Rising from what once was a bedroom, this new stair leads to a second-story addition on a turn-of-the-century Arts and Crafts home. Builder Alexander Brennen built the stair on site, using Douglas fir newel posts, oak treads and risers to match the flooring; railings and balusters to correspond with the original trim elements.

A Site-Built Stair

Using readily available materials and on-site carpentry techniques to build a tasteful staircase

by Alexander Brennen

It's easy to see why carpenters are attracted to stairs. Along with framing a roof, building a staircase is one of the most challenging geometrical tasks in building a house. And once the variables of rise, run, headroom, railing and landing configurations have been resolved, the carpenter assigned to build the stair can look forward to airing out some of the finish-carpentry tools that have been languishing in the corners of his toolbox.

Architects can also fall victim to the spell of a well-turned stair, and they often design elaborate stairs—no doubt at the request of their clients. Unfortunately, complicated stairs are frequently beyond the budget. Sometimes they must even be built off site and reassembled in place. A pleasing staircase can, however, be built using standard on-site carpentry methods. This article is about such a stair (photo above). It connects the ground floor of a turn-of-the-century Arts and Crafts-style house to a new upstairs addition, designed by architect Glen Jarvis.

From the ground floor up, the stair has two primary flights connected by a landing. Another landing on the second floor leads to a short flight with only three risers. Glen's original design for the stair detailed a traditional oak balustrade assembled from manufactured parts. But as we got further into calculating

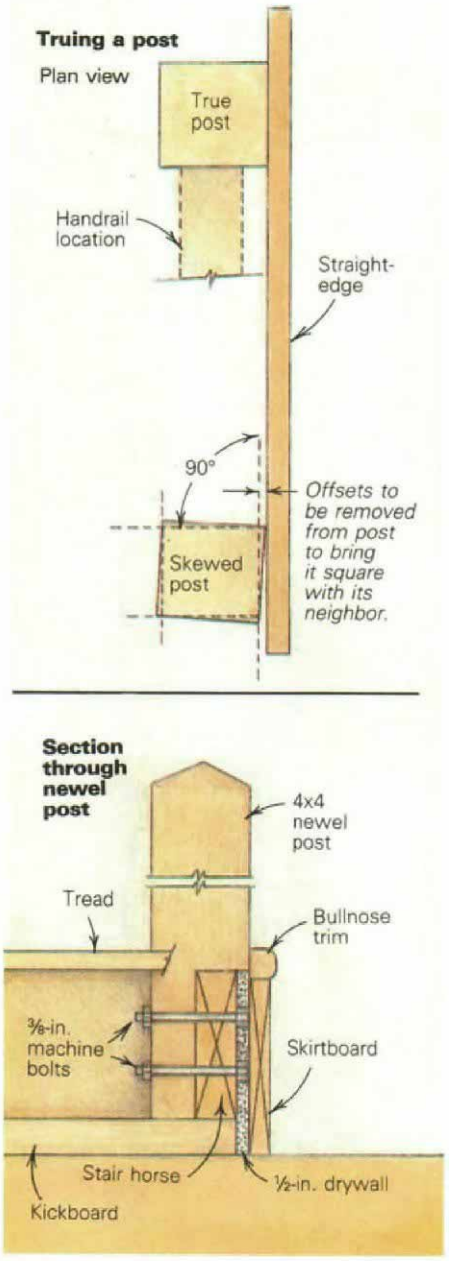
the costs of the remodel, it became clear that the money wasn't going to be available for expensive stair parts and their fastidious fitting. Jarvis and I met with the owners of the house, Morris and Regina Beatus, mulled over our options and decided to build a simpler stair in keeping with the original house. The treads and risers would still be oak, for its durability and to match the oak floor in the upper and lower halls. The railing would be of clear Douglas fir, which would match the door and window trim.

Horses on rake walls—Once we had the second floor framed and the roof in place, we calculated the rise of the stair by measuring the distance from the existing oak strip floor in the lower hall to the top of the subfloor in the upper hall. To this number we added 5/16 in. to account for the thickness of the oak strip flooring that would cover the upper-hall floor. We then divided this number by the number of risers to establish the riser height. For this stair, the rise ended up at 7¾ in. and the run at 10 in.

