



Skin-on-Frame Canoe

by [balloondoggle](#) on July 27, 2011

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Intro: Skin-on-Frame Canoe

I want a canoe. I want one really badly. New, it's going to run me \$400 or more. Used, well, I just don't like Craig's List and haven't found any other listings in my area. So what's a boy to do? Build one!!!

There is no shortage of guidelines and tips and hints and clues and allusions to canoes out there in internet-world. What I had trouble with was finding step-by-step instructions. Every time I got close, the search results would morph into kayaks. There are several well-written guides right here on Instructables, and out in the Wild Unknown Internet you can find a lot of generalities or opportunities to buy plans, but none of them gave me the info or product I wanted at a price I would pay (\$0, for the record).

So anyway, I decided that I would study the guidelines and tips and hints and clues and allusions to canoes and build one. Options are several: Skin-on-frame, plywood stitch and glue, strip planking. Right off, strip planking is out. Complex, demands skills I don't have, and would likely cost much more than the \$400 of a new fiberglass unit unless I used plywood strips. Plywood stitch and glue gives you a durable, serviceable unit, but requires epoxy and fiberglass and the results are ugly as hell. A skin-on-frame is comparatively simple, very cheap and can give you a gorgeous boat. Besides, if it was good enough for the warplanes of WWI, it's good enough to float around the local flood control lakes.

Sites that inspired or informed me on this project:

http://ecketrailmates.org/event_files/colorado-canoe-trip/dimensions-tips.htm

<http://www.dimensionsguide.com/canoe-dimensions/>

<http://www.rei.com/expertadvice/articles/canoe+paddle.html>

<http://www.bushcraft.ridgeonnet.com/canoe2.htm> (This one in particular - the finished product is **GORGEOUS** !)

<http://books.google.com/ebooks?id=g2UUAAYAAJ>

Read on if you would like to hear the tale of my trials and tribulations as I strive to build my own canoe for less than the cost of a new unit!



Image Notes

1. Paddle made from 2"x4" and 1/4" plywood.



Step 1: A false start.

After dreaming of this for some years, I finally put my foot down and decided to do it. I had been reading what I could find and had some general ideas as to size and construction method in mind. From this vague mental image I developed my take-offs and got together a materials list. I met up with my long-suffering cohort, Bob, and we headed to the big-box home improvement warehouse.

Most of my sources show frames with many ribs, all different sizes, all steam bent, all beyond my skills and patience. My plan was to buy regular 2x dimensional lumber and rip the parts I would need to frame the canoe with multiple stringers over a few frames. My "research" suggested that this is a common method in kayak construction, and since it looks simpler than 20-30 unique ribs, that's what I would do.

I knew I wanted a 16' canoe, so I needed 16' stock. 2 x 12 boards come from larger, older trees and so I expect that the grain will be less susceptible to splitting. My plan was to cut gunwales as .5" x 1.5" slices from the edge of the board, then the keel would be a 1.5" x 1.5" slice. After that, stringers would all be .5" x .5" strips. I still didn't know how many I would need, or how many useful parts I could get from a single 2 x 12. So we bought 2.

For the stems and a center frame, I used .75" plywood. Thick, strong, easy to cut curves - just the thing. We grabbed a 4' x 8' sheet and had the staff cut it in half for us.

Next came wood screws and tacks. Common and easy to find anywhere.

Fabric came from fabric.com. 6 yards of 60" wide 10 oz cotton canvas ran about \$40, shipped. I checked first to be sure they wouldn't send me 6 1-yard pieces as I can't sew well enough to put them all back together. Delivered on time, as ordered, and ready for action.

We headed back to the house with our 16' boards resting comfortably on some pool noodles (\$1.50 at Biggs) protecting the roof of the van. Once there we set up the backyard boatyard and started hacking away at the wood.

We still had no real concept of the dimensions we would need for the various parts, but decided somewhat arbitrarily that the sides would be 18" high and the stems would be 24" to give the ends that up-swept look. I took a minute to look up some basic sizes and found that a 16' canoe has 12"-13" sides. That seemed shallow to us, so we bumped it up to 18". More is better, right? A quick spin on Google SketchUp and we had our stem shapes. We cut out 4 and doubled them for each end, giving us parts that were 1.5" thick to secure the ends of the stringers and fabric to.

