

Through Mortise-and-Tenon Joinery

Cut mortises first for clean, accurate results

by Jim Richey



Work carefully when joinery is exposed. The author cuts mortises first and then marks the tenons to reduce tearout on the face side.

It's hard to hide mistakes in through mortise-and-tenon joints. Both the tenon and the mortise are there for anyone to see. I found it tough to get crisp, chip-free mortises that were uniform and had clean, square corners. Then, not too long ago, I came across a drawing of a simple bench made from 1x12 stock, like the one shown in the photo below. I wanted to build several of them, but the joint that held the bench together was a wedged through mortise and tenon. The bench was an incentive. I worked on my technique and experimented with prototypes until I could cut this joint quickly and accurately.

In a through mortise and tenon, the tenon goes all the way through its mating piece and shows on the other side. Wedges are often added to spread the end of the tenon and lock the joint together. It's a strong, attractive joint.

I can cut the mortises by hand, but when I'm faced with making a lot of them, I like to use a machine. In my shop, that means using either the drill press or the router. I prefer using the drill press because it's quiet and setup is fast and accurate. I can easily see the cut in progress.

When I'm boring holes for a through mortise, I try to minimize tearout where the bit exits the stock. If possible, I'll select the side where tearout will be the least noticeable; then I'll lay out and cut the mortise from the opposite side. If tearout is unacceptable on either side, then I'll use a router and a jig. For this bench, though, I decided I could live with some minor tearout on the back side because this area is fairly well-hidden.

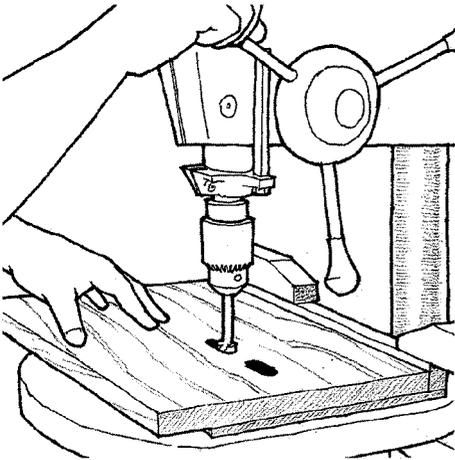
Cut the mortises first

The usual approach is to build from the "inside out." That is, cut the tenons first, and then use the tenons as a template to mark the mortise locations. The problem is that you drill the mortises from the back, which virtually guarantees some tearout on the face of the piece, no matter how careful you are. I prefer the "outside-in" approach—cut the mortises first by drilling from the face side, and then mark the tenon locations from the mortises.

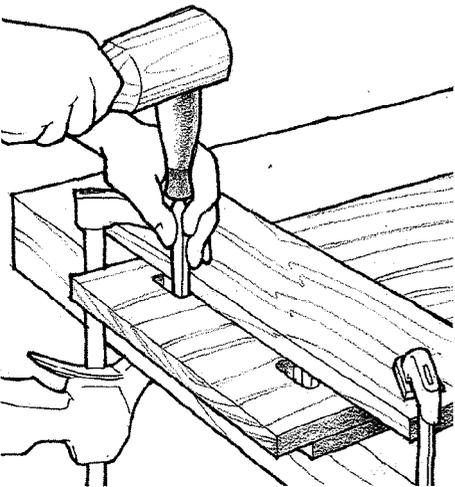
To do it this way, I set up my drill press with a Forstner bit and a fence to register the workpiece (see step 1 of the drawings on the facing page). Forstner bits are best for this operation because they make such clean cuts. Just remember that the bit diameter should be equal to or slightly smaller than the tenon thickness. You can

CUTTING THROUGH MORTISES

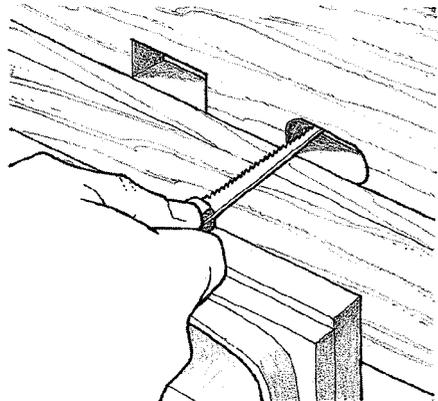
Step 1: Back up workpiece with clean scrap; use a Forstner bit to remove most of the waste. Set depth stop so bit just cuts through stock.



Step 2: Guide chisel with a straight piece of scrap, and pare remaining waste from walls of the mortise.



Step 3: A shopmade saw used like a rough file squares the corners. Carefully work the saw into the corner.



always enlarge a mortise that's too narrow.

To minimize tearout, I set the drill-press depth stop so that the bit just goes through the workpiece or leaves a paper-thin layer of material on the bottom of the mortise. It's best to back up the workpiece with a clean piece of scrap.

