

Bevin's Skiff Building Manual

Building Manual Introduction

Capacity

The recommended capacity of Bevin's Skiff is 450 lbs (the capacity with 8" of freeboard) equivalent to 3, 150lb people.

A Word on Safety-

- You're brought into this world with two eyes, two ears, ten fingers and ten toes, make sure you keep them.
- When you are using a tool, keep your hands behind the cutting edge of the blade.
- Use safety glasses, hearing protection and nitrile gloves.
- Most importantly, use common sense.
- It is your responsibility to know how to use your tools. If you don't know how to do something, ask someone who does.

This boat is designed to be easy to build, but nails can fly through the air when you try to hammer them. Hammering is noisy and polyurethane adhesive (e.g. Sikaflex or 3M 4200/5200) is not totally benign. Epoxy can sensitize your skin and cause a rash. So be smart. Also be neat! Clean up squeezed out adhesive before it dries! Life (and painting) will be easier.

A Word About This Manual

The tone of this manual reflects the importance we put on safety.

- When we say, "Don't Be Stupid!", we mean it (and we're talking from personal experience...)
- Read the directions all the way through before you start.
- Familiarize yourself with the pictures, drawings, parts list and tools/ supplies list.
- Read the directions for each step all the way through- before you mark or cut the wood.
- These instructions are written to be used as you build this boat. If something is unclear, think about how the piece will fit in the boat.
- Build the cardstock model first. It's a good introduction to how the boat parts fit together. It's available at both www.alexandriaseaport.org and the *Building To Teach* training website, where there is also access to hands on math training materials. To learn more

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about *Building To Teach*, go to www.buildingtoteach.com.

You might read these instructions all the way through at the beginning and say, "I have no idea what he's talking about. I'll never be able to build this. This isn't simple." Believe us, it is simple. A wonderful boat builder, Pete Culler, used to say, "Experience starts when you begin." So don't be afraid to get started. Remember, it's only a boat. A journey of 1,000 miles starts with one step.

Videos

Videos showing how to build a Bevin's skiff and teach math are available at www.maritimetv.com. Look for "Building To Teach." Even if you're not teaching math, the videos take you through the boat building process.

Building Technical Support

We are available to answer questions about these boats, but remember, we're a small outfit! The best way is via E-Mail. Our address is asoffice@alexandriaseaport.org. You can reach us by phone, during US East Coast work hours, at 703 549 7078.

Kit Builders vs. Plan Builders

Kit builders receive everything they need to build the boat when they buy a kit from the Alexandria Seaport Foundation. Plan builders need to obtain all the materials and make all the boat parts. There are tools, materials list and material suppliers lists at the end of this Manual. Kit builders should also familiarize themselves with all the pieces before they get started. There will be several places in the building process where plan builders will need to fabricate pieces and kit builders won't.

Math Guide v. Building Instructions

Bevin's Skiff was originally designed as a teaching tool. These instructions are also used for a Math Instructors' Guide. Each step is numbered with the Unit number first and the building step number second, i.e. 2.3

The order of the building steps reflects the optimum method of teaching math while building the boat. So, laying out and cutting the boat parts is the last unit. If you're a plan builder, you'll be doing that work first.

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Epoxy and Polyurethane Adhesive

You will be using two types of glue. Epoxy (e.g. MAS) and a polyurethane adhesive (e.g. Sikaflex) . Neither likes to come out of clothes. There are golden rules for both.

Epoxy

- Use in a warm place, 40 degrees F, or over
- Measure your resin and hardener accurately. The ratio must be correct.
- Stir the resin/ hardener mix well for at least a minute before you add wood flour filler. Mix in the filler well for at least a minute.
- Don't mix until you need it and only mix a little more than you think you'll need.
- Read the manufacturer's instructions.
- You can clean up wet epoxy from your hands and tools with ordinary household “white” vinegar or "GOJO" hand cleaner.

Polyurethane

- Use in a warm place, 40 degrees F and over.
- Make sure you remove the metal cap from the rear of the tube, if there is one, and cut the nozzle and punch a hole in the nozzle seal with a 16d nail, or other long pointed object.
- Release the pressure in the calking gun after each use. Otherwise more adhesive will end up on the floor than in the boat.

Let's Get To It!

Glossary

Tool Terms

Bevel Board	A board on which needed angles, or bevels, are marked
Bevel Gauge	A tool with a body and a movable blade that usually can be locked into position. It's used to transfer angles from one object to another, i.e. from the boat to a piece of wood. Also known as a sliding tee bevel
Bucking Iron	A small heavy mass, usually a big hammerhead, used to support a piece as it is being nailed
Carpenter's Scribes	A simple compass. Used for "scribing" – marking a piece of wood to fit it against another surface. Similar to a compass used for drafting and mechanical drawing
Carpenter's Square	A flat 90 degree square with ruler scales on each edge of both sides. The scales can include 1/8ths", 1/16ths", 1/12ths", 1/10 th " and 1/100ths". The long leg , 24" x 2" ,is the body. The shorter leg , 16 x 1 1/2", is the tongue. The front surface is the "face." The opposite surface is the "back." Most squares have tables printed on the face and back that can be used to calculate rafter lengths, board footage, brace lengths and measurements necessary to eight side a timber. Square features vary by manufacturer and model. Also known as a framing square. Stanley 45-011 or Empire e1190 are typical complete squares.
Clamping Pad	Disposable piece of wood used to spread the clamping pressure and protect the finished wood
Combination Square	A square with a 12" sliding ruler, level and usually a scribe for scratching marks. Can be used to create either 90 degree or 45 degree angles. Can also be used as a depth, or marking, gauge.
Hand Saw	You want to use a cross cut saw, rather than a rip saw. There are two styles, Western and Japanese. Both styles work well- when sharp. Japanese saws are

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thinner and cut on the “pull” stroke. They cut faster, but can be bent easier than a Western blade.

Hand Plane

You'll be using either block planes, or bench planes. The major difference that affects this project is that block planes are smaller. Which style you pick depends mainly upon your builders. Small hands like small tools... Make sure the tools are sharp. Sharpening a plane is a great example of practical geometry. The bevel and the back of the iron (blade) are planes that intersect in a straight line, which is the cutting edge.

Finger/

Feeler Gauge

A marking gauge with two parallel fingers that can reach around a protruding piece of wood (or other material.)

Saw Horse

A movable support with a cross piece and legs.

Scribers

A simple compass. Used for “scribing” – marking a piece of wood to fit it against another surface. Similar to a compass used for drafting and mechanical drawing

Toe Nail

To nail through the inside corner of one board in order to fasten it to another

Boat Terms

Aft

Towards the back of the boat

Bow

The front of the boat

Center Frame

The boat component that is placed near the mid-point of the boat which helps define the shape of the boat and allows the boat to be built without building molds.

Chine

1) The corner between the side of a flat, or vee-bottomed, boat and its bottom. 2) The piece of wood that allows the bottom to be nailed to the sides and reinforces this joint.

Deck Beam

A beam that runs across the boat and supports the deck

Fair Line

A curved line without humps, or bumps. It doesn't have to be constant, or regular, just smooth and usually pleasing to the eye.

