Site-Built Steel-Stringer Stairs

A carpenter's approach to simple, modern metal stairs

BY JOSH EDMONDS

As builders in a somewhat rural part of central New York, we often find ourselves doing things that are a bit outside our comfort zone. Sometimes we can't find anyone nearby who has the skills or experience needed for a particular task, or the people who do are booked out well into the future. So we pick up tools and learn how to use them out of necessity. That's how we—a crew of mostly carpenters—ended up doing our own metalwork.

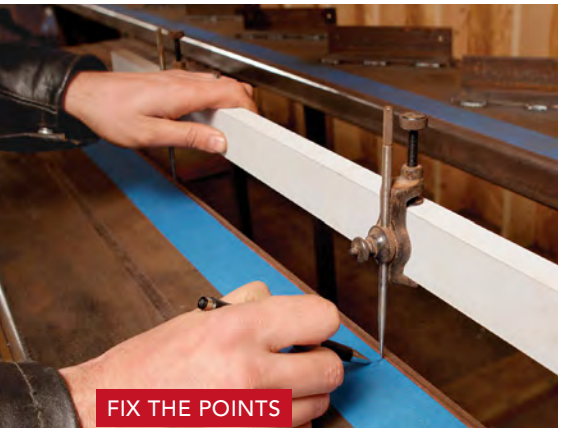
We started small, welding caps and bases on steel posts so we didn't have to wait for them to be fabricated and delivered. But as we've grown more adept with our welding equipment and techniques, our metalwork has become more ambitious.

The stairs we built for this project are easily within reach of a carpenter who knows how to build a set of simple notched stringers and has the budget and time to invest in some basic cutting and welding tools. The goal here was to create a steel staircase on par with the cost of traditional wooden stairs. The only special tools we used were a metal-cutting circular saw and a welder. □

Josh Edmonds, CPHC, is managing partner at Simple Integrity LLC in Cooperstown, N.Y. Photos by Matthew Millham.

A FAMILIAR LAYOUT

Determine the total rise and run of the stairs just as you would for wooden stringers. I recommend drawing the stringers and railings out on paper or, even better, using a program like SketchUp, which allows you to pull lengths and angles without having to calculate them. Unlike wood, steel tubing has radiused edges, and those don't play nice with stair gauges or layout lines. To take that radius out of the equation, I keep the layout ½ in. down from the top edge of the stringer, marked with a chalkline and a strip of painter's tape. During layout, factor in the thickness of the steel that will be used to cap the cuts on the ends of the stringers.



FIX THE POINTS

Start the stair layout with a trammel bar or dividers set to the diagonal distance between stairs. After determining your starting point, use the tool to step off the distance for each step, establishing the point—the top, front edge—of each tread.

SWITCH TO SQUARE

Draw the rise and run using a framing square aligned to the trammel marks at the tape's edge. Using painter's tape on the square works better than brass nuts due to the steel's radiused edges. Mark the top and bottom cuts conventionally, then offset the cut marks by the thickness of the steel caps that will be welded on later.

MARK FOR BRACKETS

I use a jig cut to the height and depth of the treads with a cutout the size of the brackets that will hold them. Align the jig with the layout lines and mark the bottom and up the inside legs, drawing an "L" on either side to set reference lines for the side and bottom edges of the angle brackets.

Drawing: Christopher Mills

FABRICATE THE STRINGERS

Our Miller MIG welder can plug into a standard 20-amp circuit and has an auto-set feature that makes things simpler. You set the size of the wire and the thickness of the steel that you are using and the machine figures out the rest, so all you have to do is weld. After making the cuts, bevel the edges back with a grinder so the molten steel has space to flow into to create a solid weld.

LEVEL AND PLUMB CUTS

Use a metal-cutting circular saw to cut along the offset cutlines at the tops and bottoms of the soon-to-be stringers. The outer lines represent the full stringer after the caps are welded on.

EXPECT A POP

Tube steel is formed by bending and welding sheet steel. There's some built-in tension in the metal, so the walls of the tube can spring apart when cut, binding the saw. When this happens, continue the cut from the opposite side, or switch to a reciprocating saw with a metal blade.

CUT THE BRACKETS

Cut the tread brackets—2-in. by 2-in. by ¼-in. stock on this job—to length.

