BUILDING A HOLLOW SHAFT SPOON BLADE OAR

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In the July 1999 issue of WoodenBoat, #149, Aime Ontario Fraser published an article on building hollow wood spars. Craig Wright and Richard Duke, two boat builders from Goshen, Connecticut had brought a nearly forgotten technique for making hollow wooden shafts back into use. They had used it successfully for shafts ranging from 3’ to 37’ in length.

Immediately upon the arrival of my issue of WoodenBoat, I began what had become my customary ritual. I buzzed through the pages looking at pictures and reading titles, flipping the pages almost continuously. As I flipped to page 32 my mind suddenly registered a drawing I had just glanced at on the previous page. I turned the page back and did a double take. The schematic of a bird’s mouth spar cross section grabbed my eye, along with its name at the top of the page. It was made of eight staves, each with one square edge and one edge with a V cut into it. The V’s nested around the square corner of their neighbors, each laid 45 degrees tangent to the next. I marveled at the simple idea. I pondered how I might use such an elegant construction.

I didn’t do anything with the idea just then. As it happened, at the end of that summer, a friend mentioned a pulling boat he had seen advertised as a kit from Chesapeake Light Craft, their Annapolis Wherry. He and I had talked about many kinds of rowing boats we might build one day, but this one caught his eye. I looked at it and fell for it right away. By September I had ordered a kit, and by October the strakes were being scarfed on my garage floor. Chesapeake’s catalog didn’t make it clear that the prices for the oars they sold were for a pair. I thought the price was *each.* When I totaled the cost for the six oars I wanted, four sculls for doubles rowing, and a short pair for fixed seat, I was in for about twice the cost of the boat. What alternative might I have?

A few days later I was again flipping through WB #149, and once again came across the article on bird’s mouths. It occurred to me that here was a way to build oars. The author even said as much, but gave no details. To make a long story short, I managed to adapt this technique to produce a hollow shaft that tapered and changed from round to oval along its length. An oval cross section at the neck of the shaft before the blade would be as stiff as possible, but narrow enough to shape into the blade smoothly. Sculls are not round in section at the oarlock, but traditionally have had a D shape to provide flats to clunk onto when feathering the oars. Mine would be round, but as luck would have it, several oar manufacturers make plastic sleeves that clamp around the shaft, giving the rower the flat surfaces needed for sculling. For use with regular oarlocks, the shafts could be leathered if desired.

Fraser's article demonstrates the process of making the shaft so well that I strongly urge reading it. It is the process I use in almost all respects. My method just involves mixing staves of differing widths into the glue-up. The amount of taper is the same for all staves, allowing the builder to use the same tapering jig for the table saw throughout.

I have chosen to demonstrate how I go about making a 9' 8" scull. It is made of Port Orford cedar with a diameter of 1 3/4" at the round end and an oval at the other end of approximately 1 3/4" X 1 1/8". Many other woods would serve well. I have used Douglas Fir, and of course Sitka Spruce would top the list. A wood that is locally native for me, but grows in many places is Monterey Cypress. I know that there are cedars, pines and spruces growing in other parts of the country that would be suitable. The Port Orford weighs about 29 lbs. per cubic foot. Sitka comes in at around 26 lbs., and is stiffer. A good wood technology book can help you decide which wood to pick of what is locally available and affordable. Using the Port Orford, the 9'8" scull comes in at just under 3 lbs. A 7' version weighs just over 2 lbs. The formula for determining the size of the staves is a simple one:

To find the width of each stave at the widest point:

Maximum diameter x .40 = maximum width of stave

At the narrowest point:

Minimum diameter x .40 = minimum width of stave

To find the thickness of each stave:

Major diameter x .20 = thickness

Wright and Duke, the boat builders from Connecticut feel that these formulae result in a wall thickness on the heavy side. Using the formula, I made a stave dimension of 5/16" x 11/16" to arrive at just over the 1 3/4" maximum diameter. I know that this produces a shaft strong enough for my recreational rowing. A boat builder in my town operated for many years building Transpac racers. His philosophy was that if something didn't break on his boats, it was probably too heavy. I don't follow this idea, but I often think of it. An Olympic racer might break one of my oars in a sprint. I used to make the staves 3/8" thick, but have lightened up in the interest of saving weight. All this is to say that heavy boats with strong rowers would require a bigger and stronger shaft than what I outline here. If the reader were to experiment with larger scantlings and a stronger wood such as ash, a stout and stiffer oar for heavier use would result. The process to build them would be the same.

