Construction manual
for a
Model Pond Boat
of the
Pirate
(r–11)

Paul Marlow
2011
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PART 1

OVERVIEW

Overview & Plans

Tools

Lumber & Materials
OVERVIEW

This manual is the result of building, since 1999, ten generations of PIRATE pond boats with Alternative School #1 in Seattle. The instructors and the students learned a great deal about building pond boats over the years.

We have a motto about building a PIRATE, “There is nothing you can do to a boat that cannot be fixed”. This is a reassurance for the students who are taking on a most complex project and for adults that may feel overwhelmed by the complexity of the project. A further reassurance for adults, if 6th, 7th and 8th graders can build these boats you can too.

A word about craftsmanship: Do not obsess about it. Remember you are building a pond boat to have fun with, not an exhibit for the Smithsonian. Do the best you can and learn from your outcomes. Remember there is, “Nothing a little bondo won’t fix”.

PLANS

A set of six plans is provided for building the PIRATE.

Lines Plan: Original lines plan.
Pattern Plans: templates for the hull.
Sail plan: For cutting the sails.
Detail Plan: Mast, Jigs and deck layout plan
Newspaper articles: Historical background
POND BOATS: Regatta & Free sailing
THE PIRATE
TOOLS : POWER, HAND & ABRASIVES

The one power tool that is mandatory for building the PIRATE is a bandsaw, with a 1/2 inch blade. Very light weight bandsaws will be unable to cut the lifts. A sabre saw will not substitute for a band saw, the cuts will be wavy and the edges will not be square, giving an unsymmetrical hull.

A variable speed portable drill is necessary for drilling holes and driving screws.

NOTE: THE USE OF POWER SANDERS

Power sanders are not used to shape the hull. The hull shape is complex with rapid changes of curvature. Power sanders with soft pads are too big to use effectively on the hull. The user has no sense of what shape is being created. Experience has shown that using a power sander will create flat spots or gouge almost instantly. This is especially true with youth, who seem to lack the attention span and coordination to use power sanders effectively.

HAND TOOLS : SEE APPENDIX 1

The entire boat is constructed using hand tools. Experience has shown that this is the easiest, quickest and most pleasant way to construct a PIRATE.

The types and number of tools can be as extensive as one wishes, the tool list here is a basic one. Experience has shown that, after many boats, a few specialized tools come in handy, but are not necessary.
TOOLS:  
HAND

HAND TOOLS

CHISELS

1/2 inch chisel
3/4 inch chisel
3/4 inch gouge

Mallet (optional)

RASPS

12” Rasp — Half round — Taper, rough
10” rasp — half round — Taper, medium

Horse Shoe rasp

PLANES

Trim plane — Stanley
Low angle Block Plane

FILES

Round 3/16 — Tapered

DRILL BITS

1/2
1/4
3/16 long shank
1/16
TOOLS (Continued)

6” tri-square
Dividers
Fine tooth saw
Hammer
Squeeze clamps
Hand Drill — (Optional)

Basic hand tools for construction
MATERIALS:  SEE: APPENDIX 2

LUMBER:

The hull is made of lifts of 3/4 inch Sugar Pine boards. One boat takes 18 lineal feet of 3/4 inch by 8 inch boards.

Buy the widest boards possible. The ideal is a board 16 inches in width that can be cut down the middle and bookmatched.

Buy pattern grade boards that are knotless. Experience has proven that no matter how hard one tries, a knot inevitably ends up in the hull. Knots complicate the lay out process and end up using more material than if the more expensive pattern grade is purchased.

Masts and booms are made of clear, straight grained red cedar. A 5 foot section of a 1/2 x 4 inch board will provide multiple masts and booms.

The deck is made of 1/8 inch mahogany doorskin.

Template stock is 1/4 inch hardboard. 1/8 inch is too flimsy from our experience.

ALTERNATIVE LUMBER:

If Sugar Pine is not readily available, use clear stock softwood. Various other pines and spruces have been used successfully, when Sugar Pine was not available.

The most important factor in choosing a wood is its carveability. Due to the shape of the PIRATE, the tools will be going across the grain at the ends of the boat. A hard, brittle wood will be harder to cut and subject to tear-out.

Red Cedar has been used successfully. Basswood may be an alternative. Radiata Pine and Poplar may also be an alternatives, but they may be unstable when wet.
MATERIALS: ABRASIVES & FASTNERS

ABRASIVES
Adhesive backed sheets of sandpaper (3M Imperial - Stikit) are best. They are used for making sanding boards and hand sanding. Grits of 36 and 80 are used. 80 is the predominate grit. Higher grits of 150 and 220 are used for finish sanding.

FASTENERS:
3D FINISH: Finish nails are used for various purposes. A quarter pound of nails will be adequate for one hull.

CARRIAGE BOLTS: 8” and 2-1/2 “ are used to fasten the hull to the building and shaping jigs. Wing nuts and fender washers are necessary.

KEEL BOLTS: 2 each of all items
- 6” x 10-24 machine screws
- 1” Stainless Steel fender washers
- 10-24 Stainless Steel nuts

DRYWALL SCREWS: A Dozen or more can be used to fasten the hull to the building board, temporarily fasten the keel to the hull and to put jigs together. 1-1/2 inch screws work well.
MATERIALS: GLUE & JIGS

GLUE:

Two types of glue are used in construction,

Polyurethane is best for gluing the hull lifts together and for the deck. It sets in four hours and sands well. Use Elmer’s Ultimate glue or Gorilla Glue.

G-5, a five minute epoxy, by West Systems is used for gluing the lift halves together. Urethane glue can be substituted, but with a greater drying time (4 Hours).

Spray glue is used for attaching the paper patterns to the hardboard template blanks.

JIGS:

The plans include templates for making jigs. These have been developed to simplify and speed up the process of building. Jigs are used for alignment, shaping, cutting and gluing. It is possible to build the PIRATE without them, as the first boats were; it just takes more time.

NOTE: The Detail Plan Sheet can be saved by Xerox copying the jig plans and gluing them to the wood being cut, instead of cutting up the plan sheet.

APPENDIX 2: BILL OF MATERIALS

A full BILL OF MATERIALS is provided in Appendix 2 at the end of this manual.
PART 2

TEMPLATES

Layout

Construction
TEMPLATES:  CONSTRUCTION

Cut out each paper pattern from the sheet of templates.

Use a straight edge and razor blade for the center line of pattern. (the long straight edge)

Leave excess paper on the outer edge. It will be cut off with the bandsaw.

Spray adhesive on the template blank. Let it cure for several minutes.

Align centerline of pattern paper on one edge of the hardboard template.

Tack one end of the pattern down and tension it from the other end.

Press centerline edge up to edge on the template blank.

Use your fingers to press the pattern down on the template in a radial pattern to avoid wrinkles.

Bandsaw technique:

Adjust the saw guide to about 1/2” above the stock.

Cut to the outer edge of the line.

Feed the stock as quickly as the saw will accept it, without binding.

A smooth, steady feed into the blade makes for a smooth line.

Make corrections in the line ahead of the cut, cut your way out.
TEMPLATE CONSTRUCTION: CUTTING

Correcting at the cut makes for a jagged edge.
Cutting a tight radius will pinch the blade, make multiple cuts.

TEMPLATES: FINISHING

Sand the cut edge using 80 grit sandpaper on a sanding block.
Use long strokes to even out the surface.
Be careful not to go beyond the printed line, over sanding will result in a template that is too narrow.

Drill out the index holes for marking the inner edge of the template on templates for the following lifts:

SHEER
1A
2A

Use a 1/16 inch drill
The other lifts are cut out and left solid. They only require 3 holes for locating and holding the templates in place.
The SHEER TEMPLATE has five important points that must be transferred to the Sheer Lift that will be cut out. They are in order: Station 8, Station 20, Station 26, Apex Point and Transom-Sheer Corners. The use of these points will speed up the construction of the hull.

These points are laid out on the paper pattern. Cut a notch in the outer edge of the template for each of these points. The notch allows a pencil mark to be made and extended inside the cut line.

After cutting the marks are extended around the lift and labeled.

**Station 8**, establishes the end point for the bow sheer piece that will be added later and is a lay out point for the Sheer Line.

**Station 20**, is the reference index point for all the lifts.

**Station 26**, is the low point for the Sheer. It will be used to lay out the Sheer Line.

The **Apex Point** is the intersection of bottom of the transom with the hull.

The **Transom - Sheer Line** establishes the corner points for the top of the transom and is the end of the Sheer Line.

**NOTE:** The **Apex Point** is also laid out and marked on the template for Lift 2A. It is vital that this point is marked
PART 3

LIFTS

LAYOUT
CUTTING
FABRICATION
Before the templates can be used, the sugar pine boards that will become the lifts must be bookmatched.

Bookmatching is the process of doubling up the boards. Attention is paid to how the grain runs. The ideal is to have the grain running in the same direction. This makes for easier shaping of the hull, because the lifts will not have the grain running in different directions once they are laminated together.

For best results, the hull lifts should come out of one long board. The board shown was 16” in width and then sawed in half lengthwise. It was then folded on back onto itself and secured with nails at each end and middle.

Once the board is bookmatched, the edges, except the ends, are trimmed in a table saw to make straight, square edges.

If it is not possible to bookmatch from a single board, just pay attention to the grain and make the best match possible.

The templates for the lifts are laid out using both edges of the board.

Arrange the templates so the bows all face the same direction. This will make shaping the hull easier because the grain will be running the same way on all the lifts.
LAYOUT: TEMPLATE DIRECTION & NESTING

Nest the templates to make maximum use of a book-matched board.

The tightest order is: Sheer, (LWL-2B), (1A-1B), 2A.

Try to space the lifts 3/8 inch apart, which makes cutting out the lifts out easier.

LAYOUT: MARKING TECHNIQUE

Run a pencil along edge of template at a right angle, and at a 45 degree angle with the lead pressed against the template.

NOTE: The templates are nailed to a board with two or three nails depending on the size of the template.

NOTE: Observe the 3/8 “ gap between the two templates.

NOTE: Young adults need to be supervised when marking. Experience has shown that they do not keep the point against the template and let the pencil wander.

LAYOUT: MARKING STATION 20

The marking of STATION 20 is a critical part of the gluing up of the lifts into a hull.

STATION 20 is used to align the hull lifts into the proper fore and aft position.

Each lift must be marked on all surfaces.

After the final cutting out of the lift, run the STATION 20 line over the cut surfaces.
Use a sharp object, an awl or a sharp nail, to transfer the inner edge points to the lift.

If a nail is used, just tap it lightly. There is no need to drive it into the lift.

Once the inner edge points are transferred, use a pencil to free-hand a line connecting the points.

When free-handing the line, err to the inside, which makes the lift thicker.

Making the inner line too thin will result in a hole in the hull when laying up or shaping it.

A directional arrow is marked on each piece of the book matched lift.

The arrow is placed on the material that will remain after the excess is cut away.

The tip of the arrow points towards the bow. This is important for some of the smaller lifts, 2B, which are fuller at the bow.

Once the lifts are glued together it is almost impossible to remove a lift facing the wrong direction.
LAYOUT: NESTING LIFTS 1A & 2B

Lifts 1A & 2B can be nested together. It is recommended that this be done to make maximum use of the bookmatched board. The two lifts can be aligned on Station 20 of lift 1A.

