

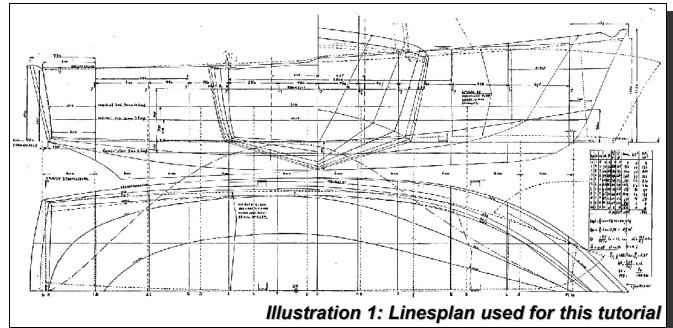
## **DELFTship tutorial – Using background images**

### **Description**

By using scanned images of an existing linesplan it is shown how a 3D DELFTship model can be created using background images. The linesplan used for this tutorial is from an old motorboat. It's a hard chined motorboat with slightly curved sides at the stern.

During this tutorial also a lot of the basics will be explained. You'll be shown how to

- Create knuckle lines
- Use background images
- Assign control curves
- Fair control curves by moving points with the mouse
- Move points with the cursor keys.
- Add new faces manually
- Insert new points
- Insert new edges
- Add new layers
- Select faces
- Assign faces to a different layer
- Add stations
- Make a curved transom that ends perpendicular to the centerplane of the hull

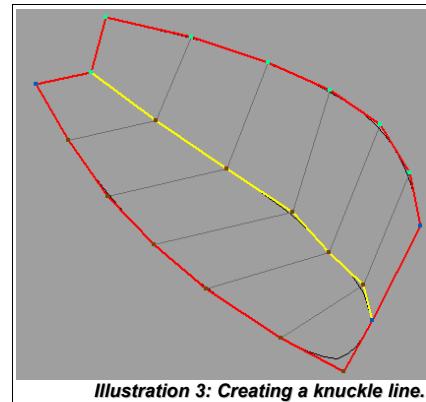


*Illustration 1: Linesplan used for this tutorial*

<b>1. Start a new model</b>													
<b>Description</b>	<b>Action</b>												
Start a new model	Select <b>File =&gt; New</b> from the mainmenu												
The window from illustration 2 appears. Fill in the appropriate numbers.	<p><b>New model.</b></p> <p>OK Cancel</p> <table border="1"> <tr> <td>No. points in longitudinal direction</td> <td>7</td> </tr> <tr> <td>No. points in vertical direction</td> <td>3</td> </tr> <tr> <td>Length</td> <td>6.75</td> </tr> <tr> <td>Beam</td> <td>2.5</td> </tr> <tr> <td>Draft</td> <td>.32</td> </tr> <tr> <td>Units</td> <td>Meters</td> </tr> </table> <p><i>Illustration 2: New model window.</i></p>	No. points in longitudinal direction	7	No. points in vertical direction	3	Length	6.75	Beam	2.5	Draft	.32	Units	Meters
No. points in longitudinal direction	7												
No. points in vertical direction	3												
Length	6.75												
Beam	2.5												
Draft	.32												
Units	Meters												

## 2. Creating knuckle lines

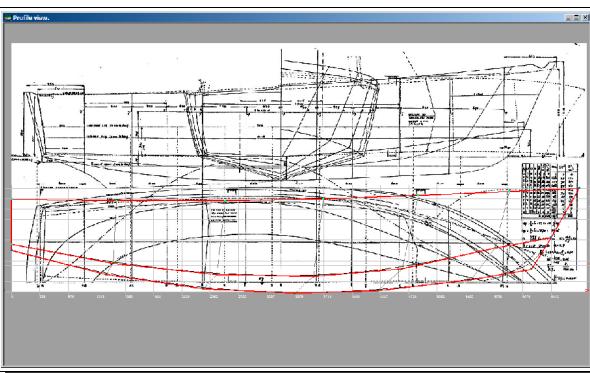
Description	Action
The default hull is a round bottomed sailing boat. The linesplan we're trying to reproduce is a hard chined motorboat. The first thing we're going to do is create a knuckle line that is going to be the chine of our motorboat	Select the edges as shown in image 3. You can select them one by one by clicking on each edge with the left mouse button. An easier and faster way is to select just one edge while keeping the Ctrl key on your keyboard pressed. DELFTship automatically traces and selects the connected edges.
Turn the normal edges into knuckle (crease) edges. DELFTship draws crease edges in red.	Select <b>Edit =&gt; Edge =&gt; Crease</b> from the mainmenu.



**Illustration 3: Creating a knuckle line.**

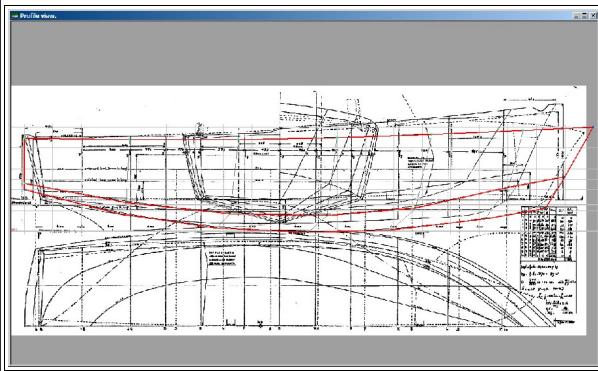
## 3. Inserting background images

Description	Action
DELFTship has three different views on your model <ul style="list-style-type: none"> <li>Plan (top) view</li> <li>Profile (side) view</li> <li>Bodyplan (front) view</li> <li>Perspective (view).</li> </ul> You can assign a different background image to each of these views, except for the perspective view	Select the window showing the profile view. If no such window is available select a random one and set the view to profile view. This is done by pressing the right mouse button somewhere in the window area. A pop-up menu appears. Select <b>View =&gt; Profile</b> . Call the pop-up menu again and select <b>Background image =&gt; Load</b> . This opens the file browser. Select the file you want to use for a background image.