DRILL THE HOLES

Use a drill press to bore two holes in the bottom of each angle bracket. The hole in the front of the bracket is ¼ in. and the one at the back is ⅜ in. to allow for movement in the wooden treads. Use 3-in-One oil to lubricate the bit while drilling.

TACK FIRST

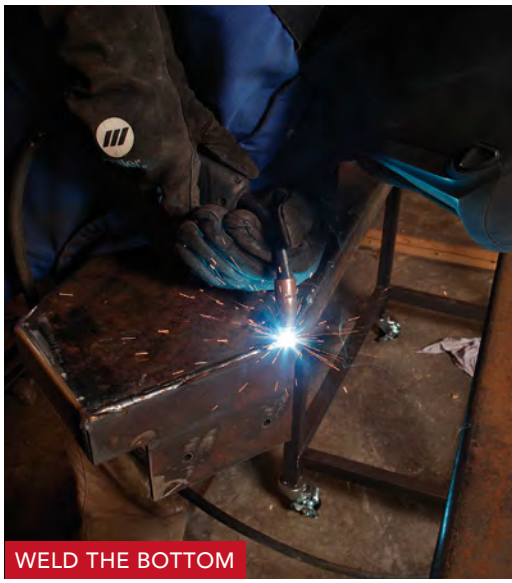
Tack the angle brackets in place first, then skip around to fill in the welds. This is to avoid heating the stringer too much in one place at a time, which can warp the steel and create an unwanted twist or bow.

WELD THE TOP

Use a pipe clamp to bring the sprung walls of the steel back together while tacking the caps. Steel bolts prewelded to the top plumb cap will secure the top ends of the stringers to an LVL header in the floor system.

GRIND IT

Depending on your welding skill and the look you're after, grind the welds down with a low-grit flap disc or grinding disc, then polish them off with a high-grit (120 or higher) flap disc.



WELD THE BOTTOM

We pre-drilled 7/16-in. holes in the L-shaped bottom plate to attach the stringers to the concrete floor. These plates will be nearly invisible once the stairs are installed.

ADD THE HANDRAIL

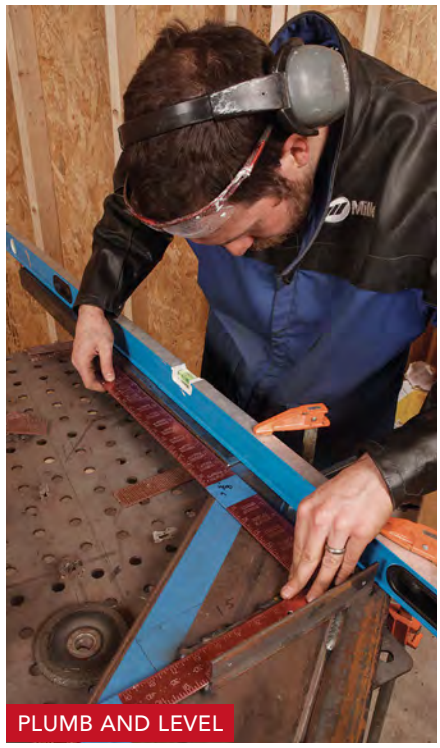
It's critical at this point to make sure the posts are plumb and "in wind" with the stringer. This can be checked by simply sighting down the assembly, but it's even easier with a set of winding sticks, typically used in woodworking. You can make a quick set of winding sticks from a pair of levels. Here, we first welded the top and bottom posts to the stringer, then added the handrail, leaving it long at both ends and cutting it to length after it was welded. Then we added the middle post and handrail return.

KEEP IN WIND

We fabricated the railing posts from 2-in. by 2-in. by ¼-in. square tube, and the handrail from 1-in. by 2-in. by ⅛-in. tubing. A set of welding tables helps keep the assembly stable and level during fabrication.

FABRICATE THE POSTS

We drilled all of the holes for our cable railing on the drill press. Because the posts will be plumb and the cables angled, the holes are drilled offset from one side to the other, leaving them at an angle matching the slope of the stairway.



PLUMB AND LEVEL

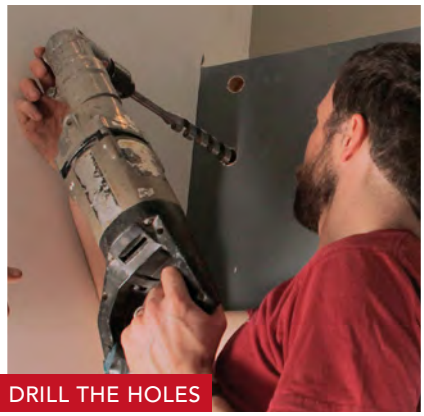
Use a framing square to set the posts square to the angle bracket, and a level and shims to flush the posts with the faces of the stringer.