LAYOUT: NESTING LIFTS 2-B & LWL

Lift 2B is nested in side of the LWL lift. Careful arrangement of the templates will allow the use of a common station 20.

Lift 2B has two additional sets of markings, KB for the keel bolts and L for the compression bolts for laminating the hull and for attachment to the shaping jig.

LAYOUT: TRANSOM APEX POINT

Mark on the Sheer and 2A Lifts the Apex Point for the transom and extend the line from the point to the sides of the lift. This will facilitate cutting the transom bevel once the lifts are glued together.

See PART 5 and page 48 for further instructions.
LAYOUT: SHEER & 2A – STATION 20 LAYOUT

Lift 2A, is ready for cutting. A Bridge has been laid out using STATION 20 as a center axis.

The Bridge is temporary. It is used to keep the lift from flexing. It will be used to secure the hull to the Shaping Jig. Do not remove it until the deck is ready to be glued on.

The width of the Bridge is between 3 and 4 inches.

The SHEER also has a Bridge at STATION 20. Lay it out the same way.

Radius the Bridge into the inner edge. The radius can be bored later with a forstner bit.

LAYOUT:

FINISHED BOARD

The finished layout of the lifts on the bookmatched board should look like the picture on the right.

NOTE: The lift pieces all have tack nails to keep the upper and lower pieces from moving while being cut. For best results have a nail forward, at Station 20 and one aft.
LIFTS: ROUGH CUTTING OF THE LIFTS

The lifts are rough cut out of the bookmatched board.

Try to rough cut the board into two or three larger pieces.

Leave 1/4 to 3/8” edge for the finish cut.

Take these larger rough cut pieces and rough cut them again to separate each lift.

NOTE: Do not try to finish cut lifts from the full board. It is too awkward.

LIFTS: LIFTS READY FOR FINISH CUTTING

Take each individual lift and finish cut the outside edge.

Once the outside edges are cut, then cut all the inside edges.

NOTE: WHEN CUTTING THE INSIDE EDGES. THE CURVES AT THE ENDS MAY BE TOO TIGHT FOR A SINGLE PASS. CUT OUT AS MUCH AS POSSIBLE IN AN EASY CURVE. MAKE A SECOND AND THIRD PASS IF NECESSARY FOR THE TIGHT CURVES IN THE ENDS.

Try to cut on the lines and err to the outside. The shaping of the interior of the hull will be done later using chisels and gouges.
OVERVIEW: CUTTING LIFTS

The cutting out of the lifts is a critical procedure in the construction of the hull. How well the lifts are cut will determine the shape of the boat. The object is not to cut wavy lines, which will cause the use of filler, but smooth flowing cut lines.

The lifts MUST be cut on a bandsaw. A 1/2 or 5/8 inch blade is best. Experience shows that Saber and Jig saws have narrow blades that bend when cutting and leave lifts that are asymmetric.

Cutting the lifts is a multi-step process. First, the bookmatched boards are rough cut into pieces that are manageable for finish cutting. Usually, the board is cut into 3 pieces. These rough pieces are cut again into separate lifts.

Next, the outside finish edges are cut from the rough cut lifts. If the nested lifts have not been separated, they are cut out. The SHEER and 2A lifts have the radius holes drilled. The interiors are cut out leaving the bridges in place. The final step is finish cutting of the interior edges of the remaining lifts.

The finished cut out lift pairs should look like the ones in the picture, after they are cut out.

After the lifts are cut, the bookmatched halves are glued together. When all the lifts, which are numbered, are finished they are dry fitted marked and then glued together to form a hull.
LIFTS: INSIDE CUTTING FOR SHEER & 1A

The topside lifts; SHEER, 1A & 2A, require special cutting for the inside. The Bridge which is centered on STATION 20, is difficult to cut out on a bandsaw, because of the throat size of most bandsaws. In order to make it easier to cut out, two holes are drilled to provide the radius curve that it is not possible to do on a bandsaw.

The radius holes are 2 to 3 inches in diameter, which is not critical. The radius holes can be made with a forstner bit, hole saw or cutout with a sabresaw.

The inside edge is cut with the bandsaw. The Bridge legs are cut as much as possible with a bandsaw or with a sabre saw.

The shape and quality of the cuts for the Bridge are not critical. It is important that the Bridge be wide enough for use on the shaping jig.

The Bridge will remain in place until the deck is ready to install.

Mark STATION 20 on the outside cut face of each lift before separating them.
LIFTS: LIFTS AFTER FINISH CUTTING

The finished lifts should look like this when you are done cutting them out.

Note: The lifts are still nailed together in pairs.

LIFTS: PREPARING THE GLUE EDGES

The gluing faces of the lifts are prepared by running a medium rasp lightly over the center-line surfaces of one of the lift pair until a shallow trough is formed. The trough allows the glue surfaces to fit more closely together.

LIFTS: GLUING JIG

The Lift Gluing Jig is made from a piece of fiberboard, 12 x 42 inches with a formica surface. Blocks and wedges are used to hold the lift pieces in place. One set of blocks can be substituted with a pair of cylinders bolted to the board.
Dry Fitting is the process of making sure the pieces of an object will fit together correctly before they are permanently glued together.

Remove the nails from a lift and lay the lift pieces flat on the jig.

Nail wedge blocks near the bow and stern ends of the lift.

Lay the lifts in between the blocks.

Install the wedges at both ends.

Drive wedges tight.

Check the alignment of pieces at the bow and stern. Adjust the lift pieces fore or aft as necessary.

The STATION 20 lines should match on the bridges for the SHEER and 2A Lifts.

Adjust wedges and blocking until a tight, flat fitting of the lift gluing surfaces is achieved.
LIFTS: GLUING UP

Stage the lift pieces for ease of gluing.

Lightly wax the centerline of the jig with paraffin wax or use wax paper.

Mix only enough epoxy for one lift.

Mix up quickset epoxy glue (G-5).

Spread epoxy evenly on both pieces.

Lay the pieces in the jig.

Use wedge pairs to force the pieces together.

Check alignment of pieces.

Wipe excess epoxy off top surface.

Excess epoxy requires sanding.

Cover glue joints with wax paper.

Place weights on lift over joints.

Wait for joint to cure. Usually 15 minutes is best.

NOTE: Practice gluing on some scraps before gluing lifts.
After the epoxy has cured, sand off the excess epoxy on both surfaces of the lift.

The finished surfaces must be flat.

NOTE: Use a long sanding board with 80 grit sand paper to remove the epoxy.

Lift 2B is a critical element in the hull, it is the garboard of the boat.

It is the lift that the keel attaches to and the lift which is used to compress the hull when it is glued together.

2B requires some preparation before the hull can be glued together.

Two 1/4 inch holes, three inches on either side of STATION 20 are drilled on the centerline. They are marked CB on the lift template. These holes are for the compression bolts that will squeeze the hull together when the hull is glued up.

STATION 20 is marked on both surfaces of 2B using a chisel. This provides a permanent starting line for marking the mast step location and for aligning the keel to the hull.
LIFTS: LIFT 2B PREPARATION FOR GLUING

Once the two clamping bolt holes are drilled, the clamping bolts are test fitted. Enlarge the holes with a rat tail file if necessary.

The bolts are 8 x 1/4 inch carriage bolts. The lifts are compressed using fender washers and wing nuts.

NOTE: the 2B Lift’s shape is deceiving. It appears that the finer end should face forward. It does not.

Make sure that the direction arrows from the template are on both sides of the lift.

The lifts are now ready to be glued together.
PART 4

HULL LAMINATING
LIFTS: GLUING LIFTS TOGETHER

OVERVIEW: Gluing of the lifts creates a hull. The critical element in the process is the dry fitting of the lifts. All the lifts are aligned fore and aft using STATION 20 and the centerline joint of each lift. The centerline joint is used for the side to side alignment or amidships symmetry. Think of this as an alignment in three axis, X,Y,& Z.

NOTE: Make sure that STATION 20 is clearly marked on all sides of the lifts before gluing the hull together.

MATERIALS:

Laminating Jig: 3/4 x 12 x 48 inch plywood
Formica faced if possible
Wax Paper
Urethane glue
2 – 8”x 1/4n carriage bolts, washers & wing nuts
LIFTS: LAMINATING JIG

Lay out a Center Line and STATION 20 at a right angle to the Centerline. The Transom Apex Line is 15 - 9/16” behind STATION 20. The notch for the Transom Jig is 6 inches deep and 3 inches on either side of the Center Line.

Align lift 2B on Station 20 and the Centerline and drill holes in the Jig for the clamping bolts.

LIFTS: TRANSOM ANGLE JIG

Xerox the Transom Jig plan from the Sheer Plan and glue it to a 3/4 x 4 -1/2 x 6 piece of plywood. Nail this to a second duplicate piece of plywood. Cut the saw guide slot with a bandsaw. Separate the two pieces and glue & screw the base to the guide pieces, after carefully aligning them.

The Transom Jig should fit snugly on the laminating Jig. Align the Transom Jig with the Apex Line and screw it in place.

Note: Draw the Apex line on the base piece and align the guides to this piece. Draw the Apex Line on the inside of the Jig to make the correct alignment.
LIFTS: GLUING — PREPARATION OF JIG

Carriage bolts are inserted from the back side of the laminating jig.

Recess the bolt holes.

Cover the jig with wax paper.

LIFTS: GLUING — DRYFITTING THE LIFTS

The lifts are placed on the jig in reverse order, starting with the sheer.

The order is SHEER, 2A, 1A, LWL, 1B and 2B.

The lifts are then aligned fore and aft using STATION 20.

The amidships alignment uses the centerline of the lifts.
LIFTS:  DRYFIT OF LIFTS – ALIGNMENT

Tighten the wing nuts on LIFT 2B. Check and adjust the Alignment of the lifts.

Once the hull lifts are in alignment, a pencil is run around the edge of each lift.

The hull is disassembled and the lifts are stacked in order of assembly. The hull in now ready to be glued up.

Each lift is lightly moistened with water, use a finger as an applicator. Wet inside of the marked line from the dry fitting.

Urethane glue is spread on the moistened area using a stick.

Glue up each lift and align using the pencil marks as a guide.

Tighten the wing nuts after the lifts are stacked up.

Check the final alignment and drive wedges under bow and stern.
LIFTS: GLUING UP THE LIFTS

When gluing LIFT 2A to the SHEER LIFT, this will be the first lift glued, do not glue the bridge pieces together at STATION 20. By not gluing the bridges together, the Sheer Bridge can be cut out, leaving the 2A bridge. This will facilitate cutting in the sheer later and allowing the Shaping Jig to still be used.
PART 5

SHAPING THE HULL

Shaping Jig
Bow Profile
Lift 3B - Garboard
Stern profile
Garboards
Transom
Sanding
HULL: SHAPING — ROUGH

OVER VIEW: The PIRATE hull is the melding of seven curved regions into one complex curved surface.

Shaping is a process of going from rough to smooth, in a series ever finer steps, starting with chisels, block planes, rasps, block sanding and finally hand sanding.

The basic steps to shaping the hull are, first creating the bow and stern profiles, then the keel — hull joint, the transom and finally the sheer.

The profiles are roughed in and are refined as shaping takes place.

TOOLS:

1/2” Chisel
1” Chisel
Trimming plane - STANLEY
Mallet
Rasps

JIGS:

Laminating Jig
Transom Bevel Jig
Shaping Jig
Bow Template Jig

NOTES:

Do not use a gouge on the outer hull, it can dig too deep and create the need for the use of filler.