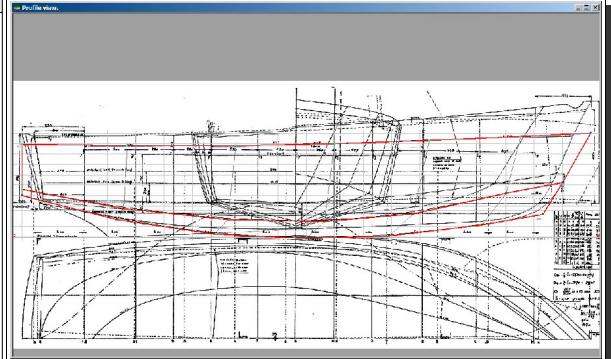


## 4. Moving a background image

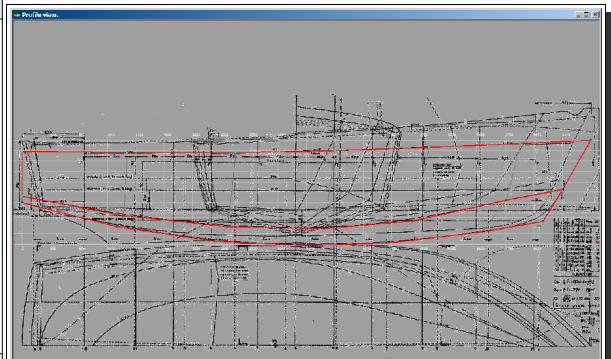
Description	Action
The background image is now inserted into your model. Every time you select the profile view this image will be shown on the background. In most cases the background image is not yet on the right location immediately after the import. We're going to drag it to the correct place now.	Select <b>Background image =&gt; Origin</b> from the pop-up menu. The cursor now changes to a cross with a big O indication you're going to change the origin. Press the left mouse button somewhere on the background image and keep it pressed down. If you move the mouse around now you'll notice the background image being dragged around as well. If you release the mouse button again the viewport will resume to normal operation. Drag the image to the correct location. In this case the lowest point of the skeg should coincide with the baseline of your model ( $Z=0.0$ ). The aft part of the transom should coincide with the aft perpendicular ( $X=0.0$ ).



## 5. Changing the scale of a background image

Description	Action
Once the background image is on the correct spot we still have to scale it to the correct dimensions.	<p>Select <b>Background image =&gt; Set scale</b> from the pop-up menu. The cursor changes to a ruler to indicate you're changing the scale of the image. Now click on a point of the background image of which you know the exact coordinates. The further this point is away from the origin the better.</p> <p>Once a point has been selected another window shows up prompting for the coordinates of the selected point. Enter the correct coordinates in this point and close the window.</p> <p>In our example the coordinate of the uppermost point of the bow is <b>6.75, 1.64</b></p>
<b>Important:</b> All new background images will automatically have the same scale applied as this one. This is particularly convenient if you're importing multiple background images originating from the same linesplan. So make sure you set the correct scale before importing the next background image! In our case we import the same image three times (once for each view) so having exactly the same scale for each image is crucial.	

## 6. Setting transparency of the background image

Description	Action
Background images with large white areas, as is often the case with a linesplan, can be very dominant. You can avoid this by assigning a transparent color. Areas with the transparent color will not be drawn on your screen. In case of a black and white linesplan only the black lines will remain visible.	<p>Select <b>Background image =&gt; Transparent color</b> from the pop-up menu. Click on a spot of your background image with the color you want removed. The background image will now be redrawn in transparent mode.</p> <p>If you find the image still too dominant try blending it with the background. Use the <b>Background image =&gt; Blending</b> option from the pop-up menu and move the slide bar until you're satisfied.</p>
<b>Note:</b> You can remove transparency again by repeating this process. Instead of clicking on a spot within the background image simply select a point <u>outside</u> the image.	

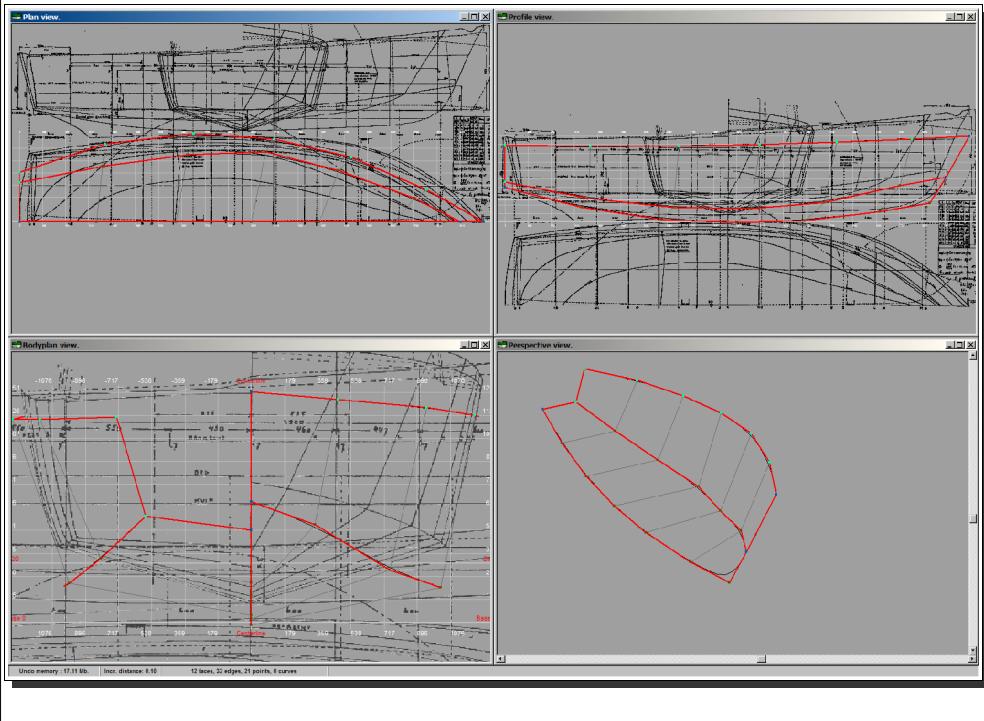
## 7. Adjusting the transparency tolerance

