Learning Maxsurf

Manual

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Table of Contents

Learning Maxsurf

Welcome to Learning Maxsurf. This introductory training manual will give new users to Maxsurf a thorough understanding of the application's architecture, main functions and give an idea of its capabilities. Experienced users will also find this manual useful to expand their understanding of concepts or simply as a refresher.

This training manual is by no means an extensive guide to using Maxsurf. If you need help or would like more information on certain topics, the manual should be consulted. The training manual consists of several short tutorials, each with their own concrete learning goal. Throughout the tutorials, the user will model a simple hullshape and make modifications to it. Each tutorial may have different related resources such as:

1. Sample designs. Some tutorials will have a "start" and "end" sample design attached to it. For example: BasicFairing_start.msd and BasicFairing_end.msd. All these designs can be found in the c:\program files\Maxsurf\Training Samples directory.
2. Explanations of background theory. It is recommended to read these sections.
3. Videos. There are several short videos you can watch that illustrate the steps explained in the tutorial.
    a. [Web] You can click on this link for each video to view the video online; i.e. on the internet. This will open up the video in your Internet browser. You do need a reasonably fast internet connection for this.
    b. [Disk] Click on this link from your PDF document when you are running this training manual from your local computer. This will start up the video from your local hard drive. This is generally much faster than viewing the videos online, but it does require that you have installed the MSLearning installer. Links to "[Disk]" only work from the PDF document and not from your internet browser.
4. Links to the User Manual for background reading on concepts, or further explanation of dialogs and related commands.

Tips on using this training material:

- **Take your time and read all instructions carefully**
- **Read explanations, try to understand the concepts explained**

Start the training by reading "Chapter 1 Maxsurf Help".

Chapter 1 Maxsurf Help

Before you can start learning how to use the program, it is important that you learn what to do when you want more information on using particular commands or you need help with a particular feature. Every command in the Maxsurf applications is thoroughly documented in the User Manual. This section of the training manual describes how to open the manual and find what you are looking for.

Opening the Manual

You can access the manual from different locations:

1. From the Windows Start Menu: Programs | Maxsurf | Help
2. From within the application in the Help menu
3. From within the application by pressing the F1 function key.

> **Note**
>
> In this Training Manual, a vertical bar '|' will be used to separate menu titles, sub-menu titles and commands in specifying the location of a command from a menu. For example, Help | Maxsurf Help indicates that Maxsurf Help can be accessed from the Help Menu.
>
> Many commands can be accessed from toolbars and via keyboard shortcuts (specified in the menus); however in this manual, access to commands will be described through navigation of the menus.

You will need Adobe PDF reader to open the manuals.

Finding a Topic

If you have opened the Maxsurf User Manual PDF file, you can search for a key word or phrase by clicking on Search from the Edit menu, and following the instructions in the Search PDF pane.

You can also use this toolbar button: 

or **Ctrl+Shft+F**.

Other Resources

The manual is also available in Adobe Acrobat (PDF) format from the Formation Design Systems Support Centre at www.formsys.com/support.

The Support Centre also offers a Knowledgebase which includes Frequently Asked Questions and Tips and Tricks databases.

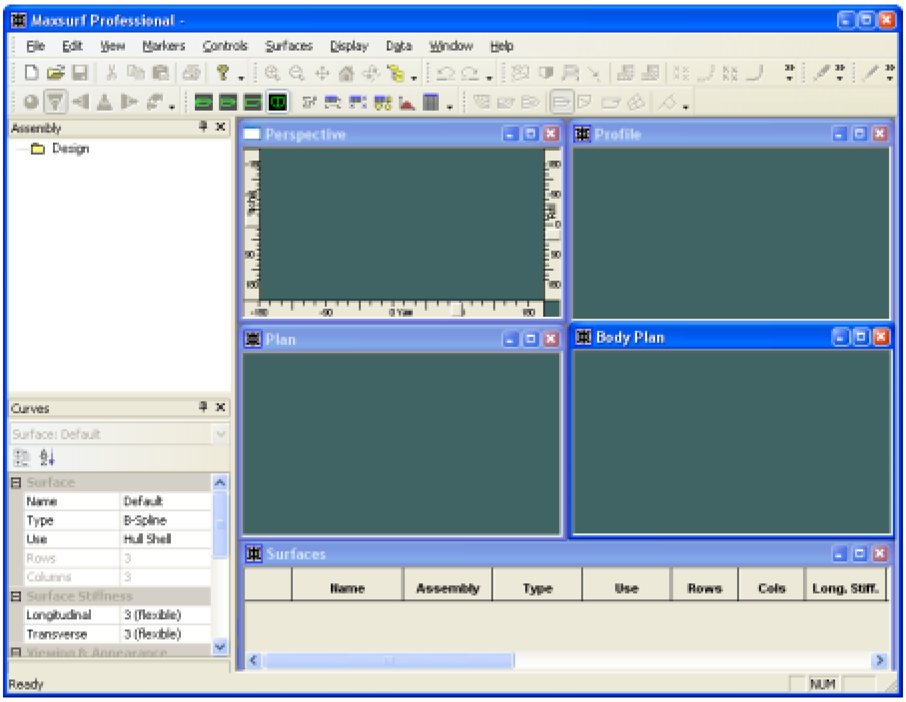
Continue with the Chapter 2 Starting Maxsurf section on the next page.

Chapter 2 Starting Maxsurf

If you have not already done so,

- **Install Maxsurf by inserting the CD and running the Setup program, and then follow the instructions on screen.**
- **Launch the Maxsurf application on your computer from the strart menu.**

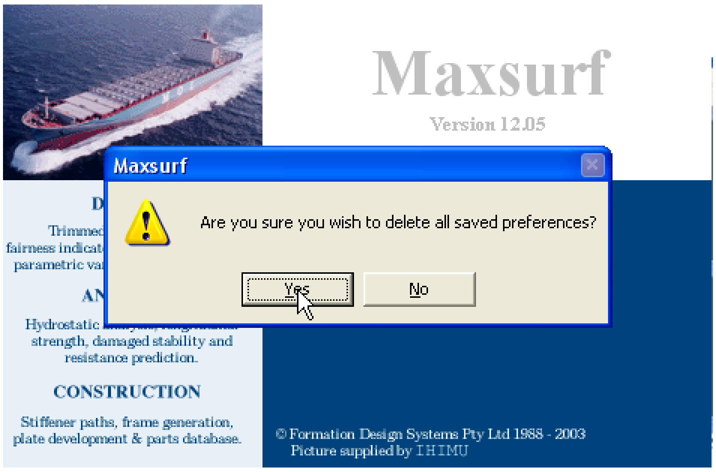
You should see something like this:



If you see something completely different:

- **Close the application and start it again, this time while holding down the Shift key.**

This will bring up the following dialog:



- **Clear all Maxsurf Preferences**

Before you can do anything in the application, you either have to start a new design or open an existing design.

Continue reading the Opening a Design section.

Opening a Design

Opening a Design - Concepts

A Maxsurf file has a .msd file extension and can be recognised by the file icon. As in most Microsoft Windows applications, you can open files in different ways. For example, you can open files by double clicking on them or by using a File | Open menu. Let's have a look at the different ways you can open a file in Maxsurf.

Opening a Design – Video

Watch a short video that shows you how to open a design in Maxsurf using the File | Open method and the drag and drop method. [Web | Disk]

Opening a Design – Procedures - File | Open

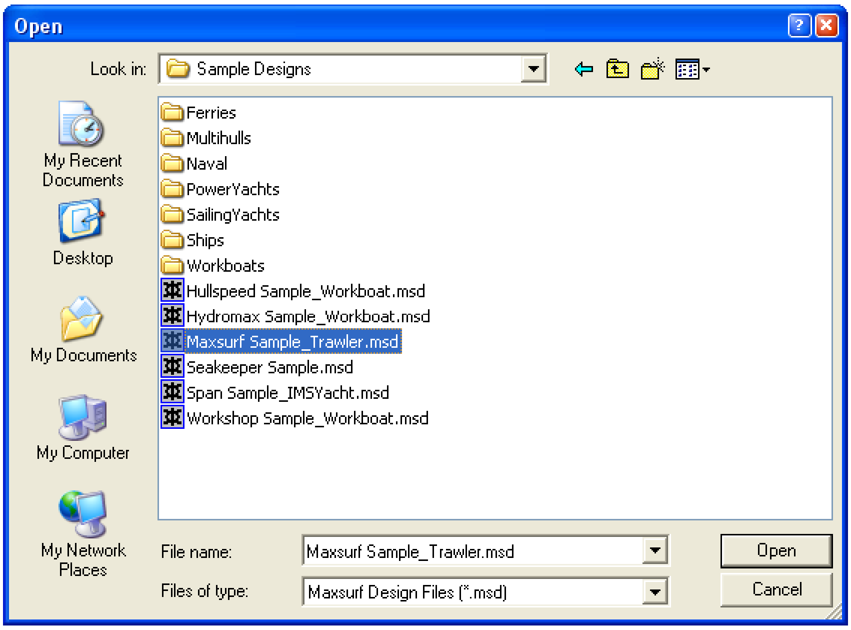
File | Open

Probably one of the most conventional ways to open a file is by:

- **Start the Maxsurf application**
- **Click File | Open Design**
- **Navigate to the Maxsurf program file directory.**

This is C:\Program Files\Maxsurf, unless you have specified it differently.

- **Open the Sample Designs folder**



- **Select the design called Maxsurf Sample_Trawler.msd and open it.**

Done! The design will initially be displayed in each of the four view windows by the outline of its surface edges (in the case of the Sample Trawler, there is only one surface), represented as solid grey lines.

