



CARLSON DESIGN

TULSA

1801 North 170th East Avenue Tulsa, Oklahoma 74116 tel 918 438-8344/8346 fax 918 438-8344

TO: Boat hull designers
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Hull Designer designs and expands for plotting the strakes, deck, bulkheads, and transoms to build a hard-chine plywood or similar boat hull at any scale. Hulls provides a visual, interactive design environment, including 3-d views.

**NOTE: YOU MUST SET YOUR WINDOWS PREFERENCES TO NUMBER
“DECIMAL = . “ AND “THOUSANDS SEPARATOR = , ”**

**NOTE: IF YOUR SYSTEM IS MISSING ANY SUPPORT FILES, GO TO
<http://www.carlsondesign.com/#Utilities>**

1. **Installation** Copy all the files provided into a directory. Create an icon or shortcut to *hull.exe*. Each time you start the program, the *default.hul* design file is loaded. Your work is periodically auto-saved to *default.hul*.

2. **Views** The three orthogonal views of the hull are pictured at the top. Clicking on any of the small views selects that view for the main window so that you can work on the hull nodes (X-Y-Z points in space). Click-and-drag the right hand mouse button to zoom in, click the right button again to resume the view.

The keyboard arrows keys or clicking the 'X/Y/Z' buttons will spin the 3D wireframe of the hull around for viewing. Clicking the 'CD' logo returns the 3D view to the default orientation. The 3D view is a slightly coarse wire-frame drawing; the panels will be faired with more points along the edges where they are created.

VRML This button creates a 3D VRML (Virtual Reality Modeling Language) *.wrl file that can be viewed with color, shadow, and texture in your web browser with the appropriate plug-ins.

3. **Chines** Set the number of chines desired, from 2 to 6. The chine number includes both the garboard (the chine between keel and strake 1), and the shear line. For instance, selecting '4' chines produces the keel panel plus 3 side strakes. Note that your keel panel may be zero width, and ignored, if desired.

4. **Bulkheads** Hulls *always* uses 5 bulkheads for shaping, although it splines 2 more fairing points along each chine between each bulkhead. The first, leftmost bulkhead, is the stem or bow transom (when it is reasonably wide), and the last, rightmost, is the stern transom. Like the keel panel, you may choose zero-width stems or transoms.

The middle three bulkheads may be placed anywhere inside the length of the boat, and are *always* held flat and vertical. The stem and transom may be 'bent' or turned at the chine ends as desired. Enter the station along the length of the boat (the stem is at zero station) for each bulkhead at the upper right. Turning on 'Lock' prevents fore/aft (Z) movements of the bulkheads.

NOTE: Bulkheads should be placed at stations where they provide the best desired overall shaping for your hull on the computer, even if you want to actually construct your boat with bulkheads in different positions. You can request construction Frames anywhere you want when creating patterns.

5. **Interaction** If your screen is larger than the Hull form, maximize the form so that you can best see the fairness of the lines. Choose the Section (aft) view. Click and drag the intersection points (nodes) between the bulkheads and the chine lines. Double-click to enter the X/Y/Z offsets directly for that point. Continually fair the chine lines as you develop your hull.



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Next, choose the Profile (side) view. Note that when you drag the center 3 bulkheads fore and aft (unless they are 'locked'), they stay flat and vertical. You may click and drag both the stem and transom off-vertical as desired. To return the stem or transom to dead-vertical, enter a new station position for them at the upper right. Fair the chine lines some more.

Now, choose the Plan view. Fair the chine lines some more. Note the maximum beam is calculated and shown at the bottom. Repeat the fairing process, 'Section > Profile > Plan', again and again until you are pleased with the hull's fairness in all views. Don't worry about maintaining the hull's exact final length yet.

Use the keyboard's arrow keys or the 'X/Y/Z' buttons anytime to see the '3-d' wireframe view of the hull.

6. Figures Under the 'Open' window, you may click on any of the figures to place them in or around your hull. While you are working with a figure, you cannot adjust the boat. Click the figure in the Open window a second time to unload. Note that the figures are inches.

7. LOA Rescale your hull to a finished length overall (LOA). If you are going to build a scale model, consider saving your design first at the full scale so that you do not lose accuracy when scaling back up.

8. Data Click the 'Data' button to see your nodes' actual 'X-Y-Z' positions. In any view except 3D, the lower left corner is always at 0-0. 'X' is from the centerline out to the gunwale (beam), 'Y' is from the bottom of the keel up (freeboard), 'Z' is from the stem aft (length or bulkhead station).

