

# Willow, Part 2



Brian Neeley, shop manager for WoodenBoat School, paddles the sleek and versatile Willow sea kayak through a tidal rip.

## Building a light, fast sea kayak

by Bill Thomas with Jane Ahlfeld

Photographs by Bill Thomas

***In our previous issue, we assembled Willow's hull.  
Now we'll fit and install the deckbeams, bulkheads, and deck.***



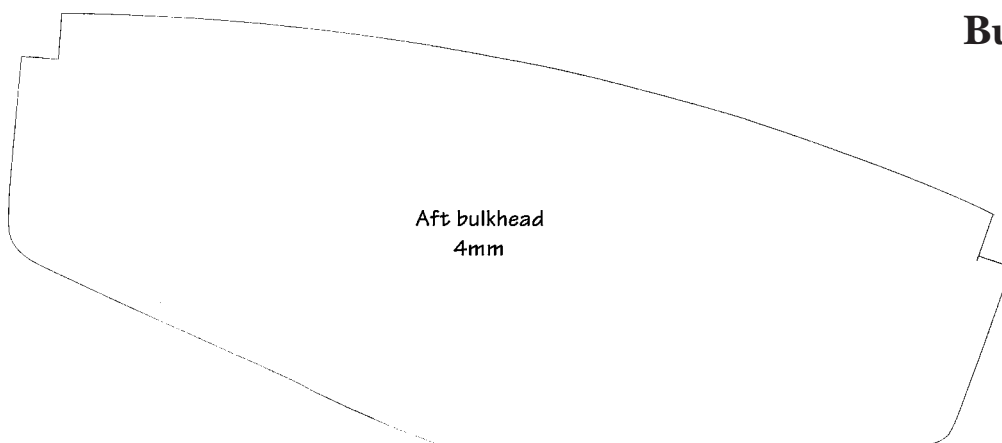
**35.** Laminate the main deckbeam from five pieces of 4mm plywood about 32" long and 1½" wide. The finished beam should have a 16" radius, but glue it up on a 15"-radius form to allow for a bit of springback.

Use clear epoxy and lots of clamp pressure. A sixth piece of plywood covered with plastic packing tape is used between the top layer and the clamps.

