Disclaimer and waiver of liability: By building these plans, you, the builder, assume all risk and responsibility for the safety of you and anyone else who uses any boat built from or based on these plans.

Like all watercraft, if used improperly, serious injury or even death could be the result. It is the builder's responsibility to build the boat properly and to acquire the necessary skills for safe recreational use. In other words: *Be smart, wear your PFD, use good judgment, and have fun!*

If you need further clarification of how to perform the steps below, go to http://www.jemwatercraft.com/forum/. Visit the tutorial section and see the techniques used to build a stitch and glue boat. If you're still not clear, please post your question in the forum.

Read these instructions start to finish at least once before you purchase materials, draw, or cut anything to ensure you're familiar with the entire process.

Random Notes/Tips:

- READ THE EPOXY LITERATURE PROVIDED BY YOUR EPOXY VENDOR.
- Some people develop sensitivity to epoxy. Severity depends on the chemical make-up of the epoxy brand used and the individual person. Common symptoms are light skin reaction or minor nasal irritation. Some people experience more severe reactions. Most people experience no symptoms. Use every effort not to get it on your skin and to work in a well-ventilated area with constant fresh air supply.
- When still wet, epoxy can be cleaned up with acetone or vinegar. Some builders try to extend the life of brushes and other tools by soaking in solvents. It's our opinion it is not worth the time, effort, or risks from solvents. Better to plan ahead and work neatly than to work sloppy and try to clean it up later.
- Epoxy is not as toxic as polyester or vinylester resin, but still has an odor that can contribute to the above mentioned sensitivity. Work in a ventilated area with a constant supply of fresh air.
- Epoxy sticks to almost EVERYTHING except plastic. If it gets on your skin and hardens, it'll take hair off when you try to remove it.
- If it gets on clothes, floor, carpet, etc, and cures, plan on it **never** coming off. Wear old clothes and use a drop cloth.
- Amine Blush: Epoxies, especially in humid conditions, can produce a wax-like film after about 72 hours of cure. As a general guideline, if the epoxy surface you're working with has cured more than 48 hours, scrub with a wet Scotch-Brite pad or lightly sand to remove the amine blush before attempting to paint or cover with more epoxy. Refer to your epoxy literature or epoxy vendor for specific application advice.
- Epoxy eventually breaks down when exposed long-term to direct UV rays from the sun. The epoxy surface needs to be covered with varnish or paint. Regardless of some manufacturers' claims, there is no such thing as "UV inhibitors" that can be added to epoxy that will allow you not to paint or varnish the hull and still have long-term UV protection.
- When using metered pumps to dispense resin from bottle, loosen the cap or poke a small hole in the top of the bottle to let air in. This will keep your pumps from "burping" and dispensing inaccurate amounts.
- Always wear a dust mask when performing any kind of sanding or cutting.

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Basic Tools Needed

- Work Space: This can be an indoor or outdoor area. The space should be well lit and about 1.5 times the length of your hull. Space should be covered to protect from the elements.
- Work Bench: This can be a formal workbench or simple flat surface. Saw horses with an aluminum ladder spanned across works very well. Do your best to make the surface flat and level. Constructing a strongback is an option, but not required.
- Measuring: A tape measure can be enough, but drywall squares 48” long (found at any home improvement store) are inexpensive and make drawing very easy.
- Saw: A handsaw will work. An electric jig saw works nicely for cutting curves. A small circular saw helps make long cuts smooth. Whichever you choose, get a blade with a high tooth-per-inch count. This will cut the plywood with less splintering.
- Pencil: Ink from a pen will soak into the wood grain and be harder to remove.
- Drill: A manual or electric hand drill is acceptable.
- Sanding: Hand sanding or electric sanding is acceptable. Hand sanding if you really enjoy sanding. But we strongly recommend a random orbit sander.
- Gloves**:** Vinyl gloves are the best. Latex is porous and will let resin soak through. Epoxy also sticks to latex more than vinyl.
- Brushes: Use inexpensive and disposable paint brushes called “chip brushes”.
- Foam Roller
- Plastic Spatula or wide putty knife
- Paper Towels
- Scissors: A pair of good quality and sharp scissors will cut fiberglass easily. You do not needs the special sheers liked used to cut Kevlar®.
- Clamps: Small c-clamps, spring type clamps, or homemade clamps.

These are the basic tools. Additional types of tool will depend on builder desires.

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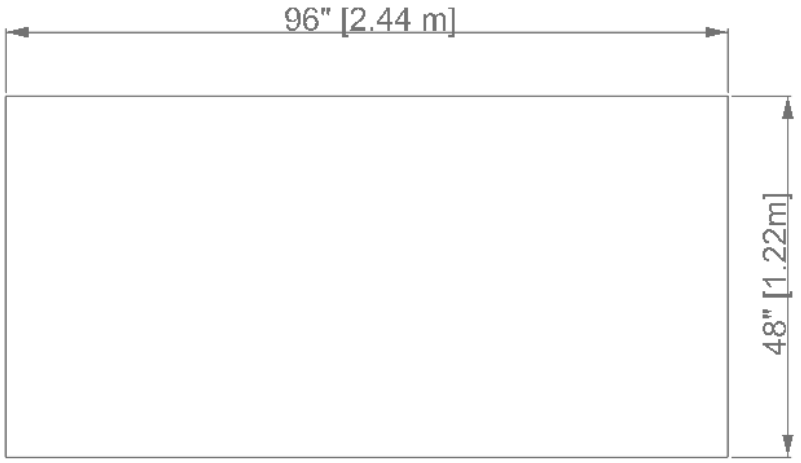
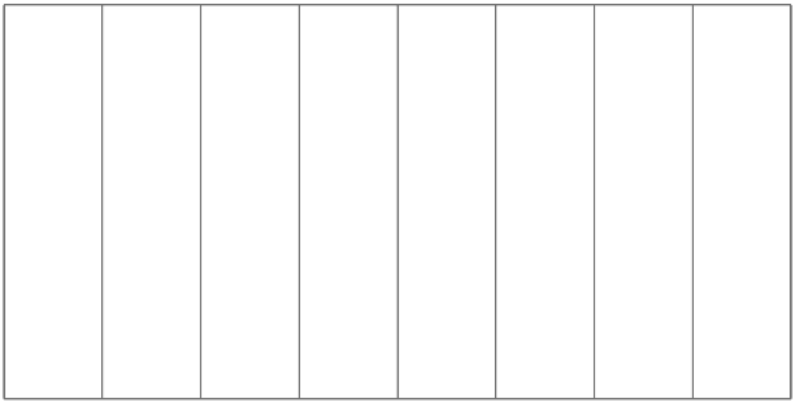
1. Trace All Panels Onto the Plywood.

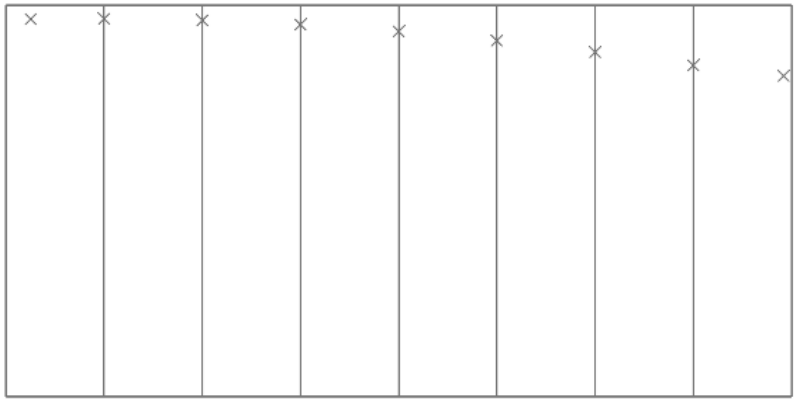
- First, ensure that your plywood measures 96” x 48” (2.44 m x 1.22 m). If it’s not, then trim as needed. This size is VERY important!



- Draw the reference lines shown in the Reference drawing. We recommend using a square to ensure the lines are straight and parallel.



- Measure the offsets as shown in the Sheet Drawings. Mark each point.



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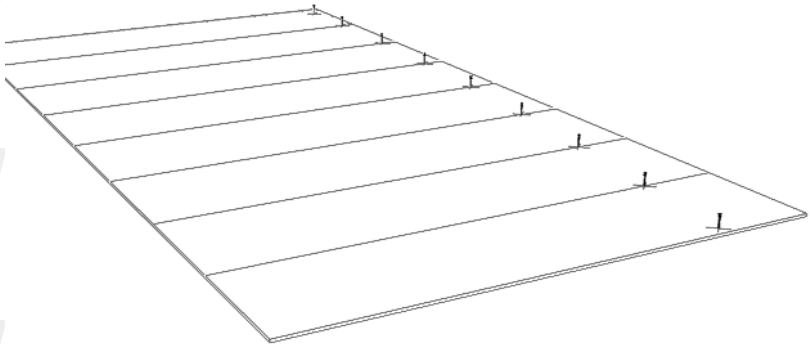
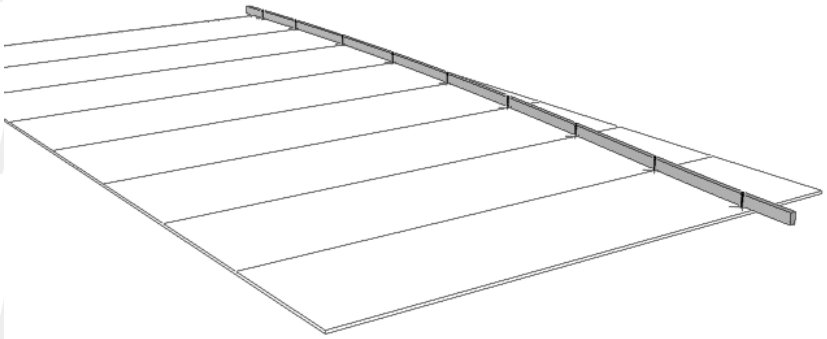
- Drive a finishing nail at the offsets marks draw.