The landing between the two primary flights of stairs is 6 ft. wide, which is the minimum width allowable by our code to accommodate our 3-ft, wide treads—also a code minimum. Once we knew our riser heights, we began our stair framing by building the lower landing first. There was nothing tricky about this part of the project because we used standard framing lumber and conventional stud-wall construction techniques to build the stair's superstructure (photo below right). The stair horses (also called carriages, stair stringers or stair jacks in some parts of the country) were cut from 2xl2s. On the open side they bear on 2x4 rake walls. On the wall side they are affixed with 16d nails to ledgers that are anchored to the stud walls (drawing, p. 45). Drywall backing blocks made from 2x10 stock fill the stud bays adjacent to the 2x6 ledgers. Once we had the landings and horses in place, we installed some temporary treads and didn't work further on the stair until the drywall work was complete.

Newel posts and treads—The newel posts are 4x4s made of clear, dry Douglas fir. I notched the bottoms of each post to fit beside the stair horse (section drawing above) or the landing rim joist. After plumbing each newel post so that it was parallel with the rise of the stair, I glued each one to the framing with PL 400 subfloor adhesive (ChemRex Inc., 7711 Computer Ave., Minneapolis, Minn. 55435; 612-835-3434) and secured each with a pair of ⅜-in. machine bolts. In places where I couldn't run the bolts, I used a half dozen 4-in. galvanized drywall screws driven from different angles to lock the post firmly in place.

I had planned to use the laminated oak-tread stock available from our regular supplier, but after learning that I could buy enough 4/4 red oak to make the treads, risers and skirtboards (sometimes called stringboards) for the same amount of money it would cost



Two straight flights of stairs engage the first landing, which is built using standard stud-wall framing techniques and materials.

to buy just the premade treads, I decided to make my own. To trim the treads, I would use 1 1/16-in. sq. bullnose trim on the front and open side. Using a separate piece for the bullnose trim would allow me to wrap the treads around the newel posts easily, and to hide the end grain of the treads.

In our area, the most economical red oak is available from a local supplier who has a pile of it in random widths and random lengths. The boards are planed on two sides and jointed on one edge only. In any given stack, most pieces are between 4 in. and 6 in. wide and about 8 ft. long. I found a few wide pieces in the pile that could be used for skirtboards and risers. Then I picked out boards that were wide enough to allow me to rip them into 5-in, boards.

Working in my shop, I cut the boards in half and glued their edges together to make 10-in, wide, 4-ft, long planks. This would be the tread stock. Because the planks were cut from the same board, their grain matched well and their figure had more character than the premade treads, which are often glued up from 2-in. wide pieces.

After gluing up the treads I ran all the oak through a 12-in, thickness planer/jointer. After a couple of passes to put their faces in plane, I ended up with pieces ¾ in. thick. I then jointed their edges and ripped all the various parts to size on the table saw.

Job-site assembly—Once the drywall crew was through making and cleaning up their traditional mess, I brought all my oak stair parts to the site. At last I could yank the temporary treads off the stair horses and get down to business. I installed the skirtboards first. On the wall side they tucked against the drywall in the gap between the horses and the 2x6 ledger. After cutting the outside skirtboards to fit at top and bottom, I clamped them in place and marked them for the tread and riser cuts. The risers and outside skirtboards met at a 45° miter (bottom left photo, following page), so the layout mark represented the backside of the cut.

Because there are two outside skirtboards running in opposite directions, I needed to make miter cuts from opposite sides of the boards. Fortunately, my worm-drive Skilsaw tilts one way, while my Porter-Cable worm-drive trim saw tilts the other way. I used sharp combination blades to make the cuts, and clamped straightedges to the skirtboards to guide them.

The skirtboards are affixed to the framing with 2-in, galvanized drywall screws. All the screw holes are plugged. To bore each screw hole and plug hole at the same time, I used a tool with a 6-in, long, ⅛-in. dia. bit and a movable #6 countersink, which carves a ⅜-in. dia. hole for a plug (W. L. Fuller, Inc., P. O. Box 8767, 7 Cypress Street, Warwick, R. I. 02888-0767; 401-467-2900).

I installed the treads and risers from the bottom up, fitting the first two risers and then the first tread. Each one had to be scribed to the skirtboard, and that's where having 4-ft.

Drawings: Michael Mandarano

stock for 3-ft, treads came in handy. I could afford to be finicky about the fit, knowing I had some extra stock to let me whittle away at one end if need be. I marked my scribe lines with a sharp utility knife, and cut to the line with a trim saw set at a 2° bevel to give me a slight back-cut. Then I used a block plane to make minute adjustments. A sharp block plane is a necessity on a job like this—I kept mine busy on every phase of the finish work.