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Faying Surface	The common surface shared by two pieces of joining wood
Feather edge	A thin , fragile, edge of wood that (in this case) results from cutting the scarph joint
Foredeck	The small, triangular deck, that goes in the front of the boat
Gussets	Plywood corner braces
Keel	The timber that runs down the center of the boat, outside of the bottom
Layout	Draw
Line	Rope (on a boat)
Lofting	Drawing the boat at a large scale, usually full scale, 1:1.
Painter	The line that is fastened to the bow of the boat. It is used for towing the boat, or tying it up to a dock.
Pilot Hole	A hole drilled to allow a nail, or screw, to be driven without splitting the wood.
Marine Grade Plywood	Traditionally made out of veneers with no voids and waterproof glue. British Standard (BS)1088 is the good stuff
Quarter Knee	Serves as a corner brace between the side and transom
Rabbet	A groove cut into a piece of wood into which another piece of wood fits. The joint between the outside of the planking and the backbone of the boat –stem, keel, transom or sternpost
Sheer	The top edge, or line, of the boat. The “sweep” of the upper edge of the boat’s side.
Skeg	The “fin” that protrudes from the keel at the aft end of the boat. Provides directional stability
Station	The location of a cross section in the boat’s drawing- also the location of a building mold. Think of it as the location of a “slice” in a loaf of bread.
Stern	The back of the boat
Stem	The piece that forms the front of the boat
Thwart	Seat

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Transom	The piece that forms the back of the boat
Pick up bevels	Measure angles. Usually using a bevel gauge
Scarf joint	A long, angled joint between two pieces of wood. The length of the joint is described as a ratio in relationship to the thicknesses of the joining pieces. In boat building, 12:1 is typical, 8:1 is used for plywood.
Flare	The angle between the side and bottom of a "Vee", or flat bottomed, boat
Stand Proud	Stick out

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Tools and Supplies Needed

For use with Bevin's Skiff plans and kits. Kits are available from the Alexandria Seaport Foundation, P.O. Box 25036, Alexandria, VA 22313 703-549-7078 www.alexandriaseaport.org

1. Basic Tools Needed

- Two Saw Horses 4' wide
- Claw Hammer
- Bucking Iron: four pound sledge hammer (preferably without the handle) or anything similarly massive (including rounded stones)
- Hand Saw
- Bevel Gauge
- Combination Square
- Pencils
- Chalk Line
- Screw driver that accepts a #2 square drive bit (the bit is included in the kit)
- Phillips head screw driver
- Hand Plane (and a way to keep it sharp)
- At least two 4" "C" Clamps
- Hand Drill with bits to drill pilot holes and countersinks for #8 and #10 screws, as well as 5/64", or 3/32" bits to pilot for nails.

2. Optional but Recommended Tools if you are building from the ASF kit

- Battery Powered Drill (to drive screws and drill holes)
- Nail Set (to help remove bent nails)
- Pliers (to help remove bent nails)
- Router w/trim bit (to trim bottom panel)
- Disk/orbital sander (to clean and prep outside of hull for painting)

3. Additional Tools Needed if you are building from the plans and didn't buy the kit

- Table Saw
- Band Saw or Good Orbital Jig Saw (recommended but not absolutely necessary)
- Hand Held Circular Saw

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- 14'x 1/2"x 1/2"square Batten straight grained spruce or pine

4. Basic Supplies Needed if you are building from the ASF kit

- 4d finish nails
- One straight 2"x 4" x 8'
- Hand Cleaner
- White Vinegar
- Paint Thinner (for clean up of polyurethane adhesive)
- 4mil Plastic (for gluing)
- 1 5/8" Drywall Screws two dozen
- Nitrile gloves
- Paper Towels
- Spreading Sticks, spatulas, or plastic "Bondo Spreaders"

5. Additional Supplies Needed if you are building from the plans and didn't buy the kit

- 3 - 2"x 4"x 8' for making a work table with the saw horses
- 4'x8' sheet of 1/4" plywood for work table top
- 10d common nails for work table assembly
- 6d Finish Nails for batten

MATERIALS LIST

#	DIMENSIONS	MATERIAL	PART
1	2"x 3" x 18"	White Oak	Stem
3	3/8" x 4' x 8'	Mahogany Marine Plywood	Side Panels & Bottom, Foredeck, Gussets
26	Linear Feet 3/4" x 1 1/2"	Spruce or Fir	Frames, Deckbeam
1	1-1/2" x 5 1/2" x 8'	Spruce or Fir	Transom
2	1-1/2" x 3/4" x 12'	Spruce or Fir	Chines
1	1-1/2" x 5 1/2" x 2'	Spruce or Fir	Quarter Knees
2	1-1/2" x 3/4" x 14'	Spruce or Fir	Rails
2	1-1/2" x 5/8" x 10'	Spruce or Fir	Seat Riser
1	3/4" x 3-1/2" x 12'	Spruce, Fir or Eastern White Pine	Keel
1	3/4" x 3-1/2"	Spruce, Fir or Eastern White Pine	Skeg
1	3/4" x 9-1/4" x 12'	Spruce, Fir or Eastern White Pine	Seats
1	1-1/2" X 1-1/2" x 1'	Spruce or Fir	Seat Support
2	1/2"	Angle Plate Oarlock Sockets	
2	1/2"	Oarlocks	

Nails

200	1"	Bronze Ring Nails #12 Gauge
100	1.5"	Bronze Ring Nails #12 Gauge
30	2"	Bronze Ring Nails #10 Gauge

Bronze Wood Screws (We recommend square drive heads)

10	#8 x 1"	
20	#8 x 1.5"	
2	#10x2"	
1	#2	Square Drive Screwdriver Bit

Glue and Adhesive

6	Tubes	SIKAFLEX Polyurethane Adhesive
1	Qt.	MAS Epoxy Kit
1	Small Bag	Wood Flour

Unit 1 Forming The Boat

Tools and Materials Needed For This Unit

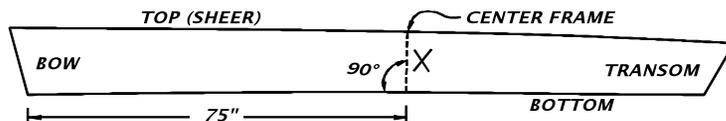
- Saw Horses
- Tape Measure
- Carpenters' Square
- Combination Square
- Polyurethane Adhesive
- Calking Gun
- 1-1/2" Ring Nails- Bronze or Stainless
- Hammer
- Drop cloth- maybe
- Pilot Drill Bit
- Drill/ Driver
- Clamps
- Disposable Gloves
- Safety Glasses
- Hearing Protection

Step 1.1) Setting Up Your Building Area

- You've gotten your boat parts all together- either by purchasing a kit, or making them yourself. (See Unit 5)
- Now, you're going to start assembling your boat.
- Set up your building area...saw horses, tools and safety equipment- disposable gloves, safety glasses, hearing protection...

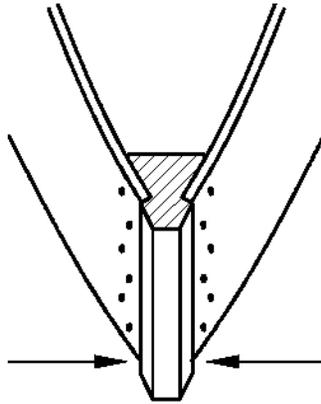
Step 1.2) Marking the Center Frame Location.

- Stack the sides exactly on top of one another and clamp them together.
- Match the pieces with the drawing, making sure you know which end is the bow and which is the transom, or stern. (NOTE: On the plans, the bottom panel and side panel have their ends reversed. The bow of the bottom panel is next to the stern of the side panel.)
- Label the transom (stern), bow, top (sheer) and bottom of each panel.
- Measure back 75" from the bow along the lower edge.
- Make a mark on the edge of both pieces. Use either a carpenter's or combination square.
- Use a carpenter's square and draw a line perpendicular (90 degrees) to the bottom on both sides of both pieces. Use the square so that the short leg (tongue) is facing the bow.
- Carry the lines around all sides and mark an "X" on the aft side of this line- on all four panel sides.
- Mark the frame thickness on the "X" side of all the lines. You can do this by tracing the outline of a frame, or by measuring.



1.3) Nail the Sides to the Stem.

- Apply adhesive into one side of the stem rabbet. You need adhesive on both "faying surfaces."
- Set the side panel into the rabbet. Make sure that the lower forward corner of the side panel is lined up with the lower corner of the rabbet.
- Hold the pieces together and drill a 3/32" pilot hole through the panel, into the stem.
- Nail it with 1-1/2" nails. Use a solid surface, such as the floor, or a saw horse, to back it up.
- Drill six more 3/32" pilot holes through the panel into the stem in a zig zag pattern about 3/4" from the edge of the panel.
- The nails need to go down the center of the stem rabbet's "faying surface"- that's where the adhesive goes....



Step 1.4) Nail the Other Side Panel to the Stem.

- Lay the nailed panel on the floor.
- Get the tallest person in the room to hold up the second side panel so it will fit into the stem rabbet at the correct angle.
- Apply adhesive to the stem rabbet.
- Align the panel in the rabbet- make sure the bottoms of the panels line up with the lower corner of the stem.
- Drill pilot holes as you did on the first side, and nail the panel to the stem as you did before.
- Clean up any squeezed out adhesive. You'll be happier if you work neatly.

