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## CAMP SAILBOAT

A FREE PDRACER CONSTRUCTION MANUAL  
FOR BUILDING A SIMPLE MULTI-PURPOSE PDRACER IN A 6-DAY CAMP FORMAT  
By Dave Gray, PolySail International



Prototype hull #841 built by Frank Jesko for his granddaughter India Holcomb (at the helm)

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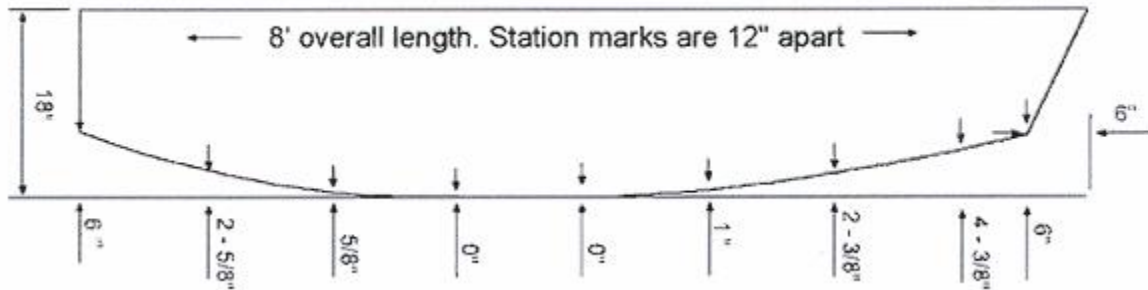
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*PDRacer stands for Puddle Duck Racer;  
thus, many of the finished boats have a  
reference to ducks in their names.*

## About the PD Racer

The PD Racer is the brainchild of David “Shorty” Routh who believes that sailing should be a sport that is “cheap, creative, and ...fun on the water.” PD Racers are basically 4' x 8' box boats that share a common hull up to a height of 10 inches. After that, the designs and sail plans are nearly all left to the imagination of the builders. Below is the side view of an 18" high hull called the designated hull shape that meets the class requirements.



Because the PD Racer is an inexpensive, easy-to-build sailboat with minimal class rules, the class is expanding rapidly among both novices and experienced boat builders. Constructing and sailing a PD Racer is a wonderful learning opportunity for a parent and child, students, scouts, retirees, or any individual or group that wants to experience the joy of building and sailing a nimble, very stable, small boat. That joy is enhanced even further when a group of PD Racer enthusiasts assemble for a messabout, an event that usually includes food, fun, stories, sailing, and otherwise messing about in boats in the best tradition of the classic children’s tale *The Wind in the Willows* by Kenneth Grahame when the River Rat says to the Mole: “Believe me, my young friend, there is NOTHING--absolute nothing--half so much worth doing as simply messing about in boats.”

## Work Space

PD Racers can be built nearly anywhere—in garages, outdoors, in an empty warehouse, under a tarp, in a storage facility, even in a small apartment. Use your imagination. It’s helpful to have a couple of sturdy sawhorses or an old picnic table to hold your work at a comfortable height, but level ground will also do. Utilize a couple of 2" x 4"s to keep your work out of the dirt. If you are using power tools, you will need a power supply and a heavy-duty extension cord; but with today’s battery-powered tools, you have more flexibility in where you work. Keep your tools organized and your work space consistently clean and it is more likely you will enjoy your building experience. Observe tool use safety precautions every time you use a tool.

## Tools

PD Racers are intended to be easily and inexpensively built with the need for only a few tools and minimal plans. A number of PD Racers have been completed (at least well enough to sail) in less than three days in a process known as a Puddle Duck Hatch. Careful planning and extensive cooperation is essential for a hatch because the hatch usually involves precutting many pieces, then building a number of boats to a single template or plan within a very limited time frame. In return for publicity, sometimes a local sponsor, such as a building materials store or a community sailing club, can be convinced to donate some or all of the essential materials and tools for the building process.

Tools in the first column below are essential to getting started. Borrow or buy what you need. Tools in the second column are helpful additions you will want to acquire as you continue to build boats. It has

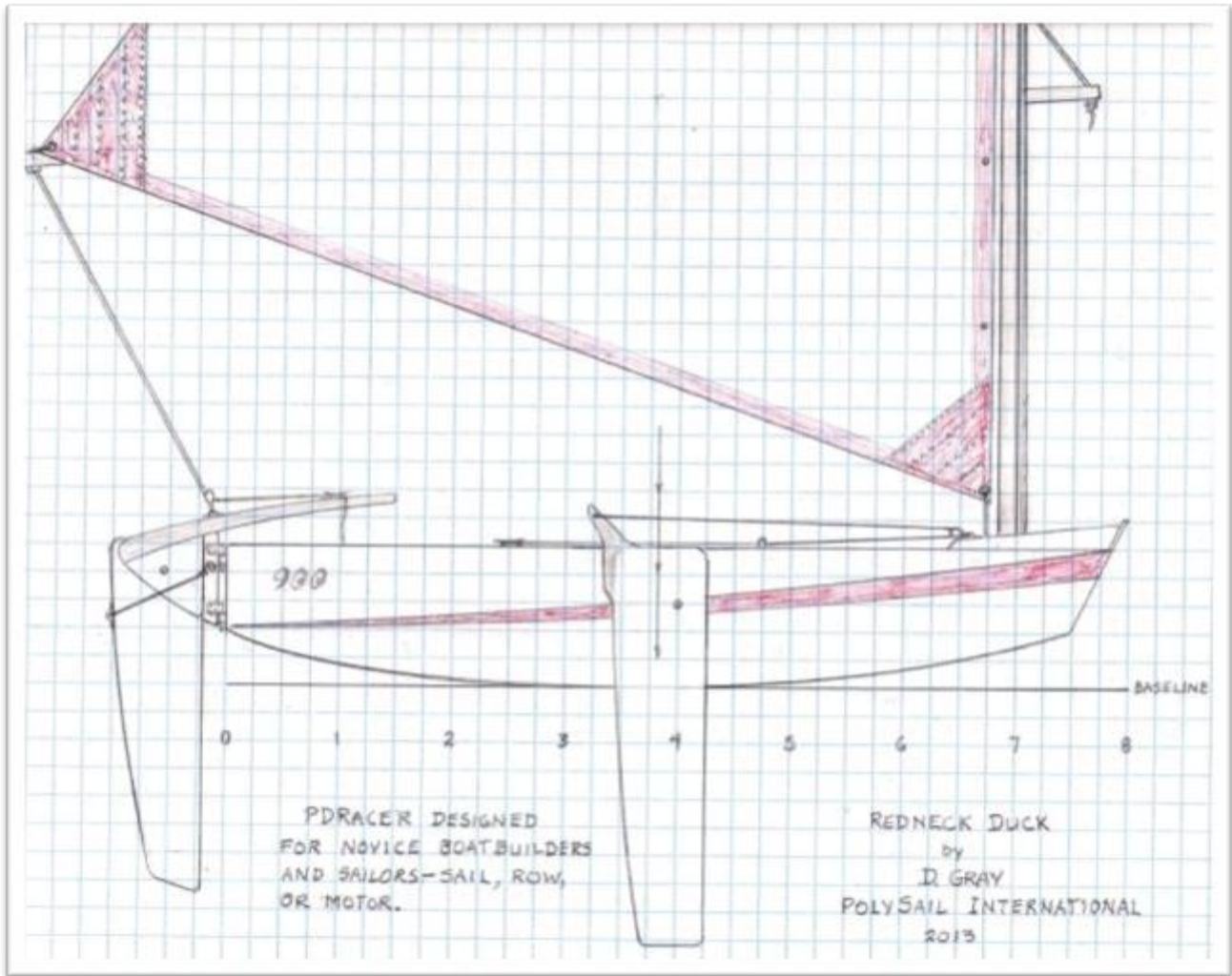
been my experience that a person who builds one boat invariably will want to build several more—it's an addiction.

Minimum Essential Tools	Helpful Additional Tools
<ul style="list-style-type: none"> <li>• Adjustable bevel gauge (for copying angles)</li> <li>• 16' steel tape measure</li> <li>• Block plane, at least 8" long</li> <li>• Caulking Gun for applying PL Premium Glue</li> <li>• Clamps (Make your own from split PVC pipe or see <i>Boat Building in Your Own Back Yard</i> by S.S. Rabl.)</li> <li>• Combination square</li> <li>• Drill and a set of drill bits from 3/32" to 1/4"</li> <li>• Portable electric jig saw</li> <li>• Hammer, 12-13 oz.</li> <li>• Jigsaw</li> <li>• Sanding block and 60 grit sandpaper</li> <li>• Screwdrivers, flat and phillips</li> <li>• Paintbrush</li> <li>• Putty knife</li> <li>• Utility knife</li> <li>• Weights of some kind. Paint cans filled with sand work well. I use 1/2 cement blocks.</li> </ul>	<ul style="list-style-type: none"> <li>• Bench vise or Black &amp; Decker WorkMate table</li> <li>• Carpenter's wood rasp, Rattail file, Surform tools</li> <li>• Cordless drill, 3/8" chuck, variable speed, reversible, and additional wood bits</li> <li>• Circular saw with guide (Good quality <i>cordless</i> circular saws are really great, but expensive. Buy quality saw blades, always)</li> <li>• Drywall square</li> <li>• Hammer, 8 oz.</li> <li>• Handheld electric belt sander, random orbital sander, portable finishing sander</li> <li>• Jack plane, electric rotary plane</li> <li>• Level</li> <li>• Nail sets/punches</li> <li>• Power router and bits</li> <li>• Quick clamps, spring clamps, pipe clamps</li> <li>• Table saw, cutoff saw</li> <li>• Wood chisels, gouges</li> </ul>

### Materials List and Plans

The free plans offered here are for those wanting an easily-built sailboat based on simplicity, ease of construction, and a PDR designer's experience in building 4 PDRacers for himself, 2 for his son, 2 kits for assembly at the 2010 *Wooden Boat Show*, 2 mailable kit PDR's, 6 boats assembled with and for others at the designer's home, and 6 other 4' x 8' non-PDR scows. (Note: Not all of the better known PDR designers have even built a single PDRacer, instead relying on others to test their designs, provide them feedback, and then make improvements to their designs if something is found by others to be out of whack.) *Lame Duck*, seen on the cover page, was my first PDRacer and had the distinction of being recorded as hull #100 in the PDRacer class. She was also the inspiration for the first Camp Sailboat curriculum. However, I've known for a long time that *Lame Duck's* construction was overly complex for most first time builders and much heavier than she needed to be, so her plans have been retired and replaced with the updated and more versatile *Redneck Duck* design.

This new design is aimed primarily at first-time boatbuilders and sailors and especially large-group PDRacer building projects called "hatches". I opted for stiffness, stability, fairly high sides, and a large open cockpit to accommodate at least two people for training purposes. I also made certain that most of the boat's structural weight is carried low in the hull and that positive Styrofoam flotation is included in all sides. *Redneck Duck* carries a proven sail plan that will drive the boat well but is unlikely to cause an upset. At the same time, I wanted a boat design that could easily be modified for racing or cruising and would appeal (at least somewhat) to youngsters. *Lame Duck* was no slouch as a PDR having hit 5.5 mph by GPS in a moderate to strong breeze; but *Redneck Duck*, our new design, should be a top performer right from the time she takes to the water. With a few alterations, she could easily compete for first place in the next PDRacer World Championship. Here's a scale drawing of *Redneck Duck*—or whatever you wish to call her when your version of this PDRacer goes 3-D. The scale is that each block =3" per side.



*Redneck Duck* is a class legal PDR that can be 3-D in three days and finished in about a week by most builders. She takes a 60 sq. ft. leg o' mutton sail as shown, but offers an easy conversion to many other mast and sail options, both larger and smaller, as needed. The plans include an option for an electric trolling motor mount and some other options that even experienced builders might find interesting. Below and on the next few pages are the material list, and detailed plans you will need to build *Redneck Duck*.

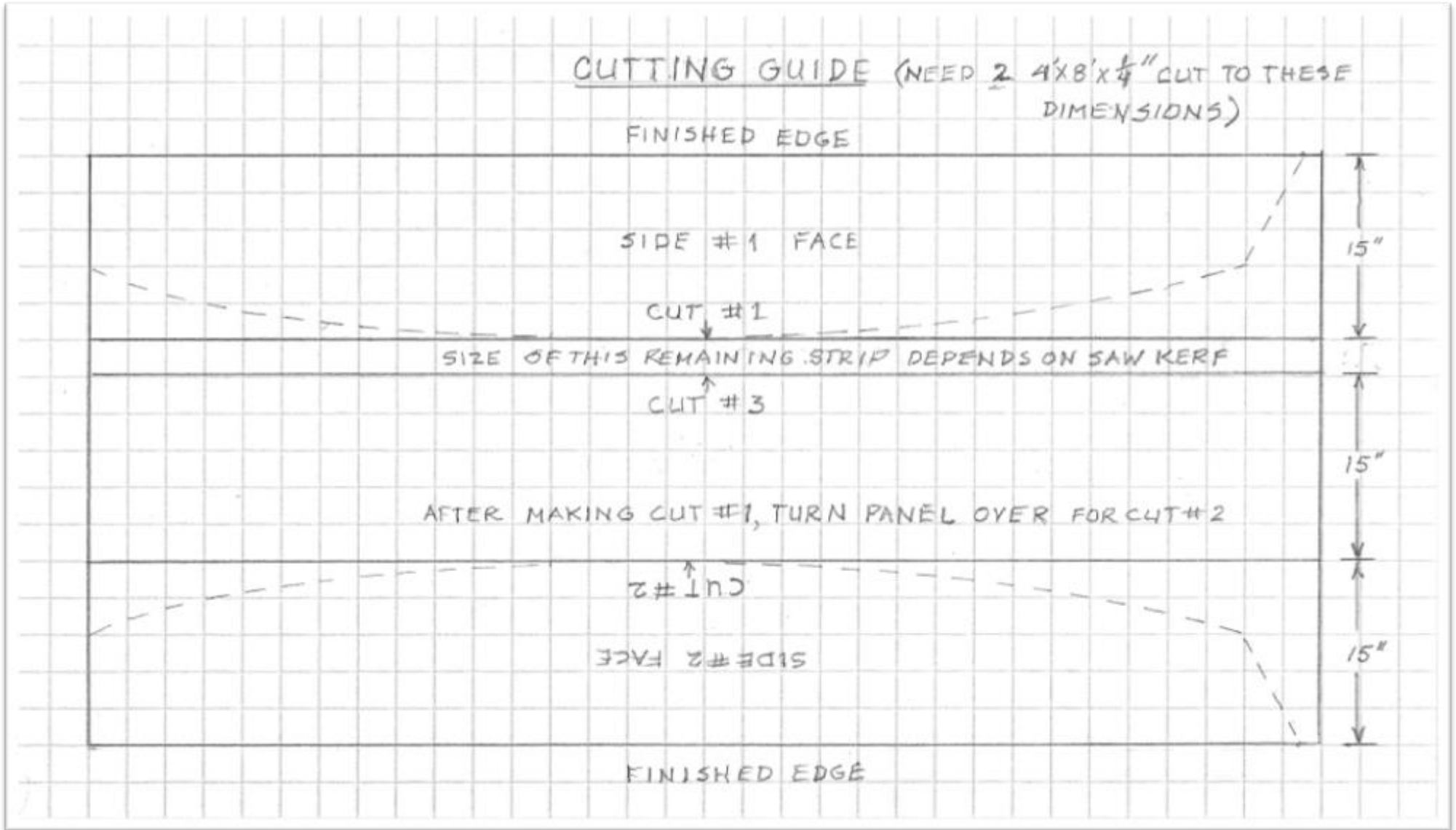
There will always be items that are left off materials lists that affect the total price you will pay for building a boat. One of the largest might be a trailer or other method of transport. One of the smallest might be a specialized bolt or type of washer. Below is our initial estimation based upon items that we know will be needed along with a few options.