Note

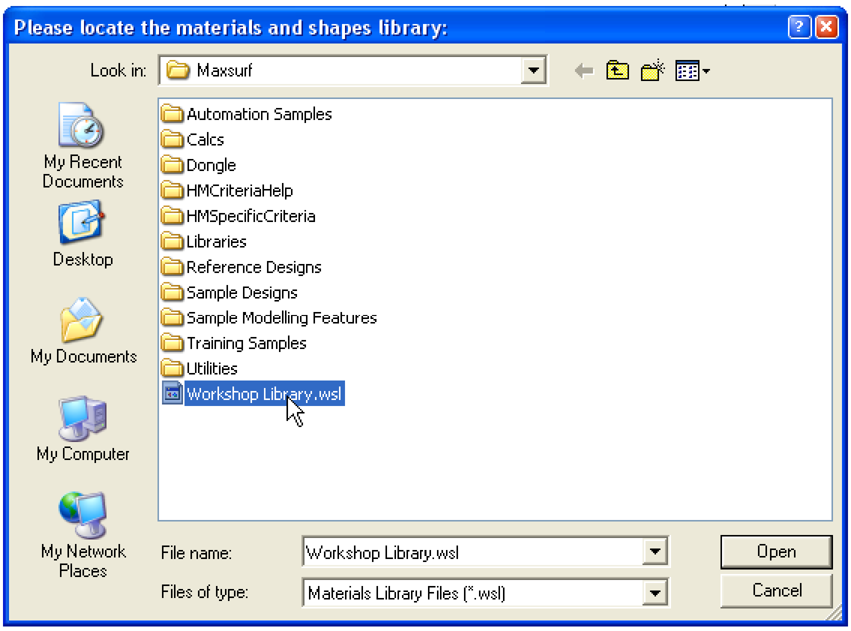
All Maxsurf applications have the ability to open different sets of data. For example in Maxsurf you can load Markers or surface models. The type of data that can be opened is determined by the Window that you have currently got "active" or "frontmost". You will learn about the different Maxsurf Windows later.

Opening a Design – Procedures - Double Click

Double Clicking on a File

- **In Windows explorer, navigate to c:\program files\Maxsurf\Sample Designs**
- **Double click on the file called Maxsurf Sample_Trawler.msd**

This will start up a new Maxsurf application and bring up the following dialog first:



- **You can select the Workshop Library.wsl or hit Escape to skip this step.**

The Workshop Library is only used in case you wish to allocate material properties (eg. material and thickness) to a surface in Maxsurf and will not be needed during the LearningMaxsurf training.

Opening a Design – Procedures – Drag and Drop

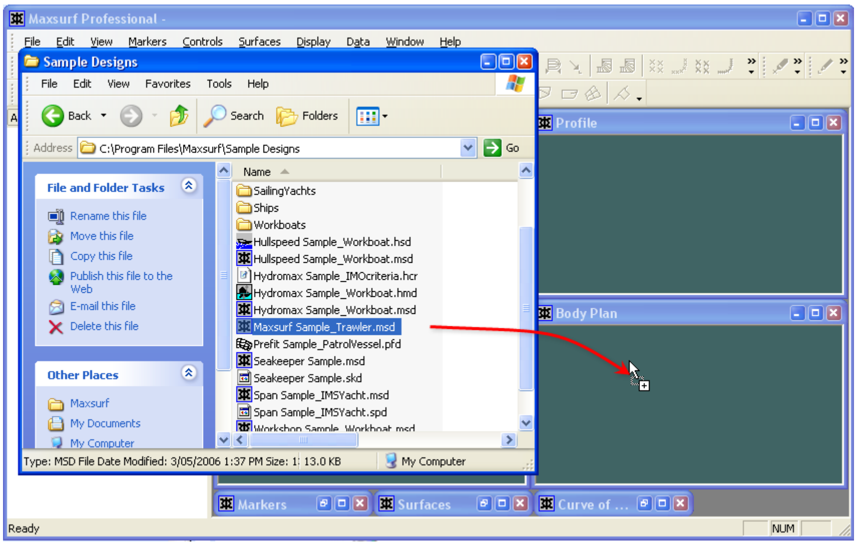
Drag and Drop

One of the less known options is that you can actually drag a .msd file onto any of the View windows of the Maxsurf application.

- **Close all applications you may have open on your computer, so that you don't get confused with the next few steps.**
- **Start Maxsurf**
- **In Windows explorer, navigate to c:\program files\Maxsurf\Sample Designs**

➢ **Hold down the left mouse button after clicking on the Maxsurf Sample_Trawler.msd once.**

➢ **Now drag and drop the file into any of the View windows in Maxsurf:**



Dragging and dropping the file from Windows explorer window into one of Maxsurf's View windows.

Continue with the section on [Closing a Maxsurf Design](#).

Closing a Maxsurf Design

You can close a design from the File menu:

➢ **File | Close Design**

In case there have been any changes to the model since you have last saved it, Maxsurf will ask you whether you wish to save the design changes.

- **Selecting yes will save the changes and close the model.**
- **Selecting no will not save your changes and close the design. You will lose all changes since the last save.**
- **Selecting cancel will cancel the close design command and allow you to continue working.**

Continue with the [Chapter 3 User Interface](#) section on the next page.

Chapter 3 User Interface

In this training manual it is assumed that the user has a reasonable familiarity with working in applications on any Microsoft Windows® operating system. Some Maxsurf specifics to the User Interface are described below. It is a good idea to read this section before you start modelling, as it will give you a good understanding of the architecture of the application which helps you find commands faster and operate the program more efficiently.

The User Interface can be defined as the aggregate of tools available that allow you to work with the application. Some of these tools can be used for viewing while others allow you to control or manipulate the object being viewed.

The Maxsurf User Interface can be divided up into three main groups:

- **Menus**
- **Toolbars**
- **Windows**

Menus

Unlike some other CAD applications Maxsurf does not have a command line. This has the advantage that you don't have to memorise different commands and everything can be done using the commands in the menus.

To enable faster access to the menu commands Maxsurf has two other options:

1. Toolbars. The most common commands can also be accessed through toolbars.
2. Additionally, Maxsurf has several object based right click commands. This means that after selecting an object and using the right mouse button, Maxsurf displays the most commonly used commands on the selected object. For example, when you select an edge of a surface and right click on it, you can access the Surface Properties or perform a trimming operation on the surface.

These are just other (usually more efficient) ways to get to a corresponding menu command.

The menus and toolbars in Maxsurf operate in the same way as most Microsoft applications and will not be explained any further. At this stage it is not required to know all the menu commands as we will cover most of them as we go along in this training manual, but for the interested reader the function of each Menu command is explained in detail in the Menus section of the Reference Chapter of the Maxsurf manual.

A brief overview of the menus is worth studying:

Menu	Description
File	Working with the file
Edit	Copy & Paste and other editing commands
View	Lets you set how you want something displayed. Often confused with the Display menu.
Markers	All commands to do with Markers
Controls	All commands to do with Control Points

Curves	All commands to do with Curves
Surfaces	All commands to do with Surfaces
Display	Select what you want to display
Data	All commands to do with calculations & producing data
Window	Different window display options
Help	Accessing different Help resources

Toolbars

The toolbars contain toolbar buttons that activate menu commands. Only the most commonly used menu commands are on the default toolbars. Maxsurf allows you to create you own toolbars and toolbar buttons. This is not covered in the LearningMaxsurf training manual. For the interested reader: information on this can be found in the Customising Toolbars section in the Maxsurf Reference chapter.

Windows

Continue reading the Maxsurf Windows section of this training manual.

Maxsurf Windows

Maxsurf consists of a total of 10 windows. Each window has its own functionality and usefulness depending on the task that you want to perform. You will rarely need all 10 windows at the same time. For example: when you are working with Offsets or when you are modelling, there is little need for the Calculations window. The Calculations window can then be minimised or closed to optimise available screen space.

Within the 10 Maxsurf windows we can identify a group of 4 “View Windows” that are used to view the model.

Continue reading the 3D Modelling in 4 View Windows section.

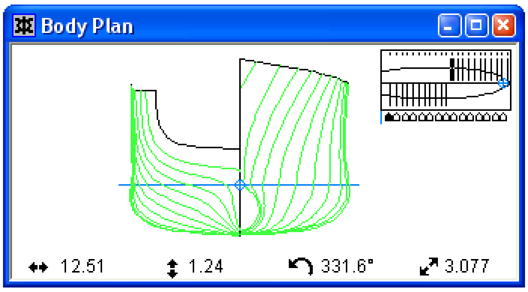
3D Modelling in 4 View Windows

One of the most difficult things to learn is working in a 3 Dimensional environment on a computer screen. Especially if you have never used 3D drafting tools before it can take some time to get used to. The Maxsurf application is specially designed to help you manipulate a shape in 3D using just your mouse and the computer screen display. The tutorials in this document will teach you different mouse techniques and screen display settings that increase your 3D modelling efficiency in Maxsurf.

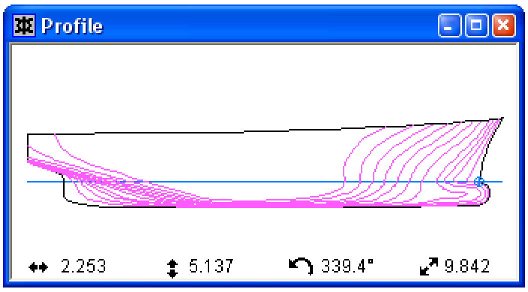
Maxsurf consists of four view windows. For each 2D view direction, Maxsurf has one window:

View direction	**View Window**
Looking from the stern to the bow	Body Plan Window
Looking from the Starboard side	Profile Window
Looking from below*	Plan Window

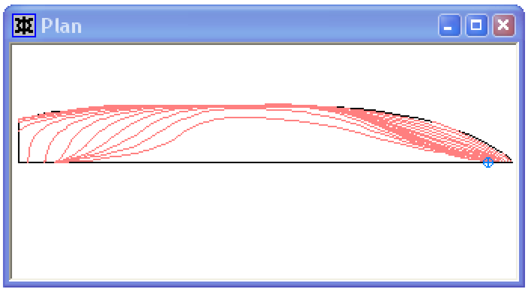
* This may appear odd, but this way the user can model above the centreline in Plan view. Research has shown that a naval architect can interpret the shape of a vessel in plan view better when it is drawn above the centreline.