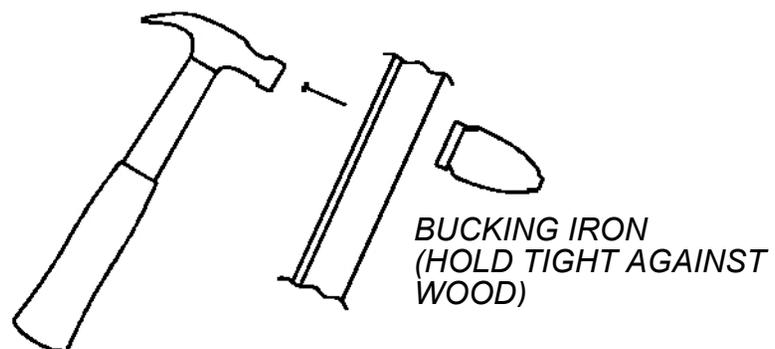
1.5) Putting the Boat on Saw Horses

The boat is now very fragile. Don't bend the sides together- keep them spread apart! If you push them together, you'll pop the nails out of the stem.

- Rotate the boat so that the bottom of the boat is up.
- Set the stem onto one horse
- Set one side, at the transom, onto another horse.
- Someone will need to hold up the other side, so the sides don't pinch and pull the stem loose. (Instead of a person, you can use a third horse.)

How to Use a Bucking Iron

A bucking Iron is a heavy piece of metal (we often use a sledge hammer head) that is used to "back up" two pieces of wood that are being nailed together. The purpose of a bucking Iron is to absorb the energy of your hammer blows. This prevents the piece you are nailing into from bouncing around. Make sure that the bucking iron is held tightly on the work, exactly opposite from where you are hammering.



Step 1.6) Attach the Center Frame to a Side.

- Apply adhesive onto the side of the center frame, or onto the inside of the side panel aft of the frame line. (where you put your "X")
- Take the frame and hold it or clamp it to the side so that the bottom of the frame lines up with the inside corner of the side panel. An easy way to make sure the pieces line up correctly is to lay a straight edge along the edge of the frame.
- Drill four 3/32" pilot holes through the panel and into the frame. Use the frame line on the outside of the panel as your guide. Make sure your pilot holes land in the middle of the frame- 3/8" away from the frame line you drew in Step 1.2
- Nail it with 1-1/2" nails. Make sure you use your bucking iron.

1.7) Attach the Center Frame to the Other Side

- Bring the aft ends of the side panels towards one another. This will bend in the other side so it can be attached to the center frame.
- Nail the center frame to the side panels, the same way you did in the previous step.
- Clean up the adhesive squeeze out!

1.8) Attaching the Transom

- On the inside face of each side panel, draw a line 1 1/2" from the aft edge.
- Align the transom with one side panel. The inside face of the transom should be up against the line you just drew. Note: the inside face of the transom is the larger face.
- Drill pilot holes in the plywood for the nails that will attach the sides to the transom. Space the holes about 2.5" apart. These holes need to be parallel to the transom face- not 90° to the surface of the side panel.
- Apply adhesive between the line you drew at the beginning of this step and the end of the side panel.
- Nail the side to transom using 2" nails.
- Bend the sides together and attach the other side panel to the transom in the same manner. To bend the panels together have one person on the end of each side panel.

Unit 2 Attaching the Bottom

Tools Needed for this Unit

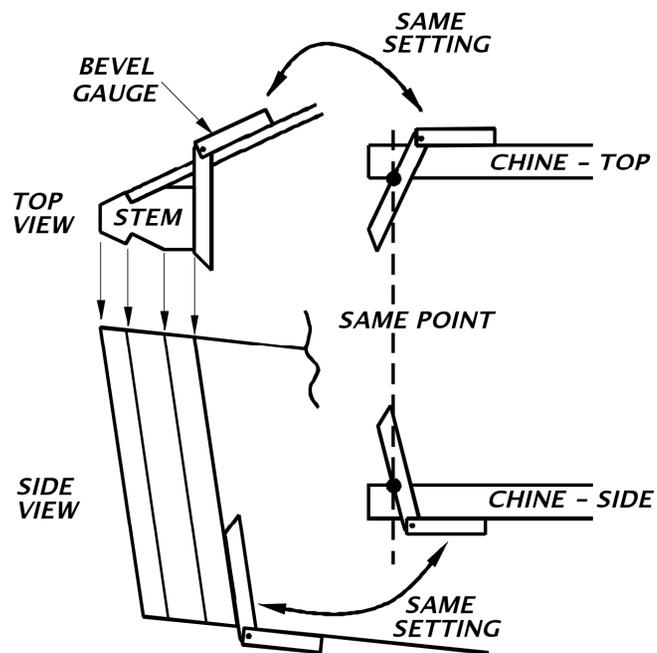
- Combination Square
- Bevel Gauge
- Pencils
- Hammer
- Bucking iron
- Finger Gauge or feeler gauge
- 4' Straightedge
- Calking Gun
- Hand saw
- Hand plane(s)

2.1) Fit the Chines at the Stem

- At this point, the chines are longer than their finished dimensions. In order to fit these pieces into the boat, you need to do two things, use a bevel gauge and subtract. Neither is hard to do.

2.1A) Label the chine faces "inside," "outside," "up," and "down."

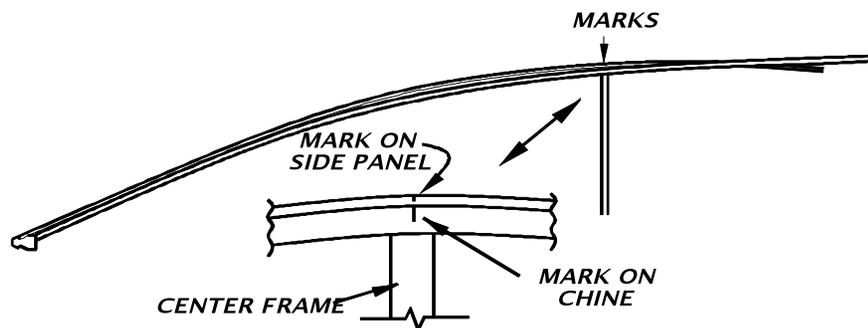
- Using the bevel gauge, measure the horizontal angle between the surface of the side panel and the inside face of the stem. Remember to keep the gauge square (90°) to the surface of the panel.
- Mark the angle at the end of the chine on the chine's top face.



- Note: The boat will be upside down. This drawing is right side up. Study the drawing.
- 2.1 B)** Next, measure the angle between the edge of the panel and the face of the stem.
- Mark it on the side of the chine with the base of its angle starting at the end of the previous angle.
- 2.1 C)** Cut the compound angle.

2.1 D) Butt the chine against the stem and bend the chine into the boat. Check the fit against the stem.

- When the forward half of the chine is tight to the side and in the mid frame notch, make a mark on the chine at the center frame and an opposite mark on the side panel.



- Firmly and carefully remove the chine from the boat. The chine is still too long.

2.2) Fitting the Chines at the Transom (Stern)

- Now, you need to measure the angles (or pick up the bevels) on the chine for the transom.

2.2A) Using the bevel gauge, measure the angle between the surface of the side panel and the transom. Remember to keep the gauge square (90°) to the surface of the panel- not parallel to the ground.

- Mark it near the end of the chine. Remember which edge is up! (Good thing you labeled it when we started fitting the chines.)

2.2 B) Measure the angle between the edge of the panel and the face of the transom.

- Mark it on the chine with the base of its angle starting at the starting point of the angle you drew in the previous step.

2.2 C) Cut the compound angle and check the fit.

- Bend the chine into the boat starting at the stern. Make sure the chine fits tightly against the transom. Fit the chine into the notch at the center frame.
- The excess length will extend past the bow. (Don't worry.) Make sure the chine also fits tightly against the side panel.

2.2D) Find the mark on side panel that you made when you were fitting the forward half of the chine and make a new mark on the chine opposite the panel mark.

