# *Three Legged Stool*

***Randy Cordle / 2016***

This stool could easily qualify as fine furniture, being equally at home in the living room or featured at the local arts and crafts fair. A few unique construction features allow it to be built quickly and easily enough that you won't feel bad about making one for your shop.

The virtues of three legged stools are widely known; they use less material, are quicker to make, and always set solidly on uneven surfaces. The drawbacks of being considered tippy and appearing to be visually unbalanced are greatly reduced by increasing the leg angles, although excessive leg angles can result in leg ends that project far enough beyond the seat diameter to create a trip hazard. The 14 degree leg splay angle used here is worth the additional leg projection as it ensures an attractive and stable design.

This design features a few unique construction details that make it both quick and easy to build, while leaving the casual observer to wonder exactly how they are done. The first detail can be found in what I refer to as a wave joint; easily created with the band saw. Contrasting wood strips replace the band saw kerf width to create a pair of flawlessly joined seat joints across the three piece seat. Another feature are the stretcher ends which appear to pass completely through the legs. This is accomplished by housing the stretcher ends in shallow tenon mortises, the stretchers anchored by using glue and 2" long #8 drywall screws. A tenon mortise is added to the outer side of the legs in line with the stretcher ends and is used to house faux tenon ends which cover the screw heads anchoring the stretchers.

All three leg stretchers are offset by 1 inch in height so the stool can be rotated to find the most comfortable position upon which to rest a foot. Although all measurements are provided on the drawing, the design is very easy to adapt for any desired height, seat diameter, leg angle, stretcher positioning, or anything else you may wish to modify. The design is so easy to work with that precise measurement isn't strictly necessary. Stretcher lengths are determined as the stool is built, thereby making this a truly versatile and easy project.

Economical to build, the entire project can be completed from an 8 foot length of 6/4 rough lumber 5-1/2" in width. A small amount of wood selected to contrast the primary wood selection is used to create the filler strip for the wave joint and the wedges for the leg tenons.

The building process is divided in four steps, (1) seat, (2) legs, (3) stretchers, and (4) finishing. Let's get started.

Seat

The seat is made by planing rough stock, gluing the overlapping sections together, drawing the wave joint over the lapped areas and cutting the sections apart with the band saw. I use a 1/2" 3 T.P.I. skip tooth blade on my band saw and it results in beautiful joints.

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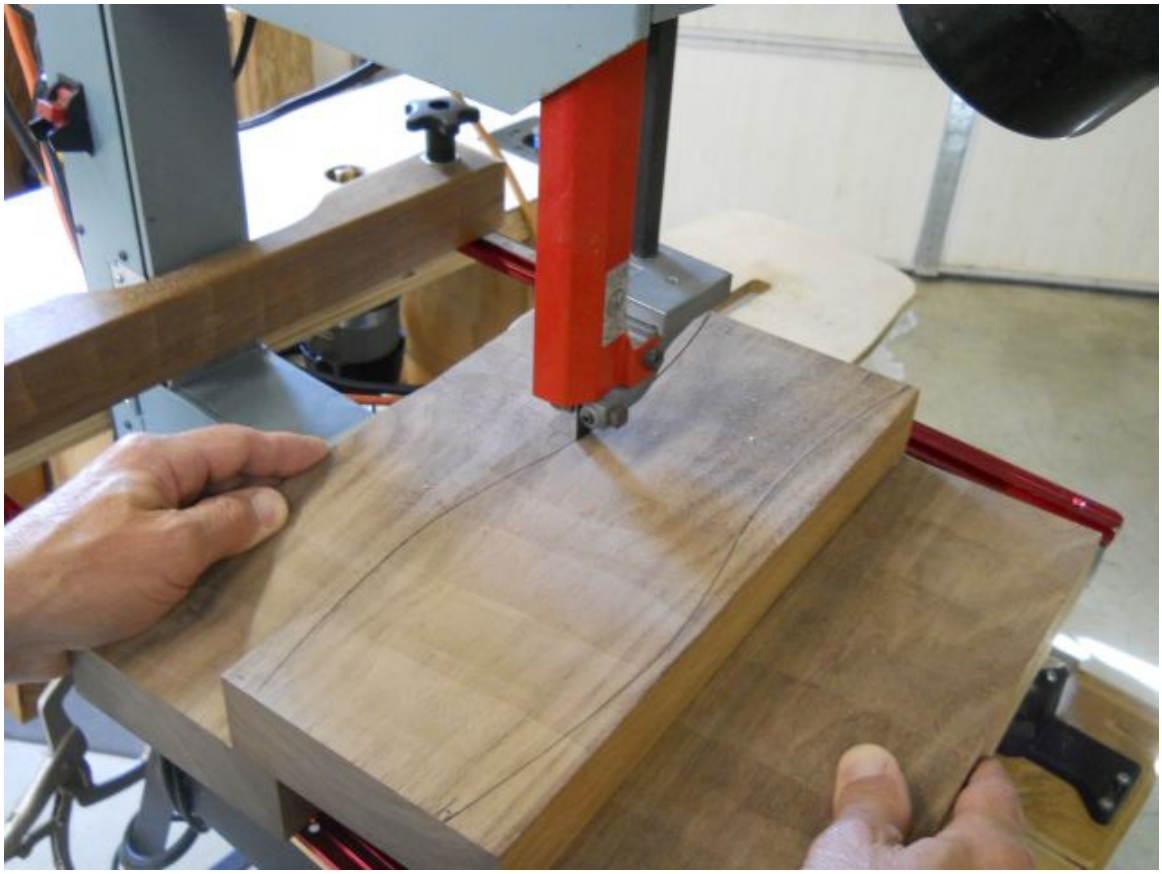
Marking the wave joint:

Cutting the wave joint with band saw:



The waste pieces created as a result of cutting the overlapped sections apart are trimmed off in preparation of glue up of the seat blank. I cut the bulk of the waste pieces away using the band saw and clean up most of what remains by lightly planing.

Cut away the waste areas that remain glued to the seat sections:

The secret to successfully joining these sections together lies in creating the contrasting wood filler strips that are sized to perfectly match your band saw kerf cut.  Create a short cut in a scrap block to use in sizing the filler strips that will be added between the seat sections. Press the joint edges together to check the fit, but DO NOT sand or otherwise alter the faces of the joints created with your bandsawn cuts.  Cover all mating surfaces with glue and clamp the seat blank together for 24 hours.