Description	Action
Especially when using compressed images like jpeg areas that appear white can consist out of many shades of white. In that case if the transparent color has been set to white a lot of "nearly white" noise remains visible. By increasing the tolerance you can remove that noise.	<p>Select <b>Background image =&gt; Tolerance</b> from the pop-up menu. Experiment a bit with the value until you're satisfied with the appearance of the background image. For most jpeg images a tolerance of 35 works fine. The higher the compression rate of the file, the higher the tolerance needs to be.</p>

## 8. Importing more images

### Description

Repeat this process for the bodyplan and plan view of your model.



## 9. Assigning control curves

### Description

Now we're going to assign a control curve to the deckline. This control curve is going to be used at a later stage to:

- 1) Match the shape of the deckline of the background images
  - 2) Fair the deckline in such a way that we end up with a very smooth curve.
- Select all of the edges from the deckline (see also step 2).*

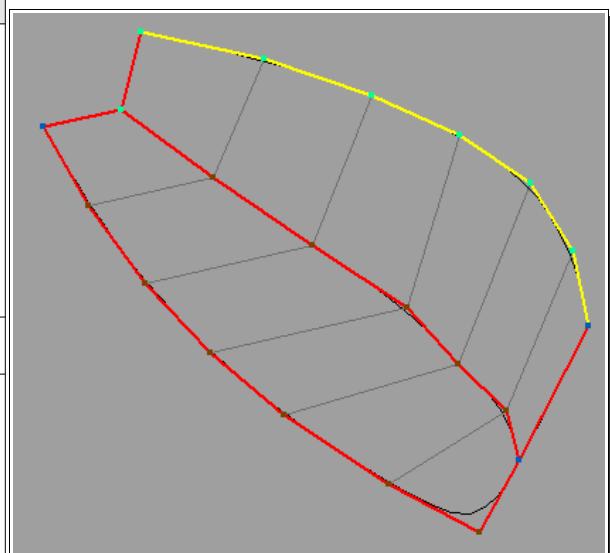
*From the main menu select **Edit => Curve => New**.*

*A blue curve is now visible. It is better visible if you hide the control net. You can do this by selecting **Display => Control net** from the main menu. If the curve is still not visible select **Display => Control curves** to turn off the display of the control curves.*

### Action

*Repeat this to add a control curve to the chine we've created in step 2.*

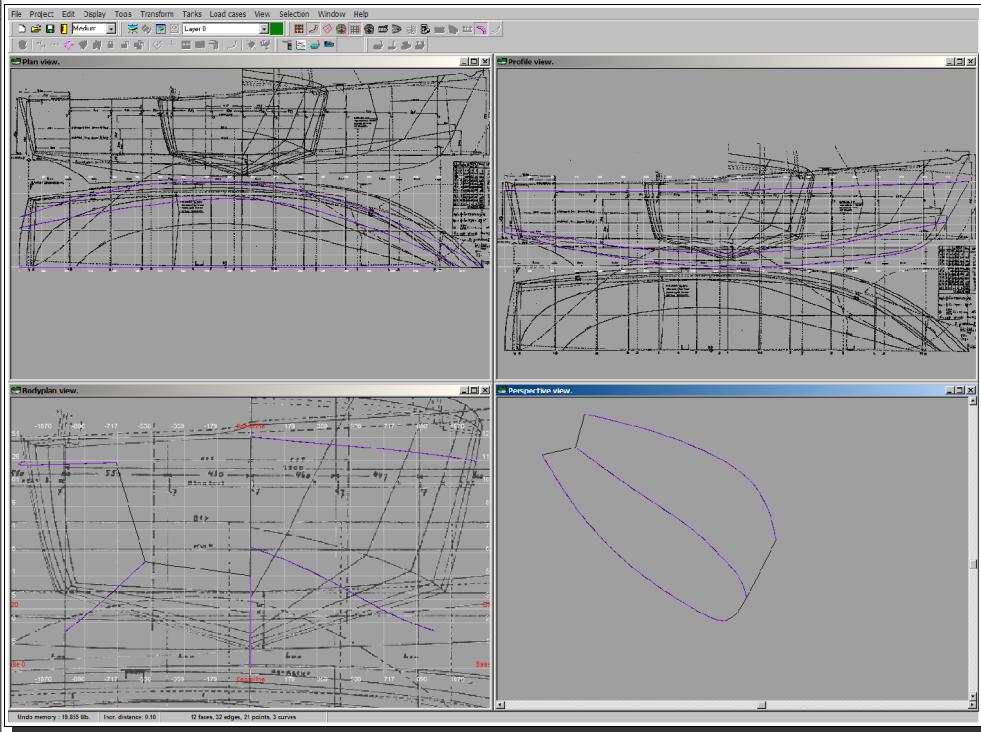
*Add a control curve to the contourline. Select all edges on the centerplane of the ship, including the edges of the bow.*



## 10. Adding the other control curves

### Description

If you've added all three control curves your model should look something like this.



## 11. Shaping the deckline

### Description

The first thing we're going to do is to try to match our deckline to that of the background image.