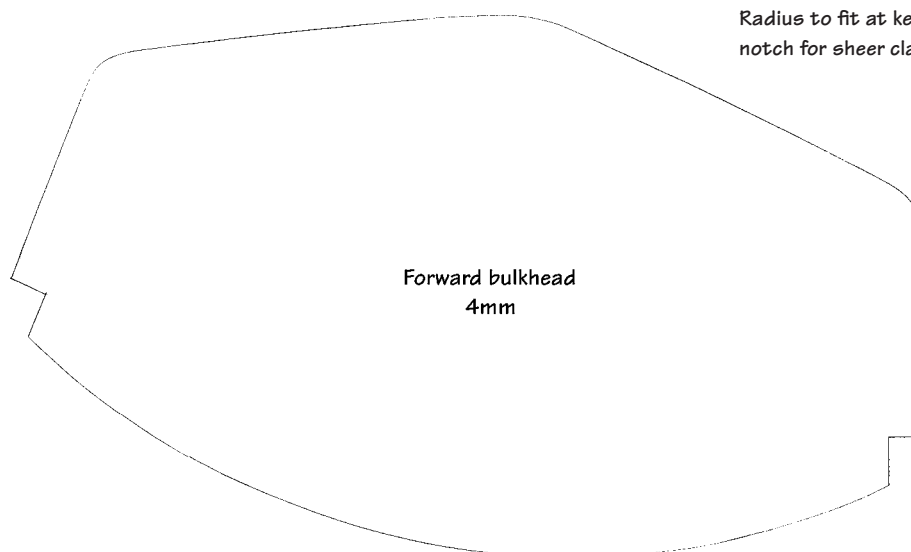


**36.** Use a bandsaw to clean up the deckbeam edges. Its final width should be 1⅛".

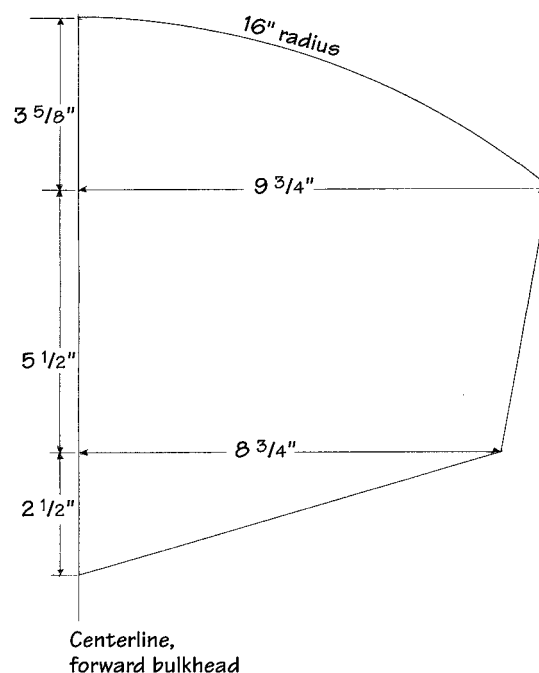
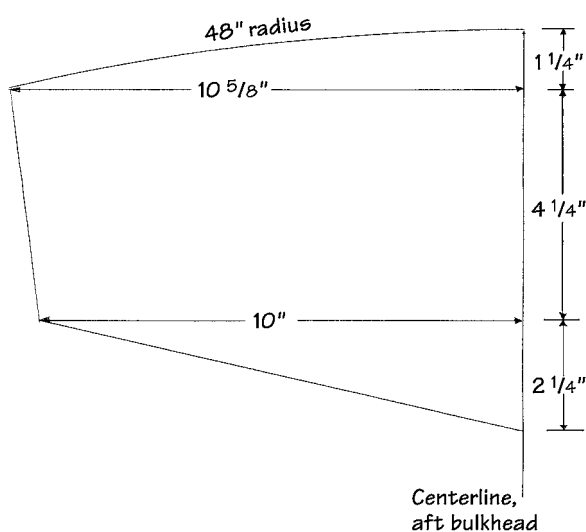
## Bulkheads



Radius to fit at keel and chine,  
notch for sheer clamps



The Willow plans set (see page 37) contains full-sized patterns for the bulkheads, which are shown here at reduced scale. Dimensioned drawings (below) will allow you to reconstruct the drawings at full scale.





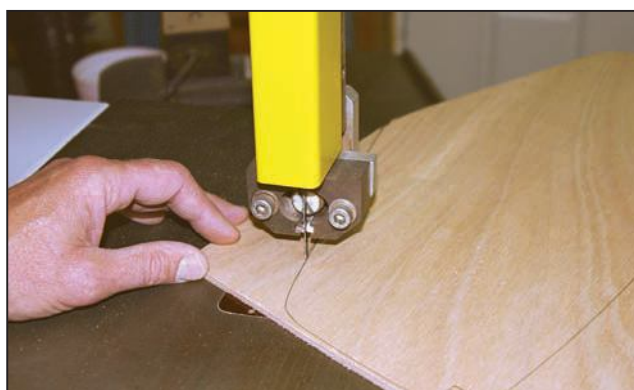
**37.** The plans show the locations of two deckbeams, the bulkheads, and an optional bow deckbeam. The forward beam fixes the hull width and helps hold the camber in the deck while it is being installed. It is not needed after the deck is finished, so I usually opt to use a temporary spreader which will be nailed into place after the outside is glassed. Mark locations for the deckbeams and bulkheads now. Make sure they are each positioned at a 90-degree angle to the centerline of the boat. Remember how we laid out the location of the maximum beam. The aft bulkhead needs to be spot-on because it defines the cockpit location. The main deckbeam should be 32" forward of this, unless you change the length of the cockpit. Just make sure there is enough space between the aft bulkhead and the main deckbeam for the cockpit rim! The locations for the forward bulkhead and the small aft deckbeam are shown on the plans.