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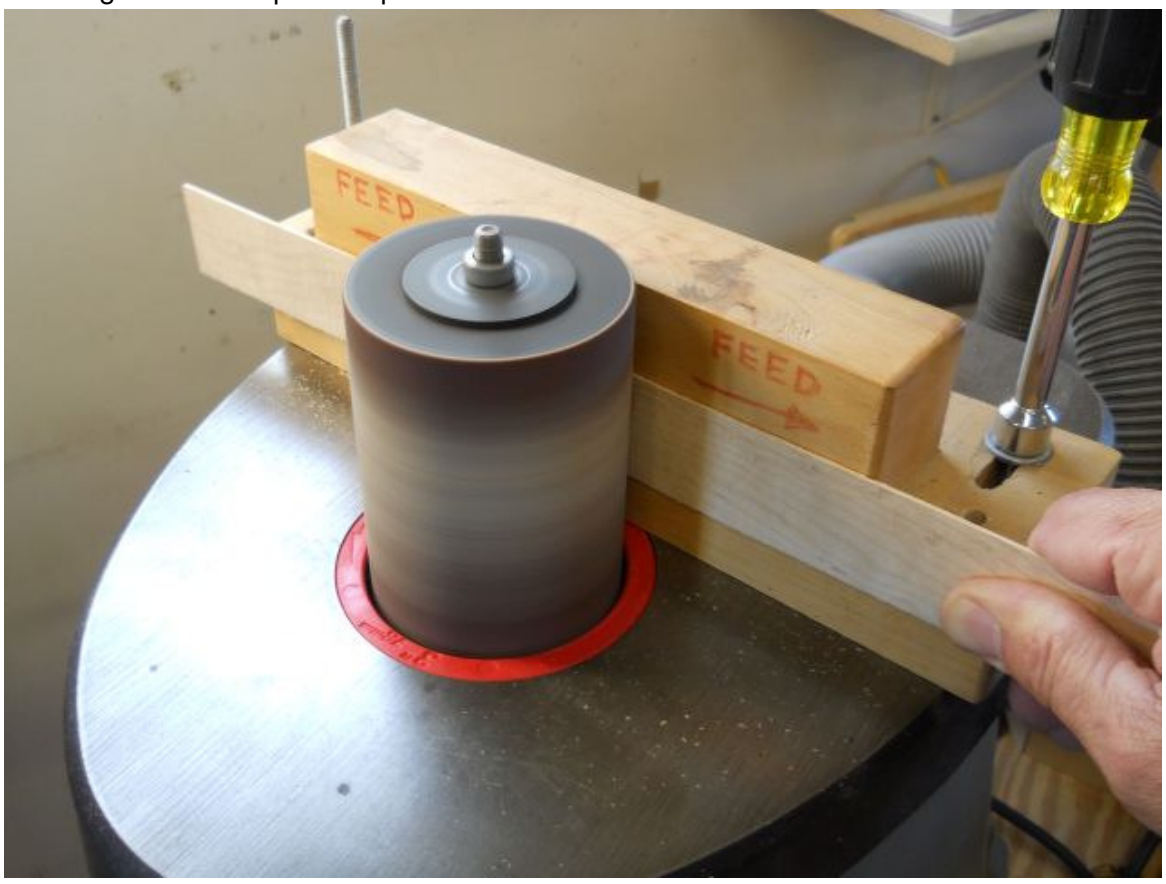
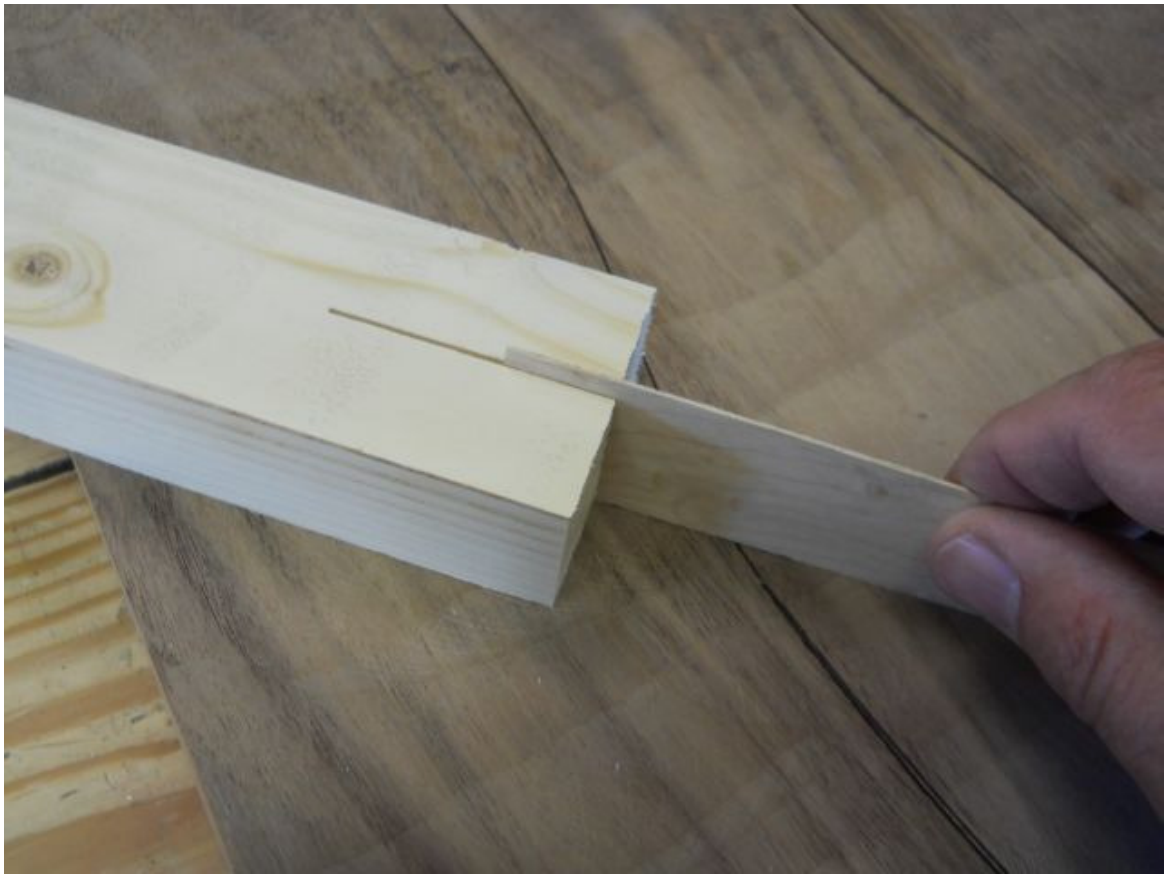
Creating the filler strip that replaces the width of the saw kerf:




Checking the filler strip thickness by using a scrap of wood with a bandsawn kerf:



Seat sections and filler strip glued together:

The seat blank is cut out slightly oversize and mounted to the lathe faceplate with four screws. Proper mounting protocol is necessary, so make sure the seat blank is securely mounted to the faceplate.  The #10 screws used here are sized to make certain there is a full 1/2” of material available to turn the 3/8” deep seat profile with no danger of contacting the screw tips.