### Action

*Turn off the control net (see step 9). Choose the plan view and select the deckline. Once the deckline is selected the controlpoints and edges used for this curve will be shown together with the curvature plot (the purple lines). If the curvature plot is not visible there are two possibilities:*

- 1) *The display of curvature plots is disabled. Check (or enable) it by selecting **Display => Curvature** from the mainmenu.*
- 2) *The scale of the curvature plot is too small to be seen. You can increase or decrease the scale by pressing F10 or F9.*

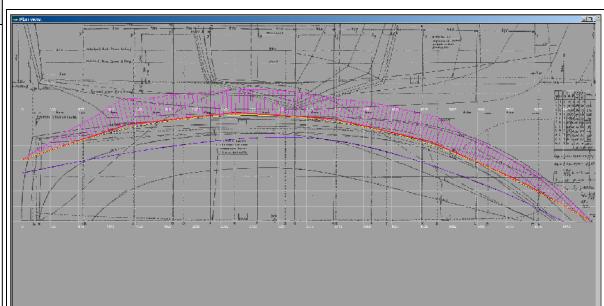


Illustration 4: Deckline before.

Modifying the shape is done by selecting a controlpoint of the curve and dragging it to another location.

*Move the controlpoints with the mouse to their new locations. Start with the startpoint and endpoint. Then move the interior points of the curve. If the deckline is roughly similar to that of the background image check your curvature plot. Make sure the curvature changes gradually along the curve. If not then adjust the controlpoints nearest to the curvature peaks or valleys. Try to distribute the points evenly along the curve*

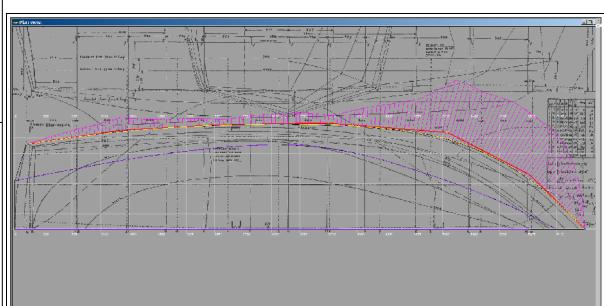
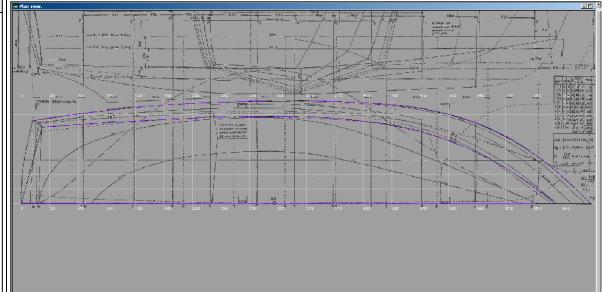


Illustration 5: Deckline modified to match the background image.

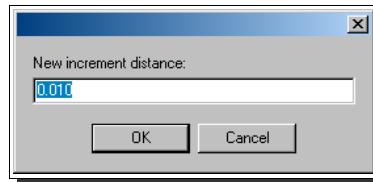
## 12. Shape the chine and profile

Description	Action
This process should be repeated for the chine and also for the profile of the hull.	

## 13. Adapting the incremental distance

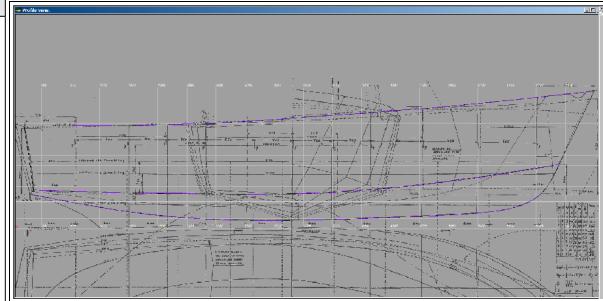
Description	Action
Now our hull looks the same in the plan view as the original linesplan. The profile however still differs. Now we can switch to the profile view and move the points again with the mouse. By doing so you run the risk of accidentally shifting the points in longitudinal direction, undoing our precious work of the previous step.	<p>Modify the “incremental” distance. This is the distance a point is being moved if we press one of the cursor keys on the keyboard. If you look at the statusbar (see illustration 6) at the bottom of the main program window there's a panel saying “Incr. Distance 0.100”. Click on it with the mouse and a window shows up requesting the new distance. Set it to 0.01. Now each time we press a cursor key the selected controlpoint will be moved 0.01 meter.</p>

Illustration 6: DELFTship statusbar



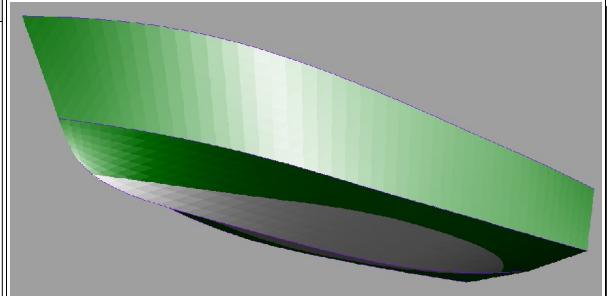
## 14. Matching the profile view

Description	Action
Now we're going to match the controlcurves in the profile view by moving controlpoints with the cursor keys rather than with the mouse.	<ol style="list-style-type: none"> <li>Select one of the controlcurves.</li> <li>Select a point on the selected control curve. Start with the start and endpoints again.</li> <li>Move the selected point up or down with the cursor keys. Repeat this for all points until the curve coincides with the corresponding curve of the linesplan</li> <li>If you find that the incremental distance is still too large then reduce it.</li> <li>Repeat the process for the other two curves.</li> </ol>



## 15. Use the shaded view

Description	Action
Congratulations! The main feature lines of the hull are finished and the boat should look very similar to the one of the linesplan. Now we're going to visualize the surface of the hull in 3D.	Select <b>Mode =&gt; Shade</b> from the pop-up menu in the perspective view. The hull surface will be shaded using virtual lights. Parts of the hull that are submerged are shaded in grey whilst the rest of the hull is shaded green. You can rotate the model by keeping the middle mouse button (or mousewheel) pressed while moving the mouse. If you have no middle mouse button you can use the scrollbars at the bottom and to the right of the perspective view.