ADD THE RETURN

After welding on the top rail, weld the return to the top of the handrail. This one is fabricated from two pieces of mitered 1-in. by 2-in. by ⅛-in. tubing and a piece of ¼-in.-thick plate steel cut from flat stock using our metal-cutting circular saw.

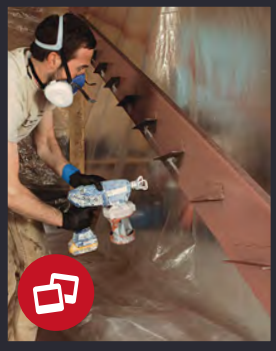
INSTALL THE STRINGERS

We made sure we had access to the bolts in the tops of the stringers so we could fasten them in place with washers and nuts. Because steel stringers are heavy—many hundreds of pounds apiece—it's impractical to fully assemble the stairs and install them as a unit, as is sometimes done with wooden stairs. Get all the manpower you can muster—you'll need it.



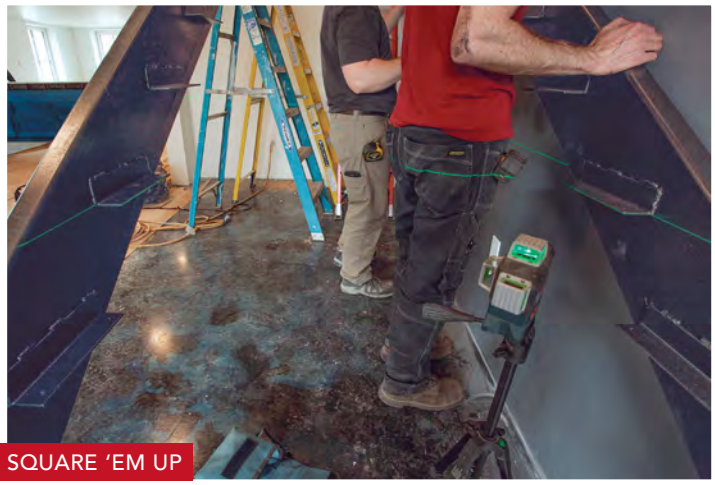
DRILL THE HOLES

We drill oversize holes through the drywall and header to receive the bolts at the tops of the stringers. The bigger holes make installation easier, and allow for minor adjustment.



Want more?

For a full rundown and photos of the prep and painting of the steel stringers in a site-made spray booth, visit FineHomebuilding.com/magazine.



SQUARE 'EM UP

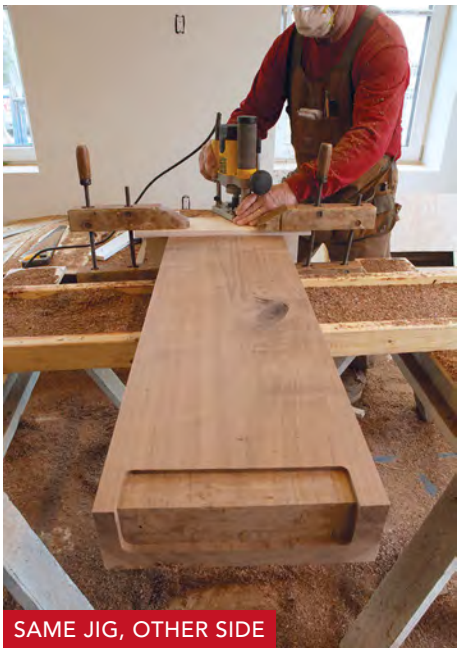
Use a laser level to check that the tread brackets are level to the floor and in plane across the stringers. When they're good, tighten the nuts on the top bolts.

TREAD ON THIS

The treads for this project are 16/4 walnut. We cut them to length using a site-built jig to ensure they were all the same length, and mortised the ends to receive the angle brackets. When milling the treads, make sure to mark and mortise them so the best faces show in the finished stair. While most of the treads are predrilled in place, the bottom tread has to be marked and removed to drill the pilot holes, and fastened with an angle drill or by hand.

