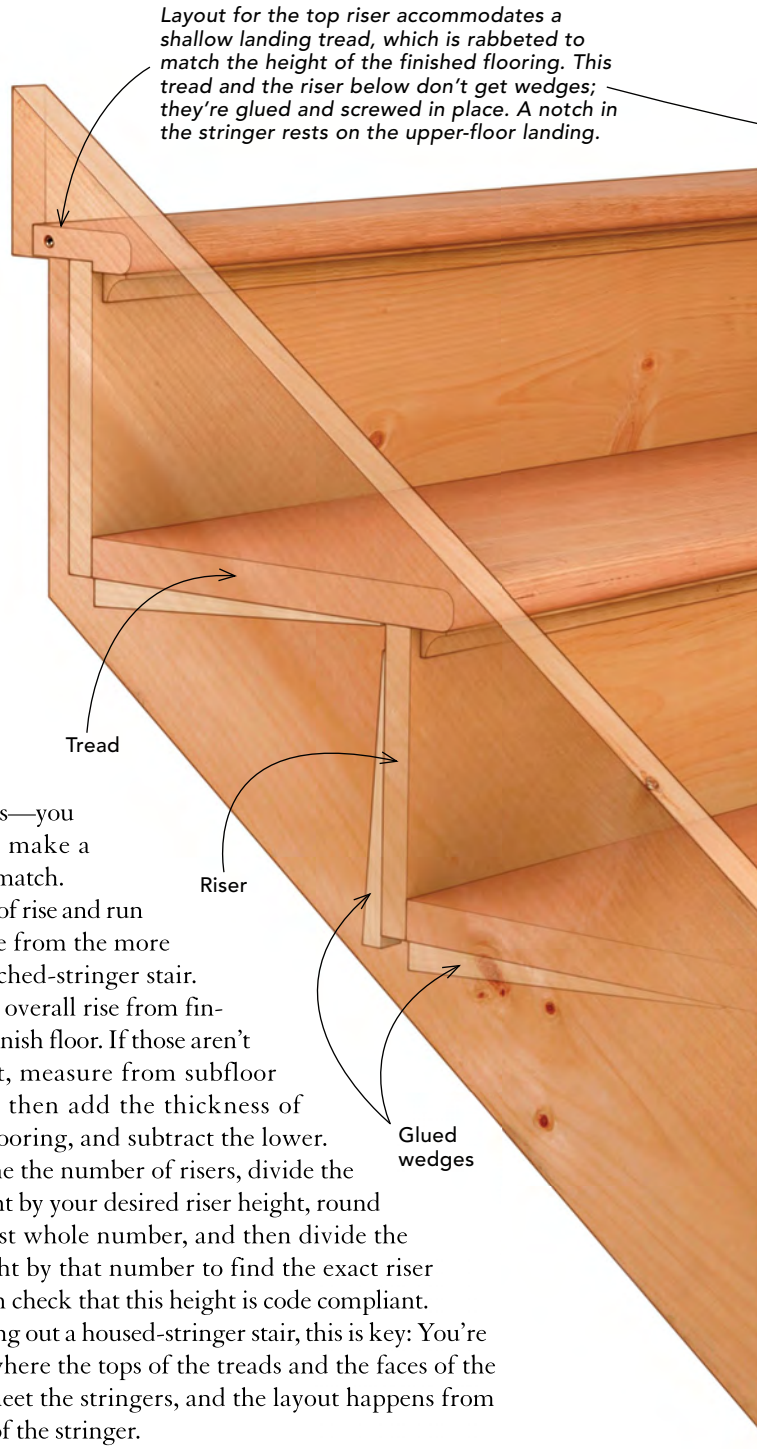
Shop-Built Housed-Stringer Stairs

Building in the shop makes assembly easier on the carpenter

BY ANDY ENGEL



Forgive the pun, but housed-stringer stairs are a step up from standard notched-stringer stairs. Not only are they stronger and less likely to squeak, they're essentially finished as soon as they're assembled.