By the time we got to this point we were exhausted. True to form, I didn't start the project until summer hit it's stride and we were working in a heat index that hovered right around 100F. Too damn hot! We had the stems cut out and secured to the keel, the gunwales were cut out and secured to the stems, and the center frame was in place. The whole assembly was upside down on my sawhorses in the shady part of the yard and ready for more.



Image Notes

<http://www.instructables.com/id/Skin-on-Frame-Canoe/>

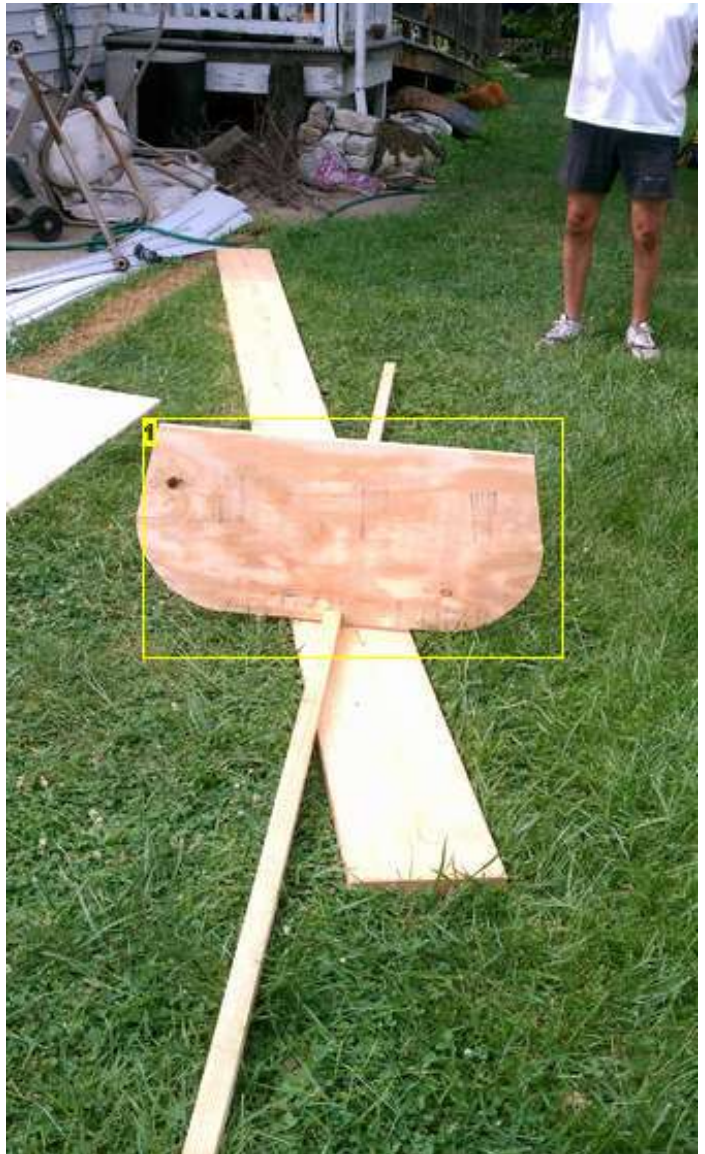


Image Notes

1. The long-suffering Bob. My hero. Learn more about Bob in "The Clubhouse".
1. Initial keel and frame. Too big and bulky for this size canoe.

Step 2: Do over!

That was Saturday. We took Sunday as a day of rest and then at work on Monday it occurred to me that the fabric was only 60" wide. I had no idea what the perimeter of the canoe was at its widest point. By the time I got home I knew I was going to be in trouble. A beam of 38" and a height of 18" is already 74" and that doesn't count the curves at the chine. So, it all came apart again. I spent an evening with Google SketchUp and made the frame fit the fabric. I redrew the stem pieces and cut the keel down to .75" x .75". I left the stringers at .5" but added two frames to support them. Then I set out some stationing based on a diagram I found online and started marking out the dimensions on the plywood.

