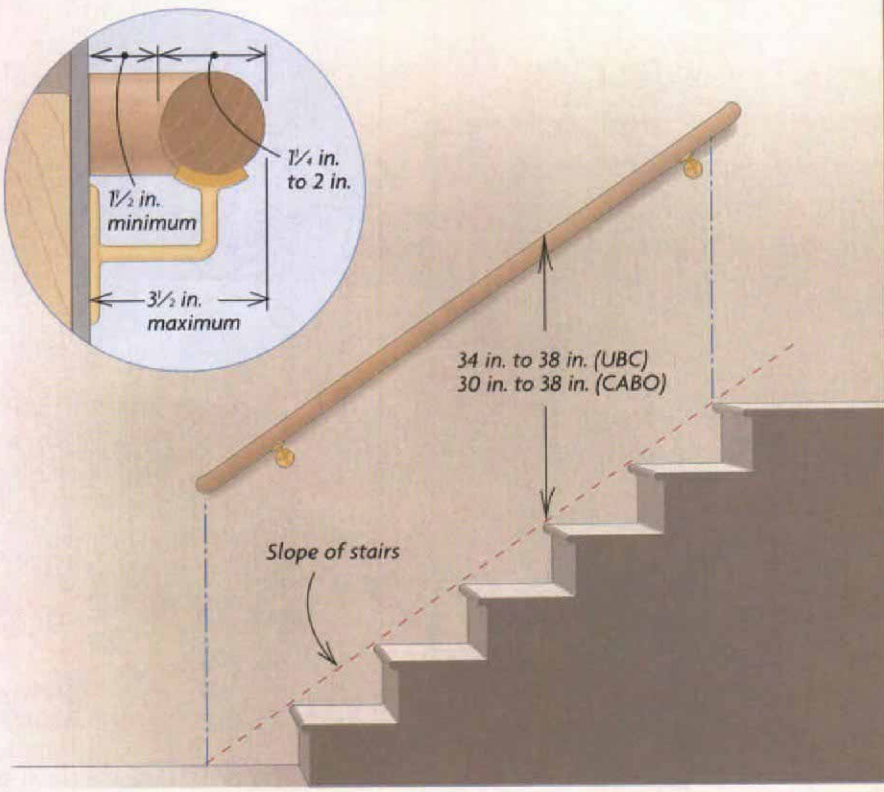
Hanging a Wall Railing

Get it at the right height and make sure it's fastened to the framing; someone's life may depend on it

BY SEBASTIAN EGGERT

Handrails and code

- A graspable handrail is required for all stairs with four or more risers (UBC) or three or more risers (CABO).
- The handrail must be 34 in. to 38 in. above the slope of the stairs (UBC), or 30 in. to 38 in. (CABO).
- Graspable portion of the handrail must be 1¼ in. to 2 in. wide, or an equivalent cross section that can be gripped.
- Handrail must not project more than 3½ in. from the wall and must be at least 1½ in. from the wall.
- Handrail ends must return to the wall.



Drawing: Dan Thornton

Building a staircase can be expensive and time-consuming. So when I tell my clients that they'll need a wall rail for the stairs to pass code, they often balk. Sometimes they ask me to install a cheap rail that they can remove after the building inspector has signed off. My response is that a permanent railing, built and installed properly, enhances the look of the staircase, and also that the railing might be all that stands between them and serious injury.

Longer handrails are better

I begin the layout by setting a straightedge (a 4-ft. level works fine) on the tread nosings and lightly scribing the slope of the stair onto the skirtboard or onto the wall (photo bottom left). Most folks like to be able to grab the railing before stepping onto the stairs. So at the bottom of the flight, I start the wall railing directly above the point where the slope of the stairs meets the floor. I find that point by extending the straightedge down the slope until it touches the landing. I then plumb up 36 in. from this point and make a mark on the wall. (For handrail code requirements, see drawing facing page).

I usually end the railing at least 3 in. beyond the nosing of the top tread at the top of the stairs. So I plumb up 36 in. from that point and make another mark on the wall. I then measure between these top and bottom points to get the rough length of the railing.

Brackets have to be screwed into studs

A safe handrail is always screwed into the framing behind the plaster or drywall. In a perfect world, the crew that framed the stair chase

Locate brackets on studs. A straightedge on the stair treads determines the slope of the railing (top left). Plumb up the height of the railing at the stud location (top right), and then scribe a circle for the mounting flange on the brackets (bottom).

would have installed 2x6 blocking on edge between the studs, parallel to the slope of the stairs and centered 32 in. above the slope. On rare occasions, I'm able to install the blocking myself. But in most cases, I have to hunt for the studs.

There are many framing-locator gadgets on the market, but I resort to one, only if I can't find any direct evidence of a stud. A nail hole in the skirtboard or a light joint-compound shadow where a drywall screw was covered are good places to start. Once I've located a stud, I transfer the stud layout up or down the stairs until I'm close to where I want to put the bracket.