LIST OF MATERIALS					
All boards listed are at least #2 grade. Sorting through common boards can result in considerable savings.					
Description	Material	Dimensions	Number	Est. Cost	Source
Bottom skids (Optional except for heavyweights)	Pine, Vinyl	1" x 2" x 8'	2	\$6-\$20.00	Home Depot or local yard
Bow and stern transom framework, deck support framework, tiller, leeboard handle.	Cedar/Pine/ Poplar/Fir (Few or no knots)	1" x 2" x 8'	7	\$21.00	Lowes "Top Choice" #2 (sort for nearly knot-free)
Bottom, sides, side frames, bow and stern transoms, leeboard, rudder. (Sort	BC or better plywood—exterior	¼" x 4' x 8'	3	\$75.00	Home Depot or local yard

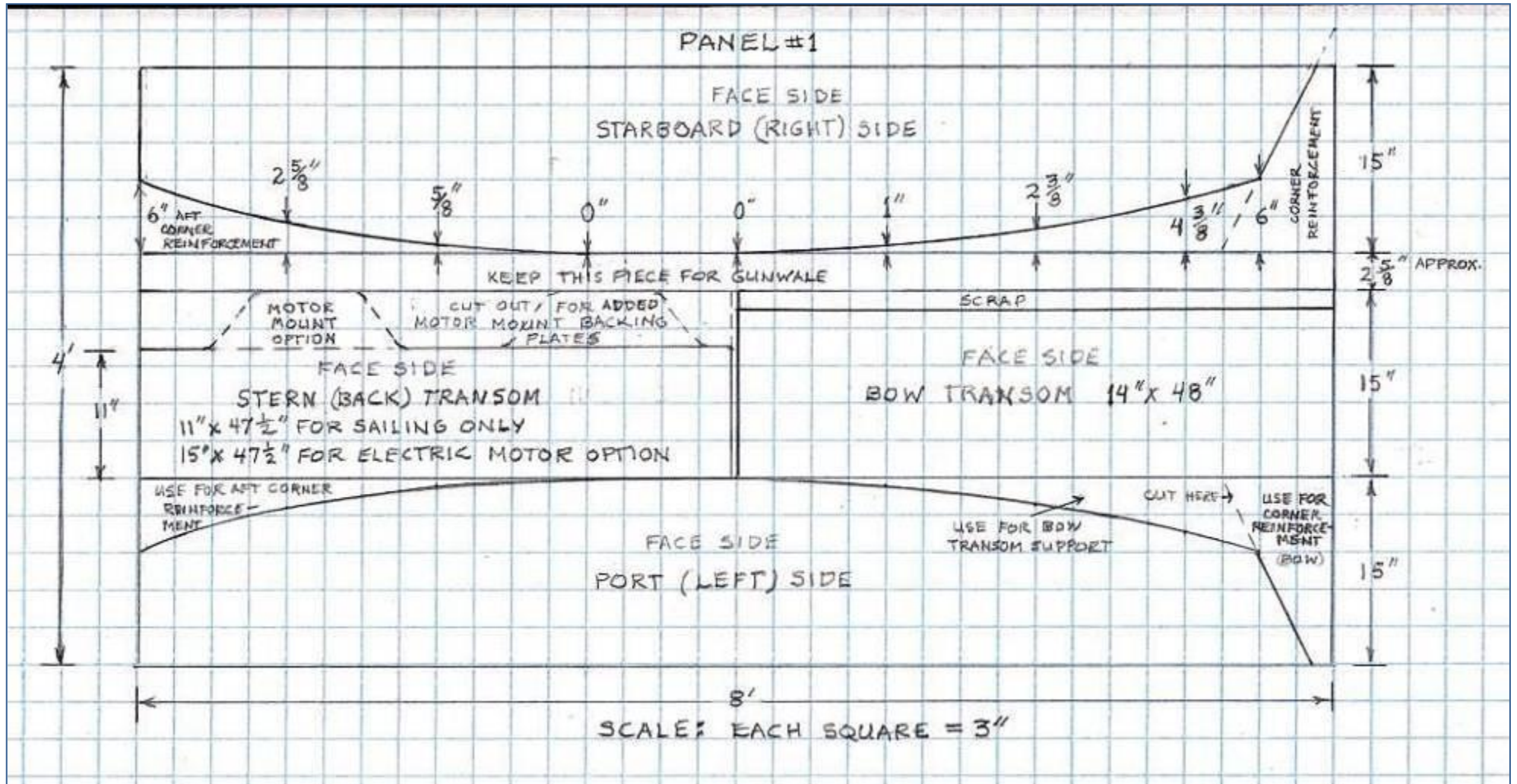
for fewest knots/voids/best back side)	glue*				
Optional ply pieces to increase the dimensions of the leeboard & rudder.	BC plywood	1/4" x 2' x 4' BC panel	1	\$12.00	Home Depot
Wishbone tiller and rudder case	BC plywood	1/2" x 2' x 4' BC panel	1	\$13.00	Home Depot
Bow, stern, center crosspieces	Cedar/Pine/ Poplar/Fir	1" x 3" x 8'	2	\$8.00	Lowes "Top Choice" #2 (sort for nearly knot-free)
Leeboard hull backing plate	Cedar/Pine/ Poplar/Fir	1" x 8" x 6'	1	\$6.00	Lowes "Top Choice" #2 (sort for nearly knot-free)
Chine logs	Pine Molding	1/2" x 3/4" x 8'	2	\$10.00	Lowes
Flotation	Polystyrene	3/4" x 13 5/8" x 48"	6 pack	\$8.00	Home Depot
Mast, boom	Pine/fir, Bamboo, other	2" x 6" x 16' 2" x 16', 1 1/4" x 10'	1	\$16.00 + ?	Home Depot or local yard Local bamboo grower
12' x 16' Essentials Only PolySail Kit	Polyethylene	12' x 16'	1	\$60.00	PolySail International
Rigging Kit for 60 sq. ft. leg o' mutton (Optional)	Blocks, cleats, line, eyes, etc.		1	TBD	PolySail International/ Duckworks
Hardware Kit for Rudder, leeboard, (includes pintles and gudgeons)	Bolts, washers, nuts, etc.		1	TBD	PolySail International/ Duckworks
Screws	Stainless hillips flathead	1 1/4" #8, 2" #8 3/4" #8	12 ea Box/50	\$10.00 \$5.00	Lowes/Ace Hardware Lowes/Ace Hardware
Fender Washers	Common	3/4" to 1" diameter with 3/16" hole	12	\$6.00	Ace Hardware
Ring nails	Bronze	3/4" #14, 1" #14	(2) 2 oz.	\$4.00 ea.	RAKA Epoxy
White latex enamel primer			1 qt.	\$11.00	Home Depot
Latex acrylic paint (choice of color)			1 qt.	\$8-14.00	Walmart, Home Depot
3" Latex Brush	Nylon		1	\$9.00	Walmart, Home Depot
Round barbell weight, 5 lb.	Cast iron, flat	5/8—3/4" thick	1	\$3.00	Play It Again Sports
Oars, oarlocks, sockets	Aluminum	6'	Set	\$54.00	RAKA Epoxy
Tite Bond II or III Wood Glue, 8 oz.			1	\$8.00	Home Depot/Lowes
Loctite/PL Premium construction adhesive, 10 oz. caulking tube	Polyurethane glue		1	\$5.00	Home Depot/Lowes
Light colored wood filler. (Elmer's 3.25 oz. plastic tube)			1	\$5.00	Walmart, Home Depot
Bamboo (Grilling) Skewers	Bamboo	1/8" x 12"	100	\$2.00	Walmart, Grocery
Estimated total for everything above except hardware				\$375.00	

On the following pages are the plans for completing this boat. Note that all the plans (except for Panel 8 and 9) are to scale with the sides of each 1/4" graph paper square equal to 3".