Body Plan Window

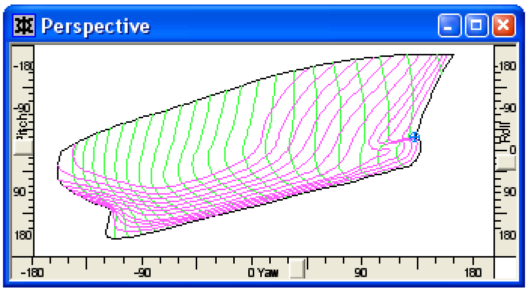


Profile Window



Plan Window

Finally Maxsurf has a 3D viewing window that allows you to view the model in 3D, rotate it and render it. This is called the Perspective Window.



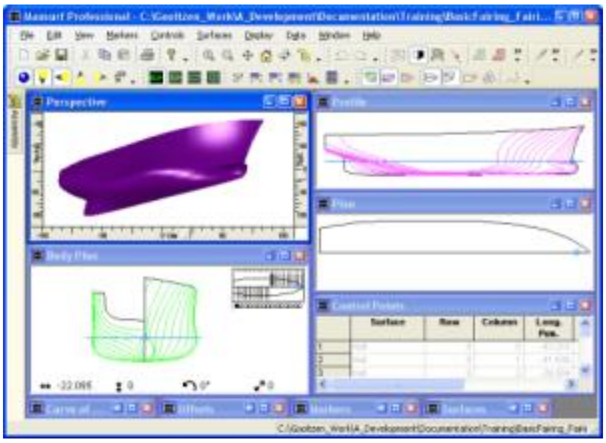
Perspective Window

Continue with the section on Working in Different Windows Layouts.

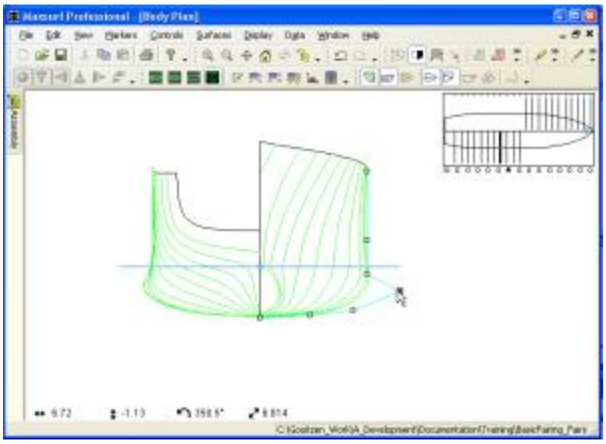
Working in Different Windows Layouts

Window Layouts - Concepts

Most computers use a 1024 x 768 resolution monitor which means that there is limited space available and you continuously have to find a compromise between the number of windows you have open and the size of the windows:



5 windows open, but each of them is quite small.



Only one window open (Body plan), but now you can't see the effect of a modification to the shape of the design in the Profile, Plan or Perspective window.

It is really a matter of experience and personal preference what suits your working methods best. Here are some tips from the Maxsurf developers:

Window layout tips:
- To maximise screen space, it is recommended to maximise the Maxsurf application window at all times. - When modelling, close all windows except for the view windows. - When modelling, switch between working with 4 view windows and just one view window. - Minimising the amount of information on your screen helps you work more efficiently.

Windows Layout – Video

View a video that shows you the different windows layouts in Maxsurf as well as different ways to switch between windows (next section). [Web | Disk]

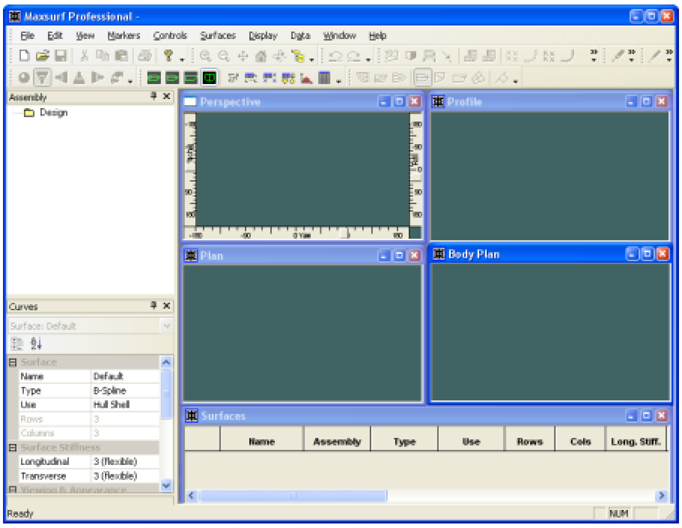
Windows Layout – Procedures

In the following steps you will learn how to setup your windows layout in Maxsurf so that you have just the 4 view windows open.

- **Start Maxsurf while holding down the Shift key**

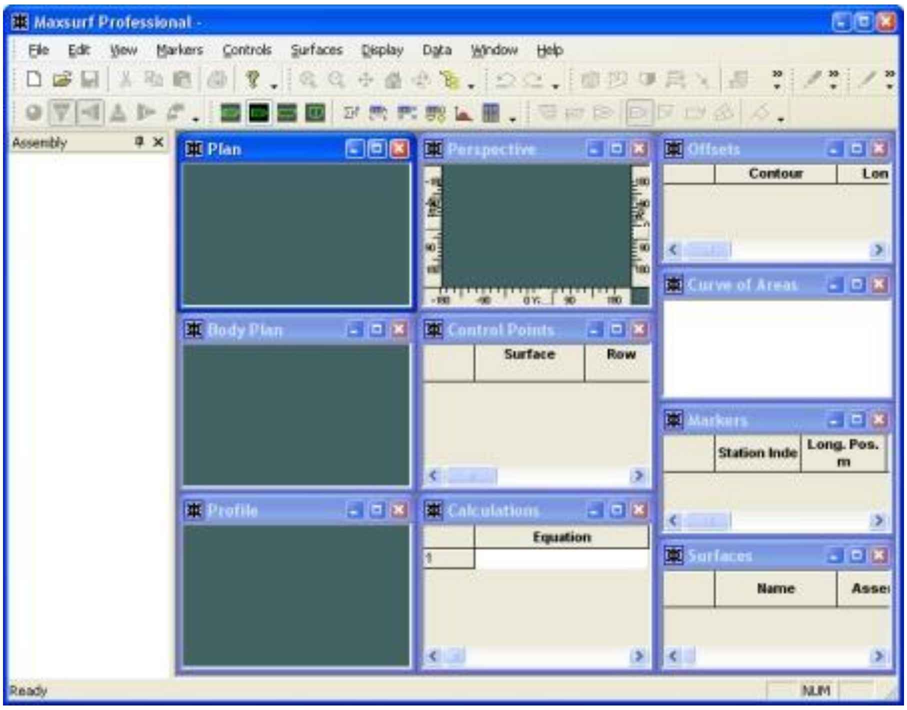
➢ **Select “yes” to clear all preferences**

This will start Maxsurf with the default windows settings:



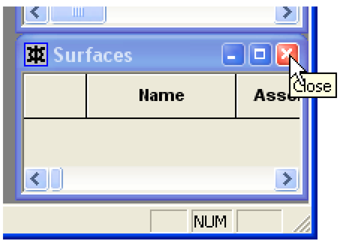
➢ **Use Window | Tile Horizontal**

You’ll see something like this:



Maxsurf windows after Tile Horizontal

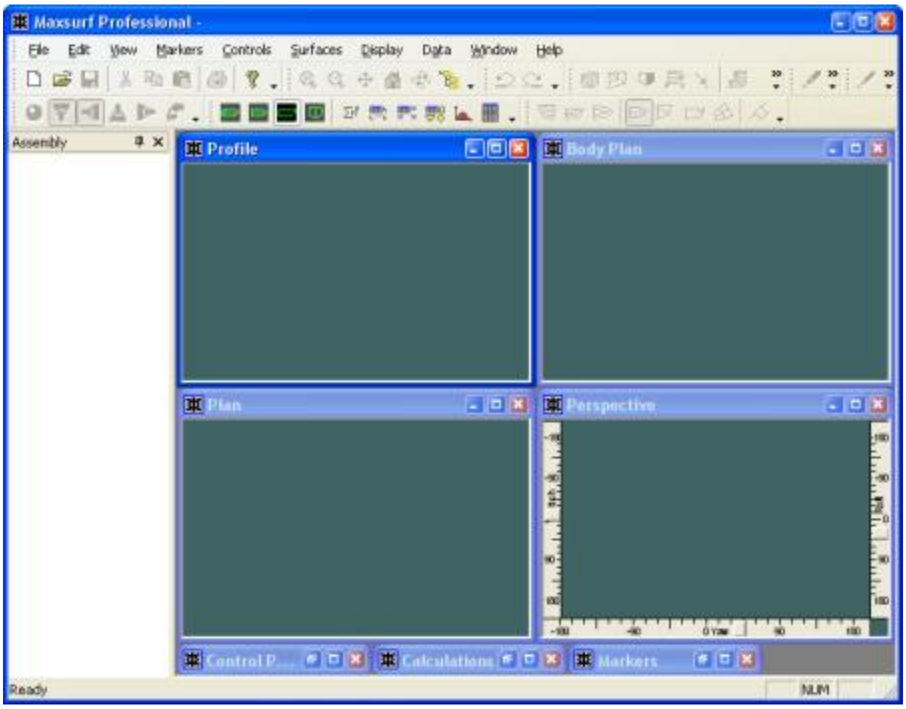
➢ **Now close all windows except for Body Plan, Profile, Plan and Perspective**



Notice how the closed windows are all stacked at the bottom of the Maxsurf application window:

➢ **Do another Window | Tile Horizontal**

You should now see something like this:



You can re-open any of the closed windows by simply selecting the window from the Window menu and the selected window will restore to its original position and size before it was closed.

Continue with the Switching Between Windows section.

Switching Between Windows

Switching between windows – Concepts

A Window can be either in the background (passive/display only) or it can be the “current window”. A background window is a passive window used for display only and you can not type or modify any of the objects in it. Only one window can be the current window or active window. In this active window objects can be modified (eg. change surface shape or text in a table).