- Firmly and carefully remove the chine from the boat.

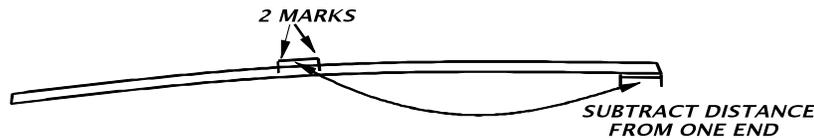
2.2) Fitting the Chines at the Transom (cont.)

2.2 E) Find your two marks on the chine. The distance between them is the distance you need to cut off of one end of the chine. You can measure the distance with a ruler, or just take a stick and make tick marks opposite the marks on the **chine**. (**Subtraction without numbers!**)

- Subtract the distance from one end of the chine and make a mark on the chine.

2.2 F) Using that mark, reconstruct the existing compound angle.

- Make the cut.



2.3) Install the Chines

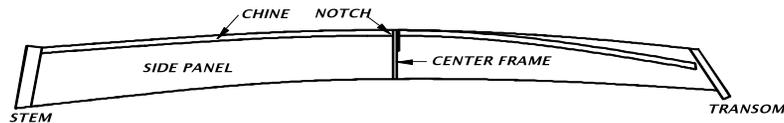
- You will need a combination square, 1" Ring nails, polyurethane adhesive, a hammer, a bucking iron and gloves.
- Using the combination square as a marking gauge, draw a line 1" down from the bottom edge of the panel on the outside face of the panel. This is your nailing line.
- Draw another line 1-1/2" down from the bottom edge of the panel on the inside face of the panel. Apply polyurethane adhesive in this area. Put plenty on. An alternative method is to apply the polyurethane to the chine.
- Take the aft (transom) end of the chine and run it down toward the floor, or ground, and back toward the transom. This will allow you room to fit the front half.
- Put a short stick between the chine and the side panel near the transom. (an offcut of the chine works well.) This minimizes the spread of adhesive until the chine is in its final position.

2.3) Install the chines (cont.)

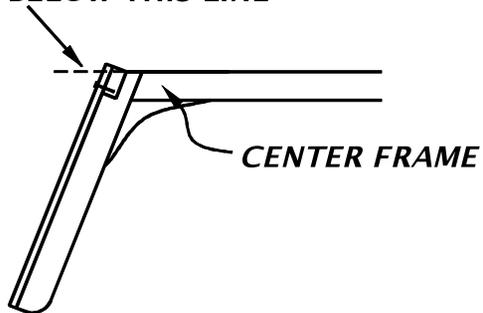
- Fit the chine into the center frame notch. Bend it all the way in. While bending the chine use clamps or hands to prevent it from springing out of the boat.
- After the chine is in, slide it forward until it fits the stem. Then, raise the aft end up until it

fits the transom.

- Align the inside edge of the chine with the inside edge of the transom. The chine will “stand proud” and will be planed to fit the bottom later.
- Starting at the center frame and working your way towards the ends, nail through the plywood side panel into the chine. Remember to use the bucking iron on the inside of the chine opposite the nail!
- Space the nails about four inches apart. Forward of the center frame, give the nails a little zig zag above and below the nailing line. Aft of the center frame, drive the nails just below the nailing line. This will keep the nails below the finished outside edge. You're going to be planing the chines flat to accept the bottom and you don't want to plane the nail heads.



NAIL BELOW THIS LINE



2.4) Planing the Chines and Transom Flat to Accept the Bottom

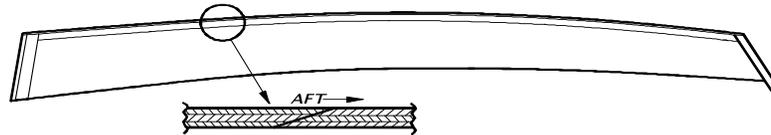
- You're going to need a straight edge at least 4' long (the seat riser works fine for this) and a sharp plane.
- Plane the chines and transom flat so the bottom will bear fully on them.
- Using the straightedge, going across the boat, ensure that both chines are flat from the bow to the stern and make sure the bottom will lie flat on the transom.
- When planing the transom work in from the ends. If you run all the way across, you'll split out the plywood on the far side.
- Trim the end of the stem, if necessary. If you have to plane the bottom of the stem, chamfer its forward and aft edges a little bit. That way you won't splinter out either face.
- Remember, you want as much surface area (faying surface) between the bottom and the edge of the chine. The better the fit, the fewer the leaks.



Checking to make sure the bottom will lie flat on the chines and transom.

2.5) Nailing the Bottom On.

- Test fit the bottom. Lay it so the trailing edge of the scarp is aft (looking from the outside.)

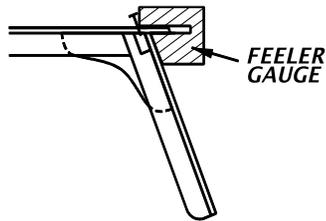


2.5 A) Make sure the bottom fits tightly on the chines, stem, center frame and transom.

- When the bottom fits tight, take it off and apply adhesive to chines (including the edge of the side panel), stem, transom and center frame.
- Put the bottom back on, align it with the back edge of the transom, allowing an even overlap on each side.
- Then, nail the bottom into the chines at both ends of the center frame.

2.5 B) Using the finger gauge, space the nails every 4 inches and locate them at the middle of the chine. You're going to need to pay attention because the flare on the boat changes and the finger gauge is made for the average angle. The pattern for a finger gauge is on the plans. You can make it out of any scrap plywood or stiff cardboard.

- Clean adhesive off the finger gauge as it builds up.



2.5 C) Start nailing from the center.

- If you have two teams of “nailers”, have them work on opposite sides of the boat.
- Nail both sides towards an end then, go back to the middle and nail towards the other end. This way you will avoid nailing any bubbles or humps into the bottom.
- Be sure your nails are parallel to the side panel, not perpendicular to the surface of the bottom panel.
- Nail the bottom to the center frame, stem and transom.

2.5 D) Space the transom nails at 4".

- Clean up any squeeze out with a scrap of wood, plastic scraper or piece of cardboard.

2.5 E) Trim the bottom so it is even with the sides.

- To rough cut the bottom to size, we use either a router with a trim bit, or a jig saw with its blade angled away from the side panel.
- Use a plane to do the final trimming.
- You can also finish the bottom/ side joint with a belt sander, or disk sander. Be careful not to make waves in the wood, or sand through the outer veneer of the plywood sides.

Unit 3 Building The Interior

Introduction

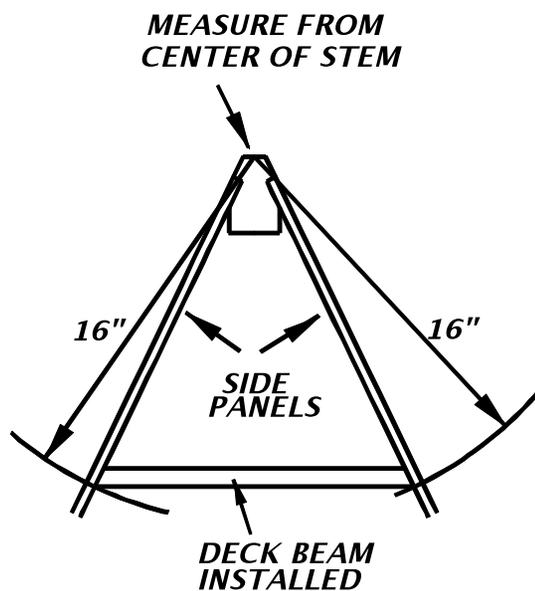
Even though the boat looks “done.” You’re only halfway to the launch. Your builders have been exposed to most of the skills they will need to finish the boat. Now, they have the opportunity to practice those skills and strengthen their weaknesses.

