Make a Shapely Bowsaw

BY WILLARD ANDERSON

Proper, tapered handle holes make this piece period-correct.

Curvaceous. This bowsaw, a reproduction of a mid-19th-century example with exuberantly curved arms, features traditional tapered pins – unlike modern commercial bowsaws.

The bowsaw is an ancient tool and a member of a class of saws called frame saws, in which tension from the frame is designed to hold the blade taut. Also sometimes called a "turning saw," the bowsaw features a very narrow and thin blade with handles that turn in the frame – that makes it particularly useful for cutting curves and fretwork. Because the blade is attached by means of loose pins that are inserted in holes at each end of the blade, it is easy for a blade to be removed from the frame and slipped through a pilot hole in the stock, then remounted on the frame for cutting.

Bowsaws range in size from 6" (about the size of a modern coping saw, which is also a frame saw) to about 15" in overall length. The bowsaw contrasts with other frame saws, such as veneer and felloe saws, which feature wider blades fixed in the center of the frame and are typically used for ripping or cutting stock lengthwise.

I spied the antique bowsaw shown in the top right photo on the facing page at a tool sale, judged it too expensive to purchase, then asked the owner to lend it to me so that I could make a reproduction. He generously gave his consent. Here's irony: The cost of reproducing this bowsaw exceeded the original's price. However, what I got for my extra money was an invaluable lesson in the design and construction of the form.

> "Men admire the man who can organize their wishes and thoughts in stone and wood and steel and brass."
>
> — Ralph Waldo Emerson (1803 - 1882) American philosopher and essayist

About the Saw

The history of the bowsaw I used as a model is interesting. Although the maker of this saw is unknown, we do know that the boxwood handles were made by James Howarth, a toolmaker in Sheffield, England, who worked between 1835 and 1863. The handles were made in the earlier years of the James Howarth firm, based on the stamp details. But if the handles were sold separately, then it is hard to say when the complete bowsaw was actually made.

The feature of this saw that appealed to me most was the delicate windlass used to tension the blade. The toggle of the windlass is neatly tenoned into the stretcher's mortise, and is tenoned through a mortise in the whorl. One of the saw's arms is shaped very gracefully and was likely the original construction, because the brass blade hardware is fitted into a tapered hole in the arm to match the taper of the brass pin. The other arm is a replacement, less well-shaped but precise in its joinery. The maker of this arm just drilled a straight hole for the handle. The saw frame shows evidence of the shaping process in various drill, rasp, carving gouge and saw marks.

The shoulders for the mortise-and-tenon joinery for the arm and stretcher were radiused to a 2¼" circle and the tenon corners were relieved. The joinery keeps the shoulders tight as the handles seat more deeply with wear, or where there is variation in blade length. The mortise for the original arm was drilled with a 5/16" bit in three steps, then it was squared. The mortise in the replacement arm was just chopped out.

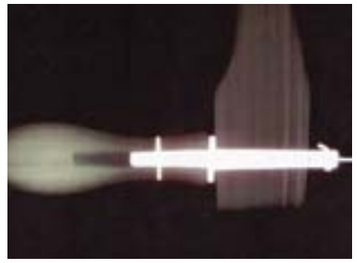
The rectangular mortise in the whorl appears to have been cut with a mortising machine in two steps, halfway from either side of the whorl, based on the appearance of rub marks on the inside of the mortise. Because this mortise may have been cut on a machine as opposed to by hand, it is possible that the maker purchased this part of the bowsaw from a vendor who specialized in this type of work. The groove for the cord in the whorl appears to have been cut to depth with a crosscut saw, a conclusion based on saw marks in the bottom of the groove.

The brass pin holding the saw blade is tapered through the original arm. A local veterinarian friend of mine kindly took an X-ray of the handle area, which verified that the brass hardware was tapered into the handle as well. The holes in the handles were drilled very deep – much longer than the pins required. There are grooves on the pin inside the handle, indicating that the pin was probably glued in place initially. Later, a steel cross pin was inserted through the minor diameter of the handle to lock the handle in place on the brass pin.