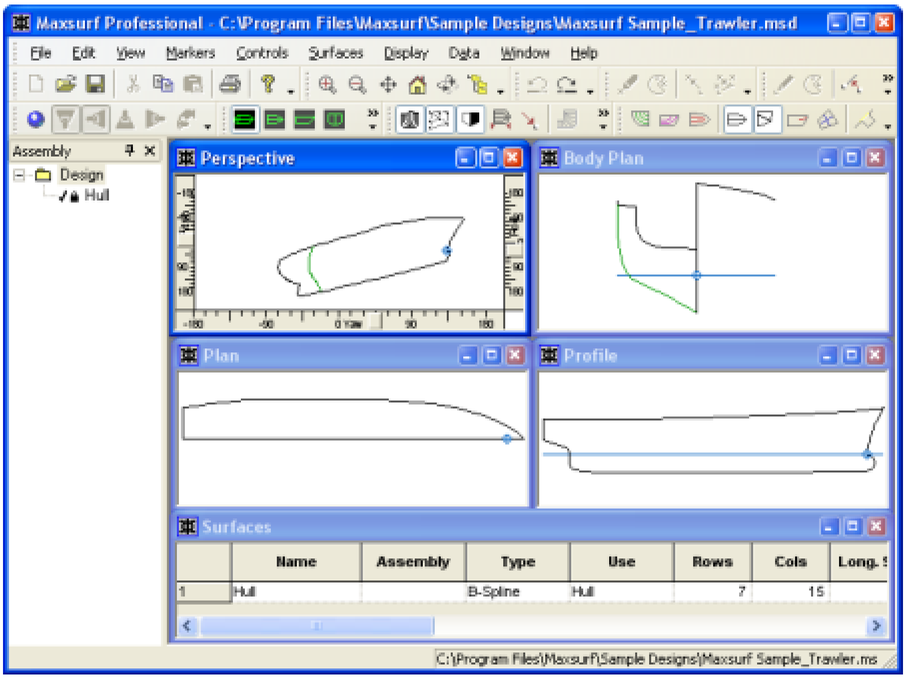
You may click within any window to make it the active window. If you have several windows open, you can recognise the active window by the brighter colour of the title bar. A window may also be brought to the top by selecting its name from the Windows menu.

Switching between windows – Procedures

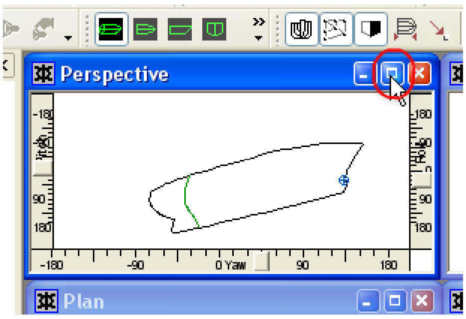
➢ **Start Maxsurf while holding down the shift key**

- **Click yes to clear all saved Preferences**

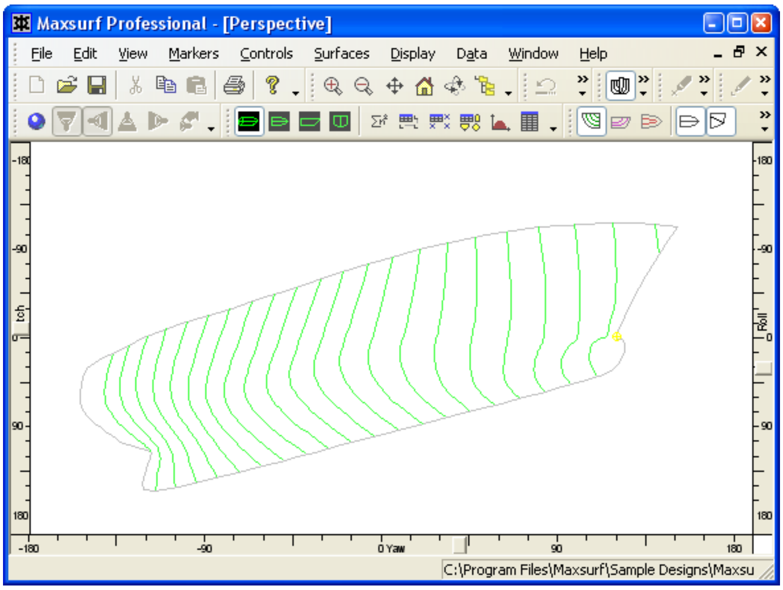
In the images below the Maxsurf Sample_Trawler design is used.



- **Maximise the perspective window by clicking the ◻ button in the top right corner of the window.**



This will maximise the Perspective window inside the Maxsurf application window:



Perspective window maximised inside the Maxsurf application window.

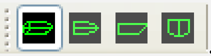
Note: When a particular window is maximised, the program's title bar reflects which window is being displayed: 

- **Now select Window | Profile**

This switched to the Profile window. Notice how the Window toolbar has updated from:

- **Now Click on the Restore window button in the top right of the Maxsurf application window;**

This restored the Profile window to its previous size and location.

> **Tip:**
> You can also switch between the design view windows by using the Window toolbar: .

Continue with the Assembly Pane section.

Assembly Pane

The Assembly Pane is a special case and deserves an extra explanation when discussing windows layouts. When used properly, the Assembly Pane can speed up your work significantly.

First read about the different modes of operation for the Assembly Pane in the Assembly Window section of the Maxsurf manual.

Again, as you get more experienced using Maxsurf you will develop your own personal preference with regards to using the Assembly Pane. The experience is that having the assembly tree docked on either the right or left side of your screen provides quick access to right click commands and speeds up your work.

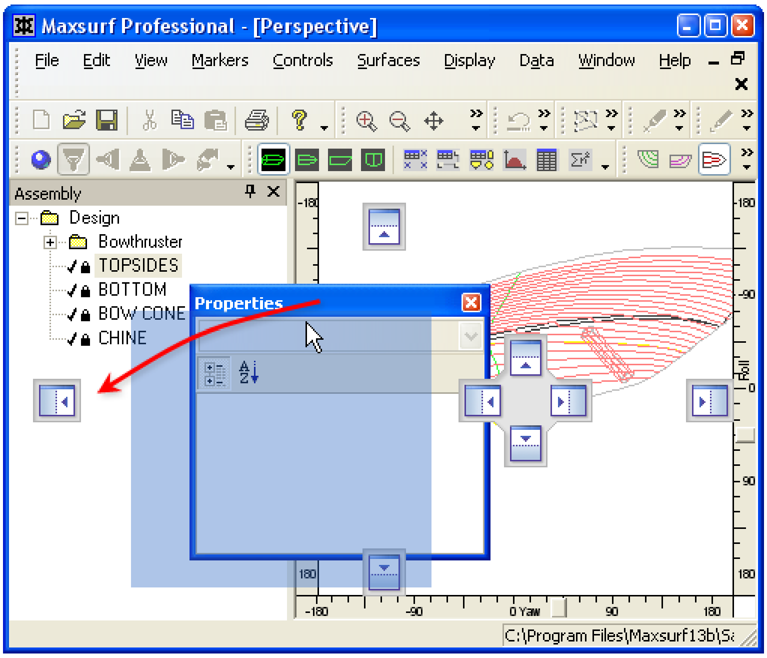
Assembly Window – Video

View a video that will show you the different window options for the Assembly Pane. [Web | Disk]

Continue with the section on the Properties Pane.

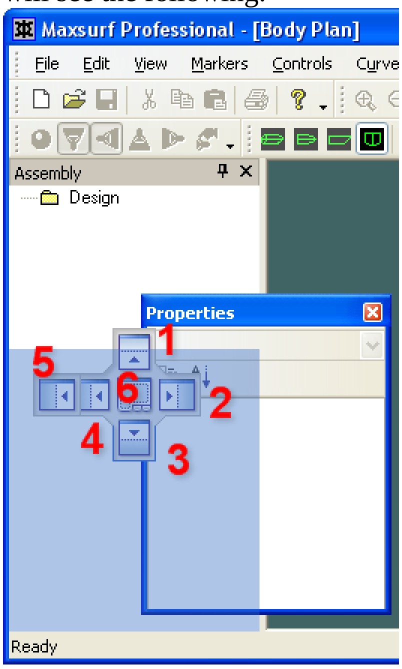
Properties Pane

The properties pane is very similar to the Assembly Pane in the way that it can be floating, docked or auto hide. The Assembly Pane and the Properties pane can also be docked together into one pane or as tabbed panes.

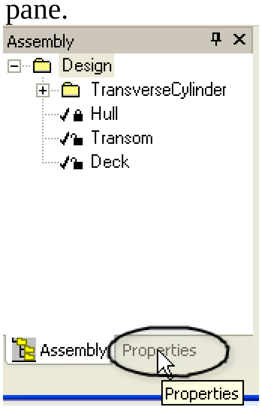


Regular docking and floating options for properties pane same as for the Assembly Pane.

When you drag the Properties Pane on top of the docked Assembly Pane, you will see the following:



Properties pane docking position:
1: Above Assembly pane
2: To the right of Assembly pane
3: Below Assembly pane
4: To the left of Assembly pane
5: To the left of Assembly pane as a separate pane
6: Underneath the Assembly pane into a tabbed pane.



Properties pane docking in the same area as the Assembly pane has different options.

Continue with the section on Working in the Perspective Window.

Working in the Perspective Window

Working in the Perspective Window – Concepts

We will now explore two viewing options unique to the Perspective window – rendering and rotation.