### Cutting Guide

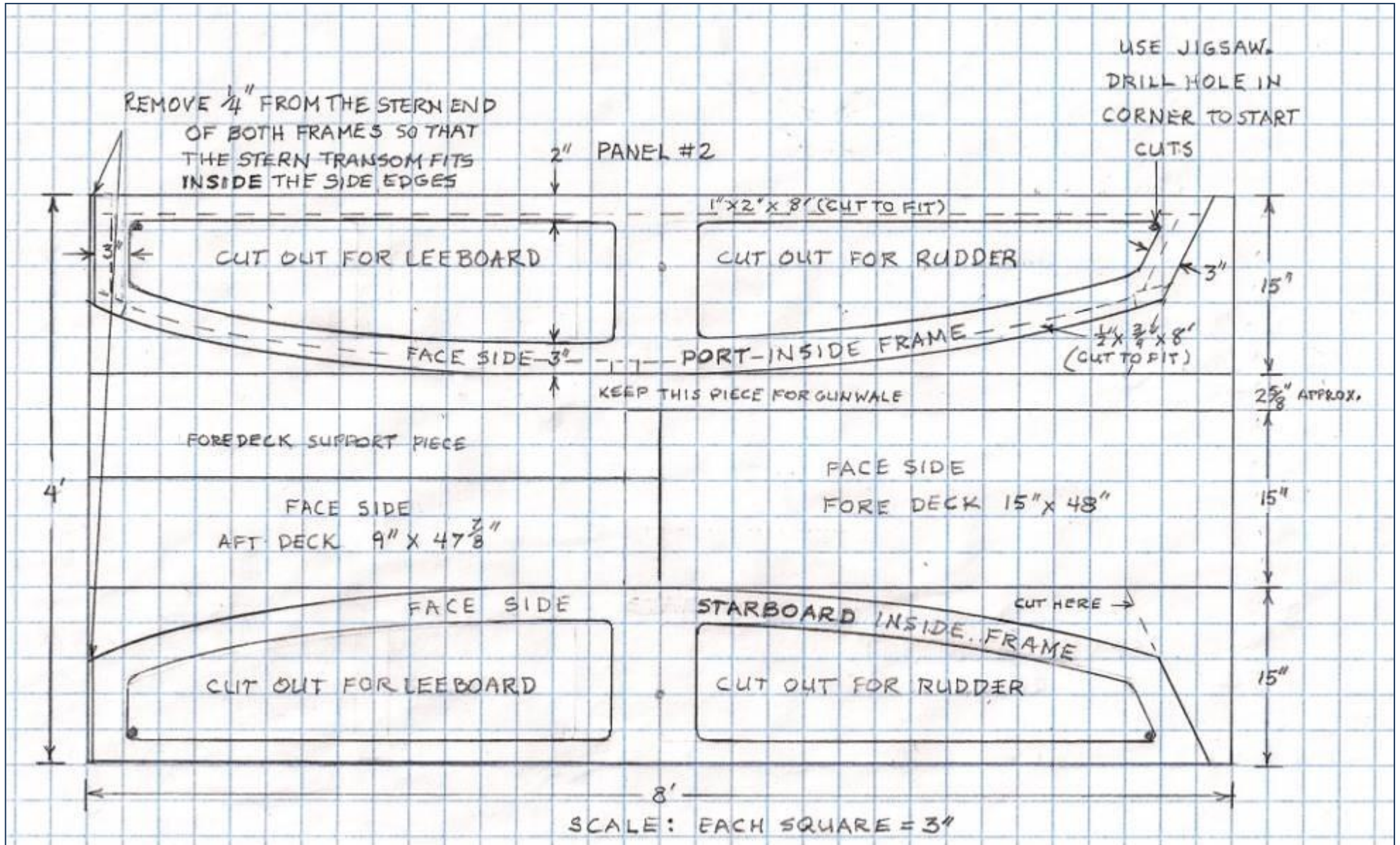


## Panel 1: Sides

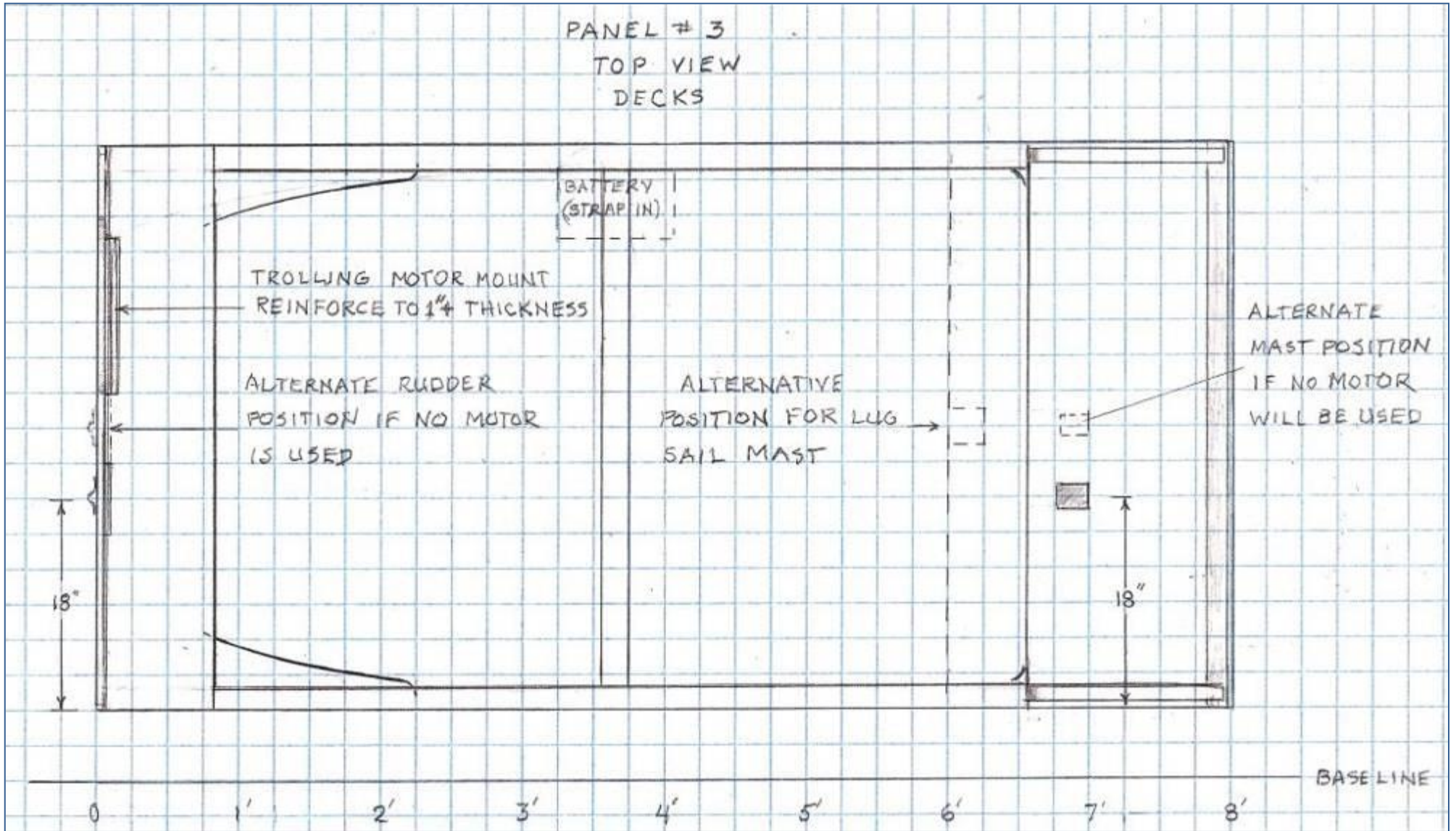




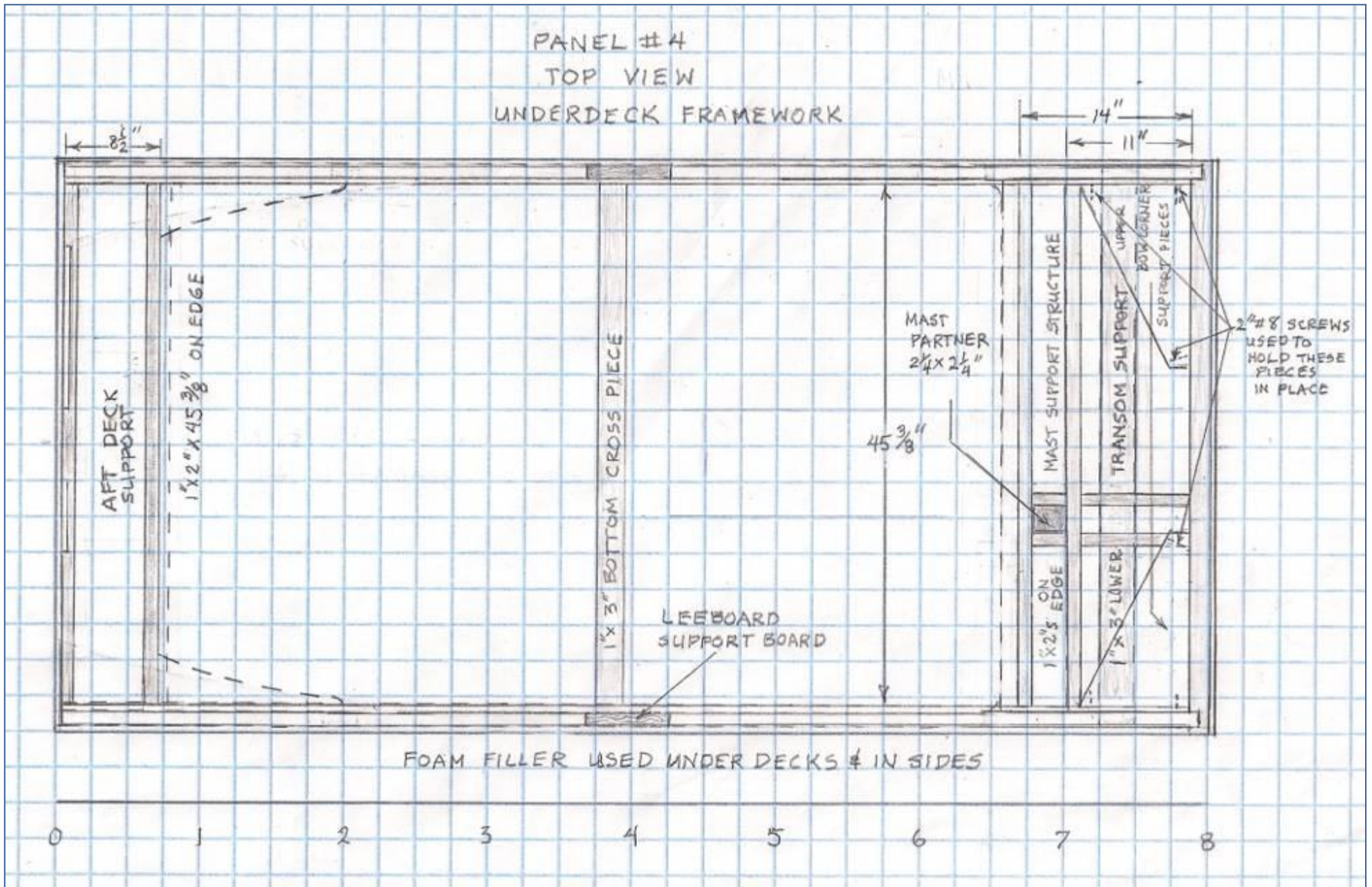
## Panel 2: Inside Frames



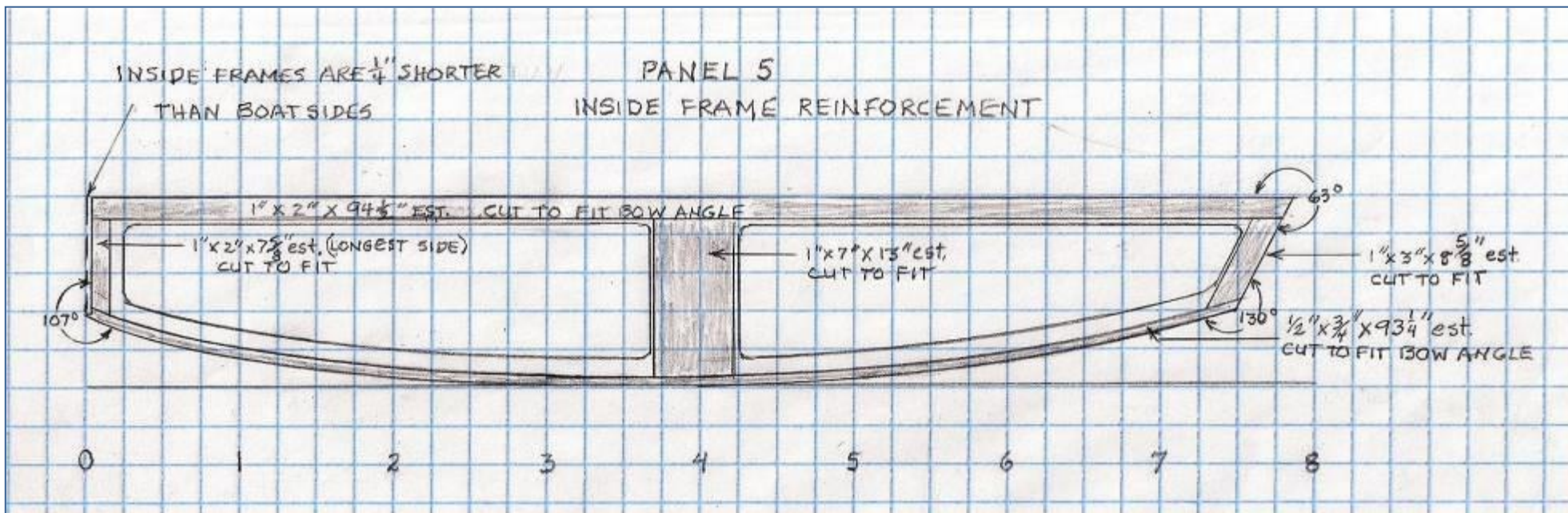
# Panel 3: Decks



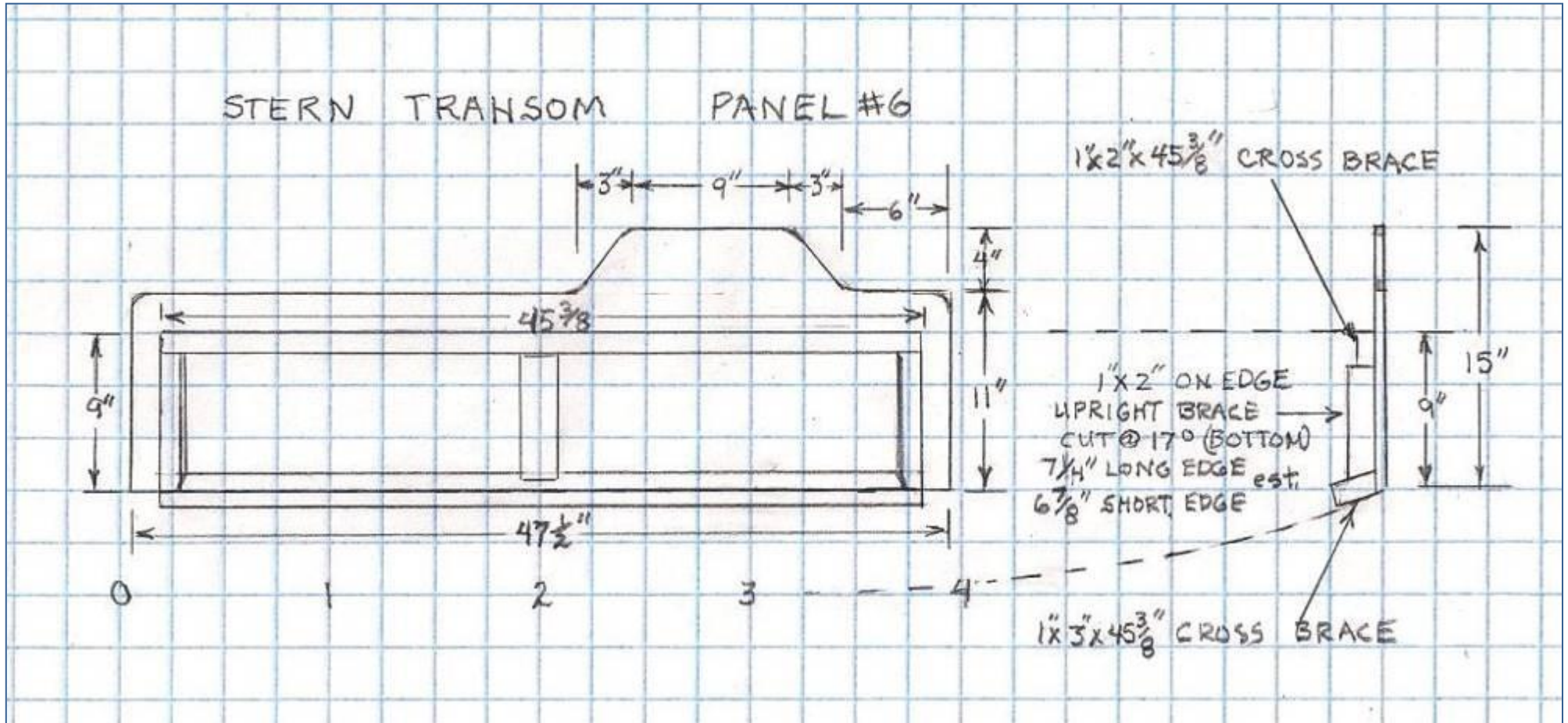
### Panel 4: Underdeck Framework



### Panel 5: Inside Frame Reinforcement



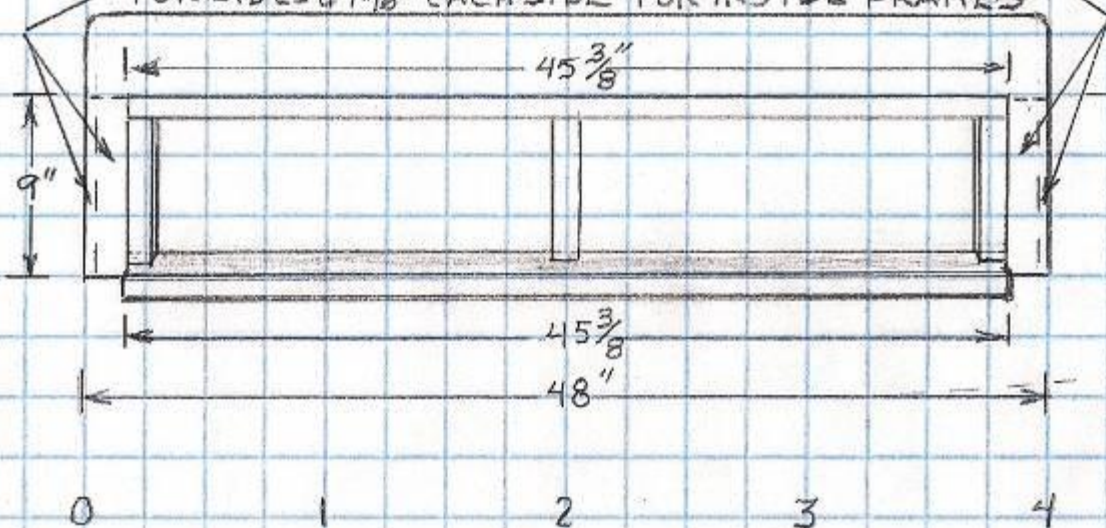
**Panel 6: Stern Transom**



### Panel 7: Bow Transom

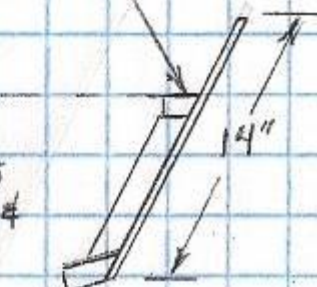
#### BOW TRANSOM PANEL #7

BOW TRANSOM OVERLAPS BOTH SIDE PANELS & INSIDE FRAME. ALLOW  $\frac{1}{4}$ " EACH SIDE FOR SIDES &  $\frac{1}{16}$ " EACH SIDE FOR INSIDE FRAMES



