HOW TO BUILD AN EASY HOME BUILT SEA KAYAK

BY JEFF SPIRA
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Hi, I'm Jeff Spira. I've been designing, building and sailing boats for nearly 40 years. I'd like to thank you for deciding to buy a Spira International boat plan. These are, I believe, some of the easiest modern home built boat plans available anywhere.

I have a Mechanical Engineering degree from California Polytechnic State University in San Luis Obispo located in coastal central California. While I was at Cal Poly I apprenticed under a Naval Architect and boat carpenter helping to design and build boats. I also commercial fished out of Morro Bay fishing for Albacore tuna and Rock Cod (sometimes referred to as Pacific Red Snapper) I also lived on a commercial boat for quite a while, when attending school. At this time I did everything I could to get out on the water, whether it was surfing, sailing, fishing, diving, and swimming. If it had anything to do with water, I was ready.

The boats I design are not wooden boats in the traditional sense. In traditional wooden boats, the wood framing is attached together and the planking is fastened to the frames with fasteners that are used to transfer the loads of the water to the various parts of the hull.

Not so in my boats. These boats are designed as unified structures, much like the unibody construction of modern cars or bonded monocoque construction of airplanes combining the framing and the skin into a single unit from a structural point of view.

In addition, traditional wooden boats absorbed water into the wood to become soaked, swelling up to seal the joints. In a Spira International boat, the wood is completely sealed by the epoxy, making them easy to maintain, rot resistant and able to be built from inexpensive, commonly available materials.

Good luck with your build and please email me pictures if you complete one of these boats:

info@spirainternational.com
TOOLS TO BUILD YOUR SEA KAYAK

To build the one of these boats, you should also be familiar with using wood working hand tools and hand-type power tool such as saber saws, electric drills, and electric sanders. You could build this boat using only hand tools but power tools sure makes the construction go much faster. I personally find the time savings using power tools allows me to do a better job. If you have spent some time using wood working tools, you'll have no trouble building this boat.

To build this boat you should have at least these tools:

**POWER TOOLS:**
- Electric Drill
- Random Orbital Sander
- Saber Saw

Old fashioned corded tools are fine but modern cordless ones are also great and even more convenient to use.

In addition, you'll also need these hand tools at least.

- Crosscut Saw
- Back Saw
- Block Plane
- Wood Chisel
- Hammer
- Screwdrivers
- Framing Square
- Small C-Clamps
- Tape Measure
OF COURSE THERE ARE SOME OTHER TOOLS THAT COULD COME IN HANDY, SUCH AS A TABLE SAW, A POWER PLANE, AND ONE OF MY FAVORITES, AN OLD FASHIONED DRAWKNIFE. DON'T CONCERN YOURSELF WITH HAVING A FULL TOOL CHEST BEFORE BEGINNING. YOU CAN ADD TOOLS AS YOU NEED THEM.

LUMBER FOR YOUR KAYAK

THE FIRST CONSIDERATION YOU SHOULD MAKE IS USAGE. IF YOU ARE PLANNING ON A 5 YEAR 'ROUND THE HORN' SEA VOYAGE, OBVIOUSLY YOU SHOULD SELECT YOUR MATERIALS WITH MORE CONSIDERATION AND CARE THAN IF YOU ARE BUILDING THE BOAT TO KEEP AT YOUR MOUNTAIN CABIN TO USE A WEEKEND A MONTH ON THE LOCAL LAKE DURING THE SUMMER MONTHS. NONETHELESS, YOU ARE GOING TO PUT LOTS OF EFFORT INTO THE CONSTRUCTION OF YOUR BOAT AND SHOULD SELECT THE BEST MATERIALS YOU CAN, TO FIT YOUR USAGE AND BUDGET.