Working in the Perspective Window – Video

View a video that will show you how to rotate the model in the Perspective view window using the slider bars and free rotate. The video also shows how to render the model and toggle different light sources. [Web | Disk]

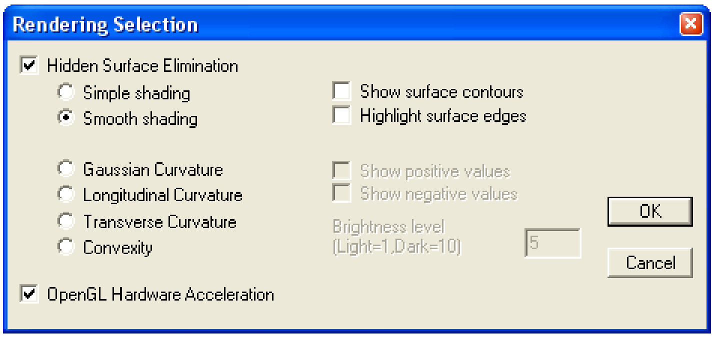
Working in the Perspective Window – Procedures

Render

- **Click within the Perspective window to make it active or use the Windows menu or toolbar.**

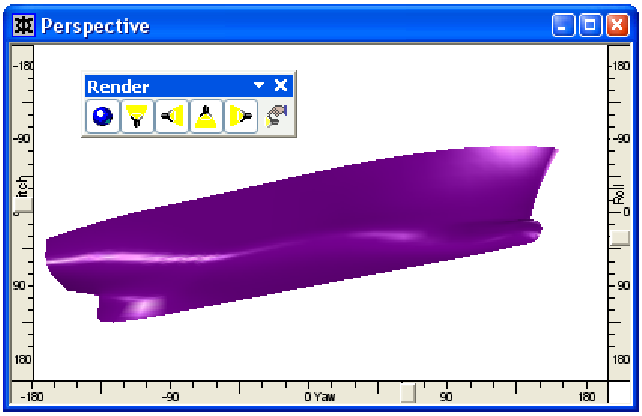
To get a realistic 3-D representation of the model as a solid body, you can render the surface.

- **Go to Display | Render and ensure that the dialog box appears as below before clicking OK:**



To maximise the light incident on the surface,

- **Activate the four light sources in the Render toolbar:**



The model rendered in Perspective window with all four light sources switched on.

Note
Rendering only works in the Perspective window. The Display | Render as well as the Render toolbar are disabled when the Perspective window is not active.

Rotate

The Rotate function lets you freely rotate a design in the perspective window.

- **Select View | Rotate or use the**  **toolbar button from the View toolbar**
- **Move the cursor to a location in the Perspective window and press the left mouse button**
- **Keeping the left button depressed, rotate the image by moving the mouse around**

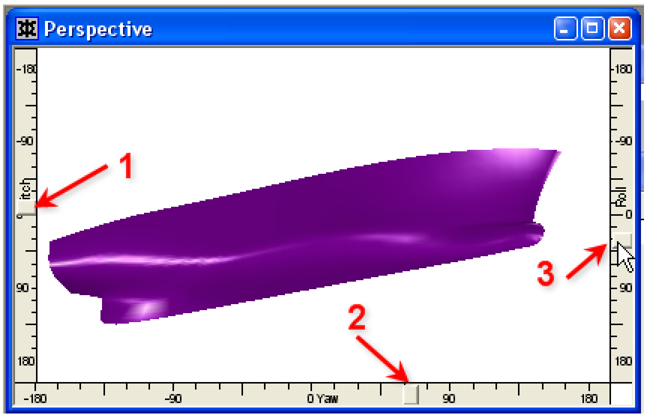
The rotation is performed by projecting the cursor movements onto a virtual sphere in the perspective window centred on the centre of the surface – essentially the rotate function performs like a virtual trackball. Generally speaking, moving the mouse left and right rotates the model about a vertical axis while moving the mouse up and down rotates it about a horizontal axis.

- **Release the left mouse button to exit the Rotate mode.**

To rotate the model with greater accuracy and control, you can use the pitch, roll and yaw slider bars on the sides of the perspective window.

- **"Grab" the yaw control block within the yaw scale by clicking it, and while still holding the left mouse button, drag it over the 0 (degrees) marker.**
- **In the same way, set the pitch and roll to 0**

You should end up with something like this:



1 = Pitch, 2 =Yaw, 3 = Roll

Continue with the section on Displaying Contours.

Displaying Contours

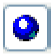
Displaying Contours – Concepts

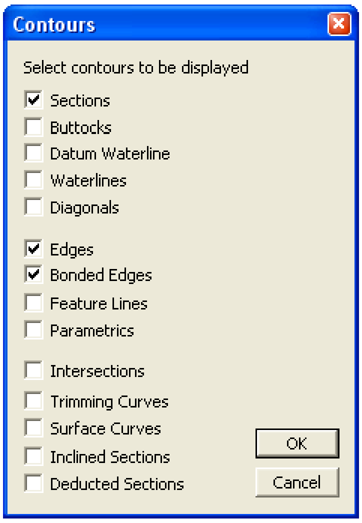
An alternative to using rendering to visualise the shape of a surface is to make surface contours visible.

Displaying Contours – Video

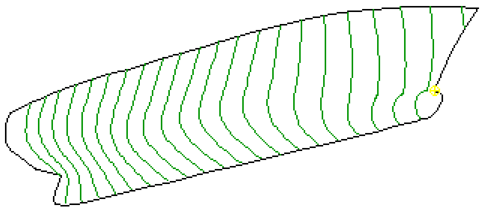
 Watch a video that will show you how to toggle the display of different contour lines in different windows using toolbar buttons and the Contours dialog. [Web | Disk]

Displaying Contours – Procedures

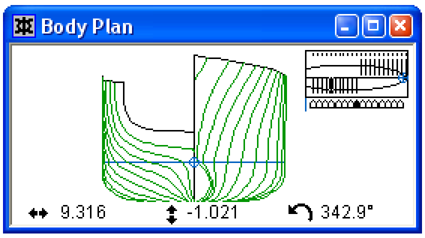
- In Perspective window, switch rendering off by clicking on the  toolbar button
- Change the pitch to 15° and the yaw to 45° to better visualise the contours
- Go to Display | Contours and tick the sections box:



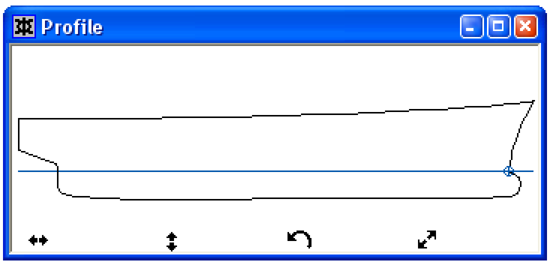
The sections define the intersections between the surface and numerous transverse planes through the model.



- Switch to Body Plan window



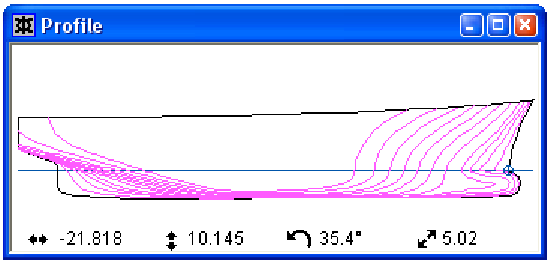
- Now switch to Profile window



Sections are not displayed in the Profile or Plan window

Though the sections would appear as vertical lines on the screen in both the profile and plan windows, since these lines would bear no information about the shape of the sections, they are not displayed.

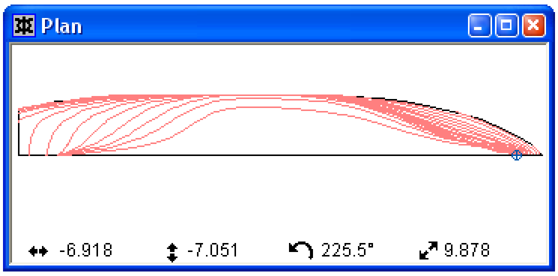
- **In the Contours dialog box, uncheck sections but tick the buttocks box**



- **Switch to the Plan window**

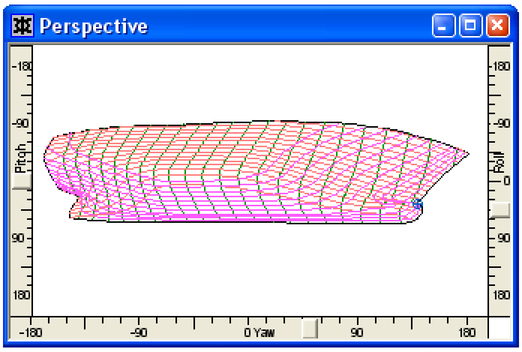
The buttocks define the intersections between the surface and numerous vertical longitudinal planes through the model. For the same reasons as above, they do not appear in the Plan or Body Plan windows.

- **In the Contours dialog box, uncheck buttocks but tick the waterlines box.**



The waterlines define the intersections between the surface and numerous horizontal longitudinal planes through the model. For the same reasons as above, they do not appear in the Profile or Body Plan windows.

- **In the Contours dialog box, check Sections, Buttocks and Waterlines**
- **Switch to Perspective view**



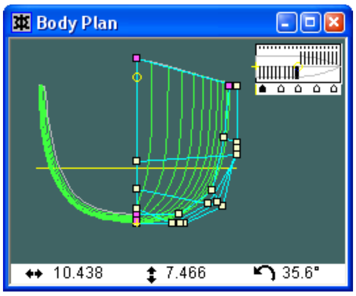
In the Perspective window, all contours are displayed

Continue with the section on Working in the Body Plan window.