All of the modern bowsaws I've looked at have straight handle pins, and all of the antique bowsaws I've looked at have tapered pins. Tapering the pins through the bowsaw arms locks the handles in place by the wedging action of the taper, as well as by the tension from the windlass. This is an excellent mechanical method to ensure that the saw does not rotate about the handles during use, which may happen once a straight hole is worn slightly.

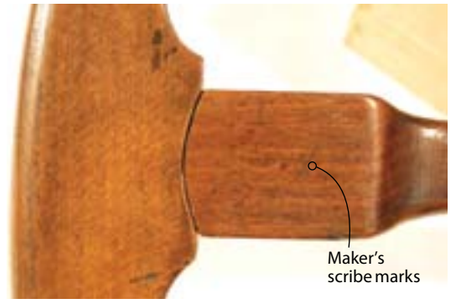
I do not know if the blade is original to the saw or not. It does not appear to be a band saw blade. The 15" blade is 9 points per inch (8 teeth per inch), filed to a rip cut with the blade oriented to cut on the push stroke. The rake is on average about 17°, which seems high for a ripsaw. The included angle is around 70° or more, indicating that as the

A special find. This bowsaw, which was probably made in the mid-1800s, was discovered at a Mid-West Tool Collectors Association meeting.



X-ray view. This X-ray of the long handle of the bowsaw reveals the depth of the hardware hole in the handle and the taper of the brass pin at each end.

Add tension. This picture shows the detail of the windlass, which is used to apply tension to the bowsaw blade.



Period marks. Note the crossed scribe marks on the stretcher made by the original maker and used to lay out the arc of the tenon shoulder.

LEAD PHOTO BY AL PARRISH; STEP PHOTOS BY THE AUTHOR; ILLUSTRATIONS BY LINDA WATTS FROM THE AUTHOR'S DRAWINGS

user refiled the blade, he focused the file on the leading edge of each tooth, which would explain why the rake was so high. The teeth have a heavy set: 6 thousandths on each side.

For the following reasons, this bowsaw was probably made by a user. First, manufacturers often stamped their work but this saw has no stamp on the body. Second, the curvature of the arms is exuberant. In commercial bowsaws, the handle, the mortise shoulders and the finial are usually in a line, which allows all of the joinery and the holes to be cut from straight and square stock. This particular bowsaw had to be partially shaped in order to get access to the joinery surfaces for drilling the holes and cutting the mortise. And third, the degree of shaping of the bowsaw arms and stretcher is quite refined and required a lot of handwork – which would likely not have been economical in production.

Gather Your Materials

I generally cut my blades from band saw blades but you can find 15" 9 ppi pinless blades (note that these are only 14½" hole to hole) at traditionalwoodworker.com.

I bought this project's Turkish boxwood as a log from Tropical Exotic Hardwoods. The quartersawn European steamed beech was purchased by special order through a local dealer.

You'll also need two taper reamers. I recommend the Brown and Sharp No. 2 taper (½" per foot).

The tapered brass hardware for the handles is copied from the Howarth design and machined to my specifications. It's available at edwardsmountainwoodworks.com.

I made extensive photographs, drawings and measurements of the original saw and of the brass pins in particular. I then made templates for laying out the arms and the stretcher. The schematics of these are on the facing page.

Cut your pieces to the dimensions on the cut list at right (these are the dimensions that the stock needs to be prior to shaping).

Handles

Any tight, straight-grained wood would be suitable for handles, but boxwood is often used. I cut my boxwood log to length and cut the handle blanks from the log just shy of the pith. Drill one end of the blanks to 9/32" (the small diameter of the brass pins).

Pin hole. Drill a 9/32" hole in one end of each handle blank.

Ream. Before turning each handle to its final dimensions, use a hand reamer to ream the holes so that the brass pin is just shy of fully seating.