THERE ARE ESSENTIALLY TWO DIFFERENT KINDS OF TREES HARVESTED TO MAKE LUMBER. THESE ARE DECIDUOUS AND CONIFER. DECIDUOUS TREES ARE BROADLEAF TREES LIKE WALNUT, OAK, MAPLE, BIRCH, MAHOGANY, AND SIMILAR. THESE TREES LOSE THEIR LEAVES IN THE AUTUMN AND REGROW THEM IN THE SPRING. THE LUMBER CUT FROM THESE TREES IS USUALLY REFERRED TO AS HARDWOOD.

THE OTHER TYPE OF TREES, THE CONIFERS, ARE EVERGREENS LIKE PINE, SPRUCE, FIR, CEDAR, ETC. ARE CONIFERS. THESE ARE SOMETIMES CALLED SOFTWOODS. SOFTWOODS ARE WHAT IS USED AS CONSTRUCTION LUMBER THROUGHOUT THE WORLD BECAUSE IT GROWS QUICKLY, IS EASY TO MILL, LIGHTWEIGHT, AND IS STRONG ENOUGH TO CREATE STURDY STRUCTURES.

TRADITIONALLY, BOATS HAVE BEEN BUILT OF HARDWOOD FRAMING, AND OFTEN HAD SOFTWOOD PLANKING. THAT WAS WHEN EACH FRAMING PIECE WAS REQUIRED TO CARRY IT'S FULL LOAD RATHER THAN BEING PART OF AN INTEGRATED STRUCTURE. THIS BOAT IS DIFFERENT. THE ELEMENTS ARE BONDED TOGETHER TO CREATE A UNIBODY STRUCTURE.

ANY SOFTWOOD, IF IT IS STRUCTURALLY SOUND AND BONDS WELL, IS SUITABLE TO BUILD THIS KAYAK. IN DIFFERENT PARTS OF THE U.S. AND IN DIFFERENT PARTS OF THE WORLD, DIFFERENT SPECIES OF WOODS ARE USED AS CONSTRUCTION MATERIALS. FOR INSTANCE, IF YOU WALKED INTO A HOME DEPOT IN FLORIDA AND BOUGHT A 2X4 OFF THE RACK, IT WOULD PROBABLY BE YELLOW PINE, IF IN OREGON, IT WOULD PROBABLY BE DOUGLAS FIR. EITHER ARE EQUALLY ACCEPTABLE FROM A STRUCTURAL VIEWPOINT.

THE BIGGEST CONCERN WITH USING CONSTRUCTION GRADE LUMBER FOR BUILDING YOUR BOAT IS DECIDING WHAT DEFECTS IN THE LUMBER ARE ACCEPTABLE AND WHICH ARE NOT. HERE ARE A FEW OF THE COMMON DEFECTS IN CONSTRUCTION LUMBER:
The cups, twists, and warps present no major problems if not too severe, but checking, knots and splits are of some concern. Examine your structural pieces carefully for splits, any splits should be avoided in all framing. If you discover one after you've already assembled and glued up your framing - don't worry about it, but it is best to cut off any splits you find in lumber before you assemble frame elements.

Knots present a special problem. Clear lumber, which is knot free, is best, but small tight knots are not a problem so long as they aren't at the corner edges of the lumber. Here are some examples of tight and loose knots. Do not use lumber with loose knots:

If this is your first endeavor into any kind of woodworking, I'd suggest building a tune up project of some type before building the boat. One great idea is to build a pair of saw horses. You'll need them to build the boat and it will give you a chance to get used to the tools. Make from 2 x 4 lumber (35 x 90 timber) about 3' wide (1 m) and 3 feet long (1 m.)
PLYWOOD FOR YOUR BOAT

Let's first discuss the different types of ply. There used to be a type of plywood called interior ply that was manufactured using natural glues that would let loose when wet. It is not made anymore. Nearly all ply made now uses synthetic, waterproof glues.

Plies made of softwoods, usually fir but sometimes pine, have knotholes. If these are left open on the surface laminations, it is called "C" grade. If the knotholes are filled with football shaped plugs, it is considered "B" grade. If it has no knotholes, it is considered "A" grade. So ABX plywood would have no knotholes on one side, filled knotholes on the other and has been laminated with waterproof glue (X = exterior.) Knotholes are normally left unfilled in the interior laminations, leaving a voids. In marine plywood these interior knotholes are also filled ensuring the ply is void free.