Work from amidships- forward or amidships - aft. This generally keeps you going with the wood grain and keeps tear out to a minimum.
The Shaping Jig is designed to hold the hull in a horizontal position or a vertical position.

The hull is held on to the jig by using the 8 inch carriage bolts that were used in gluing up the hull or by 2-1/2 inch carriage bolts when the hull is right side up for hollowing.

To keep the hull from rocking, a stop that matches the sheer line 3” on either side of STATION 20 is fitted to the jig.

The Bridge formed by the SHEER and 1A lifts is an important part to the use of the board. It provides a bearing surface for the hull to press on the Shaping Jig.

An alternative means of fastening the hull to the jig is to use drywall screws through the back of the jig and into the Bridge. This technique is used when the keel is fitted, finished and joined to the hull.

The hull is hollowed by turning the hull upright and using the short (2-1/2 “) carriage bolts.
The Transom Jig is inserted into the slot on the end of the Laminating Jig and is adjusted until the Apex lines of the hull and the Jig are in alignment. The Transom Jig is then screwed down to prevent it from moving.

**NOTE:** If the layout of Station 20 and the Apex line is carefully done, no realignment of the Transom Jig will be necessary.

Leave the hull bolted to the Laminating Jig. Insert a Japanese Pullsaw or a Mitre Saw into the slot and carefully cut the transom bevel. The step between the SHEER and 2A LIFT should just disappear.

Drive a small nail into the Apex Point. This will prevent the transom from migrating as the hull & transom are finished.

Mark the transom Sheer corners, refer to the profile plan in the drawings. The corners are approximately 1/2" from the end of the SHEER LIFT and 1/2" up. Draw a line across the transom. Now draw a straight line from the apex to the corners of the transom. This will roughly define the shape of the Transom.
HULL: SHAPING THE TRANSOM - ROUGH

NOTE: The Transom Jig only cuts the proper angle of the transom. The true shape of the transom will be a much smaller part of the surface after the cut.

The rough after profile should be chiseled in. It should stop about 3/8" down lift 2A at The APEX Point. This will expose the actual Apex Point.

Go back and begin to shape the aft section of the hull. As the hull is shaped, the transom edges will be further defined. These edges are sharp and not rounded.

Rounding occurs when a rasp or sanding block goes over the edge, rather than straight off the edge.

NOTE: The shape of the transom is a curved Vee. It is not heart shaped and does not have any tumble home at the top.
BEGIN SHAPING THE BOW AND THE FORWARD SECTION OF THE HULL. LOOK AT THE PLANS TO SEE THE COMPLEX PROFILE CURVE.

START IN THE MIDDLE AND CHISEL A 1/2" GROOVE TOWARDS THE BOW. STOP AT THE END OF THE LWL LIFT. A TEMPLATE IS USED TO SHAPE THE BOW BEYOND LWL.

CHISEL FORWARD GOING BACKWARDS LIFT 2B.

LEAVE ABOUT 1/8" STEP AT THE JOINT BETWEEN LIFTS. THIS IS JUST A PRELIMINARY REMOVAL OF MATERIAL.

USE A CHISEL AND OR A TRIM PLANE TO REMOVE MATERIAL DOWN TO THE CHISELED PROFILE.

THE BOW PROFILE IS MARKED ON THE HULL AND A RASP IS USED TO ROUGH SHAPE THE CURVE OF THE STEM.
HULL: BOW PROFILE — SHAPING THE STEM

The profile of the stem is roughly marked on the lifts.

Use a medium rasp to shape the stem curve. Use the Stem Template frequently.

The shape of the stem is not finished, but left to about 1/8 inch high. As the hull is finished this will diminish to the desired profile.

Mark the rasped flat of the stem profile with a lead pencil. Color the whole surface. This prevents the profile from changing when the bow is being shaped. This is called a signal coat. It will disappear during the final sanding of the hull.

NOTE: Scrape the excess glue from the lifts by using a sharp chisel as a scraper
Once the bow and stern profiles are established, the garboards are shaped. This is a more complex operation due to the concave shapes involved.

The object is to shape lifts 3B and 2B which are the transition pieces between the hull and the keel. This involves three distinct processes in a 6 inch space.

The leading edge of the keel is faired into the hull. The midsection fairs the bow and stern together and the trailing edge which fairs the rudder and keel together.

The first step is to tack nail Lift 3B to the hull. Two finish nails are adequate for the job. DO NOT GLUE IT! 3B will be removed and used to build the keel after the shaping of the garboards.

3B is aligned using STATION 20. The Joint is then marked with a pencil on lift 2B.

Lift 4B is then aligned and its outline marked on top of 3B. Remove 4B.

3B is then drilled from inside the hull through the gluing bolt holes. The hull with 3B is then fastened up side down on the Shaping Jig using screws.
SHAPING – STERN PROFILE

The stern profile is done in the same manner as the bow. The profile is a sharp parabolic curve that flattens out as it reaches the transom.

The best technique is to carve a rough profile ramp and then remove the material around it.

When carving the profile ramp, go no deeper than 3/8 inch on Station 2A at the Apex Point of the Transom. The transom will be finish shaped later.

Use a small gouge, rasp and trim plane to shape the stern.

Use the rasps and gouge below the waterline and the trim plane above the waterline.

It is best to have a copy of the plans behind the hull, so the profile can be referred to while shaping the stern profile.

Once the preliminary shaping of the profile is done, the hull is attached to a Shaping Jig. The jig allows the hull to be shaped while being held in a vice and to be rotated to different positions during the shaping process.
**HULL:**

**SHAPING – GARBOARDS, AFT**

The process of shaping of the garboards aft of amidships is generally the same as the forward ones, except for the radius becoming progressively smaller.

**NOTE:** Mark the flat behind 3B with a signal coat and the sides of 2B. Shape this last. There should be a small triangular flat for the rudder tube to rest on when the shaping is finished.

3B narrows down at the top and the sides are almost vertical by the rudder.

Begin with a gouge and work downward and at an angle towards the stern. Shape 2B and 1B as well.

Begin rasping to smooth and shape as was done in the forward garboard.

Finish sand by using 80 grit on a round piece of pipe and using the heel of the hand as a sanding pad (it is very useful).
The garboard shape is a radius, a curved shape, that connects the hull to the keel. The radius changes along the entire length of the keel.

Begin by rough shaping lift 2B about half way up to 3B.

Use a gouge to begin the radius on 3B, by gouging down and forward from amidships.

Work slowly back towards the 4B line, but not up to it. Leave material for rasping and sanding, when the keel is assembled. This is just the rough shaping.

Begin to rasp the shape, using the rounded side or the rough rasp. Always work down and away in long strokes that are shaping 2B and 1B as well.

NOTE: SEE PAGE 41

The shaping process is about making a curved surface not a flat one. Rasping in one spot will dig a groove and does not make a curved surface.

As the surface works down, the joint line between the lifts will begin to shrink in height. Shift to the medium rasp when the joint line is about 1/8 “ Stop rasping when about 1/16” is left. Sanding will finish the radius.
RASPING IS FIRST DONE WITH LONG
STROKES. THE OBJECT IS TO CREATE A
ROUGH CURVED SURFACE AND NOT TO CREATE FLAT SPOTS.

GENERALLY, RASP AT A 45 DEGREE ANGLE TOWARDS THE BOW OR STERN.

AN X PATTERN GIVES A BETTER SMOOTHING RESULT, BECAUSE THE SURFACE IS BEING SHAPED IN TWO DIRECTIONS. CONTINUOUS ONE DIRECTION RASPING LEADS TO FLAT SPOTS AND OR GROOVES.

AT THE TURN OF THE GARBOARD, THE ROUNDED EDGE OF THE RASP IS USED TO CREATE A RADIUS BY ROLLING IT AND PUSHING IT ALONG THE RADIUS.

NOTE: BE CAREFUL BY THE RUDDER, WHERE 3B IS ALMOST VERTICAL, IT IS COMMON TO HOLLOW TOO MUCH. IF THIS HAPPENS, THE AREA CAN BE FILLED WITH FILLER AND Sanded.

RASP TO 1/8 INCH OF A FINISHED SURFACE WITH THE ROUGH FILE, THEN TO 1/16TH INCH WITH THE MEDIUM RASP AND FINISH WITH 80 GRIT SANDPAPER.
The sanding of the garboards is done with a series of sanding tubes made of plastic pipe sections and doweling.

The tubes are 4 to 6 inches long. The diameters go from 1 – 1/2, 1-1/4, 1, 3/4 and 1/2.

Use 80 grit 3M adhesive backed paper on the tubes. Finer grit can be used for finishing.

Roll and push the tubes in the same way the rasps were used.

If adhesive paper is not available, use spray adhesive to glue the sand paper to the tubes.

Finish sanding is done with a soft piece of open cell foam and by using the heel of the hand. Use grits in the 100 – 200 range.
HULL: SHAPING – MEDIUM AND FINISH

Shaping the hull is the longest and hardest part of constructing a Pirate.

Patience, persistence and attention to detail will determine the outcome of the shaping.

When the rough shaping is done, the medium and final finishing begins.

Medium shaping is the process of joining the rough shaped areas of the boat together into a continuously changing curved shape. There are no flat surfaces on the hull.

Medium shaping removes material with rasps and sanding boards until the edges of the lifts are almost gone, 1/16" or less.

At this point only sanding boards and hand sanding, using the heel of the hand, with 80 grit should be used.

Finish sanding is the continuation of the process, using 150 Grit, until the lift ridges are gone.

The object is to create a curved surface that is smooth, without lumps, ridges or hollows.

The final sanding is 220 grit. This will remove scratches and leave a good surface for painting.
The transom shape is the last surface finished on the hull. The after section of the hull is finish sanded at the same time as the transom.

Pencil the edges of the transom, the unfairness of the lines will show where material needs to be removed from the hull. Experience has shown that the edge shape is mostly controlled by taking material off the hull and not the transom. Taking material off the transom changes the angle and moves the apex point forward. Taking material off the hull makes the transom smaller and sharpens the edges.

Remember that the edges of the transom are straight and not curved.

The most difficult part is to finish the corners, without rounding the sheer. A fine sanding board and patience works best.
PART 6

KEEL FABRICATION

Forming Blank
Shaping Blank
Fitting to hull
Final installation
KEEL:

OVERVIEW

A finished keel ready for joining to hull. The wooden portion is glued and shaped. The lead keel is not glued to wooden portion at this time.

Keel bolts are holding entire assembly together.

MATERIALS REQUIRED:

Lifts 3B, 4B, 5B & 6B
Lead Ballast Keel
10-24 x 6” flat head machine screws steel  2 each
10-24 nuts—stainless steel 2 each
1” Fender washers—stainless steel 2 each
Urethane Glue
Sand paper  80 grit

JIGS:

Lift templates
Alignment jig
Bevel jig
Leading edge profile jig
Shaping jig

TOOLS:

Rasp — All sizes
Screwdriver
Wrench     Fine Tooth Saw
KEEL: LIFTS 3B, 4B, 5B AND 6B
Lifts ready for assembly.
Lifts have been cut with long trailing edges which will be trimmed off later.
Make sure the top and bottom surfaces are sanded flat.
Station 20 is clearly marked on each lift.