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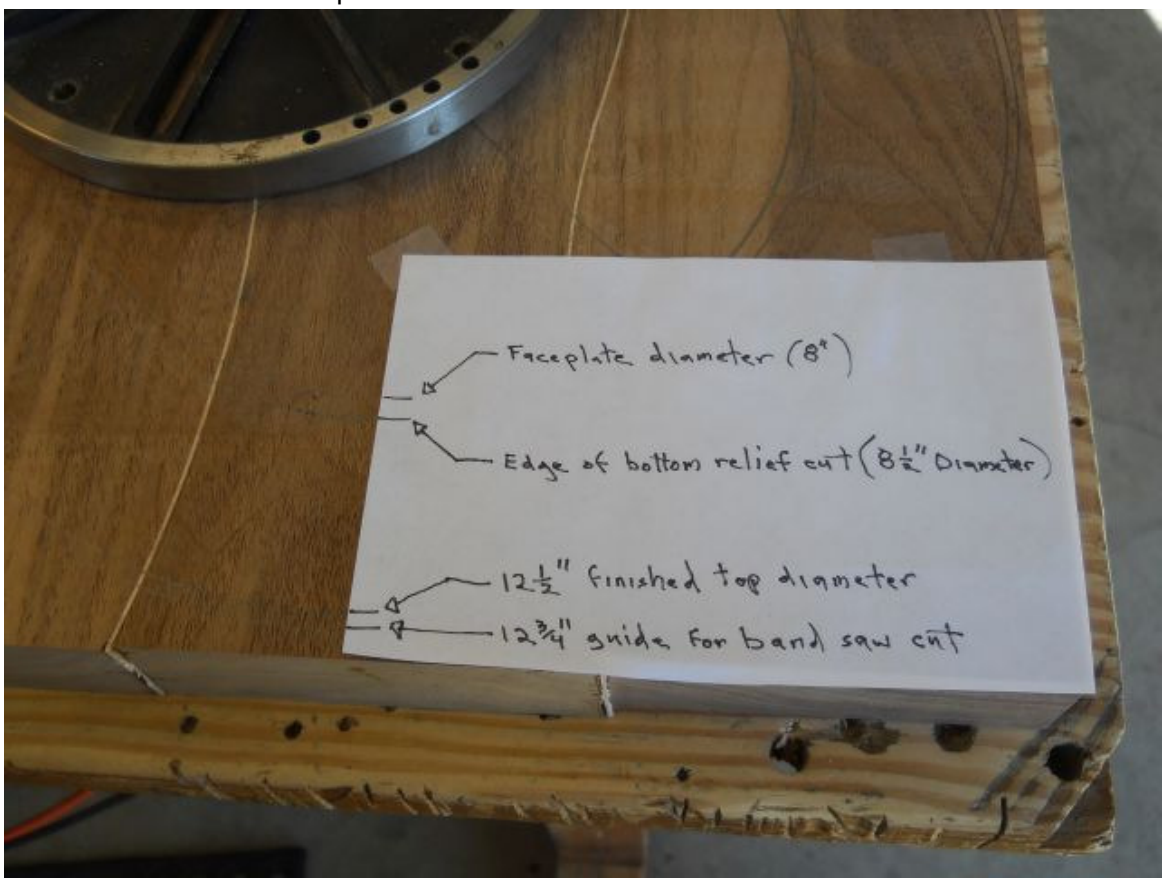
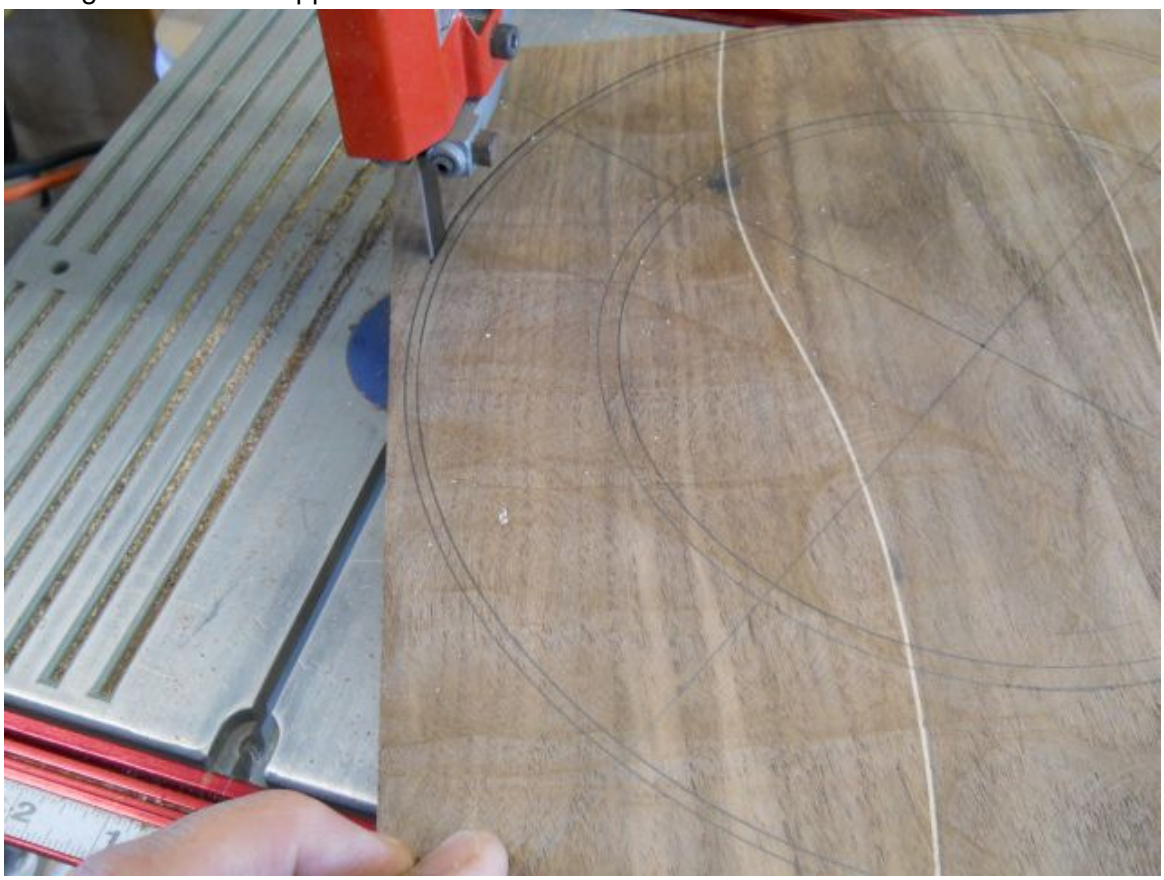
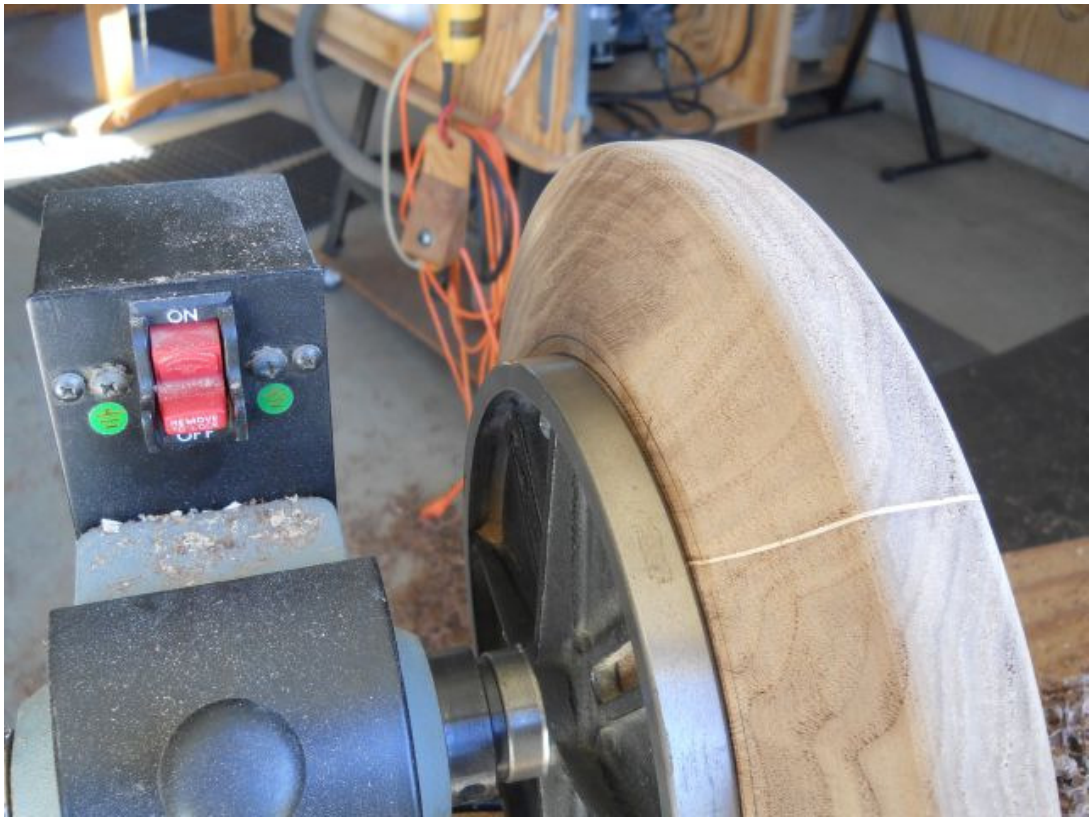
Details of seat blank rear profile:




Cutting seat blank to approximate finished dimension:



The outer diameter is trued, the bottom angle cut, and the outer edges rounded before forming the gently contoured seat top surface. The seat blank is sanded to remove all of the remaining lathe marks using a 220 grit disk on a 5” random orbit sander.




Straightedge shows top contour:

Sanding seat top contour, easier to do after removing from lathe!

Don’t despair if your lathe capacity isn’t large enough to turn the seat diameter. It is perfectly acceptable to cut your seat outline with a band saw and finish the shaping with alternative tool choices. Band sawing the seat profile is also a good option if you would prefer to make an alternative seat shape such as a large triangle.

There are various ways of drilling the leg tenon mortise holes, but I prefer using a simple wooden guide clamped to the top of the seat to align and hold the bit at the proper 14 degree angle to create the proper splay for the legs. The guide has a U-shaped wood saddle screwed over the angled end that keeps the bit aligned both side to side and at the correct 14 degree angle. The holes are drilled 4-1/2” from the seat center. The front hole is located mid-way between the wave joint and the remaining two are spaced 4-1/2” from the center and 120 degrees apart using a simple layout guide. I prefer drilling from the top as the hole created by the Forstner bit will have sharp edges with no visible tear-out if the bit is held firmly by the alignment jig. A bit of scrap wood can be clamped against the bottom exit area to minimize the chance for tear-out as the bit exits the seat bottom.