I drill the first hole at one end of the mortise. Then I nibble away the remaining waste by sliding the work face down on the fence and drilling successive holes every $\frac{1}{4}$ in. or so until I reach the other end. Toward the bottom of each hole, I slow down and use light pressure on the drill-press arm.

Shopmade saw cleans out corners

After roughing out the mortise on the drill press, I trim up those little waves on the sides and any remaining waste on the bottom of the mortise with a sharp chisel. This can be done by eye, but you'll get better results if you clamp a straight piece of $\frac{3}{4}$ -in.-thick scrap across the workpiece to serve as a guide (see step 2 at left). You can use the guide to square up the corners by working toward the corner from one direction and then swinging the guide 90° and working in from the other. If you use a chisel to square up the corners, be sure to work in from both sides of the workpiece, or you'll tear out some really nasty chipping on the back side.

The way I square up the corners is to saw them out with a small, stiff saw (see step 3 below left). I made my saw by filing teeth into the back of a carbon-steel paring knife. But you could also modify a wall-board saw by hammering the teeth flat, filing the sides of the blade to remove all set and then filing the teeth straight across like a rip saw.

I lay the saw against the wooden guide clamped to the workpiece and saw to the corner of the mortise. I use the saw as a rough file to square out the corners (there will be minor tearout on the back side).

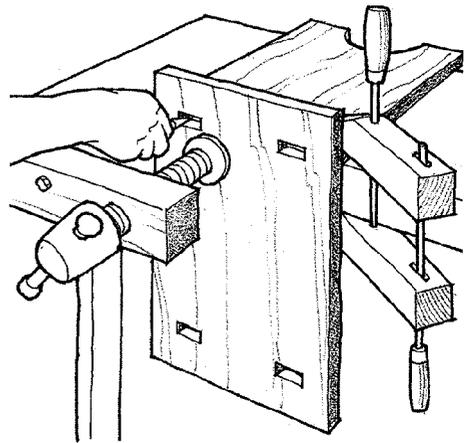
Lay out and cut the tenons

I mark the tenon directly from the mortise using a small knife or pencil sharpened to a chisel point. Because the tenon thickness is the full stock thickness, only the width must be marked (see step 4 above right). I use a square to extend this line down the face of the stock (see step 5) and a marking gauge to scribe the tenon length. The tenon should extend completely through the mortised stock with an extra $\frac{1}{32}$ in. or so. This will be trimmed flush later, after the wedges have been glued in place.

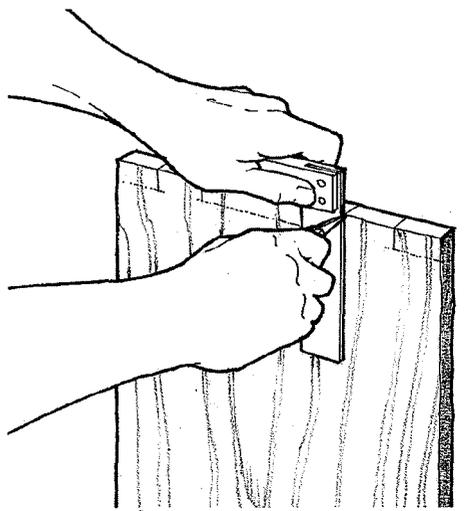
I bandsaw the tenons using the cutting sequence shown in step 6 at right. If all

MAKING THE TENONS

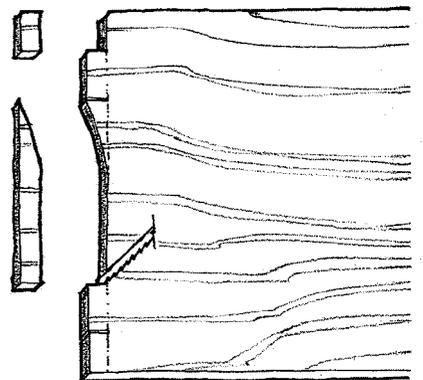
Step 4: Transfer mortise location to tenon stock. Use a knife or sharp pencil to mark out the tenon width.



Step 5: Extend tenon layout lines down the face of the stock with a square.



Step 6: Mark the length of the tenons with a marking gauge or knife, and then cut to the line on a bandsaw.



goes well, the tenons will fit snugly into the mortises on the first try. This never happens for me, though, so some fitting is usually required. Filing either the mortise or the tenon usually will take care of a too-tight fit. If you have some gaps, don't worry. Small shims cut from the same stock will hide them.

Cutting wedges and assembly

After fitting the mortises and tenons, I cut the wedge slots in the tenons. A thin-kerf

cutoff blade in a tablesaw will produce a clean slot that's about the right width. Depending on the size of the tenon and its direction in the mating stock, I use one or two wedges to spread the tenon and create a tight joint.