KEEL: ALIGNMENT OF LIFTS
The keel jig is used to align the lifts as shown.
Lifts are pushed to touch the front end of the jig.
The station 20 witness lines are not used, if the jig is used. The witness lines are a check.
Mark the front edge of each lift and the sides. This will make alignment easy when the lifts are glued together.

KEEL: ASSEMBLED BLANK
The keel blank is now ready to be glued together. Glue lifts 4B, 5B & 6B together. Do not glue 3B to the other lifts. 3B is shaped separately on the hull. The lifts should not be floating in the glue. Use enough glue to stick them together. Small nails can be used to hold the lifts in alignment, but experience has shown that they are not necessary.
Once the keel blank dries, tack nail it to 3B. It is now ready for beveling.
**KEEL BLANK:**

**LAYOUT OF LEADING EDGE**

The Leading Edge Keel template is fit over one side of the stepped leading edge of the keel.

Match the point of the jig with the bottom corner of 3B. Mark the curve with a pencil.

**KEEL BLANK:**

**LAYOUT OF THE TRAILING EDGE**

The Keel Jig is placed back on the keel blank and the trailing edge is marked. This is a straight line.

The rudder will fit next to the trailing edge.

**KEEL:**

**BLANK IN BEVELING JIG**

Keel blank is placed in Beveling Jig with lift 3B touching front of jig.

Secure the keel blank in place with two drywall screws through the bottom.

**KEEL:**

**MARKING BALLAST BEVEL**

Mark the bevel line on the keel blank for reference when it is cut.
**KEEL:**

**CUTTING BALLAST BEVEL**

Start the cut at the nose.

Keep the blade flat on both edges of the jig by putting a finger on the blade over each edge and pressing the blade down on the jig edges.

A Japanese finish saw works best.

The bevel can also be cut on a bandsaw, using the jig as a guide.

Keep the knub, which is cut off.

Use a sanding block to smooth off the cut surface.

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**KEEL BLANK:**

**CUTTING THE EDGES**

The keel blank is removed from the inside of the jig and screwed to the outside bottom. This allows the blank to be cut on a bandsaw using the jig as a guide.

Cut the leading edge on a bandsaw and leave 1/8 to 1/16 " for final shaping with a rasp.

Cut the trailing edge the same way. It will be trued up with a sanding block.
KEEL: BEVELED BLANK on SHAPING JIG

The beveled keel blank is removed from the jig and is screwed on to the shaping jig.

Screw the blank on to the jig from the bottom of the jig. Use drywall screws.

KEEL: SHAPING LEADING EDGE OF KEEL

Use rasp to remove edges. Use curved back of a half round file to shape the leading edge of keel blank.

Try to avoid making a sharp leading edge. Leave a 1/8 “ flat and signal coat it like the stem. The finished edge is rounded.

Rough shape and then semi- finish with a medium rasp and sandpaper. Leading edge is finished after ballast is attached.

KEEL: SHAPING KEEL BLANK - AFT SECTION

Use rasp to remove edges and flatten surface.

Use the same progression of rasps to create a semi-finished surface.

Do not taper the end of the blank to a sharp edge. Leave 3/16 inch flat for the rudder to fair into. Mark the width on the end before starting to shape.
KEEL:  MARKING STATION 20 ON BALLAST

Place ballast on plans drawing and align in the best position possible. Mark STATION 20.

**Note:** The ballast will be slightly smaller than shown on the plan, due to shrinkage of the ballast during casting.

KEEL:  DRILLING KEELBOLT HOLES

Align the ballast on keel blank. Use STATION 20 to align with the keel blank and ballast.

Use a long 3/16” drill bit to drill through a cored hole in the ballast into the keel blank and through the shaping jig.

Insert a keel bolt in the drilled hole and screw it partially into the keel bolt hole.

Check the alignment of the ballast.

Repeat the process for the after keel bolt hole.

**Note:** When drilling, make multiple drills and clean the chips from the flutes. This will result in a straight hole.

KEEL:  SEMI–FINISHED KEEL BLANK

This keel blank is semi-finished. Final sanding will take place when it is attached to the hull.

The leading edge of the keel is left at a semi-finished state at this stage.

Final shaping will take place once the lead ballast is attached.
Once the keel is shaped, it is dry fitted to the hull.

The keel is aligned using STATION 20 on the hull and the keel.

Remove the keel from the shaping jig.

Pull the keel bolts back to allow the keel to rest on the hull.

Pull one keel bolt out and use the Keel bolt hole to guide the 3/16” drill.

Align the keel and drill through the hull.

Screw the keel bolt through the hull and bolt up in side the hull.

Pull the second keel bolt.

Check the alignment of the keel.

Repeat the process and bolt up the second keel bolt.

Refasten the hull on the shaping board using drywall screws placed into the bridge.

Put the jig into a vice so that the hull is horizontal.

Finish shaping and fairing the keel in this position.

Remove the keel and store it until the hull is finished and the rudder tube is being installed.
PART 7

INTERIOR SHAPING

Gouging Out
Mast Step
Bow
Bow Sheer Lift
Stern - Gouging
Bow Profile
Boat Stand
OVERVIEW: The shaping of the interior of the PIRATE is an easy project, that does not require as high a level of finish as the exterior of the hull. The process is similar in that the lifts are gouged, rasped and sanded until a smooth surface results. Hull thickness is determined by the amount of material removed from the interior. The hull thickness should be about a maximum of 3/8 of an inch in thickness. A thinner hull usually results in cracking.

The interior is not hollowed out all at once. It is done in three steps. The bow is hollowed out first, in preparation for the addition of the Sheer Piece. The stern is hollowed out next. The midsection, under the bridge is last, just before the deck is installed.

TOOLS:
- Gouge
- Rasps
- Sand paper
- Mallet

HULL: FABRICATING THE MAST STEP

Locating and drilling the mast step is the first step in hollowing the interior.

On the lines plan, locate STATION 20 and the intersection with the top of lift 2B. This is the chiseled line in the hull.
The Mast Step is a 1/2” diameter hole located on the inside of the hull and on the centerline. The mast is placed in the hole, which supports and holds the mast in place.

The center of the hole should have been marked on Lift 1B, when it was laid out. If not, take a short stick and put one end on the 2B – STATION 20 point on the Lines Plan and mark the other end, where it crosses the centerline of the mast on STATION 1B.

Take the stick and place one end in the hull at 2B-20 and transfer the mark on the other end to a point on the centerline of Lift 1B.

Take a 1/2 inch brad point drill bit and bore a hole approximately 3/8 to 1/2 inch deep.

Drill the hole perpendicular to the lift. The result should look like the mast step at the bottom of the page.

Mark up the flat around the mast step with a pencil. This will act as a reminder not to remove the wood around the mast step when gouging out the hull.
Mark the edge of material to be removed on the top of the sheer.

The top edge of the sheer is left 1/2 inch thick. This is for strength and to provide a bigger surface area for the deck to bond to.

Mark STATION 8 on the sheer if it was not marked during the original layout. Use the layout template, align it on STATION 20 and mark it on the SHEER lift.

STATION 8, is the starting point for the BOW SHEER LIFT. This point, Station 8, will be used in laying out the sheer line, before the sheer is cut.

NOTE: To gage the thickness of the hull when hollowing out, use your fingers as a caliper gage. Place a finger on the outside of the hull and one on the inside. Your sense of touch will give you a good sense of thickness.

Occasionally hold the hull up to the light. If a bright spot appears, the hull is too thin in that spot and will require putty.
HULL: INTERIOR — GOUGHING OUT BOW

Shaping of the interior bow, begins by starting a profile groove. This is same process as on the exterior of the hull. Start in the center and groove down toward the keel, LIFT 2B.

Do not gouge out Lift 2B.

Remember that the mast step on LIFT 1B is not cut down.

Once the groove has been established, Start gouging away towards the side of the hull.

NOTE: Gouge from the bow towards the stern. Go with the grain or diagonally. Going against the grain will cause tear out, which may make the hull too thin.

Gouge lift by lift towards the keel.

Remember not to chip away the mast step. Avoiding this can helped buy cleaning the chips of frequently.

Gouge only to the bridge. It will be removed much later.

After rough shaping with the gouge, begin smoothing with the medium rasp or a spoon plane. Smooth the ridges down.

The final step is sanding the surface. Start with 40 grit and finish with 80 grit. The finished surface should be smooth, but not finely finished.
HULL:

BOW SHEER LIFT

OVERVIEW: The bow sheer lift is a small lift that is added to the sheer lift in order to create a graceful sheer line. The lift runs from station 8 to the bow. It is 7/16 inches thick.

Place the bow lift piece on the bow with one end aligned on the station 8 marks. Hold down and mark a line on the bottom side of the lift. Mark the top as “top”. Extend the lines until they cross at the bow. The intersection should be beyond the existing bow, by 3/8 inch or so. The extra length is because the stem profile extends beyond the existing bow. See the original plans to clarify the geometry.

Cut the piece out. Cut the interior out, leaving about 3 – 1/2 inches solid from the bow back.

Tape the hull below the bow lift, in preparation for gluing.

Dry fit the piece and make sure that the side that is labeled “top” is facing up.

Apply urethane glue and align. Use a weight to hold the bow lift in place.
HULL: INTERIOR — GOUGING OUT STERN

Gouging out the stern section interior is done the same way as the bow.

Leave about 3 inches of the transom un-gouged. This provides a good gluing surface for the deck. The area for gluing will decrease once the Sheer Line is cut. Once the Sheer is cut, more material at the transom can be removed if necessary.

Rasp and sand until a smooth surface is achieved.

The bridge is left in place.

Shape the hull only down to Lift 2B. 2B is left flat for the keel bolts and washers to land on.
OVERVIEW: The final shaping of the bow is much like the rough shaping. A medium rasp and a sanding board with 80 grit is used. The object is to remove the last of the ridges created by the lifts and create a smooth curved complex surface. The PIRATE’s bow is a hollow flaring shape, which creates a hollow spot just above the waterline. Reminder: There are no flat spots on the entire hull.

The first step is to complete the stem profile. Use the rasp and the sanding block to create a smooth curve. Use the stem template to check progress.

Use a pencil to signal coat the resulting surface. Do not flare the hull sides into the stem until this done.

Shaping the hull sides begins by working on the Bow Sheer and Sheer lifts. There is an excess of material at the top which has to be carefully removed. Draw a diagonal line on the Bow Sheer Lift from the tip of the bow to STATION 8 on both sides. Shape to this line and not above it.

Look carefully at the profile of the stem in the drawings. It is not a straight line. The shape is like a spoon, a gentle, complex curve. Just above the LWL, there is a subtle hollow, it is the result of the changing shape of the bow.
HULL – BOW PROFILE : FINAL SHAPING

Keep fairing and working both sides of the hull until they are smooth. Keep a close watch on the stem profile and centerline.

Use a pencil to mark the edge of the stem. This will keep it from wandering. It is easy to lower the profile of the stem, by taking material away from the centerline edge rather than from the sides.

The best way to avoid this is to work from the stem centerline towards the sheer.

A small sanding block, long and narrow, will help for small adjustments in the stem line and profile.

Work in an X pattern to keep from creating flat spots.

The hollow above the LWL takes time to develop. It manifests itself by being a flat spot in the lifts at the stem that will not go away, when all the other lifts at the stem are fairing into lines. The trick is to remove material without making a big divot in the stem profile.
BOAT STAND: CONSTRUCTION

The boat stand or cradle is constructed to hold the boat, once the keel has been joined to the boat. The cradle is a nice preliminary project. It can be as simple or fancy as you wish.

