

Drawboring Demystified

BY JENNIE ALEXANDER &
PETER FOLLANSBEE

This ancient mortise-
and-tenon joinery
technique needs no
glue, no clamps.

The excerpt that follows is adapted from “Make a Joint Stool from a Tree,” a new book by Jennie Alexander and Peter Follansbee (Lost Art Press). While the book teaches you start to finish how to make a joint stool, many of the techniques you’ll learn therein are applicable in the modern shop – perhaps none so much as drawboring.

Drawboring is a method used in 17th-century joinery that is still valid today. That a mortise-and-tenon joint can be permanently secured with no glue and no clamps is hard for some modern woodworkers to swallow. But all it takes is some careful planning, a brace and bit, and a tapered wooden pin. Jennie Alexander and I have been very fortunate to closely study many



Joint stool. The joint stool above, made by Peter Follansbee, is built in the 17th-century tradition, employing drawbored mortise-and-tenon joints for centuries of durability.

examples of surviving woodwork from the 17th century, and have worked repeatedly to try to mimic the tool marks and techniques we saw there.

There’s no need for glue in this scenario; that means you can take your time to get the framing just right. There’s no need for haste, nor for clamps to pull things together. That’s what the pins do.

— Peter Follansbee

Simply put, drawboring is an intentional misalignment of the holes bored in the mortises and tenons.

These holes are bored through each component separately, and they are offset so that a tapered pin driven into them will pull the tenoned rail up tight against the mortised stile.

We know this is a period practice because we have seen it in surviving works, sometimes in disassembled pieces, or in those worn down by misuse. The photo at left shows clearly the kink in the pin resulting from snaking its way through the offset holes. In addition to this sort of evidence, we have a documentary record for drawboring as well. Joseph Moxon describes it in his section on joinery in “Mechanick Exercises:”

Then with the Piercer pierce two holes through the Sides, or Cheeks of the Mortess, about half an Inch off either end one.



Solid for centuries. This cutaway shows a drawbore pin snaking its way through the offset holes; the kink in the pin is clearly evident. This joint is a testament to the great strength of oak and the use of drawboring – a thin piece of hardwood like this can hold a mortise-and-tenon joint together for centuries. It pulls the tenon into the mortise and never lets it go.



Follansbee's marking technique. The thinnest awl in the shop is best for marking your drawbore location. It can get right in against the circumference and transfer it accurately to the tenon's face.



Alexander's marking technique. The centerpunch needs to fill the hole completely, so make one with material chosen to fit your boring tool. It makes a very clear depression on the tenon face.

Then knock the Tennant stiff into the Mortess, and set it upright, by applying the Angle of the outer Square, to the Angle the two Quarters make, and with your Pricker, prick round about the insides of the Pierced holes upon the Tennant. Then take the Tennant out again, and Pierce two holes with the same Bit, about the thickness of a shilling above the pricked holes on the Tennant, that is, nearer the shoulder of the Tennant, that the Pins you are to drive in, may draw the Shoulder of the Tennant the closer to the flat side of the Quarter the Mortess is made in. Then with the Paring-chissel make two Pins somewhat Tapering, full big

enough, and setting the two Quarters again square, as before, drive the Pins stiff into the Pierced holes.

We're using the joint stool shown in the book from which this is excerpted as the example – but the following applies to any drawbored mortise-and-tenon joint. At this point, the holes through the mortises have already been bored, two per mortise, approximately a mortise chisel's width back from the edge of the workpiece.

With the test-fitted frames on the bench, mark the tenons for the pins that will secure these joints for the next few centuries. The faces of rails

and stiles must be in the same plane. The rails' outer shoulders should be a tight fit against the stiles' arrises. The inside corners should not touch the stiles. Check that the apron's upper edge lines up properly with the marks on the stiles that define the top of the stool. At the stretcher level, be sure there's no gap in the mortise above the stretcher, where it will be visible in the finished stool. If there is a gap, bump the stretcher upward, shifting the space beneath the stretcher. You might need to check that the ends of the mortise are cut square to the edge, so they don't interfere with the tenon's fit.

When all that is checked, scribe inside the hole onto the tenon face with a thin, sharp awl. Alexander prefers lightly tapping a centerpunch into the pin hole. Make a punch by pointing the shank of an old drill bit or steel rod that fits snugly into the pin hole.

Disassemble the frame and bore the holes in the tenons. It is critical to remember to move in the proper direction: toward the tenon shoulder. You can eyeball this placement, or you might find it helpful to mark the center of the tenon's pin hole. With the awl, prick the new centerpoint about $\frac{1}{16}$ " closer to the tenon shoulder.

Reassemble the joint and sight through the offset holes. The picture at near right shows the general idea of what we're after; the offset should take up about one-quarter to one-third of the hole. When you have bored all four tenons for one frame, you can test-assemble this frame yet again, and

FIX A MIS-BORED HOLE

So you mis-bored a hole in a tenon. Usually this means you moved away from the shoulder instead of toward it. It's not the end of the world; you can fix it. The simplest way is to make a pin to fill the hole. Use bone-dry oak and shave it to fit the hole completely. Then glue it in, and trim it off. Once the glue dries, you can re-mark the hole and bore again.