**38.** Scribe the main deckbeam to fit. I use a Japanese saw to make the compound cut. It might take several cuts to get a good fit, but be sure the fit is right. Too loose, and the hull will pull in at the beam; too tight, and...well, you get the idea.



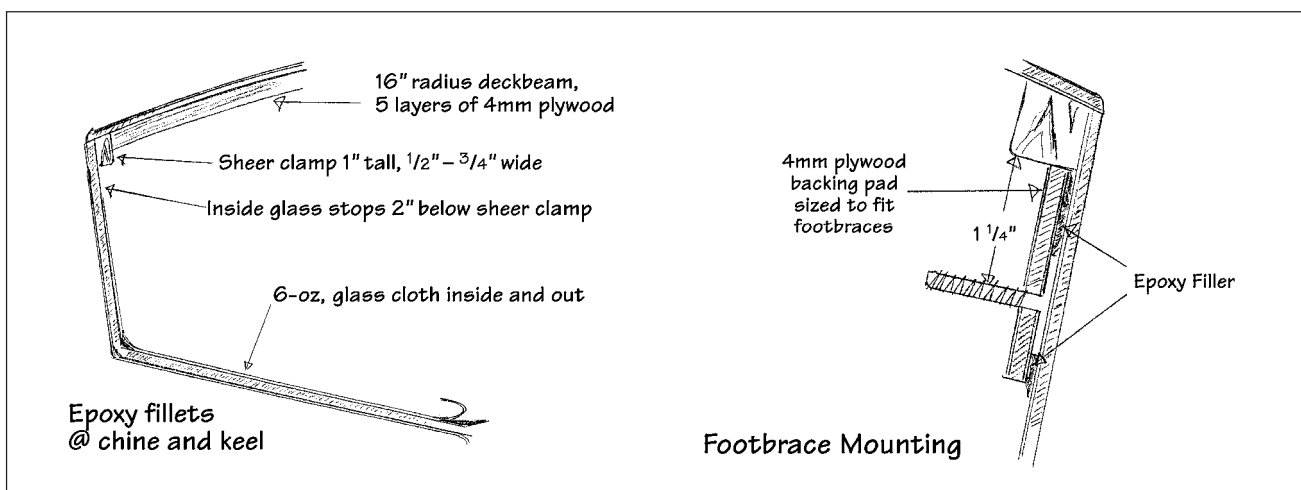
**39.** Install the laminated deckbeam flush with the top of the sheerclamp, using stainless-steel No. 8 1½" wood screws. Mark carefully. Use a ruler clamped to the beam to help line up your drill. Countersink the screws. Fill the holes with wood-flour-thickened epoxy.



**40.** The bulkheads are cut from 4mm plywood. Full-sized patterns are included in the plans, but there is enough information in the accompanying drawings to lay them out. Cut the bulkheads on a bandsaw. Touch up the fit with sandpaper if needed.



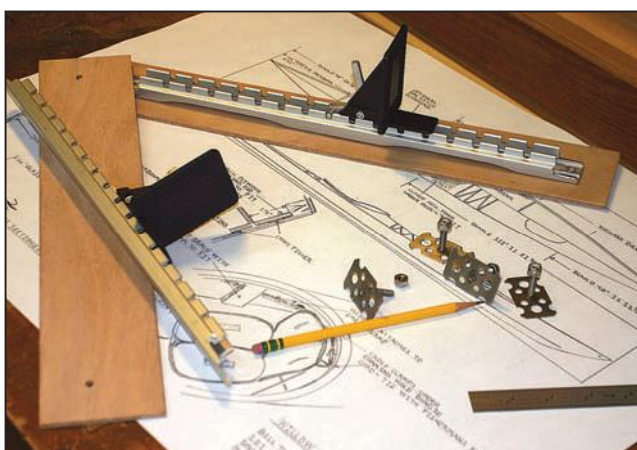
**41.** Hold the bulkheads in place with three wires: one near the keel and two on the sides just below the sheer clamps. Don't force the fit; a ⅛" gap all around is fine. Glue each side of the bulkhead to the sides and bottom with neat fillets. If you are going to add a day hatch to your boat, cut, fit, and install the extra bulkhead now.