I try to have the railing supported with a bracket as close to the ends as possible, so I hope to find a stud within 6 in. of the marks I made for the ends of the rail. If more than 6 in. of railing extends past the last bracket, I either lengthen the railing past the next stud or screw the end return to the framing. The UBC codebook specifies that the railing must be able to withstand 150 lb. of lateral force. So in addition to the end brackets, I try to put a bracket at least every 5 ft. along the rail for stiffness and support.

The railing I install most often is 1¾-in. dia. round stock that I make in my shop (sidebar p. 108), although the same procedure should be followed for hanging stock handrail and brackets. I mount the railing on brass rail brackets with round wall-mounting flanges and concave top saddles that fit the round handrail (Lavi Industries; 800-624-6225). If I put the center of the flange 32 in. from the slope of the stairs, the top of the railing falls at 36 in.

Let the railing align the brackets

Next I measure up 32 in. from the slope of the stairs, and I mark that height on the centerline of the stud where each of the brackets will be attached (photo top right, p. 105). I start at the bottom bracket location by striking a circle slightly smaller than the diameter of the bracket flange using the mark as the centerpoint (bottom photo, p. 105). I then center the bracket in place by viewing the circle through the screw holes that are in the mounting flange.

The bracket is rotated until the saddle is roughly at the slope of the stair, and one screw is driven to hold the bracket in place (photo top left). I then repeat the procedure with the bracket at the top of the stairs. Next, I lay a long uncut rail section on top of the saddles and spring-clamp it to the top bracket. The brackets can now be rotated slightly until the saddles are in line with the railing (photo top right). Once the brackets have been aligned, I drill holes and drive the rest of the mounting-flange screws (photo center right), making sure every screw hits a stud. While the railing is clamped to the brackets, I locate and secure intermediate brackets to studs, making sure the railing stays straight.



Brackets are screwed to the wall. As the author views the circle scribed on the wall through the screw holes, the bracket is roughly aligned with the slope of the stair, and one screw is driven (left). The bracket is then rotated into alignment with the rail (top right), and the remaining screws are driven into the wall framing (bottom right).

Don't forget the end returns

Now I can mark the exact length I want the rail to be, remembering to include the end returns when figuring the total length. Besides being required by code, returning the rail to the wall helps to prevent loose clothing and pocket-book straps from catching on the ends of the railing. With my railing system, each end return adds about 3½ in. in length and must be fastened to the rail beyond the end brackets.

After unclamping the railing from the brackets, I cut it to length with a chopsaw. I mark the center of the railing ends with a center-finding jig and a utility knife (photo bottom left). The end returns are joined to the railing with ½-in. dowel, and I use the chopsaw fence to align the drill bit for the dowel hole (photo bottom right). I drill holes 1 in. deep using a masking-tape flag on the bit as a depth gauge.


Drilling for the dowels. After squaring the ends of the railing, holes are drilled for dowels that attach the end returns. Holes are located with a center-finding jig (above) and drilled using the chopsaw as a guide (right).

The next step is cutting the end returns. The railing could be returned to the wall with a simple 90° mitered return, but I prefer the smooth transition of the quarter-circle. A semicircular cutting jig holds the shop-made doughnut safely and lets me make accurate 90° pieces. I secure the jig to the chopsaw with the centerline of the jig aligned with the sawblade. Next, I make the first cut with the doughnut grain perpendicular to the sawblade. Then I rotate the doughnut 90°, lining up the first cut with the front of the jig and make the second cut (top photo).

I check the aits with a combination square to make sure the ends are perpendicular. If need be, I fine-tune the cuts by clamping the quarter-turn back to the jig. By the way, I use this same jig for more sophisticated installations to plot and cut arc sections from the doughnut for changes in slope or direction.

End returns cut from a wooden doughnut. A semicircular jig mounts on a chopsaw for cutting the 90° end returns. Lines on the jig keep the cuts at right angles.

Scribe the end returns to the wall

Next I spring-clamp the rail-back to the brackets. Holding the end return with the grain lined up parallel with the handrail, I note the amount, if any, that the return sticks out beyond the line of the rail (photo center left). That amount is then removed from the end of the return that touches the wall.

Again using the chopsaw fence as a guide, I drill the end return for the connecting dowel. I insert a short section of dowel and dry-fit the return to the railing. Light pencil marks index the position of the returns to the rail (photo center right); then the rail is removed from the brackets for assembly and sanding.

Fitting the end returns. If wall variations make the return stick past the rail (left), that amount is removed. The return is then set in place and indexed to the railing with pencil marks (right) for alignment during assembly. All surfaces including the dowel are coated with glue (below), and the parts are joined together.

I like to join the parts of the railing with a thick-consistency, industrial-strength cyanoacrylate glue, Hot Stuff Super T (Satellite City; 805-522-0062). It is strong and dries quickly, especially when accelerator is sprayed onto the wet glue. I apply glue to all the mating surfaces, insert the dowel (bottom photo) and join the parts, keeping the index marks aligned. I then spray the glue joint lightly with accelerator.