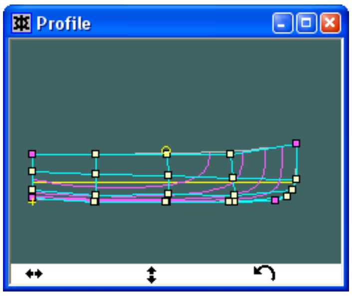
Working in the Body Plan window

Working in the Body Plan Window – Concepts

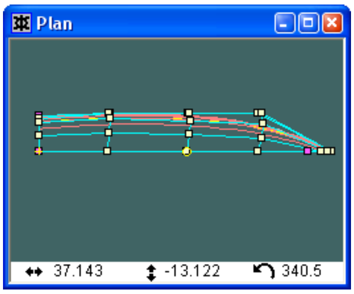
The body plan window displays the transverse sections as seen from aft of the model. Starboard is on the right of the centreline. Working in the Body Plan view window is different to working in Plan or Profile because in Body Plan you are looking down the length of the vessel which can appear quite messy. In Plan or Profile you are looking from the bottom or starboard respectively and this usually does not look quite as confusing:



Body plan

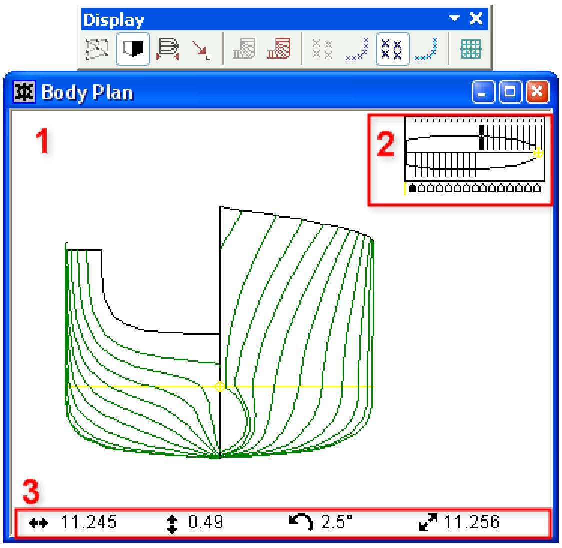


Profile



Plan

In the image below, 22 sections are displayed in one 2D window. Even though the eye of the naval architect is trained in interpreting images like this and translate this into a 3D shape, it can sometimes be difficult to establish the longitudinal position of a particular section along the length of the hull. This is why the Body Plan window has an extra feature built in: the Control Box. This powerful tool allows you to select the station you would like to display or the column of control points you wish to modify. This enables you to do some useful modelling in the Body Plan window and manipulate the shape by working one section at a time. In the procedures below we'll have a closer look at this control box.



Half hull display in Body Plan view

You can identify three regions in the Body Plan window:

1. Main view window area
2. Control box
3. Coordinate display

Tip: As with most Windows in Maxsurf, but especially in the Body Plan view, it is important to make sure you display only the data that you need using the Contour display dialog or toolbar buttons.

Working in the Body Plan window – Video

View a video that will show you the different view options in body plan such as Show/Hide Net, Display/Hide Sections and how to use the control box to switch between sections or switch your active column of control points.
[Web | Disk]

Working in the Body Plan window – Procedures - Introduction

Introduction to the Body Plan view window

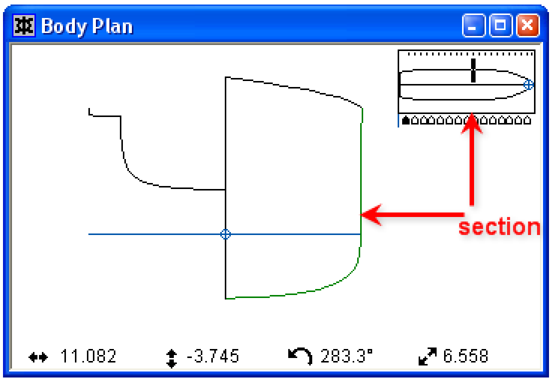
- **Open the Maxsurf Sample_Trawler.msd sample file from the c:\program files\Maxsurf\Sample Designs directory**
- **Maximise the Body Plan view:**
- **Display only the Edges and the Sections**
- **Select Display | Half or use the toolbar button**

Working in the Body Plan window – Procedures – Control Box

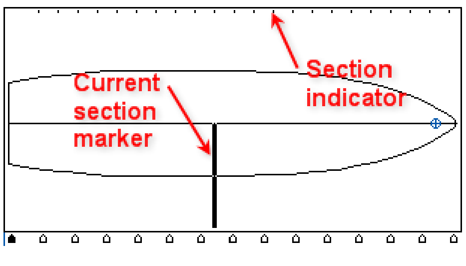
Using the Control Box

- **Switch the sections off**

You should now see just one section displayed on your screen:

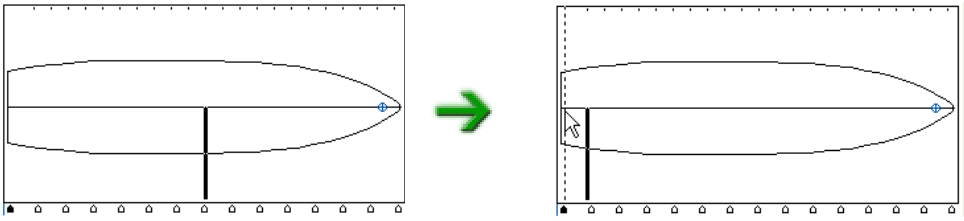


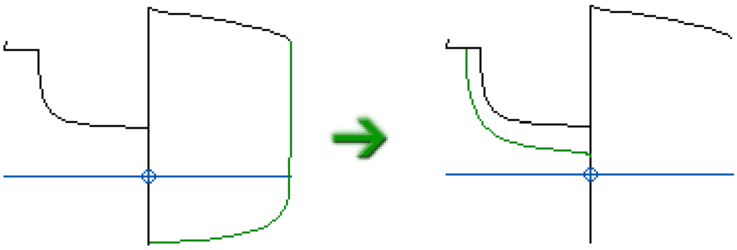
The control box is a miniature view of the plan shape of all currently visible surfaces – in this case just the one surface modelling the trawler's hull.



At the top of the control box several short vertical lines are drawn. These are the section or station indicators; there is one indicator for each of the sections specified in the Grid Spacing dialog.

- **Click in the control box near the stern of the ship:**





The current section marker line shows which section is currently displayed. When a point in the control box is clicked, the nearest section will be selected. Notice how in the Body Plan window the current section has changed:

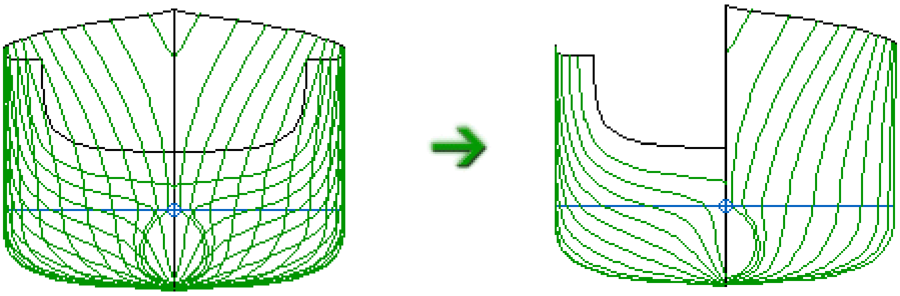
After clicking in the control box, you can use the arrow keys on your keyboard to scroll through the sections. The right arrow displays the next station forward and the left arrow displays the next station aft.

- **Use your keyboard keys to scroll through the sections of the trawler model**

Working in the Body Plan window – Procedures – Half Display

Half Display

When working in Body plan you will usually toggle the section display on/off to visualise the effect of a change to one section on the 3D shape. When all sections are displayed simultaneously, the display can be a bit messy. The Half display can then help to clean the display up.

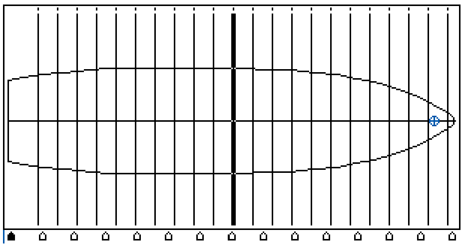


- **Switch Display of sections off**
- **Switch Display | Half off**

Notice how the section is now mirrored to the other side of the centreline. Also notice how the control box current section marker is now drawn across the centreline.

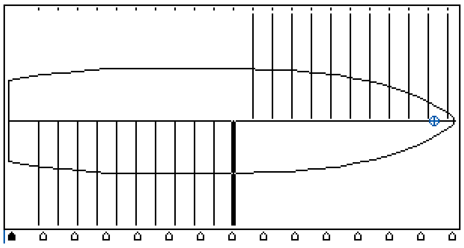
- **Switch display of section on**

Notice how the control box now displays all sections with the current section marker drawn with a thicker line:



Control box with all sections displayed and half hull display off

- **Switch Display | Half on**



Control box with all sections displayed and half hull display on

When Half hull display is switched on, Maxsurf automatically determines which sections will be displayed on the right and which on the left of the centreline. There is a way for the user to overrule this default split location on a surface-by-surface base. This is not covered in the LearningMaxsurf training manual.

Note:
When the cursor is within the control box the horizontal cursor coordinate at the bottom of the Body Plan window refers to the cursor's longitudinal position within the control box. For the control box to work correctly it is important that the Frame of Reference is setup correctly. You will learn about this later; just remember this at this stage.

Continue with the section on Zoom, Shrink and Pan.

Zoom, Shrink and Pan

Zoom, Shrink and Pan – Concepts

In all Maxsurf view windows you can zoom, shrink and pan to manipulate the way that the model is displayed. Additionally Maxsurf lets you set a Home view that remembers a particular zoom & position of the model on the screen.

Zoom, Shrink and Pan – Video

View a video that shows the use of zoom, shrink and pan commands. This video also shows how to customise the home view to your own personal preference and use the Home view command. [Web | Disk]

Zoom, Shrink and Pan – Procedures - Zooming

Zoom

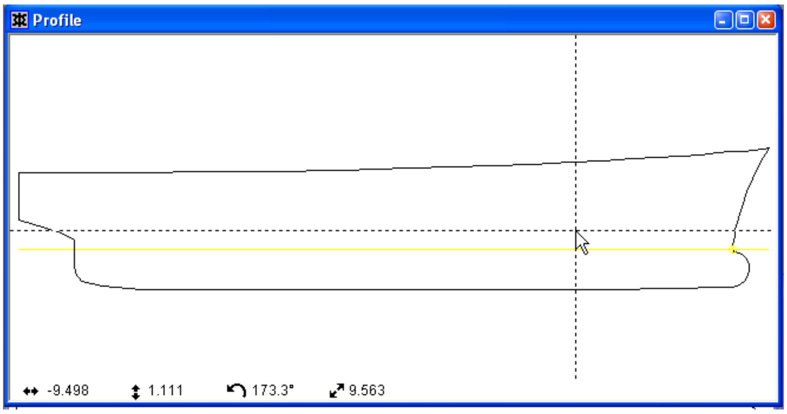
The Zoom function allows you to work on any part of your design by enlarging a particular area to fill the screen.