## 16. Adding a new face

Description	Action
Our boat has no transom yet. We're going to add a new face manually to fill in the transom.	<p>Switch to perspective view.</p> <p>Select the points shown on illustration 7. Start with the point on the centerplane, then the point on the chine and finally the point on the deckline. If you need to select more than one point you need to keep the CTRL-key on your keyboard pressed.</p> <p>Select <b>Edit =&gt; Face =&gt; New</b> from the mainmenu to add the new face.</p> <p>Your model will look now like the one shown on illustration 8.</p>

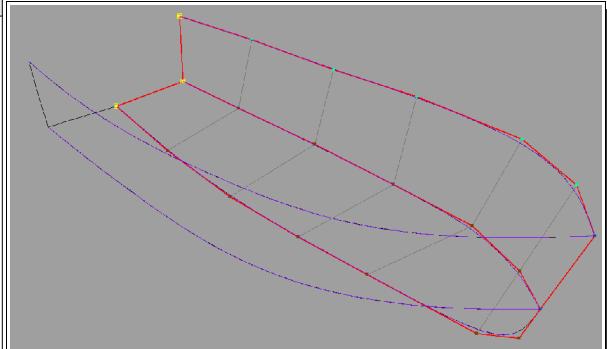


Illustration 7: Selecting points

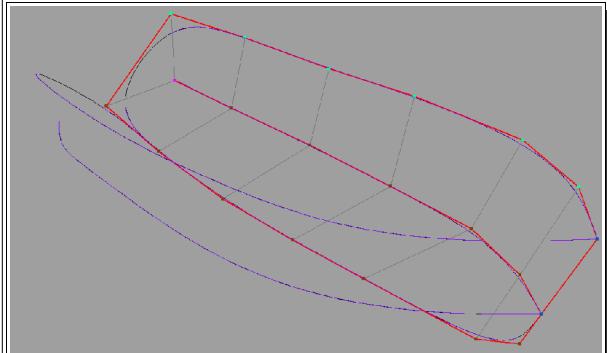
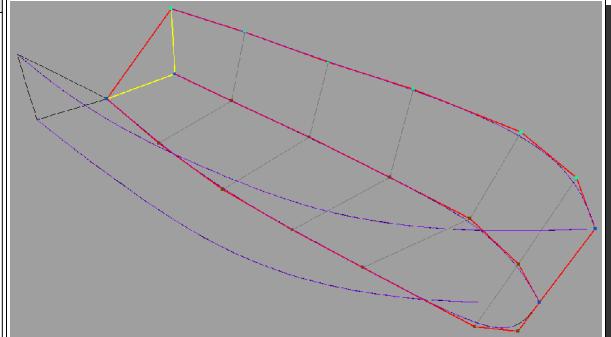
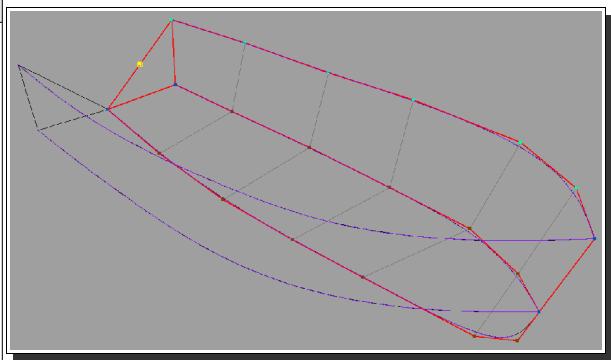


Illustration 8: The new face added

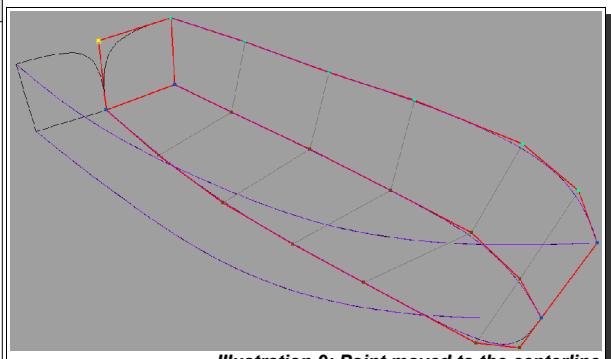
## 17. Setting the crease property

Description	Action
By adding the new face the two edges that form the transition of the transom into the bottom and side of the hull have changed from crease edges to non-crease edges.	<p>By now you should be able to modify the crease property of the two edges. If you're not sure just have another look at step 2. Select the two edges and make them knuckle lines again.</p> 

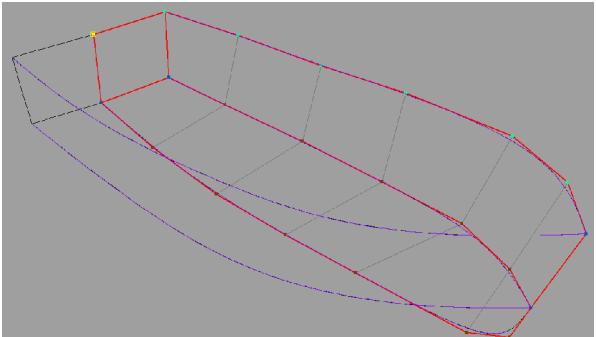
## 18. Inserting new points

Description	Action
The transom is triangular in shape. We're going to insert a new point in the transom to modify its shape.	<p>Select the edge of the transom.</p> <p>Select <b>Edit =&gt; Edge =&gt; Split</b> from the mainmenu. A new point is inserted in the middle of the selected edge causing the edge to be split in two.</p> 

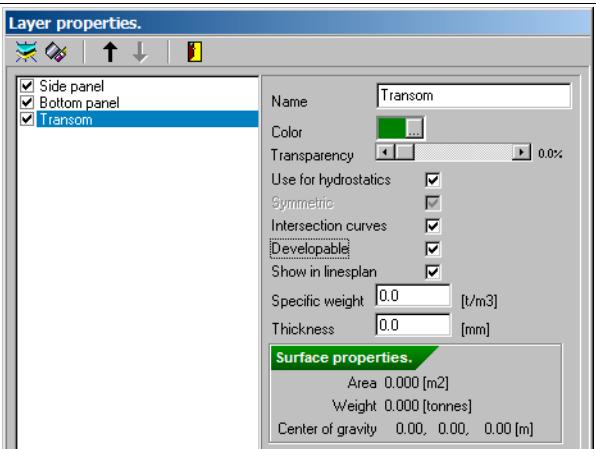
## 17. Modifying the location of a point manually