- Construct the arcs and curves by clamping a piece of semi-flexible batten (a batten is a strip of wood or other material used for building purposes) to the nails. A piece of woodworking trim works very well for this application. Trace the curve. Remove the nails before cutting.



  - Alternatively, you could also hold the batten in place with weights instead of using nails. The choice is yours.

- ***BEFORE YOU CUT*** Use the **QA1 Drawing** to ensure each part was drawn correctly.

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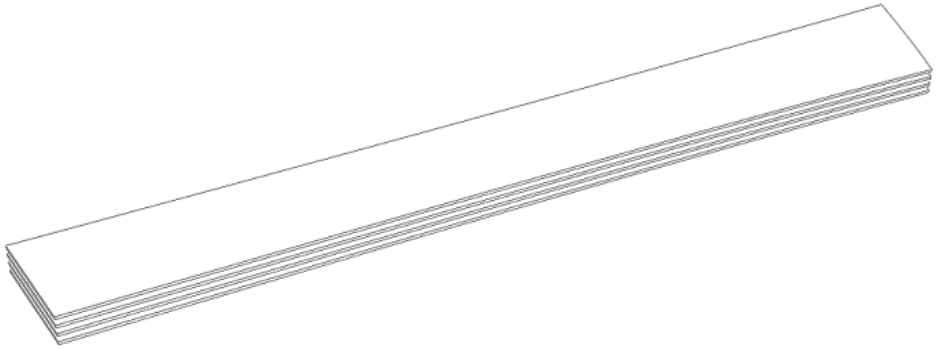
2. Cut the panels.

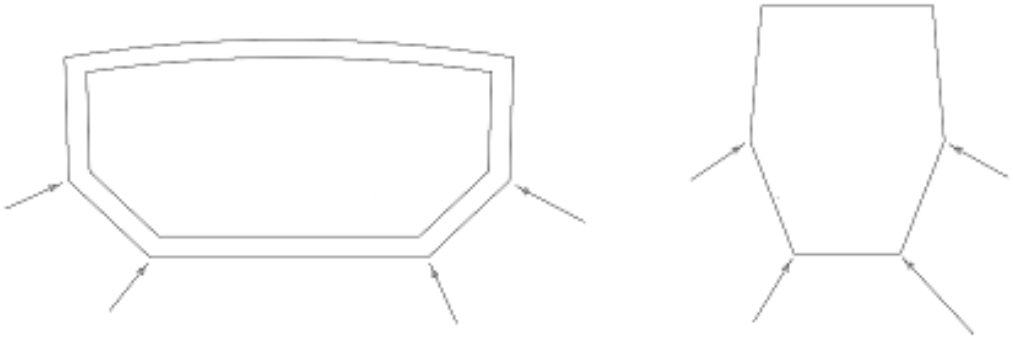
- To minimize splintering, use a saw blade with a high tooth-per-inch count.
- Sand the panels to clean up the surfaces and remove any lines.
- Use the 1st copy of the panels as templates for the remaining copies.
- After cutting, stack up the same shape pieces and sand the edges so all pieces are the same size.



(above image is for reference only)

3. Apply Clear Packaging Tape to the Frames

- Cover the areas indicated by the arrows.



- Later, when drilling holes into the frames, drill right through the tape.
- This step may not make much sense now but you'll be glad you did it later. ;)

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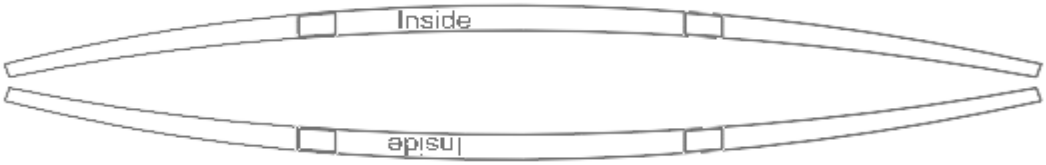
BEFORE WE COVER ASSEMBLING THE PANEL, LET'S BRIEFLY DISCUSS MIRRORED COPIES:

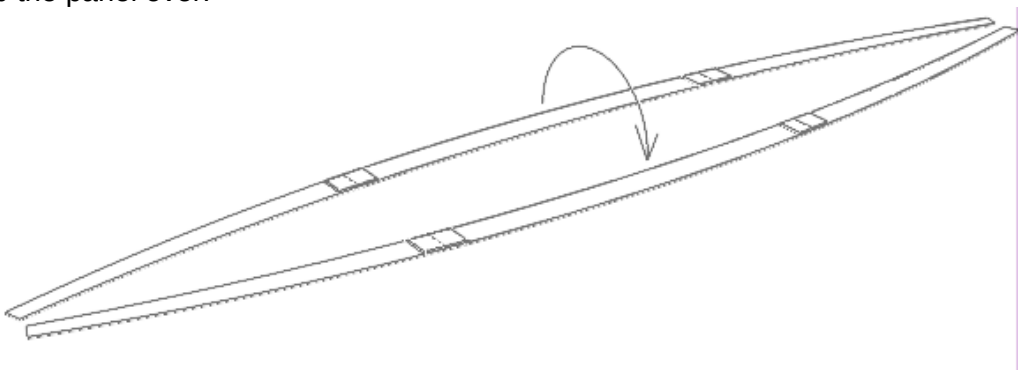
Mirrored Copies

- 2 copies of each panel are required. They are to be MIRRORED COPIES of each other. 1 for the left half of the hull and one for the right half.
- Establish which side of the panels will face the outside or inside of the boat. Mark them so you don't get confused. This is especially important if using wooden butt blocks. ***You do NOT want the wooden butt blocks on the outside of the hull!***



(above image is for reference only)

- After completing the 1st, panel splice, you may use it as an alignment tool for the second copy. This way, you won't have to do the alignment with the string again.
- While keeping track of which side of the panel is the inside and which is the outside, flip the panel over.



- Stack the panels and place a sheet of plastic between the panels in the seam area.
- Align all pieces, hold in place with clamps or temp screws and epoxy-glue as done previously.

    - **Tip:** Once all panels are assembled, inspect and sand where needed. It is easy to think "Oh well, I'll just sand that later". But trust us… it is easier to do clean up and fairing (a term we'll discuss later) as you go along rather than waiting to do all the clean up after the panels are assembled.

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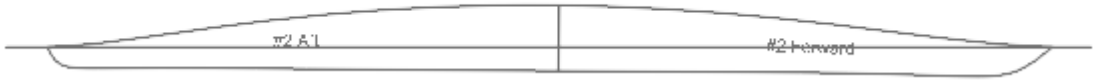
BACK TO PANEL ASSEMBLY…

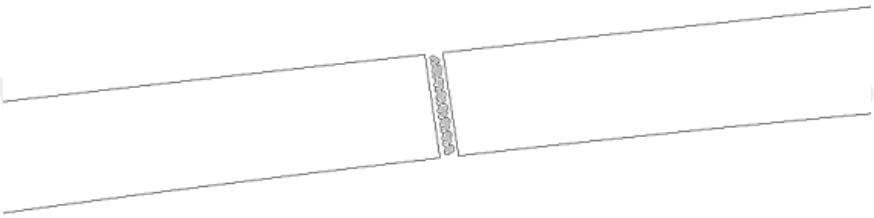
4. **Assemble the long panels with wooden butt blocks or fiberglass splices.** *(Review our online tutorial in our Customer Service Forum for color pictures of how to perform this step)*

- Place some plastic under the areas where the seams will be epoxy-glued.
- Line up the panels.
- Using the **QA2 Drawing**, lay a string from tip to tip of each panel and adjust the panels to the specified measurement.



(Note: the above drawing may not represent the actual shape of your design. The drawing is for reference only. The process is the same for your design)

  - Tip: If space is available, mark lines dimensions onto surface using pencil, chalk, masking tape, etc. Then use those surface markings to align the panels. It's a little easier to deal with than the string.
- Make some epoxy-glue. Carefully place a bead of epoxy-glue between your panel ends. Reposition your panels per the **QA2 Drawing** as needed



- To ensure the panel ends remain flat, place a piece of plastic on top of the seam area and weigh down with books or weights.
- Repeat this process for all your panels. Let cure overnight.
- After cure, inspect the seam. Sand down any excess material. Fill in voids with epoxy-glue.

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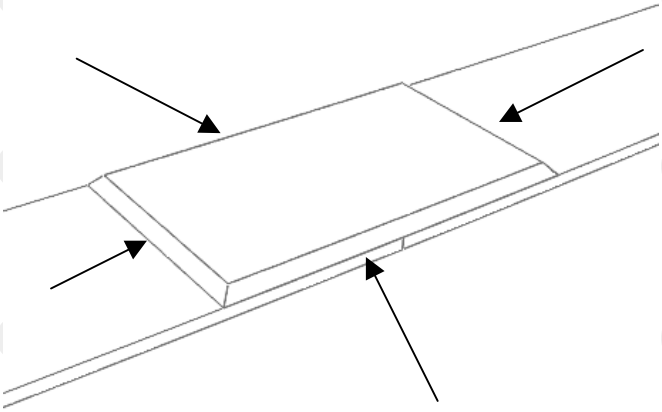
The panels can be finished with a wooden butt block or fiberglass splice.

- Wooden butt blocks will help add stiffness to the hull but can make applying fiberglass more difficult. They do not look as "clean" as fiberglass splices.
- Fiberglass splices make applying fiberglass easy but are slightly more time consuming to install. They do not offer the stiffness of wooden butt blocks.

Wooden Butt Blocks

- Cut the butt block so it matches the height of each panel. The length of the butt block should be a total of 8" (20 cm). Locate the butt block so 4" (10 cm) extends over each side of the seam.
- Sand/grind a 45-degree bevel to each edge of the butt block.



- Coat the Butt Block area with epoxy-glue and install into place. Hold in place with weights, books, etc.
    - **Note:** High clamping pressure is NOT required when using epoxy-glue. Moderate pressure…only enough to hold the pieces in place…is all that is required.
    - Ensure you align the center of the butt block to the seam formed by the panels.