Tools and Materials Needed For This Unit

- Carpenter’s Scribes
- Carpenter’s Square
- Combination Square
- Pencil
- Hammer
- Bucking iron
- Tape measure
- Drill with a Pilot Bit
- Jig Saw, or Band Saw
- Calking Gun
- 1-1/2", 2” Ring nails,
- Polyurethane adhesive
- Deck Beam
- Quarter Knees

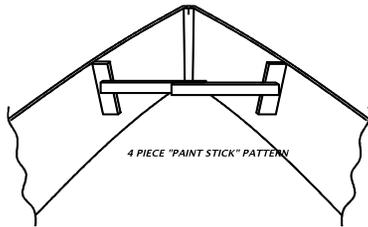
3.1) Putting in the Deck Beam

- With at least one helper, turn the boat right side up.
- Using the center point (apex or vertex) of the stem as the starting point, measure back 16" along the top edge of each side panel. Congratulations you just made another Isosceles triangle! This is the back edge of the deck beam.



3.1.A) Measuring and Cutting Deckbeam

- Plan builders need to measure and cut the deck beam. The easiest way to "pick up" the compound bevels is to use a hot melt glue gun and glue together a pattern out of paint stir sticks (or the like.) This will give you the length of the piece and the angle of the boat's flare. You can then use your bevel gauge to pick up the fore and aft angle. We usually cut this compound angle with a hand saw- just like the chines.



- Place the deck beam in its location, make sure it fits.
- Apply adhesive to its ends.
- Set it even with the top the side panels.
- Drill pilot holes through the sides into the ends of the deck beam and then nail from the outside into the ends of the beam with (2) 1-1/2" ring nails.



3.2) Cutting out the Quarter Knees (Plan Builders Only)

- Transfer the shape of the quarter knees from the plans onto the stock.
- Make sure the grain is running the right way, diagonally, as indicated on the plans.
- Then, cut both straight cuts using a saw that tilts. Pick up the angles from the bevel board on the plans.
- A band saw or a good jig saw is best for this. You can also use a hand saw. Don't use a hand circular saw. It is difficult to clamp the piece and make a safe cut.
- The inside, curved face of the quarter knee is cut with the saw set at 90 degrees.

3.3) Installing the Quarter Knees

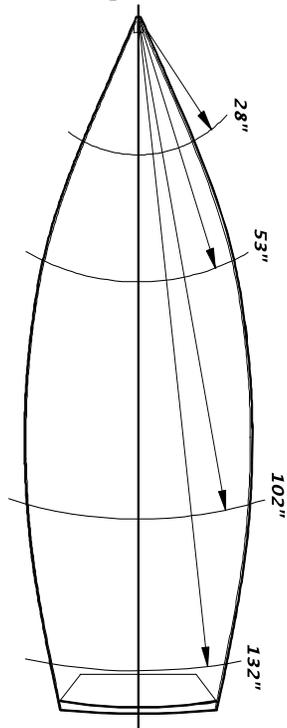
- Depending upon how closely your boat matches the plans, you may need to fine tune the fit of the quarter knees against the transom. We use a pair of carpenter's scribes (a simple compass) and mark the gap on the upper and lower surfaces of the quarter knee. You can then plane, or belt sand, down to those lines.
- Apply adhesive to the angled faces of the knees.
- Set them so the top edge is even with the top edge of the side panel.
- Nail the quarter knees from the outside in. Use 2" nails for the transom face and 1 1/2" nails from the sides.
- Also "toe nail" in two 1 1/2" nails from the inside corner of the knee into the transom. Using a bucking iron helps when driving the nail



Installing a Quarter knee

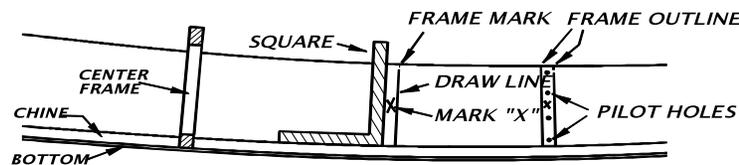
3.4 Locating the frames (Lots of isosceles triangles!)

- You will be installing 4 sets of frames. Starting at the apex of the stem measure straight back to each location along the top edge of each side.
- Make a mark on the top inside of the side panels at each frame location.



3.5) Marking the Frame Lines

- Take a framing, or carpenter's, square and set the short leg (tongue) on the chine pointing towards the middle of the boat.
- Slide the square along the chine until the long blade hits the pencil mark and draw the line.
- Make an "X" on the side closer to the middle of the boat. Do this for both sides of the boat.
- Remember to keep the short leg of the square pointed to the center frame. (This means you have to flip the square when you move from the front of the boat to the back...) When you are done you should have four sets of frame lines.
- The frames are placed so that they cover the "X"s.
- Take the frame and line up its edge with the line. Make sure the frame covers the "X"
- Draw a line on the other edge of the frame.
- Remove the frame and, from the inside of the boat, drill four evenly spaced $3/32$ " pilot holes down the center of the outlined frame.
- These are the pilot holes for your frame nails.



3.6) Installing Frames

- Apply polyurethane adhesive to the edge of a frame. Put the frame over the "X"s so that one edge lines up with your frame line. Clamp it and nail through the plywood panels into the frame with 1-1/2" nails. Remember to use the bucking iron. Clamps may be used to help secure the frames, as well. Clean up the adhesive squeeze out.
- Using your bevel gauge, draw a line across the top of each frame angled inward. The exact angle is not important- something about 45 degrees is fine. You just want to make sure that you don't leave a sharp corner on the top of the frame. They hurt if you land on them when you're using the finished boat...
- Make sure to tighten your gauge so that you mark each frame with the same angle. Cut off the top of each frame following the lines you just marked.

3.7) Installing Seat Risers

- This step takes at least two people.
- The seat risers are 5/8" x 1-1/2" pieces that support the seats. Measure and mark each frame 6-1/2" below the top edge of the sides (sheer). This mark is the top edge of the seat riser.
- Put an "X" below this mark.
- Put a dab of polyurethane adhesive on each "X".
- Using your helper(s), position the seat riser in place.
- Drill 5/64" pilot holes and nail the seat riser to each of the frames using two 1-1/2" nails per frame.



- Start nailing at the center frame and work your way towards the ends. Use the bucking iron to support the side panel from the outside.

Unit 4 Finishing the Outside

Tools Needed for this Unit

- Carpenters Square
- Combination square
- Hammer
- Bucking iron
- Tape measure
- Pencil
- Chalk Line
- Calking Gun
- Clamps
- Hand Saw
- Drill/ Driver

4.1) Installing Rails

This takes at least two people!

- The rail runs from the forward end of the stem to the aft end of the transom on the outside of the side panel. The top edge of the rail is even to the top edge of the side panel.
- Using a combination square, draw a line on the inside of the side panel, 3/4" down from the top edge. This is your nailing line.
- Apply adhesive to the inside of the rail.
- Drill a pilot hole and nail the side panel into the stem from the outside with a 1-1/2" nail.
- From the stem, nail the rail into the frames from the outside using 1-1/2" ring nails. Use a bucking Iron to support the inside of the frames.
- Drill pilot holes and set three 1-1/2" nails into the transom and quarter knee. Try to avoid hitting the other nails already fastening the side to the quarter knee.
- The rail will tend to slide down, so you will need to hold it into position with clamps or hands.
- Along the nailing line on the inside of the panel, drill three evenly spaced holes between each set of frames. Using 1" nails, nail the rail on from the inside. Remember to use the bucking iron. Make sure the polyurethane adhesive is squeezing out of the joint!
- Fasten the other rail in the same way. You can then cut the protruding rail ends flush to the stem and transom. Or, you can cut all your "overhanging" pieces at the end.

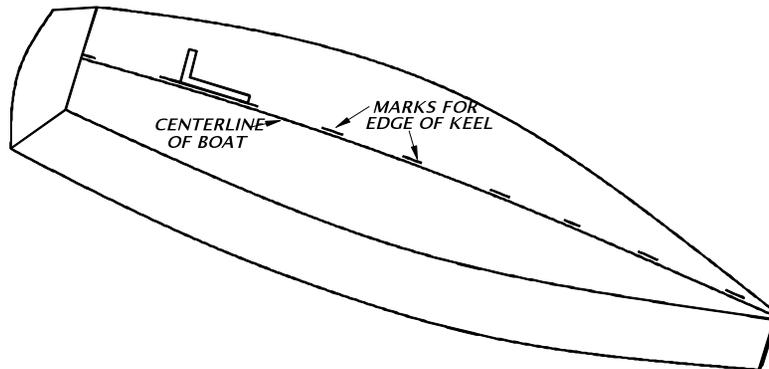
4.2) Installing the foredeck

- Plane the stem, or cut it with a saw, so that the top is flush with the rails.
- Plane the deckbeam and the rails so the foredeck lays evenly over the stem, rails, sides and deckbeam.
- Once it all is planed and the foredeck fits well, apply polyurethane adhesive, line up the aft end of the foredeck with the deckbeam,
- Drill pilot holes and nail the foredeck to the deck beam and rails with 1" nails. Space the nails every 3". Use clamps to hold the deck down.