The zoom function works in any of the Maxsurf drawing windows. To demonstrate how it works,

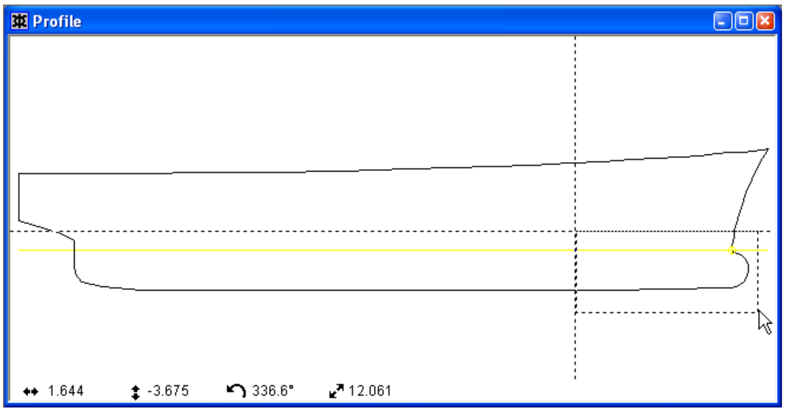
- **Click on or otherwise activate the Profile window**
- **Select Zoom from the View menu (or use the keyboard equivalent Ctrl+E).**

A cross hair will appear that follows the movement of the mouse. This is used to set the starting position of the zoom rectangle. Supposing we wish to zoom in on the bulbous part of the bow profile:

- **Click and hold the mouse from approximately this position:**



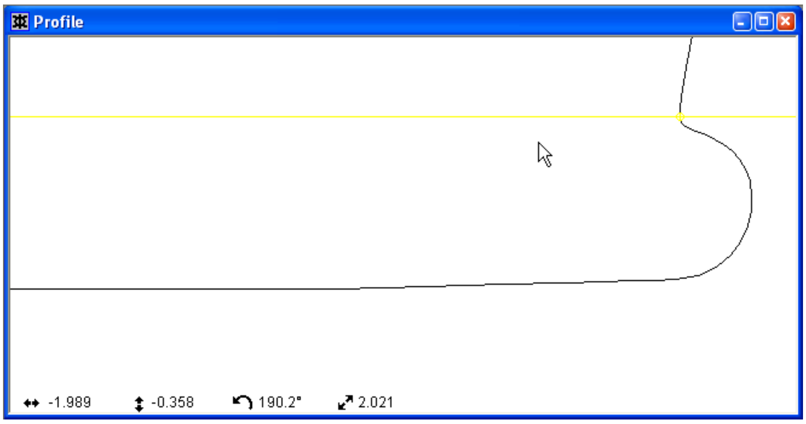
- **Drag the mouse to form the following zoom rectangle:**



The zoom rectangle will grow as the mouse moves.

- **Release the mouse button.**

The view contained in the zoom rectangle will be enlarged to fit the screen.



There is a limit on how far you can zoom; you will find that after continual zooming the image will not enlarge any further.

> **Note:**
> If, before releasing the mouse button, you decide that you do not wish to use Zoom, or that you wish to change the starting position of the zoom rectangle, simply return the cursor to within a few pixels of the starting position, release the mouse button, and the cross hairs will reappear.

Zoom, Shrink and Pan – Procedures - Shrinking

Shrinking

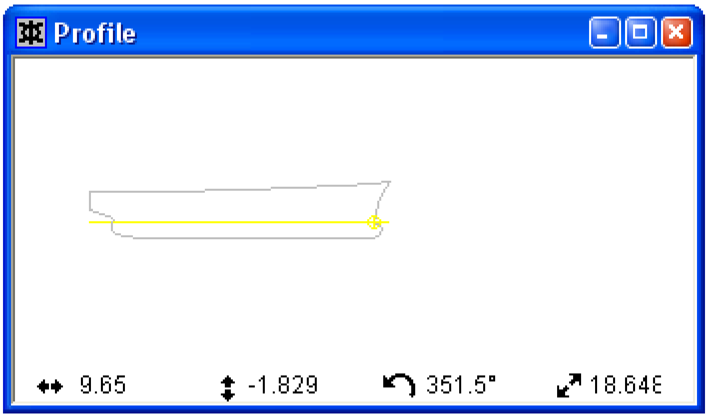
Choosing Shrink will reduce the size of the displayed image in an active drawing window by a factor of two.

To shrink the displayed image:

- **Select Shrink from the View menu.**

Tip: You can also use the shortcut key Ctrl + R or the  toolbar button.

- **Shrink the image until the entire profile is contained within the Profile window**



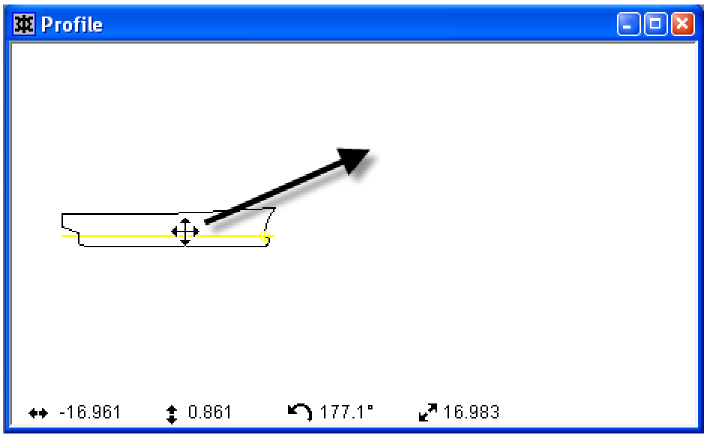
Zoom, Shrink and Pan – Procedures - Panning

Panning

Choosing Pan allows you to move the image around within a drawing window. To Pan an image:

- **Select Pan from the View menu.**

- **Click anywhere within the window and drag the drawing to a new position,**



The image will move with the cursor until the mouse button is released.

Tip: you can also use the toolbar button or hold down the scroll wheel of your mouse to Pan.

Zoom, Shrink and Pan – Procedures – Home View

Home View

When you select Home View a zoomed or panned image is returned to a particular state. This state may be set at any time for any combination of zooming and panning by selecting Set Home View from the View menu.

- **In Profile view, zoom in on the bulbous bow again**
- **Select View | Set Home View**
- **Now Zoom out a couple of times**
- **Select View | Home or use the toolbar button**

Notice how the display returns to the Home view as you specified it earlier.

Note:

Maxsurf starts up with default Home View settings, which are based on the Home Views in use the last time the program was operated.

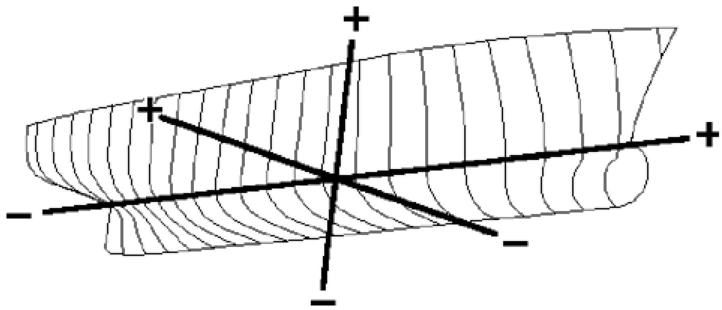
If a Home View is set within the Perspective window, the specific rotational orientation of the model will not be restored if the model is rotated and Home View is selected.

Continue with the section on Measuring Coordinates in Maxsurf.

Measuring Coordinates in Maxsurf

Measuring Coordinates in Maxsurf - Concepts

Maxsurf has defined its views to be consistent with Naval Architecture standards throughout all view windows.



+ve forward	-ve aft
+ve starboard	-ve port
+ve up	-ve down

Window	View direction
Body plan	Looking forward from the stern
Profile view	Looking from starboard, bow to the right
Plan view	Looking from below, starboard above the centreline

In the case of the sample trawler, the origin of the coordinate system at the forward-most point on the model's waterplane, as illustrated by the ⊕ symbol in the profile view of the trawler:

In the design view windows, other than the perspective view, Maxsurf displays a number of co-ordinates and measurements in the bottom-left corner of the windows.

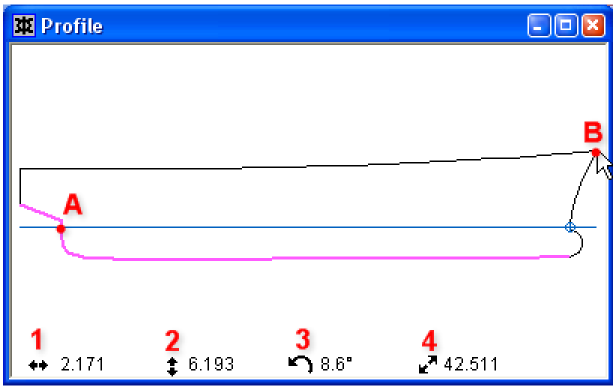
Measuring Coordinates in Maxsurf – Video

View a video that will show you how to measure absolute and relative coordinates and angles in Maxsurf. [Web | Disk]

Measuring Coordinates in Maxsurf – Procedures

To ensure that coordinates are interpreted correctly, the units must be set as desired.

- **Select Units from the Data menu and select Metres for Dimension Units.**
- **In the Profile window, left-click the aft intersection of the datum waterline and the surface's edge. (Point A)**
- **Now move the cursor towards the bow and hover at point B. As you do so, watch the coordinates change in the coordinate bar in the bottom of the Profile window.**



1. The horizontal coordinate in metres of the cursor's tip (Point B relative to the origin). The horizontal axis is relative to the screen, e.g. here the horizontal axis runs longitudinally but in the body plan view the horizontal axis runs transversely.
2. The vertical coordinate in metres of the cursor's tip (Point B relative to the origin).
3. The counter-clockwise angle in degrees between a line connecting the cursor's tip (B) and the clicked point (A) and a line running right from the clicked point (in this case the waterline to the right of point A). If no point has been clicked, the angle is relative to the origin.
4. The relative distance in metres between A and the cursor's tip B. If no point has been clicked, the distance is relative to the origin.