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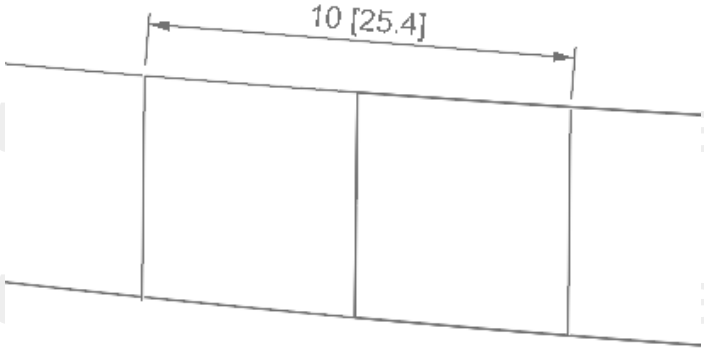
Fiberglass Splices

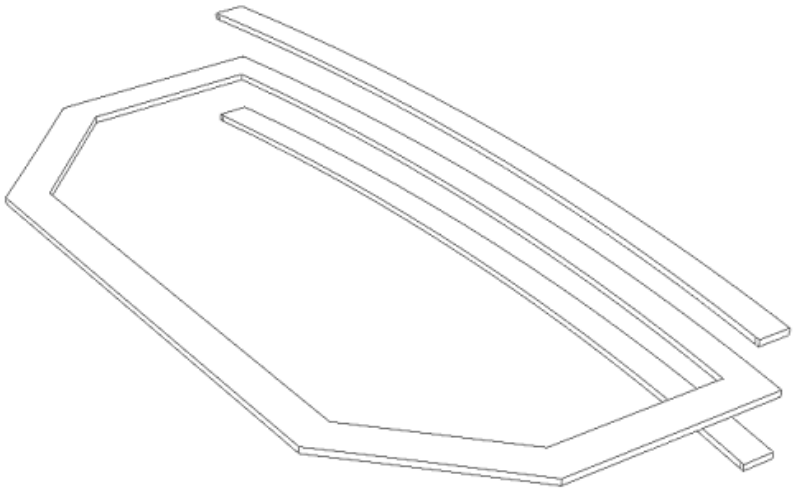
- Follow the same procedure to align and join the panels.
- Fill in any voids in the seams, sand smooth any excess cured material.
- Measure and cut a fiberglass patch that is a total of 10” (25.4 cm). The patch will be centered over the panel seam. You may wish to cut the patch a little over sized to allow for the woven fiberglass strands to unravel on the edges.



- Apply resin to the splice area and place the fiberglass patch.
- Place the fiberglass tape over the seam. Flatten out the tape and allow 1-2 minutes for the fiberglass to soak up the resin. Apply additional resin where the fiberglass did not completely wet out.
- Remove all air bubbles and excess resin from the seam. Having excess resin in the fiberglass will not add strength to the hull.
- Allow to cure. Repeat for both sides of the panel. YOU MUST APPLY THE FIBERGLASS SPLICE TO BOTH SIDES OF ALL SEAMS.

5. Assemble the Permanent Frames

- Glue the Frame Stiffeners to Main Frame.



- Repeat for both Permanent Frames.

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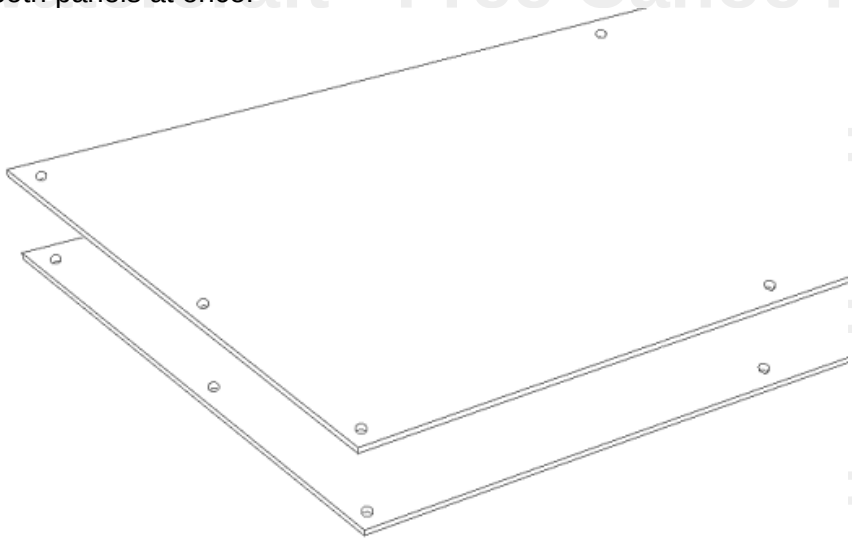
6. Draw the Frame Reference Lines as Shown in the Provided Drawings

- It is important to keep these lines drawn consistently on each mirrored panel copy.

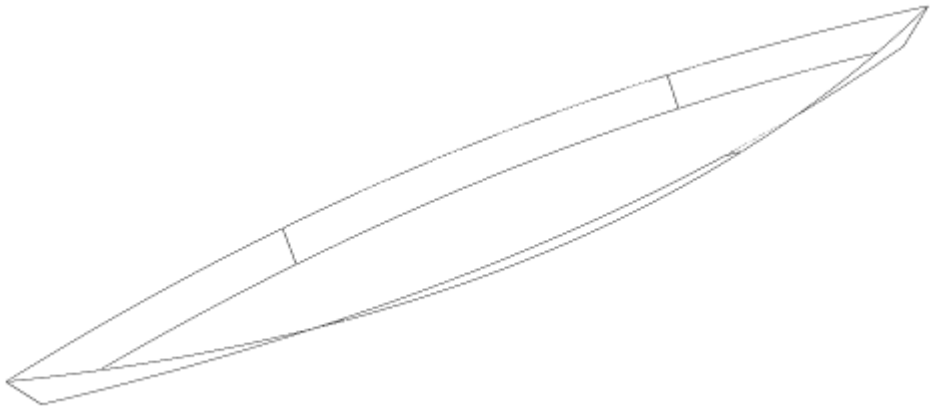
7. Hull Stitching

- Plastic zip (cable) ties or copper wire for stitching.
- Start with the **Mid Panels**. Lay the **Mid Panels** on top of each other so you are drilling through both panels at once.



- Check out our online tutorials for a great way to drill evenly spaced stitch holes.
- Drill a hole just large enough for the stitch to fit through. Drill the hole so the outer edge of the holes is about ¼" (6mm) away from the edge of plywood. Don't drill too close to the edge otherwise you'll pull the stitches through the wood.
- Drill holes around the **entire perimeter of the Mid Panels.**

- Thread the stitches through **just the ends of the Mid Panel** and spread open. Do not make the stitches too tight. For now, leave them a little loose.



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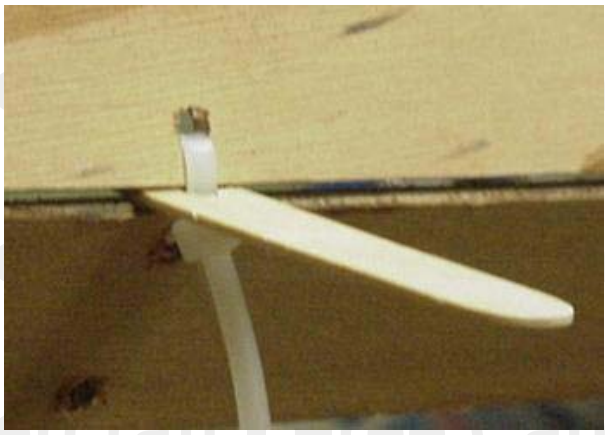
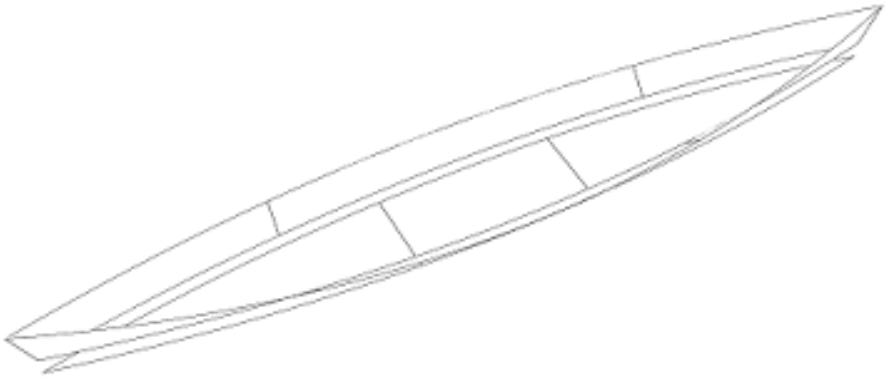
- Optional : Use the spacer method shown in our forum to maintain a 1/16” (1.5 mm) gap between all panels.



- The spacer technique is very useful for controlling the alignment of the panels. See our Tips and Tricks section of our forum for more information.

8. Stitch the Mid Panels to the Bottom Panels

- Place the Mid Panels over the Bottom Panel and align.



- Begin working from the center out to the ends, drilling a stitch hole, and then installing a stitch. Follow the sequence. Alternate sides as you go along.