Once the stems and frames were cut/recut to useable sizes, I started ripping stringers. Luckily, I was able to get the stock into my basement through a window so I could work in the relative cool. Heat indices in our area were a bit over 100F at the time, so this was a welcome relief. Several hours later I had 15 gallons of sawdust and 17 stringers - 14 needed and 3 spares. This consumed one 2"x12"x16' board, and left my entire basement - and everything in it - coated in sawdust.

The frames were notched to accept the stringers and help keep a fairly smooth appearance on the outside once the skin is on. It also helped prevent splitting by the screws when I began fastening things together by "clamping" the stringer at the screw hole.

Once I had that done, I had to move everything back to the Great Outdoors. If I build a boat in the basement, it will never leave the house and will only float when the sewer backs up.



Image Notes

1. Outfeed roller by Tonka.

File Downloads



canoe.skp (126 KB)

[NOTE: When saving, if you see .tmp as the file ext, rename it to 'canoe.skp']

Step 3:

Once everything was cut and in the backyard, it was time to begin assembly.

I laid the keel and gunwales across my sawhorses and put the frames in place. It became immediately clear that I needed a strongback to support the canoe through the earliest stages of construction. I used the remaining 2"x12" for this and it worked out well. I just screwed down some scrap wood to hold the frames upright at the appropriate station points.

Next I fastened the stringers to the frames and began to see the actual shape of the canoe begin to come out.

Once they were all fastened to the frames, I felt comfortable turning the whole assembly right-side-up. This let me secure the gunwales to the stems and firm up the whole structure. This is where I began to suspect a problem....

When I began fastening the ends of the stringers to the stem, there was a lot of extra material hanging over the ends. This should have been a clue, but the heat and insects clouded my view and my mind and I just kept plugging away, aware that something was not quite right, but not knowing what.

As I worked on fastening the stringers, it became apparent that the individual stringers had distinct characteristics based on where in the tree it had been at the time of harvest. By using a 2"x12" board, I got some material from the center of the tree. This turned out to be very resistant to bending and I snapped several stringers trying to force them to a contour they just didn't like. Knots also turned out to be problematic if they were too close to a bend.

Seats were added by lashing boards to the gunwales at stations I had determined during the planning stage.

Eventually, I got the whole frame assembled and ready to cover.