1" x 2" x 45  $\frac{3}{8}$ " CROSS BRACE  
FORWARD EDGE CUT @ 27°

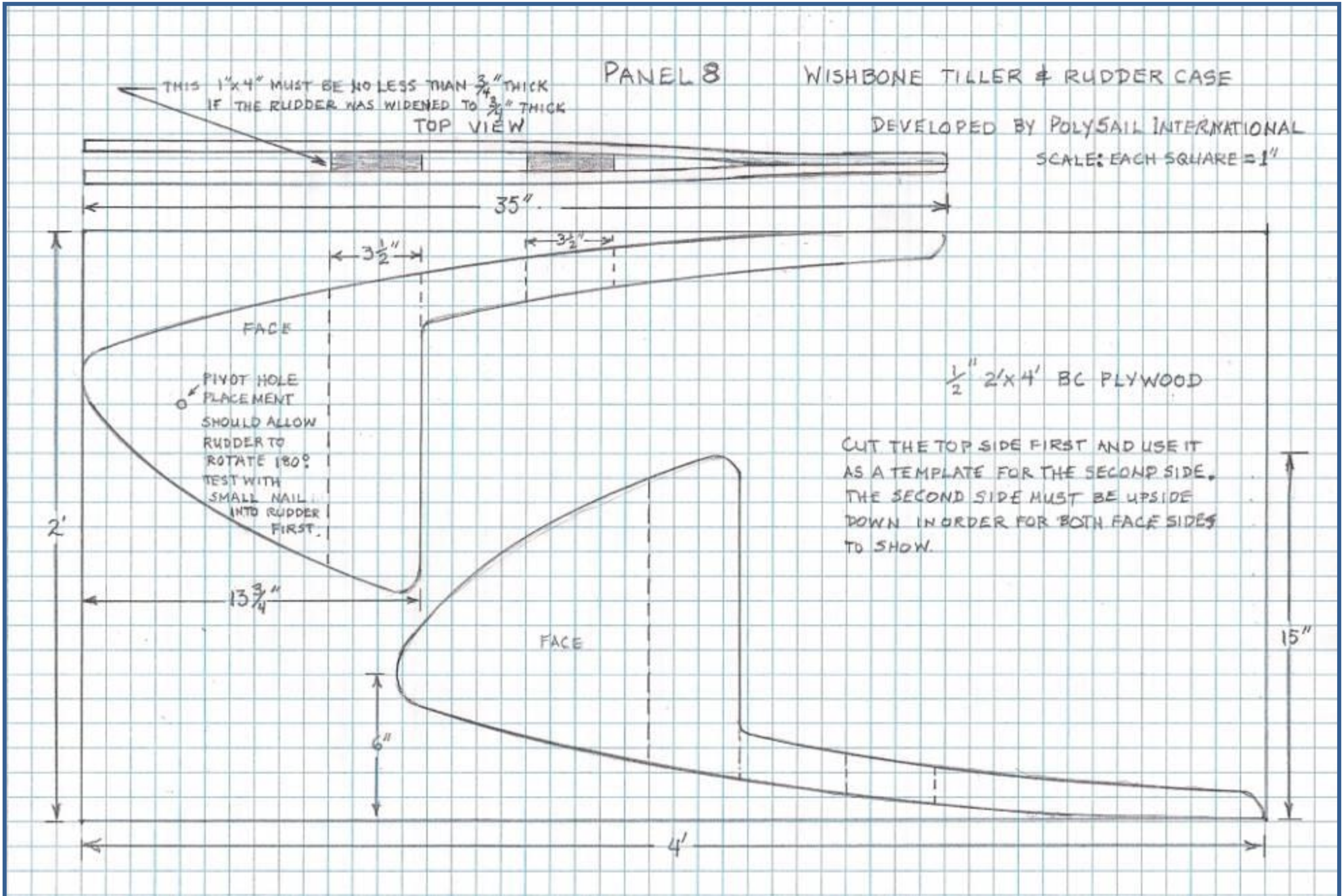
(3) 1" x 2" ON EDGE  
UPRIGHT BRACES  
CUT @ 27° (TOP) &  
40° (BOTTOM)  
9  $\frac{1}{16}$ " LONG EDGE est.  
8  $\frac{1}{2}$ " SHORT EDGE



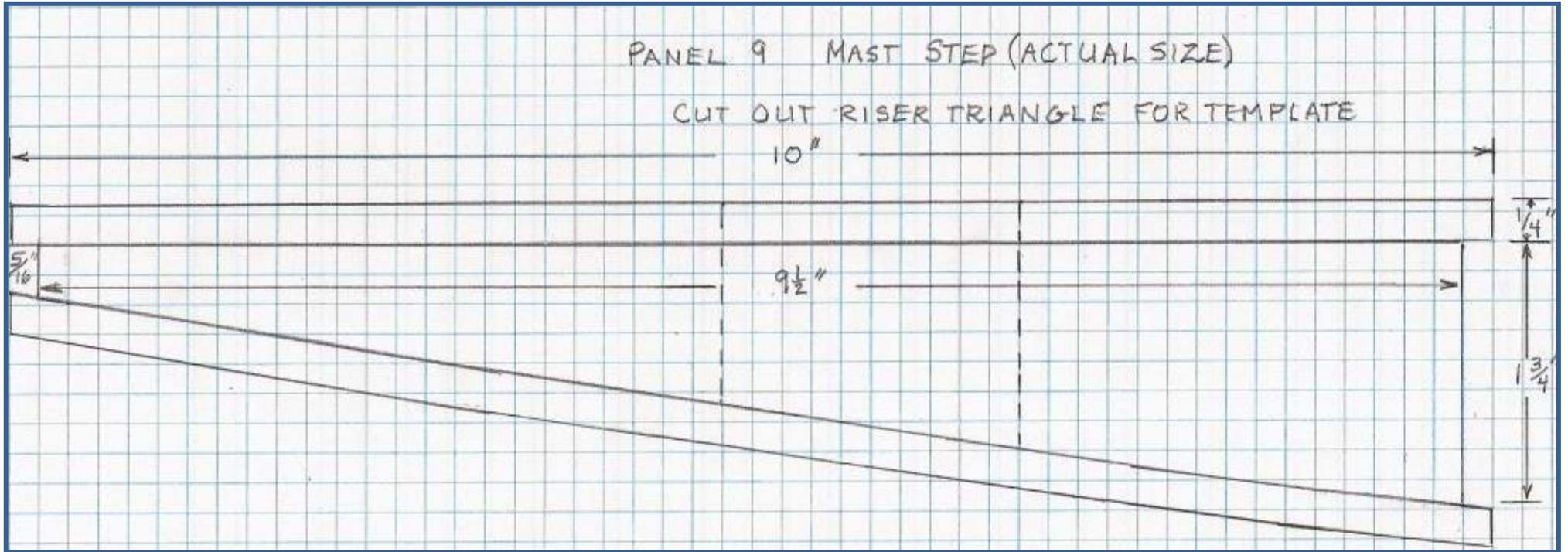
1" x 3" x 45  $\frac{3}{8}$ " CROSS BRACE  
FORWARD EDGE CUT @ 40°

SEE NOTE ON PANEL #6 REGARDING CUT ANGLES.

## Panel 8: Wishbone Tiller and Rudder Case

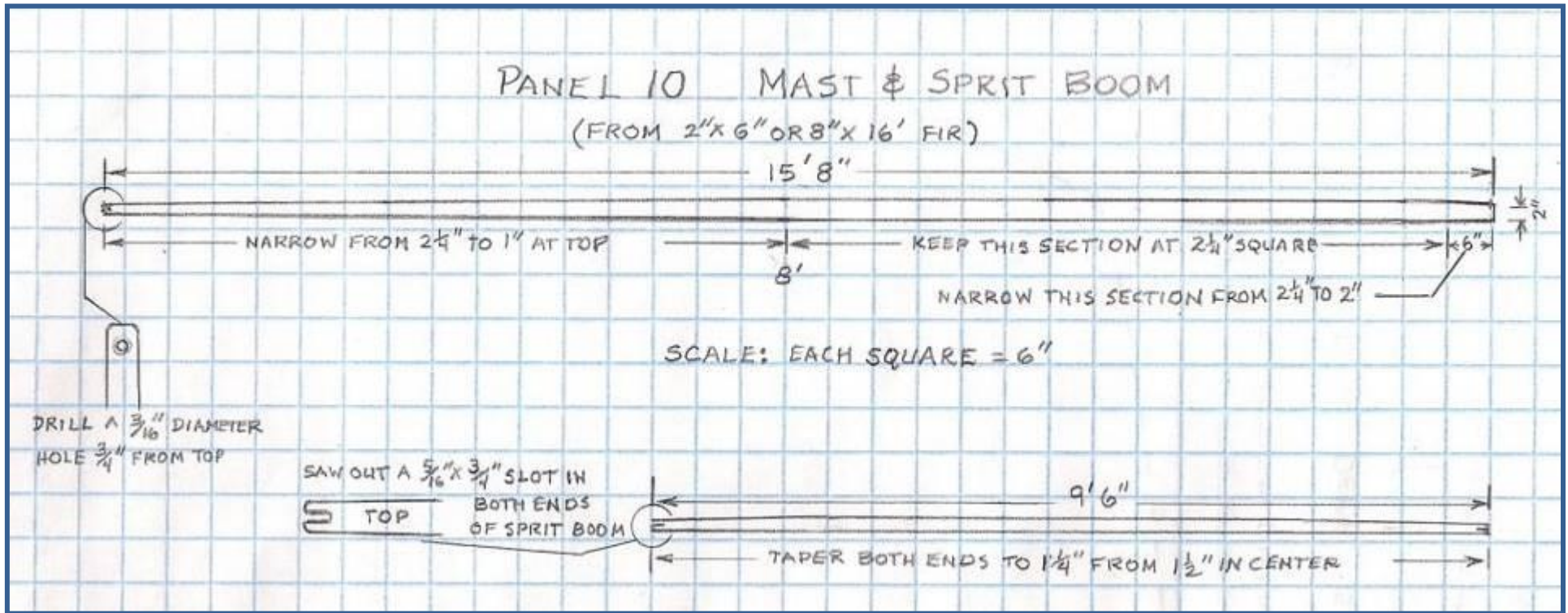


**Panel 9: Mast Step**





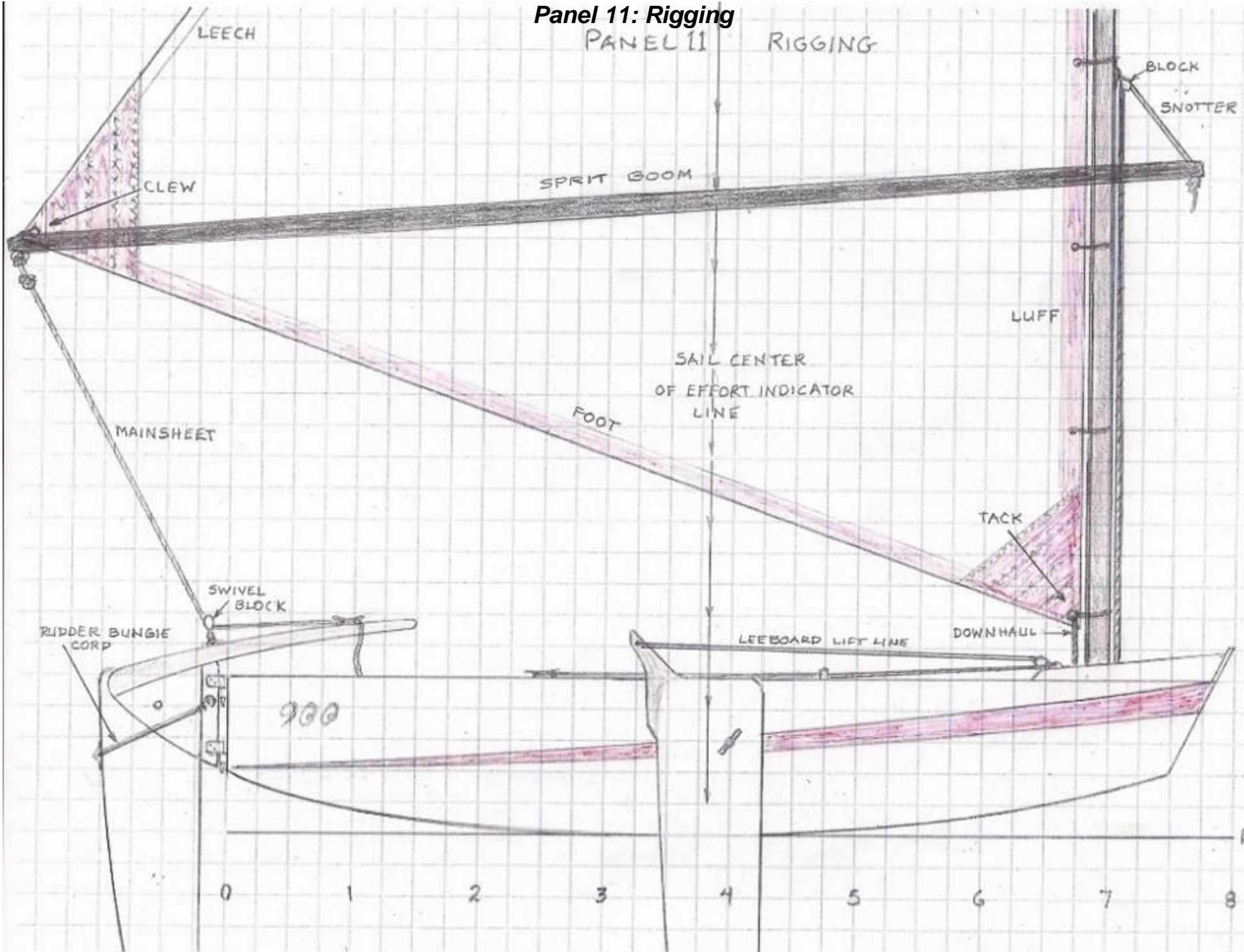
# Panel 10: Mast and Sprit Boom



Panel 11: Rigging

PANEL 11

RIGGING



## ***A Warning about Wood Measurements***

The dimensions used in referring to wood boards and plywood panels by the lumber industry do not really reflect the true measured sizes of those boards and panels. A ¼" thick BC plywood sheathing panel, for example, is usually 11/32" thick instead of ¼". A 1" x 2" x 8' board in pine is usually only ¾" thick and 1 ½" wide. The thickness of the same board in cedar is usually only 11/16". Lengths are usually more consistent but can be different than stated. In addition, the practice of big box stores of stapling a bar code to the ends of their boards can affect measurements of length if you don't notice the staple. The measurements in these plans are generally plus or minus 1/16", but even cutting a board to the inside of a line instead of the outside can affect a measurement by 1/16" if that is the saw's kerf. A couple of sloppy measurements and cuts at the beginning of the assembly process can have unforeseen consequences later, and nearly anyone who has built a boat has experienced the problems resulting from a faulty measurement at some time in their boat construction careers. It's a good practice to follow the old adage and "measure twice, and cut once" when working in wood.