The base is 17 x 6 x 3/4 inches.

The ends are 1/4 inch plywood.

Half—templates for the ends are provided in the plans.

The lightening holes are bored for aesthetic reasons.

Clamp the base, end up, in a vice.

Screw an end on, using three screws. Pre drill the end piece. Fasten the center screw first.

Use a little glue for added strength.

Repeat the procedure on the other end piece.

To keep from damaging the hull, put foam pipe insulation on the top of each end piece or clear vinyl tubing.

Paint or varnish as desired.

The cradle is nice for practicing varnishing.

Use up any excess varnish in the brush and paint cup after varnishing the mast and deck on the cradle.
HULL BRIDGE: REMOVAL & HULL SEALING

Once the hull is finished on the outside including the keel, the hull bridge can be removed. The bow and stern sections of the interior are finished. All that remains to finish the interior is to cut the bridge out and gouge out the material underneath it.

Attach the hull to the shaping jig right side up, using the 2-1/2 inch carriage bolts and wing nuts.

Cut the bridge out with a Japanese saw. Make the cut lines about 1-1/2 inches from the edge of the hull. Trim the remaining material from the hull with a chisel and or block plane.

The hull is gouged and sanded in the same manner as the forward and aft sections. Smooth the interior with a rasp and then 40 and 80 grid sand paper.

The hull is now ready to have the interior sealed. The object is to create a waterproof barrier, which will prevent the hull from swelling and delaminating if water splashes into the hull.

The first choice of a sealant is West System or any other two part epoxy. System Three or MAS will work equally well. One coat is enough, two are better.

An alternative is to use two coats of wood sealer or thinned down varnish.

Before sealing, write your name and the date inside of the hull at mid-ships.
PART 8
RUDDER

FABRICATION
TUBE INSTALLATION
The rudder tube is made out of a 2 inch length 7/32 inch brass tube.

One end of the rudder tube is flared to catch the outer edge of the hull. Flaring is accomplished by putting a tapered object in on one end of the tube and rotating it until a lip forms.

The rudder shaft is a 6-1/2 inch x 3/16” brass rod. Both ends are chamfered to aid in fitting in the tube.

**DO NOT ATTACH THE RUDDER BLADE TO THE SHAFT UNTIL THE RUDDER TUBE IS INSTALLED IN THE HULL.**

A #50 hole is drilled into the shaft 2 inches form one end. This is for driving a 18 Ga. Brass escution pin into the blade as a mechanical fastener.

The head of the pin is ground off.

The rudder blade is made from scrap 3/16 plywood or wood.

A groove is rasped into the edge that will join with the shaft. Use a 3/16 rat tail file.

The shaft and blade are joined together with super glue and the pin.

The blade can be tapered by running it over a sanding belt. This is usually done after rudder is constructed.
RUDDER: INSTALLATION OF THE TUBE

OVERVIEW: The rudder assembly is the only mechanical feature installed in the hull. It consists of a tube and shaft with blade. The tube is the first item installed. The rudder blade is attached to the shaft and installed after the boat is finished. The critical operation is to install the rudder in line with the trailing edge of the keel.

Temporarily install the keel. The trailing edge of the keel is extended down to lift 2B. A small triangle should be left on 2B. If not, a piece can be graved in and re-carved.

The finished trailing edge of the keel is blocked flat, horizontally and vertically.

A pilot hole is punched with an awl for a long shaft 3/16 drill.

Hold the drill bit in line and against the trailing edge of the keel. Drill through the hull.

Test fit the rudder tube — it should not fit. Use a 3/16 rattail file to open the hole until the rudder tube just fits.
RUDDER : INSTALLATION OF THE TUBE

The rudder tube is test fit by inserting the rudder shaft and carefully pushing it into the hull.

The rudder shaft must turn freely in the tube and be inline with the keel.

Pull the tube down into position behind the trailing edge of the keel. Rasp the hole until a close fit is achieved.

The rudder tube is glued in place using urethane glue. Tape the hull around the rudder hole and use Vaseline on the inside of the tube and the shaft.

NOTE: the urethane glue is very aggressive in sticking to metal and wood so place a barrier on any object that needs to be glue free.

GLUING: dampen the hole with water, put a little glue down the hole and on the outer wall of the tube. Put into position and use the shaft to align with the keel and use tape to hold it in position. Wipe off any excess urethane glue.

Remove the keel, once the tube installation is finished. The keel will have its final installation after the deck is installed and trimmed.
PART 9
SHEER

Layout & Cutting
HULL: LAYOUT SHEER OF SHEER

The hull is now ready for cutting in the sheer. The sheer is a curving line formed by the hull-deck edge.

The sheer is laid out on the hull by connecting five known points with wooden batten to create a fair curve.

The five points are: The tip of the bow, STATIONS 8, 20, 26 and at the transom-hull edge.

The points are picked up with dividers off the plans, using the bottom edge of the Sheer Lift as one point and the sheer line as the other point.

The points are then transferred to the hull at the appropriate station. The bow point and Station 8 do not require transfer, as they are known points on the hull. Station 20, 26 and the Transom are the only ones requiring transfer.

Once the points are established, a thin batten, 1/2 x 1/16 x 48”, is bent on to the hull connecting the points. It is held in place by squeeze clamps. Clamp first at Station 20 and fair up the bow, place a clamp at Station 8. Fair up aft, and place a clamp at Station 26.
HULL: SHEER LAYOUT & CUTTING

Work with the batten, making small adjustments until a smooth concave line forms. Be careful not to create a reverse sheer, which is caused by having a hump in the line.

The lowest point in the sheer is at Station 26.

Once a good line is established, mark the sheer with a pencil line.

Repeat the process on the other side of the hull. Lift the station points from the sheer line that has been just drawn.

Draw a line across the transom to connect the two sheer lines. It should have a slight crown to it.

The Bridges for the Sheer and 2A lifts can now be cut out. The interior of the hull can be finished now or after the sheer is cut.

There are two methods for cutting down the Sheer, depending on skills. The first is to make a series of small guide cuts down to the sheer and plane down to them. The second method is to just plane down to the sheer line. Using skill and experience to make a fair Sheer Line.
HULL: SHEER — PLANING DOWN

Start planning the sheer between Station 8 and 20. Plane towards Station 20.

Plane down to about 1/8 “ above the sheer line.

Work the aft section down the same way, planning from the transom towards Station 20.

Planning the Bow Sheer Piece requires special care. Do not start planning at the bow.

First, signal coat the sheer piece an inch back from the bow. It will be sanded down.

Start planning at Station 8 and gradually work back towards the bow. The plane’s direction should be towards Station 20. Check the progress often, if too much wood is taken off, a hump or powder horn will appear and will ruin the sheer line.

Sight along the sheer line and use a pencil to mark the high spots where planning will take place.

Gradually remove material with the object of trying to end up with a sheer line that is 1/16 inch above the finished line. The sheer is then finished by a final planning and sanding.
Once the sheer is within 1/16 inch of being finished, use the remaining material to smooth out any waviness in the curve.

The Bow Sheer Piece is finished by using a sanding block to fair it into the curve. Be careful not to sand in a reverse curve at the bow.

Sight down the sheer from the bow on both sides, the curves should be the same on both sides. Make any minor adjustments to equalize the curves by running a sanding board over the sheers.
PART 10

DECK INSTALLATION

Deck Beams
Deck
Installation
Cockpit
Mast Hole
DECK BEAMS : CONSTRUCTION

A pair of deck beams are required to support the deck and mast.

The forward deck beam is called the partner and the other is the after deck beam. Both beams are cambered to cause the deck to shed water.

Take a scrap from cutting out the lifts. Mark out two deck beams. The beams are wider than they are deep. Nail the halves together and cut out with a bandsaw.

Mark the centerline on the pieces, as was done on the lifts.

Take the beams apart and glue them together.

Both deck beams are drilled out at the crown, one for the mast and the other for the rudder shaft.

The mast partner is drilled for a 1/2 inch hole and the other with a 3/6 hole for the rudder.
DECK BEAMS : MAST PARTNER INSTALLATION

The mast partner is aligned with the mast step by using a 18” x 1/2 inch dowel. The dowel is stuck in the mast step after it is pushed through the mast partner.

The assembly is then aligned to be vertical in all axis. Mast rake can be added after the boat is assembled by rasping the mast partner hole out and tapering the butt of the mast.

The mast partner is aligned to be equidistant from the tip of the bow. Measure one side and then match the distance on the other.

Hold the partner in place and mark the sheer on the both sides of the partner.

Mark the top, bottom and sides of the partner. This forms the cut line.

Cut the partner 1/8 inch out side of the cut line.

The partner is fitted by hand sanding both sides until it is centered and rests easily in place. Do not force fit the piece, it will distort the hull and cause cracking.

Epoxy the partner in place. Saw dust can be added to the epoxy to thicken it and fill any gaps in the joints.
DECK BEAMS:

AFT BEAM – INSTALLATION

The after deck beam is installed the same way as the mast partner.

Use the rudder shaft to center the deck beam. Mark and cut to fit. Epoxy the beam in place.

The deck beams are now faired to the sheer. A block plane is bridged between the sheer and deck beam. It is run at a 45 degree angle out to the center line. This is done on the forward and back sides.

The deck is now ready for installation.

RUDDER INSTALLATION: If the boat is going to be radio controlled, it is best to fit the rudder before the deck is attached.

Put the rudder through the tube and cut the shaft off until the top of the rudder is 1/8” below the deck beam.

Fit the bell crank arm on the rudder. It should ride on the top of the rudder tube and 90 degrees to the surface of the rudder blade.

Mark the top of the bell crank on the shaft with a felt tip pen.

Remove the rudder and grind a flat for the bell crank set screw.

Do not reinstall rudder until the hull is finished and painted.
The deck is fabricated out of a single piece of mahogany door skin. A piece 10-12 x 45–48 “ is sufficient.

Turn the hull upside down and mark the outline of the sheer on the door skin. Make sure the good face of the deck is facing down and the outline is being traced on the backside of the door skin.

Give a 3/8 inch excess on all the edges and an overhang on the transom of 2 inches. The excess will be trimmed off later.

Sealing the underside of the deck can be done at this time. If regular epoxy, (West 105) is not available, varnish or sealer can be used. Avoid sealing with varnish within 1” of the edges and in the area of the deck beams. The Urethane glue may not bond well.

The topside of the deck can be sealed with a base coat of epoxy or varnish. This will keep it clean and speed up the finishing process.

Dry fit the deck.
DECK: INSTALLATION PREPARATION

Tape the hull down from the sheer. Use three sections of 3/4 inch tape on the hull, down to the waterline amidships.

Put Vaseline in the mast partner hole and tape over the mast step hole. This will prevent glue from sticking to them.

Put Vaseline in the rudder shaft hole in the after deck beam.

The deck has both camber and sheer.

The deck is held down by wrapping the hull with a 12 foot length of 1/4” bungee cord. Pay special attention to the bow and stern where extra wraps are necessary.

Wrap in an lacing pattern, keeping tension on the cord.

Make a dry fit several times.

Make sure the deck stays centered and there is 3/8 “ overhang on both sides at the bow and a 2 inch overhang at the transom.

Use Urethane glue rather than epoxy glue. The urethane is easier to use and trim than the epoxy.