Click on any offset to change it in decimal inches in the input box. You can work in inches and eighths; note that '5-4' is equivalent to '5 4/8' or '5.5'. Add a '+' or '-' on the right-hand side of your input to add or subtract another 1/16" to your input. For instance, '5-0+' is equivalent to '5 1/16' or '5.0625'. Click 'Done' when you are done.

Metric With the LOA feature, you may enter offsets in whatever **units or scale** you like. Use the LOA button afterwards to rescale the whole hull back to 'Length (in inches) OverAll'. (Note: 1 inch = 2.54 cm, be sure to use the decimal convention 0.00, not 0,00)

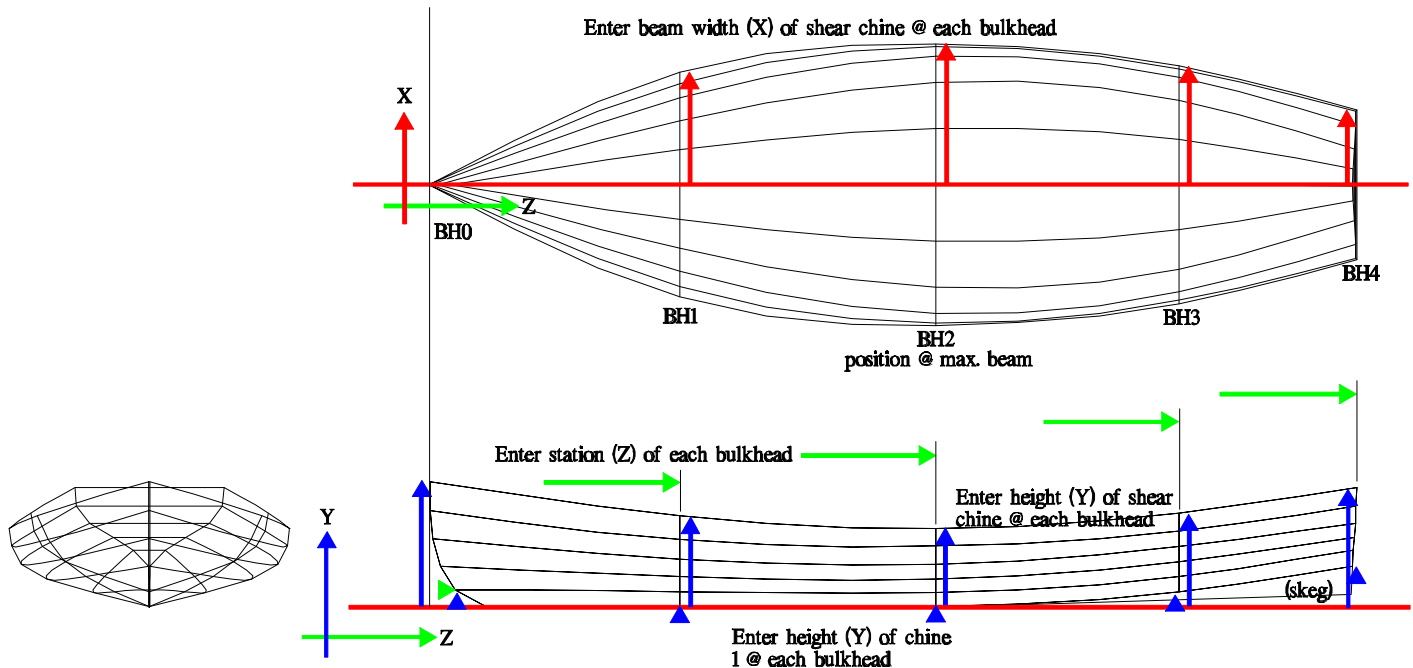
The 'Data' table method is useful in taking lines off an existing drawing. First, strike a bulkhead line across the maximum beam of both profile and plan views. Then, place the two intermediate bulkheads halfway or so to both the stem and stern. Use any scale to measure your drawing, since you can later Rescale the whole boat to the required LOA (do try to use a scale such that most of your measurements are larger than 1 unit).



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First, measure and enter the X (beam width), Y (height), Z (length from bow) dimensions for the shear line (the highest number chine you are using becomes the shear line) at each bulkhead. A shortcut for entering the 'Z' dimensions is to enter them in the boxes on the upper right of the main form. Enter the Z dimensions. Then, do the same thing for chine 1, which is your keel chine line. If you keel has zero width, all your 'X' dimensions will be zero.