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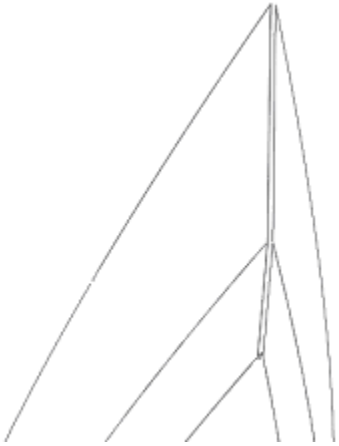
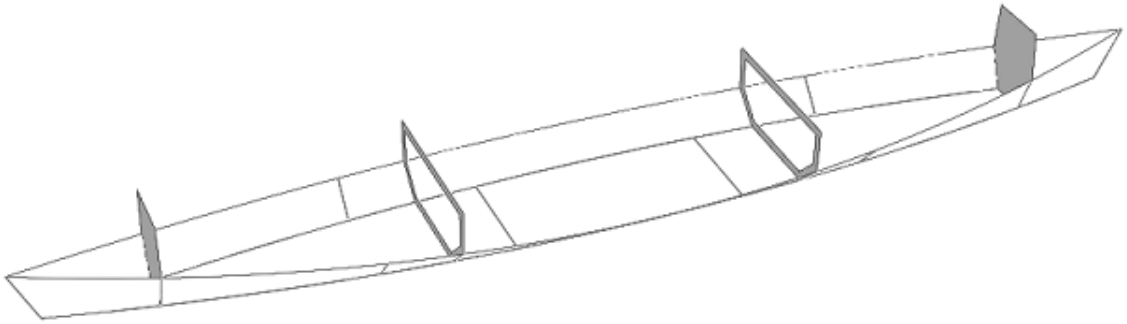
9. Bow/stern Alignment.

- Depending on how well/consistent you assembled the panels, the bow ends may need some trimming for a straight and perpendicular seam.
- We recommend you do not do this until all hull panels are stitched together.
- View the bows from a distance. Trim the ends of the panels as needed.
- A slight gap up to ½" (12 mm) ok on the bow/stern for easier fiberglass application.

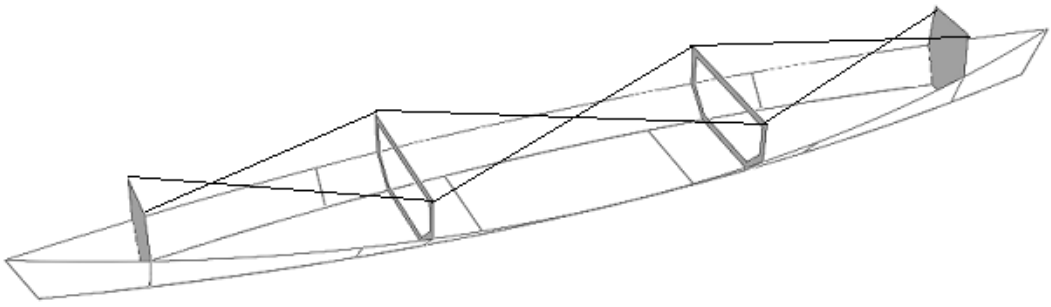


10. Install the Frames.

- Align the Frames with the Frame Reference Lines.



- Verify the hull is square by measure diagonal distances between frames. The distances should be the same. Minor differences up to 1/2" (12mm) are acceptable.



- Make adjustments as needed or desired.

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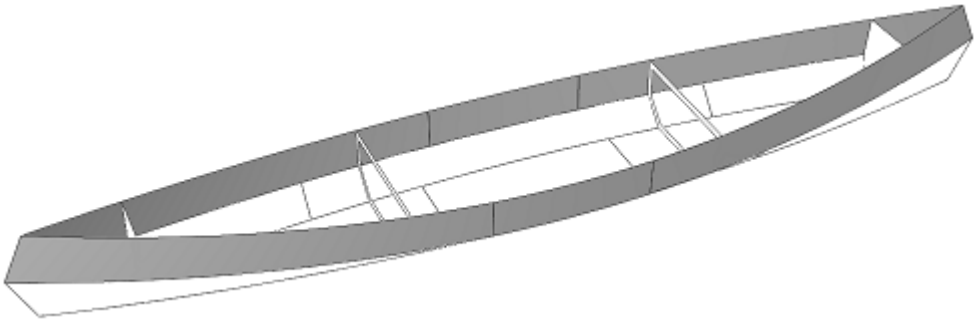
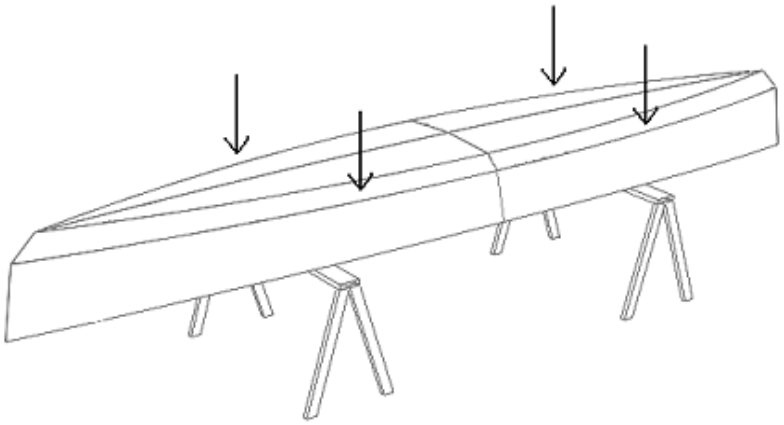
11. Install the Top Panels.



- Double-check the frame spacing to ensure the distances are parallel.

12. Check for Hull Twist

- Carefully flip the hull (get someone to help you) and place on top of saw horses. Ensure the horses are flat and level in relationship to each other.
- If saw horses are not available, then 2x4s raised the same distance above a flat and level surface will work.



- Apply downward pressure to make the sheer line touch the horse in 4 places. This will ensure the hull is not twisted.
- Review the hull from different angles and distances. Make adjustments as required. It sometimes helps to get someone else took take a look as a “fresh” set of eyes.

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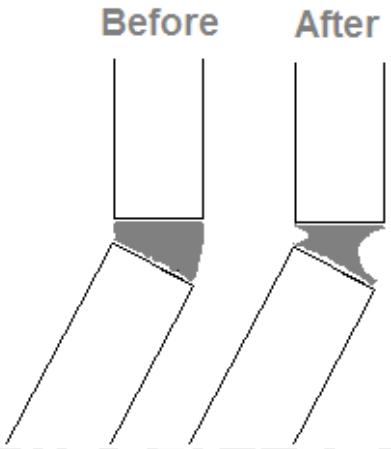
13. Tack Welding. (Review our online tutorial**)**

- The wood grain will absorb some of the filleting material as the material cures (dries). The result is depicted in this cut-away (cross sectional) image of a seam:



- As you can see, the filleting material is no longer smooth and flush with the wood surface. How much material gets absorbed will vary depending on the wood type, temperature, resin brand, and other factors. This is unacceptable. To address this, either precoat the wood grain of the edges with resin and let cure to seal the wood grain or apply additional filleting material after the initial filleting material has cured. Be mindful of amine blush.

- Mix the resin. <u>After</u> the resin is thoroughly mixed, add wood flour until it is the consistency of peanut butter. This is known as "***Filleting Material***".
- Place a small amount of filleting material in the seam gaps between your stitches. You can apply material right over the corner of the frames since they were masked off earlier.

- You can apply the filleting material many different ways. Check out our forums and ask what other builders prefer to use and why.
  - Gloved finger (Can get sloppy. Keep a good supply of paper towels near by.)
  - Back of a spoon (Fillets can be made as the filleting material is applied)
  - Craft stick
  - Bakers Frosting Bag: Mix some filleting material and place into a plastic bag. Snip a corner of the bag. Squeeze the bag to dispense the material into the seam. (This method is the neatest but you'll waste the most).
  - Use a large syringe and inject the filleting material. (Very neat but a little time consuming to keep filling the syringe and cleaning up after).

- Fill as much of the gap as possible between the stitches. DO NOT get the material on the stitches. Let fully cure.
  - ***<u>Note: Work neatly and clean up excess material and drips while still uncured. It will be much easier to take the time to do this now rather than sanding it off later. Please take this advice! You'll be glad you did.</u>***

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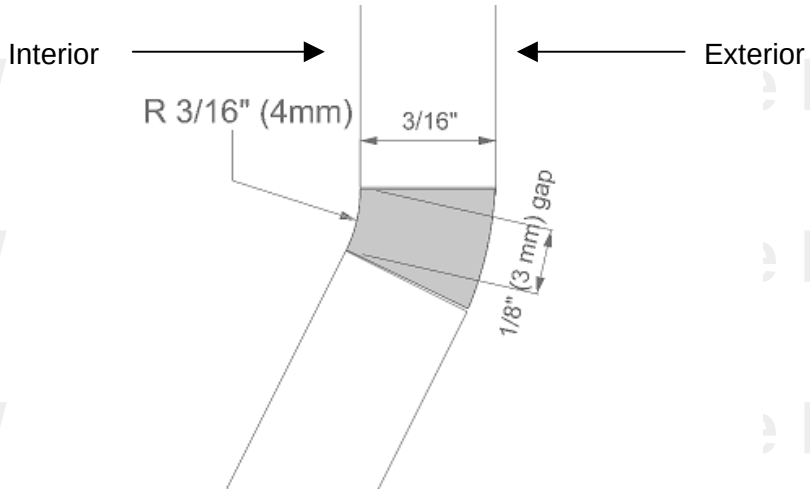
- Allow to fully cure. When cured, remove the stitches and fill in the remaining gaps from the hull exterior. The Frames might fall out of place with the stitches removed. This is acceptable but don't go out of your way to remove them.
- Note: If you have to flip the hull to get some of the stitches out, do so with a helper and proceed very carefully.

Round off the Exterior Seams

- In order for the hull to have sufficient strength and for the fiberglass to be easily installed, the seams need to have the proper shape. This shape is achieved by sanding the seams so they have a rounded edge.
- The general rule is that each seam must have smooth, tangent radius equal to the thickest panel of wood on the interior hull seam. The exterior seams will have a larger radius.



(This image and its dimensions for reference only)

- Fill in any voids or gaps with filleting material.
  - **Note:** The bow/stern seams might be a little troublesome getting the seam to stay completely filled in after sanding. This is not a big issue. Just go back and fill in any open gaps with more tack welding (filleting) material.
- Give all surfaces a light sanding to remove any dirt or imperfections.