Housed-stringer stairs rely on mortises cut in the stringers to support the treads and risers. The backsides of these mortises taper, and wedges that match the taper are glued and driven in to lock the stairs into a cohesive unit. From the topside, the assembly looks like it grew together.

I usually build housed-stringer stairs in the comfort of my shop, where I can assemble them on a pair of sawhorses. With the stringers oriented face down at about waist height, it's easy to control glue drips, and everything is reachable from a standing position. When assembling the same stairs in place on site, I have to work from below, which is especially uncomfortable for the lower treads and risers, and it's usually not long before I'm spattered in glue drips.

The keys to the process are a simple router template and a bearing-guided bit. You can make the template, and the ¾-in. pattern router bit is commonly available.

Stringer layout

I usually use 5/4x10 stock for the stringers, but 2x material also works. When I lay out the treads and risers, I try to locate defects such as knots where they won't show in the completed stair. I usually use commercially available treads, but they're easy enough to make. If you make your own, round the tread noses using a ⅜-in. roundover bit so the radius matches that from the ¾-in. pattern bit. Risers are almost always cut from 1x10 boards. That said, the treads and risers can be almost any thickness—you just have to make a template to match.

The basics of rise and run don't change from the more familiar notched-stringer stair. Measure the overall rise from finish floor to finish floor. If those aren't installed yet, measure from subfloor to subfloor, then add the thickness of the upper flooring, and subtract the lower. To determine the number of risers, divide the overall height by your desired riser height, round to the nearest whole number, and then divide the overall height by that number to find the exact riser height. Then check that this height is code compliant.

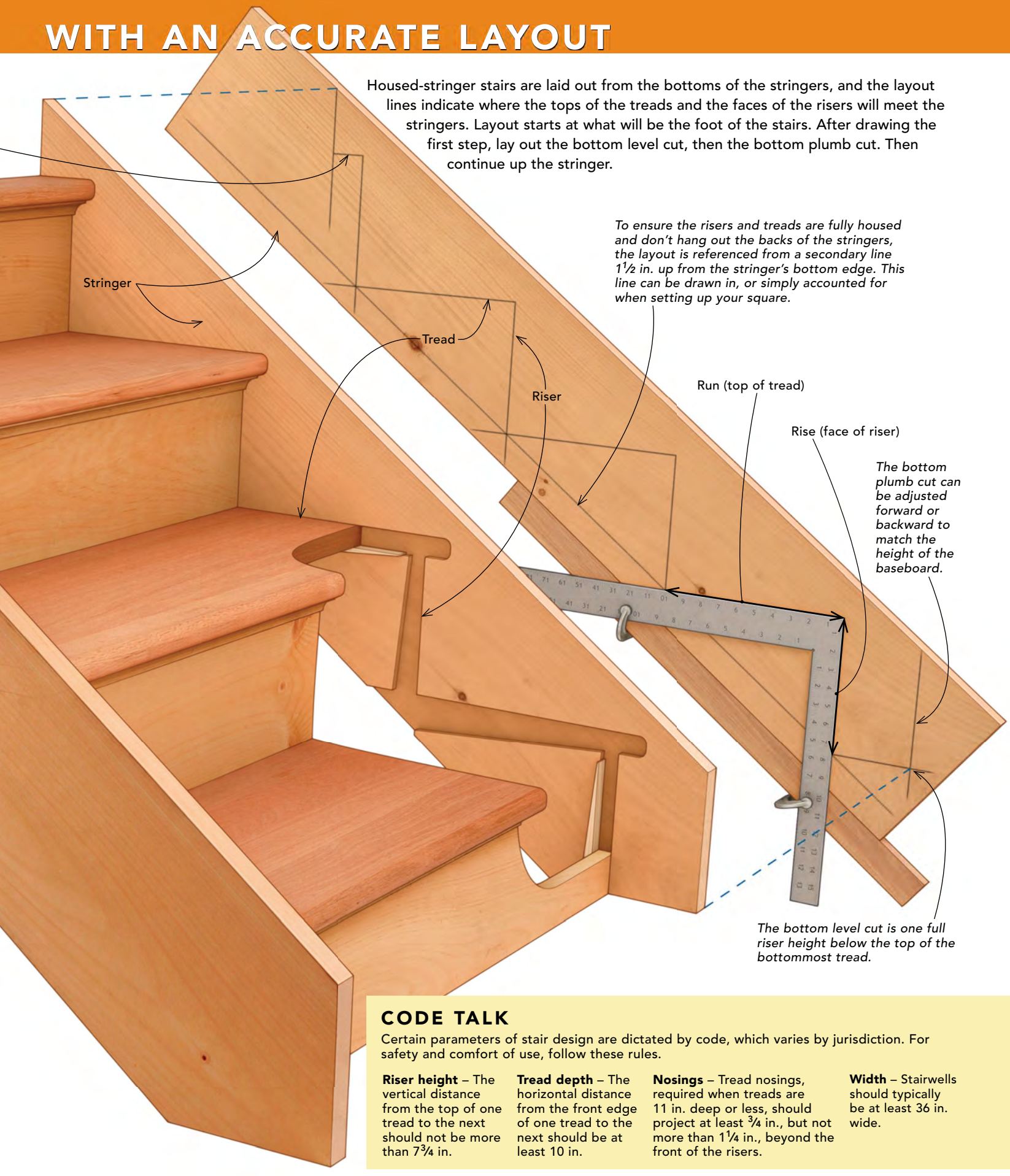
When laying out a housed-stringer stair, this is key: You're laying out where the tops of the treads and the faces of the risers will meet the stringers, and the layout happens from the bottom of the stringer.