### **CAMP SAILBOAT: DAY 1**

#### *Summary of Activities*

1. **Read over pp 1-19 of this *Camp Sailboat* project manual.** Carefully review this summary of the day's activities as well as the notes and tips before beginning. Note that most of the materials you need can be acquired locally.
2. **Keep a notebook.** Purchase or designate a small notebook or notepad for logging day by day work notes, recording costs, doing calculations, etc. Take photos to complement your notes and share with others.
3. **Identify your work space.** Determine a suitable work place and set up for cutting out the hull pieces. A work table or a couple of saw horses are useful.
4. **Check to make certain that you have the necessary tools listed in the column "Minimum Essential Tools."** You will need a tape measure, pencil, long batten, jigsaw and/or portable circular saw, a block plane, a sander or sanding block, and a Work Mate or similar upright clamping device for today's work.
5. **Purchase the Plywood.** Purchase 2 suitable plywood panels for the sides, side frames, transoms, boards, etc. as shown in panels 1 and 2 of the plans. Have two of these panels cut into 6 equal 15" pieces and two leftover 8' strips of less than 3" wide as shown in the "Cutting Guide" in the plans. Purchase a third full panel for the bottom.
6. **Purchase a putty knife and some light-colored wood filler.** Fill in any knots, cracks, or indentations in the faces of the plywood, then fill in all voids in the edges. You will need to repeat this step after cutting out the separate pieces.
7. **Cut the panels into pieces.** Mark the panels as shown in panels 1 and 2 of the plans with a pencil. **IMPORTANT:** Make certain that you identify each piece as shown on Panels 1 and 2 as port inside frame, port side, starboard inside frame, and starboard side. The face or "good" side of each piece will be showing when the sides and frames are assembled later if marked as shown on the plan before cutting. When you are certain you have the pieces identified correctly, cut out the pieces exactly as shown in the plan. Usually, you can use the first side you cut out as the template for the rest of the sides and frames. It's also helpful to identify this piece by penciling "template" on it.
8. **Match the side and inside frame pieces.** Align the four side and side frame pieces along their finished edges and plane and sand the pieces to a uniform size around the edges so that they all match up. Avoid taking off too much wood from the bottom edges or your

boat might not measure as “class legal” according to the designated hull shape. However, there is enough “slop” in the measurements (about ½” at each station) that you would have to make a very serious error to disqualify your boat.

9. **Cut out the rudder and leeboard pieces.** Cut these pieces from the port and starboard inner frames using the dimensions shown in Panel 2 of the plans.
10. **Order a sail kit, a hardware kit, oars or a paddle and boat nails.** In order to get these items in time for your launch, you need to order them early. You can order a sail kit or a finished sail from PolySail depending upon your budget. Find those products on either the kits page at <http://polysail.com/kits.htm> or <http://polysail.com/finished.htm> You can order the hardware from Duckworks at <http://www.duckworks.com/hardware.htm> and oars or a paddle, and bronze ring nails from RAKA at <http://www.raka.com/marine-accessories.html>
11. **Clean up.**

		
<p>Cut out parts and pieces shown near the end of Day 1.</p>	<p>Having another PDRacer helps demonstrate some framing and flotation solutions.</p>	<p>Frank Jesko sands an inside frame that he cut out near the end of Day 1.</p>

*Notes and Tips Below Correspond to the Daily Activity Numbers Above*

5. Keep in mind that we are not building a show quality boat. However, we do want it to last for about a minimum of five years. To be on the safe side, that means building with at least BC grade exterior plywood that has few knots visible and as few voids in the edges as you can find. At most big box stores that means having someone help you sort through panels and purchasing better BC exterior sheathing as a minimum at about \$23-\$25 a sheet. If your panel costs less, your hull probably won't last longer than two years at best. Sometimes it's not a bad idea to buy marine grade plywood for a minimum of about \$50 a sheet, but I wouldn't spend that until you've already built a boat or two. On my recent trips to Lowe's and Home Depot, I found that Home Depot had the superior plywood, and Lowe's had the superior framing boards like pine 1" x 2" x 8'. That situation could easily be reversed in another area of the country. In the Midwest, Menards is a good source for materials. Occasionally, you can still find a local lumber yard that carries exterior glue AC or even AB plywood, but these yards are hard to find these days.

It's probably best to purchase the plywood panels that will be cut early in the morning before the store gets too busy. Take the Cutting Guide on p. 8 and sketch of the boat from p. 19 with you and explain what you are doing to the saw operator. Try to gain his or her support for the project and explain carefully the reason for the cutting sequence, i.e., that all the 15" pieces need to match up. Some big box stores cut from the lower part of the panel instead of the upper part first, so the sequence might be reversed, but you still want the panel reversed after the first cut. Watch closely to see that he or she makes all cuts with the same side of the panel facing outward. Once finished, thank the operator profusely for the time they have saved you.

6. We want to keep sanding to a minimum, so lightly sanding the back sides of all panels with 60 or 80 grit sandpaper before beginning cutting is a good idea. If there are deep knots or splits on the C side of your BC plywood, you might want to fill these flaws with a purchased wood filler or a paste of Titebond and wood flour (fine sawdust) or epoxy and wood flour before sanding. You can expect to find a number of flaws that need filling. After cutting out your pieces, you particularly need to look for voids in the edges that were not visible before the pieces were cut out.

7. The plans are drawn so that nearly every piece will be used in construction. Make all cuts as shown on the plans otherwise you might need to buy an extra panel of plywood.

Anytime you cut across the grain of the outside plies of the plywood, it's a good idea to apply clear packing tape over the entire line you will be cutting then wrap the tape over the ends of the piece you are cutting. Run your thumbnail along the tape immediately over your line a few times before starting the cut. If using a circular saw, set it just deep enough to make the cut. For a jigsaw, use a smooth wood blade rather than a coarse blade. Using these techniques will help you avoid splintering the edges of cuts that go across the plywood grain.

9. If you have both a circular saw and a jigsaw, you don't need to drill a hole to start your jig saw cut. Instead use a "plunge cut" by dropping the spinning blade of your circular saw straight down through the plywood along the inside of your straight line to start your cut outs of the leeboard and rudder from the inner frame piece. This way you avoid having a drill hole to fill in at the ends of your rudder and leeboard later.

10. Bronze ring nails are often hard to find locally. If you want to attach your boat's bottom using my preferred method, order these nails early from RAKA Inc. at 772 489-4070 so these fasteners will be available when you need them. Otherwise, use 3/4" #8 stainless steel screws purchased locally. You have the option of countersinking the heads and leaving all the stainless steel screws in the plywood, or removing some or all of the screws and inserting bamboo skewers dipped in glue in the holes. Later, the tops of the skewers can be planed or sanded off flush.

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## **CAMP SAILBOAT: DAY 2**

### *Summary of Activities*

1. **Purchase materials.** Purchase the following in #2 or better lumber in pine, fir, poplar, or cedar: (7) 1" x 2" x 8' strips; (2) 1" x 3" x 8' strips, (2) 1/2" x 3/4" x 8' clear pine molding. Purchase a box of 50 stainless steel 3/4" #8 flathead screws, a dozen 2" #8 stainless steel screws, a dozen 3/4" to 1" fender washers with a 3/16" holes, a 10 oz. tube of Loctite/PL Premium Construction Adhesive, an 8 oz. plastic container of Titebond II or Titebond III glue.

2. **Borrow, purchase, or make at least a dozen clamps.** At least 8 of these can be spring clamps. At least 2 should be heavier C-clamps or similar heavy duty clamps.
3. **Add reinforcing pieces to the inside frames.** Set up your work space to reinforce the inside side frames of the boat. Align a 1"x 2" x 8' with the top of an inside frame as shown by the dotted line in Panel #2 as well as the inside view of the inside frame in Panel #5. Apply Titebond glue to the strip and clamp it along the top edge. Do the same with a 1/2" x 3/4" x 8' molding strip along the bottom edge of the inner frame with the 1/2" side glued to the surface of the inner frame. Finish the inside frames by adding the reinforcement pieces between the straight top edge and the curved bottom edge as shown in Panels #2 and #5. Make certain that the reinforcing strips will be on the inside or "C" side of the BC plywood frame, not on the face or "B" side. You can use 3/4" screws as well as clamps to hold the pieces in place while the glue is drying.



3/4" screws are driven through the face into the reinforcing strips then removed after the glue dries. The washers help protect the wood surface from the screw heads.

This photo shows the reverse side after the reinforcing strips and pieces are glued in place. Note the wide leeboard backing plate in the center of the inside frame. Place one of these backing plates in the center of each inside frame.

The bow reinforcing strip is made from a 1" x 3" piece that is cut to fit along the front edge of the bow between the chine log and the gunwale support framing. We used PL Premium to fill any gaps we had between the pieces. The 3/4" piece is cut flush with the bow.

4. **Reinforce the stern transom.** Mark the outline of the side frame on the stern transom. Set the stern edge of the completed inside frame upright on the edge of the stern transom piece so that the bottom edge of the frame matches the bottom edge of the transom and the inside edge of the frame is flush with the side edge of the transom. (See the photos below.). Repeat for the other side of the transom. After

completing this marking procedure, cut out the top and bottom cross pieces and upright support pieces for the stern transom. See Panel #6 for dimensions of these pieces and refer to the photos below to clarify their location. Both the bottoms of the upright supports and the bottom cross piece require angle cuts of approximately 17°. If you have access to a table saw, the long cut on the bottom cross piece is simple to make. It's much more difficult with just a jig saw or circular saw, but a sharp block plane can usually correct variations. If you find that you have gaps between the lower cross piece and the transom itself, run a bead of PL Premium along the gap, then smooth out the fillet with a popsicle stick, tongue depressor, or small spoon. The PL Premium can fill gaps up to about ¼", will dry hard, and can be sanded smooth.



The mentor evaluates the side frame construction and tests its strength.



Stand the inside frame on the rear transom to mark where the cross pieces goes. A helper might be needed to hold the frame upright. We follow a similar procedure with the bow framing process. The side frame should be flush with the edge of the stern transom at a width of 47 ½" leaving ¼" on each side of the transom for the sides to overlap.



The bottom corners of the frame and transom as well as the sides are matched and then the outline of the side frame is marked directly on the transom. We had a slight offset because the pine gunwale support piece was about 1/8" wider than the chine log molding and the reinforcing piece between them.



Stern transom view showing reinforcing framework. Note how the pieces have been screwed to the plywood after glue was applied. See Panel #6 for the dimensions and angles.



Edge view of the stern transom reinforcing framework. Note the screw holes where the framing will be glued and screwed to the side frame.



Stern transom view after side frames are attached. Note how the upper transom corners have been rounded off using a plastic cup to mark the radius.

5. **Reinforce the bow transom.** Unlike the *stern* transom which is cut off at 47 ½” so that it fits *inside* the aft edges of the two ¼” sides, the *bow* transom is cut at the full 48” in order to fit *over* the forward edges of the sides. So, in marking where the outside edges of the reinforcing framing fall for the bow framing, allow an extra ¼” on either side of the inside frames for the sides. See Panel 7 for framing dimensions then cut out the 2 cross pieces and three uprights and carefully clamp and glue all pieces into position.



The bow reinforcement structure consists of two angled cross pieces and three uprights. All have angles that must be cut. See the note on Panel 6 concerning cutting these angles.



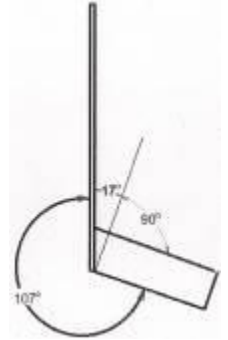
The lower angle of 130° is achieved with a 40° cut along the forward facing edge of the lower cross piece. Note that the bow bottom has also been planed to an angle. The upper cross piece is cut at 27°. The uprights are cut at similar angles.



The bow is glued snugly between the inner frame pieces and is aligned along the bottom. The upper cross piece helps support the forward part of the bow deck.



6. **Add an additional cross piece to help support the bottom.** Cut the 1" x 3" x 45 3/8" bottom cross piece shown in Panel #4 and attach it with glue and screws to the inside frames where indicated in the plans with the back of the cross piece at 3' 9" from station 0 at the stern of the boat. Make certain that the bottom of the board is flush with the bottom of the 1/2" x 3/4" moldings that were used as chine logs along the base of the inside frame.
7. **Add the mast partner support framing.** Cut the 1" x 2" deck and mast support pieces shown in Panel #4 and screw and glue these pieces in place as shown in the plans. All deck support cross pieces are 45 3/8" in length and are installed on edge. Two small pieces of 1" x 2" x 2 1/4" are glued between the forward deck cross pieces to form the square mast partner structure. The square opening for the mast between these support pieces should measure 2 1/4" on each side when the two small pieces are glued in place. Next, two longer pieces of 1" x 2" are aligned with the shorter pieces and glued to the lower edges of the most forward cross piece and then to the bow transom to complete the mast partner support structure. These last two pieces measure approximately 9" on the upper long side and 8 1/2" on the lower short side with an angle of 27° to match the bow. However, these two pieces might need to be cut to fit if you cut a piece to the given dimensions and find it does not fit snugly between the bow and cross piece.
8. **Round the transom corners.** Using a plastic cup, coffee mug, compass, or other means for drawing circles with a diameter of 3"-3 1/2", draw round edges at the top corners *only* of the bow and stern transom, then use a jig saw to round off these four corners. Save the little pieces you cut off to insert at the front inside corners of the decks later.
9. **Clean up.**



*Notes and Tips Below Correspond to the Numbers Above.*

1. Often you will have to use screws instead of clamps to hold a piece in place while the glue sets. By placing a fender washer under the head of the screw, the head of the screw will not harm the face of the wood when it is screwed in tightly. After the glue dries, you have the option of removing the screw, slathering a 1/8" diameter bamboo skewer with glue and driving it into the screw hole, or removing the washers and using the screw itself to help hold the pieces in place. If you choose to leave the screws in the wood, I recommend using a countersink bit to widen out the top of the holes so that the screw heads will easily be set just below the surface of the wood.

With respect to glues, neither Titebond nor PL Premium are recommended for use below the waterline. However, I haven't had problems with either glue in these applications for previous PDRacers. I like PL Premium for applications such as filling gaps, holding the bottom on (along with a number of bronze nails/and or stainless screws). Above the potential waterline, I generally prefer Titebond for its quicker drying time.

2. Spring clamps are often on sale at the big box stores for less than \$2 each. Harbor Freight often offers the 1' bar type clamps for about the same amount.

3. We actually used a 3/4" x 3/4" piece of molding instead of a 1/2" x 3/4" piece of molding for the chine logs along the bottom of the inside frames. However, the thicker piece was a problem to bend to the PDRacer bottom curve, and not all builders will have helpers with the strength to hold that piece in place along the boat's rocker while the next clamp or screw is set in place. Eventually, we settled on the thinner of the two pieces for the chines. I believe I took that 1/4" difference into account when determining the sizes of the reinforcing braces between the sheer and chine at the bow, center, and stern; however, it's a good idea to check those measurements carefully against those provided in Panel 5. For that matter, it's a good idea to check every measurement at least two times.

5. Angles are tricky to discuss. Outside angles are given in Panel 5 where corners are not simply 90°. However, to achieve those outside angles, three boards have to be cut for the stern and bow transoms with certain angles all along the long edges of those boards. I give these angles in the degrees that would be found on a circular saw or table saw for making the correct cut. For example, to get an outside angle of 107° at the stern, the saw is set to cut along the edge of the stern transom cross brace at 17° which is the number of degrees *more than* a saw's normal 90° cut that is required to cut the 107° corner. I show saw cut angles for the stern transom in Panel #6 and for the two cross braces for the bow transom in Panel #7.