4.3) Installing Keel and Skeg- Caution! Fractions Ahead.

With helpers, turn the boat upside down.

- Marking on the bottom, find the centers of the transom, mid frame and stem.
- Strike the center line with a chalk line or straight edge.
- Measure the width of the keel and divide it in half.
- Using a framing square, make a couple of marks that "half width" distance away from your newly made center line. These indicate the edge of your keel.

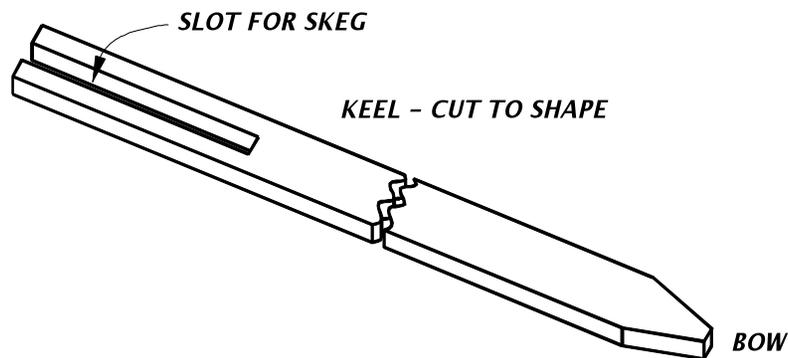


- Take the keel and lay it on the boat. Line it up with your marks. The keel should overhang 1/4" at the transom.

- Trace the outside edges of the keel and the slot for the skeg (Fig23) on the bottom of the boat.
- Remove the keel.
- Within the outline of the keel, from the stem to the start of the skeg slot, mark and drill pilot holes through the bottom about 4" apart in a zig zag pattern.

4.3) Installing Keel and Skeg (cont.)

- Continue drilling holes spaced 4" apart down each finger of the keel alongside the skeg. These "fingers" have been created by the slot in the keel.
- Measure and drill 5 evenly spaced holes in the skeg slot.
- Apply and spread polyurethane adhesive to the bottom between the lines. Spread evenly.
- Place the keel on the bottom.
- Make sure that the trailing edge of your scarp is facing aft! You don't want the feather edge to catch on anything when you drag the boat onto the beach.



- Spread adhesive in the slot of the keel. Insert the skeg.
- Align keel and skeg on the bottom panel. The keel and skeg should overhang the transom by about 1/4". From outside the boat, set two 1-1/2" nails through the keel into the transom.

- From outside the boat, set two 1-1/2" nails through the keel into the center frame and one 1-1/2" nail through the keel into the stem.

At this point, you need to nail from the inside of the boat, through the bottom panel and into the keel. You can use several different techniques to accomplish this task.

One is to set the boat, right side up on a hard floor- with a drop cloth between the boat and the floor. In this way the floor serves as a bucking iron for all except the aftermost nails.

A second technique is to put the boat on its side; have two people hold the boat in position and then have one person nail from the inside, while another person holds the bucking iron on the outside.

The third way is to keep the boat upside down and send somebody underneath (with hearing protection) to nail. Another person stays outside to use the bucking iron.

All these techniques work, although the second technique is usually fastest. Select the technique that fits your situation.

- Regardless of which technique you chose, make sure the skeg is aligned perpendicular to the bottom and pushed forward in its slot in the keel.
- From inside the boat, nail through the bottom panel into the skeg. Put three 1-1/2" nails into the back (large end) of the skeg and two 1" nails through the bottom panel into the front (skinny) end of the skeg.
- Start at the transom (inside the boat) and nail through the bottom panel into the keel with 1" nails using the pilot holes you drilled earlier.
- Use a saw to trim the keel flush at the stem and in line with the transom. Or, you can do all your trimming at the end.

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4.4) Install Seats

Kit builders- put them where they fit!

- But seriously... the forward seat should fit behind the most forward frame. The middle seat, or thwart, fits in front of the center frame. The stern seat fits forward of the after most frame. Look at the plans for locations.
- Plan builders need to mark the seats location on the seat risers. Then, take the measurements for the front and rear edge of each seat. Divide each measurement in half. These half widths are what you need. Next, go to the seat stock (1x10)and lay out your measurements. The key is to draw the centerline of the seat and lay out your half widths from there. That way, your angles at the end of the seats will be correct.

4.5) Seat Posts

This is optional; but we recommend putting a 1-1/2"x 1-1/2" seat post under the middle of the center seat.

- Fit the seat so it lands in the middle of the boat- over the keel. Put a dab of adhesive on the bottom of the post, then nail the seat to the top of the post. You can put supports under the other seat, if you like.

4.6) Installing Oar Lock Sockets

- The center of the oar lock sockets are located 13" behind the back edge of the center seat. Mount the oarlock socket on the inside top edge of the side panel.
- Drill pilot holes for your screws.
- Insert the horizontal screws into the rail while holding the socket in place.
- Drill pilot holes and install the vertical screws.
- When you're using the boat, tie the oarlocks to the seat riser. That way they won't fall into the drink.

4.7) Filling

- Mix up a batch of epoxy filled with wood flour and fill all the holes in the boat. Microballoons can be added to make a smoother mix. Be neat. You can also use "Famowood" wood filler for the holes above the waterline.

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4.8) Sanding

- Some people go crazy sanding and finishing boats. We don't. They're boats- not pianos. If you use the boat, you're going to scratch it up. Paint to protect the boat. You still need to be neat and clean but you don't have to go wild. It's very easy to spend as much time painting a boat as building it. Be careful!

4.9) Paint

- We don't supply paint with our kits. We recommend oil based enamels for the finish coat. You can thin that enamel to make a primer. We recommend epoxy coating the exposed end grain of the plywood bottom. (Straight Epoxy- no filler) You can also epoxy coat the outside of the hull.

4.10) The Painter

- To attach your painter line, we usually drill a 1/2" hole in the side panel on either side of the stem just below the rail and pass a line in one hole, around the back of the stem and out through the other hole. You can then splice an eye or tie a bowline.

4.11) Oars

- Oars are easy and fun to build. *WoodenBoat Magazine* and Mystic Seaport sell oar plans. *WoodenBoat Magazine* has run several articles on how to build oars. You can also buy oars from several suppliers including Shaw and Tenney and American Traders

Notes on Using the Boat

- Lift the boat by the seat risers, not the seats.
- This boat is designed for rowing and sailing- not power.
- If you choose to put flotation under the seats, add a second seat riser above the seats. That will prevent the seat screws from pulling out if the flotation is ever put to use.