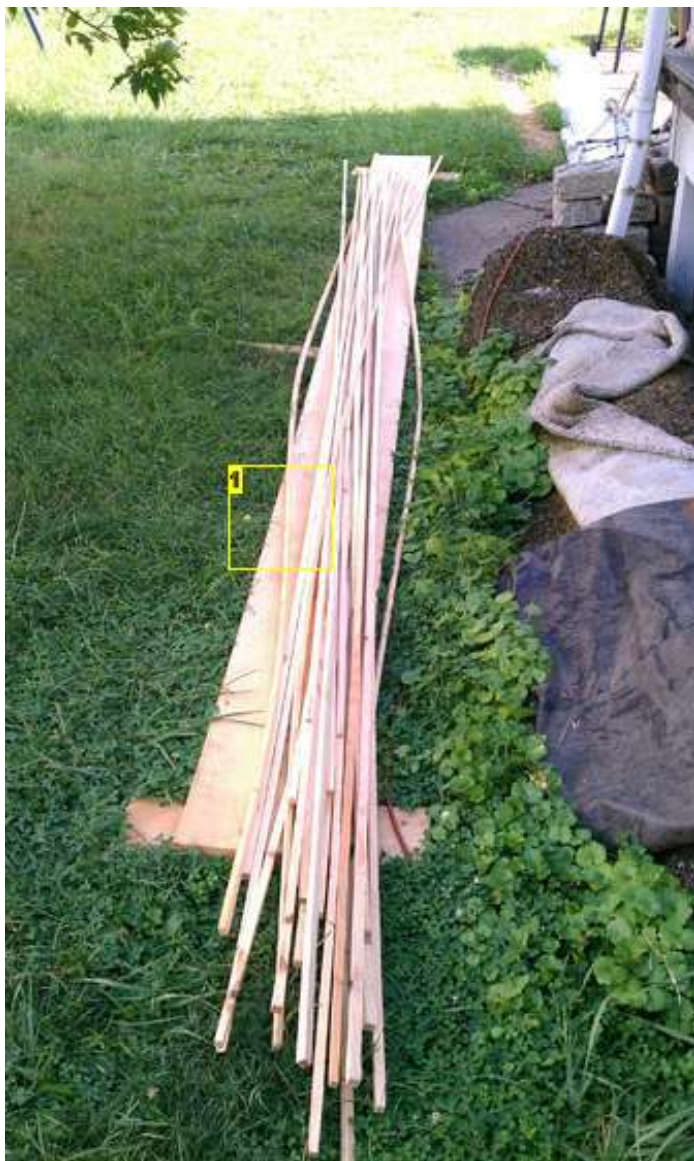


Image Notes

1. One canoe, some assembly required.

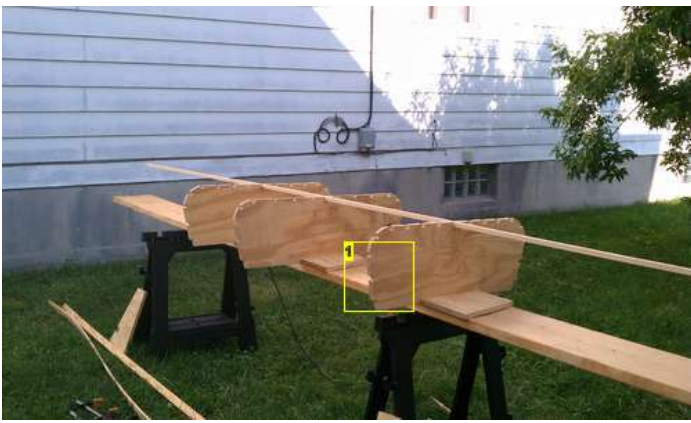


Image Notes

1. Keel and frames on strongback.



Image Notes

1. First hint that the dimensions were off. I ignored this hint.

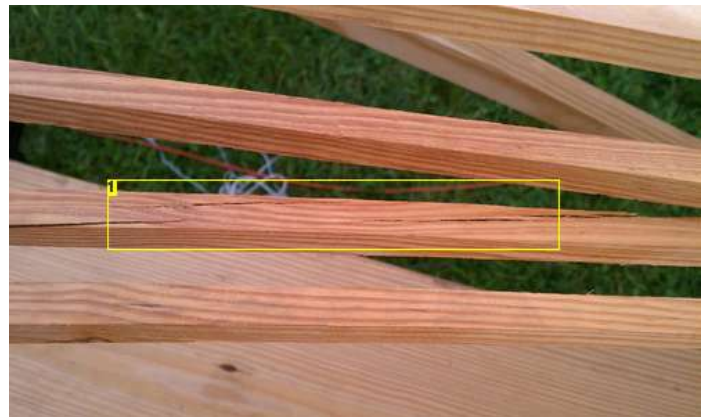


Image Notes

1. Splits and non-uniform flexibility are the hallmarks of this method.

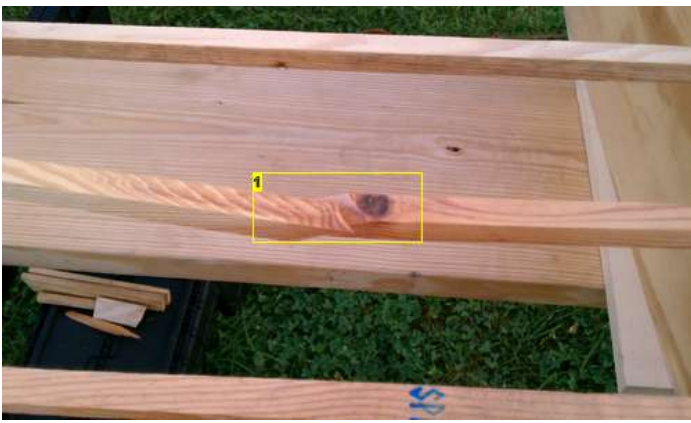


Image Notes
1. Knotty wood is weak.



Image Notes
1. Now it looks like a canoe!