Try to have gluing be the last step of a work session.
This is the easiest and preferred method of deck installation. The pre-fitted & finished keel is not bolted on until the deck is installed trimmed and ready for finish.

The hull is bolted upright on the Building Board, using the 2-1/2 “carriage bolts, which are inserted from the inside of the hull. The bolts need to be captured with a stick screwed over the heads. This allows the use of the bolts to fasten the hull on a shaping board. This allows the deck to trimmed easily.

A pair of Bending Boards are temporarily fastened to the Laminating Jig. They are made from a 2 x 2 x48” board that has pegs or fasteners placed every three inches along its length.

The bungee cord is bent around the pegs when the deck is glued down, using a lacing pattern.

When gluing the deck with urethane, moisten the hull portion slightly. Use enough glue to evenly cover the hull surfaces, but not so much that the deck is floating in excess glue. This reduces the trimming cleanup.

When the glue is dry, the hull is unbolted and transferred to a Shaping Board and the deck is trimmed.
If the keel has been installed prior to this step use the following procedure to install the deck to the hull.

The hull is placed in a boat stand. Apply glue to the sheer and deck-beams. Align the deck and begin to wrap it with the bungee cord.

The deck is held down by wrapping the hull with a 12 foot length of 1/4” bungee cord. Start with a loop at the rudder - Keel and wrap towards the bow.

Check the alignment of the deck, it can slide out of alignment during the wrapping.

Pay special attention to the bow and stern where extra wraps are necessary.

Wrap in an X pattern, keeping tension on the cord.

The final wrap is from the stern to the bow. Tie off the end.

Wipe off excess glue.

If a heavier, 3/4” plywood boat-stand is built, it can be mounted on the building board and the kelless system can be used to hold the deck on. This was the standard system until recently, but is no longer recommended.
DECK: TRIMMING

The deck is trimmed using a trim plane and sanding blocks.

Attach the hull to the trimming jig and mount the hull horizontally in a vice.

Leave the tape on the sheer until the final sanding. This protects the hull from over trimming or sanding.

The edge of the deck is a continuation of the hull and is a continuous changing bevel. The bevel is straight at amidships and becomes more extreme at the ends.

Start at amidships, STATION 20, and trim forward to the bow. Trim in a diagonal motion, the X pattern of finishing the hull.

Plane and sand in a diagonal direction, to prevent flat spots.

The aft section of the deck has the most extreme bevel.

Sand with 80 grit to start and finish with 150 grit.

The tape will ware off by the final sanding.
DECK: TRIMMING THE TRANSOM

The first step in trimming the transom is to tape off the top surface. This helps prevent tearout of the deck.

Cut the excess decking off in an arc that matches the transom, leaving 3/8 to 1/2 inch.

Turn the hull keel up and rest it on soft pads. Use a sanding block to slowly work the transom deck edge back towards the transom.

Make the edge angle match that of the transom. When the edge is within 1/16 “ switch to a finer grit and finish off.

Finish the feather edge off by flattening it, this will help prevent chipping when the boat is in use.

Carefully remove the tape. Use a heat gun if necessary.

The hull – transom edge should make a Vee shape. Be careful not to round over the edge at the sheer.
To lay out the location of the cockpit and the mast hole, use a straight edge and run a centerline from the tip of the bow to the center of the transom. Lightly mark only the center section, starting about 20” back from the bow.

Use a pair of dividers to check the center line, at amidships or STATION 20. It is important to make sure the line is on center. If the cockpit is off center, it will be visually apparent.

The cockpit is opened by using a 2–1/4 inch hole saw to cut out the ends. Mark a center point for the hole saw at 20 inches and 27 inches from the bow.

Drill slowly and gently, rotating the saw in the cut hole. Cut trough at one point and gently increase the cut. This will eliminate tearout under the deck.

Connect the two holes with tangential lines drawn between the holes.
DECK: COCKPIT – CUTTING OUT

The sides of the cockpit are cut 1/4 “ inside of the drawn lines.
Use the trim plane to finish the edges.
Sand the underside of the edges.

DECK: LAYOUT OF MAST HOLE

A mast hole location jig is created by taking an 8 to 10” stick with a finish nail in one end.
The stick is slipped under the deck and the nail into the back of the mast hole.
Mark the exposed end of the stick at the forward end of the cockpit.
DECK: LAYOUT OF MAST HOLE

Remove the jig and place it on the centerline of the deck.

Align the pencil mark with the forward edge of the cockpit.

The nail will approximately locate the back of the mast hole under the deck.

Mark the spot lightly with a pencil.

Use a 1/8 inch drill bit to drill a pilot hole. It should go through with no resistance. Carefully enlarge the hole with a 1/4” drill.

Use the 3/16 rat-tail file to enlarge the hole gradually.

Expand the hole until it is 1/2 inch in diameter.

If the mast is finished, test fit it.

SEE Page 84 for cutting to the proper final length.

Finish sand the deck and seal coat it with varnish.
HULL:

FASTENING KEEL TO HULL

The keel is attached to the hull once the final shaping is completed on the exterior and interior of the hull and the deck is installed and trimmed.

Tape all the glue joints.

Final dry fit for alignment.

Moisten all joint surfaces with water for the urethane glue.

Apply Urethane glue to the keel-ballast joint. Squeeze the joint together. Wipe away excess glue.

Insert the keel and keel bolts onto the hull.

Apply glue to the keel - hull joint.

Push the keel against the hull.

Tighten the keel bolts.

Wipe off excess glue.

Let glue cure for 6 to 12 hours.

Remove tape from the keel.

Finish sand the joints.

For epoxy glue: Same procedure, but do not moisten the joint surfaces.
PART 11

PAINTING

TOPSIDES

BOTTOM
PAINTING: TOPSIDES

OVERVIEW: Painting is the last step before rigging the boat. It can be as time consuming as one chooses it to be.

A good choice is a 3 foot paint job, i.e— it looks good from that distance.

TECHNIQUE: Several thin coats are preferable to one thick one. Thin coats dry quickly and flow on smoothly.

There are two basic choices in painting, spraying or brushing. In either case, preparation prior to painting will determine the quality of the finish.

The paint schedule is as follows for a two color hull:

sealer : 3 coats, sealer or clear shellac

Tape off waterline for topside & deck

Primer Topside — 2 coats

Putty — As necessary

Sand — 150 & 220 grit

Primer — seal the putty

Sand 220

Color coat 1

Color coat 2

Sand lightly — 240 grit

Color coat 3 — let dry 2 days

Tape waterline on top edge of existing taped waterline
PAINTING:  

BOTTOM & DECK

Painting the bottom is done in the same manner as the topsides.

Prime as necessary with shellac

Sand 150 & 220

Putty

Sand

Prime

Sand 240

Color coat 1

Color coat 2

Sand 240 — if necessary

Color coat 3

Rudder Blade — Paint at same time

The deck is varnished once the hull is painted. To keep varnish from running down the hull, make a tape dam by running masking tape around the hull at the sheer and 1/8 “ above the sheer. Build up the varnish with thin coats. Sand every other coat with 240. Six coats will give a nice finish.

A painting stand can be fabricated by cutting the deck camber into the end pieces and covering the surfaces with foam.
PART 12

MAST & BOOMS

Construction
Hardware Installation
Fitting to hull
Booms
MAST: CONSTRUCTION

OVERVIEW:

The mast is made in the traditional way real masts are. Start with a square piece of stock and trim the edges into an octagon. The octagon is then sanded into a tapered circular mast. The finished mast should be 1/2” in diameter at the deck and 3/8” at the masthead.

MATERIALS:

The mast is made from a blank of 1/2 x 1/2 by 60 inch piece of wood. Red Cedar, Alaska Yellow Cedar or spruce can be used. Hardwood doweling is not used because the of the weight.

TOOLS:

Trim plane, 80, 150 & 240 grit sandpaper

Use the trim plane to start a flat between the two faces. The flat should be 1/8” in width.

Do one flat at a time.

Once the octagon has been created, pick one end to be the top, masthead, of the mast.

Measure down 19 inches from the masthead to locate the spreader. This is one inch more than the actual location. Once the mast is shaped, the inch can be cut off from the mast head, if necessary.

Taper the upper portion of the mast from the spreader to the mast head. The mast head should be about 3/8 “ in diameter.
Mast: Construction

The mast is finished by rotating the mast in a piece of sandpaper held in a cupped hand. The technique is a combination of running the mast over the sandpaper and rotating it at the same time.

Start with 80 grit and as the mast progresses, go to finer grits to remove scratches.

The ideal mast is one continuous taper from the deck to the mast head. For practical purposes, the mast is 1/2” diameter from the deck to the spreader and then tapers from there.

Lumps in the mast can be removed by running the mast over a sanding long board. While rotating the mast.

Varnish the mast with four coats of shellac or varnish.

Mast Layout Jig:

The mast layout jig is a 4” wide board which is 5 feet long. Cut out and glue the hardware pattern, provided in the plans, on to the board.

A notched stop is attached at one end and two low pads are placed on either side of the mast at the spreader to support and hold the mast.

A string is attached to the stop and is used as a centerline on the mast.
OVERVIEW: There are three steps to installing the mast hardware. The spreaders are first. The luff wire eyes are second and the gooseneck and main sail-sheet eye are last.

The mast blank is placed in the mast layout jig and the spreader location is marked on the center line of the mast.

Drill 1/16 " a pilot hole for the spreader bolt.

Chuck the 1-1/2 " x 2/56 threaded rod stud in a drill and screw it through the mast until it is equidistant on each side of the mast.

Screw the 2/56 nuts on each side and tighten them. Super glue can be used to secure the nuts.

LUFF WIRE EYES: There are five luff wire eyes. They are aligned in a straight line on the back side of the mast at 8” intervals. The luff wire is run through them. This is how the sail is attached to the mast.

Put the mast back in the jig and rest the spreader stud on the two pads.

Stretch the centering string down the mast. Tension the string by placing a shallow saw cut in the end of the mast butt and pulling the sting into it.

Use an awl or pencil to mark the luff eye location in the middle of the back of the mast.
Drill the holes for the luff eyes with a 1/16" drill or smaller. To avoid drilling through the mast, tape off the drill bit so only 1/4" is showing at the tip.

To drill the holes vertically, visually check the drill angle along the mast axis and at a right angle to it.

The luff wire eyes are fabricated from 1/16” stainless steel cotter pins. Four are cut off to 3/8” length and one is cut to 3/16”.

The longer eyes are put in the lower four holes and the shorter one is put in the upper most hole.

Align the eyes such that when looking down the mast, it is possible to look through all the eyes.

The eyes are held in by spring tension and or Super Glue. Spread the cotter pins slightly and insert them in the holes. Tap them lightly into place.

Do not drive the pin in the hole until the loop at the end is flush with the mast, this will prevent the sail from moving freely. Leave the eye 1/8 inch above the mast.
MAST:  

CUTTING TO CORRECT HEIGHT

To ensure the mast and boom height is the same on all PIRATE’S, the mast jig has a Deck line which is the point at which the mast must be at the deck.

The Deck Line is usually scratched into the mast with an awl. It is marked on the mast plan.

For rigging purposes a piece of tape is wrapped around the mast with its bottom edge touching the line.

The mast is placed into the mast hole, some filing may be necessary to enlarge the mast hole, and it is set into the mast step.

The distance between the deck and the deck line is measured. This distance is the amount that needs to be cut off the mast.