GUIDE FOR MORTISES

Use a jig and guide bushing for consistent mortises, and finish up with a chisel if necessary. We slightly oversize the height and width of the mortises to allow for minor adjustment of the treads during installation, and to account for the welds.



SAME JIG, OTHER SIDE

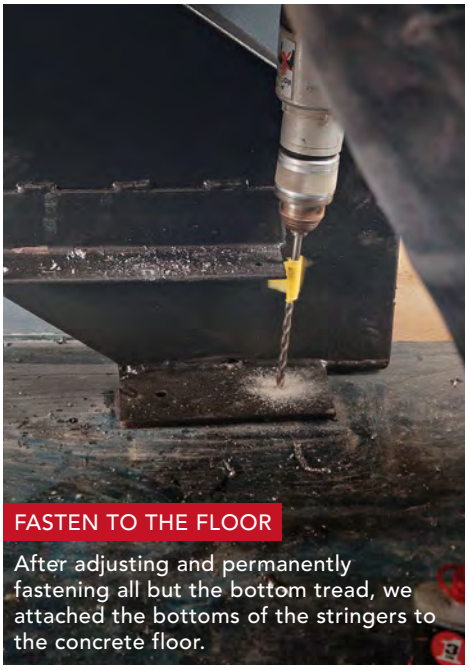
This jig has stops to register it to the front of the tread at both ends, and allows for both the bottom and end mortises to be made without readjustment.

LAY THE TREADS

Carefully lay the finished treads on the angle brackets, making sure to put the correct face out. Check each for proper fit, but don't fasten them yet.

STRING AND ADJUST

Run stringlines from the top and bottom treads to use as guides to adjust the intermediate treads into the same diagonal plane. A ratchet strap in the middle of the stair's run keeps everything tight. Using the holes in the brackets as guides, drill pilot holes, then fasten the treads with 2-in. structural screws.



FASTEN TO THE FLOOR

After adjusting and permanently fastening all but the bottom tread, we attached the bottoms of the stringers to the concrete floor.

RUN THE CABLE RAIL

We used Ram Tail fittings and cables for this cable rail. Take the time to determine your cable length so that you have even reveals in your hardware connections once tightened. We ran the first run of cable to determine the length, then proceeded to install all the hardware before running the rest of the cables. Our cable hardware didn't show up until after we'd installed everything else. Ideally, we would have drilled the angled holes for the hardware to their final diameter before painting.

ADJUST FOR HARDWARE

Using a bevel gauge as a guide and a drill with a stepped bit, enlarge the predrilled holes in the rail posts to receive the cable-rail hardware.

OIL FITTINGS

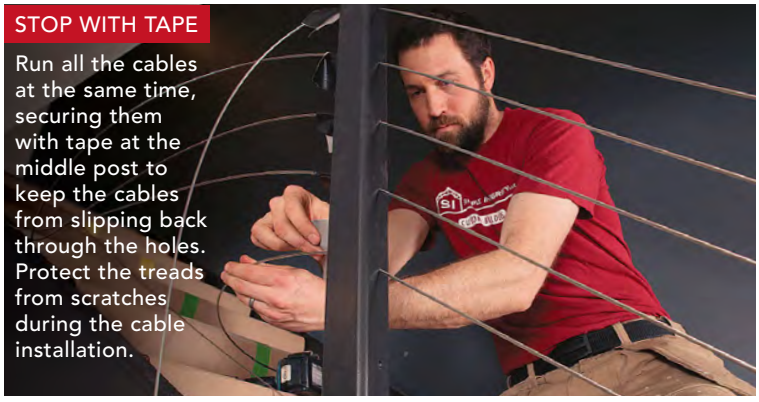
Most cable-rail fittings are made of stainless steel, and the threads can bind as they're tightened. Oil all the fittings before installation to make adjustments and tightening easier.

TIGHTEN CAREFULLY

Because stainless steel is soft, it's best practice to tighten stainless fittings using hand tools rather than power tools to avoid heating up the fittings, which can cause them to expand, bind, and break.

STOP WITH TAPE

Run all the cables at the same time, securing them with tape at the middle post to keep the cables from slipping back through the holes. Protect the treads from scratches during the cable installation.



CINCH IT UP

Cable railings are typically tightened in a particular order, but this steel handrail is so stiff, the order in which they're tightened doesn't matter.