These oars will be 9'8", and the handle will be 6" of that. The finished spoon I'll join to the shaft will be 22" long, and the overlap where the two are joined is 13". The spoon continues 9" past the end of the shaft. The finished shaft length will therefore need to be 8'5".

To begin the process, mill six pieces of quarter sawn material to a finished size of 5/16" x 11/16" x 8'7" (a few extra inches for good luck). Mill two pieces to 5/16" x 1-1/16" x 8'7". This will be enough for one oar. Make enough for all the oars and perhaps a few extras.

A few words about making accurate measurements when woodworking. I am a finish carpenter by trade. In our work we generally fit pieces to 1/64" or 1/32" tolerance. This is adequate for decent work. However, in my shop I find that more and more I reach for my dial calipers when fitting or dimensioning parts. A dial caliper reliably measures to .001". A thousandth of an inch. Some might laugh at attempting such precision. But consider that there has been a proliferation of inexpensive import stainless steel dial calipers on the market for the last few years. I have paid about $25 for several pair that I have bought. Aging eyes really appreciate reading the dial. Fits required for mortise and tenon work for example, are easy to achieve to perfection. To arrive at an exact diameter when making a bird's mouth shaft depends on very accurate measurement. I said that the stave for the 1 ¾" shaft would need to be 11/16" wide. Actually, it is .700". Very easy to measure with dial calipers. O.K., it's true that I want to finish at 1 ¾". But the glue up is a messy process, and to clean up the surface adequately afterwards, I want to figure in an additional bit of diameter into my shaft to allow for planing smooth and sanding. What I actually do is mill the staves by running them through the planer on edge (send through at least four at a time while holding them together to stabilize the group) until I reach a width of .720". Try that with a tape measure. I think that if you spend the money for a pair of calipers, you will come to love using them.

Mill the bird's mouth into the edge of each stave. I have found it easiest to use a molding head for the table saw with a v-cutter. See the photo. A v-cutter in a router table, or a shaper would do the same. Because of the small dimensions of the work pieces, be *sure* to use feather boards, hold downs, push sticks, or a power feeder to push the pieces past the cutter. These small pieces can easily vibrate and catch (and explode) if simply pushed through manually. Please. Be careful. The v-cut can also be made with two subsequent passes over the table saw tilted to 45 degrees. I don't favor this as much because of the petite dimensions of the work piece, and their potential to misbehave, but it can be done. I would use the smallest, most docile blade I owned. Once again, feather boards, etc.

You now have eight pieces, six narrow ones and two wide ones for each oar, all milled with the V along one edge. You are ready to taper them.

Jigs to taper on the table saw could vary infinitely in detail, but they all must accomplish the same task. I use one made from a piece of ½" x 6" x 8' plywood. See photo. I make it 8' long even though my staves are 8'7" and feel safe with it because I don't taper the first 29" of each stave. Each stave will have 3/8" of taper cut into it. Strike a line on the top surface of the plywood starting at the first end onto the saw that is 11/16" from the left edge. Actually, don't make it at the very end, but at the point that will be the pivot point of the oar. On this oar that will be 29" from the end of the stave. That will be 22" from the end of the jig. Make a dark ink point here. At the other end, (the last end over the saw) make a dark ink point 5/16" from the left edge. Connect the two points with a dark line. I use a chalk line followed by ink. You now have a strip of plywood with a line out of parallel drawn near its left edge. It should be 3/8" out of parallel in 6' of the 8' of the plywood's length.

