Rapid Hull Modeling in Rhinoceros

This is a tutorial for rapid hull modeling in Rhinoceros (Rhino3D). This tutorial may be freely copied and spread. Comments and improvements are very welcome and can be send to Bas Goris (Bas.Goris@GustoMSC.com).

How to use this tutorial

The underlined commands as given in this tutorial are the commands to be typed in the command bar of Rhino. The commands can also be found in the menu-bar or via the icons.

Rhino offers many more commands to create and manipulate curves or surfaces as mentioned in this tutorial. Please use the Help function of Rhino or the tutorials to learn more about them.

Drawing Tolerance

Before starting a project, the tolerance has to be set. Rhino rounds of the drawing coordinates by the specified tolerance. If you do not set the tolerance right, you can get problems with snapping, cutting or joining functions in Rhino and your result will not be on production level.
To set the tolerance use the command DocumentProperties, than choose Units and set the units on meters and the tolerance on 0.0001units.
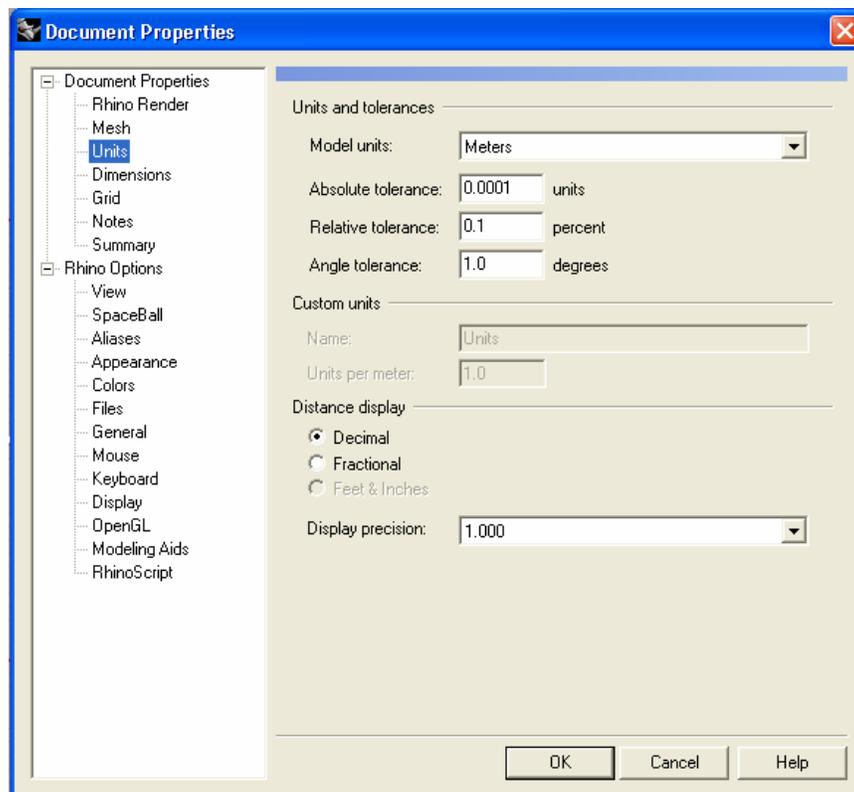
Figure 0-1 DocumentProperties

Some Fairing Rules

This chapter explains the fairing rules for curves (using the command <u>curve</u>) and surfaces (using the command <u>loft</u>). Every line, curve or surface contains control points. Control points can be displayed via <u>PointsOn</u>.

A Line

To draw a straight line, all control points should be on a straight line too.