**42.** The aft deckbeam serves to strengthen the deck behind the stern hatch and is made from 9mm plywood. The aft deck radius is 48". Nail the deckbeam in place and add small fillets where it meets the sheer clamps. Position it so the top edge is about 1/4" below the top of the sheer clamp.



**44.** Mix up enough epoxy thickened with Cab-O-Sil to thickly butter the footbrace pads and clamp them in place. Use enough clamps to ensure a good bond, and clean up the edges where any epoxy oozes out. Protect the threaded edges by covering with a bit of packing tape.



**43.** Rather than install footbraces with a bolt through the hull, I have chosen to use threaded studs with a 4mm plywood backing plate. This is a simple and very strong system, but it does commit you to one style of footbrace and makes it difficult to add a rudder. In choosing footbraces, don't skimp. On most of the plastic footbraces I have tried, the pads have popped off under pressure.



**45.** Take the three temporary beam spreaders off. Flip the boat over. Trim the wires. Cut them as flush as possible and use a file to knock down any rough ends.



**46.** If necessary, use a block plane and sanding block to fair in the bow and stern.



**47.** Use a soft sanding block with 80-grit paper to evenly round over the keel, chines, and ends of the boat. (A power sander would be too aggressive.) Take your time and soften up the hard corners, sculpting a nice shape at the bow and stern. The next step is to 'glass the hull. What you create now is the final shape of the hull.



**48.** It takes about 18' of 38"-wide 6-oz 'glass cloth to cover the outside of the Willow. Lay the 'glass over the boat and use a brush to smooth out any wrinkles. Similar to the inside, we want to use just enough epoxy to "glue" the fabric to the plywood. Again, a squeegee works well; I use a cut-down chip brush to work the ends. Start in the middle and work toward an end. At the bow, the 'glass can be worked so it lies down evenly, without needing darts cut in the cloth.



**49.** Once you have worked your way down to the stern, you will need to cut a dart. There's no point in making this cut ahead of time—the cloth will move and stretch as you work. Wrap the cloth around the stern so the fabric is doubled over the end. Later we may choose to reinforce both the bow and stern with another layer of 6-oz cloth.



**50.** After the epoxy has cured, flip the boat back over. Make foam or wooden cradles that will hold the hull solidly on the sawhorses. Paint the inside of the boat with clear epoxy. Make sure to cover all the surfaces; this includes the bottom and inside of the sheer clamp, but not the top of the sheer clamp. Let this dry.

Next, the sheer clamps need to be cambered so the deck fits nicely. Make two planing guides out of scrap plywood. Both need to be about 28" long. Use a 16"-radius guide forward of the main deckbeam and a 48"-radius guide behind the aft bulkhead. The transition between the two points will be done by eye. Before you start planing, screw a few cross-braces to the horses. Use a tie-down strap to secure the boat. Using a sharp block plane and starting at the main deckbeam, plane a nice, even camber into the sheer clamp; the 16" guide helps you check that the camber is correct. Move forward, working both sides of the boat as you go. Check your work often; do not rush. You will notice that the camber is pronounced amidships, but almost flat at the bow.



**51.** It is okay to carry the camber into the plywood just a bit, but do not cut into the inside corner; this is the control edge and defines the fairness of the sheer. Using the 48"-radius guide, work the back half of the boat, starting at the aft bulkhead. The outside edge of the guides should just touch the outside edge of the plywood. If any of the bulkheads need to be trimmed, mark them with the guides and trim them with a block plane.



**52.** Plane the transition from the aft bulkhead to the main deckbeam. Use a longboard with 80-grit paper to smooth out any high spots along the entire sheer clamp.