To set up my framing square, I first draw a single step in pencil, carefully aligning the rise and run dimensions on the square with the edge of the stringer. It doesn't matter where the step is; this is just for setting up. Once I've drawn the step, I slide the square about 1½ in. forward and along the tread line, keeping it exactly on the line, and clamp a straight piece of scrap wood to the square to lock in the rise and run in this offset position. Moving the square forward moves the layout higher in the stringer, ensuring the backs of the treads and risers are fully housed and don't protrude from the bot-

Drawings: Christopher Mills

WITH AN ACCURATE LAYOUT

Housed-stringer stairs are laid out from the bottoms of the stringers, and the layout lines indicate where the tops of the treads and the faces of the risers will meet the stringers. Layout starts at what will be the foot of the stairs. After drawing the first step, lay out the bottom level cut, then the bottom plumb cut. Then continue up the stringer.



CODE TALK

Certain parameters of stair design are dictated by code, which varies by jurisdiction. For safety and comfort of use, follow these rules.

Riser height – The vertical distance from the top of one tread to the next should not be more than 7¾ in.

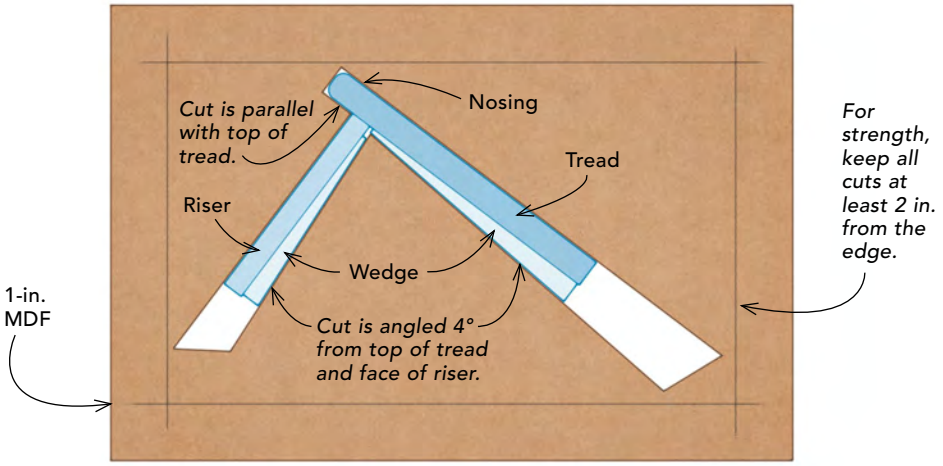
Tread depth – The horizontal distance from the front edge of one tread to the next should be at least 10 in.