Image Notes
1. This deep V is unnecessary and undesirable. I figured that out too late.



Image Notes
1. Seats are lashed in place. If sealed against water, paracord is a good option here.

Step 4: Skin!

This is where I doubled the cost of the project. Before covering the frame I wanted to waterproof it to avoid rot problems with the wood. To that end, I picked up a quart of spar urethane to coat all the members. I prefer to avoid getting plastic shopping bags when I can, so I put the quart can in my backpack and put that in the back of the car. When I got home, I found a can with a new dent and only about 1/3 of the original contents. Sharing space there were my emergency clown nose and a Panasonic Lumix camera my parents had given us the previous Christmas. Don't worry; I was able to salvage the nose.

To cover the frame I used 10oz cotton canvas. It turned out to be easy to rip if I pulled too hard, but I was able to adapt and overcome.

After laying the material out over the frame, I aligned it so it was centered on the keel. To assist with this, I folded the fabric in half lengthwise and ironed a crease down the center. Be careful if you do this on the dining room carpet. Hot irons will not play nice with synthetic carpet fibers when set for cotton. I've already made this mistake - go make your own.

Once I was comfortable that I had sufficient fabric on each side of the canoe, I started tacking it to the keel. I started in the center and worked fore a few inches, then aft a few inches. This lets you adjust the tension as you go and keeps things uniform and relatively unwrinkled. I put my bar clamps on each end of the fabric and let them hang loose to keep it from bunching up.

After only a couple of tacks I switched to staples. The tacks I had were too soft for the pine and the points would just curl under instead of setting in the wood. The staples make the work go more quickly and held just fine. The question will be whether they rust away over the winter and allow the fabric to shift or tear.

Folding the fabric over the stem took some trial and error, but eventually I got it done and minimized the cutting. I didn't want any seams below the water line, so the folds probably resulted in an odd pattern if I were to lay it all out flat.

When everything was stapled along the keel, up the stems and along the gunwales, I was ready to flip it and trim the excess fabric. At this point it is really looking like a canoe and my neighbors stopped giving me the ole stinkeye.

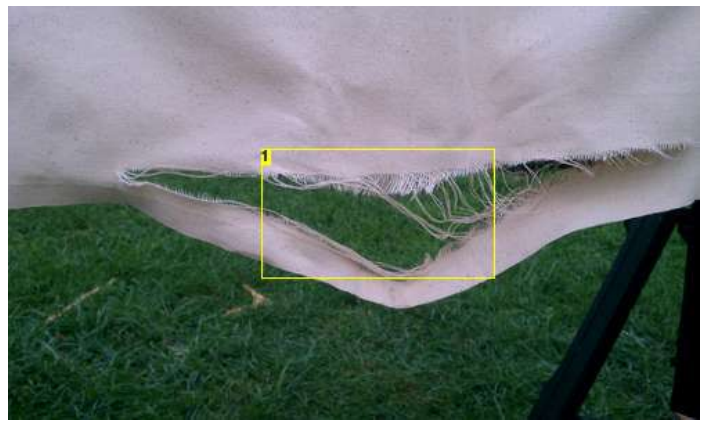


Image Notes

1. Surprisingly little tensile strength.



Step 5: Paint

To seal the fabric I used latex exterior paint. It didn't go as far as I had hoped, so I would recommend that you get a full gallon instead of buying one quart at a time. Ultimately, it is less expensive this way.

I put on three or four coats and it helped to further shrink the fabric a little.

Once the entire surface was painted and made watertight, I added some rub rails and a skid strip on the keel. These help protect areas that are subject to friction during use or transportation and lend a little more appeal to the look. To get wood around the short-radius curve, I cut an arched piece that matched the radius and screwed it on. The grain runs the wrong way for this to work well though. I will probably replace it with some sort of plastic or a strip of aluminium.



Step 6: Launch!

For my paddle, I had some scrap 1/4" plywood and 2"x4" material that I was able to knock together into a simple yet functional tool. It is visible in the lead shot.

My little car doesn't have any luggage racks, so I had to be sure I protected the roof for the short drive to the lake. I slotted the pool noodles and slipped them on, then used ratcheting cargo straps to secure the canoe to the car. Don't forget some sort of lateral support or it will slide off on turns. Trust me.....