Alternating riser, then tread as I worked my way up the stair, I fastened the risers to the outer skirtboards and the treads to the horses with 8d galvanized finish nails and aliphatic resin glue. From the back of each riser I drove 2-in, galvanized drywall screws, 9 in. o. c., into predrilled holes in the adjacent treads, and used the same screws to anchor the leading edges of the treads to the risers below. They too are glued. I anchored the back edge of the top tread to a ledger that is screwed and glued to the framing. Where a riser abuted a newel post, I checked to make sure that the post was plumb in both directions. If it wasn't, I leaned on the post a little, and drove screws through the riser into the post to bring it plumb. Once I had all the treads and risers in place, I glued and nailed bullnose trim to all the treads and around both landings.

I plugged the countersunk screw holes with oak plugs, and pared them flush with a chisel. Then I used a hand scraper to remove the excess glue and smooth out the edges between the treads and the bullnose trim. Using a scraper sounds fancy, but once you get the hang of sharpening it, the scraper is a very fast tool-especially when working with oak. Before bringing on the flooring subcontractor, I filled all the nail holes and sanded the entire stair.

After beveling the tops of the posts with a saw, Brennen dresses the cuts with a sharp block plane (top photo). To avoid splitting the ends of the balusters, Brennen predrills all nail holes while holding the piece in place (middle photo). The risers and outer skirtboards are cross-nailed and glued where they meet at mitered corners (bottom photo). Here, a tread notched to accommodate a landing newel post is lowered onto a fresh line of aliphatic resin glue. The tread's ends will be nailed to the horses, while its front and back edges will be screwed to the adjacent risers. The raw edge of the tread will be covered with oak bullnose trim.

Precise bevels. **Using a clamped-on jig to guide his worm-drive saw, the author begins the first of four bevel cuts that will result in shallow, pyramidal tops for the newel posts. The cuts here were made with the saw set at 22.5°.**

Railing—I returned to the project to work on the railing and balusters after the two landings and the upstairs hall had been laid with oak strip flooring, and everything—stair included—had been finished with a light stain and three coats of polyurethane.

Simplicity remained our watchword, as we decided to use a stock mushroom-type handrail affixed to the top of a 2-in, by 2½-in. piece of Douglas fir (middle left photo, facing page) to give the railing some mass. But before I could install the railing between the posts, I needed to cut their tops to length.

I used my worm-drive saw along with a clamped-on guide to bevel the tops of the posts to a shallow peak (large photo, facing page). For this bevel, I set the base of the saw to make a 22.5° cut.

Next I used a long straightedge, held against adjacent posts, to see if they were square to one another. Nope. As shown in the top drawing on p. 43, which is exaggerated for clarity, the posts were skewed in relation to one another. This didn't make any difference structurally, but it made it difficult to fit a railing precisely between them. To correct the situation, I marked the top of the skewed post and used my block plane (what else) to taper the post so as to put it in plane with its mate. Then I squared off this line to make each face of the post match its neighbor. This doctoring doesn't extend all the way down the post. It's actually a slight corkscrew that isn't noticeable.

I installed the lower portion of the railing first. I clamped it to both posts at the correct height (34 inches in this case) and used my knife to scribe the angle of cut directly on the rail. I made these cuts with a 14-in. power miter box, and left the setting the same for the handrail cuts. The lower portion of the rail is anchored to the newel posts with a couple of 3-in, galvanized drywall screws at each intersection. The screw holes were covered by the mushroom-cap portion of the railing, which I affixed to the bottom rail with glue and screws driven from below so that no fastener holes show on the topside of the rail.

The 2x2 balusters are spaced evenly on 5-in. centers. Two balusters fall on each tread, and they are toenailed to the treads from opposite directions and to the underside of the handrail with 6d finish nails driven into predrilled holes. I laid out their positions on the treads and railing with light pencil marks, and cut all the balusters at once. There are two lengths, and I cut each one slightly long (1/64 in.) to allow myself some adjustment. After a test fit, I nailed each one in place, securing their tops first because the angle of the rail held them steady.

By the time I tacked the last baluster in place, Morris Beatus was ready to take over. He filled the nail holes, sanded the unfinished surfaces and then finished them with three coats of Watco oil. □

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