7. The middle cross brace might not be necessary for a lighter weight sailor. However, if the skipper and crew will weigh over 250 lb. combined, it's an extra brace that might be needed. If the skipper alone weighs significantly over 220 lb., then adding (2) 1 ½" wide x ¾" thick skids to the bottom will help brace the bottom even more. I like the middle cross brace for its functionality as well. It keeps my \$10 aluminum beach chair that I sometimes take along on longer cruises from sliding all around the boat.

### CAMP SAILBOAT: DAY 3

*Summary of Activities (This is a good day to involve children or grandchildren who might not have been present for earlier activities)*

1. **Purchase paint materials.** Buy a quart of exterior latex primer and a quart of white semi-gloss exterior acrylic latex paint. (Purchase the white paint if you haven't made up your mind yet on a base color for your PDRacer. If you have selected a color, buy that color instead of the white.) Purchase a good 3" paint brush made for applying latex paint if you don't have a brush of that size.
2. **Purchase flotation.** Buy two packages of six ¾" x 13 5/8" x 48" expanded polystyrene panels.
3. **Install the bow corner support pieces.** Identify the upper bow corner support pieces from Panels 1 and 2 of the plans. There should be 4 matching pieces. Glue and clamp the pieces together in pairs to make two pieces ½" thick. Repeat this process for the bow transom support pieces. Also, glue all three of the motor mount pieces together. Do not glue the aft corner deck support pieces, the rudder, or leeboard pieces together at this time.






Put the children to work gluing and clamping



This view shows the bow deck support pieces glued



One option for the aft corner deck support pieces is

<p>pieces together. However, it's a good idea to supervise them closely to make certain the edges of the parts match once the clamps are on. Glued pieces can slide easily while being clamped.</p>	<p>and screwed in place. See Panel 4 for the position of the screws that hold these panels in place while the glue dries. The screws can be inset and remain in place or be removed and replaced with bamboo skewers dipped in glue.</p>	<p>to match the pieces, glue both together, and glue and screw them flush with the aft deck support cross piece and the tops of the inside frames. Once the deck pieces are installed, both pieces will be <i>under</i> the edges of the deck.</p>
		
<p>The second option for installing the aft corner support pieces allows a more finished look. The second piece on each side is not installed until the deck is in place. Once the deck is installed the second aft corner deck support pieces are installed on top of the first pieces but offset so they are <i>flush</i> with the deck instead of under it.</p>	<p>Test fit the major deck pieces. Make certain that the foredeck does not “ride up” on the bow transom when the side pieces of the deck are inserted between the aft deck and the foredeck.</p>	<p>Once the boat is square, the width measurements are correct, the mast partner has been cut out, and all deck pieces fit correctly, the deck pieces can be glued and clamped to the framework.</p>

4. **Install the bow corner reinforcement pieces.** Support the frame of the boat so that each lower transom corner is 6” off the floor. Using a carpenter’s square, check the corners of the inside frame and transoms to make certain that they are square. Test fit the bow corner reinforcement pieces where indicated in Panel #4 so that they will be flush with the tops of the inside frame piece and the mast cross piece. Place glue on the edges and screw the pieces into place.
5. **Install the aft corner reinforcement pieces.** Test fit the aft corner reinforcement pieces as shown in Panel #4. Select one of the two optional methods for fitting these pieces in place from those shown in the photos above. The first option (matching pieces glued together and fit flush with the tops of the inside frame pieces and the aft deck support piece) offers more strength. The second option (wait to glue the second pieces in place until the decks are on) provides a more finished appearance.
6. **Cut out the mast partner in the foredeck.** Place the foredeck in place on the inside frames and note the test fit against the bow transom. Plane and sand the forward edge so that it fits snugly against the bow transom and the edges line up with the edges of the bow transom. There should be a ¼” overlap on each side edge of the foredeck where the sides will fit. Next, from underneath, mark the position of the 2 ¼” x 2 ¼” mast partner location. Remove the foredeck and use a jigsaw to cut out this marked piece. See Panels #3 and #4 of the plans as reminders of the correct mast partner location.

7. **Position the aft deck.** Place the aft deck in place so that it overlaps each side edge of the stern transom by  $\frac{1}{4}$ " and the aft edge is flush with the stern transom.
8. **Check to make certain that the framework of the boat is still square.** Before continuing, measure the distance near the middle of the boat from the outside edge of the starboard inside frame to the outside edge of the port inside frame. This distance should be  $47 \frac{1}{2}$ ". If this measurement is off, temporarily attach a  $1" \times 2"$  cut to the correct length to the undersides of the top framing of the side frames in order to bring the sides into proper position.
9. **Cut the side deck pieces (gunwales).** Mark the side deck plywood pieces so that they will fit snugly between the foredeck and the aft deck and overlap the outside edges of the inside frames by  $\frac{1}{4}$ ".



This view shows the placement of the four deck pieces: the foredeck, the aft deck, and the two side deck pieces that must be cut to fit between the foredeck and aft deck.



The deck pieces are glued into place, and an additional  $1" \times 2" \times 47 \frac{1}{2}"$  piece is fitted on top of the aft deck as shown to provide additional support for the stern transom and the motor mount.



Note the mast support structure under the bow deck. Hard to paint areas have to be primed before the sides are attached. Areas that will be glued, such as the chine logs, are not primed.

10. **Dry fit then glue all the deck pieces in place.** After they fit well, then glue and clamp these pieces in place. Once the deck pieces are glued on and the clamps removed, the bow transom support pieces may be screwed and glued into place. These are the pieces that are installed upright and appear to swoop up from the deck to the top of the bow transom. Their function is not only to support that part of the bow transom that is above the foredeck, but also to keep water from splashing onto the deck from the sides. **Option:** For a more finished look, you can also fit and glue the little corner pieces that were removed when you rounded the transoms, into the forward corners of the deck.
11. **Prime the areas that will be hard to reach.** Many places will be difficult to reach once the sides and bottom are attached. Painting these with primer and at least one coat of paint will be simplified if done now rather than later. Do not paint the bottom areas that will be glued to the bottom or those areas on the inside frames where the sides will be glued and attached.
12. **Fill the side cavities with foam.** Cut 4 of the  $\frac{3}{4}" \times 13 \frac{5}{8}" \times 48"$  expanded polystyrene panels to fit in the cavities on the outside of the inner side frames. The cut out leeboard and rudder pieces can act as a rough guide for the lower curves, but you will have to estimate how much larger the cut panels will have to be to fit in the cavities. A sharp utility knife will usually be all that you need to cut out these panels.

13. **Paint the foam panels.** Prime and paint each of the polystyrene panels so that there is a thin protective layer of latex paint over the panels including the edges. Insert these panels in place after the paint is dry. If they do not fit too tightly, you might want to glue them in place with PL Premium.
14. **Glue the sides in place.** Turn the boat on its side and fit a side over the polystyrene panels and align the side with the decks, bottom of the inner side frame, and the edge of the stern transom. If everything fits to your satisfaction, glue the side in place. Repeat this procedure for the other side.
15. **Reinforce the top of the stern transom.** Add an additional piece of 1" x 2" x 48" on edge along the top of the stern deck to reinforce the top of the stern transom. This piece should also butt up against the motor mount and be of a similar thickness. Round the edges to match the corners of the stern transom. Frank is shown installing this piece in the middle photo of the photos above.
16. **Check the fit of the bottom.** At this point you are far enough along you will want to go ahead and add the bottom. Put a drop cloth or old tarp down then turn the boat bottom up on the tarp and level it. Test fit and square the bottom by aligning one finished end with the stern transom bottom. Drill a hole into the chine log in each corner about 5/8" in from the sides and temporarily attach each corner with a 3/4" #8 screw with a fender washer placed under the head of the screw. Add three additional screws/washers across the stern drilled into the stern cross piece. Bend the plywood panel over the chine logs at the bottom placing a screw/washer in about every 15" aligning the sides as you go. When you have reached the bow, place additional screws in the corners and across the bow cross piece. We also recommend at least three screws be placed across the middle cross piece if you included one. We recommend that the fender washers be used under the screws to avoid leaving screw head indentations in the bottom. Check the spacing between the bottom and the chine logs. Note those areas which might need extra PL Premium as a space filler and mark these points with a pencil on the sides as a reminder. Now loosen all the screws so that the bottom is loose from the chine logs and cross pieces but leave the screws embedded in the bottom panel with the points slightly showing underneath. Set the bottom aside.
17. **Attach the bottom of the boat.** Load your caulk gun with a fresh or almost full tube of PL Premium. Run double lines of PL Premium all along the stern cross piece, the bottom of the stern transom, and the edges of the chine logs near the stern. Run additional thick lines of PL Premium up the chines for about 36". Extend the points of the stern corner screws in the bottom, and use those points to locate the guide holes where these screws were previously attached. When you are certain that the holes have been properly located, screw the bottom panel securely down into the glue at the corners and across the stern cross piece. Continue to fasten down the screws up to the first screws along the chine logs on each side. Lift up on the panel to expose the areas that have not been glued, then run thick lines of PL Premium along the chine logs until about all but the last third of the chine logs have been covered. Next, continue screwing down the bottom until you reach the screw just beyond the middle of the panel. Complete the gluing along the edges of the chine logs and across the bow transom and bow cross piece. Screw the remaining screws into their guide holes. Finish attaching the bottom by driving bronze boat nails through the bottom and into the chine logs about 5/8" in from the edges every two inches along the sides. Add a double row of these nails across both the bow and stern cross pieces and lower transoms, and a single row across the middle cross piece. Try to drive the nails in so that the heads are level with the surface without leaving hammer head marks. Once the nails are in, the screws can either be removed and replaced with bamboo skewers dipped in PL Premium, or the screws can be removed, the washers taken off, the holes countersunk, and the screws screwed back in flush with the bottom.
18. **Clean up and take photos.** Congratulations, your hull is now 3-D. You are eligible for a hull number! But clean up before taking any photos. You can see how scruffy these builders look after a hard day of boatbuilding.



*Notes and Tips Below Correspond to the Numbers Above.*

1. It can be argued that using other paint options such as oil-based paints or garage and floor paints will result in a longer lasting or more beautiful boat. However, our objective in building this boat is to keep costs down, and using a good quality primer and exterior semi-gloss latex enamel house paint will result in long-lasting coverage if allowed to dry for a few days before the boat is test floated. Even if you can't get all the boat primed and painted on this day, it's a good idea to try to get that part of the exterior that will be immersed painted as early as possible in

construction. Save the thinned epoxy coatings, endless sanding, and gloss marine topsides paint for a later build. Semi-gloss latex paint hides some of those minor imperfections that enamel and high gloss latex paints seem to highlight.

2. Here again we might be criticized for using a less than optimal flotation material, but based on our experiences, nearly any foam material will stay dry and perform its function if given a barrier coating of latex paint. The material chosen is relatively inexpensive, easy to cut to shape, and provides about 4 lb. of positive flotation per sq. ft. It can be glued together into blocks that fit nicely under decks and provide some additional support. It is subject to damage from kicks and nicks, but covering it with 1 mm PVC (available in 4' x 8' sheets at Home Depot), using painted/glue-immersed cloth, or gluing on other protective coverings will help to keep the foam undamaged. If you don't cover it, you can live with the dings; but it is important to repaint damaged areas to help keep water out. An occasional spray of bug killer is not a bad idea either.

16. & 17. These instructions are critical for "squaring up" your boat so that the bottom will fit and will not leak. Read these instructions over until you have a firm grasp of the process. Make certain that you have all the materials at hand that you will need before beginning to add the bottom. It will help to have a partner when test fitting and attaching the bottom. Ideally, the sanded B side or good side of the BC plywood should be down with the C side inside the boat. But if you have a piece with few knots or filled imperfections, then the C side can be down, particularly if the panel has a more natural curve with the C side down.

## **CAMP SAILBOAT: DAY 4**

### *Summary of Activities*

1. **Purchase a 5 lb. weight and other materials for the leeboard and rudder.** Try to find a 5 lb. flat barbell weight at a Play it Again Sports or similar sports store. These weights are usually about 5/8" thick and a little over 6" in diameter and can often be purchased for a couple of dollars. Buy (1) 3/8" x 3 1/2" and (1) 3/8" x 3" galvanized or stainless steel bolt, (6) stainless fender washers, and (2) stainless or galvanized wing nuts that will fit on the 3/8" bolts. Purchase a 1/2" x 2' x 4' BC plywood panel. See activities 2 and 3 below for an additional plywood panel purchase you might want to make. One extra panel will be all that is needed for both options in activities 2 and 3.
2. **Glue the leeboard together.** Match up the two cutouts from the aft section of the inside frame shown in Panel 2. Glue and clamp these pieces together securely with the face sides out. **IMPORTANT OPTION:** Purchase a 2' x 4' x 1/4" BC plywood panel. Using one of the existing leeboard pieces as a template, draw an outline similar to the template only add about 1" to its width and about 3/4" to its length. Cut out this new piece and sandwich it between the other two when gluing making certain that the new middle panel is flush at the top and that about 1/4" of the middle panel protrudes from the forward edge and about 3/4" protrudes from the aft edge. This 3/4" thick leeboard will provide you with a wider and much stronger leeboard than the 1/2" leeboard made from only two pieces. Use this option if you expect to sail in rough conditions or on larger bodies of water anytime.
3. **Glue the rudder together.** Match up the two cutouts from the forward section of the inside frame shown in Panel 2. Glue and clamp these pieces together securely making certain that the good sides are facing out. **IMPORTANT OPTION:** If you chose to purchase the extra 1/4" plywood panel mentioned above, follow the same procedure to make a wider and stronger 3/4" thick rudder. Use this option if you expect to sail in rough conditions or on larger bodies of water anytime.
4. **Paint the hull.** While you are waiting for the glue to dry on the leeboard and rudder, you can be working on painting the hull inside and out.



5. **Cut out a handle for the leeboard.** Looking at the original sketch of the “Redneck Duck” design, fashion a handle out of scrap wood that is the same thickness as your leeboard and looks like the handle in the sketch. The “grip” should be about 3” at the base narrowing to 1 ¼” at the top and angled as shown. There should be a 6” or longer back edge of the handle piece that can be screwed and glued to the leeboard. Flatten the top and backside of the leeboard, then use that back corner of the leeboard to draw the cutout on the handle so that the handle makes a tight fit. Fill in any gaps with PL Premium and sand the handle edges so that it is comfortable to grip.
6. **Shape and sand the leeboard.** If you can borrow a belt sander with 60 grit sandpaper, this step can go much, much faster. Otherwise use a sharp block plane and an orbital or other electric sander to shape the leeboard. Viewed from the bottom, the leeboard should be shaped like a modern submarine with a rounded nose, a 6” flat section, and a long taper that is squared off in an aft edge that is about ¼” thick. Plywood will splinter easily when the surfaces are being planed, sometimes even with a sharp-bladed hand plane or electric plane. If you find that is the case, fill the splinter holes with wood filler and use the sander to complete the task.