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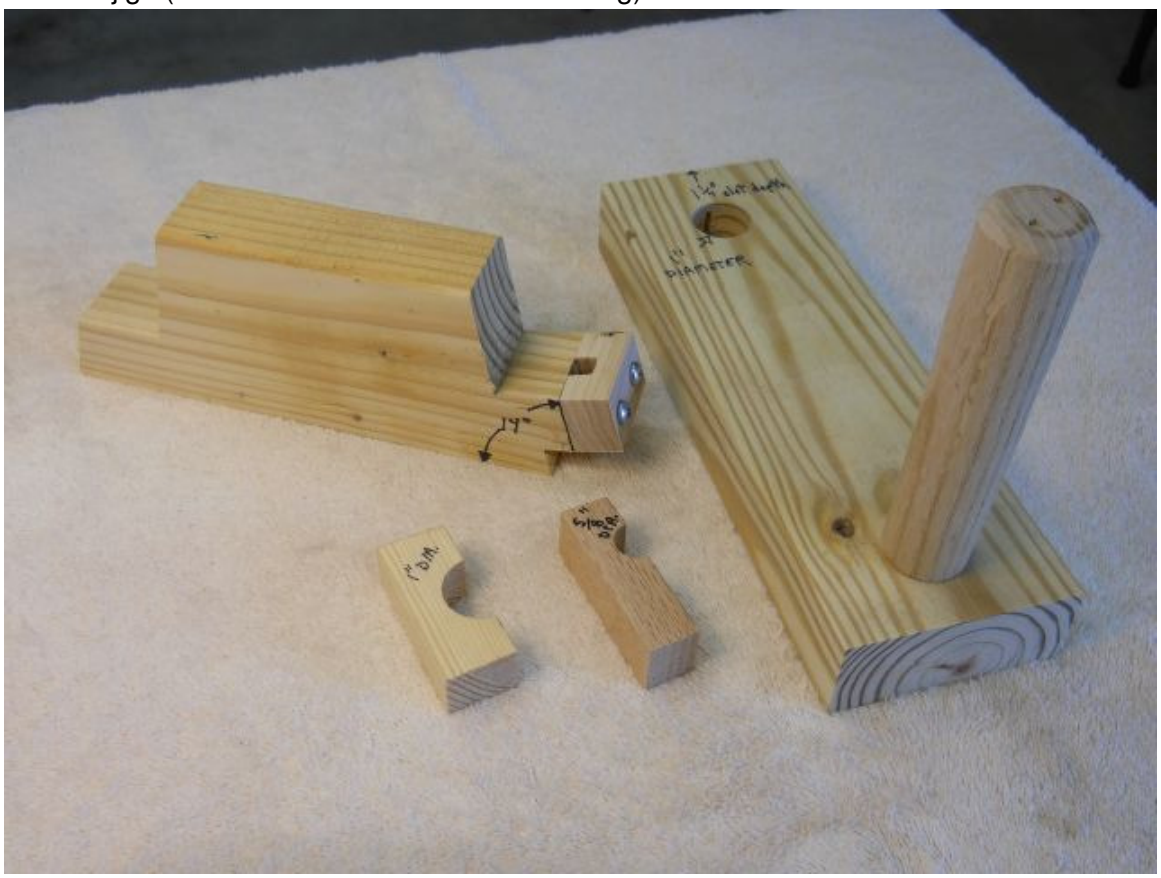
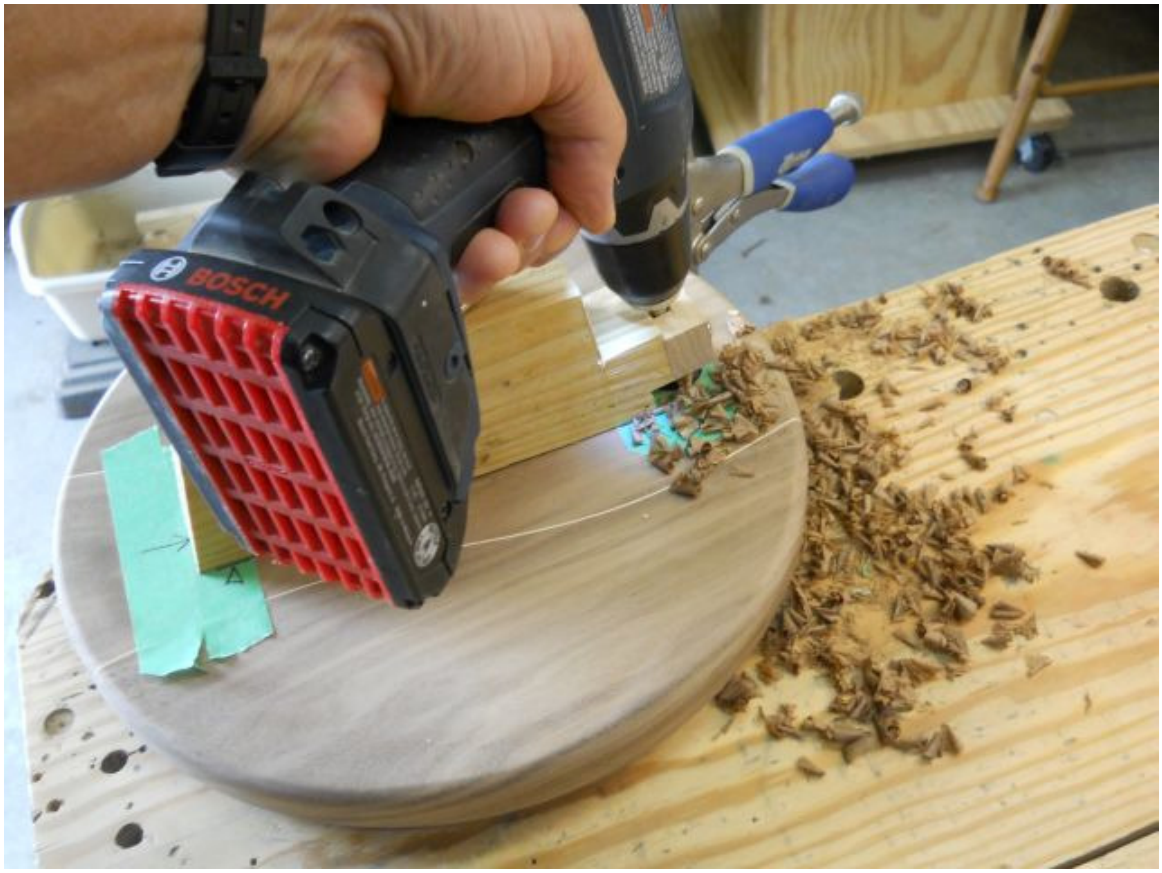
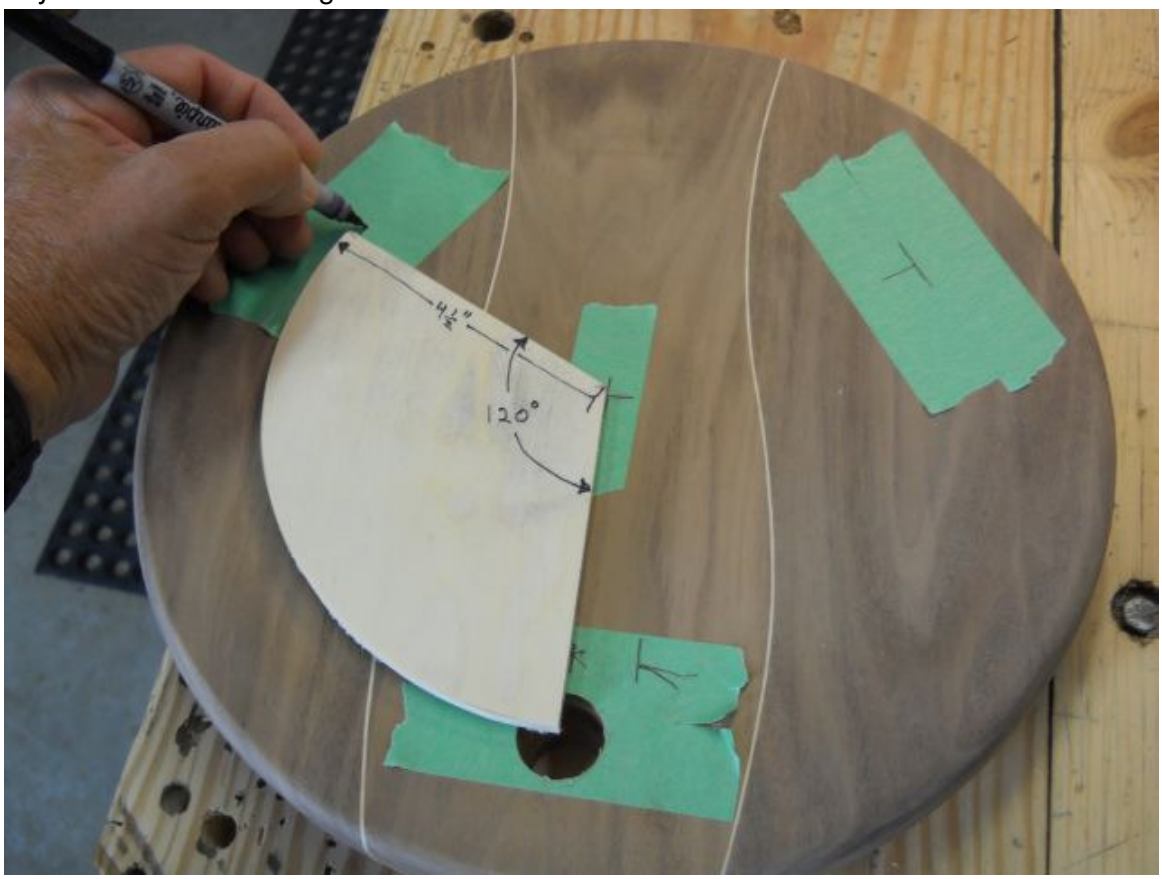
Various jigs (as detailed on construction drawing):