This line will be the location of the right edge of the stave as it passes over the saw. You need to hold the wood tightly to this line as the cut is made. There are many ways one might hold the wood securely to this line. The photo of the jig shows how I use thumbscrews pushing plywood blocks down on top of the staves to hold them tightly. The thumbscrews thread into t-nuts on the bottom side of the jig. Not fancy or fast to operate. Be aware that the blade will come very close to the hold down blocks. Hence they are wood. The blocks are canted down toward the stave slightly because that will put the most pressure on the tip of the block, holding tighter. On the right edge of the work piece (and on the ink line) I tack a "fence" to the jig to press the stave up against.

Set the saw's fence 6" from the blade. The jig will just slide between blade and fence. Clamp the first of the narrow staves into the jig with the bird's mouth *away* from the blade, *towards* the fence. You will be beginning the cut at the handle end of the stave. The stave will begin to protrude past the left edge of the jig at the pivot point of the oar. This is where the cut will begin. See photo. Push the jig through the saw. You have one stave, tapered from 11/16" to 5/16" in width. Do all six. Now move the fence 3/8" *further away* from the blade, to 6 3/8". Put one of the wide staves into the jig, again with the v away from the blade, facing the fence.

The last two staves are cut somewhat differently from the first six. They need to be the same width as the other six, 11/16" at the handle end, in order to make the shaft round. They want to continue at this width down the shaft until they reach the pivot point. They must then begin to taper in width from this point onwards to a larger dimension of 1-1/16". Don't worry. This jig will do it, and it's not difficult. You must just proceed thoughtfully and methodically. What you are going to do is begin to cut the wider stave at its *blade* end, the wider end. The first six staves were cut beginning at the handle end. Begin the cut with the jig to the right of the blade as usual and the fence set at 6 3/8". The blade should just touch the stave on its' left side beginning at the very end of the stave; unlike the first six you did which started cutting 29" from the end. The blade will enter the wood immediately as you push the jig into the cut. You will push the jig through the saw, but not all the way. You will stop the cut 32" before you get to the other end. Make a dark mark on the jig at this point. This is 3" before the pivot point. Hit the stop button of the saw and let it come completely to a stop. Remove the stave and do the same thing to the remaining stave. This is step one.

Remove the jig from the saw. Set the fence the same distance from the blade as the width of the first six staves were cut at their widest (.720"). Reverse the stave end for end and place the bird's mouth against the fence with the uncut end of the stave poised to begin cutting. Push the stave into the blade and cut until you are 6" from meeting your first cut head on. See photo. Stop the saw and do the same to the remaining stave. This completes step two. Take the staves to the band saw and carefully finish the uncut area of the stave and connect the two cuts. You could use a jigsaw, a coping saw, or a Japanese handsaw if you like. Cut a wee bit proud of the line and clean up with a block plane.

You now have eight staves for each oar that all have one bird's mouth edge and all have one end that is 11/16" wide. Place them together so all these 11/16" ends are at the same end. You will glue them together so that the other ends (which are 6 @ 5/16" wide and 2 @ 1-1/16" wide) are in the sequence WNNNWNNN (wide and narrow).

I made a group of three different blocks to hold the staves in position while I spread the glue. See photo. The v cut edges have to be held level to each other. The difficult part is that at one end they are all the same height, while at the other end they vary widely in height, and in the middle they vary a bit less. I made the blocks with a dado cutter on the table saw. If you use this method, make sure the block is long enough to safely dado, at least 12". I use slow set, thickened epoxy for the glue up. The next part is a little tricky, but I now do it routinely by myself. Begin to nest the staves together in sequence. See photo. A piece of 1" dowel about a foot long placed into the center of the staves as they nest together and begin to assume the curve will support the whole group until all eight are in place. Click! They grab each other. Remove the dowel and hold tightly as a group until you can get a hose clamp around them. As soon as the first clamp is snug, you can relax. Your hands will be a mess, so wear gloves.