While the blanks are in the rough, ream the holes using a hand reamer until the pins are just shy of seating completely. Turn the handles to their final dimensions. The handles are then carefully reamed for the final snug fit of the pin. Coat the pins with hide glue and tap them into place. Because the hole in the small handle is so much shorter than in the long handle, two reamers will be needed, one cut to length for the small handle.

Arms

On most bowsaws, the inside face of the arm at the handle hole, the mortise and the finial are all in a line. This makes it easy to lay out and cut the holes and joinery on square stock, then to shape the arm afterward.

But on this bowsaw, the curvature of the arm is so exuberant that the finial is well in front of the mortise. Therefore, the arm needs to be partially shaped before the joinery is done. I used perfectly quartersawn beech for the frame but many other options are possible.

The weakest part of the arm is at the finial, so orient the template to give the longest grain in this region. Saw two parallel cuts to define the front and back of the arms as much as possible. Plane and spokeshave these two surfaces flat and square.

I inserted a 3/8"-thick spline into a ¾"-deep slot into the end of each arm, at right angles to the face of the arm. The

Spline. While the tool I was copying didn't have this spline, I added it to reinforce the tapered hole for the handle.

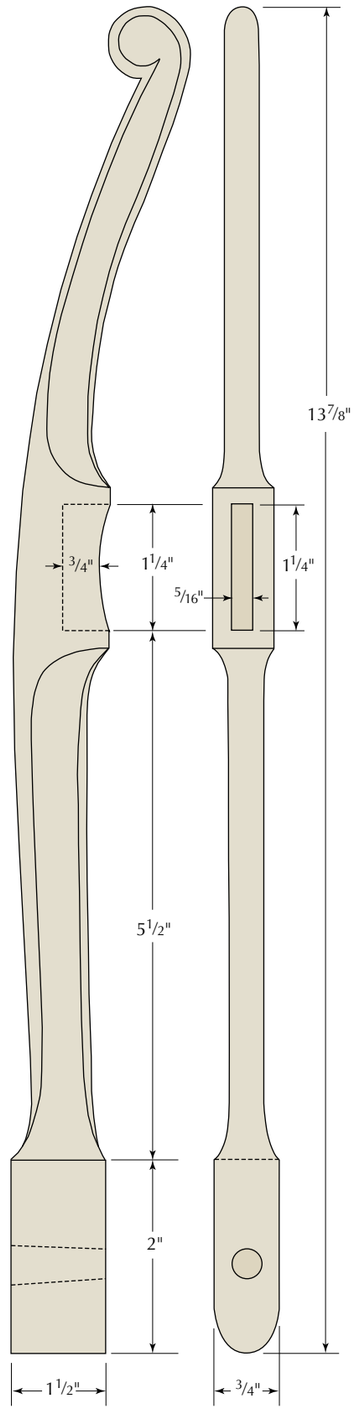
Bowsaw

	NO.	ITEM	DIMENSIONS (INCHES) T	W	L	MATERIAL	COMMENTS
■	2	Arms	3/4	5	14	Beech*	Quartersawn
■	1	Stretcher	3/4	1 1/4	16 3/4	Beech*	Quartersawn
■	1	Toggle	3/8	3/4	5 3/4	Beech*	Quartersawn
■	1	Whorl	5/8	1 1/4	3 3/8	Beech*	Quartersawn
■	2	Handles	1 1/2	1 1/2	4-6	Boxwood**	

