A Hollow-Post Spiral Stair

If you keep it simple, you don't need much more than a table saw and a drill to build one

by Peter Lucchesi, III

I bought my house in 1969. At that time it was a summer camp, built into a steep hill that plunged into the Connecticut River. For ten years I lived in what was essentially a Hobbit hole.

My remodeling project began, innocently enough, as an attempt to fix the leaks that inevitably occur on flat roofs in New England. Before I was done, though, I built a whole new roof and a 900-sq. ft. addition. The biggest challenge of the project proved to be building the spiral staircase up to the bedroom loft (photo below).

Given the space limitations inside the addition, a spiral stairway was the obvious choice for access to the loft. But how to build it and where to put it were not so obvious. I ended up centering the stair under the apex of the cathedral ceiling.

Material selection for the stair came down to a choice between cherry and oak, since both were available locally at about the same price. I chose oak because of its light color, thinking it would contribute to the light and open feeling I was trying to incorporate into my former Hobbit hole.

Scaling the heights—The distance from finished floor to finished floor measured 94 in. Eight inches is usually the maximum rise allowed by code on a straight run of stairs. But most codes permit a steeper rise on spirals (up to 9½ in.). I chose 8 in. as a starting point and divided it into my total rise of 94 in. The result was 11¾. 1 rounded that off to 12, meaning 12 rises over 94 in. Dividing 94 by 12, I came up with an individual rise of about 7⅞ in. for each step. My stair would have 12 risers and 11 treads, since the number of treads is always one less than the number of risers.

Post time—I'm not a mathematician and had never built a spiral stairway before, so most of the work was done by trial and error. I figured it would be tough to make a perfectly round post, and besides, I wanted something I could make on a table saw. Also I wanted the post to be hollow, with access to the inside so I could bolt the treads in place. I decided to make the post an octagon. I'm not sure why I chose eight sides, instead of six or ten, but I liked its shape and it seemed like it would work right for the tread layout.

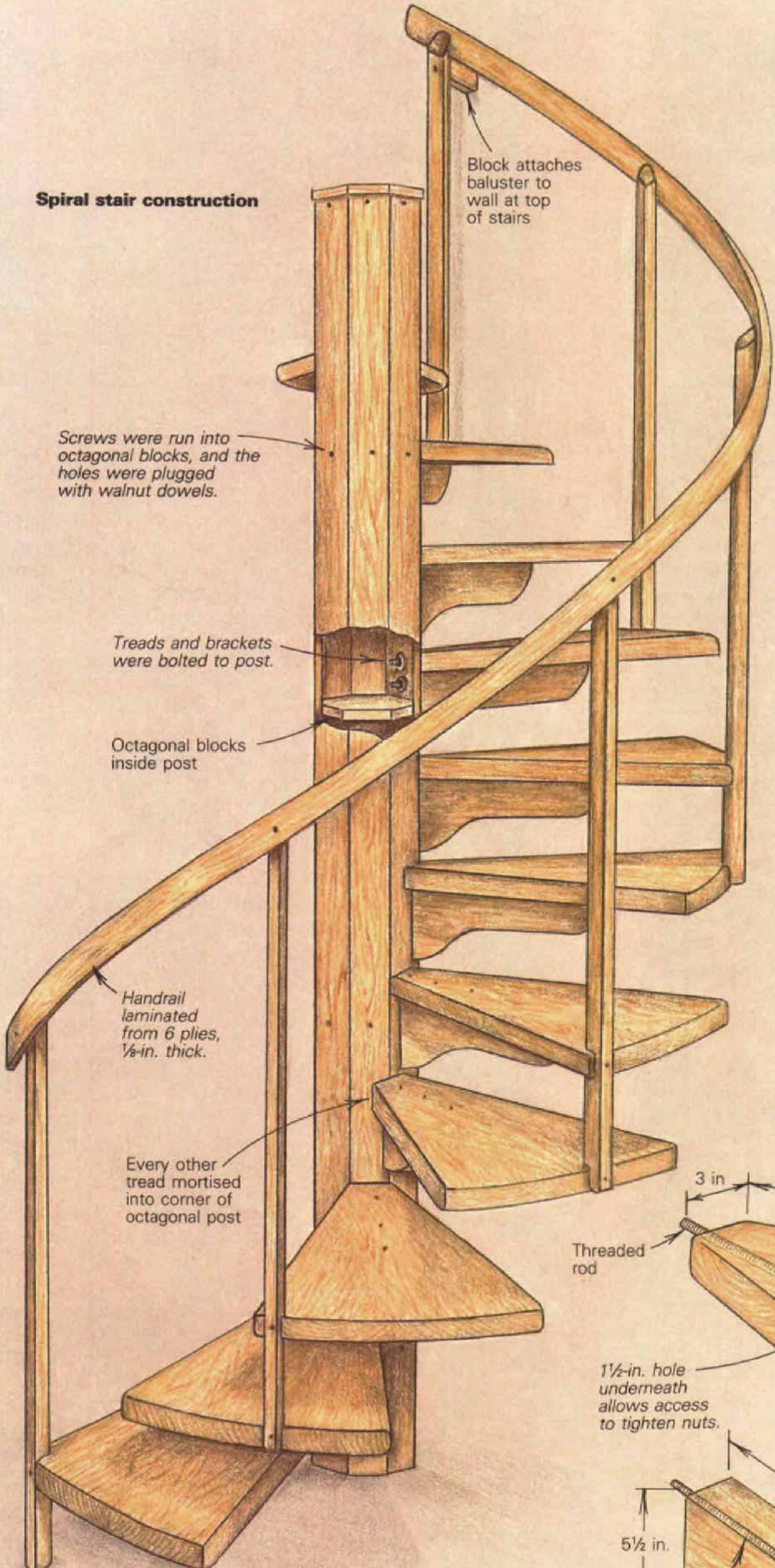
I had the local millwork shop, Amherst Woodworking and Supply, mill the lumber for the sides of the post into 1¾ in. by 3 in. by 12 ft. lengths. On their advice, I stacked and clamped the pieces together until I was ready to cut them, which helped keep them from twisting out of shape.