Nosings – Tread nosings, required when treads are 11 in. deep or less, should project at least ¾ in., but not more than 1¼ in., beyond the front of the risers.

Width – Stairwells should typically be at least 36 in. wide.

BUILD THE TEMPLATE

The template will be your guide for routing identical mortises in the stringers. It should be 1 in. thick; any thinner than that, and the guide bearing on the router bit may not make sufficient contact with the template while routing.



Cut the wedges. *Set the miter saw's table to 2° and cut with the grain. Flip the board end for end, cut again, and the resulting wedge will have a 4° slope. Use a zero-clearance fence, and mark the width of the wedge's skinny end on the fence for consistency.*

Lay out the template. *Mark a 90° corner to start, extend a box out for the nosing, then use scraps of tread and riser stock along with precut wedges to precisely match the template's taper to the wedges' slope.*

Cut cleanly. *Clamp the template to sawhorses or a sacrificial base, and use a circular saw to make the long cuts for the risers and treads. Don't overcut; stop at the ends of the lines.*

Finish with a jigsaw. *Use a jigsaw to finish the cuts, and to cut out the nosing. Use sharp blades and a steady hand, as the router will follow any errors in the template.*

tom edge of the stringer. To avoid confusion, erase that first step before proceeding.

Before laying out the treads and risers, I check the crowns of the stringers, and face them both up. Then, layout begins at the bottom. After drawing the first tread and riser on the first stringer, I lay out the level cut at the bottom, which is essentially what would have been the top of the next tread down. I lay out the plumb cut about 4 in. in front of the bottom riser, but that can vary if, for example, you want to match its height with the house's base molding. Then I continue moving up the stringer, aligning the rise dimension on the square with the line I drew for the tread below. At the top, I draw plumb cuts flush with the back of the top riser, and with the back of the landing tread. A level cut along the bottom of the landing tread leaves an ear on the stringer that will extend onto the upper floor landing.