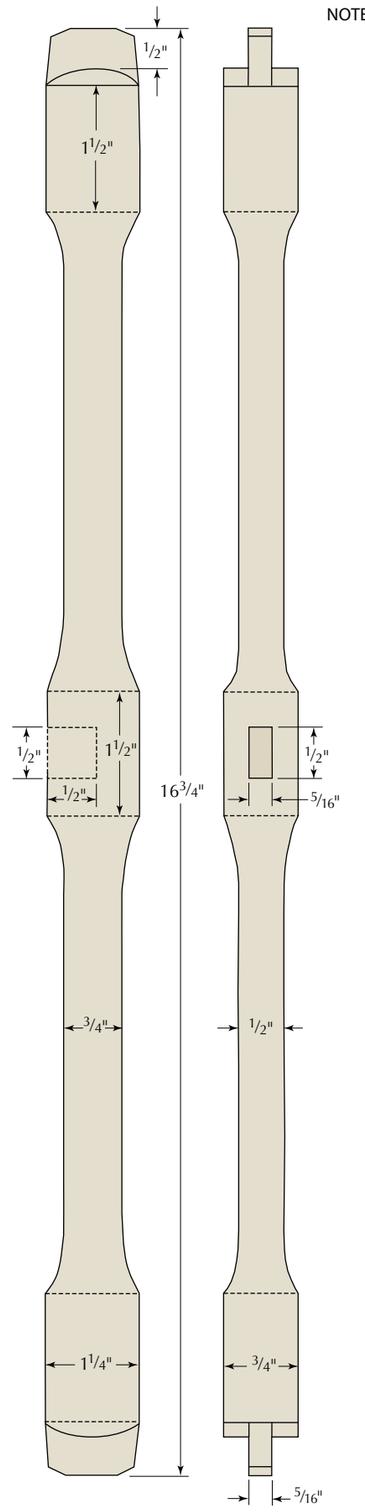
* Or hickory, ash, maple or other straight-grained hardwood

** Or ebony, dogwood or other hardwood

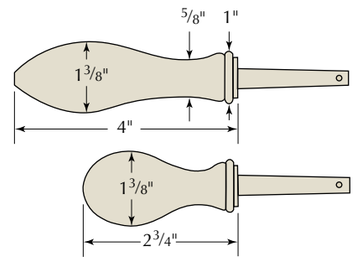
NOTE: These illustrations are not drawn to relative scale.



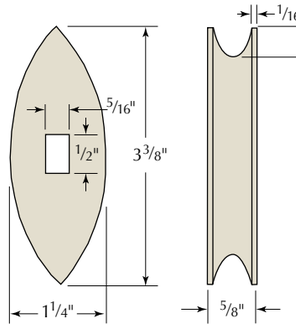
ARM LAYOUT



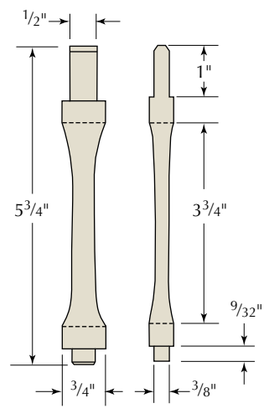
STRETCHER LAYOUT



HANDLE LAYOUTS



WHORL LAYOUT



TOGGLE LAYOUT

original bowsaw does not have such a spline, but I have often seen these on other examples of the tool. The spline ends just below the handle hole and functions to prevent the handle from splitting under the force of the taper from the pins.

The handle hole is drilled from both faces of the arm to ensure that it is square to the handle. Scribe the midline from both cheeks, then scribe a line 1" up from the bottom. Clamp the stock in a vise flush with the bench surface, and drill the hole with a 9/32" bit, using a square to help keep the drill vertical.

When reaming for the handle, the goal is to seat the handle so that it is locked in by the taper and not by abutting the arm. This is a trial-and-error process until the gap between the arm and the handle is 1/8" to 1/4". If you taper too far, you can take a few shavings from the outside face of the arm until the handle seats properly. You will correct for this when you make the stretcher.

The mortise is as wide as the stretcher (1 1/4"), with shoulders only on the cheeks. Eventually the mortise cheeks are cut to an arc, but for now they are left straight. The dimensions of the mortise are 5/16" wide and 3/4" deep. I chopped this with a sash mortise chisel.