Unit 5 Making the Kit

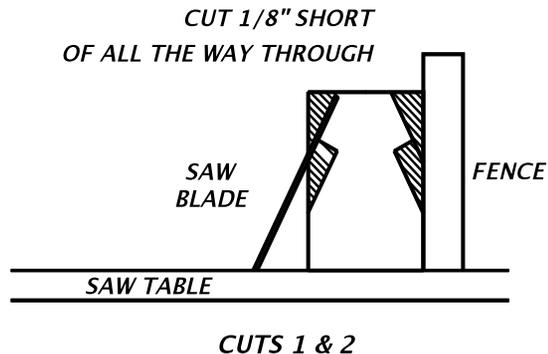
Tools List for this Unit

- Hand Plane
- Jointer
- Batten- ½" x ¾" x 14'
- Bar Clamps
- Tape Measure
- Drill/ Driver
- Pilot/ countersink Bit
- Chalk Line
- 4' Straightedge
- Framing Square
- Hammer
- Table Saw
- Push stick
- Feather board
- Bevel Gauge
- Protractor

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5.1) Cutting the Stem (Plan Builders Only)

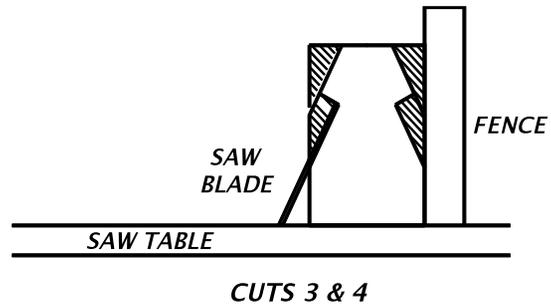
- To start you need a 2" x 3" x 18" piece of appropriate material, "stock". White Oak, Locust, good Yellow Pine or Douglas Fir will do (in that order). The easiest way to cut the rabbets in the stem is to use a table saw.
- **Table saws are dangerous. Use push sticks and finger boards to hold the work safely.** If you don't know what I'm talking about- find somebody who does.
- Trace the stem section from the plans onto the end of the stem stock. To do this you can use, tracing paper, mylar, or you can prick through the drawing with a nail- into the wood below. When you are setting your cuts, you can set your saw blade heights and angles using a straightedge to project from the saw blade to this tracing. Or, you can make a pattern of the stem cross section out of pattern stock and use it to set the saw.
- Set the saw to 26 °.
- Lay the 2" face of the stem on the table and make cut #1.
- Make this cut stop 1/8" short of cutting all the way through the piece.



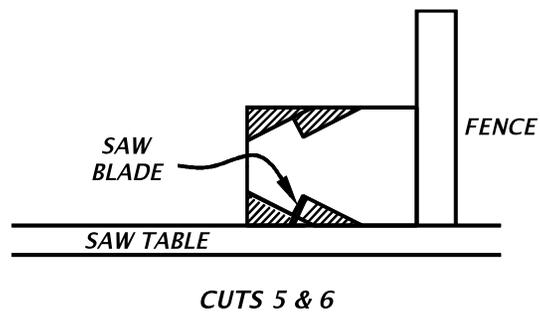
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5.1) Cutting the Stem (Cont.)

- Put the other 3" face against the saw fence and repeat the process for cut #2
- Reset saw depth and fence to make cuts #3 and #4.



- Lay the 3" face of the stem on the table. Reset saw depth and fence to make cuts #5 and #6.



- Now, use a hand saw to finish cuts 1 & 2

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5.2) Building the Transom

- The transom is designed to be cut out of an 8' long 2x6. You can use framing lumber that has good, tight knots.

5.2A) Cut a Pattern for the Transom

- Find some stiff cardboard, or 1/4" plywood, to use as pattern stock.
- Using the dimensions on the drawing, lay out the center line and measure off your heights and half breadths so that you locate the four corners of the transom.
- Connect the dots.
- Then, measure 2" up from the sheer height at the center line.
- Bend (or "spring") a batten from the two corner sheer points through this higher center point and draw the line. You've just drawn the crown of the transom.
- Cut the pattern out.
- This is the pattern of the inside (and larger) face of the transom.

5.2B) Lay Out Transom Pieces

- Your transom is made out of three pieces of 2x6.
- Lay your pattern on top of your 8' 2x6.
- Line up the bottom edge of the pattern with the edge of the 2x6. Mark on the pattern where the top edge of the 2x6 crosses the pattern.
- Mark the edges of the pattern on the 2x6.
- Rotate the pattern 180 degrees. Line up the "2x6 edge marks" you just made on the pattern with the edge of the 2x6. The angles of the first and second piece will complement one another (isn't geometry wonderful.) Make sure you leave 1/8" between pieces for your saw cut.
- Draw the edges of the second piece.
- Repeat the process for the third piece.

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5.2D) Straighten the Edges of the Boards

- Use a plane, jointer or table saw to straighten the edges of the 2x6s- if they need it.
- If you're going to use a power tool, it's assumed you know how to perform this operation.

Follow these steps to joint two pieces with a hand plane:

- Clamp them in a vise side by side.
- Plane until the surfaces are straight. Try to keep your plane at 90 degrees so the edges are square. Don't sweat it if they're a little off.
- When you have the edges straight, unclamp the boards and flip the top board up using the middle seam between the two boards as a hinge.
- Do this for both joints.

5.2E) Glue the Transom Pieces Together

For this, you'll need three bar or pipe clamps at least 18" long.

- Mix up your epoxy of choice. Stir it well for at least one minute.
- Add in your wood flour, or high-density filler of choice, until it is the consistency of thick molasses. Stir it for at least a minute.
- Spread the glue on both sides of each joint.
- Clamp it up. It will be messy.
- Scrape off the excess epoxy. You should be getting squeeze out all along both joints. If not, undo it, add more epoxy, and re-clamp.
- We also clamp a straight edge along the surface of the transom. This avoids a cupped transom. Make sure you put wax paper or plastic in between the work and the straight edge. Otherwise, it will stick together.

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5.2F) Cut the Bevels on the Transom

- Lay the pattern on top of the transom.
- Draw the outline.
- Pick up the angles for the transom sides from the bevel board on the drawing using a bevel gauge.
- Using either a hand saw, band saw or hand circular saw (preferred), cut the bevels.
- Remember, your pattern is the wide face of the transom. These are **under** bevels. Also, make sure you clamp your work down when you cut.
- Pick up the bevel for the bottom and make the cut.
- **Remember to cut the crown of the transom. (no bevel)**

5.3) Rip Stock for Chines, Rails, Frames and Seat Risers (Plan Builders Only)

- Using a table saw rip out enough stock for your chines, rails, frames and seat risers. See the material list at the end of these instructions. All but the frames need to be straight grained stock. It all can be gotten out of "2 by" lumber. Either you need to pick over the local lumber yards supply of framing lumber or spend the money and buy "C and Better" grade lumber. If your going to pick, think about buying 2x12s and ripping the clear straight wood off the edges for rails etc... and using the middle, knottier sections, for your transom.

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5.4) Scarphing Your Plywood Panels

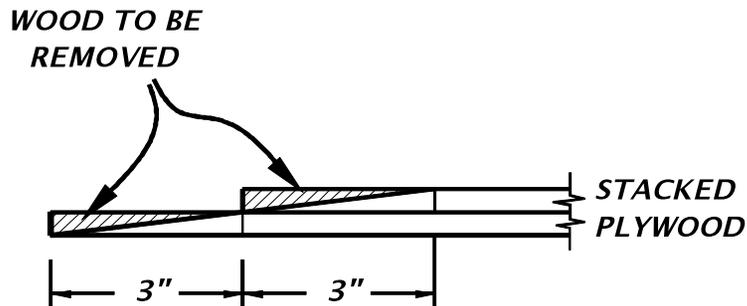
- You've spent the money and gotten the good, marine grade, BS1088, plywood. (Right?!)
- Now is the time to measure twice and cut once. You will be joining your plywood pieces together using a scarph joint- which is two long angles glued together. The keys to successful glue up are: proper layout, flat surfaces, plenty of glue, proper alignment and good clamping pressure.

5.4A) Cut the Short Pieces

- Take a piece of plywood and cross cut it at 53-5/8". This will give you two pieces: one 48" x 53 5/8" - the other 48" x 42 3/8".
- On both pieces, draw a line 3" in from the uncut, "factory edge" of the 48" face.
- Draw the same 3" lines in from the edges on one end of both remaining full sheets.

5.4B) Set Up to Cut the Joints

- Lay a full sheet of plywood on a well supported work surface. Saw horses with 2x4s running underneath and a piece of 1/4" plywood on top will do.
- Line up the end of the full sheet of marine plywood with the end of the supporting plywood. Make sure your 3" line is facing up.
- Nail the marine plywood down with 4d finish nails. Sink the nail heads.
- Lay one of the short pieces of plywood cut in the previous step on top of the long piece.
- Line up the factory edge with the full sheet's 3" line. Nail the short piece down with 4d finish nails.
- Don't put any nails inside your 3" lines!