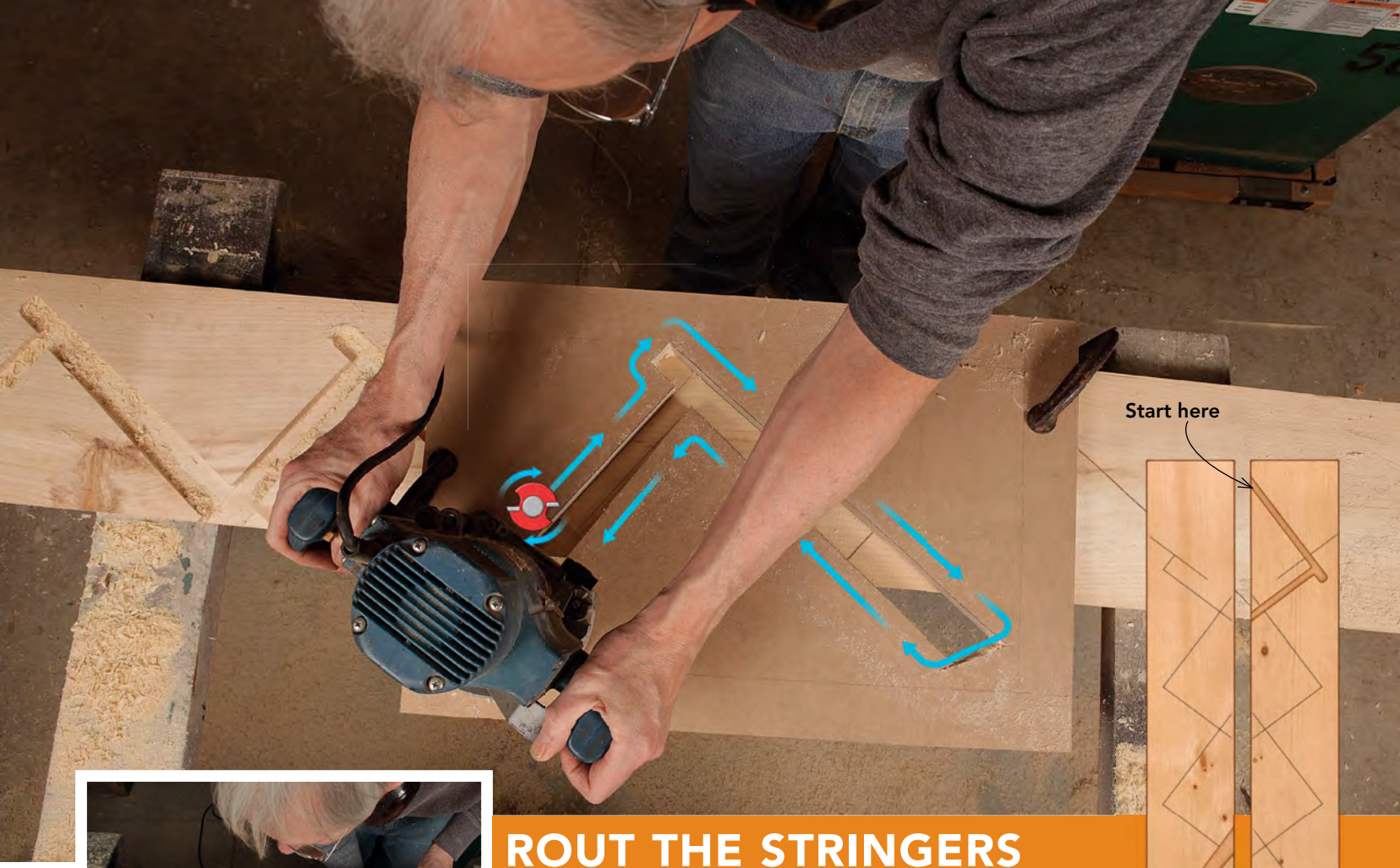
With the first stringer laid out, I place its bottom against the bottom of the second stringer, and use a square and a pencil to draw lines transferring the intersections of the backs of the treads and risers on the laid-out stringer to the blank stringer. These lines help keep the layout consistent between stringers. Then I repeat the layout process on the second stringer.

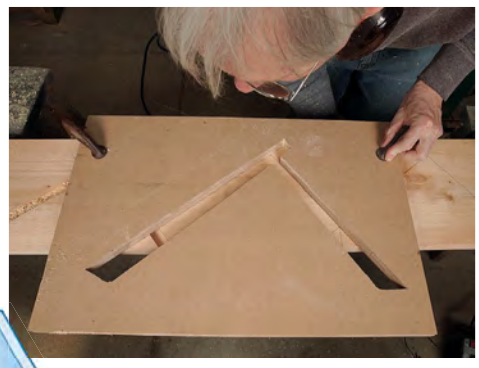
A simple template is the key

One in. is the perfect thickness for the template, and I make mine about 16 in. wide by 24 in. long. I make the blank from two pieces of ½-in. MDF glued together, but plywood or OSB work as well.

Before laying out the template, I cut the wedges so that their angle can be matched in the template. Typically, I make wedges from 1x10 scrap cut to the run dimension of the stairs—about 10 in. or so long—and cut the wedges at a 4° angle. Make the thin end about 1/16 in. thick, and use a zero-clearance auxiliary fence on the saw for safety and accuracy.

Turning to the template, I first draw a border around the blank, about 2 in. from the edge. Keeping the layout inside the border helps ensure a strong template. Layout begins by drawing a 90° corner with the point about 1 in. from the top border and a few inches off center. Extend the lines toward the bottom corners, and at least a couple inches beyond the planned rise and run to provide room for the router to run through the backs of the stringers. These lines represent the face of the riser and the top of the tread, minus the