Drilling the leg tenons with the Forstner guide:



Layout of the two rear leg tenon locations:




Legs

Basic cylinders are lathe turned to make the leg blanks and the desired dimensions are marked along the length to create three uniformly shaped legs. The 1-1/2” tenon area (immediately behind the drive spur mounting area) is turned to a 1” diameter to match the drilled leg tenon mortise holes in the seat blank. Standard tenon sizing techniques can be used to create the 1” tenon but I use the “sharpened wrench tenon sizing tool” (widely popularized in Youtube videos) to quickly form a close to ideal diameter for tenons. I made my 1” tenon sizer from a 1” combination wrench by grinding back the front 1/4” of the wrench’s top jaw to create a sharpened cutting tip. It is best to rough turn each tenon area about 1/8” oversize and then switch to the tenon sizing tool. The tool is eased over the slightly oversize tenon diameter while the longer bottom portion of the wrench opening is kept pressed up against the bottom of the turning. This sounds tricky, but it’s actually quite easy, with the cutting action of the top of the wrench jaw stopping instantly as the wrench jaw opening width is reached and the wrench slips over the sized tenon. I was dubious about how well these would work until I invested the 8 dollars for the 1” wrench and tried it for myself. The tenon sizer turns the otherwise tedious work of accurately sizing tenons into a quick and easy process. I won’t be other methods of sizing tenons anytime in the near future!

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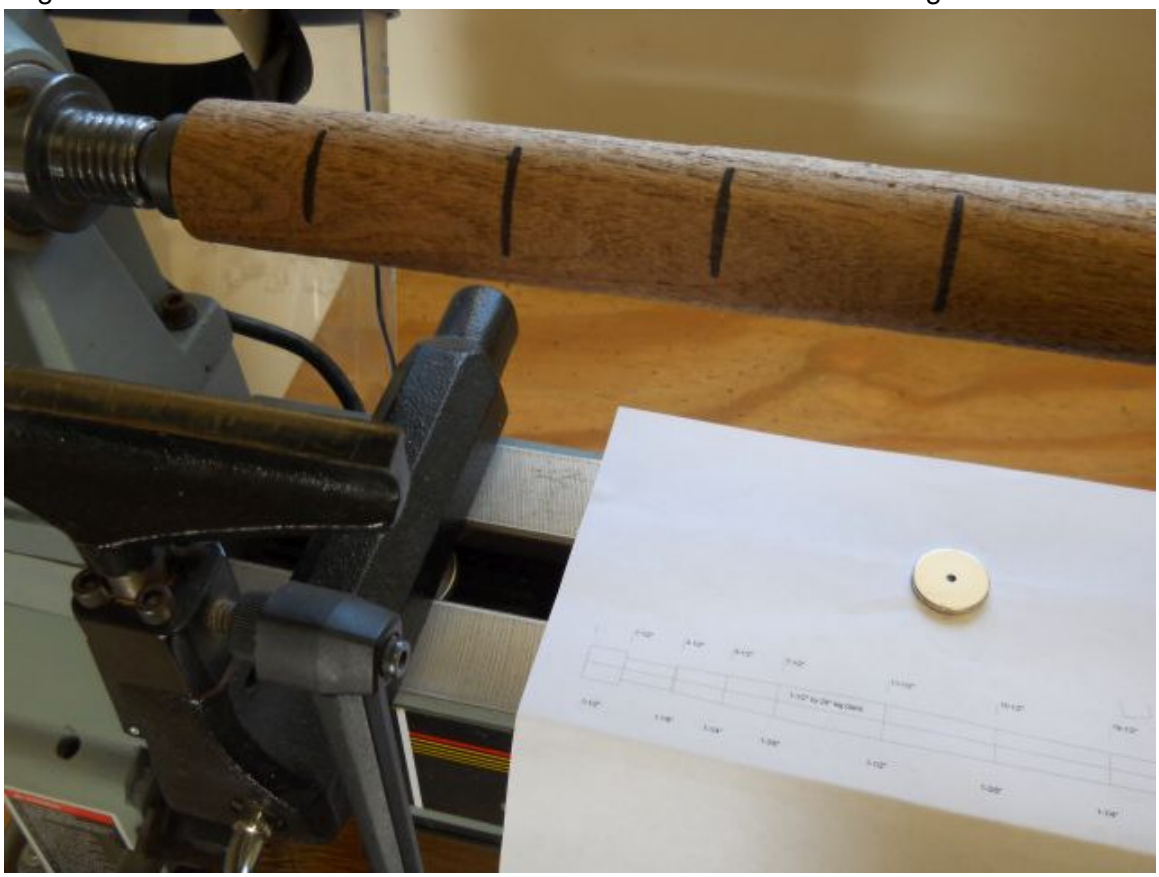
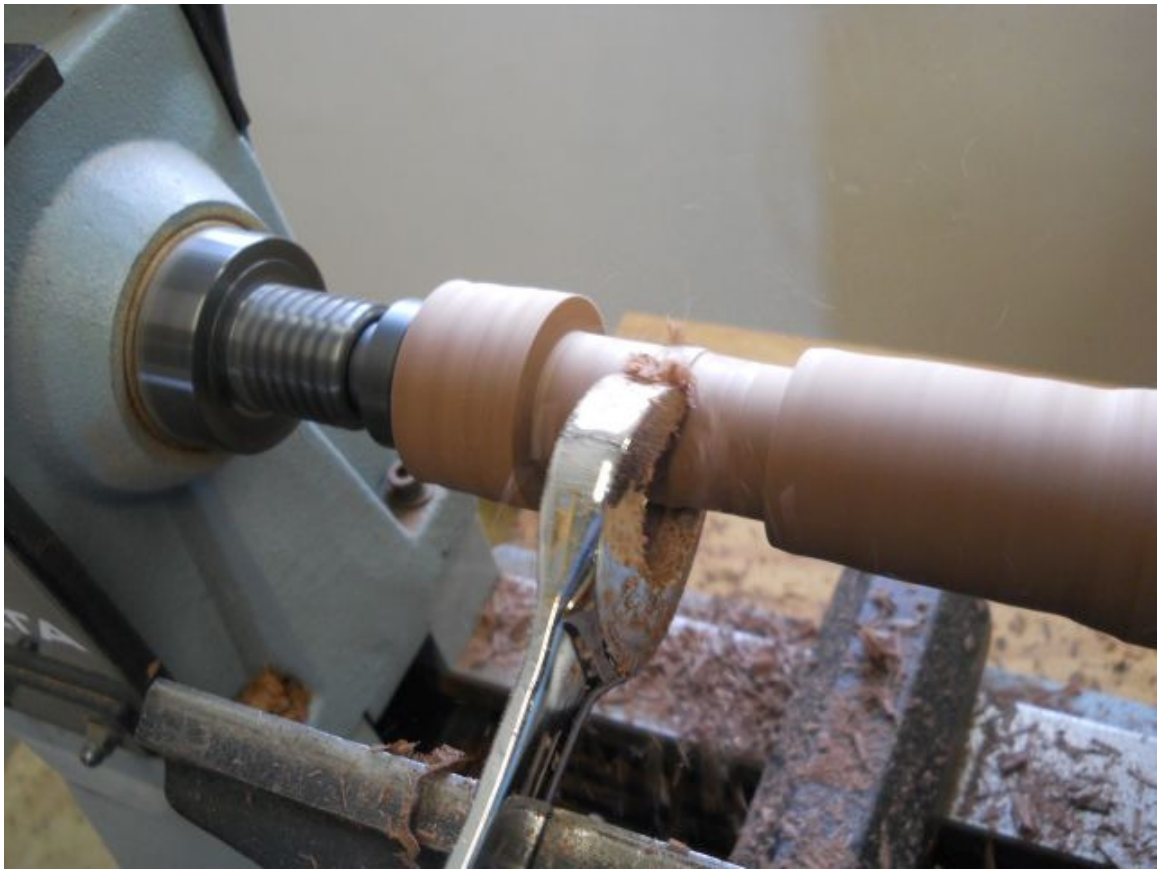
Legs marked to indicated diameter measurement locations from drawing:



Using a “sharpened one inch wrench” tenon sizing tool:



Sizing tenons in this manner will get you very close, but it is still necessary to fine tune the tenon diameter. I use a simple gage made by boring a hole in a hardwood scrap with the Forstner bit and cutting it exactly in half. Sand the tenon a bit, stop the lathe and check the fit. The test gage will mate with the tenon perfectly when it is sized correctly. After the leg tenon is sized the remaining marked intervals along the leg are turned to the proper diameters and the waste between these areas removed to complete the rough tapered legs. True up the surface profiles and sand them to create a finished leg.
When you're satisfied with the leg you can remove it from the lathe and trim the excess length where the drive spur and live center were used. Leave the excess top tenon length; it will be trimmed when fitting the tenon to the leg mortise in the seat.

Checking tenon size with a gage made from scrap drilled with a 1" Forstner bit:

The legs are now fitted to the leg tenon mortise holes previously drilled in the seat. Each leg tenon has the excess tenon length marked about 1/8" above the seat surface. The legs are removed and the excess tenon length trimmed away with the band saw. A line is drawn across the top of the leg tenons at 90 degrees to the tenon end grain to indicate the location of the leg tenon wedge. Rotate the front leg so the wedge will exert pressure in the same direction as the wood grain of the top to prevent any chance of the wedge splitting the seat top when it is driven in. The remaining two legs are turned so the wedges point to the center of the seat. Purely an aesthetic decision, the wedges could also be oriented in the same direction as the front leg wedge if desired. Do mark each leg so it can quickly be replaced into the same hole and oriented in the same way. You don't want to try and figure out how you want the tenon wedge positioned after it glue has been applied and it is inserted in the seat hole. Moving joints around can quickly become difficult once the glue is applied and the tenon is inserted in its corresponding hole.

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Leg tenons trimmed so 1/8” protrudes above seat surface:

Cut the leg tenon wedge slots as a last detail before adding the legs to the seat. A scrap of 2 by 4  is drilled to hold the leg tenon while cutting a slot for a wooden wedge. The slot width isn’t critical; the blade you have installed on your table saw will do fine. Set the blade height to cut the wedge slot to within 1/8” of the flared area of the leg that will butt against the bottom of the seat.

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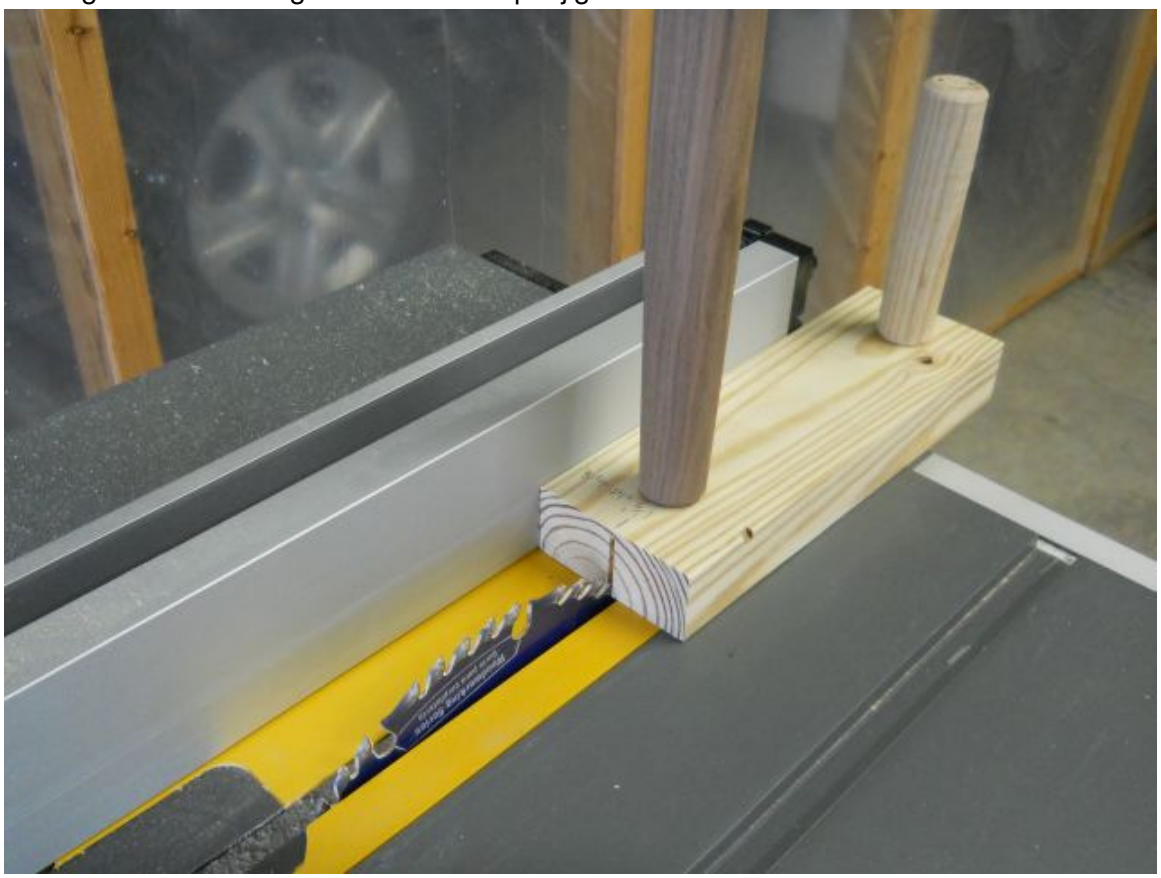
Cutting the tenon wedge slot with a simple jig and table saw blade:



Contrasting wood wedges are cut to match the tenon hole diameter. The wedges are made by cutting a strip of contrasting hardwood to the width of the tenon diameter and about 1/16” thicker than the slot. The strip is sanded to create a long taper length that matches the wedge slot depth, the wedge cut to length, and the procedure repeated two more times so you have three wedges ready to go.