Description	Action
The new location of the new point needs to be adapted to put it on the centerline of the hull.	<p>Modify the coordinate by specifying the following values in the controlpoint window that shows the alpha numerical values of the controlpoint:</p> <p>X-coord : 0.1398  Y-coord : 0.0000:  Z-coord : 1.1160</p>  <p>Illustration 9: Point moved to the centerline</p>

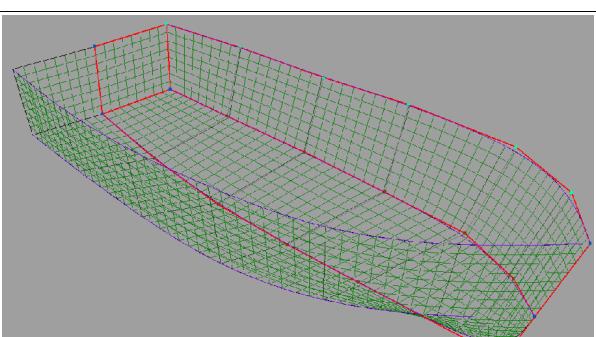
## 18. Creating cornerpoints

Description	Action
Illustration 9 shows that the transom does not go through the new point but curves down. You can force the surface through that point by making it a corner point.	<p>In the previous step we've modified the values of the point manually in the controlpoint window. This window also has a checkbox that says "Corner". Make sure this checkbox is checked. Your transom will now look like the one on illustration 10.</p>  <p>Illustration 10: The cornerpoint has been set.</p>

## 19. Adding new layers.

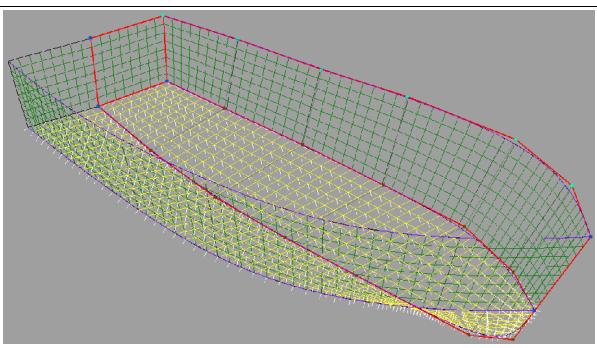
Description	Action
We're going to add two new layers so we have three different layers. One layer each for the bottom, side and transom.	<p>Open the layer dialog by selecting <b>Edit =&gt; Layer =&gt; Dialog...</b> from the mainmenu (or by pressing <b>CTRL-L</b> shortcut on the keyboard). After the layer windows shows up, modify the name of the current layer, which is "layer 0" into "Side panel".</p> <p>Now press the "New layer" button on the toolbar from the layer window. It's the leftmost button that displays the hint "Create a new empty layer" when you hover over it with the mouse. A new layer is created. Set the name of this layer to "Bottom panel".</p> <p>Add another layer with the name "Transom"</p> 

## 20. Display the interior edges

Description	Action
The two new layers we've just created are still empty. In order to be able to select faces the interior edges must be displayed. The interior edges are in fact the edges of the subdivided surface mesh. The higher the precision setting of your model, the larger the number of displayed edges and faces will be.	<p>Select <b>Display =&gt; Interior edges</b> from the mainmenu. The interior edges will now be drawn.</p> 

## 21. Selecting (a group of) faces

Description	Action
Now the interior edges are visible you'll be able to select the faces.	<p>Click on one of the small green lines of the bottom. The face it belongs to will be selected and all the subdivided edges belonging to this face will be drawn in yellow indicating this face is selected. You can repeat this for all the faces in the bottom panel but there's another way to quickly select a group of faces. If you select a face while keeping the CTRL-key on your keyboard pressed the program assembles all faces that:</p> <ul style="list-style-type: none"> <li>Belong to the same layer as the face you've just selected.</li> <li>Are connected to the selected face.</li> <li>The program stops if a knuckle line is encountered.</li> </ul> <p>This is a convenient way to select the entire bottom or side panel in one pass.</p>
<p><b>Note:</b> The thin white lines that are drawn are called “normals”. They indicate the facing of the surface. For hydrostatic calculations it's crucial the front side of each face is on the side of the water. The normals should point outside the hull, not inside!</p>	



## 22. Assign faces to a different layer.

Description	Action
This step shows how to assign the faces you've just selected to a different layer.	<p>Go to the layer toolbar on the top of the program window. It is shown on illustration 11.</p> <p>If you have <u>no</u> faces selected then this toolbar shows the name of the currently selected layer.</p> <p>If you have just selected some faces then there are two possibilities:</p> <ol style="list-style-type: none"> <li>All the selected faces belong to the <u>same</u> layer. In that case the name of that layer is shown.</li> <li>The selected faces belong to <u>multiple</u> layers. In that case the field remains white and no layer name is shown at all.</li> </ol> <p>Click on the arrow button to make all layers visible and click on the entry in the list that says “Bottom panel”.</p> <p>You've just assigned the selected faces to the bottom panel layer. Press the Esc-key or <b>Selection =&gt; Deselect all</b> from the mainmenu to clear the selection.</p> <p>Repeat this to assign the faces of the transom to the transom layer and the faces forming the side panel to the side panel layer.</p>