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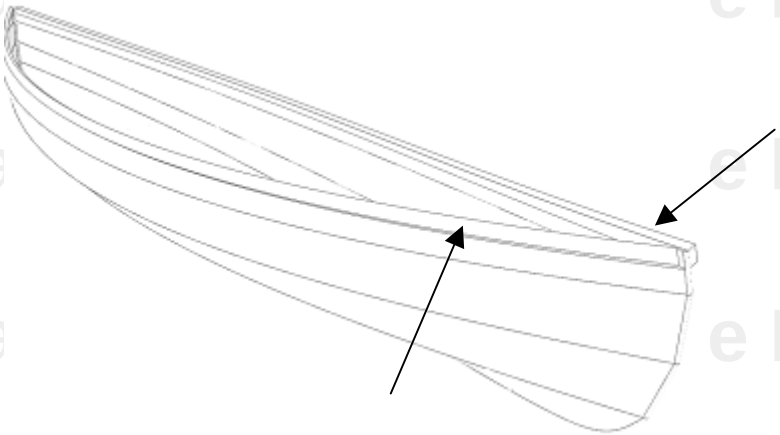
14. A Note about Gunwales

- **The following applies if you plan on covering the entire hull in fiberglass cloth.**

- Before detailing how to apply fiberglass cloth, we must look ahead a couple steps. This hull will require the installation of gunwales (also known as gunnels, inwales, outwales, rubrails, etc).



(above image is for reference only. It may not be the exact shape of your hull)

- To get the surest bond, the glue the gunwales directly to the wood surface. Gluing to the fiberglass is acceptable. Some builders prefer not to glue to fiberglass because of the fiberglass ever delaminates, anything glued on top of the fiberglass will delaminate as well. This is an extreme case but if you want to ensure a wood-to-bond, it can be achieved in a few different ways.
    A. Do not apply fiberglass to the bonding area (can be difficult if working with large pieces of cloth).
    B. Fiberglass can be applied and sanded off from the bonding area after cure.
    C. The bonding area can be masked off with clear packaging tape prior to applying fiberglass cloth to the hull. The cloth is applied normally. After cure, sanding off the fiberglass and removing the tape will be a little easier than option A.

As epoxy cures with fiberglass cloth, it reaches a gummy state where the fiberglass can be trimmed easily with a utility knife or box cutter. A builder would apply the cloth and then trim back the fiberglass from the bonding area **before** the resin and glass fully cure.

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Back to fiberglassing…

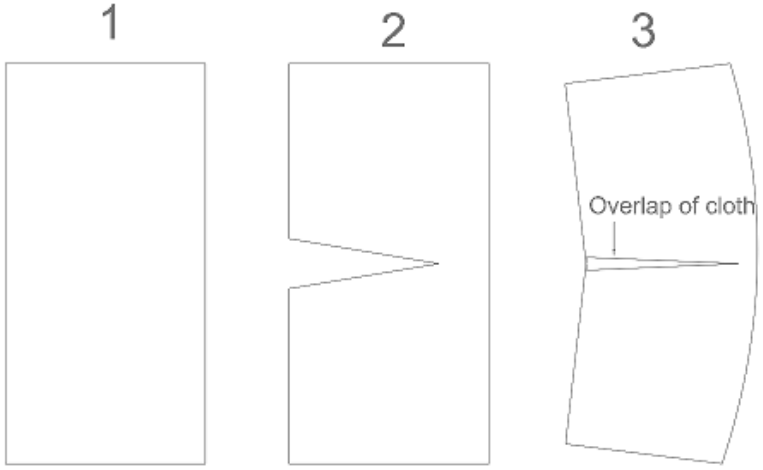
Note: For filleting and fiberglassing seams, there is a technique known as “wet-on-wet”. This consists of applying fiberglass to a seam fillet that has not completely cured. It allows you to shape the fillet as the glass is being laid over it. This helps reduce the chance of air bubbles getting into your seams. To do this, simply apply the fillet, allow the material to cure until it reaches a chewed bubblegum like consistency, and then apply the fiberglass.

This technique is best used when working with the seams on the interior hull. It is not very effective on seams of the hull exterior. However, if you have to fill in a small void on the hull exterior, you can apply fiberglass over it before it is fully cured.

- When complete, wipe down the entire hull exterior with a lint free cloth dampened (but not dripping) with water to remove dust. Allow to fully dry.
- Scrub hull seams with acetone if amine blush is a concern.

15. BOM Option #2: Apply Fiberglass Cloth to the Hull Exterior

- This is build Option #2 in the BOM
- Applying fiberglass cloth can be tricky if you’re a first time builder. We recommend you work with a partner or in sections rather than trying to do the entire hull at once by yourself.
- Lay the cloth over the hull (dry) and smooth out and wrinkles. You’ll be able to work the weave so it bends around curves and corners.
    - To get the cloth to conform to some edges and curves, especially the bow, some “slotting” or ”slitting” maybe be needed as shown:



    - Shown is an exaggerated example. Typically only minor slits are needed to get the cloth to fit properly.
    - To install the cloth, you will have to work somewhat quickly to wet it out with epoxy. With a partner is preferred. You may find it easier to apply the cloth in smaller sections. This is acceptable as long as the sections of cloth have about a 1” (2.54 cm) overlap to ensure strength. We recommend this method when fiberglassing the bow/sterns areas.
    - Perform a dry-run with the fiberglass before mixing any epoxy.

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- Mix the resin and apply from the center of the cloth area to the outer edges. The resin can be spread with a squeegee, brush, or a foam paint roller (our preferred method).
- Be sure work out any small air bubbles that get trapped under the cloth. Usually these can be removed by rolling over the cloth back and forth a few times with a little extra pressure. For stubborn air pocket, use a gloved finger to "squish out" the air pocket.

Note: Resin cures with an "exothermic" reaction. Meaning it gives off heat as it cures and will cure faster with additional heat. If using a foam roller, some resin will remain in the foam toward the middle of the roller. As it cures, it will give off heat and cause any resin near it to cure faster and could cause problems wetting out your cloth. To avoid this becoming an issue, change the foam roller about every 20 minutes or if the roller starts feeling very warm to the touch. How quickly this happens will depend on the type of epoxy and what the temperature is in the work area.

NOTE: It's to best to work with epoxy in a stable temperature environment or when the plywood temperature is declining. Otherwise you start to get some small gas bubbles forming on the skin surface of the epoxy. This will happen about 1 hour after apply the epoxy. To pop these bubbles, simply drag a paint brush over the gas bubbles. To also help minimize out-gassing, you could precoat the wood with a thin coat of epoxy. Let it cure before applying fiberglass.

TIP: *If it appears you have excess resin in your cloth, after glass is fully wet-out, gently squeegee off excess resin and resin runs. This will help ensure a consistent thickness of resin and reduce sanding later on. An automotive body filler applicator or wind-washing squeegee works well.*

Treat your squeegee like the precision instrument it is. Use it gently working from the centerline along the boats length, and working in overlapping wipes out to the edges and down the sides.

After each successive coat of resin, repeat the process of squeegeeing off excess resin and runs. After each use, carefully clean the blade and place where it will not be damaged.

- After cure, inspect your work looking for areas that did not wet out and are dry. Small spots are acceptable. Sand these out and remove any dry cloth.
- Any spots that did not wet out larger than the width of your thumb will need a fiberglass patch applied. If you're not sure if a small patch is required, error on the side of caution.
- Apply 2 more thin coats of epoxy.
- Be mindful of amine blush issues. If you apply additional coats of resin with 48 hours of the previous coats, you <u>*should have no*</u> amine blush issues. The quality of epoxy used will dictate these results.
- To ensure against amine blush, you may scrub the surface lightly with acetone. Follow all required safety guidelines when working with solvents.

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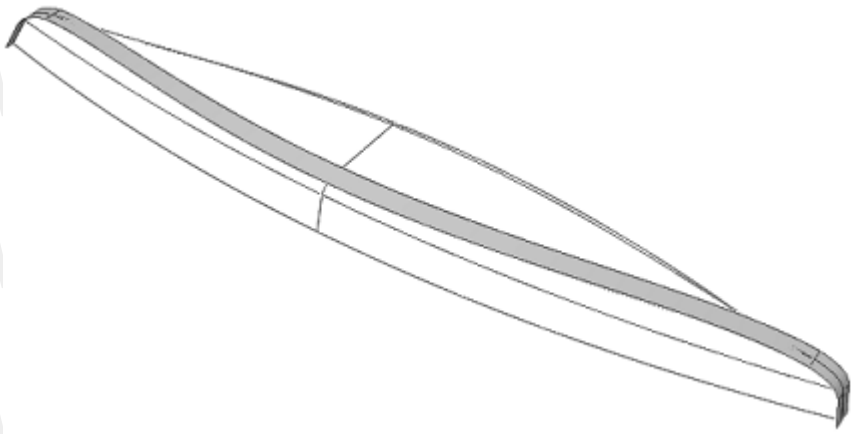
16. BOM Option #1: Apply Fiberglass Tape to the Hull Chines (Seams)

- A "chine" is a name for the hard angle created when to hull panels meet.
- Select one chine to work with and lay the fiberglass tape over it. The fiberglass tape weave is stretchable so work it with your hands to get it to conform to the shape of the hull. You can hold it in place with small pieces of masking tape just along the edges.
- You can lay overlapping sections of tape but if you're a new builder, we recommend working with one chine at a time, letting cure, then working with another chines.



17. The epoxy is applied to the fiberglass tape is applied in the same manner as the fiberglass cloth.

Which ever fiberglass option you choose, the weave of the fiberglass can be filled in by applying 2-3 coats of epoxy over the cured fiberglass. More may be required if you used a fiberglass with a thicker/heavier weave. How smooth the final surface becomes is a choice and preference of the builder. Read to the end to see comments about fairing the hull.

18. Interior Hull Seams

- We won't lie to you. Applying fiberglass to the interior is a pain. And that's putting it nicely. But by applying fiberglass to the hull exterior, you now have a good feel for what it takes to work with the cloth.
- Remove all Frames and masking tape. If the frames are stuck/glued in a couple small places to the hull, a firm tap with a hammer will break them free. If any excess cured epoxy-glue/filleting material present, chip loose any big pieces with a chisel. Sand any small bumps.
- Perform a light sanding of the areas that were covered with masking tape to remove and residual adhesive.