Shape the Arm

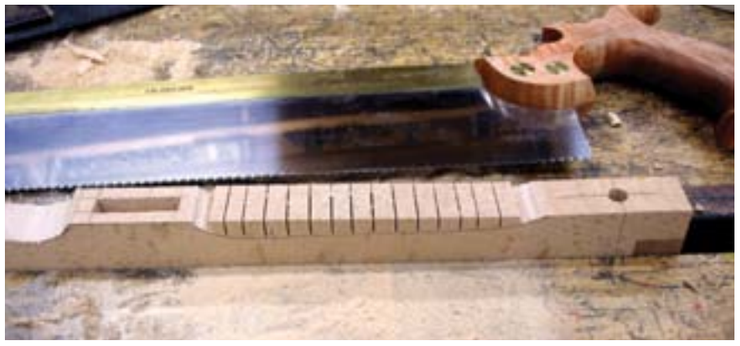
The arm is shaped from three perspectives: the face profile (laid out with the template), the long edge view (to lay out a narrow waist between the handle and the mortise, and a taper up to the finial) and, finally, by rounding the outside edges to half-circle profiles.

The first shaping can be done either by cutting along the layout line with a coping saw or a bowsaw, or alternatively cutting to the profile line with a series of closely spaced crosscuts, then chopping out the waste with a chisel. I used both methods and they took me exactly the same amount of time. In either case, rasp the blanks to the final profile. At this point, draw a centerline completely around the arm stock, then lay out the waist and the taper profiles symmetrically.

Shape the waist profile first, then cut the tapers. The taper is not straight, but rather fat near the mortise, then curving to about 3/8" thick at the finial. Clamp the arm almost horizontally in a vise, and support in underneath with a block to hold the finial up a bit.

Shape the curve with a spokeshave. The transitions from curved surfaces to flat surfaces (at the mortise and the handle hole) should be crisp and square to the profile and meet at the corners of each edge. Define these shoulders with careful rasp and shallow gouge work.

The last shaping step is to round over the long edges of the arms. On the inside long edges, taper the rounding down from the finial and along the waist of the lower arm to end at points at the shoulders. Use a spokeshave to round the profile through the shoulders along the whole length of the arm along the outside edges of the arms. The effect will be for the shoulder arrises to curve up and down from the mortise area in gentle arcs. At the finial, carve the rounding to give a pleasing neck at the bottom of the whorl.



Shape the arms. You can cut the shape with a coping saw or bowsaw, or make a series of crosscuts and chop the waste with a chisel.

Size the Stretcher

The stretcher length is dependent on the length of the blade to be used (hole to hole), plus how far the handle pins extend through the arms. Both of these will depend on how the blade was made and how the arms were shaped and reamed. To get an accurate measurement, assemble the handles in the arms and insert the blades into the brass pins. Measure the distance from the inside face of each arm. This will be the length of the stretcher measured from the bottom of the arc of the two tenon shoulders. In addition, allow for the height of the arc (approximately 1/4"), plus the length of the tenons (approximately 1/2"). This accounts for an additional 1 1/2" of stock length.

Cut the Tenons

The mortise-and-tenon joints where the stretcher meets the arms are meant to rotate to account for slight variations in the effective blade length at the handles, as the handles wear in and seat over time. The tenon shoulders are curved with an arc (a 2 1/4" diameter) over the full width of the stretcher material and this arc matches the arc cut on the mortise cheeks.

The tenons are tapered and rounded at the ends to give play in the joint. The cheek faces of the mortise and the tenon should be snug, however. I cut a template to match the width of the stretcher stock (1 1/4") and shaped inside and outside arcs at both ends. I used this template to lay out the arcs on the tenon shoulders and on the mortise cheeks so they would match. An alternative method (one that the original maker used) is to define the arc on the stretcher using a divider set to the radius of the circle. The maker found the midpoint on the stretcher by scribing a curve from each corner of the tenon shoulder, then used this midpoint to scribe the arc across the width of the stretcher. Lay out the tenons as 5/16" thick and 1/2" long at either end. Lay out a second tenon shoulder at 3/4". Cut the tenons to the first shoulder. Lay out the arc using the template or dividers set to the second shoulder. Chop the curved shoulder profile with vertical cuts using a bench chisel. Taper the two long edges of the tenons and knock off the corners of the ends of the tenons.