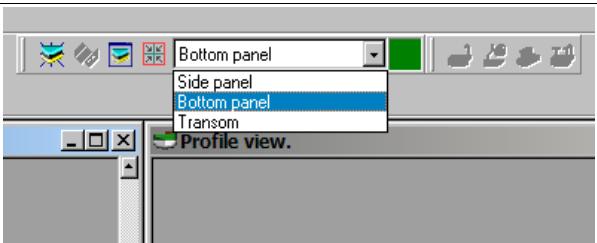
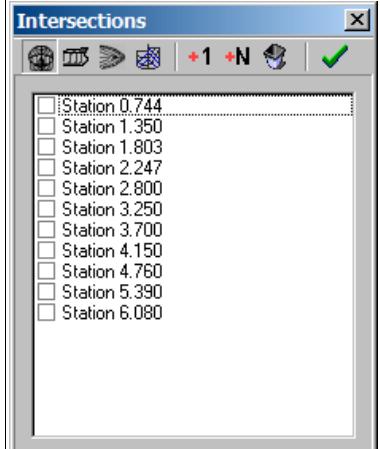
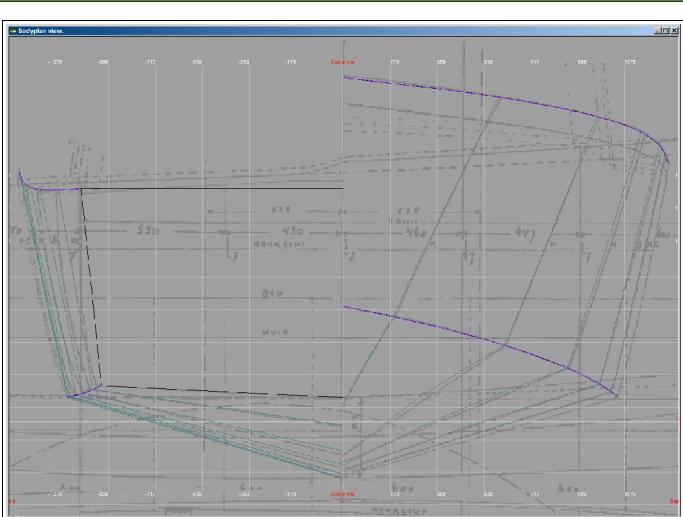


Illustration 11: Layer toolbar

## 23. Adding stations

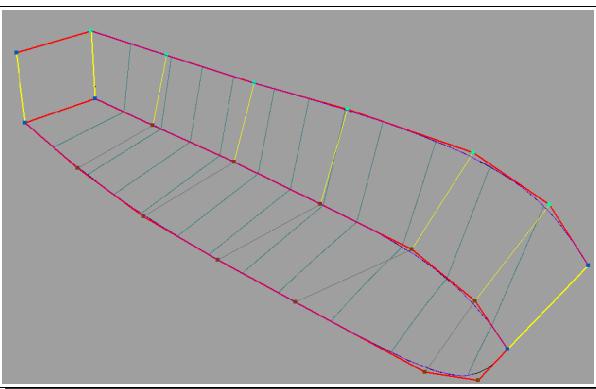
Description	Action
In this step we are going to add stations to the model we have created. It is crucial that these stations are placed at the same longitudinal position as the stations of our background image. That way we can compare our linesplan against the background image to check for differences.	<p>There are two different ways to obtain the locations of the stations:</p> <ol style="list-style-type: none"> <li>1) Measure them from a printed version of the background image by hand using a ruler and calculator.</li> <li>2) Hover with the mouse over the stations of the background image in either the profile view or the plan view of DELFTship. The caption bar of the window showing this view displays the coordinates of the mouse. This is the easiest way. Write down the positions of all the stations on a piece of paper. You can see the locations measured from our model on the illustration to the right.</li> </ol> <p>Call the intersection window by selecting <b>View =&gt; Intersections...</b> from the mainmenu. This window shows which intersections are currently defined.</p> <p>Clear any present stations by pressing the trash button (7<sup>th</sup> button from the left)</p> <p>Add the stations one by one by pressing the +1 button (5<sup>th</sup> button from the left) and specifying the correct location.</p> 

## 24. Compare the model against the background image

Description	Action
The bodyplan view is used to check how the stations we've just added compare to the stations of the background image.	<p>Select the bodyplan view. Make sure the display of interior edges is off (step 20).</p> <p>If you've added the stations at the right locations DELFTship will now draw them on the same location as the ones from the background image. They look very similar. If you look closely though you'll notice that the original stations at the stern are slightly curved at the side, while ours are straight.</p> 

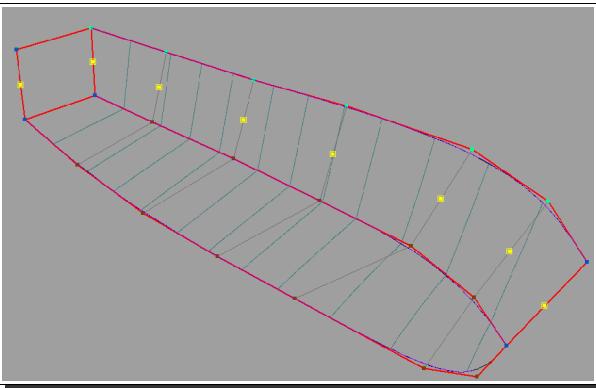
## 25. Adjusting the side panel.

Description	Action
The side panel needs adjustment to create the curved stations at the stern. To do that we need to insert new points to be able to pull the surface outwards in the middle of the panel.	Select all the vertical edges of the side panel. Make sure you select them in chronological order because that will come in handy for the next step. Start with the edge on the centerline of the transom and work your way up to the front of the boat.



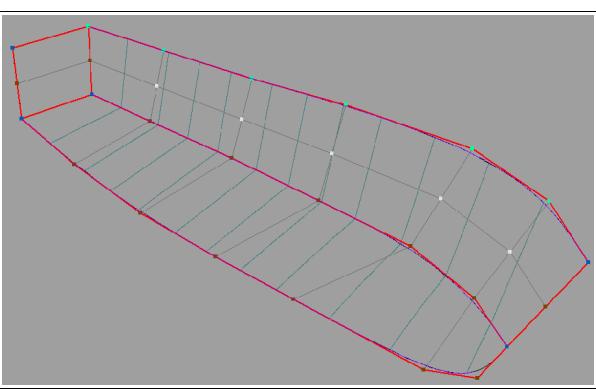
## 26. Insert new points in the side panel.