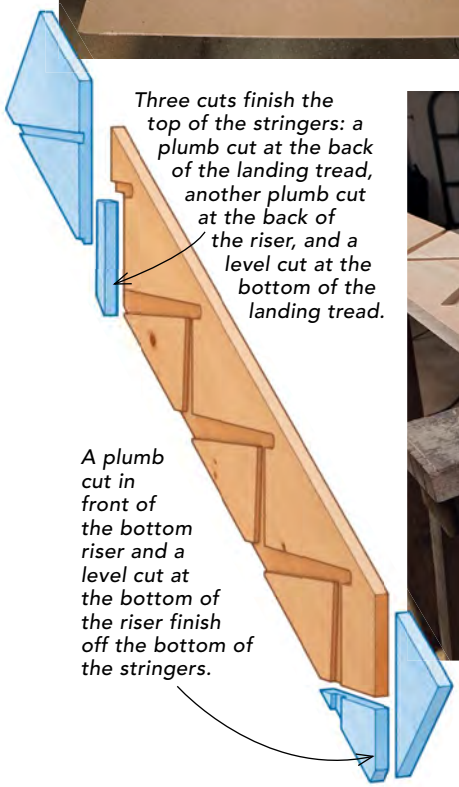




ROUT THE STRINGERS

Position the template. *Align the tread and riser faces on the template with the layout lines on the stringers. Clamp the template securely to the stringers, making sure the clamps won't get in the way of routing.*

Rout the stringers. *Always move the router in a clockwise direction around the template. Rout the right-hand stringer (as viewed from the bottom of the stairs) from top to bottom and the left-hand stringer from bottom to top to avoid blowing out corners that will be visible in the finished stairs.*



Cut tops and bottoms. *Use a circular saw to make the bottom plumb and level cuts, and to start the plumb and level cuts at the top of the stringers. Don't overcut.*

Finish with a handsaw. *Use a handsaw to finish off the level and plumb cuts at the top of the stringers.*

SET THE TREADS

Stand it up. *Stand the stringers backside-up about a tread's width apart on evenly matched sawhorses set on a flat floor. If the treads are bowed, orient the arches up. Fit the bottom tread and topmost full tread in their mortises, and clamp the stringers together top and bottom.*

Check for square. *Measure diagonals from the bottom of one stringer to the top of the other, and adjust the stringers and clamps as necessary until the measurements for both diagonals are equal.*

Start at the bottom. *Working one side of each tread at a time, apply a bead of glue to the bottom of the tread, inside or just to the edge of its mortise. Run a similar bead of glue in the wedge where it will contact the mortise.*

Drive it home. *Insert the glued wedge into the mortise, and hammer it home with a few quick taps. Repeat the process with the topmost full tread and check for square. On long stairs, set a center tread next, then fill in the rest.*

nosing. To add the nosing, extend the tread line out and draw a rectangle. The rectangle's length is equal to the depth of the overhang, and its height is the tread's thickness.

Hold a piece of tread stock with its top edge on the tread line, and, with a wedge in place below it, draw the bottom of the tread section. Repeat that with a piece of riser stock and a wedge for the riser area.

That's the template laid out. I use a circular saw to plunge-cut to the lines, and finish the cuts with a jigsaw. Be careful with this step—any wobbles in your cuts will show up in the mortises you make later. There's no shame in clamping a fence to the nascent template to guide your cuts.

Mortise the stringers

With 5/4 stringers, I rout the mortises ⅜ in. deep—enough to get a good glue joint and still leave some structural meat in the stringer. With thicker stringers, I'll mortise to ½ in.