Figure 0-2 Straight Line

A Circle

To draw a circle, all control points can be placed on a square as per Figure 0-3, where the control points on the corners have a <u>weight</u> of 0.707107 as per Figure 0-4.
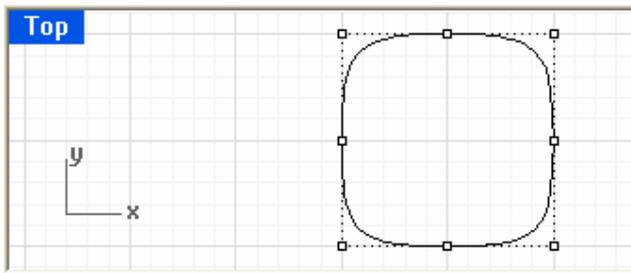
Figure 0-3 How to create a circle; step 1 draw <u>curve</u>
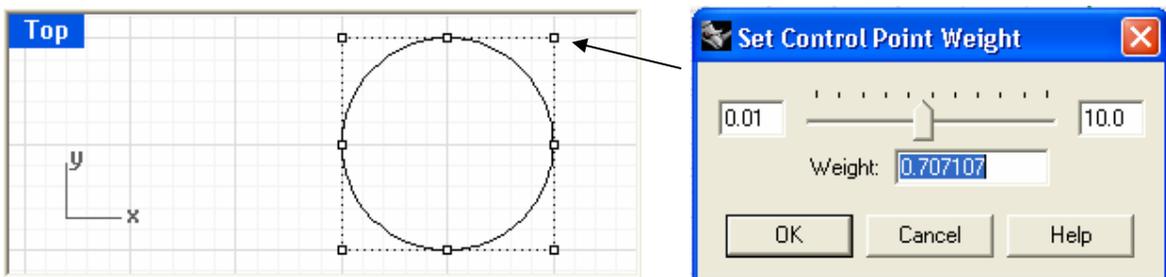
Figure 0-4 How to create a circle; step 2 set point <u>weight</u> (Tip: Use multiple selection via the 'Control' button to set al corner points at once).

Definition of a faired curve

A faired curve is a curve or a combination of curves of which the mathematical derivative is a smooth curve. In Rhino you can check this via the function <u>CurvatureGraph</u>.

A Faired Curve

A line or a circle on its own is a faired curve. A line connected to a circle is **not** a faired curve. See Figure 0-5.
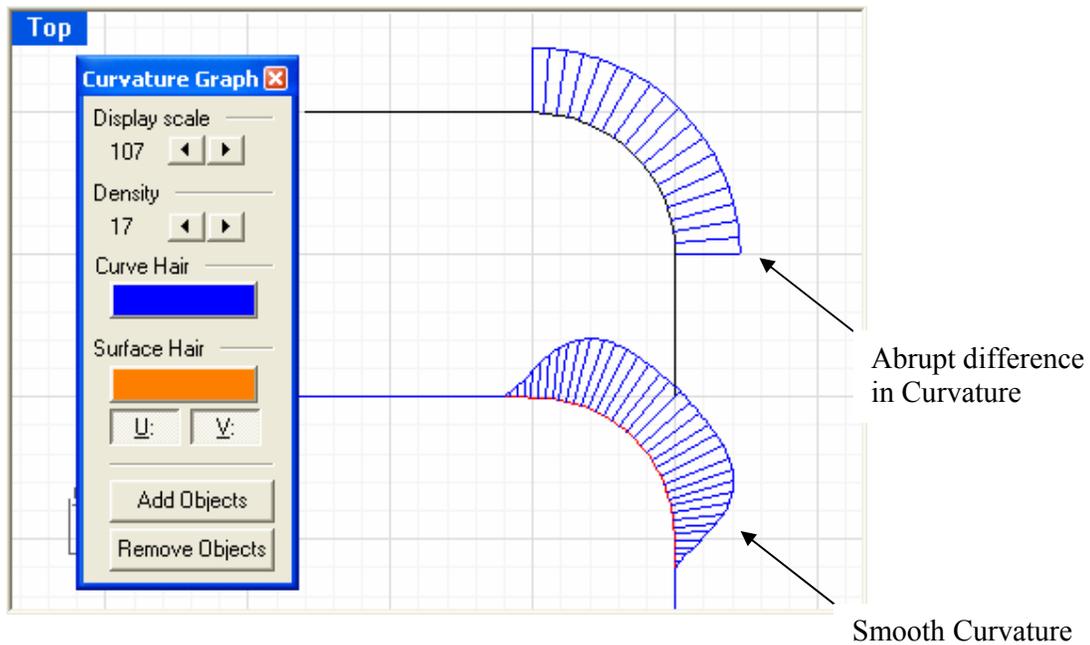
Figure 0-5 Difference in curvature:
Above a curve created from two straight lines and a quarter of a circle; This is not fair.
Below a continues curve with a 'quarter of a circle' look a like. This is a faired curve.