Description	Action
During this step the new points are inserted into the side panel.	Select <b>Edit =&gt; Edge =&gt; Split</b> from the mainmenu. All selected edges are split in two and the new points are automatically selected. If you have selected the edges in chronological order then the new points are selected in the same order. That will be convenient for the next step.

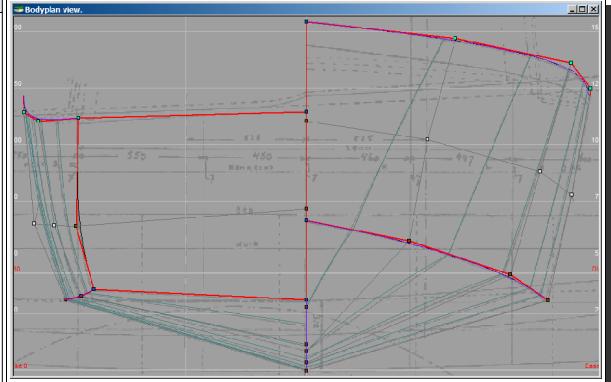


## 27. Connect the new points with edges.

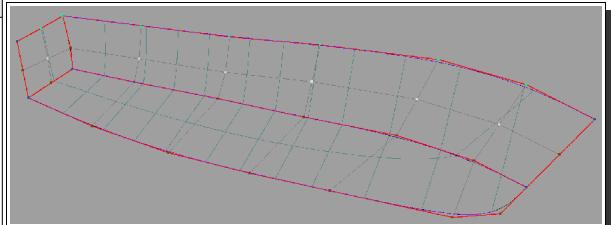
Description	Action
The new points need to be connected with edges to maintain a regular network. All faces should consist of 4 points whenever possible and every point in the interior of the surface should be connected to 4 faces and four edges. This is crucial if you want a good faired surface.	Select <b>Edit =&gt; Edge =&gt; Insert</b> from the mainmenu. If you've selected the edges in the correct order in step 25 then all the points will be connected to each other with new edges as shown to the right. If the new edges do not run continuously from the transom to the stem (there's a gap) then simply select the two endpoints and repeat the process.  Remember that in order to insert a new edge between two selected points the points must share the same face!



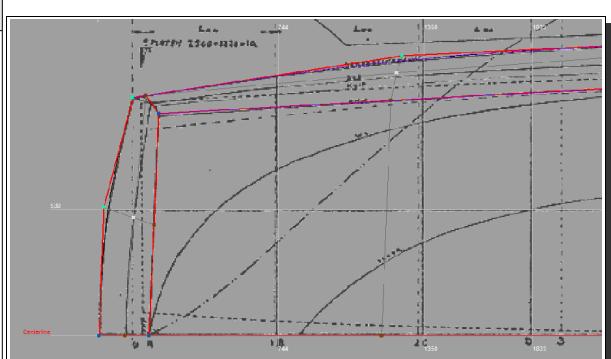
## 28. Adjust the shape of the side panel.

Description	Action
With the new points inserted we can start adjusting the shape of the side panel.	<p>Switch back to the bodyplan view. Make sure the control net is visible. Carefully move the new points a little outwards until the shape of the stations is the same as the original stations. The bow needs no adjustment so the displacement of the points should gradually reduce to zero while you work your way to the front. This is an iterative process, so keep adjusting the control points until you're satisfied with the shape of the stations.</p> 

## 29. Creating a curved transom.

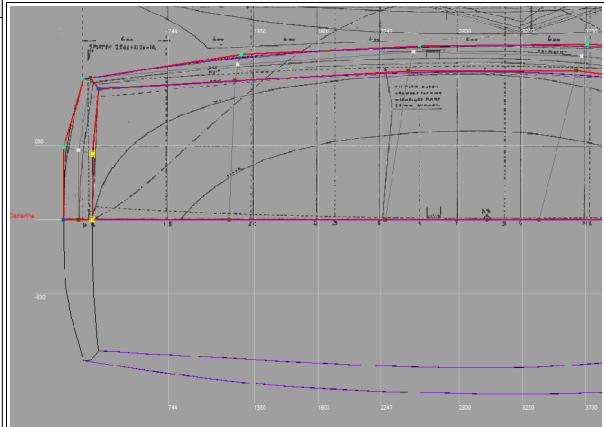
Description	Action
The transom of our new hull is still flat. The original transom shows a radius in the plan view. To adjust the shape of the transom we need to insert some points and edges again.	<p>Select the three horizontal edges from the transom. Insert new points on these edges. If you're not sure how to do this then have a look at step 26. Connect the new points by inserting new edges (see step 27). Your transom should look now like the one displayed to the right.</p> 

## 30. Modifying the shape of the transom

Description	Action
To adjust the shape of the transom the new points need to be shifted.	<p>Go to the plan view. Shift the new points so that the top and bottom edges of the transom coincide with the ones of the background image</p> 

### 31. Making sure that transom is perpendicular to the centerplane

Description	Action
Although the transom may look right it's not completely finished yet. We have to make sure that where the transom ends at the centerplane it is perpendicular to the centerplane. Otherwise it would like there's a knuckle line running vertically over the middle of the transom	<p>Select the top edge of the transom (the one nearest to the centerplane). Make sure that the startpoint end endpoint have exactly the same X-coordinate. If not, them adjust one of them manually.</p> <p>Do the same for the middle and lower edge as shown to the right.</p> <p>If the shape of the transom has changed significantly it might be necessary to repeat step 30 and 31 until the shape is satisfactory.</p>



### That's it!

You've now successfully recreated a linesplan. If everything has been done correctly you should have ended up with a boat that should be very similar to the one shown below.