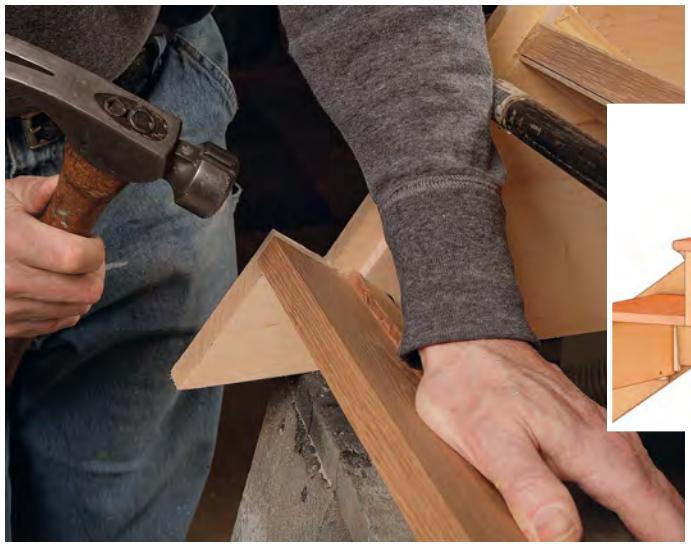
Align the template with the layout lines on the stringer, then clamp it in place. Rout in a clockwise direction, working the right stringer (viewed from the bottom of the stair) from the top down, and the left stringer from the bottom up, to avoid chipping out the short grain where the tread backs and riser faces intersect.

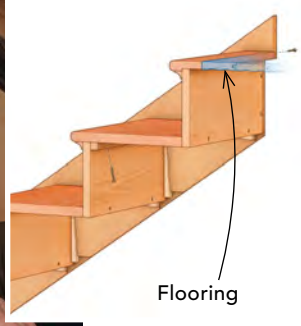
After the mortises are cut, use a circular saw to make the plumb and level cuts, cutting downhill on the grain. For example,

Trim to fit. *Before the glue sets, use a chisel to trim any riser wedges that intrude into adjacent riser mortises.*

Trim to length. *Use a handsaw to trim the long back ends of the wedges flush with the backs of the treads.*

Special treatment at the top tread





The rear portion of the landing tread sits on the subfloor, and is rabbeted the thickness of the finish flooring to sit flush with it. The landing tread doesn't get wedges. Instead, run small beads of glue in the mortises, drill countersunk pilot holes through the stringers and into the landing tread, and fasten with screws.

when making the plumb cut at the bottom, cut from the top of the stringer toward the bottom. This ensures that the wood fibers are supported by longer fibers ahead of them and minimizes tearout. Hit the stringer up with 100-grit paper in a random-orbit sander to clean up any stray pencil marks or tearout.

Cut risers and treads

To determine the riser and tread width, reverse engineer from the stairwell width. A typical well might be 40 in. between the studs. Allowing 1½ in. for drywall (the extra ½ in. is so that the drywallers can slip sheets down between the stringers and the studs), I would make the stairs 38½ in. outside to outside, with 5/4 stringers and ⅜-in.-deep mortises. The remaining stringer thickness is ⅝ in. on each side, or a total of 1¼ in. Subtracting this amount from the 38½-in. stair width results in a tread and riser width of 37¼ in.

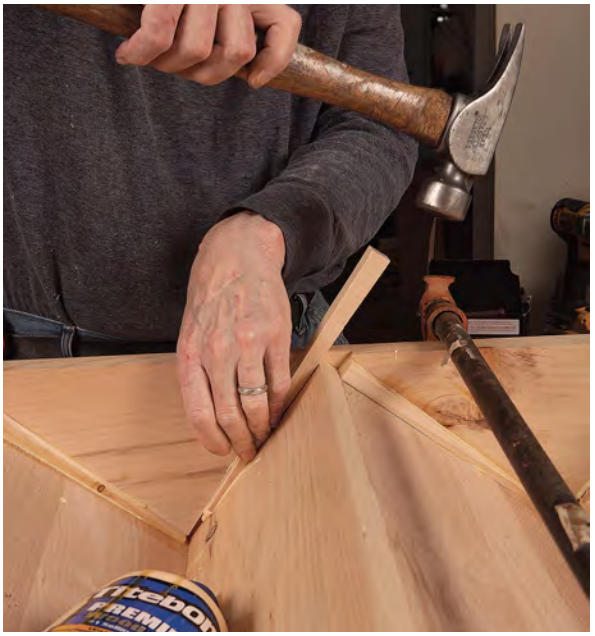
Rip the treads to whatever your run is plus the tread overhang. For a typical stair with a 10-in. run and a 1¼-in. overhang, the treads are all 11¼ in. wide. Most stairs top out with a narrow landing tread, which is rabbeted out to ¾-in. thickness to sit flush with standard hardwood flooring.