Ignore your intermediate points while you establish the shear chine and keel chine. Then, close the 'Data' window and go to the 'Sections' view and begin roughing in the bulkheads one at a time by clicking and dragging. Go to the 'Profile' view and further fair the chine lines. Also, adjust the stem and transom points fore and aft if they are not plumb. Be careful not to re-enter the stem or transom position in the upper right input boxes, or they will be placed plumb again.

When you are through fairing the boat in all three views, use the 'LOA' button to rescale the boat to the proper LOA in inches.

9. WL/Disp The **WL** button will display any waterline desired on any of the three orthogonal main views and report the cubic inch displacement and weight of water displaced. The **Disp** button will sink the hull until the weight of water displaced equals the desired displacement (combined weight of hull, gear, and occupants). This shows you how the hull will float at any given total load. Note that fore-and-aft trim is ignored (i.e. boats, in reality, pitch some as they are loaded.) Reset the WL to zero anytime eliminate its display on the views.

10. Pitch/Heel You can enter a **Pitch** angle to raise or lower the bow of the boat. (The Y-Z offsets will change, so be careful not to save if this will be a problem.)

The most interesting view for entering a **Heel** angle is the Section view. The hull's CG (center of gravity) is placed at the centroid (center of volume) of the hull, by assuming your hull structural weights will be homogeneous. The CB (center of buoyancy) of the hull is the centroid of the part of the hull below the waterline. As the hull heels, the CB shifts out sideways from under the CG and a righting moment is produced. At present, there is no provision for ballast or equipment, which also effects moment. Heeling under the plan view shows you the effect on the shape of the waterline.



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11. **Save/Create** You may want to build with **Frames** at stations other than where you have designed with bulkheads. In the 'Save' window, enter up to eight stations for construction Frames (your requests will be moved if they are not completely between the stem and the transom). You will still get your bulkheads which you may choose to use or ignore.

Enter a name of the form *hullname.hul*, and click 'Save'. A '3-d' file of the form *hullname.dxf* is created for import into CAD programs for further study of the design (the expanded panels are not included in this dxf).

Hulls then creates *carlson*.uc* plot files (a special format for our own plotter/cutters) and a *handplot.txt* file for the bulkheads, frames, stem, transom, and expanded strakes, keel, deck and up to 2 soles. If the stem and transom were not vertical, they will be elongated as required to properly meet the strakes (you will have to make cuts or bends in the stem and transom patterns as appropriate). Each strake is marked top and bottom, fore and aft. These patterns may be plotted on Carlson Design plotters. Also, HPGL and DXF may be created for importing to other CAD programs.

12. **Nesting** After producing patterns, you may enter the pattern Nesting window. If you are using other than 4 by 8 foot plywood, you can enter a custom sheet size. Pick and place patterns you want on the sheets of material. You may use the hand-measure dimensions on the screen, or save a hand-plotting text file of your nesting.

Support

I am happy to correspond with you by email to discuss your projects, questions, bugs, or suggestions. If possible, please attach your *.hul file to your email (please note if you do not want your design added to the distribution *.zip.) Please bear in mind this is a free program written and provided for fun (and that doesn't mean you should ask for my source code!).

Boat Building References

Boats with an Open mind, by Philip Bolger, International Marine (McGraw-Hill), Camden, Maine, 1994, ISBN 0-07-006376-1

The Nature of Boats, by Dave Gerr, International Marine, 1992, ISBN 0-87742-289-3

Propeller Handbook, by Dave Gerr, International Marine, 1989, ISBN 0-87742-988-X

Understanding Boat Design, by Ted Brewer, International Marine, 1994, ISBN 0-87742-392-X

The Gougeon Brothers on Boat Construction, by Gougeon Bros, Inc., Bay City, MI, ISBN 0-87812-166-8

Build the Instant Boats

Go Build Your Own Boat

Instant Boat

Build the Instant Catboat, by Harold Payson, International Marine, 1986 ISBN 0-87742-222-2

Devlin's Boat Building, by Sam Devlin, International Marine, 1996

The Chinese Sailing Rig, by Derek Van Loen, Paradise Cay Publ., Middleton, Calif., 1993, ISBN 0939837 13-7

Sources

Jamestown Distributors - fasteners, tools, supplies - Jamestown, Rhode Island (800) 423-0030

Fiberglass Coatings - cloth, resins - St. Petersburg, Florida (813) 327-8117