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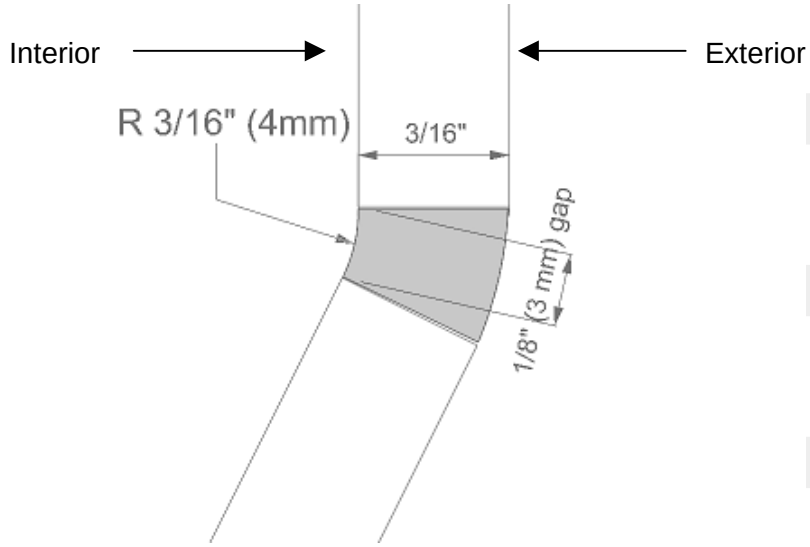
- Reminder: The general rule is that each seam must have smooth, tangent radius equal to the thickest panel of wood. Review the section about working "wet-on-wet".



(this image and its dimensions for reference only)

- To achieve this radius on the ***interior hull seams***, apply filleting material and run the tip of a plastic spoon (see the tutorial in our Forum) over the seam. Removing excess filleting material before it cures is easier. If there are bumps or sharp points after the filleting material hardens, sand until a smooth radius is achieved.
- If you used wooden butt blocks, apply a fillet to where the butt block and hull panels intersect.

- **Note:** The bow/stern ends will be the most difficult because of the sharp angle the panels meet at. Extra filleting material will need to be push into that seam. Keep adding material until you are able to smooth it out with the tip of a plastic spoon (or which ever tool you choose to use).
- These sections are easiest to use the wet-on-wet method.
    - Do a dry run to size up your cloth and decide where slits may be needed. Size the cloth so you cover the entire bow seam plus about 12" (30 cm) of each side of the hull panels.
    - Apply filleting material to the seams
    - With a foam roller, roll on a thin layer of epoxy where the cloth will go.
    - Place the cloth and work it into the bow seam with your gloved fingers getting all the air out.
    - Roll the epoxy onto the cloth ensuring a complete wet out and that all air pockets are removed.
    - Once cured, feather the edges so it transitions smoothly to the hull. This will make laying the next layer of fiberglass over it easy.

    - Repeat the process for the remaining hull interior. It's best do not rush into this. Do some thinking, plan ahead, do a dry run.

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Note: Unless you're working with a helper, consider working in smaller sections or be prepared to work very quickly. This step is easy to write but requires a lot of effort. Be sure to prep your area and have all tools in place and ready to go. You do not want to have to be searching for tools while the resin is curing.

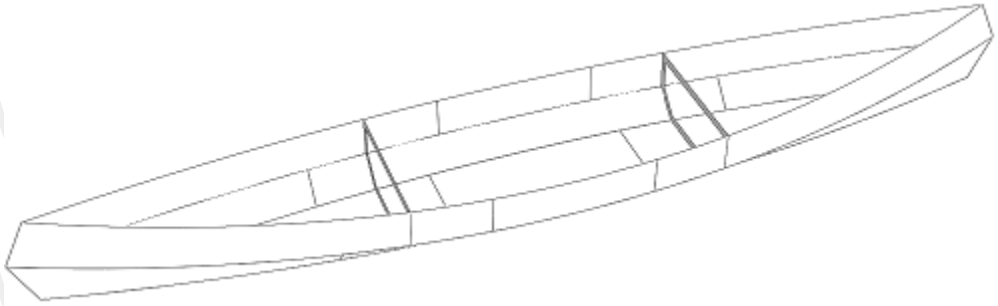
- Mix the resin and apply from the center of the cloth area to the outer edges. The resin can be spread with a squeegee, brush, or (our preferred method) a foam paint roller.

> **Note:** Resin cures with an "exothermic" reaction. Meaning it gives off heat as it cures and will cure faster with additional heat. If using a foam roller, some resin will remain in the foam toward the middle of the roller. As it cures, it will give off heat and cause any resin near it to cure faster and could cause problems wetting out your cloth. To avoid this becoming an issue, change the foam roller about every 10 minutes or if the roller starts feeling very warm to the touch.

- Inspect your work looking for areas that did not wet out and are dry. Small spots are acceptable. Sand these out and remove any dry cloth
- Anything larger than the width of your thumb will need a fiberglass patch applied. If you're not sure if a small patch is required, error on the side of caution.
- Apply a second coat of epoxy. Be mindful of amine blush issues.

19. Install Inner Frames

- Reinstall the inner frames to their locations.
- Some minor sanding might be needed is order to get them to fit properly.
- Glue, fillet, and fiberglass these frames to the hull.



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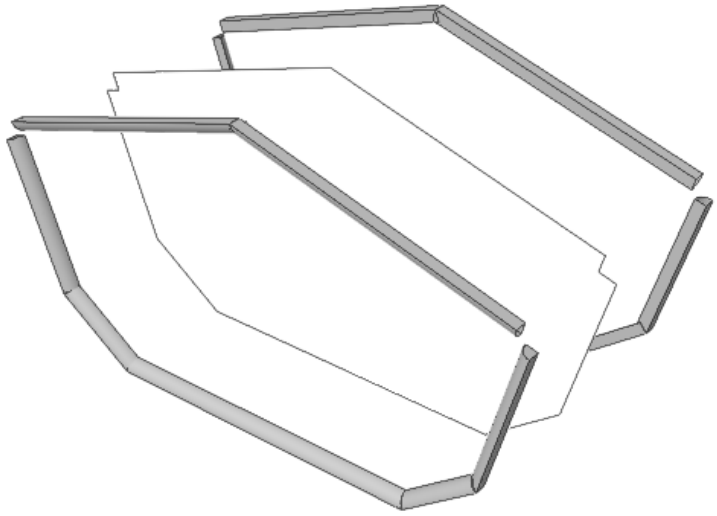
- An alternate method of attaching the frames and bulkheads can be done by gluing sections of woodworking trim, usually sold in 8' lengths. Minimum width of 3/8" [9mm].
- Square strips or ¼-round will work nicely.

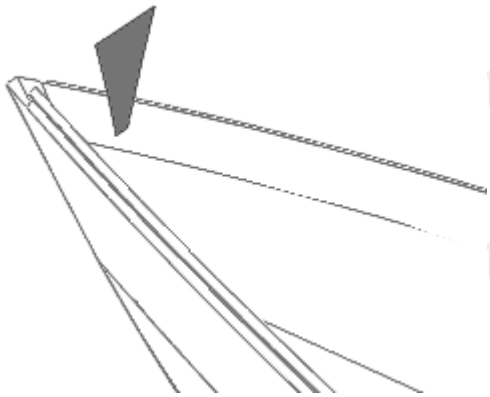


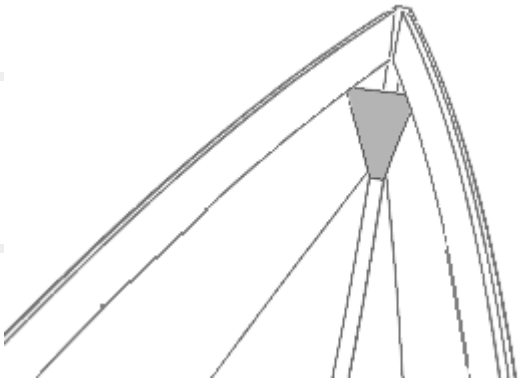
(above image is for reference only)

We recommend sizing all strips before attempting to install.

20. End Pours (optional)

- An end-pour consists of filling the very end of the bow/stern with epoxy and letting it harden. This strengthens the hull and also allows you to install a bow line or rudder without having a hole that leads to the inside of your hull.
- The size and location of the end pour with depend on what you will be passing through the hull.
- Construct a temporary damn about 4-5" (10-12 cm) from the end of the hull. Use cardboard or thick, stiff paper as it will be easy to fit and trim.





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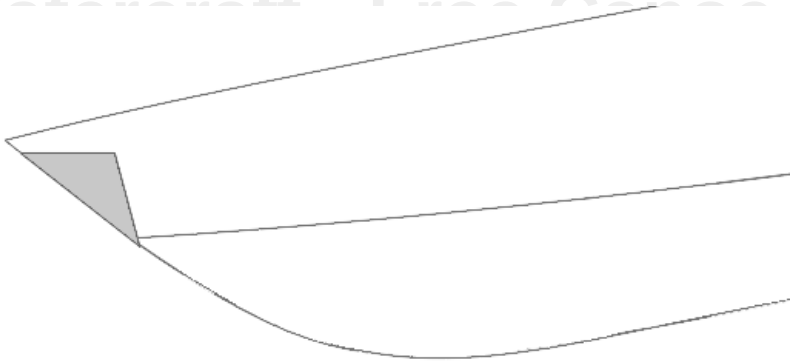
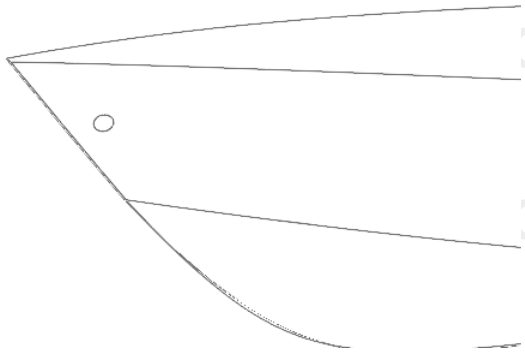
- Wrap the dam in clear packaging tape or wax paper and hold in place with clear packaging tape.