**53.** I like to do an end-pour in each end of the boat. The sheer clamps and fillets make for a plenty-strong boat, but the end-pours pull it all together and give a solid bit of epoxy to drill holes in for bow and stern loops. Set the boat on end so that the bow is parallel to the ground. Pour about 3 or 4 oz of epoxy thickened with Cab-O-Sil (thickened, but fluid enough to pour) into the bow, and let the mixture cure. For the stern, you will probably have to take the boat outside, unless your shop has an 18' ceiling. If you have the boat outside and it's cold, use a heat lamp to help the epoxy cure.



**54.** Before the deck goes on, sand the inside lightly with 120-grit and apply a coat or two of matte varnish.



**55.** The footbraces I use and ship with kits must have their ends notched (see photo, step 43) so the stop-nut can be tightened onto the studs. Aluminum is soft enough to cut with a standard woodworking bandsaw blade.



**56.** If you work carefully, all the deck parts can be cut from one piece of 4mm plywood. The stern deck is less than 8' long, but the forward deck will need to be scarfed to length. Lay the parts out as shown in the plans. The rough opening for the cockpit is about 4" smaller than the finished opening; lay out the panels oversized and trim them flush after the deck is installed. Cut the parts out with a jigsaw.



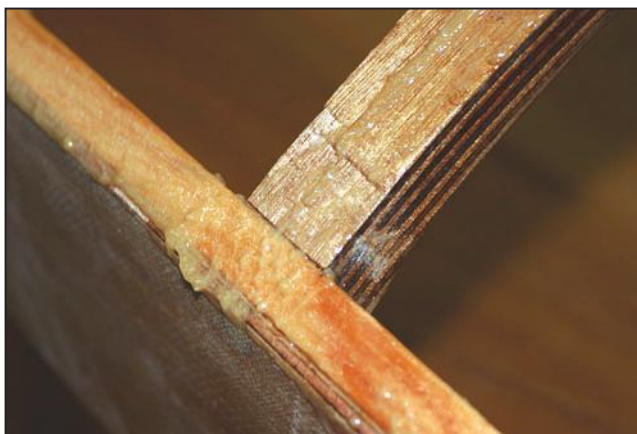
**57.** With the inside of the boat sanded and varnished, the footbraces installed, the end-pours done, and the decks cut, it is time to install the decks. If you have omitted the bow deckbeam, you'll need to install a temporary spreader about 22" back from the bow; remove this spreader after the decks have been installed.



**58.** Make a marking gauge that will help locate the center of the sheer clamp for nailing when the deck is in place. In my shop, I use a pneumatic stapler to tack the deck down while the epoxy cures. For many builders and in classes, an air-driven stapler is not an option, so use  $\frac{3}{4}$ " bronze ring nails on 4" centers to hold the decks in place. If you are using staples, the sheer clamp can be  $\frac{1}{2}$ " thick. Use a  $\frac{3}{4}$ " sheer clamp if you are nailing down your deck.



**59.** Dry-fit the decks before mixing up epoxy. Use three or four tie-down straps to hold the front deck in place. The first strap should be over the main deckbeam and a second over the forward bulkhead. Line up the deck so it is centered on the boat. Make sure the front of the deck is centered over the bow and the rough opening for the cockpit does not come past the deckbeam. Place the aft deck section on the boat and make sure it fits. Center it, check that the cockpit opening is forward of the aft bulkhead, and make sure the two panels overlap at least  $\frac{1}{4}$ " at the butt joint. If the fit looks good, remove the back deck. Mark on the sheer clamps the location of the aft ends of the forward deck.