I place hose clamps about 6" o.c. down the length. Make them tight. The clamps will dig into the points, but no matter. They will be planed off. You now have to make the shaft straight by eye. Very light taps and pushes will do it, as the greased staves will slide easily against each other. The adjustment screws will obscure your view of part of the shaft as you look down it. As you look down the length imagine you can see the other side obscured by the screws. The shaft will not be one continuous straight line. Remember that the first 29" are a straight section, then it begins to taper in another straight line. We carpenters have a saying which I think applies here. A good carpenter is a good guesser. Give it your best shot and remember that this is a handmade oar you're making.

Transforming a shaft with eight sharp edges to a beautiful tapering rounded stick with a sharp block plane is pleasant work. Using Port Orford cedar, the aroma is intense. As the shape emerges, I simply follow it by eye, making few measurements. I start to sand with 80 grit and a rubber block, progressing to 120 grit. I also use a 4X24 sanding belt wrapped around a plywood block to help even out the sanding. I have even used a random orbit sander, rolling it over the surface as I slowly turned the shaft in a contraption on the bench. See photo. I rigged up the rotisserie motor from our BBQ to slowly turn the shaft as I rolled the spinning sander back and forth over the surface. I would use a lathe if the shaft was round, but the taper to oval cross section precludes that. If you are going to use plastic sleeves around your oars where they rest in the oarlocks, then you must pay attention to one critical dimension. The inside diameter of many of these sleeves is 1 ¾", making this dimension the mandatory outside diameter of your shaft at its' pivot point. With my sliding seat rig, this point is 34" from the end of the handle. You don't want to stumble onto this requirement after you've done a beautiful job of varnishing a 1 7/8" shaft. By the way, your shaft was made 8' 7 " long, but you only need 8' 5". You can trim a little from each end. Save these pieces.

When the shaft is complete, I make the spoon. The spoon I use is laminated from three layers of 1/8" x 7 ½" cedar. Actually, they're thinner than that. About .090". Most band saws, with a sharp blade and well tuned, will produce 1/8" veneers. If you can't get your band saw to behave, make the veneers 1/8" x 4" and edge glue them together. I clean them up with the planer taking *very* light cuts and using a plywood board underneath to support the veneer as it passes through. I now take the veneers to a guitar builder friend who has a wide belt sander. He sands them to thickness for me. But I have made many without his help by planing with sharp knives to just under 1/8" and then belt sanding as best I could. The finished thickness of the spoon I'm aiming for is ¼ - 5/16".

The spoon is *flat* in cross section, and shaped to typical spoon profile along its' length. The accompanying drawings show the shapes. The tables will allow you to lay out a series of points for each curve. Connect the points with a flexible batten and pencil them onto the work piece. The blade, as I said is 22" long. It finishes out at 6 ¾" at its' widest, and the end which mates with the shaft is 1 1/8" wide. I laminate them in a male/female mold using thickened epoxy glue and a piece of 4 oz. cloth in between each layer. Put a piece of wax paper or plastic above and below the lamination. See photo. These blades are very strong; I use mine hard. Traditional spoons are carved three dimensionally with a spine traveling down their length as an extension of the shaft for strength. They involve a lot of work and are not easy to shape. The epoxy and cloth produce a spoon with all the necessary strength; albeit untraditional in appearance. The composition adds no more weight than other glues would.