Before cutting the oak, I experimented with spruce 2x4s, ripping them to 3-in. widths and running them through the table saw set at 22½°. I found that I had to adjust the angle a few times before the last piece would fit together with the others.

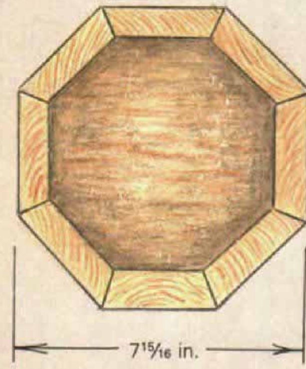
Once I got the angle right, I cut the bevels on the oak—a very slow and tedious process. When all eight pieces were beveled, I clamped them together again; I didn't want to take a chance that they might twist overnight.

The next step was to assemble the post. I cut a half-dozen octagonal blocks out of 1½-in. thick oak to fit inside the post and located them where they wouldn't interfere with bolting the treads later (drawing following page). I assembled the whole thing as a unit, gluing the sides of the post to the blocks (and to each other) with yellow glue. I left the glue off the last side so it could be

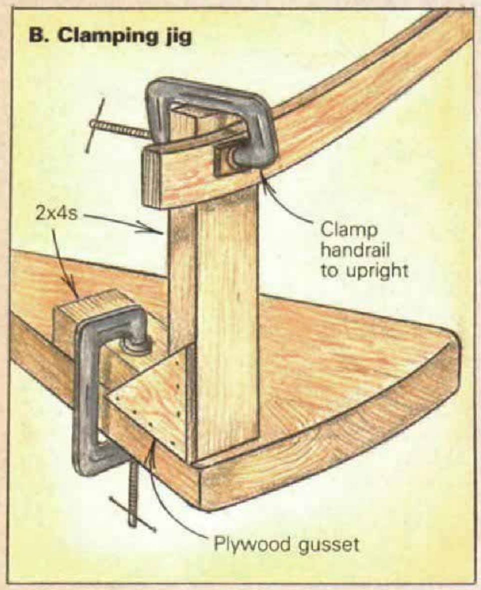
Spiral stair construction



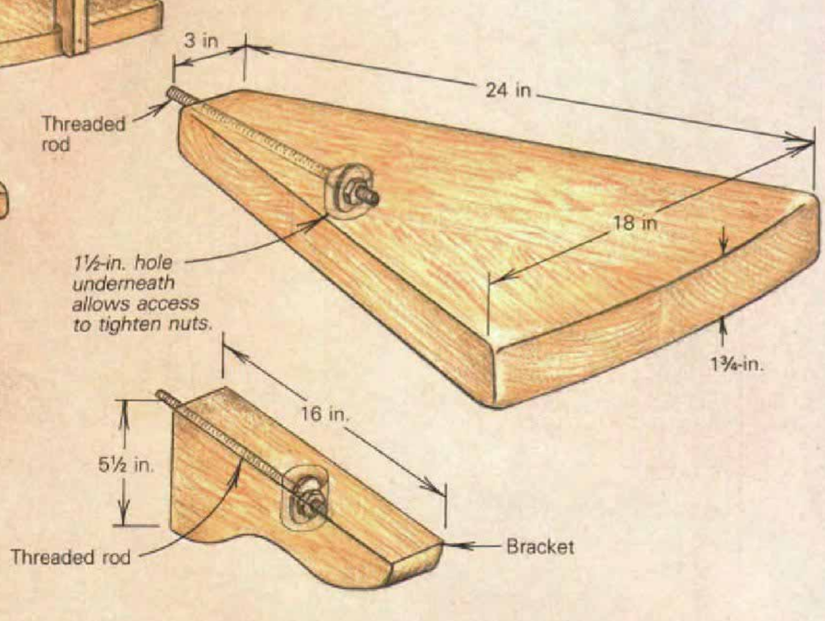
A. Section through post



B. Clamping jig



C. Tread and bracket detail



removed later and clamped the whole affair with perforated metal strapping (also called plumber's tape) held together with bolts.