Second chance. This is how you get a second chance on the mis-bored tenon. One pin has been trimmed with a saw; the other is as it was driven. Once they are both trimmed, use a chisel to pare them flush. Then test-fit the joint, mark it and re-bore it.



Fixed. In the end, all that will remain of these pins is a crescent-shaped fragment filling the errant hole.



Slowly now. Toward the shoulder – that’s the thing to keep in mind. Bore the hole slowly. The tenon is thin, and you don’t want to blow out the back of it. The piercer bit excels at this; it pokes through the stock very cleanly.

lightly pull the joints tight by driving in tapered metal “drawbore pins.” These pins can be easily made by adapting a machinist’s alignment pin. Any rod or awl that tapers from $\frac{5}{32}$ " to $\frac{5}{16}$ " along 4" can be used. Installed in octagonal cross-sectioned wooden handles, they can be tapped in with a hammer and easily removed by hand.

If there is a question about a particular joint, remove the pin and sight through the hole against the light. If the interference is too great, use a hand-held square-tapered reamer to enlarge the tenon hole. This tool is nothing but a drawbore pin that has been filed to a sharp-edged square cross-section.

You are approaching final assembly of the joint stool. Don’t hurry. Drawboring is the heart of the matter. (Again, our example applies to the build in “Make a Joint Stool from a Tree,” but the technique can be applied to any drawbored mortise-and-tenon project.)

After the two straight frames are fitted it’s time to take up the angled side frames, test-fit the aprons and determine the length apart, and set the straight rails aside. Take two mating stiles that define one side of the stool and ensure you have the correct stiles.

Now pare and fit the tenons from one apron to these stiles. Take this apron all the way to the drawboring stage, then test-fit the two stiles and the apron. The stretcher’s shoulder-to-shoulder length is found by scribing, not measuring. Place a side stretcher on its stiles with the stretcher’s upper edge lying across the stile’s faces. Line

the stretcher up so its front shoulder meets the stile’s arris right at the point that marks the top of the mortise.

Now prick a mark on the stretcher where it hits the other stile. That’s the point from which you should lay out the other tenon shoulder with the adjustable bevel. Then complete the tenon as before. Some of this seems a little upside down, but it gets you a closer fit than working from measurements.

There’s no need to hurry here. Check the layout before cutting the second tenon.

Mark the inside of the side rails with this joint I.D. system: One end of the side rails is marked with the chisel, the other end with a gouge. Repeat the whole process for the other side stretcher. They should be the same length or very close. If they are too far off, the stool will be out of square.

Now you can test-fit the entire joint stool frame. Then knock it apart again. It’s time to make the pins and assemble the stool frame.

Make the Pins

For the pins to pull the joints together, they must be incredibly strong. Make them from the straightest-grained off-cuts you can find. Alexander and Follansbee have different approaches to pins; we will show you both methods.



Offset. This offset looks like it will work fine. Experimentation will help you get the hang of it. There’s leeway involved; it’s not an exact science. Too much offset can be fixed more easily than not enough.

“Shall the ax boast itself against him that heweth therewith? or shall the saw magnify itself against him that shaketh it?”

— Isaiah 10:15 (King James Bible)

Alexander uses a shaving horse and drawknife to make very carefully tapered long pins from riven straight stock. Select the best straight-grained 15"-long rail stock. Rive this into $\frac{1}{2}$ "-square sticks. Hold the stick in a shaving horse and drawknife a 5"-long square on the butt so that the shaving horse can secure the stick and register it when it is rotated 90° at a time. Support the thin stock with a narrow board held under the workpiece. Place the square butt under the shaving horse jaw and make a 10"-long taper. Bore a test hole in a thin board with your piercer bit and taper the pin until it goes halfway through. Try your drawknife with the bevel down and up to see what works best for you. After the tapered square stick is finished, slightly relieve the corners.

Follansbee shaves pins at the bench from short (5"- to 8"-long) stuff using a large, broad chisel. These blanks are riven into sections about $\frac{1}{2}$ " square using a stout knife or small cleaver as a sort of mini-froe. Hold the blank from



Scribe. Find your shoulder-to-shoulder length by scribing. This concept works without fail if you follow the steps; no ruler, no numbers. It’s accurate and quick.

MAKE THE PINS



Alexander shaves the pins. Working long stock like this goes hand in hand with using the draw-knife and shaving horse. The extra length also lends itself to getting a long and gradual taper, the best form for these pins.



Follansbee rives. Riving principles apply here, just as on larger-scale stuff. Split in halves. Straight-grained stock is key. Never throw out any perfectly straight off-cuts, and keep a large supply on hand. The pins are the driest stock in the whole stool.



Posture counts. It's easy to think you just trim the pins, but there's more to it than that. Body posture makes a difference. The left hand is braced against the torso, helping to hold the stock steady. The right hand has the chisel tucked against the body as well. Very smooth and powerful movements guide the chisel.