Do not cut all of it off. Leave the mast about 3/4 inch longer and trial fit it again.

Sand a taper around the bottom 1/2” of the mast. This makes entry into the mast step easier. The mast step depth must be taken into account at each measurement. The mast must fit into the mast step.

Repeat the cut and taper process, until the mast line is level with the deck.

The mast is now ready for the sails.
BOOMS: MAIN & JIB

The booms are made out of red cedar or equivalent wood.

The MAIN BOOM dimensions are 23 x 5/16 x 1/2. The edges are rounded over to simulate an oval shape. It can be tapered on both ends.

The boom is varnished or shellacked to the desired finish.

An eyelet is put in one end for the gooseneck.

A tack eyelet is put on the top of the boom about 3/8 inch from the end of the boom.

The main sheet is run through an eye on the bottom of the boom six inches from the end.

The JIB BOOM is made of Red Cedar. Its dimensions are: 10-3/4 x 5/16 x 3/8. All edges are rounded to simulate an oval.

There are four eyelets on the boom.

The jib is attached to an eyelet on the top 3/8 “ from the front.

The boom is attached to the deck by an eye and a swivel 2” back from the front and on the bottom.

The jib clew is secured to the top of boom by a eyelet 3/8” from the end.

The jib sheet is run through an eyelet 3/4 “from the end on the bottom of the boom.
CHAPTER 13
SAILS

Layout
Cutting
Sewing
Jib Rigging
Solid luff wire
Soft luff wire
SAILS : LAYOUT

OVERVIEW:  The sails are designed to have a foil shape, just like the sails on the real PIRATE. The sails may look like simple triangles, but the edges are all curved, which give the sail its shape.

MATERIAL:  1 yard of 36” 3/4 ounce Dacron sail cloth.

72” 1” Dacron tape

72” 1/8” double stick tape

24” 3/4 “ Dacron adhesive tape

NOTE:  WORK ON CLEAN SURFACES. SAILS ARE DIRT MAGNETS. THEY SHOW EVERY SPECK OF DIRT.

Lay the sail plan out on a flat surface. Lay out and cut the main sail first and the jib, second.

Unroll the sail cloth on the sail plan and align the weave with the leach of the sail. An instruction arrow is on the sail plan. Weight, tape or pin down the sail cloth to prevent movement.

Trace the outline of the sail on to the cloth using a #5 pencil. Make the trace as light as possible to minimize smudging onto the cloth.

Mark the reinforcing patches for the corners of the sail and the batten locations, use a line at the leech and a point at the end.
SAILS:  CUTTING & CONSTRUCTION

Rough cut the sail using a pair of scissors. Leave an inch on the sail for final trimming.

Trimming of the sails is done with a hot knife, which sears the edges. If a hot knife is not available, a soldering gun with a flat blade should be tried.

For best results with a hot knife, cut the sail with a piece of glass as a backing. The melted Dacron does not stick to it and the blade will not burn or melt it.

Re-enforcing patches are cut from signal cloth, which is heavy Dacron with adhesive on one side. Apply the patches. In the case of double patches on the clews, apply the smallest first and then the larger one over it.

BATTENS: Each sail has battens, they are on the leech of the sail and keep the edge from curling over. The Main has four and the Jib has two. The lengths are specified on the sail plan.

Cut the battens from the tail of a 1/8” nylon zip tie.

Batten pockets are made from single backed tape that is cut 3/4 “ longer than the batten, One end is rounded.

The batten is placed on the sticky side of the batten pocket, the ends of the pocket are turned up and the batten is aligned to marks on the sail and pressed down, trim off any excess.
SAILS:

SEWING THE LUFF POCKET

The luff, or leading edge, of both the sails has a pocket sewed on to them. The pocket will hold a wire that is used to hold the Mainsail on to the mast and support the Jib.

The Jib luff pocket has a #12 wire run through it, which supports the jib. It is called a forestay.

The pocket is made by folding a length of 1“ Dacron luff tape in half. It is 4 to 6 inches longer than the sail luff.

The tape is pinned down at both ends and tensioned. One edge then has 1/4” double stick tape applied to the outer edge of the tape, leaving the inner 1/4” clear of tape.

The luff edge of the sail is then carefully pressed on to the double stick tape, following the curve cut in the sail.

Make sure there are no wrinkles in the sails, reset the sail if necessary.

Fold the tape over on itself on the excess beyond the sail. This will give a lead for the sewing of the luff.

A single line of single stitching is run down the outer edge of the luff tape as close to the outer edge as possible.

Tack stitch each end of the single stitching.
RIGGING: MAIN SAIL — ATTACHING TO MAST

Attaching the main sail to the mast is the first step in rigging the mast.

Lay the mast and main out together, on a flat surface. Attach the boom to the gooseneck.

Move the main sail tack to just above the gooseneck and boom. Move the luff against the mast.

Mark where the luff eyes touch the sail with a light pencil mark.

Insert a 3/16 x 36” brass rod into the sewn luff pocket.

Use a hot knife or soldering gun with a flat tip, to create an opening 1/4” long by 3/16” deep for the luff eye to rest in.

The mainsail should fit on the mast with the luff eyes fitting in the center of the pockets cut for the eyes.

Screw a small eyelet into the tip of the mast.

Begin running a 60 inch length of #12 wire through the mast head eyelet and into the sewn luff pocket. Snake it through each eye until it comes out at the gooseneck.
RIGGING: MAIN SAIL ATTACHEMENT TO MAST

Feed the wire down the luff pocket, from the top of the mast and through each luff wire eye.

Check to see if the main sail swings freely on the mast. It should not bind or be wrinkled.

If the sail luff binds on the mast, gently pull a luff eye out until the sail is free.

The luff wire is passed through the gooseneck eyelet.

At the head of the mast, the luff wire is bent back on self and around the mast head eye. Leave a tail on the wire that is long enough to be tucked about 1/2 “ into the luff wire pocket.

Clip the luff wire off about 3/8” inch below the gooseneck eye.

If a luff eye pulls out and is loose in its mast hole, put a drop of super glue in the hole and reinsert the luff eye.
The jib is attached to the mast by a wire forestay. It is the same gage as the mainsail luff wire, #12 and 36 inches long.

The wire is run through the luff pocket. No eyes are required, unlike the main mast.

The lower end of the wire is attached to the tip of the jib boom by running it through the eye and crimping the end back about 3/4 inch.

The luff wire can be trimmed to length once the tack portion is finished and it is attached to the boom.

A swivel is attached to the top end of wire by crimping the wire back on to itself.

The wire and swivel should extend about one inch beyond the head of the sail.
The jib is attached to the mast by a soft wire or Kevlar forestay. It is 36 inches long. Braided picture hanging wire or Kevlar line is used.

The wire is run through the luff pocket. No eyes are required, unlike the main mast.

The lower end of the wire is attached to the tip of the jib boom by making an eye. The eye is made by running it through the screw eye and crimping it in a ferrule made of soft copper tubing.

The luff wire at the head of the jib can be trimmed to length once the tack portion is finished and it is attached to the boom.

A swivel is attached to the top end of wire by making an eye to capture it.

The wire and swivel should extend about one inch beyond the head of the sail.
PART 14
RIGGING

BOWSERS
SPREADERS
DECK FITTINGS
SHROUDS & SHEETS
Before the standing rigging shrouds are attached to the mast; seven bowsers must be fabricated.

A bowser is nautical term for a toggle, which is a friction device that allows the tensioning of the shrouds without tying a knot.

The bowsers for the Pirate rig are made by burning three holes into a 5/16 inch wide tail of a nylon zip tie.

A 3-d nail is bent into an L shape. It is heated to cherry red with a propane torch and series of 3 holes are burned down the center line of the tie, about 1/8” apart.

Leave 1/4” or more between the sets of holes.

Use a chisel to scrape off the melted nylon from the burnt holes.

Cut individual pieces from the strip, leaving about 1/8” on the ends.

The bowsers can be shaped to ovals by sanding the ends or touching the ends to a grinding wheel.
RIGGING: SPREADERS

The spreaders are used to carry the load on the upper part of the mast by creating a truss.

The spreaders are cut from 1/8 “ brass tube. Two are cut 3-1/2 “ long.

The best method is to put hacksaw with a very fine blade in a vice and rub the tube back and forth over the blade. An alternate method is to use a tubing cutter. A third method is to use the wire cutter in a needle nose pliers and cut the tube 1/4 “ longer and then grind it back on a grinding wheel.

Eyes to hold the shroud at the end of the spreader are made from 1/16” stainless cotter pins.

In one end of the spreader tube add a drop of urethane glue, insert the cotter pin and swage the end with needle nose pliers.

Spread the cotterpin slightly before inserting it in the spreader. This keeps it from slipping out before it is swaged.
RIGGING: DECK FITTINGS AND LAYOUT

The Chain Plates and Sheet eyes are laid out and installed before the shrouds can be rigged.

Use a template with an indexing hole that uses the mast hole. After aligning the template to the centerline, use an awl to mark the fitting location of the Jib boom attachment, Jib sheet fitting and chainplates.

The chain plate eyes should be 1/4 inch in from the sheer.

Open the chain plate eyelets slightly before screwing them in, so the shrouds can be slipped on and off.

Dress the eyelet threads with paraffin wax, for ease of installation. (It really does make a difference.)

The Main Sheet fitting is located separately.

The hull is now ready for rigging.
RIGGING:  \textbf{SHROUDS}

The shrouds hold the mast in place and take the load put on the mast by the sails. The more the boat heels the greater the load on the shrouds.

The \textit{PIRATE} has two pairs of shrouds, an Upper and a Lower. The upper pair is 62 inches long and the lower pair is 39 inches long.

The Lowers are attached to the mast by tying a soft eye, which goes over the spreader on the opposite side of the mast and around the mast.

Tie the soft eye as close to the mast as possible, but not on the mast, so the lower runs smoothly to the Chain Plate Eye in the deck.

Rig a Bowser to the other end of the shroud. Slip the loop formed by the bowser through the eye in the deck and it tighten up.

Repeat the procedure for the other side of the mast.

The Upper Shroud is done the same way, except that the shroud is run through the spreader eye and an eye at the head of the mast.

The Upper Shroud uses the same Chain Plate Eye as the Lower.

Separate chain plate eyes about 1” apart can be used, but it is not necessary.
RIGGING: SHEETS

Each sail has a sheet, a line, which connects the boom and sail to the boat. They are the means by which the sails are trimmed.

Each sheet has a Bowser, which allows for adjustment without tying a knot each time the sail is adjusted.

The Main Sheet is the longest, 42 inches. It starts with at an eye on the after deck, goes through an eye on the boom, through a bowser and then through an eye on the mast.

The Jib Sheet, 22 inches, follows the same path, except that it goes through the boom eye at the swivel.

The sheets are trimmed to balance the boat.
PART 15

RADIO CONTROL
At the present time only steering is used in the boats. The RC unit used in the boats is the JRC “Beat Gear” unit. It has two channels.

The connecting rod is made of 2-56 threaded rod, two stop nuts and two snap ends. The rod is approximately 5 inches long.

The rod is attached to the inner most hole on the tiller arm. Attach the other end to the middle hole in the servo arm.

Use the longest servo arm supplied in the RC kit. To prevent interference, the aft facing arm is clipped off.

If the rudder shaft was not trimmed during construction, insert the rudder in the rudder tube and trim the shaft to just clear the underside of the deck beam.