For this boat, I recommend marine plywood in the event you elect not to fiberglass and epoxy coat the boat on the outside. If you decide to glass cover the boat, ABX plywood is sufficient. As an alternate, hardwood plywood may be used. Mahogany and Birch are the most common. They have no knotholes, so don't have any voids.

FASTENERS FOR YOUR BOAT

My recommendation is to use what are called "deck screws." These are thin screws that can be screwed into place using a cordless drill without drilling a starter hole. This has revolutionized home wooden boat building world. Like drywall screws have replaced nailing, so have deck screws replaced boat nails. They're just easy.

It used to be that stainless steel was very expensive, but with most of the fasteners coming from offshore, stainless just isn't that expensive any more and for most small boats like this kayak, stainless makes an ideal fastener. You could also use zinc coated steel if you use your kayak only occasionally and store it inside where it will stay dry between outings.
GLUES FOR YOUR BOATS

There are a number of products suitable for building these kind of framed boats but by far the best choice is Epoxy. Epoxy is a 2 part thermosetting (which means it polymerizes into a hard plastic that cannot be reversed or melted after it is cured) adhesive ideal for boat building because it it extremely strong, flexible and waterproof. The very same resin may be used to laminate fiberglass cloth to the outside of the boat to seal and strengthen the planking.

I often get e-mails from people asking about what kind of epoxy is best to use for building my boats. I’ve used an online supplier, John Greer, in the past and find his products excellent quality and very well priced. He ships quickly, answers questions promptly and also stocks thickening agents like Cab-O-Sil and microspheres, and also carries fiberglass cloth and tape, also at excellent prices. Check out his web site: http://www.jgreer.com/.

You may also use polyurethane adhesives, such as Elmer’s Ultimate, Sticky-Ass Glue, Loctite Polyurethane and others. These will also make the ‘stronger then the surrounding wood’ joints, sufficiently water resistant for boat building use.

The only downside to using polyurethane is that it cannot be used as a resin to reinforce fiberglass cloth. You need to use epoxy for that, but as a wood-to-wood glue, it is fine.
KAYAK BILL OF MATERIALS

- 2 SHEETS 4’ X 8’ (1200 X 2400 MM) 1/4” (6 MM) MAHOGANY PLY
- 1 SHEET 3’ X 7’ (900 X 1900 MM) 1/8” (3 MM) MAHOGANY PLY (DOOR SKIN)
- 56’ (17 M) 1/2” X 2” (12 X 50 MM) MOLDINGS (SHEER CLAMP AND CHINE LOG)
- 28’ (8 1/2 M) 3/8” X 1-1/2” (10 X 38 MM) MOLDINGS FOR RUB RAIL
- 24’ (7 1/5M) 1X4 3/4” X 3-1/2” LUMBER (19 X 90 MM) FOR FRAMES AND KEELSON
- 100 #6 X 1-1/4 (M3 X 18) DECK SCREWS
- 2 QT (2 L) EPOXY RESIN
- 3 YDS (3 M) 6 OZ. FIBERGLASS CLOTH, 50” WIDE

IF YOU CAN BUY THE MOLDINGS IN 14’ (4.3 M) LENGTHS, GREAT. IF NOT, YOU MAY CREATE THE ELEMENTS FROM RANDOM LENGTHS BY USING A SPECIAL JOINT TO LENGTHEN THEM TO THE LENGTH NEEDED. THIS IS CALLED SCARFING AND IT CREATES A VERY STRONG JOINT THAT WILL BE ABLE TO BEND AND FLEX AS WELL AS AN UNSPLICED ELEMENT. YOU CUT AN ANGLE EQUAL TO 8 TIMES THE WIDTH OF THE BOARD, THEN GLUE THE PIECES AND Clamp Them SO THAT THEY DON’T MOVE UNTIL THE GLUE IS FULLY SET UP:
**STRONGBACK CONSTRUCTION JIG**

Building a wooden framed boat is best accomplished on a strongback. Generally this is made of a strong wooden beam just long enough to fit inside the boat. This brings the boat up to a comfortable working height and keeps everything aligned while the boat is under construction. For your kayak, this strongback jig can be made from standard scrap construction lumber you may have around the house.