A faired curve can be made via <u>Curve.</u> The lesser points you use the smoother your fairing will be. See example of Figure 0-6.
Note: The control points at the ends are the ends of the curve. All the other control points are pulling to the curves as weights.
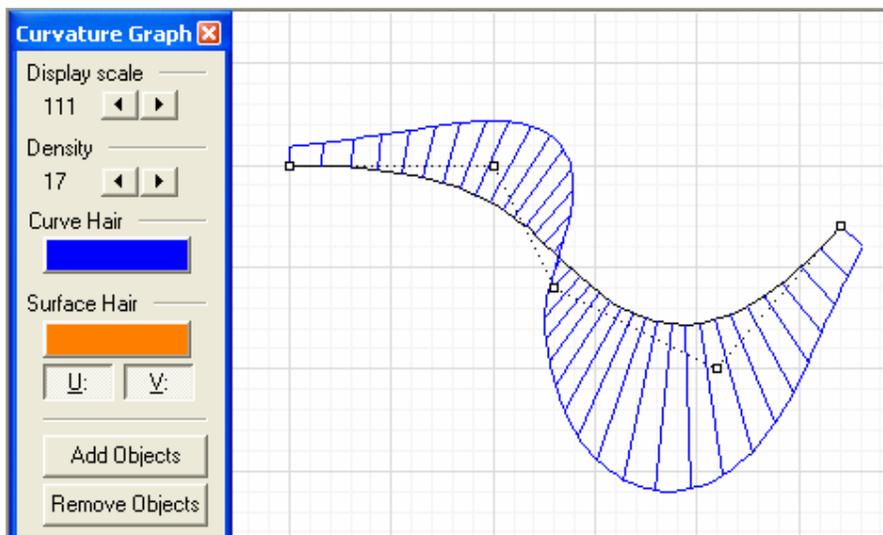
Figure 0-6 An example of a faired <u>Curve</u>, with the control points and the curvature shown via <u>PointsOn</u> and <u>CurvatureGraph</u>.

Fairing into a straight line

Use at least three (3) control points in line to fair into a straight line. See Figure 0-7. Use at least Four (4) control points in line to fair into a straight line from both sides. See Figure 0-8.

Minimum of 3 Control Points in a line

Straight part of the Curve

Top

y

x
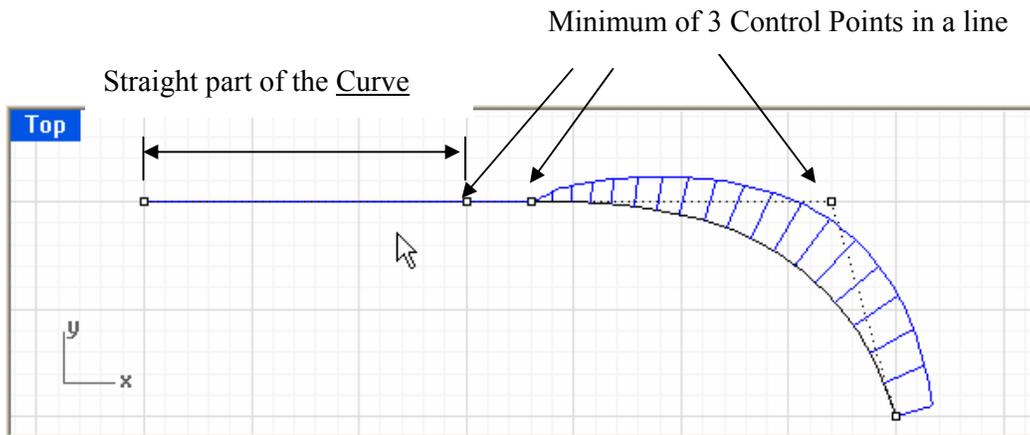
Figure 0-7 Fairing into a straight line. (Tip: set Ortho on when drawing the control points in x, y or z direction)