When the blade is out of the mold, but before I have cut it to shape on the band saw, I trace the profile of the spoon onto the flatter side of the oval shaft. See photo. I cut this profile on the band saw so that the spoon is notched into the shaft at the top end of the spoon and the profile cuts into the shaft towards the other end of the spoon leaving 3/8" of shaft thickness at the end. This mating surface is 13" long. I then cut the shape of the spoon on the band saw. I mill a small piece of wood to insert into the hollow shaft where it will mate to the blade. I insert it into the shaft just an inch or so past the top end of the blade and glue with epoxy. See photo. After the glue is set, trim the filler piece back to the original cut line and spoke shave and file the surface flat. Carefully align the shaft and spoon to be in the same line, and glue together with thickened epoxy. I clamp with a few very gentle clamps, such as wooden parallel clamps. To date I have not reinforced this joint with any joinery, dowels etc., and have had no failures. After the glue has hardened, a small amount of spoke shaving, filing and sanding blends the edges of the spoon to the shaft.

The last step is to make and install a handle. The diameters of oar handles vary greatly, depending mostly on the size of the rower's hands. I have been using a rubber handle cover slid down over the wood handle. This cover is commercially available, along with the oarlock sleeves from one of the many sources that cater to rowers. The diameter of the oar handle and the inside diameter of the cover are in the neighborhood of 1" – 1 1/8". A 12" dowel turned to this diameter glued into the end of the shaft and protruding 6" serves well for a handle. I make handles with octagonal cross sections to insert into the shaft, and turned round for the grip. I don't have a lathe, and so I sand the handle round in a contraption on my drill press. See photo. It's not perfect, but serviceable. Many people do want a wooden grip, and a lathe will make any diameter easily. Many scull handles are in the 1 ½" range. By the way, it is traditional to leave grips unvarnished. Many rowers will testify to the power of varnish to raise blisters.

I spray multiple coats of varnish on the oar while it turns slowly in my rotisserie gadget. I have built a few fishing rods, and this is the method used to prevent sags and runs in their epoxy coatings.

You now possess a light spoon blade oar. I would suggest taking the thin cross sections from each end of the shaft and placing them prominently on the mantle of your lodge. I guarantee you will see the same grin I see creep over the face of any woodworker who spies them. Good luck to you. Happy rowing.

October, 2002

I write this postscript nearly two years after the article. I've continued to tinker with the oars in an attempt to make them as stiff as possible without increasing the weight. The lastest pair were made of Sitka spruce. At the same time, I increased the diameter to 2-1/8" and made the wall slightly thinner. Each stave was initially milled to 9/32" X 13/16". The amount of taper cut into each is still 3/8", so they taper in width to 7/16" for the narrow ones, and 1-3/16" for the wide ones. After the glue up, and the shaft is planed and sanded, the wall thickness averages about ¼".

In the location of the pivot point, a red cedar block is glued into the center of the shaft, completely filling it. The handle end is plugged with a red cedar handle, again filling it completely, and where the blade glues to the shaft there is a cedar filler block. They're all glued with epoxy. The blade itself is laminated with three laminations to a total thickness of only ¼", once again with red cedar. I used the cedar because it is so light, and the spruce because it is both strong and light. I confess the blade laminations are difficult to produce this thin unless you have access to a wide belt sander, but I do. The blade is easy to flex with the hand, but with the even pressure of the water against it, seems as stiff as the earlier versions.

I think the three filled areas of the shaft make it into, in effect a truss. It is noticeably stiffer than my earliest versions. The reason I make the shaft 2-1/8" now instead of 1-3/4" is not only to increase the stiffness. The earlier versions were 1-3/4" to fit inside the factory made sleeves and collars at the pivot. They sometimes slipped, and are unattractive anyway. I now make the D shape needed for the feathering action of sculls an integral part of the shaft for a 4" length of the shaft. I do this by glueing two "corners" of wood to the bottom of the shaft. The picture does a better job of describing what I do than I can with words. I wrap it with two light layers of glass cloth and epoxy. I also glue a stop collar at the exact pivot point for the oar to stop against the oarlock. The commercial collars are adjustable, and mine are not. I realized however, that once the location is known for the pivot, I never adjust them. I found that in my boat, and most all sculling boats, that point is 34" from the end of the handle. This gives about 4-5" of handle overlap. The 2-1/8" diameter of the oar shaft is the same as the outside diameter of the commercial collars.