Painter’s masking tape is applied to all surfaces that might have the possibility of excess glue contaminating the wood surfaces. A bit of preparation saves a LOT of surface prep work later. Cover the mating surfaces with glue, insert the legs in the seat holes, making sure the wedge slots are aligned correctly, driving in the wedges to tighten the joint. Let the glued tenons dry 24 hours before doing any further work on them.

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Gluing leg tenons into seat and locking with tapered wood wedges:

The tenons and wedges are carefully brought down close to the seat surface with a 150 grit sanding disk in a 4” right angle grinder. Use a light touch, a new sanding disk, and short intervals of sanding so as not to burn the end grain of the tenon.  The tape does double duty here, acting as an aid against getting overzealous when bringing the tenon end down flush with the seat top.  A 5” random orbit sander with a 220 grit disk performs the final leveling nicely after the tape has been removed.

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Quick and light cuts with a 150 grit disk levels tenon end to seat surface:

Final leveling done with a 5” random orbit sander fitted with a 220 grit disc:

Stretchers

With the legs now solidly glued in position we'll make up the stretchers that run between the three legs. Each stretcher will be measured for length and lathe-turned, with the taper ending in a 5/8" diameter tenon end that will be housed in the leg mortises.

Three sets of blocks are cut to transfer the desired stretcher heights to the correct location on the legs as referenced from floor level. To position the stretchers on approximate 7", 8", and 9" centers three marking blocks are cut 6-3/4", 7-3/4", and 8-3/4". Stretcher locations were chosen by determining comfortable foot rest heights and visually balancing the overall design of the stool. Mark the stretcher positions on the legs and drill 3/8" deep tenon mortises with a 5/8" Forstner bit at the 6 marked positions. Exact depth isn't important; I drill until the Forstner bit body is flush with the surface which comes close to the 3/8" specified depth. One of the blocks matching stretcher height can be positioned at the rear of the drill to visually assist with keeping the drill level as each tenon hole is drilled while visually aligning the drill between the legs as the tenon mortise is drilled. Repeat the process to drill the corresponding tenon mortise in the opposing leg. Follow the same procedure to drill the tenon holes for the remaining two stretchers.

Pairs of blocks are used to mark stretcher centers at three different heights:

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Drilling pocket mortise for stretcher end; block used to assist with vertical alignment of mortise:

Determine the three stretcher lengths needed by measuring the distance between tenon mortise bottoms and lathe turn the stretchers. Make them an inch or two longer than the precise length needed and trim them to length as they are installed. Stretchers are turned to 7/8" diameter at the centers and taper down to the 5/8" diameter tenon ends. Stretcher tenon sizing was again done by using the "sharpened wrench" technique. The tenons will end up being just a tiny bit oversized and are brought down to their final diameter by using sandpaper. A tenon sizing gage as used previously for the leg tenons is made to assist with correctly sizing the stretcher tenons.

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Checking tenon diameter on stretcher end:

Carefully cut the stretchers to exact length, keeping them in the correct locations since they will all be different lengths. You can save the cut off pieces to use as faux tenon ends if you don't want to make them separately as outlined later.

Before installing the first stretcher we'll need to add the 3/8" depth stub mortise to the opposite side of the stretcher mortises to house the faux tenon end that covers the screw head. This is done by drilling through the leg to the outside face with a 3/32" bit, using the dimple left at the bottom of the drilled tenon mortise to center the drill. The exit hole at the outside of the leg is used as a guide for the center tip of the 5/8" Forstner bit to create a 3/8" deep stub tenon mortise to house the faux tenon end. Visually align the drill with the stretcher's location so the faux tenon end will appear to be the extended end of the stretcher tenon. Enlarge each of these 3/32" holes to 11/64" followed with a countersink to create the clearance hole for the #8 by 2" long drywall screw used to secure the stretcher in the leg tenon mortise.

Install the first stretcher in its leg tenon mortises, first one end and then carefully tucking the opposite end into its corresponding tenon mortise. I orient the grain of the stretcher vertically for additional strength in that direction. The stretcher end is now pilot drilled with a 1/8" drill bit for the 2" long #8 drywall screw. Mark the exact stretcher orientation by using a couple of pieces of painter's masking tape at the mating edge of one stretcher end and where it meets the leg tenon mortise. Carefully remove the stretcher, clean out any debris from the mortises, apply glue to the inner walls of the mortises and reposition the stretcher. Lubricate the screw threads with a bit of wax and snug them down to pull the stretcher tightly into the leg tenon mortises. Mask around the joint before assembly if you tend to be ham-handed in your glue application, but in any case clean up any glue squeeze out immediately.

Repeat the process for the remaining two stretchers.

The last step in stretcher installation is to add the faux tenon ends. If you didn't choose to use the cut off pieces from trimming the stretchers you can use a 14" length of 1" square stock is used to turn the six 1-1/2" by 5/8" diameter stub tenons.  I find it's easier to make them from a single turning rather than handle the small cut off pieces.

After turning, sizing and sanding the stub tenon sections they are ready to be cut to length with the band saw. Each stub tenon is cut to length so the pre-beveled end protrudes slightly beyond the mortise edge and glued in place with a bit of glue placed on the walls of the stub tenon mortise. When the faux tenon ends are in place it looks very much like each stretcher tenon end passes entirely through the leg.

"Stub tenons" are turned and sanded, ready to slice off and cover the stretcher mounting screws:

Finishing

Lightly sand any areas that might need attention and apply your finish of choice.  I like to use three coats of satin wipe on polyester varnish for a fast and durable finish. Let the finish completely cure for a few days and lightly buff with 0000 steel wool to knock off any surface dust. All that's left now is to practice your sitting technique!

Beautiful as well as practical, once you get a feel for how easy this type of stool is to produce you may end up making more for additional practical seating, plant stands, gifts for friends and relatives, or even as a craft show staple.  The laminated wave joint and faux tenon construction will get plenty of admiration and are so quick, easy, and attractive that they  are sure to find their way into a wide variety of your woodworking projects in the future.

Wave joint in seat top:

“Faux” through tenons:

The completed stool:

I hope you've enjoyed this pictorial guide to the construction of the Bluestem Three Legged Stool.
Thank you for your interest!
Randy Cordle / Bluestemstrings.com / 2016