Minimum of 4 Control Points in a line

Top

y

x

Straight part of the Curve
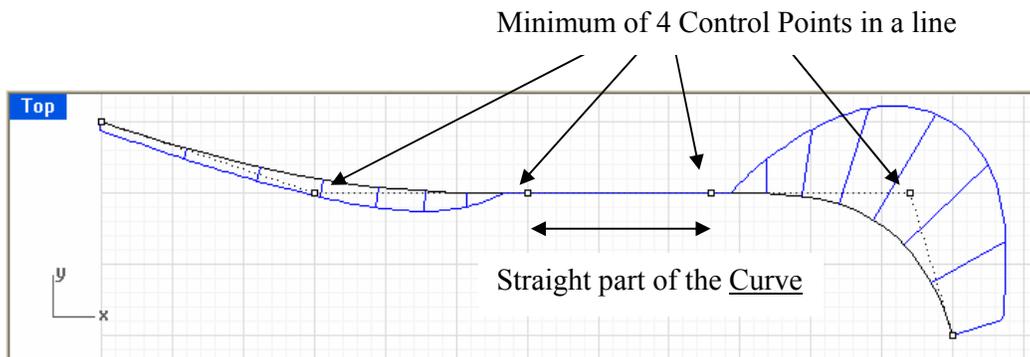
Figure 0-8 Fairing from both sides into a straight line.

To create a fairing line in between straight lines see Figure 0-9 and Figure 0-10
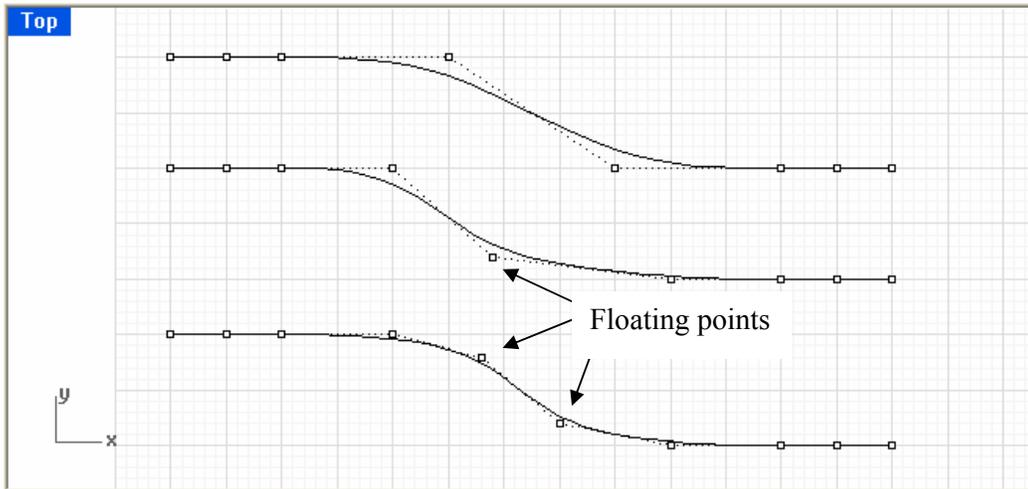
Figure 0-9 Fairing examples between two straight lines. Above with no extra floating point; mid with one extra floating point; and below with two extra floating points. With floating points is mend the extra point not part of the control points which create the straight line. Try to use as less as possible floating points to get the shape you want.
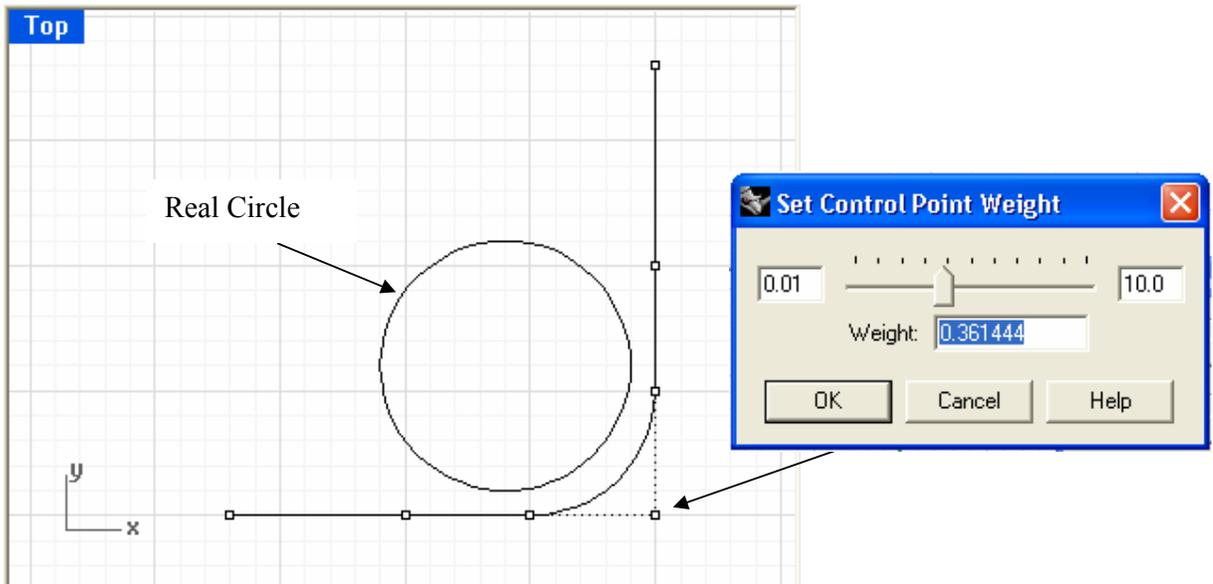
Figure 0-10 Fairing between two straight ends with reduced weight for the control point on the corner. This is a look-a-like for the quarter circle like a round bilge keel in the midship section.