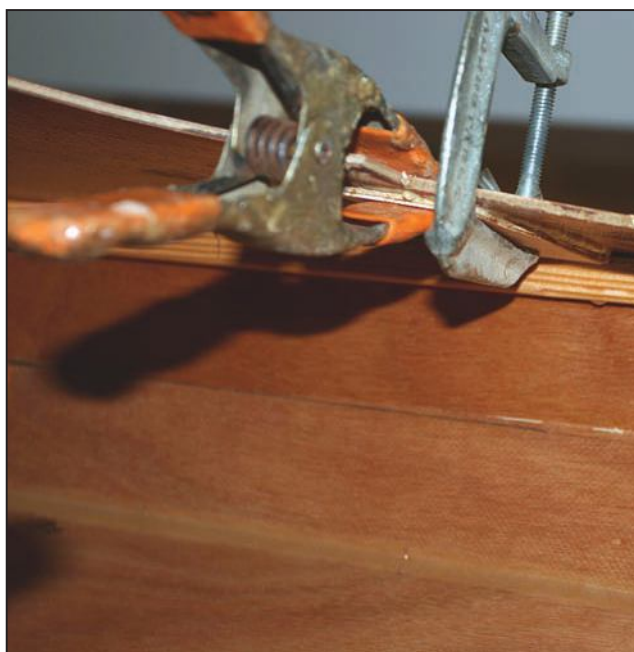
**60.** Take off the forward deck. Mix up 6 oz of unthickened epoxy and roll it onto the underside of the forward deck. Mix up 3 oz of epoxy thickened with Cab-O-Sil and wood flour to a thin peanut butter consistency; brush it on the forward sheer clamps. Stop at the marks indicating the aft ends of the deck.



**62.** Dry-fit the aft deck. Place the deck so it sits on top of and just overlaps the forward deck. Reach underneath and scribe a line on the aft deck; plane to this line and check the fit. If the butt joint looks tight and the overhang is even all around, take the deck off, coat the underside with clear epoxy, butter the clamps with thickened epoxy, and set it back on the boat. Use straps to pull the deck down to the hull. The aft deck radius is much less than the forward deck. Be careful not to flatten the deck with the straps. Use four pinch clamps to hold the butt joint tight while the deck is nailed/stapled in place.



**61.** Carefully place the deck back on the boat and use straps to pull it down to the hull. Use pinch clamps to hold the aft end in place. Don't overtighten the straps. The deck overhangs cantilever out from the hull; maintain the proper camber, and avoid too much pressure on the deck. Make sure the overhangs around the bow are even. If the fit looks good, it's time to start nailing or stapling. Start aft and move forward, alternating from side to side; moving about a foot before changing sides. Be sure the deck touches the main deck beam for its full width. Leapfrog the straps as you work forward. Be sure to maintain the camber of the deck as you work toward the upswept section of the hull. If you are using nails, space them about 4" apart, and use a marking gauge to locate the center of the sheer clamp. If you are using staples, drive them through plywood "buttons"; these act as washers and allow the staples to be pulled out after the epoxy cures.



**63.** Make two butt blocks, 2" wide and 4" long, from 4mm plywood. Butter these with thickened epoxy. Center them under the butt joint and clamp in place.



**64.** Clean up any excess epoxy before it cures. Take a break—you have earned it.




**67.** The deck can also be trimmed with a handsaw. A Japanese handsaw works best.



**65.** After the epoxy cures, pull the staples, being careful not to damage the deck. If you used nails, set the heads.



**68.** Whichever deck trim method was used, the deck still needs to be flush with the hull. Start with a sharp block plane, and finish off the job with a sanding block or random-orbit sander, using 80-grit paper. 

*Bill Thomas lives in South Berwick, Maine, where he designs and builds boats, custom cabinets, and furniture. He is a Maine Guide and an instructor at WoodenBoat School, where he will teach “Build Your Own Willow Sea Kayak” June 3–9 and September 9–15.*

*Jane Ahlfeld teaches seamanship skills and sailing on the WoodenBoat waterfront, and she is a computer consultant.*



**66.** Trim off the deck overhang. Be very careful; it’s very easy to cut into the hull at the bow and stern. I use a router with a pilot bit.

**In our next issue, we’ll install the cockpit rim and tend to the finishing details. Then this fine kayak will be ready for day trips and expeditions.**

*Although you can build Willow directly from these pages, working to the large-scale plans with full-sized patterns will ease the job. Those plans (\$95 plus \$8 shipping), as well as kits and finished boats, are available through Bill Thomas Woodworking, 151 Ogunquit Rd., South Berwick, ME 03908; <[www.billthomaswoodworking.com](http://www.billthomaswoodworking.com)>.*