I hold the fittings tightly together for a few moments until the glue begins to set up. The glue takes about ten or fifteen minutes to cure fully inside the joint, so I handle the work gingerly during that time. After the glue has cured thoroughly, I sand the joints to remove excess glue and to fair slight imperfections. In many cases, I also apply the finish on the railing before final installation.

Finally, I bring the finished railing to the stairs and hold it in place on the brackets, taking care to keep the end returns tight to the wall. The rail is then drilled and screwed to the bracket saddles (photo p. 104). If I need to attach the return to a stud, I predrill and drive a 3-in. screw through the bottom of the return and into the framing. The hole can then be plugged and sanded. Before I leave, I always give the stairs and railing a test for comfort and for assurance that nothing has loosened during installation. □

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A shop-built handrail and fittings

Railing takes shape. Square stock is fed through a molding machine that cuts a half-round profile (photo left). The ledges left on the sides guide the stock while completing the round shape (photo right).

There are a number of companies (including my own) that make and sell handrail in just about any shape and size you can get your hand around. But I get a certain satisfaction installing a railing that I've made myself.

SHAPING THE RAILING

The stock I cut my railings from is $1\frac{13}{16}$ in. thick by $2\frac{1}{4}$ in. wide, and I make the lengths of railing as long as possible with a few extra 2-ft. pieces to test the setups.

Rounding over the edges of the railing can be done on a router, but I prefer to use a Williams & Hussey molding machine (800-258-1380). With $1\frac{3}{4}$-in. dia. half-round knives, the molding machine leaves a better surface. The stock slides through the machine on a guide-track jig that centers the $2\frac{1}{4}$-in. stock width on the knives, leaving a $\frac{1}{4}$-in. ledge on each side of the half-round shape (photo left).

I make several passes, cutting slightly deeper with each pass until the top surface is round. To complete the round shape, the stock rides through the machine on a second jig that supports the ledges created by the first step (photo right). The test pieces I made help to align the jig so that I'm left with a $1\frac{3}{4}$-in. dia. dowel when I am finished.

TIME TO MAKE THE DOUGHNUTS

I make end returns and other transitional railing parts from what your high-school geometry teacher would call a "torus." However, I use the same word that Homer Simpson uses, "doughnut." They are made in four steps (photos below).

The size of the doughnut is determined by how far the handrail bracket holds the railing from the wall. For brackets like the ones in this article, I make the outside diameter of the doughnut $7\frac{1}{4}$ in. The inside diameter is $3\frac{3}{4}$ in., and the cross-sectional diameter is $1\frac{3}{4}$ in., the same as the handrail. With the radius slightly larger than needed for the return, I can usually get four quarter-turns from each doughnut, allowing for saw kerfs and irregular wall surfaces during installation.

STEP 1:1 start with wood blocks $1\frac{3}{4}$ in. thick and $7\frac{1}{2}$ in. square. At the center of each block, I draw a $3\frac{1}{2}$-in. dia. circle with a compass. On a drill press, I drill a series of 1-in. holes just inside the circle. The 1-in. holes reduce the resistance for the $3\frac{3}{4}$-in. drill bit that makes the finished hole, but the centerpoint is left for the center spur on the bit to follow.

STEP 2:1 use a table saw to cut the outside of the blocks to a circle. (My bandsaw is lousy, and the table saw gives me better results.) The block is quick-clamped to a jig with a wooden disk on top and a guide strip for the saw table on the bottom. The edge of the disk is set exactly $1\frac{3}{4}$ in. from the table-saw blade. The clamp holds the work and keeps it from rotating while it passes through the blade.

I gradually slice the corners off the block with full passes past the blade, turning the block into a polygon that is close to being a circle. I then

Turning a block of wood into stair parts in four easy steps

Step 1. *Cut the inside hole.*

Step 2. Cut *the outside circle.*

Step 1: Cut the inside hole. After a drill removes some meat in several small holes, a large spur bit in a drill press completes the inside hole.

Step 2: Cut the outside circle. A special jig holds the block while the table saw cuts off the corners (left). The blade is then raised slowly while the block is rotated to round the outside edge (right).

lower the sawblade and clamp the jig to the table beside the blade. With the saw running, I rotate the block on the jig, raising the blade about ⅛ in. for every rotation, leaving a smooth, circular outside edge.

STEP 3: Next, I chuck a ⅞-in. roundover bit with a top guide bearing into my router table. I slip the round blank onto a jig with a tapered center plug that friction-fits into the doughnut's hole, and I round-over the outside of the stock top and bottom.

STEP 4: To round-over the inside hole, I put the doughnut into another jig that holds the doughnut between four blocks using tapered wedges. The inside roundover completes the shape.—*S. E.*

Step 3: Rounding over the outside edges. A jig with a tapered center plug (left) holds the doughnut securely while a roundover bit in a router cuts the profile (right).

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Step 3. *Round over the outside edges.*

Step 4. *Round over the inside edges.*

Step 4: Round over the inside edges. Tapered wedges hold the doughnut in a jig that lets the author keep his hands above the work while rounding over the inside edges.