- Tilt the hull so the opposite end from the one you're working on is raised. This will ensure the top of the end pour is angled down so any moisture that may collect will drain.



- Mix some epoxy and fill with filler until the mixture is very thick but still runny enough to pour. Pour the contents into the dammed off area and let cure.
- When cured, remove the dam and fillet and fiberglass tape the dam to the hull. This will ensure stress forces put on the bow will distribute to the hull more evenly. This is especially important for strapping the kayak down to a car.
- Determine the diameter of the bow line (or bolt) that will pass through the end pour. Drill a hole 2x that diameter through the hull in the area of the end pour.



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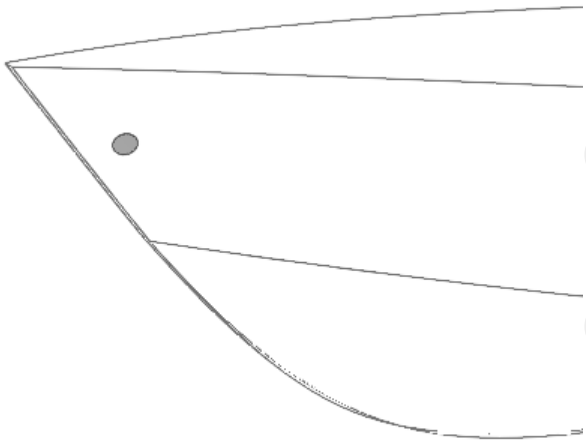
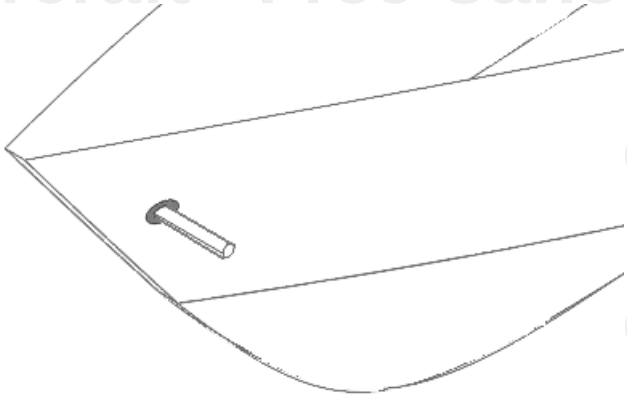
- Fill in the hole with a filleting material mixture.



- Push a plastic straw through the center of the wet filleting material. It is very important the straw stays centered in the hole.



- Allow to fully cure. When cured, pull the straw out. If the hole is a little too small, drill the hole out as needed.
- Repeat for the other end of the hull as needed.

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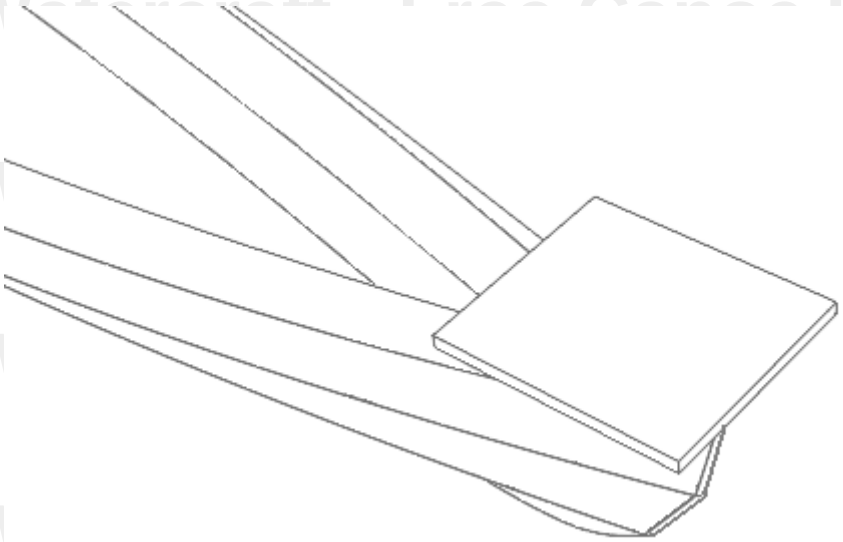
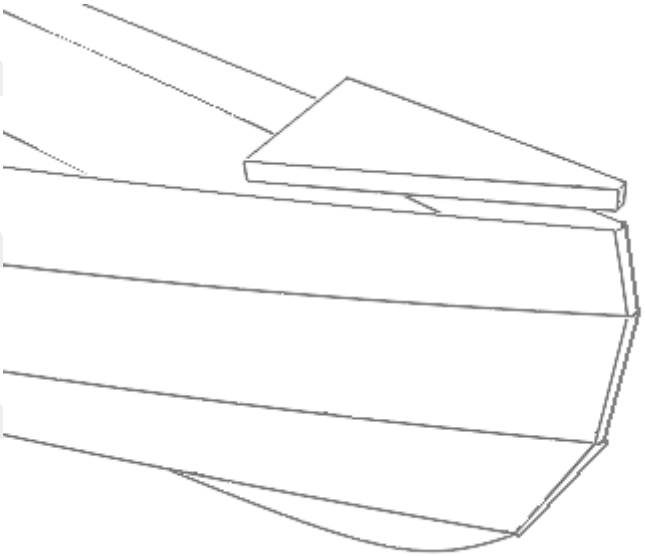
21. Install Decks (option #1)

- Mini deck ends (also known as breasthooks or endcaps) are required on each end of the boat for strength. They must be at least ¾" (1.9 cm) thick and 12" (30.5 cm) long. This can be made of one solid piece of lumber or laminated layers of left over plywood.
- Create by placing the wood over the hull end and tracing at least the last 12" (30.5 cm) of the hull.



- Cut out the shape and coat all surfaces of the deck with resin.



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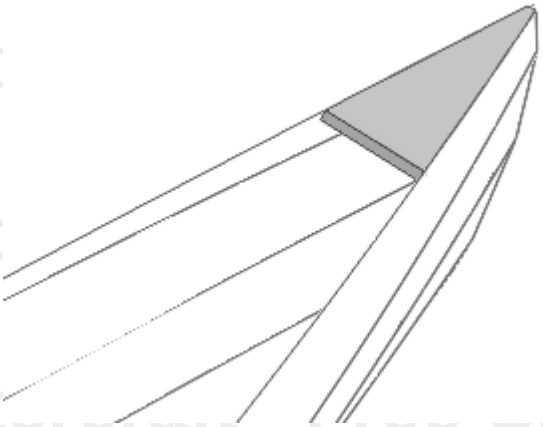
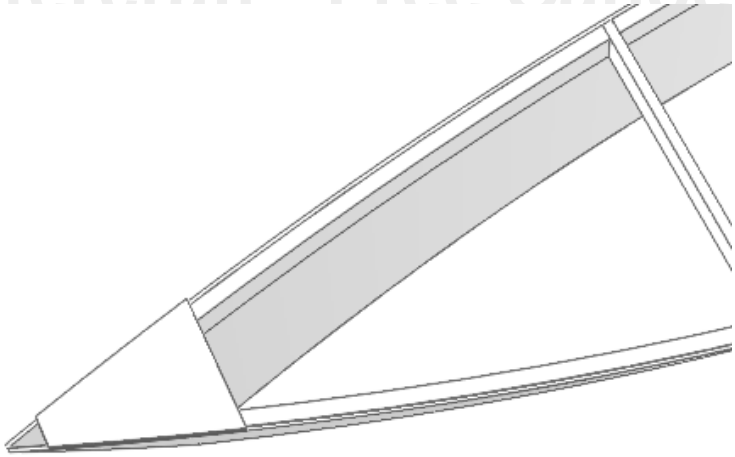
- Glue the deck into place. We also recommend driving 2-3 small stainless steel wood screws from the hull exterior into the deck. Be sure to drill a pilot hole first to prevent splitting the wood. Drive the head of the screws so they are beneath the surface of the hull plywood.



- For best drainage when storing the boat, leave a small gap on the very ends of the decks (***picture below is exaggerated***) for proper drainage of any water drippings taken on during paddling. You should store your boat upside-down when not in use.



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The decks can be shaped for more decorative looks. Just be sure to leave the minimum dimensions.

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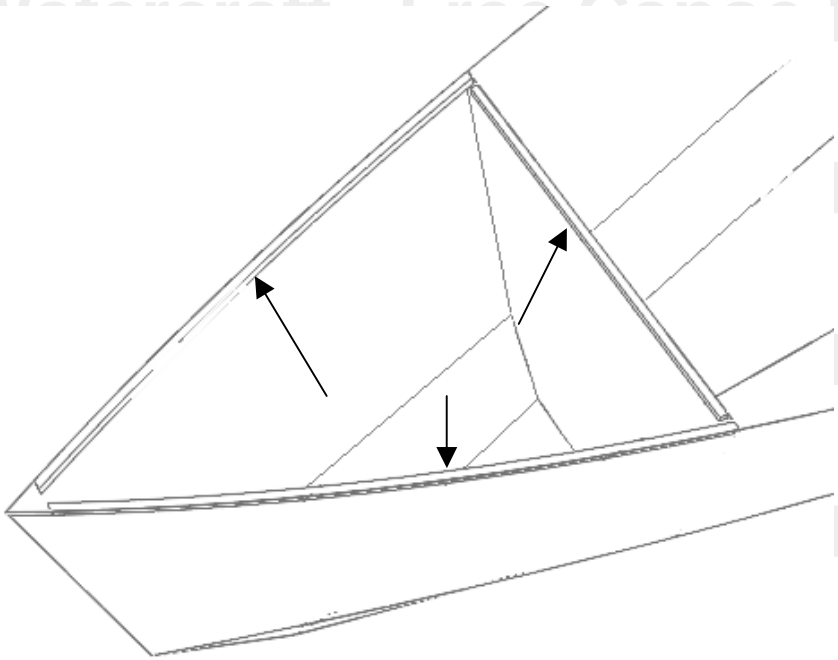
22. Storage Compartments (option #2)

- If leaving the end frames in as part of the hull, they need to be filleted, and fiberglassed to the hull.
- **PERFORM THIS STEP <u>AFTER</u> YOU FIBERGLASS THE HULL INTERIOR.**



- To install the deck:
  - Glue, fillet and fiberglass (or use woodworking trim) the end frames to the hull.
  - Apply 2 coats of epoxy to the underside of the deck and on the compartment interior walls. It will not be exposed to sunlight but you may choose to paint it. Painting the inside of the compartment white (or use a white pigment in your epoxy) will allow light to reflect better when looking inside it.
  - If installing a hatch into the deck lid or bulkhead, do so now.
  - Glue some cleats to the compartment interior top edge and let cure.
  - Apply a heavy coat of glue to the top of the cleats.
  - Place the deck lids. Hold in place with some weight or duct tape. Light contact pressure is all you need. Allow to completely cure.
  - Round the edges of the deck exterior seams and apply fiberglass tape.