Fairing Surfaces via Loose Loft

Fairing of surfaces via <u>Loft</u> (option Loose) is working via the same principles as fairing with a curve. Instead of control points you have control curves. Look at the example hulls created with loose loft method.
Note: Keep rid of the idea to work with transverse frames, try to think in 3D and try to understand the way the commands <u>Curve</u> and <u>Loft</u> work.

This chapter gives tips about the use of <u>Loft </u>for fairing a ships hull. Figure 0-11 show an example hull made in Rhino. The basis of this hull is created by 10 basic curves as shown in Figure 0-12.
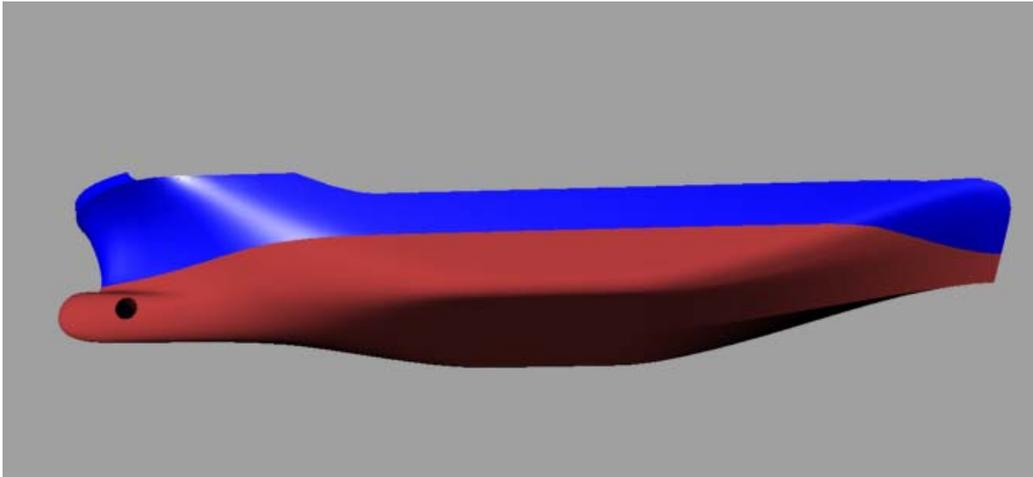
Figure 0-11 Example hull created in Rhino by <u>Loft.</u>
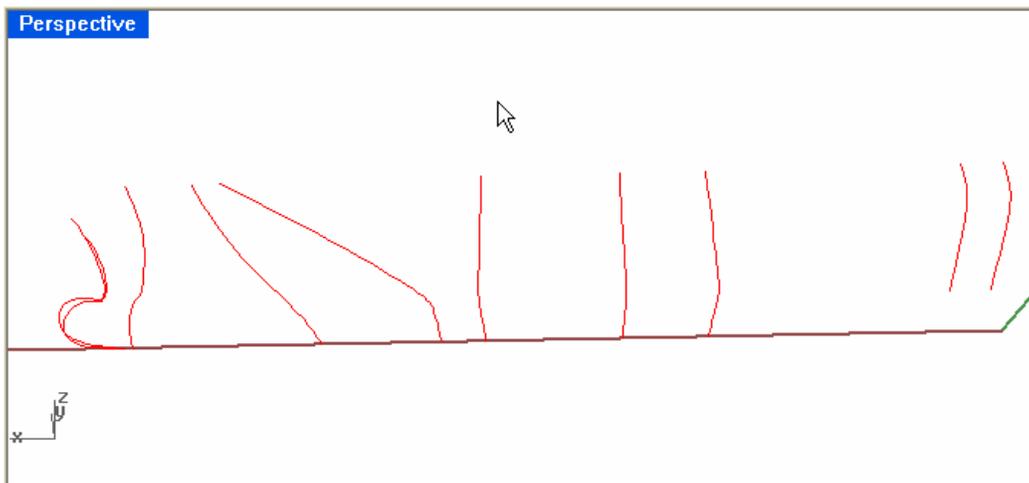
Figure 0-12 Basic lines for the example hull created in Rhino by <u>Loft.</u>