Play. The ends of the stretcher are rounded to allow a little play in the joint. You can lay out the curve from the template or set a pair of dividers or compass to scribe the curve.

Cut the Toggle Mortise

The mortise is centered on the long edge of the top of the stretcher. This mortise is meant only to catch the toggle of the windlass. The mortise measures 5/16" by 1/2" and is approximately 1/2" deep. Note that the tenon on the toggle is only 9/32" long.

Shape the Stretcher

The stretcher is shaped in much the same way as the arms. There is a straight, flat area at each end of the stretcher approximately 2" in length where the tenons begin, and an area of about 1 1/2" in the center for the mortise. Each of these elements is defined by crisp shoulders. The area between these elements is shaped in two dimensions to give it a waist. I cut these waist profiles using both the coping saw and the crosscut methods, rough shaping with rasps and defining the shoulders with gouges.

Make the Windlass

The windlass has two parts: the toggle and the whorl.

The string whorl has a central through-mortise. Lay out the whorl on square stock. Draw centerlines and carry these around on both faces. Center the mortise on these centerlines using a mortise gauge and one long and one short reference edge of the stock. In this manner, you can chop the 1/2" long, 5/16"-wide mortise accurately from both faces using a bench chisel.

Whorl. To lay out and cut the mortise on the whorl, start with square stock and draw centerlines on both faces, then use a gauge to define the mortise on both faces, and chop in from both sides with your chisel.

Groove. To cut the groove on the whorl that holds the string in place, use an 11-sweep 10 mm gouge to define the depth, then switch to an 8-sweep 11 mm gouge to shape the curve up the groove's sides.

Once the mortise is cut, lay out fair curves using the centerlines as a reference. The whorl is cut to shape with a coping saw, then rasped smooth.

To cut the groove, first lay out 1/16"-wide marks on all edges. Clamp the whorl in a vise and use an 11-sweep 10 mm gutter gouge to define the depth of the slot, then shape the curve up to the edges with an 8-sweep 10 mm gouge. Refine the groove with a round rasp and sandpaper.

The toggle is designed so that the shoulder-to-shoulder length between tenons is just a bit longer than the distance between the top of the stretcher and the bottom of the whorl when the toggle is in place. So, the tension of the string pushes the two toggle tenons snugly into their respective mortises. The tenon through the whorl is fairly snug and protrudes through the whorl. The tenon into the stretcher is relatively loose (approximately 1/32" shy in both dimensions).

Lay out the toggle tenons with a mortise gauge, then cut them with a bench chisel (because so little material has to be removed). Shape the waist, starting approximately 3/8" from each tenon shoulder. Because the cuts are so shallow, use a rasp for this step.

The Finishing Steps

The period bowsaw I copied for this build appears to have been stained – although this could be patina from age. I decided to sand my bowsaw parts up to #220 grit. I then applied three coats of shellac, and followed that by buffing with #0000 steel wool, then topped it with a final coat of wax.

The final task is to string the saw. I used a heavy cotton twine, but jute would work, too. I tied one end with a loop, then wound the string around the finials three full times. On the fourth course, I cut the string off halfway around then wove the end through the three strings on one side.

Now insert the toggle and whorl between the two groups of three strands and turn the windlass until the blade is tight. The blade should have a sharp pitch when plucked, but not be overtight (this is a matter of feel and, ultimately, of performance).

When the saw is not in use, release the windlass a turn or two so that the tension is off the blade but the saw pieces remain together. PWM

Bill works and teaches woodworking classes in his workshop at the base of Edwards Mountain in Chapel Hill, N. C.

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