Wedges should always exert pressure against the end grain of the mortise to keep the workpiece from splitting. I locate the slots as shown in figure 1 below.

I saw the wedge material by ripping the stock, on edge, on the tablesaw, as shown

in figure 2 below. I angle the blade at 3°, and adjust the fence until the point of the wedge will just fit into the kerfs I've sawed into the tenons. I cut the wedge material to length, and now I'm ready to assemble the joint. After clamping everything together, I drive the wedges home with a bit of glue on the leading edge. □

Jim Richey works wood in Katy, Texas, and is the "Methods of Work" editor for Fine Woodworking.

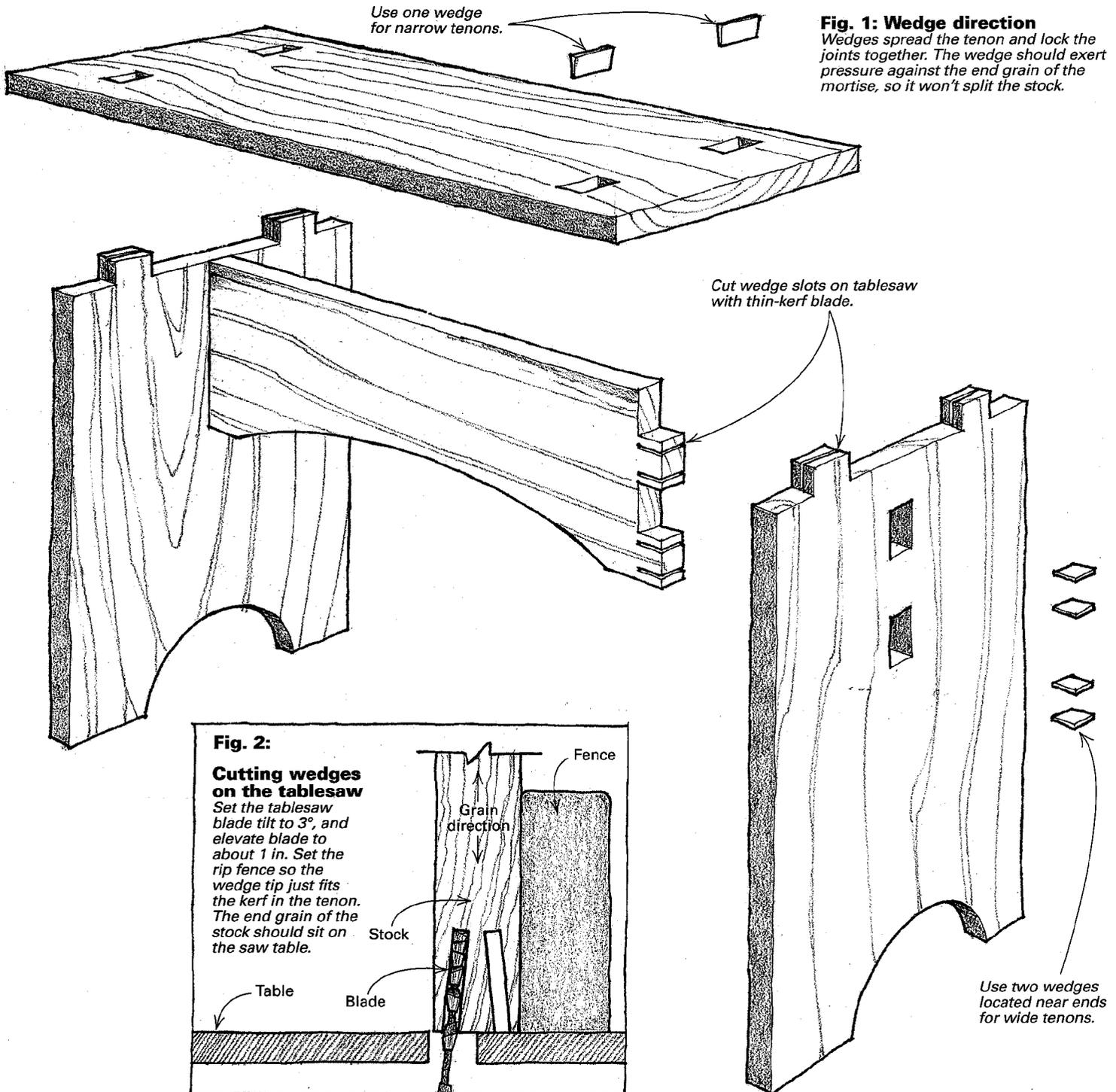


Fig. 1: Wedge direction
Wedges spread the tenon and lock the joints together. The wedge should exert pressure against the end grain of the mortise, so it won't split the stock.