These are usually built about 3 feet high. You can adjust it higher or lower as you see fit to make it most comfortable for you to work. The top beam is made from a 2x4 (measuring 1-1/2 x 3-1/2 or in metric 35 x 90 millimeters.) It should be cut like this:

![Diagram of a strongback construction jig]

10' 1" (3073 mm)

45° BOTH ENDS

Make sure you glue and securely fasten the strongback joints, so that the finished jig is sturdy and doesn’t wobble too much. I prefer deck screws but some builders like nails. Nails are fine if you use a strong glue like Elmer’s Ultimate.
Kayak Construction Procedure

You begin by building the frames. There are two and they are identical in shape. Here is the finished dimensions of the frames:

The frames are built on a piece of scrap plywood, or a workbench top that you don't mind driving nails into. You first lay out the shape of the frame and use it as a pattern to cut out the frame elements. Use a factory cut edge of the ply, or the front edge of your workbench as the baseline that the bottom element will rest against.
Next, lay your frame material on the drawing and mark the cuts.

You can then cut out the frame element using your back saw.

Next, you need to assemble the frame elements. A little kitchen waxed paper will keep the glue from sticking to your ply or bench top. Use plenty of glue and drive three screws into each joint, keeping the corner free, because you'll have to later notch it.
Next you need to notch the frames to make room for the keelson. This is the same depth as the keelson is thick, but it is wider than the keelson. This leaves a little room on each side to allow water to drain past the frames. These are known as limber holes.

It’s best if you drill a hole in the corner using a 1/2” (12 MM) or 3/4” (19 MM) drill bit. This makes for a nice smooth transition and prevents the wood from cracking. The rest of the material is easily sawn out with a power scroll (saber) saw, or if you are working with only hand tools a thin bladed saw such as a coping saw.

Next cut out the stems. Two are required, one for the bow and one for the stern as shown below. Make this piece from a section of 1 x 4 lumber (19 x 90 timber.) Construction grade is fine, but be sure it doesn’t have any splits or loose knots.
Now is time to set up your frames on the strongback and start assembling the framing. Begin by tacking the stems in-place slightly higher than the top of your strongback as shown below. Toenail some long, thin nails through the stems into the strongback to keep them in-place.

Next orient your frames in their correct locations. Note that the lower crossmembers face each other. Measure from the top edge of the strongback to the first frame's lap joint. Then measure from the lap joint of the first frame to the second frame. Use your square to be sure they are at 90 degrees to the strongback and your tape measure to be sure they are centered side to side, then toenail these frames to the strongback as well.

It is time now to install the keelson. Locate or scarf together a 12 - 1/2' long piece of 1 x 4 lumber (19 x 95 Timber) for the keelson and lay it across the top of the assembly running longitudinally. Apply plenty of glue to the mating surfaces and run deck screws downwards through the keelson into the frames and stems.
The chine log and sheer clamp come next. You must cut out notches in the frames as shown for these longitudinal elements to fit in.

The easiest way to do this is by cutting a small piece of the material used for the chine log and sheer clamp to use as a marking tool. Holding it up to the top of the frame and angling it to the approximate angle it will be sitting once attached. Simply use a pencil to mark the top (for the sheer clamp) or bottom of the frame (for the chine log) then mark the side of the frame for the correct distance of the cut to account for the width of the material. No need to get too fussy at this stage, you’ll get a chance to fit it better using a rasp or file for a good tight fit. Here’s how that marking and cutting will look:

Then use a back saw to cut out the notches at the correct angles.
As you approach the bow and stern, you'll need to notch the transom and stem to receive the sheer clamp and chine log.