We got it to the lake and I took the kids around in it for a few laps. In a little over an hour in the water, it accumulated a couple ounces of water in the stern where the fabric and paint may not have made a proper seal. This, and other things, will be corrected in the next model.

In order to validate my work, I had the boat inspected and registered with the state. It passed, and I was complemented on my work which felt pretty good coming from someone who inspects boats daily. Now it's legal on all the waterways I am likely to get it to!

Remember that nagging problem when I had stringers too long for the frame? When the inspector from Ohio Department of Natural Resources Watercraft Office measured it, the total length came to 14' 9". I designed a 16' canoe. What happened? When I decided to do the resizing, I cut the key members shorter and didn't think about how that affected the overall length of the boat. I should have cut a new, longer, keel. No problem, it still floats. The stationing was affected though, so my legs don't fit between the seat and the frame the way I would like. Just another thing to fix next time.

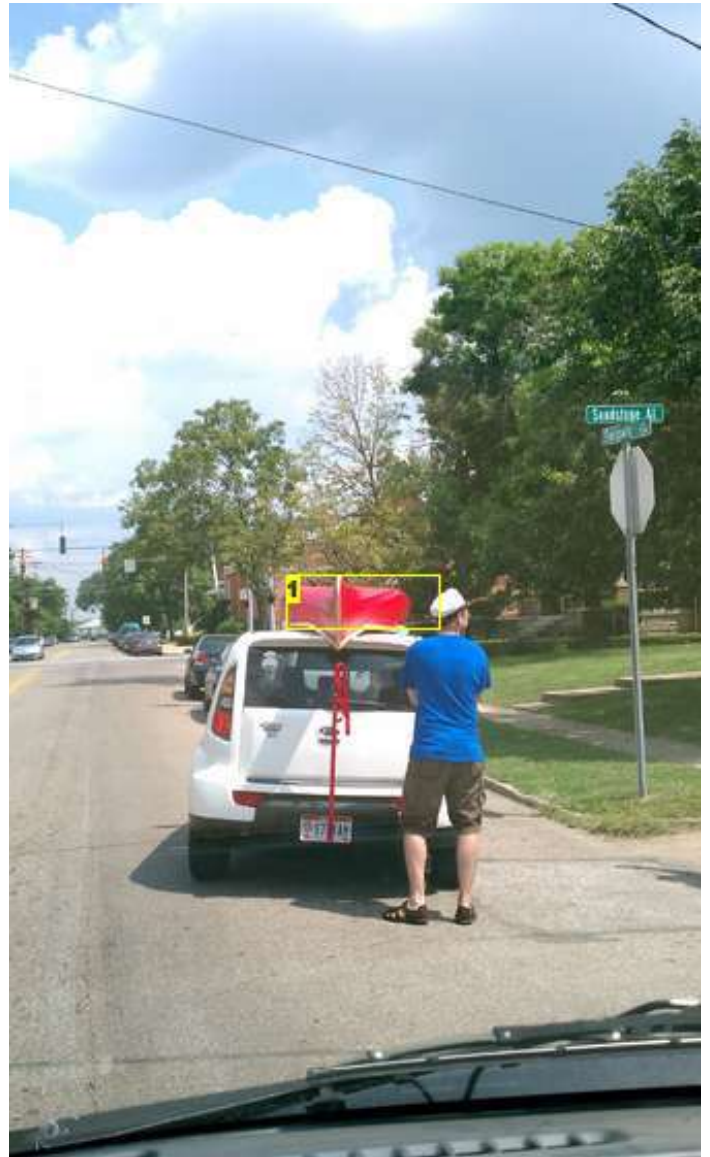


Image Notes

1. Re-centering after the first turn.



Image Notes

1. Bob provides lateral support.



Image Notes

1. Disappointed she won't be sailing with me. Or maybe that's a look of relief; tough to tell sometimes.





Image Notes

1. El Capitan!

Step 7: Finale...

