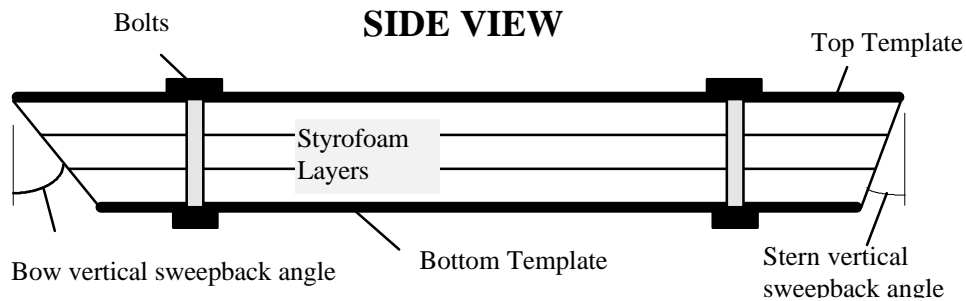


## STEP BY STEP INSTRUCTIONS FOR CREATING STYROFOAM BOAT HULLS

1.) Design (paper) templates for the top and bottom of the boat hull. If you are the artistic type (I am not!) you can draw them free hand. If you choose this method, first draw a centerline (using a ruler) then draw one side of the hull. Fold the paper about the centerline, and cut it out with a scissors [this will assure that the hull is symmetric].

Otherwise, you may want to try out the quick basic program boat2.bas, which will allow you to design a variety of hull shapes by providing a number of critical "control point" parameters. A discussion of these parameters is already available on the web under [www.ee.ttu.edu/lab/robot](http://www.ee.ttu.edu/lab/robot) under the "Dazzlin' Daves Latest Project" link, and will not be discussed further here. Note that the "bottom" hull template is typically shorter than the top hull in order to give the bow a "sweepback" angle, as shown in the side view below. Also, the bottom hull is usually narrower than the top hull, in order to give the hull some degree of a "vee" shape.



The program boat2.bas will (optionally) create an ".eps" encapsulated postscript file. You must have access to a postscript printer in order to print out this drawing, which is a full-scale drawing. Otherwise you can simply have the program print out a list of "half-beam" widths. You can then draw out the pattern using a ruler and pencil as follows:

Draw a centerline on a piece of paper (for hulls longer than 9" you will actually draw out the front part of the hull on one sheet, the rear part of the hull on another sheet, then tape the two sheets together later). Now measure back one inch from the bow (i.e. one end of the centerline), then measure out to each side by the first indicated measurement (printed out from the boat2.bas program) and mark a small dot there using a pencil. Then measure back two inches from the bow and repeat, making a pair of pencil dots for the 2nd half beam measurement. Then measure back three inches from the bow etc. until you have placed a pair of dots for all of the half beam measurements. Finally, "connect the dots" using a ruler or a french curve etc..

Shown below is an example of the file generated by boat2.bas, called "boat.txt", that gives the successive (1" spaced) half-beam measurements:

X pos.(in.) from bow	half beam(in.)
0	0 - in.
1	0 - 1 / 2 in.
2	0 - 29 / 32 in.
3	1 - 3 / 16 in.
4	1 - 13 / 32 in.
5	1 - 17 / 32 in.
6	1 - 19 / 32 in.
7	1 - 5 / 8 in.

8	1 - 19 /32 in.
9	1 - 17 /32 in.
10	1 - 7 /16 in.
11	1 - 9 /32 in.
12	1 - 3 /32 in.
13	0 - 13 /16 in.
14	0 - 1 /2 in.

Irregardless of how you made the paper templates, after you have drawn or printed out the templates, cut them out with a scissors.

2.) Make wood templates as follows. (The wood templates, when bolted to the styrofoam blank, serve as guides for the hot wire styrofoam cutters). First tape the paper template to the wood. I prefer a good thin hardwood such as 1/4" thick poplar slats available at Builder's Square. Then using a hammer and a small nail, use the nail to "punch thru" the paper (at the locations where you drew the "dots") and place a shallow nail hole in the wood. When done, "connect the dots" with a pencil (or French curve etc.) between the small nail holes.

Now, using an inexpensive keyhole saw (available with a very fine toothed blade) or a coping saw, cut out the wood template. A vise is very handy while doing this. Also, it is advisable to place a short 1x4 block behind the 1/4" wood to help support it during cutting (be sure to position the cut line just beyond the edge of the 1x4 - you don't want to have to cut through the 1x4 too!) and maybe even clamp the 1/4" board to the 1x4 using a suitable C-clamp. I suggest you cut "just outside the line". Later, you can use a sanding block to sand it back right to the pencil line. A sanding block can be made easily by just wrapping some sand paper around a 1x4 block of wood.

3.) Place the top and bottom wood templates against each other, aligning their centerlines. Presuming the bottom hull template is shorter than the top hull template, you will also want to hold the bow of the bottom template back from the bow of the top template, as this will give your hull a vertical "sweepback" angle at the bow (see the side view figure above). Now drill two bolt holes (you should clamp the two pieces together before drilling), at appropriate places near the bow and stern along the centerline.

4.) Make a styrofoam blank by layering several chunks of 3/4" styrofoam together, using double sided carpet tape to adhere adjacent layers. E.g., for my first hull, I used 3 layers, making my hulls  $3 \times 3/4" = 2-1/4"$  deep. Cut the styrofoam chunks with a keyhole saw, or even a sharp kitchen steak knife. Just make sure the chunks are bigger than the hull templates (you'll cut away the waste later).

5.) Lay the top hull template on top of the styrofoam blank and mark the boltholes with a pencil. Now drill the boltholes through the styrofoam, trying to drill the holes "straight down" (this is where a drill press is handy - it drills the holes perpendicular to the surface - a drill press is available in the basement project lab).

6.) Bolt the templates and styrofoam together. You can use metal bolts if you plan on removing the wood templates later. Some people may want to keep the top template and bolts in place as a convenient and solid surface to mount motors, servos etc. onto later. If you plan on keeping the bolts in place, be sure to use plastic or nylon bolts (available at Builder's Square, Home Depot etc.) as they are much lighter in weight than metal bolts.

- 7.) Now cut out the styrofoam using a hot wire cutters, using the wood templates to "guide" the cutting wire. A hot wire cutters will be made available later in the EE basement lab room.
- 8.) If necessary, finish the hull by sanding down bumps. If you have any unsightly "gouges", you may be able to fill them in using auto body putty (which will be sanded down later) or other suitable filling material. Be sure, however, to try out any fillers on a scrap piece of styrofoam first, to be sure that they won't dissolve the styrofoam. If necessary, cut another hull. Once you've made the wood templates, it's a cinch to make more styrofoam hulls!
- 9.) At this point, the hull is essentially finished. You may optionally paint it, or perhaps even cover it (maybe a hobby shop such as Wings and Things has suitable covering material?). You may want to wait until later, however, to do these finishing touches.