The keelson has to be cut away to get the chine log to smoothly transition into a point at the bow. This will look something like this. Once you have made the cutouts and shaped them so that the longitudinal elements fit well, apply glue and screw the ends into the stems.

Once the framing is complete, the next step is to "fair" the boat. This involves planing the frames and chine log so that plywood will smoothly fit on the outside of the boat. Take your time doing this so the fits are tight and smooth. Some people (and I include myself) like a drawknife for this work, but be careful, it takes some practice to keep from removing too much material.
Once the glue is fully cured, you may now remove the nails holding the boat to the strongback. Better now than after the framing is complete when you won’t have easy access to the nail heads.

There is no way to pre-determine the exact sizes and shapes of the plywood for framed hulls like this beforehand. If you build each rib within plus or minus 1/8” and locate them precisely within plus and minus 1/8” the plywood planking can vary by as much as 2”! It’s probably more likely that most of these dimensions will vary by a good deal more than that. I’d say if a builder gets within 1/2” he’s probably doing a pretty good job on his boat. This means that the plywood planking shape can vary between one hull and the other by as much as 6”. It just doesn’t make any sense to try to cut this out beforehand.

The correct way to cut out the plywood is to first frame the hull. Put all elements in-place, glued and fastened so that the precise hull size and shape is fully established. The boat’s framing is then used as the only reliable pattern to cut out the plywood covering. The framing is then used as a pattern to cut out the framing.

Begin with the side plywood planking. Lean the plywood against the framing. Make sure the edge falls between frames (you’ll use a butt block in the inside after the planking is in place to deal with the seam. Use a pencil to trace around the pattern you need to cut out. It is usually advisable to make it a little too big. You can always trim it down later after the planking is in-place.

Once you’re happy with the shape of the panel, glue and screw it into place into the frames, sheer clamp, chine log and stems.
The extra material left projecting over the edges of the framing is easily removed with a rasp, sander or angle grinder to make the edges precisely align with the framing:

Repeat the process of using the framing as a pattern to cut out the bottom planking also. Glue and screw it in-place then trim the edges to make for a nice, smooth edge transition. Round the edge so that you have no splinters, voids or sharp edges:
You now need to remove the kayak from the strongback construction jig and flip it over.

Wherever there are seams in the planking, you’ll need to cut out a butt block about 6” wide to fully cover the seam on the inside. Make it from the same thickness of plywood as the hull planking. Apply glue to the butt block and clamp or screw through the outside planking inward to secure it in-place until the adhesive cures fully.

Once the planking and butt blocks are in-place, spend some time filling the screw heads, holes, voids and other defects in the hull. The easiest thing to use is some sawdust - preferable very fine dust (clean out your power sander for best results) mixed with epoxy resin. You may also use talc or silica (Cab-O-Sil) or other wood flour products as a thickening agent.

Mix up a small batch of resin and add the filler slowly, stirring well, until your mixture has about the consistency of peanut butter. This will make a great, strong, and watertight sealing putty that you can apply to joints and any defects in the wood you may encounter.
Next - sand the hull smooth. (It's not nearly as much fun as it looks!)

Your kayak will benefit by a layer of fiberglass on the outside. If you elect not to glass the hull, at a minimum, you should at least use 3" wide fiberglass tape along the seams and saturate the outside of the hull with epoxy. Select a good quality non-blushing epoxy resin and 6 oz fiberglass cloth for the covering or the taping. 6 oz means there are 6 ounces of glass per square yard of fabric. It's an indication of how thick the material will end up. You can buy the materials at any marine supply store shop or online - even on eBay. One of my favorite suppliers is www.aeromarineproducts.com.