All the risers except for the top and the bottom have the calculated stair-riser dimension. The bottom riser will be one tread thickness narrower, and the top riser will usually be

ASSEMBLE THE RISERS, AND TRIM

One at a time. *If the risers are crowned, set them crown-up to match the bow of the treads. The intermediate risers are all the same height as the stair-riser dimension. The bottom riser is one tread thickness shorter, and the top riser is typically ¼ in. taller to tuck into the rabbet in the landing tread.*

Glue the joint. *Before wedging the risers, pull them back from the tread and apply a thin bead of glue to the back of the tread. Immediately allow the riser to fall back to the tread to spread the glue and prevent it from dripping onto the tread.*



Wedge it. *Using the same method as before, apply glue to the risers and wedges, and drive them home.*

¼ in. wider in order to tuck into the landing tread's rabbet.

Assemble the stairs

Set the stringers on their top edges on horses, and sight the tops to be sure they're in the same plane so you don't build a twist into the stairs. Align the stringers so they're square with one another and the correct distance apart.

Check the bow of the treads, and always put the arch facing up. Slide the bottom tread in, and clamp above and below it with pipe clamps. Do the same with the uppermost full tread, then check that the clamped assembly is square. On a full set of stairs—13 or 14 risers—I aim to be no more than ⅛ in. out of square.

Now comes the fun part. Smear a whole bunch of wood glue on a wedge, and tap it into the mortise at the bottom tread. As you drive it in, keep an eye on the back of the tread to be sure it stays flush with the face of the riser mortise. The wedge is in far enough when you can't hammer it in further. Repeat this on the other side of the tread, then wipe up excess glue before repeating the process on the upper tread. On longer stairs, I like to set a center tread at this point, and then proceed to set all the treads. The landing tread gets attached with screws through the stringer into its end grain.

Once the treads are set, chisel away any wedges that have intruded into the riser

Screw it. *Drive one 1½-in. screw per foot of tread width through the back of the riser and into the tread.*

Cut the excess. *Just as before, use a handsaw and chisel to trim the riser wedges flush with or a bit below the stringers.*

Special treatment at the top with risers

Like the landing tread, the topmost riser doesn't get wedges. Apply beads of glue to the back of the lower tread and under the landing tread, and insert the riser. Then drive multipurpose screws through the back of the riser into the stringer and into the back of the lower tread.

Reinforce the joint. *Cut ¾-in.-square strips to length and glue and screw them in place to reinforce the back of the joint where the tops of the risers and the bottoms of the treads meet. Angle the 1½-in. screws slightly toward the tread nosings to pull it all tight.*

Apply the cove. *Turn the stairs right-side up. Cut strips of cove molding to length, and attach them beneath the nosings with 1¼-in. finish nails.*

mortise. Then, check the crowns of the risers; you'll set them arch-up to match the bow of the treads. The risers slip into the mortises similarly to the treads, with one difference. Before driving a wedge, I pull the riser away from the back of the tread and quickly run a bead of glue along the edge of the tread. Then I slap the riser against the tread to smear the glue and minimize the chances of it dripping to the face. Next come the wedges, followed by one 1½-in. screw per foot of width through the riser and into the back of the tread.

Once all the risers are installed, I add glue blocks to reinforce the joints between the tops of the risers and the bottoms of the treads. Here, there's no virtue in beauty. I just slop a bunch of glue into the corner, being sure to coat both the tread and riser, then pop the glue block into place. I drive 1½-in. screws about every foot through the blocks into the treads, angling them slightly forward.

I use a handsaw to trim the wedges flush with the stringers, then turn the stair over and check for glue drips. Finally, I cut pieces of cove molding to length and fasten them beneath the nosings with 1¼-in. finish nails, and then let the stairs sit for 24 hours so the glue can fully set. □

Andy Engel is a former senior editor and author of *Building Stairs* by The Taunton Press. Photos by Matthew Millham.