Facets. The pins we've found protruding inside stools and other joined works are usually faceted like the ones shown here. There's no need to make them perfectly round; driving them through the joint will burnish them to a degree.

its top end and shave downward with the broad chisel. Position the tip of the pin on a piece of scrap wood so you don't mark up your bench. Working each face in turn, shave them into even squares.

Then taper them by paring down with the chisel, taking shavings from each face for an even taper. Sometimes you need to flip the pin end-for-end to get the right amount of taper. Once it's tapered, shave off the corners so the resulting piece is generally octagonal. Then point the thin tip with your chisel or a knife.

People are leery of shaving small stuff like these pins with a large chisel, but like many of these procedures, body position and movement make this task simple and efficient. For a right-handed joiner, hold the chisel in your right hand with the forefinger extended along the back of the chisel. The chisel is braced in your grip, and your arm is tucked against your torso.

The movement comes from your legs. Rise up on your right foot and come down with the chisel in place. With your arm braced against your torso, you limit the travel of the chisel. It is quite a short stroke. This posture provides considerable power and accuracy. With some practice you will become quite accurate and able to shape pins quickly and easily.

Assemble the Stool

At assembly, it's a good idea to take a moment to clear the bench of extra stuff that will be in the way. Start with the straight front and rear frames of the stool. Check the marking system, and gather two stiles, and an apron and stretcher that fit them.

Put the apron and stretcher into one stile then lay the stile on the bench with the rails pointing upward, and drop the other stile onto the tenons. Knock things about to fit the pieces together, and drive the apron upward until its top edge aligns with the scribed lines on the stiles that mark the top of the stool. When you are satisfied that things are as they should be, tap a metal drawbore pin into each joint.



Assemble. The extra length at the top of the stile is helpful for knocking things this way and that. A wooden mallet shouldn't mar the stock, but it's best to strike it where it doesn't matter.

Now remove the pin(s) from one joint and hammer in your oak pins. It helps if the pin is pointed when starting it in the drawbored holes. Hold the oak pin steady and hammer it down into the joint. Listen as you drive it; the sound will change pitch as the pin reaches the point at which it will go no more.

Make sure as you are driving these pins that there is clearance below the stool's frame for the pin to exit. You can try to align things on the bench so you are working over one of your holdfast holes. Stop just before the stile splits. Now drive the next pin. Do one stile's apron and stretcher, then pin the next stile to that assembly.

If the pin threatens to break, trim it off so it protrudes just an inch or two above the face of the stock, then drive it some more. This often steadies the pin so it can withstand further blows.

Trim the Pins

Trim the pins on the inside of the assembly any number of ways. You can saw them off or trim them with a chisel or gouge. Use the chisel bevel down and pare from both sides. Cutting straight across will blow out the edge of the pin. Trim the outside just above the surface with your tenon saw, then pare it down to the surface with a broad chisel, again held bevel down.

Once the front and rear frames are assembled, trim the pins. Then set the



Steady on. Steady, even blows from the hammer are what you are after here. An errant hammer blow can shatter the pin, and then it's difficult to remove. No need to hurry; take your time and drive them home. It will be helpful if you make a test joint or two.

frames face-down on the bench, with the feet pointing at each other.

If you marked your joints clearly, this step is a snap. If you didn't, then it can be pretty confounding. Many of these pieces look alike, and sometimes they will almost fit together the wrong way. That's enough to really cause confusion. We've built stools with parts upside down before. It's not hard to do. But it is hard to un-do.

Next, drop the end rails into the mortises in one frame. It doesn't matter which, but check all joint I.D. marks so you have the proper rails in place. Also make sure all the joints are bored for pins. Then fit the other frame down onto these rails. Just as before, knock things about until the frame is all test-fitted again.

Lay the stool on one side frame and insert the drawbore pins in the opposite frame. Repeat the procedure with your oak pins just as you did for the straight frames. Trim the pins on the face so you can then flip the stool over onto this face to drive the last pins in the final frame. Now the stool is all pinned, and you're ready to trim its feet and top. **PWM**

Jennie Alexander (formerly known as John Alexander) is the author of "Make a Chair from a Tree" (Taunton). Peter Follansbee is the joiner at Plimoth Plantation, the host of two DVDs on 17th-century style carving (both from Lie-Nielsen Toolworks). Both authors have written numerous magazine and journal articles.



Flush the pins. There is a tendency to try to pare straight across the pin's head. You might get away with it sometimes, but it often causes tear-out. Get in the habit of working from both sides of the pin. It takes only a minute to do it right.

ONLINE EXTRAS

For links to all these online extras, go to:

■ popularwoodworking.com/jun12



IN OUR STORE: "Make a Joint Stool from a Tree," by Jennie Alexander and Peter Follansbee.

ARTICLE: "A 1600s Joiner's Tool Kit," by Peter Follansbee.

ARTICLE: "The Best Oak Money Can't Buy," by Peter Follansbee.

BLOG: Read "Joiner's Notes," Peter Follansbee's blog.

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