After the glue had dried and the clamps were removed, I pulled off the unglued side and put it out of harm's way. Then I ran 3-in. #8 screws into ail of the blocks through counterbored holes in each of the sides and plugged them with walnut. If my glue joints were perfect, then the screws were an unnecessary precaution, but 1 felt better knowing they were there, and too, the walnut plugs later became a design theme. The finished post is just under 8 in. in diameter at the widest point.

Treads—I made plywood patterns for the treads and brackets. Amherst also glued up and cut out these pieces for me. The treads are 1¾ in. thick and 24 in. long. Most codes require that treads be at least 26 in. long on a spiral stair, but local codes may vary and the final decision always rests with the building inspector. Treads taper from 18 in. wide on the outside to 3 in. wide where they butt into the post. Most codes require that the treads on a spiral stair measure at least 7½-in. wide at a point 12 in. from the inside edge; mine measured 10½ in. at that point. The brackets are 16 in. long and 5½-in. deep.

The treads and brackets were screwed and glued together, then bolted through the central post. Each baluster was screwed to two treads—mortised into the upper one and scribed over the lower. *Photo by Wendy Jackson.*

Using a 24-in. long twist bit chucked into a portable drill, I drilled a ½-in. hole 10 in. deep down the length of each tread and bracket (detail C, drawing facing page). On the underside of each tread and on the top of each bracket, I then drilled a 1½-in. hole deep enough to meet the end of the ½-in. hole (the same way you would when connecting handrail parts together with a rail-bolt). A Forstner bit would have been a good choice for this because it drills a flat-bottomed hole. But all I had was a spade bit, so I watched the depth carefully to make sure the center point didn't come through the top of the tread. I ran ½-in. threaded rods through the treads and brackets, leaving about 2 in. sticking out. I secured them with nuts and washers located in the 1½-in. holes, which were large enough to get a box wrench on the nuts and tighten them.

Next I screwed and glued the treads and brackets together. I ran three 2-in. screws down through the top of the treads into the brackets, and once again, counterbored and plugged the holes with walnut.

I stood the post in place temporarily and marked the locations for the tops of the treads. Then I took the post down and laid it on a pair saw horses, ready for drilling.

The alignment of the threaded rods was a little different on each tread and bracket. So I measured each set of rods with a pair of dividers and transfered the measurements to the post. I drilled the holes in the post freehand, but held a square beside the bit to help me keep it perpendicular.

False start—I stood the post in position, screwed it to the subfloor through a block in the bottom of the post and braced it temporarily from above. Then I began attaching the tread and bracket units, bolting one to each side of the post. I glued all surfaces that made contact with the post with yellow glue and, taking care to wipe off any excess glue with a wet sponge, I tightened the nuts with a ratchet as I went. I found that by leaving out one of the post's staves, I was able to get a ratchet on all the nuts.

I had six treads attached when I realized that my plan wasn't going to work. By the time I got around to the seventh tread, there wouldn't be enough headroom beneath it to get on the first step (unless I was 4 ft. tall).

Since I had paid over $850 for all the lumber and millwork, I wasn't about to scrap anything. I decided to remove the treads and brackets, patch the holes and turn the post end for end.

When I undid the nuts and set out to break the glue joint holding the treads in place, I discovered something that I'd long suspected—glue does indeed hold to end grain. I was able to stand on the treads without breaking the glue joints. I really had to whack them with a framing hammer and a block of wood before they came apart. And even then, shreds of the post came off, stuck to the end grain of the treads.

I started again, and this time, I mounted the first tread on one side of the octagon and mortised the next into the point (or corner) between the first and second side.

With all the treads attached, the stair made only about a 220° revolution, instead of a full 360°. It is somewhat steep, but very manageable. I sanded it down and put a quick coat of urethane on the treads, brackets and the post, because I didn't want any moisture getting in to make the wood expand.

Since wood compresses, I tightened each nut inside the post every couple of days for the next few weeks. When I was satisfied that the wood had compressed all it was going to, I glued the last stave of the post in place.

On the rail—I used a very simple post and rail design for the balustrade. To make the handrail, I ripped six pieces of oak ⅛-in. thick and 2½-in. wide on the table saw. Then I made clamping jigs using two short lengths of 2x4 joined at right angles and strengthened with plywood gussets. I C-clamped one of these jigs to each of the stair treads and used them as forms for the handrail (see detail B, facing page). Gluing up two plies at once was all I could handle in the time it took to get the glue spread and the clamps turned down. I needed more clamps than I had, so I made some with ¾-in. pine and drywall screws. The handrail had to be clamped about every three or four inches.

Once all the plies were glued up, I removed the clamps and went at the handrail with a belt sander. Since there was a lot of unevenness, it took several hours of sanding.

I made the balusters out of 1½-in. oak and radiused the edges with a ½-in. roundover router bit. For stronger support, I attached each baluster to two treads, mortising them into the first and scribing them over the second (photo above). I glued and screwed them in place, and of course, covered the screw holes with walnut plugs. The handrail is simply screwed to the side of the balusters and braced to the wall at the top of the stairs. □

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Drawing: Michael Mandarano