Try to sand your boards into a modern submarine shape when viewed from the end. However, leave about 1/4" on the trailing edge instead of shaping the aft edge to the knife point shown in this photo.

This photo shows how inserting the extra 1/4" board can provide added width to the leeboard.

The sanded BC plywood leeboard. Note that the part of the leeboard that is usually above the water line does not have to be shaped. In fact, the aft top edge needs to be squared off so that a handle can be added.

7. **Drill the pivot hole in the leeboard and the side of the boat.** Place a piece of scrap wood under the leeboard where you will be drilling your hole. If the scrap is tightly pinned to the back of the board, your pivot hole will almost always be perfect on both sides, if not, the drill can splinter the back side of the hole. The position of this pivot hole in the leeboard is 3" from the forward edge and 6" down from the top of the board as long as the top of the leeboard is aligned with the top of the boat's gunwale. (Refer to the initial sketch of the "Redneck Duck" design.) If you are planning to use a 60 sq. ft. leg o' mutton for your sail as recommended for this initial PDRacer hull, the pivot hole in the boat's side will be located 4' from the stern of the boat and 6" down from the top of the gunwale. Temporarily screw a piece of scrap wood to the inside of the hull as a backing plate where this hole will be drilled just as you did when drilling the initial hole in the leeboard. Use a 3/8" drill for both the hole in the leeboard and the hole in the boat. Check for fit using the 3/8" bolt.
8. **Cut the weight hole in the leeboard.** Place the 5 lb. weight on your leeboard so that it is as low and as far forward as it can be and still be in the 6"-wide flat part of the board. Draw a circle around the edge of the weight and cut the circle out to the inside of your line with a jigsaw. Test fit the weight inside the board and sand off any high places so that the weight will fit snugly in the hole. Place wax paper or a piece of smooth plastic like a thick garbage bag under the leeboard where the hole has been filled. Fill any gaps on the top side between the weight and the leeboard with PL Premium or epoxy mixed with wood flour. Fill the center hole with a wood plug cut from the round scrap

and/or with glue. Once the glue or epoxy has set, sand the surface smooth, turn the board over and repeat the gap-filling process on the other side of the leeboard.

		
<p>Cut a hole in the leeboard for the weight. If you need additional weight in the board because you sail in salt water. Add an extra 2 lb. weight closer to the bottom of the board.</p>	<p>Insert the weight and plug into the leeboard. Make certain that you are working on a flat surface and that you have wax paper or plastic under the weight area.</p>	<p>Spread glue or epoxy over the surface of the weight on both sides. Once sanded, the weight will be difficult to detect until you lift the board.</p>

9. **Shape and sand the rudder.** Repeat the procedure in activity 6 to shape and sand the rudder after the glue has set. Some shaping and cutting of the top corners will have to wait until the next activity is complete.
10. **Cut, shape, and sand the wishbone tiller/rudder case.** See Panel #8 for detailed dimensions and the cutting plan for the sides and other pieces. The sides that make up the tiller and case are best cut from a 2' x 4' x 1/2" BC plywood panel which has to be purchased separately. After the two sides are cut out, match them up and plane and sand the pieces to the same shape. Once this process is complete, cut and shape a piece of 1" x 4" to fit the front of the rudder case. Make certain that this piece is thick enough (usually slightly more than 3/4" in thickness) that a 3/4" thick rudder will not bind inside the case. Be especially careful if you expanded the thickness of the rudder by adding a 1/4" -thick center piece of plywood to the rudder. Cut another smaller piece of 1" x 4" to act as a spreader between the two sides of the tiller handle. I recommend priming and painting the inside parts of the rudder case before gluing the two sides together along the 1" x 4". Later, it will be nearly impossible to get a paint brush into the narrow opening between the two sides of the rudder case. When the paint is dry, glue the sides to the 1" x 4" pieces shown as dotted lines in the plan. The ends of the handle are joined for about 5"- 6" with glue as well. Clamp and/or screw these end pieces together securely. If you are using screws to hold pieces together, use fender washers under the heads to keep them from denting the faces of the rudder case and tiller handle. After the glue has dried, remove the screws and replace them with shortened skewers.that have been dipped in glue. Later you can plane the tips of the skewers off flush with the face sides of the rudder case and tiller. Next, sand the pieces smooth then prime and paint the rest of the finished case and tiller.

11. **Test fit the rudder in the case.** Fit the rudder in the case with the forward top corner of the rudder just clearing the top of the case when the forward edge of the rudder is butted up against the 1" x 4" "butt" board. Mark a pivot hole about 3" to 4" from the back of the case and positioned roughly where shown in Panel #8 of the plans.



Place the rudder flat against the 1" x 4" "butt" board.



Drill a small 1/8" hole in the rudder about where you think the pivot point should be. Place a small nail through the hole and into the case. Test that the rudder will rotate all the way around in the case. If it doesn't, cut more curve into the forward top corner of the rudder or move the pivot hole.



Once the rudder "kicks up" properly, glue on the other side of the rudder case and tiller.



The "butt board" in the photos above was replaced with a slightly thicker piece made from a 3/4" thick piece of plywood that the builder had on hand.



Try to achieve a submarine shape when looking at the board from the bottom end. Use this shape for both the leeboard and rudder.



A bungee cord secured to the aft edge of the rudder by a small padeye and to the case by a 2 1/2" x 1/4" bolt with fender washers on each side keeps the rudder in the down position. The bolt should be located about 3" lower on the case than shown in this photo.

12. **Drill the pivot hole.** Once you have located your rudder's pivot point, place a piece of scrap under the rudder case and with the rudder properly positioned, drill a 3/8" pivot bolt hole.
13. **Prime and paint the leeboard, rudder, and rudder case and tiller.** After the paint is dry, attach the rudder in the rudder case with a 3/8" x 3" stainless or galvanized bolt, fender washers, and a wing nut.
14. **Clean up.**




*Notes and Tips Below Correspond to the Daily Activity Numbers Above*

10. Do not deviate from the cutting plan shown in Panel 8 if you want to have both B or good sides facing outward when your wishbone rudder case is complete.

## **CAMP SAILBOAT: DAY 5**

### *Summary of Activities*

1. **Build a mast step.** Using scrap 1/4" BC plywood about 10" x 10" and a piece of 1" x 4" x 1' board, you can make a mast step. Use the template provided in Panel 9 of the plans to cut out two triangular risers from the 1" x 4" x 1' board. Cut out a piece of 1/4" plywood that is 6" x 10" as a plate. Mount the two risers 2" apart on the plate as shown in the photos below with the gentle curved side down. Screw and glue the risers to the plate. Next, cut out another piece of plywood that measures about 3 3/4" x 10". At the place indicated in Panel 9, cut out a 2" x 2" square hole for the mast. Screw and glue this piece to the top of the risers.

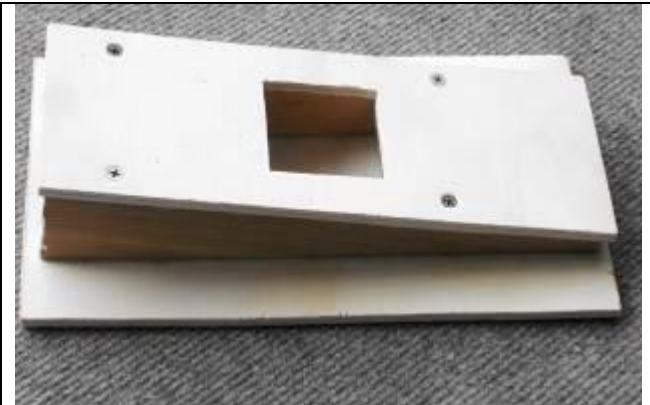
		
<p>Cut out a piece of 1/4" plywood at least 6" x 10" as a base plate. Draw in the position of two "riser" triangles. These must be 2" apart.</p>	<p>Mount the risers on the plate with the slightly curved sides down, drill 2 guide holes in each riser from underneath, glue the bottoms of the risers, and screw them firmly to the base plate.</p>	<p>Cut a 2" square hole in the top piece of plywood before gluing and screwing it to the top. We added a couple of additional 2"-wide strips of plywood inside the step at the top to increase strength.</p>



In this view, you can see the additional strip added below the top piece of plywood.



Top view of the mast step before it is glued and screwed in place on the bottom of the PDRacer.



Side view of the mast step. When mounted on the bottom of the “Redneck Duck” design, the forward rocker of the bottom will cause the top of the mast step to be horizontal.

2. **Position and mount the mast step.** Place the completed mast step beneath the mast hole in the deck. Make certain that the hull is leveled on a flat surface with all corners 6” above the ground. Using a long piece of 1” x 2” to substitute temporarily for a mast. Level this board in the step both fore and aft and from side to side. When you are confident that the step is positioned so that the temporary “mast” is straight in all directions, mark the position of the mast step on the bottom with a pencil. Drill two holes through the low ends of the two risers through the bottom of the boat. Place two skewers through the holes to hold the step in position. Turn the boat over, drill two additional holes near the front of the step into the taller parts of the risers and place at least 1 ¼” #8 screws through the bottom into the step risers. Turn the boat on its side, remove the screws and skewers from the step but insert four screws in the holes so that just the tips are showing for placement purposes. Remove the mast step and smear the step plate with PL Premium. Replace it in the correct position and screw the step into position until the glue sets. The screws can be removed, the holes countersunk for the heads, smeared with glue and reset in place permanently, or glue smeared skewers can be inserted into the holes and the tops clipped off with a set of cutters or pliers with cutters. Later, when the glue has set, the heads of the skewers can be planed and/or sanded flush then painted over.
3. **Decide on a mast option.** The 2” square mast step and 2 ¼” square mast partner at the deck allow several mast options. By adding (3) ¼” plywood 4” x 4” squares with different sized or shaped holes in them over (and under) the partner and at the top of the step, you could use a round aluminum mast, a bamboo mast, or a solid mast made from a 2” x 6” or 8” x 16’ piece of knot free fir or pine. Or, you can leave the partner and step as it is and use a laminated mast like the one we show in the “Redneck Duck” design in Panel 10. The size and length of the mast is, of course, dependent on the sail chosen, as well. Our 15’ 6” laminated mast is designed for a 60 sq. ft. leg o’ mutton, but other sails can be used as well if the Center of Effort is within a range of 30”-36” from the back side of the mast. Consequently, sprits, batwings, gaffs, high aspect lateens, board sails, and other experimental sails could potentially be used on the “Redneck Duck” design. Consult PolySail International for optional mast and sail designs to your liking if you don’t want to use the stock 60 sq. ft. leg o’ mutton sail.
4. **Construct a mast and sprit boom.** Refer to Panel 10 of the plans when constructing these two pieces. The most economical way to make a mast and sprit boom is to purchase a knot free 2” x 6” or 8” x 16’ pine or fir board. It is almost impossible to find knot free lumber in 2” x 4” sizes, so do the sorting in these larger sizes, and occasionally you will find a straight, knot free board suitable for a mast. Cut your mast from one of these pieces such that it measures 2” at the base, 2 ¼” at the partner up to about 8’ then is gradually narrowed to 1” square at the top. The length of the mast should be at minimum of 15’ 8” long. Your board will only measure about 1 5/8” thick along the

narrow side of its length, so it is advisable to add strength to this side by adding a 1/2" x 2 1/4" x 8' piece of BC plywood after you have cut the mast to shape. Ideally, another short section of plywood of 1/4" would be pieced onto the end of the 8' section to widen the mast up to at least 10' from the base. These pieces can be screwed and glued to the mast. Once the glue has set, remove all screws and replace them in the screw holes with glue-dipped bamboo skewers. Plane and sand your mast to shape and round the corners above the partner. You will have a heavy mast when finished, but if cared for, it will give you years of service. Using the remainder of the 16' board, saw out a 1 1/2" x 1 5/8" x 9' 6" board tapered at each end to 1 1/4". Cut the slots in each end indicated on the plans. Sand to shape rounding the corners and edges slightly. If you are fortunate enough to live in the Deep South, you might be able to use pieces of bamboo for the mast and sprit boom. However, I strongly suggest buying your bamboo from a knowledgeable grower. Not all bamboo is strong enough to use for these pieces.

5. **Prime and paint the mast and sprit boom.**
6. **Test fit the mast in the partner and step.** After the paint has dried and with the boat leveled at 6" at each corner, fit the mast to its partner and step. The mast should fit snugly but not be too tight. Wood will swell when it gets wet, and if the fit is too snug, you might not be able to remove the mast when you need to. Check that the mast fits straight when checked fore and aft and from side to side with a level. Shim the mast if necessary.
7. **Construct a leg o' mutton sail.** There is an 8-page "Construction Guide for Making High Performing Polytarp Sails" on the PolySail International Library Page at <http://polysail.com/library.htm> that can be printed out. More instructions for making a 60 sq. ft. leg o' mutton sail are included on the same Library Page in the Sail Database at the bottom of the page. However, until the sail database is updated, the "Construction Guide ....." is the better of the two guides to follow in constructing your sail.
8. **Clean up.**







The prototype *Phantom of the Operetta*—ready for its hardware, sail, lines, and launch!

## CAMP SAILBOAT: DAY 6

### *Summary of Activities*

1. **Add lines and hardware:** You will need the following:

- A **dock line** or **painter** for tying up your boat or anchoring it. Usually this line is fairly long and strong to allow for towing if you need help getting back to shore when the wind dies. I recommend 3/8" diamond braided polyester or polypropylene (which floats).
- A **mainsheet** for controlling the main sail. With the Bolger sail, this line is attached at the clew (back corner) of the sail. The tail end of the line slips through the slot at the aft (back) end of the sprit boom where one or more figure 8 knots are tied in for adjustment purposes. The line then runs down through a pivoting block (pulley) attached to the top of the tiller right above the rudder case. For more leverage or purchase, this line can be run back up through another block attached to the lower part of the sprit boom a couple of feet forward of the clew. I recommend a 3/8" low stretch, braided polyester line that is long enough to allow the sprit sail to swing all the way forward of the mast. (Important: Always tie a figure 8 knot in the end of this line after it is rigged for sailing to prevent the line from going overboard and causing a loss of control of the sail and boat.)
- The **snotter** is used to control the shape of the leg o' mutton sail by causing the sprit boom to move backwards and forward putting more or less tension on the clew or back corner of the sail. A sling or a block (pulley) is attached to the mast and the snotter runs down through the sling or block to a block on the deck and back to a cleat where the line is fastened. The other end of the snotter fits through the slotted forward end of the sprit boom. This 3/16" to 1/4" low stretch braided polyester line is knotted with a figure 8 knot below the slot to keep it in place.
- A **downhaul** is a line attached to the lower front corner of the sail or tack. This short line runs down to a cleat or block and is used to tension the luff or forward edge of the sail.
- (Optional) A **halyard** is used with some sails to raise and lower the sail. The halyard is attached to the top of the sail, run through a sheave, or pulley, at the top of the mast and down to a cleat on the mast, deck, or some other part of the boat directly below the mast. With the leg o' mutton, the sail usually is attached directly to the mast through the hole in the top of the mast with plastic zip ties and rolled around the main mast when not in use. A main halyard is usually not needed with this sail.