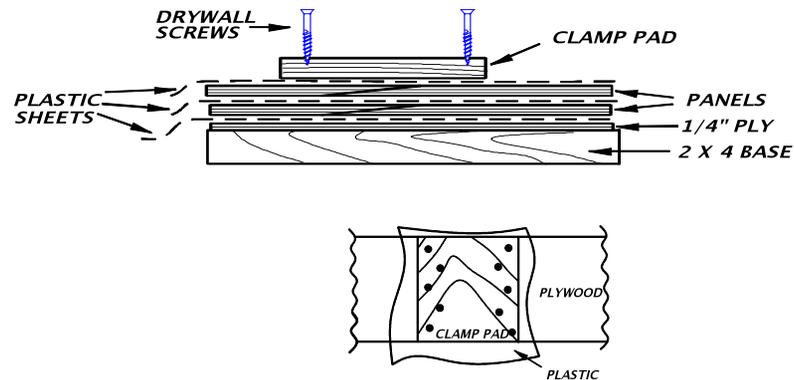
5.5) Glue the Panels Together

- Use your saw horses, 2x4s, and 1/4" plywood with a sheet of plastic over it as a gluing table.
- You are going to be stacking the two complete panels with wet epoxy in the scarphs on top of one another- while the glue is still wet. In order to prevent the layers of plywood from sticking together, you will need a strip of plastic to put in between the layers, underneath the glue joint.
- Make sure you have 4d finish nails, or drywall screws, to hold your pieces in place.
- You will be applying clamping pressure with drywall screws run through a scrap of 3/8" or 1/2" plywood long enough to cover the entire scarph joint. Make sure that you have 20 or so 1 5/8" drywall screws with a screwdriver (a power drill/ driver really helps.)
- Mix your epoxy then add wood flour so that the glue is the consistency of thin molasses.
- Coat both sides of each joint.
- Tack them down on the table with 4d finish nails, so your center lines make one straight line. Use a string to check. The side edges of the finished panel should also be straight.

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5.5) Glue the Panels Together (cont)

- Lay down a strip of plastic on top wide enough that no epoxy squeeze-out can join the stacked panels.
- Repeat the gluing process with your second set of panels. Make sure the joints for each set of panels line up on top of one another.
- Lay down another strip of plastic, over the joint, on top of the last panel.
- Take your clamping pad of 3/8" plywood and lay it over the joint. on top of the plastic.
- Screw down through the clamping pad, the two layers of marine ply and the wooden surface beneath it. Starting from one end, put one screw every 3 inches and zig zag them. You should get lots of squeezed out epoxy. You want a saturated joint (excess epoxy) rather than a "starved" joint.
- Allow 24 hours for the epoxy to harden. Longer is better. If you can make a dent in the epoxy with your fingernail, it's not hard enough to proceed. Let the epoxy set for another day, or so.



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5.6) Laying Out the Side Panel Shapes

This is nothing more than a big version of "connect the dots." On the plans are the measurements for the expanded shapes of the sides and **half** the bottom. (You will be making a whole bottom.) You're going to be making full size copies of these drawings on your plywood panels.

5.6A) Laying Out the First Side Panel

- You will need a tape measure, pencil, 6d finish nails, hammer and 4' straight edge or chalk line and a 14' batten. The batten should be a straight grained piece of pine, spruce or Douglas Fir 1/2" x 1/2".
- First, you need to undo your glue up of the plywood panels.
- **The sides come out of the longer panel.**
- Take the longer panel and lay it either on the ground or on your saw horses and 2x4s. Again, you'll cut your sides from this panel.
- Take your chalk line (or string), pull it tight and see if the long edge of the panel is straight. If it is, use it as your baseline.
- If its not straight, chalk a straight-line about 1" up from the edge and that will be your baseline.
- You will also need a line parallel to the baseline on the other edge of the plywood. You can use the edge of the plywood, if it is straight. If not, snap another chalk line, or draw another line, one inch in from the edge.
- The next thing you need to do is layout a grid of lines 1' apart.

5.6A) Laying Out the First Side Panel (Cont.)

- Hook your tape on the end of the panel and make marks on the baseline at 1 through 12 feet. Do the same along the other edge.
- Connect the dots and you have your grid.
- Label the edge of the plywood, on which you hooked your tape measure, "0" and the next line "1" etc...
- These are now your "stations."
- On the plans, each station has two measurements. They both are taken from the baseline. One measurement is for the bottom edge of the side panel and the other for the sheer. (top edge of the side panel).
- Mark all these points. Set a finish nail (6d works well) vertically in each point.
- Spring the batten through all the points. Set a few finish nails on the other side of the batten to hold it in place. Put these nails on the station lines- opposite the original set of nails. There shouldn't be any lumps or bumps. If there are, shift the batten as little as possible to "fair" the curve. It's usually better to make a few adjustments, at several stations, rather than one big adjustment.
- Draw the bottom line.
- Create the other needed points and draw the remaining lines until your plywood looks like the plans.
- The measurements for locating the ends of the panels, the stem and transom, are also on the plans.
- Cut the side out with either a jig saw or a hand held circular saw. Stay 1/16 to the outside of the line.

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5.6B) Laying Out and Cutting the Second Side Panel

- Use the cut out side piece as a pattern and mark your second side on the remaining stock.
- Cut it out. Then, clamp or nail both pieces together (grid lines visible) and plane both down to your original lines. They should be identical. Remember to hold your plane 90 degrees to the surface of the panel.

5.7) Laying out and Cutting the Bottom Panel

This panel is drawn oversized. When you install it, you're going to lay the panel on the boat and then trim it to its final size. Therefore, if you want to skip this step you can. We have included it because the smaller "oversize bottom" is easier to handle than the larger uncut panel.

- Draw the same grid on this panel as you did with the side panels.
- Then, draw a centerline down the length of the panel.
- The measurements on the plan are taken from the centerline. Only half of the bottom is drawn on the plans. The other half is a mirror image.
- Lay out both sides.
- Remember this is a flat bottomed boat. You cut the perimeter of the bottom panel. DO NOT cut the centerline.

5.8) Gluing Rails, Chines, Keel and Seat Risers (Kit Builders Only)

Because of shipping rules we had to cut your long pieces. (Sob!) Now you have to glue them together. Fortunately, we've cut the scarp joints for you. The key is to get them aligned- not crooked. Here's one way to glue them together.

- Get a piece of 2x4 that's flat and straight and at least 8' long.
- Nail it to a couple of saw horses. This is your gluing table.
- Lay a strip of plastic over the 2x4 where your glue joints will be.
- We'll start with the rails.
- Take your long section of rail, lay it so the bevel is up, the edge is flush with the edge of the 2x4 and the joint will be at about the center of the 8' length of 2x4.
- Nail it with two 4d finish nails.
- Get its partner and check the fit before you glue.

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- Mix epoxy, and thicken with wood flour, to a heavy molasses consistency.
- Spread glue on both sides of the joint.
- Put the mate into place.
- Nail it with two 4d finish nails- so it won't wiggle.
- Put a piece of plastic over the glued area.
- Stack the second rail right on top and repeat the steps. Then clamp the joints together (c- clamp, bar clamp, etc). Make sure you have squeeze-out.
- Clamp and glue the chines the same way on the other edge of the 2x4.
- Clamp and glue your seat risers and keel the same way as the chines.

5.9) Make a Pattern for your Center Frame (Plan Builders Only)

- Using the dimensions in the plans, lay out a full width pattern for the center frame. You can make this out of cardboard, or thin plywood. You will use this as a layout table to build your center frame.
- This process is the same as for laying out the transom pattern.
- Only the half breadth dimensions are given on the plan. So, make sure you mark off this distance from the centerline of the pattern.

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5.10) Assembling the Center Frame. (Plan Builders Only)

- Take the bottom and two sides of the frame. Run the frame sides past the bottom, apply adhesive and nail the gusset on with 1" nails.
- Use the gusset to give you the correct frame angle or better yet, use the center frame pattern you just made.
- Make sure you cut 3/4" by 1-1/2" notches on the bottom corners to accept the chine log.
- Nail, or screw, a spreader at the top of the frame to hold the top dimension
- Don't glue the spreader to the frame; you will remove it later. And make sure there is enough room for the sides to fit below the spreader.