I am proud of my work, but learned a lot about what not to do. I went too far in making the ends "pointy" and when I am solo in the boat, fully half of the front end comes up out of the water. It can be narrower, making paddling solo easier and allowing for more freeboard. I will paint the full wood frame instead of using a clear coat, thus avoiding missed spots that will rot.

A video of the launch can be seen [here](#) .

Notes for the next effort:

Do not twist the stringers to bring the ends to a sharp "V" shape. Less displacement at bow and stern, more stress on members, completely unnecessary. It also seems to have warped the entire thing, making it arch high in the center.

Give it a narrower beam at the center. I'm most likely to be using is solo, and I'll need to be in the middle for that. Too much width means too much leaning to paddle.

Don't use screws. Even with counter sunk pilot holes, I still split a lot of stringers. I saw a kayak design that used paracord for lashing all the members together, so I think I'll try that method instead.

Seal the entire wood structure prior to assembly. Water will get in anywhere it can and rot it from the inside out. This will most certainly happen in the least accessible areas, making repairs nearly impossible.

Related Instructables



Sailing Canoe Chapter X: Maiden Voyage by TimAnderson



Sailing Canoe Chapter 9: Dipaakak by TimAnderson



Build a Greenland Kayak by nativewater



easy way to cartop a canoe or boat by rowerwet



Skin-On-Frame Outrigger Sailing Canoe. Chapter 3: Lash the frame. by TimAnderson



Sailing Canoe Chapter 10: Independent Suspension by TimAnderson

Comments

4 comments [Add Comment](#)



rickharris says:

Mar 5, 2012. 12:53 AM [REPLY](#)

Nice build - If you decide to do it again have a look at the links in my instructable

When you car top put 2 straps one to each end of the bumper so the canoe doesn't shift laterally. A proper roof rack is a better idea. Stopping in a hurry is inclined to end up with the canoe on the bonnet - Don't ask!

Wetting the fabric and if possible placing on the frame corner to corner will allow you to pull most of the wrinkles out - Cotton cloth will shrink as it dries and tighten - Nylon doesn't. If you can get Polyester (Dacron) it can be heat shrunk somewhat with a hot air gun. see aerolight boats link.

Strong back is essential if you want the canoe to be straight. As a construction medium you might have been better off using plywood. Either wet bending 1/4 inch (9 mm) or dry bending 2 layers of 6mm ply (a stronger option when the 2 layers are glued together.) The aerolight construction can be done this way producing a light strong result.



balloondoggle says:

Mar 5, 2012. 8:18 AM [REPLY](#)

I'll have to see if your double strap will work on my car. I'm not sure there are secure places at the corners to hook to. It would certainly be better than a central strap through the back doors!

I hadn't thought about going corner-to-corner with the fabric. I'll try that on the next round. The cotton shrank nicely though, and except for the weight I'm pretty happy with that. I did see one where the builder used a white synthetic and whatever he sealed it with made it nearly transparent - that looked pretty cool!

I might try plywood, but cutting the strips will be a challenge with a bench saw. I would probably waste an inordinate amount of wood.

I'll definitely check out your links! Thanks.



l8nite says:

Mar 4, 2012. 10:28 PM [REPLY](#)

very nice project and well documented "ible" I wouldn't worry to much about half the boat being out of the water when your seated in the stern, many shorter canoes and even jonboats do the same thing. Of course you're supposed to kneel in the center of a canoe to paddle it but that's uncomfortable, and personally I never do it. Trying to make wood curve without steaming can be very difficult and you end up with cracks or splits, even at a half inch your wood was thick to attempt this but you made it work ! Plywood would make a good choice but you would need to scarf the lengths together. My great uncle was a boat builder, he always stuck his brass screws in a bar of soap, he worked primarily with cedar and had few problems with the screws splitting the wood. Thank you for sharing your project ! I hope you get many years of use from it



balloondoggle says:

Mar 5, 2012. 7:23 AM [REPLY](#)

Having the bow up out of the water made navigation a challenge because of a stiff wind on launch day. There's nothing like trying to paddle a weather vane around a lake. Like you said, kneeling is painful, and it's a little wide for that - something to keep in mind next time! Thanks for the tip on soap - I've used paraffin before but I think soap may work better.