Parallel mid ship
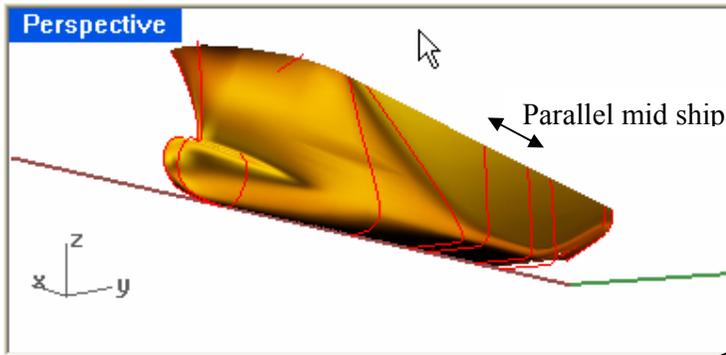
Ten basic curves are required to create this hull.
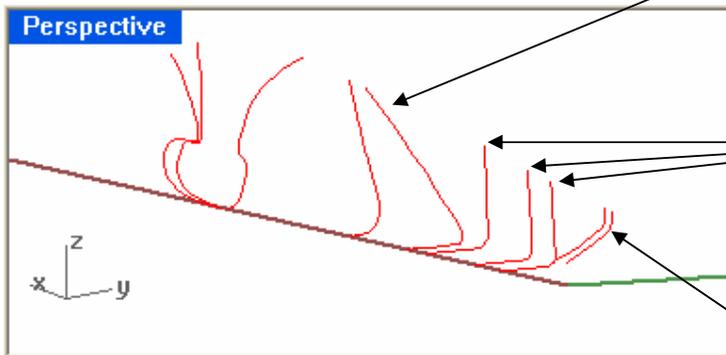
One curve to define the flat of side. This curve is created from a midship section curve. The vertical part is pulled forward.

Three identical midship sections and the "flat of site curve" to create the parallel mid ship. Note that the midship part is between two of the midship sections.
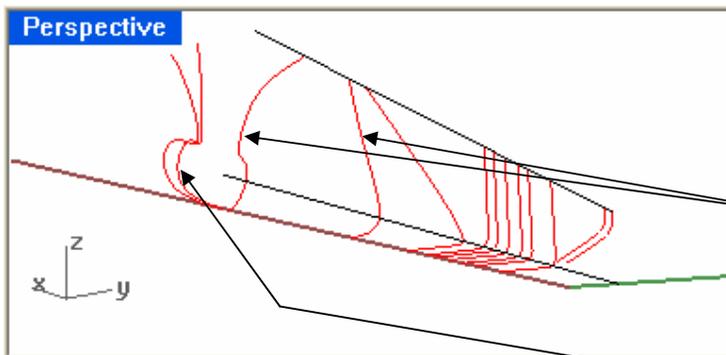
One curve to define the stern and one floating curve to manipulate the fairing between the stern and the parallel midship.

Two floating curves to manipulate the fairing between the bow and the parallel midship.
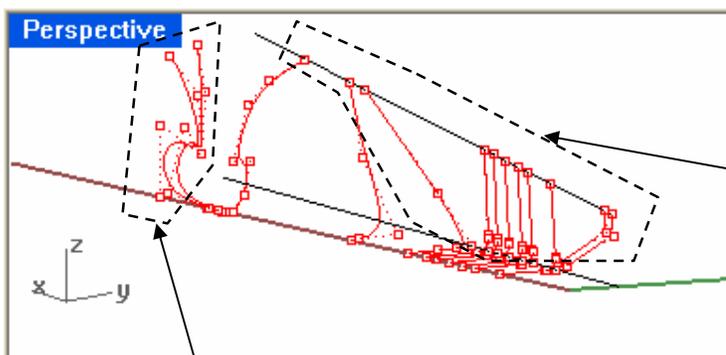
One curve to create the bow line and one curve to manipulate the rounding in the bow and bulbous bow.