Note: condensation will eventually build up in a sealed chamber. We recommend at least some vent holes if you choose not to install some sort of hatch access.

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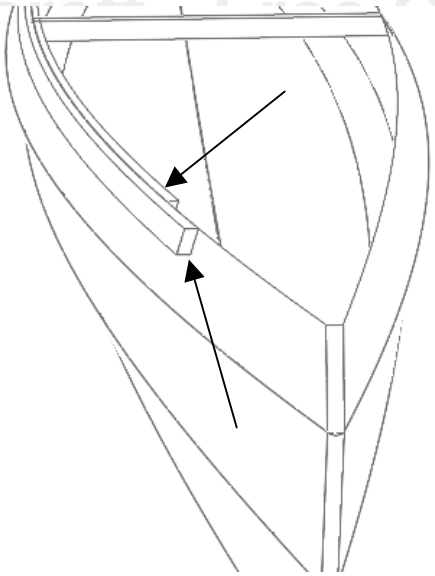
Install Gunwales

- Gunwales are require to provide stiffness and structural strength to the hull.
- The gunwales must be **at least** a total of 1” (2.5 cm) thick and 1.5” (3.8 cm) tall. We recommend an inwale, installed on the sheer line of the hull interior, and an outwale, installed on the sheer line of the hull exterior.



(Shown is a staggered, cut-away view of the inwale and outwale.)

- Gunwales can be made of solid lumber or in strips/layers building up to the minimum thickness.
  - Glue the gunwale pieces directly to the sheer line. Hold in place while glue is curing with temporary screws or clamps. If constructing the gunwales from strips of plywood, install one layer at a time. Let one layer fully cure before installing the next.
  - Stagger and strips or shorter pieces.
  - Maintain one continuous piece of wood for as much of midship portion of the gunnels/ rub rails as possible.

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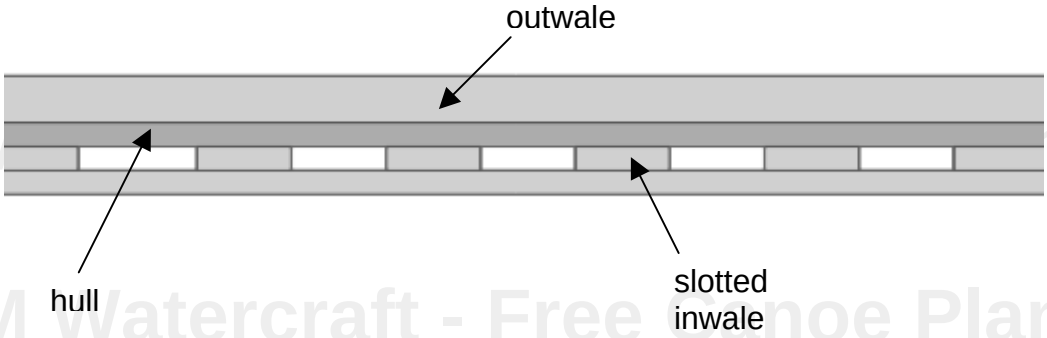
- **Optional: Slotted inwales.**



- A slotted inwale allows water to easily drain from the hull when stored upside-down and makes mounting seats easier.

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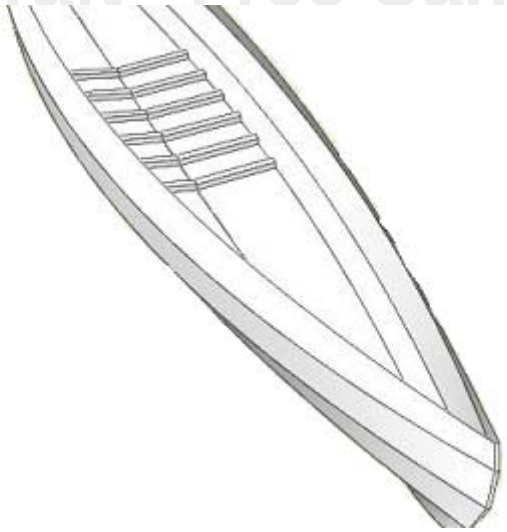
23. Bottom Reinforcement

- The bottom panels span a comparatively wide distance. This wide span may result in the hull oil canning (flexing inward) while on the water.
- To test for this happening, take the hull out for a test paddle after all construction steps, except faring, are complete.
- **This probably won't happen, but in case it does this is how you can address it.**

- Additional layers of fiberglass may be applied or a series of flat ribs may be installed in the midship area.



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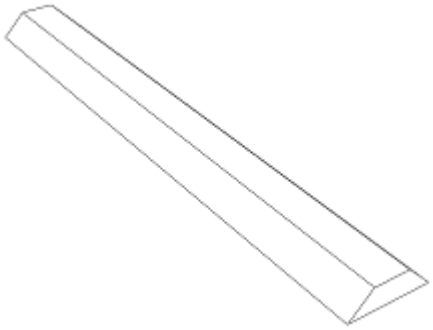
- Glue the ribs in place. For added stiffness, bevel the edges of the ribs and apply a layer of fiberglass over each rib.



- Leave a small gap between ribs along the centerline of the hull. This will allow any water drippings in the hull to flow through and not puddle-up in one area.
- Quantity of ribs required will depend on the wood used for the hull. At a minimum, each rib should be ½" (1.3 cm) tall and 1" (2.5 cm) wide. 3-4 sets of ribs spaced 12" (31 cm) should be enough.

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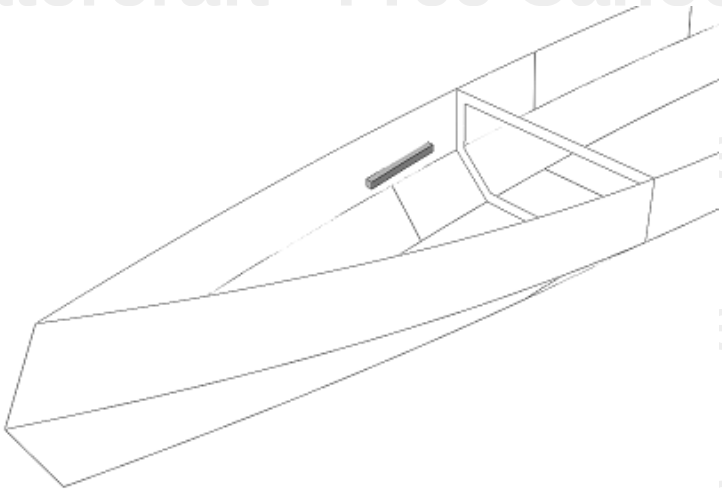
24. Install seats.

- Seat height will change the stability of the hull. When the seat height is raised, the center of gravity is also raised and that will make the canoe feel less stable.
- Seats can be hung from the gunwales or you can construct a simple bench-style seat
- and glue it to the hull by installing some cleats (strips of lumber glued to the hull sides)



25. Sand, Fair, and Paint/Varnish.

- Fairing is the process of sanding down the peaks and filling in the valleys made from applying fiberglass and epoxy.
- At a minimum, you should knock down any bumps because these will create wear spots on the hull.
- Typical minimal faring is feathering any edges of fiberglass glass to make a smooth transition to the wood surface. This can go quickly or be very time consuming depending on how cleanly you built the hull.
- How much of a smooth surface you want is up to you. Some builders prefer a museum quality finish while others prefer only a reasonably good finish that will touched up at times because they intend to use the hull a lot.
- Use caution when sanding fiberglass. You should only sand enough to remove slight bumps from the surface. Removing more will degrade the strength of the fiberglass.
- There are many fillers that can be added to epoxy to aid in the fairing process. Most of these change the color of the hull so if you plan on having a natural wood finish, chose you fairing materials wisely.
- **Note: Epoxy will become cloudy and begin to break down when exposed long-term to U.V. rays from the sun. Paint or varnish is required over all surfaces. This process will take weeks of direct sunlight for it to become a real problem. So if you want to paddle it a few times before the final finishing is complete, that's ok.**
- Follow the manufacturers' instructions when applying paint or varnish.
- Check our forum for more specific information regarding faring. Post any questions you have.

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- Be sure to check out our “Tips and Tricks” section for ideas like applying graphite to the hull bottom to make it more abrasion resistant.

26. Take pictures of your kayak in action and send them to us. This is the most important step of them all! ;) Don’t forget, you can get a rebate on the cost of the plans by sending pictures. Contact us for details.

27. ALWAYS use good judgment and wear your PFD.

28. Did we mention to ALWAYS use good judgment and wear your PFD?

29. GET PADDLING!

Now that you’ve built a set of our free plans and can see how easy and enjoyable we make the process, please consider us for any future building projects you may have.

We’ve put a lot of work into providing these plans for free. If you can, please support us by purchasing your building materials from one of our partners and mention you’re a JEM Watercraft customer.

If we don’t have a design you like, let us know. You never know what we have on the drawing board. Custom design services are also available.

JEM Watercraft - Free Canoe Plans

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