It is best to cut all panels out first, bottoms and sides, because you'll want to make sure that once you mix up a batch of resin you use it all before it starts to harden - usually 3 or 4 hours. You could apply both layers of glass for most boats in this amount of time. It is perfectly acceptable to add a layer of fiberglass over another layer while it is still wet. In fact it is preferred. Cut them out so that they overlap any edges and make a double layer over the chine and stems.
Next, mix up a batch of epoxy resin in accordance with the manufacturer's recommendations and paint or squeegee it on the area you wish to fiberglass:

Whether you are planning only to tape the seams or cover the entire hull in glass, you should saturate the outside of the hull completely with epoxy. This strengthens and helps seal the hull. Now carefully lay the glass cloth or tape onto the still-wet epoxy under-layer:

When you are happy stretching the glass cloth out on the wet epoxy, apply a second coat and squeegee it in until the cloth turns from white to transparent. This tells you the glass is wetted out properly.
You can lay the second layer of cloth right over the first that you just wet out if it is still tacky. If the epoxy is cured already, apply another coat of epoxy resin over the cured epoxy before laying the next layer of cloth on.

Once it is cured you will be able to see the texture of the cloth on the surface. This will require considerable sanding to get smooth. A trick to minimize this effect is to use plain old waxed paper, the kind your grandmother wrapped sandwiches in. Just lay it on the wet glass/epoxy surface after wetting and roll or squeegee down. After the epoxy cures, the waxed paper will peel off and leave a smooth surface that needs only minimal sanding.
Once you peel off the waxed paper, three things need to be done: 1) sand, 2) sand, and 3) sand some more. About now, you’ll start to wish you had taken up basket weaving instead of boat building, but keep at it anyway, and eventually you’ll get the finish nice and smooth.

Now remove the kayak from the strongback jig. You are now finished with the jig and can dismantle it (or save it - because once your friends and family see what you’ve done, they’re going to want one too!)

Now you make the two deck beams. These are cut out from 1 x 4 stock (actually the dimensions are 3/4” x 3-1/2” or 19 x 90 mm.) Cut them out in this shape:

You create the curve on top, by driving thin nails into the center and both end of the arc locations, then use a thin strip of wood like a molding, and use it as a flexible spline to contact the three nails. You can then use this as a guide to draw out the arc. Cut the material with your scroll saw.

Once cut out, glue and screw these beams with the top edge flush with the tops of the frames. The deck beams should go on the side of the frames closest to the center of the boat.
You then use the top of the boat as a pattern to cut out the fore and aft decking out of the 1/8" (3mm) Mahogany door stock. Glue and tack (or staple) the decks in-place until the adhesive cures fully.

Next, you'll need to saturate the inside of the hull and the decks with epoxy. Mix up a batch in accordance with the manufacturer's recommendations and paint it on all exposed wood. This both seals and strengthens the wood.

Finally you need to coat your kayak with a finish coat. This may be a good quality latex enamel paint or, if you wish to allow the wood grain to shine through, a polyurethane varnish.

You may also make a paddle for your kayak if you wish out of a standard closet pole available at any home do-it-yourself center, and a piece of 3/8" (9mm) plywood. Cut out two paddle blades from the plywood like this:

Then slot a 7' to 8' (2 - 2.4 m) closet pole (1 3/8 - 35 mm dia solid wood round) about 18" deep and the width of the ply thickness on each end setting the blades so that they are 90 degrees apart, and glue the blades to the closet pole.

Finish the paddle like you did the boat, saturate with epoxy, let cure then paint with enamel if you want it colored, or polyurethane varnish if you want the wood to shine through.
OTHER BOATS YOU CAN BUILD

Plans to build many other boats of all types may be purchased either in downloadable electronic format or large size printed paper. Just a few of the many drift boat, dory, fishing, cruising, and sailing boats available on www.spirainternational.com:

Along with more info on these boats and many others, find free study plans, free videos, free e-books, free reports at:

SPIRAINTERNATIONAL.COM
YOU CAN BUILD THIS GREAT KAYAK AT HOME FROM MATERIALS YOU CAN BUY AT ANY DO IT YOURSELF HOME WAREHOUSE AND BE ON THE WATER ENJOYING YOURSELF IN JUST A FEW WEEKS! HERE ARE SOME HAPPY BUILDERS WHO, LIKE YOU, WONDERED IF THEY COULD BUILD THEIR OWN BOAT, TOO!