Fairleads	Padeyes	Horn and Jam Cleats	
			

Some of the hardware needed on your boat, such as cleats, pad eyes, and blocks, have already been mentioned above. Here are some additional pieces of hardware you might want or need:

- **Pintles and gudgeons** come in sets and are used for attaching and removing the rudder. The pintle fits on the rudder case (see the picture on p ?), while the gudgeon is affixed to the stern transom. Two sets of pintles and gudgeons are needed with one set attached high on the transom and rudder case and the other attached lower down. Usually, the top pintle is a little shorter than the lower pintle to make it easier to lower the pintles into the holes in the gudgeons. Some builders save money by using door hinges with removable pins to attach the rudder to the transom. A **stop** of some kind that will swing over the top of the pintle is needed to prevent the rudder from being pulled upward and loose during sailing.
- A **swivel block** should be mounted on the back part of the tiller or top of the rudder case for the main sheet. Look closely at the picture below on the far right to identify this special block.
- **Cam cleats** allow you to pull the line through the cleat but will lock the line in place when the line is pulled from the opposite direction. The spring-loaded cam cleats are handy to have, but are much more expensive than most standard horn or jam cleats.
- **Oarlocks and sockets** are a better backup than just a paddle if the wind dies or some other catastrophe occurs. Paddling a PDRacer can be very frustrating if there is current or wind to contend with. I highly recommend carrying a a set of oars onboard for emergencies.

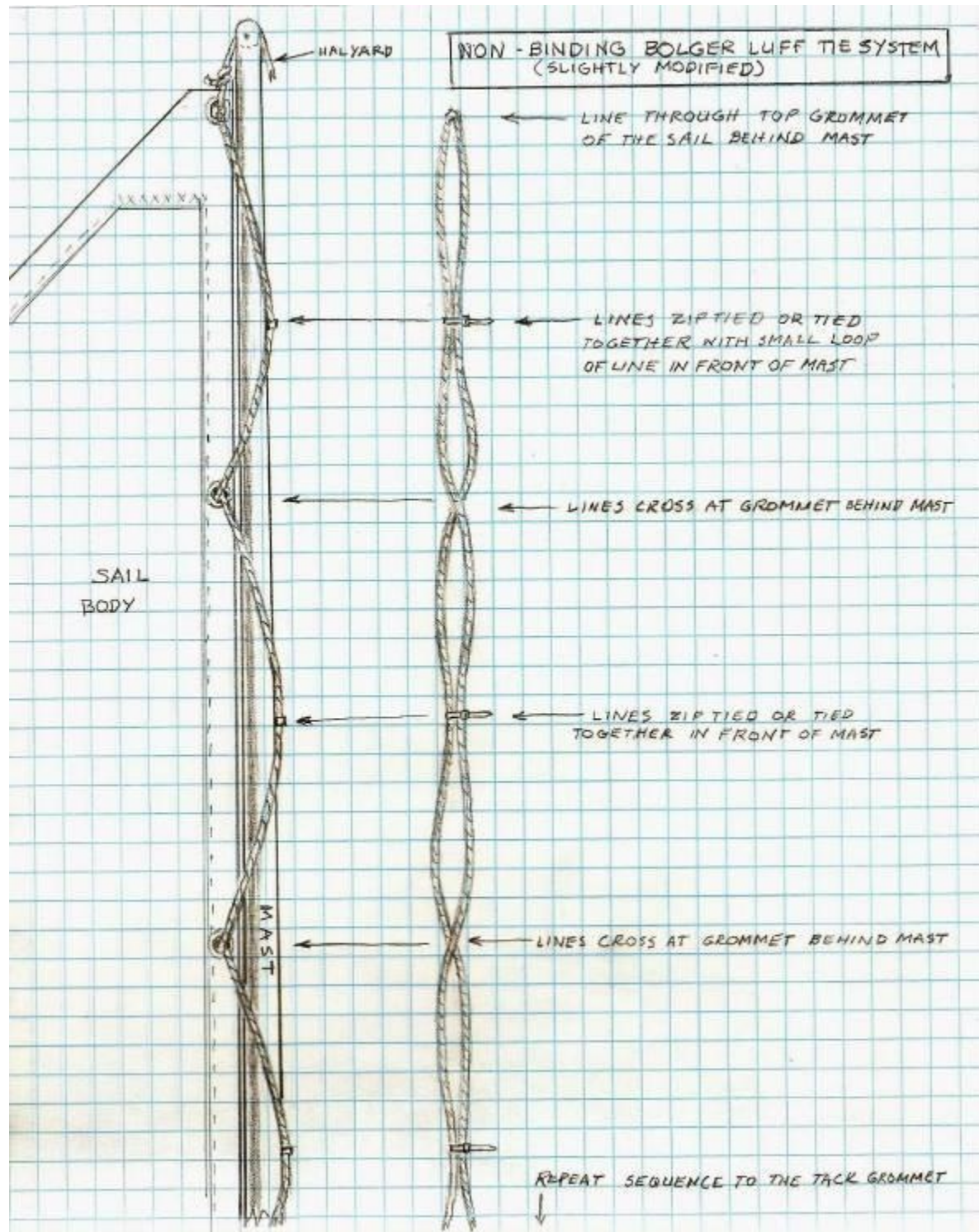
- (Optional) **Lifting handles** are a good idea to have attached to the stern and bow of the boat for lugging the boat around on land. Duckworks has handles that can also double as steps to get back aboard if you fall overboard.

Pintles and Gudgeons	Cam and Clam Cleats		Oarlocks and Sockets		Single & Swivel blocks	
						

**Duckworks Boat Builders' Supply** at <http://www.duckworksbs.com/index.htm> provided me with permission to use pictures of the hardware pictured above and is a good source for hardware. Duckworks is an invaluable resource for boat builders and is operated by two of the nicest and most interesting people anyone could want to meet.

- Attach the rudder case.** Mount the gudgeons on the stern transom directly in line with the mast so they are centered 18" in from the starboard side. (See Panel # 3 for location.) The top gudgeon should be near the top of the transom and the lower one should be mounted about 1" above the intersection of the bottom and the stern transom so that the pintle and the rudder case will not drag in the water. **Caution:** You might have to glue a small piece of 1" x 2" to the inside of the stern transom where the screws will come through the transom. Mount the pintles on the rudder case so that they fit snugly into the gudgeons. Trial fit and mark their location before drilling and screwing in the screws. Use 1" round-headed stainless steel screws to hold the pintles in place. Attach the swivel block for the mainsheet through a padeye anchored to the top of the 1" x 4" "butt board" with 2" long screws. Drill a 1/4" hole through the rudder case near the middle of the "butt" board location. Place a 1/4" x 2 1/2" bolt through the hole with fender washers next to the head of the bolt on one side of the case and next to the nylon stop nut on the opposite side of the case. Loop the hooks of a commercial bungee cord around the bolt and then stretch the cord out so that it encircles the back of the rudder as shown in the right hand photo just before Activity 12 of Day 4. Attach the bungee cord at the back of the rudder with a small padeye to hold the cord in place. Test that the bungee cord has enough tension to hold the rudder down and in place when moving rapidly through the water.
- Attach the leeboard.** Using the holes you previously drilled in the leeboard and side of the boat, attach the leeboard with a 3/8" x 3 1/2" stainless steel bolt, fender washers, a lock washer, and a wing nut. Make certain the wing nut is on the outside of the leeboard for easy access. You might want to mount an old CD between the leeboard and the side to help avoid friction and damage to the side from the pivoting leeboard. Drill a hole in the handle and attach the 3/16" leeboard lifting line as shown in Panel 11.
- Step the mast.** Attach the sail to the mast with zip ties or use the sail lacing method shown in the diagram below these instructions. Raise the mast and attach the lines shown in Panel 11 to the mast and sail. The snotter on the forward edge of the sprit boom should have about 1' of travel between the block on the mast and the forward end of the sprit boom. This extra travel will allow the boom to swing out somewhat when the sail is on the so-called "bad tack" where the boom presses against the body of the sail. On the aft end of the sprit boom, try to position the mainsheet in the slot so that the line is at an angle that bisects the clew angle of the sail. **Important:** The sprit boom itself should actually slant downward slightly rather than upward as shown in Panel 11. This angle helps prevent the forward end of the sprit boom from lifting too much when the snotter is tensioned and perhaps flailing about and causing the snotter to come out of the slot.





## 5. Review the checklist below:

Sailing can be life threatening. Before jumping into an untested sailboat and attempting to sail off, it's a good idea to go over the following checklist and be able to answer each question positively:

- Do you know the basics of sailing?
- Have you set up and tested your boat at home on dry land with the sail up to make certain everything works as expected? (It's good to have your tools nearby.)
- Is the weather right for testing? Light winds about 5-7 mph? Warm water? No threat of storms?
- Are you located on protected waters, such as a small lake, with some people around and possible help nearby?

Does your family or a close friend know where you are?

- Is the water relatively free of powerboat and personal watercraft traffic?
- Are you wearing a personal flotation device (PFD) or life jacket?**
- Do you have a whistle or portable air horn that will float and that you can locate easily if the need arises?
- Are your car keys attached to your PFD or to a belt loop so that they can't be lost overboard? Did you leave your wallet locked and hidden in the car or in a waterproof floating container attached to your boat?
- Does your boat have adequate flotation and can you re-board and recover easily from a capsize? (Test the boat in shallow water by upsetting it. Realize, however, that recovering from a capsize in deep water is much, much more difficult even if your boat takes on little water.)
- Have you tied in figure 8 knots in the main sheet and leeboard/centerboard hoist after feeding the line through the hardware? Is there enough slack in the main sheet to allow the sail to swing all the way forward of the mast?
- With the sail flapping in the wind (luffing), are you able to launch from a pier or fairly deep water by rowing or paddling out to a depth where your rudder and board can be fully down or nearly down to begin with?
- Do you know which direction the wind is blowing? (Face your boat into the wind with your sail flapping.)
- Do you have both your tiller and main sheet in hand?

I highly recommend taking a boating safety course before you go sailing. Go to the following US Coast Guard web site for certification: <http://www.uscgboating.org/safety/courses.htm>



6. **Launch your boat.** If your answers to all these questions above are “yes”, then you should be ready to give your PDRacer a shakedown sail. Take a partner with you who can take photos or video with a camera or I-phone. You will want a record of this event. Once you arrive at the launch area, prepare your boat for launch as mentioned above. Row or paddle into the wind out to water that is deep enough to put both your rudder and tiller down. Move your tiller so that the boat will head off at about 45° from the wind and start “sheeting in” your sail, and your PDRacer should start moving under sail power. As you tighten the main sheet a little more, you should start moving away even faster. From this point on, you are sailing on your own, and chances are high that you will soon learn how to handle your boat without risking disaster.
7. **Store Your Boat, Mast and Sails.** One advantage of the PDRacer is that it can be stored vertically in a small space on its stern. If there is room in the garage, that is where I would store a PDRacer between uses. Otherwise, store it upside down on concrete blocks or some elevated surface. Once a season, give your boat a fresh coat of paint. Changing the colors or using a different theme can sometimes help rekindle your interest in the sport of sailing.

I recommend storing the sail rolled on the mast on some elevated brackets in the garage or some other protected area. Constant exposure to moisture and the sun's ultra violet rays will eventually damage nearly any sail material. If your sail has gotten wet, lay out the sail and wipe it down on both sides before wrapping it around the mast for storage. The PolySail surface cleans up readily if wiped down with a towel occasionally after sailing. Following these recommendations will extend the life of both your boat and sail.

*Notes and Tips Below Correspond to the Daily Activity Numbers Above*

4. Most mast lacing techniques do not work too well with the leg o' mutton sail because the snotter attachment on the mast interferes with lowering the sail completely. This problem might be one more reason that Phil Bolger, who used this sail on many of his small boat designs, often showed the sprit boom slanting downward from the attachment point near the clew to the forward end even though this arrangement does not appear initially to be as efficient in tensioning the clew and flattening the sail as a horizontal or slightly upward slanted sprit boom. At any rate, I prefer using zip ties or simple mast hoops made of 3/16" line to attach this sail to the mast as long as the sail will be stored on the mast and not used in heavy air conditions. If there is a chance of bad conditions, I prefer the luff tie system for lowering the sail quickly. One other last ditch safety measure that works with this sail if you have a long enough mainsheet, is to let the sail go all the way forward of the mast, sit as far to the stern as possible, and gently steer yourself to shore-hopefully, a sandy beach.

### **Welcome to the world of PDRacers!**

*On the Following Pages are PDRacers and Variations That the Author Has Built or Assisted in Building Since 2005*



Dave Gray, Lame Duck #100 (Assumed deceased in Fishers, IN)



John Nystrom, John Duck #133 and Andy Cogill, Never Registered.



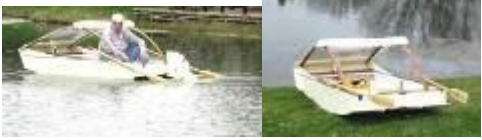
John Nystrom, John Duck # 133



Tom Heiser, Amakusa Duck # 223



Dave Gray, Wild Duck #143 (Lost in I-95 Fire)



Dave Gray, Transformer #199 (Nearly all foam) (Assumed deceased in Fishers, IN)



Daniel Meith, S.S. Infinity, #241



Ryan Gray, Z-PDR Duck, #351, now renamed Zeppelin-PDR and owned by Cecilia Sherwood, Pennsylvania



Ceci Sherwood, Zeppelin-PDR #351










Carol Roffe, PDR kit assembled at the 2010 Wooden Boat Show in Mystic, CT. Never Registered.



Dean Herring, Fowl Follies Redux #548 From PDR kit assembled at the 2010 Wooden Boat Show



Dave Gray, Wedgie—not quite a PDR @3' 6" x 7' 6" Destroyed in the fire on I-95.

			
<p>Roger Jewell, DR Duck (No number) Dominican Republic</p>	<p>Tom Horan, Mailable PDR Kit, New Jersey. Unknown</p>	<p>Ron Kastner, Mailable PDR Kit, Cincinnati, OH. Unknown</p>	<p>Dave Gray, Dangerous Duck #100</p>
			
<p>Narrow PDR to fit customer and her car. Not recorded.</p>	<p>Ryan Gray, Not yet named. #772</p>	<p>Frank Jesko/India Holcomb, Phantom of the Operetta #841</p>	

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*PolySails—Sold on the Web since 1996. Customers in all 50 states and around the globe.*

This page updated on 11/17/13



*DID YOU KNOW?....  
Styrofoam was originally developed as a  
lifeboat material for the US Navy.*

Our first PDRacer *Lame Duck*, Hull # 100, 2005