The Tiller arm is a standard R/C Aircraft Steering arm. Its bushing hole is 5/32 and the rudder shaft is 3/16. Carefully sand the rudder shaft to fit the arm. File a flat on the front of the shaft for the tightening bolt to seat on.

Replace the screw in the tiller arm with a s/s socket head bolt.
RADIO CONTROL: Servo Platform

The servo platform is made of two pieces. A base and the platform.

The base piece is made to fit between the keel bolts. It is drilled for two screws, pilot the holes. It is 3/4 to 1" in width.

The platform is cut out of 1/4 inch plywood. It is cut out to accept two servos, one for steering and the other for sail trim, which is not used at this time.

The platform is varnished or sealed to provide a waterproof surface for the velcro to stick on. It is screwed separately onto the base. This allows for easy removal.

A servo is fitted into the horn on the after end and screwed into place. Pilot the holes for best results.

The battery pack is secured forward of the servo with velcro.

The receiver may be placed forward of the battery pack or under the deck. The on-off switch is placed forward or on top of the battery pack.

The antenna is lead out of the cockpit and run up the mast or through a small hole in the deck aft of the mast. A small grommet, from the servo kit, can be put in the hole for a nice finished penetration.

NOTE: Regular AA Batteries will last for hours. Do not buy rechargeable ones.
PART 16

APPENDICIES

Tool List
Material List
Casting Keels
APPENDIX 1 TOOL LIST

HAND TOOLS

Trim Plane - Stanley
Block plane - Low Angle (Optional)

Spoon Plane (Optional)
Chisel - 1 inch
Chisel - ½ inch
Gouge - 1 inch
Gouge - ½ inch

Rasp 12 inch Half Round Tapered — Rough
Rasp 10 inch Half Round Tapered — Medium
Finishing file — 8 inch
Horseshoe Rasp - 6 inch
3/16 File - Rat Tail

Mallet
Hammer
Tri-Square — 6 inch
Dividers — 8 inch
Hand Drill
Saw - Japanese or fine tooth
Scissors
Hot Knife
Propane Torch
Needle Nose Pliers
POWER TOOLS

Band Saw 9" or bigger
Variable Speed Drill 3/8 or 1/2 inch
Drill Press

DRILL BITS

1/2 inch (Brad Point – Ideal)
1/4 inch
3/16 inch - 8 inch shank
1/16 inch
#50
Forstner Bits
Hole Saw - 2-1/4 inches
APPENDIX 2 MATERIALS LIST

HULL & DECK

\[
\begin{align*}
\frac{3}{4} & \times 6 \text{ Sugar Pine} \quad 16 \text{ feet} \\
12 & \times 48 \text{ Mahogany Door Skin} \quad \text{Deck}
\end{align*}
\]

JIGS & PATTERNS

\[
\begin{align*}
\frac{1}{4} & \times 4 \times 8 \text{ Hard Board (Half Sheet)} \\
\frac{3}{4} & \times 12 \times 48 \text{ Plywood - Laminating Board} \\
\frac{3}{4} & \times 12 \times 24 \text{ Plywood - Shaping JIG} \\
\frac{3}{4} & \text{ Plywood - Miscellaneous Jigs}
\end{align*}
\]

\[
\begin{align*}
2 & \quad \frac{1}{4} \times 8 \text{ NC Carriage Bolts} \\
2 & \quad \frac{1}{4} \times 2-1/2 \text{ NC Carriage Bolts} \\
2 & \quad \frac{1}{4} \times 1 \text{ Fender Washers} \\
2 & \quad \frac{1}{4} \text{ Wing Nuts}
\end{align*}
\]

KEEL

\[
\begin{align*}
\text{Lead Ballast - Pre-cast} \\
2 & \quad 10/24 \times 6'' \text{ Machine Screw} \\
2 & \quad 10/24 \text{ S.S. Nuts} \\
2 & \quad 10/24 \text{ S.S. Fender Washers - 1 inch}
\end{align*}
\]

RUDDER

\[
\begin{align*}
\frac{3}{16} & \text{ Brass Tube} \quad 4 \text{ inches} \\
\frac{7}{32} & \text{ Brass Rod} \quad 6 \text{ inches} \\
\#18 & \text{ Escution Pin}
\end{align*}
\]
MAST

\( \frac{1}{2} \times \frac{1}{2} \times 60" \) Red Cedar - Main Mast

6 1/16 cotter Pins - Cut to 5/8" length

3 .054 x 7/16 Eyelets

1 2/54 Threaded Rod - 2-1/2 inches

2 2/54 Nuts (2 each)

6 1/16 S.S. Cotter Pins

2 1/8 x 3-1/2 Brass tube - Spreaders

2 1/16 cotter pins

BOOMS

5/16 x 24" Red Cedar - Main Boom

5/16 x 5/16 x 12 Red Cedar - Jib Boom

4 .054 x 7/16 Eyelets

4 .063 x 1/2 Eyelets Gooseneck

6FT Luff Wire - #12 galvanized Steel

RIGGING

20FT 90lb Dacron Kite String

2 Upper Shrouds 62 inches

2 Lower Shrouds 39 inches

1 Main Sheet 42 inches

1 Jib Sheet 22 inches

2 Swivels - 40# S.S.

3 12in Electrical Zip Tie # Tail

7 Bowser - 3 Hole

4 .063 x 1/2 Eyelets - Chain Plates & Sheet Eyes
CRADLE
1 Base 3/4 x 17 x 6 Wood
2 Uprights 1/4 x 7 x 9 Plywood
6 Screws #6 x 3/4 Round head
12in 3/4 Pipe Insulation - Padding

ADHESIVES
Polyurethane Glue - Ultimate Glue
G-5 Epoxy Kit – Small
Ultra Light Fairing - Polyester putty
Spray Adhesive
Plastic Squeegee
Bungee Cord 1/4” - 12ft

ABRASIVES
40 Grit Sandpaper - Adhesive Backed
80 Grit Sandpaper - “ “
120 Grit Sandpaper - “ “
220 Grit Sandpaper - “ “

PAINT
Masking tape 3/4” - 3M Blue
Paint Thinner
Varnish
Chip Brushes – 1 inch
Tack Rag
SAFETY EQUIPMENT

Vinyl Gloves
Safety Glasses & Goggles
Dust Masks

SAILS

1yd Sail Cloth - 3/4 oz. Dacron
6’ 1” Luff Tape – Dacron
1ft Signal Cloth
2’ Single sided Dacron tape
8’ ¼ double sided tape

DETAILS:

LUMBER

Sugar Pine 16 lineal feet ¾ x 8” – Pattern Grade
Door Skin 12 x 48 Mahogany
Red Cedar 2 x 2 x 6 or Common Length – Clear

FASTENERS & METAL PARTS

2 ¼ x 8 Carriage Bolt
2 ¼ x 2-1/2 Carriage Bolt
2 1” Fender Washer
2 Wing Nuts

2 10/24 x 6 Machine Screws
2 10/24 Nuts Stainless Steel
2 1” Fender Washers Stainless Steel
1 1/8” Brass Tube – Spreaders (3-1/2”)
1 7/32” Brass Tube – Rudder Tube
1 3/16” Brass Rod – Rudder Shaft
<table>
<thead>
<tr>
<th>Quantity</th>
<th>Description</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>.063 x 1/2 Eyelets - Goosenecks and Chain Plates</td>
<td></td>
</tr>
<tr>
<td>X</td>
<td>.054 x 7/16 Eyelets - Mast &amp; Booms</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>2/56 x 2-1/2” Spreader Rod</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>2/56 nuts – Brass</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>1/16 x 3/4 Cotter Pin – Stainless Steel</td>
<td></td>
</tr>
<tr>
<td>10’</td>
<td>#12 Steel Wire – Galvanized – Luff wire</td>
<td></td>
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</table>

**Radio Control**

<table>
<thead>
<tr>
<th>Quantity</th>
<th>Description</th>
<th>Notes</th>
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<tbody>
<tr>
<td>JRC</td>
<td>BEAT GEAR – 2 Chanel 75 Mhz</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>5/32 Landing gear arm (tiller arm)</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Snap clips – 2/56 thread</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>2/56 nuts – Brass</td>
<td></td>
</tr>
<tr>
<td>5”</td>
<td>2/56 threaded ready rod</td>
<td></td>
</tr>
<tr>
<td>4”</td>
<td>Velcro strips</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>AA batteries – 10 for transmitter 4– Servo</td>
<td></td>
</tr>
</tbody>
</table>
Appendix 3: KEEL CASTING:

The keels are cast in a mold. For a single keel this can be made of Plaster of Paris. The pictures here are for a custom metal mold used at the Center for Wooden Boats.

The lead, about 3-1/2 pounds is heated in a plumbers pot on a white gas stove or a propane stove for large pots.

The Propane stove is best.

It is best to use a 5 pound block, this gives an adequate amount to pour.

The mold is set up in the holding jig and leveled in all axis.

The mold must be preheated, to prevent warping and cracking. This is done with a propane torch provided in the keel mold box. Heat the mold cavities until the outside of the mold cannot be touched by a bare finger.

Insert the keel bolt cores in each mold, 3/16” wooden dowels. Make sure they are parallel and aligned.

Make sure no water has condensed in the mold from the propane flame.

Wear gloves, face shield, and long sleeves and dust mask.

Pour the lead in a slow steady stream until it reaches the top of the mold. Avoid excess lead which will require trimming.

The lead will shrink and cause a hollow to form in the top of the keel. This is normal.

Wash hands thoroughly before eating.
Pond Boats: Sailing
KIT PRICE LISTS

PIRATE PLANS KIT:  $40.00
The basic plans kit consists six sheets consisting of four drawings and two historical reprints of newspaper promotions.

Lines Plan: Reproduced from the original drawing.

Lift Templates: Templates for each lift used to fabricate the hull and jigs to help align the keel

Sail Plan: Main and jib and patch templates. Plus dimensions for the booms and spreaders.

Details: Sheer plan, mast layout, and fabrication jigs.

Newspaper reprint: Los Angeles Evening Herald

CONSTRUCTION MANUAL - FREE
A 130 page illustrated manual available on line at cwb.org - store page.

KEEL KIT:  $ 40.00
A 3.5 pound lead keel cast from a mold. The keel comes bored for keel bolts.
Kit includes keel bolts, washers and nuts. The top edge may require some final flattening to mate with the deadwood.

RUDDER KIT:  $ 10.00
A brass rudder shaft, tube, rudder blank and brad. The shaft is 3/16 diameter and six inches long it is drilled for a brad. The rudder tube is 2 inches long and is 7/32 in diameter. The rudder blank is plywood.

RIGGING KIT:  $ 25.00
This kit provides all the necessary materials for rigging a Pirate. The kit consists of the spreaders, spreader rod with nuts, luff wires, cotter pins, eyelets, swivels, bowsers and line for shrouds, sheets.

SAIL KIT:  $ 40.00
The kit consists of a main and jib which are precut. Luff tape, double stick tape, corner patch material, battens and batten pocket tape.
KIT PRICE LISTS

SAIL SUIT: $ 120.00

A finished suit of sails, consisting of a main and jib ready to be fitted to a mast. Main sail is not burned for luff eyelet connections.

SHIPPING:

Plans: $ 12.00
Keel: $ 12.00
Rudder $ 3.00
Rigging $ 5.00
Sails $ 12.00