The selected control points are all located on the moulded breadth of the hull. These points manipulate the flat of site.
This is similar for the flat of bottom.

Each control point on the bow curve has a twin point on the "bow-help-curve" with the same X and Z position. The difference in Y position rules the curvature of the rounding.
For a sharp bow-line you need to have differences in X positions as well.

If all the basic curves are drawn, use the command Loft.
In the command loft pop-up choose the style 'Loose' and 'do not simplify', press OK.
You now will have a half hull.
You can now measure angle of inflow and outflow, check the Hydrostatics, create a deck line and mirror, a bow thruster tunnel etc.
You can use the command Contour to create a 3D lines plan and Make2D to make an American or European projection of this lines plan.
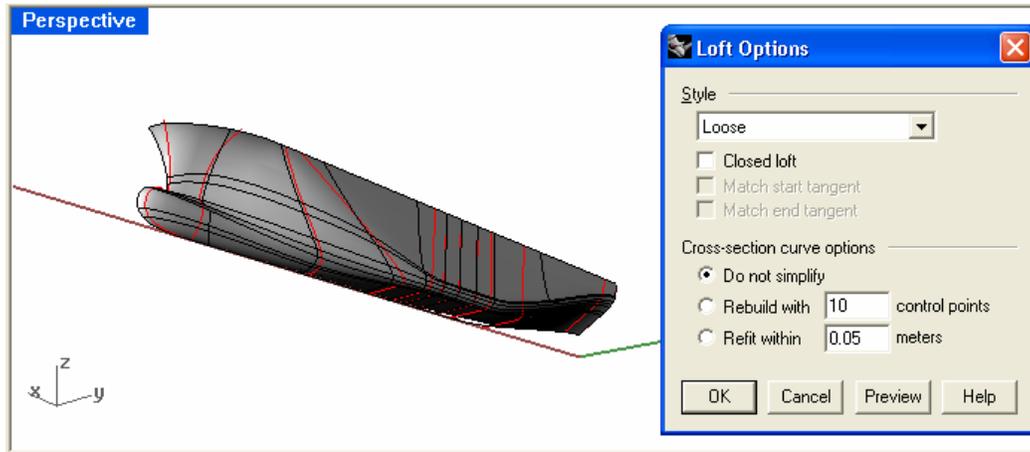
Figure 0-13 Command Loft Pop-up
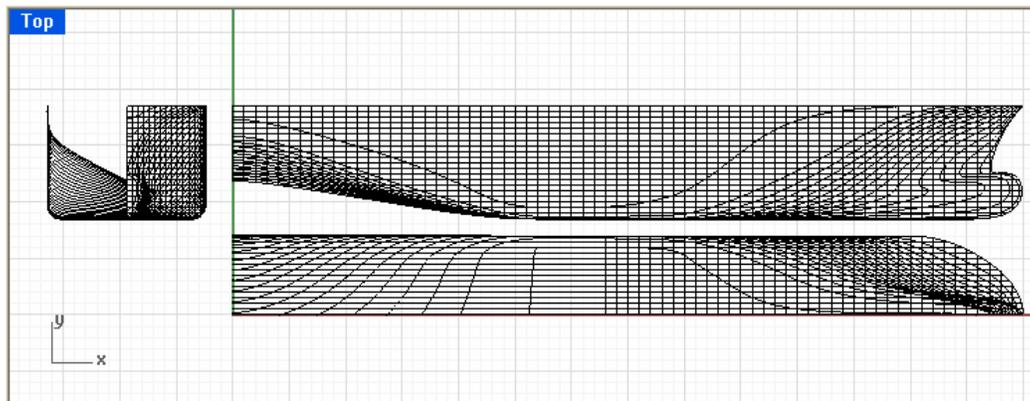
Figure 0-14 Lines plan by Contour and Make2D

Good Luck,

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