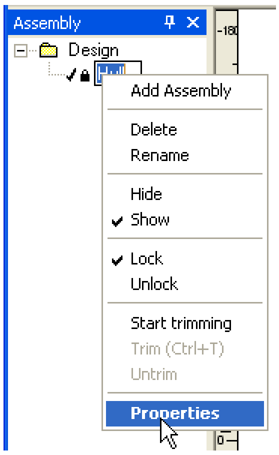
Continue with the section on Using the mouse in Maxsurf.

Using the mouse in Maxsurf

This section describes different mouse techniques that you can use throughout all of the Maxsurf applications.

Right Mouse button

Maxsurf supports several right click mouse actions. Right clicking on selected objects brings up a so called "right click menu" that lists the most commonly used commands applicable to that object. For example after right clicking on a surface in the Assembly Pane can give you quick access to the Surface Properties:



Right click menu

Using right clicking can greatly speed up your work.

Using the Mouse Wheel

You can use the mouse wheel to easily zoom into and out of a design. You can use this feature if you have a mouse with a 'wheel' in the centre of the mouse, i.e. Microsoft Intellimouse or Logitech Wheelmouse.

Rolling the wheel forward zooms in and rolling it backwards zooms out. When zooming in with the mouse wheel, the zooming will be centred on the centre of the drawing window. To zoom in on a particular area, View | Zoom or Ctrl + E must be used.

Holding down the mouse wheel to pan is also supported.

Continue with the section on Undo / Redo.

Undo / Redo

Since a lot of work in Maxsurf is iterative and based on trial and error, it is important to make note of the Undo and Redo capability in Maxsurf.

Changes can be Undone from the Edit menu. An action that has been Undone can be redone from the Edit menu as well. In the image below you have the option to redo the deletion of the surface, or undo the most recent control point move.

Each time a change is made Maxsurf stores a copy of the file into the RAM memory of your computer. The number of Undo levels that Maxsurf stores is set in the Edit | Preferences.

Tip

The fastest way to Undo and Redo is by using the Ctrl + Z and Ctrl + Y shortcut keys respectively.

Save regularly. Additionally use different file names if radical changes are made to the model.

Congratulations! You have now completed the Chapter 3 User Interface.

Continue with the Chapter 4 NURB Surfaces section on the next page.

Chapter 4 NURB Surfaces

Before you can start to create your first model it is important to understand the basic principles of surface modelling in Maxsurf. Understanding the basic principles behind NURB surfaces will improve the quality of your Maxsurf models and your ability to produce them significantly.

- **Read Chapter 2 of the Maxsurf manual on Basic Principles (Ignore the link to "Working with Surfaces").**

From this you should at least remember:

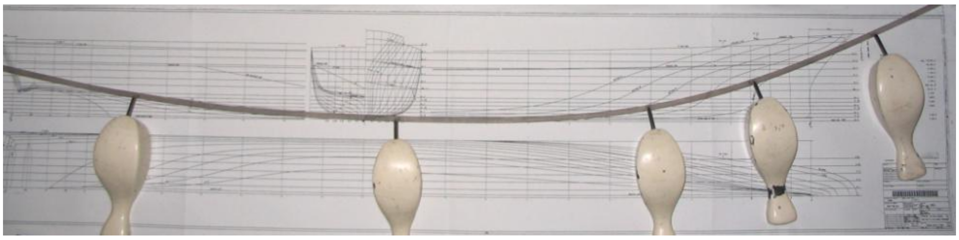
1. That the net of control points is always topologically quadrilateral; there are four corner control points and four edges. The control point net is arranged in rows (which run longitudinally) and columns (which run transversely). Each row has the same number of control points as every other row and each column has the same number of control points as every other column.
2. A surface always consists of 4 corner control points and may consist of additional edge control points and internal control points.

Continue with the section on Surface Stiffness.

Surface Stiffness

Surface Stiffness – Concepts

In Chapter 2 of the manual, the stiffness of a spline curve was compared to the stiffness of springs altering the shape of a wooden spline/batten. This analogy also holds when you think of the fact that if the wooden spline itself were stiffer, its curvature when loaded transversely would be lesser. Similarly: when drawing a smooth shallow curve you could select a stiff spline, and when drawing a curve featuring a high rate of change of curvature you could select a flexible spline.



A Perspex batten is used to draw a spline. Its stiffness determines how much curvature can be drawn.

In Maxsurf there are a number of stiffness levels or "orders" for both the longitudinal and transverse directions of the surface:

Linear	Order 2
Flexible	Order 3
….	…..
Stiff	Order 10

The order reflects the number of coefficients used in the polynomial that describes the spline's shape. For example: the order 2 polynomial "$y = a \cdot x + b$" uses 2 coefficients 'a' and 'b' and describes a straight line (read: linear curve).

When using NURB surfaces, flexible surfaces are useful for modelling knuckles (a region on a surface with sudden or very high change in curvature) and discontinuities.

Surface Stiffness – Video

Watch a video that shows you the effects that a change to the surface stiffness has on the shape of a spline. [Web | Disk]

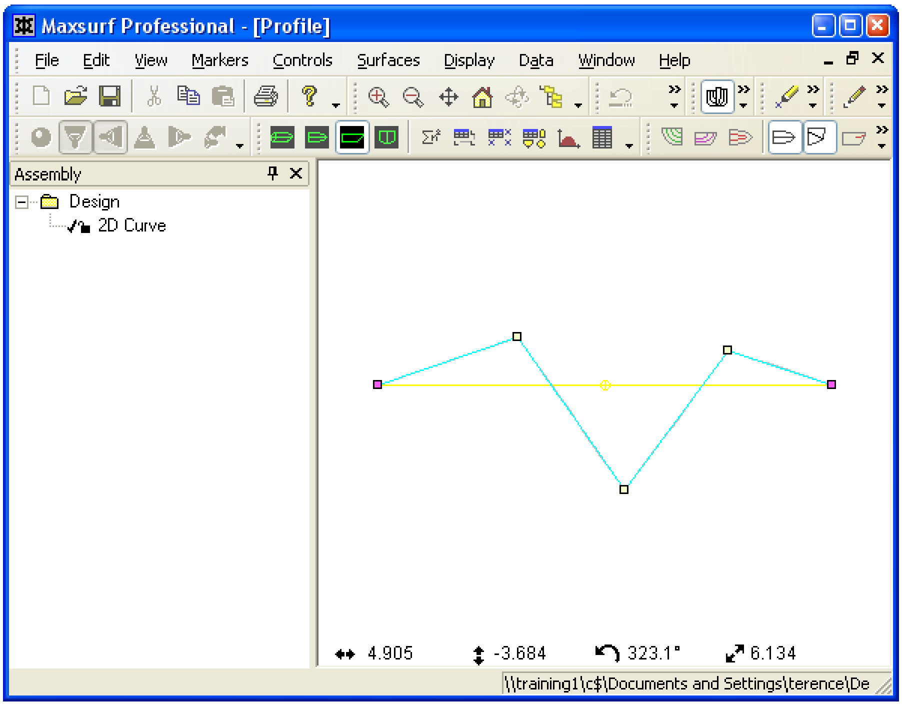
Watch a video that shows how a change in stiffness affects the shape of the surface. [Web | Disk]

Surface Stiffness – Procedures – 2D Curve

2D Curve

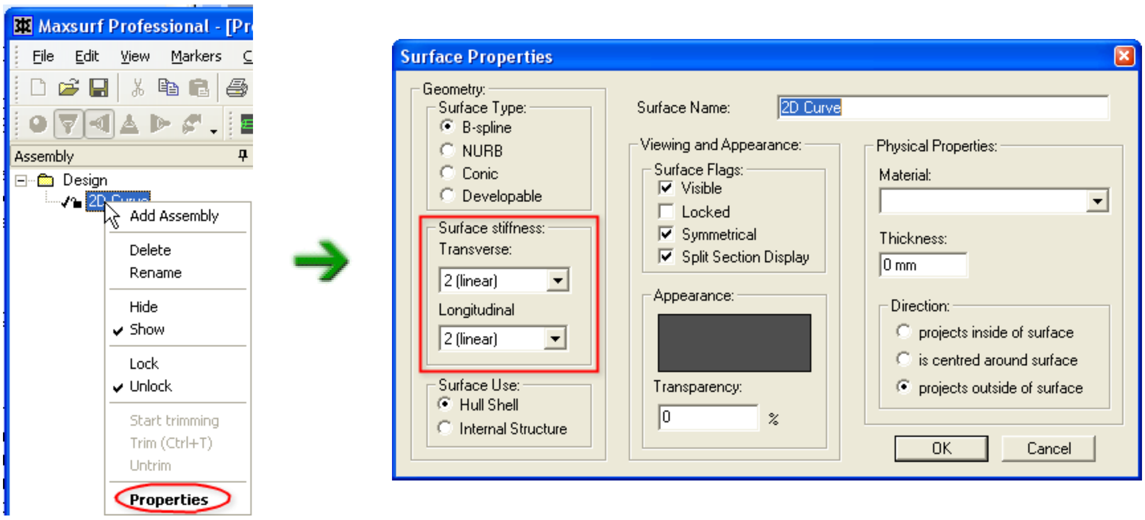
In the section on Basic Fairing we will discuss stiffness further, but first let's have a look at the effects of stiffness on a curve:

- **Maximise the Profile window**
- **Open SurfaceStiffness2D_start.msd**



The model consists of a single chain (or "row") of control points that produces a spline that lies in a single plane (you can see this in the Plan and Body Plan windows). Thus the model is best viewed in the Profile window. The 'curve' produced is simply a jagged line connecting the control points.

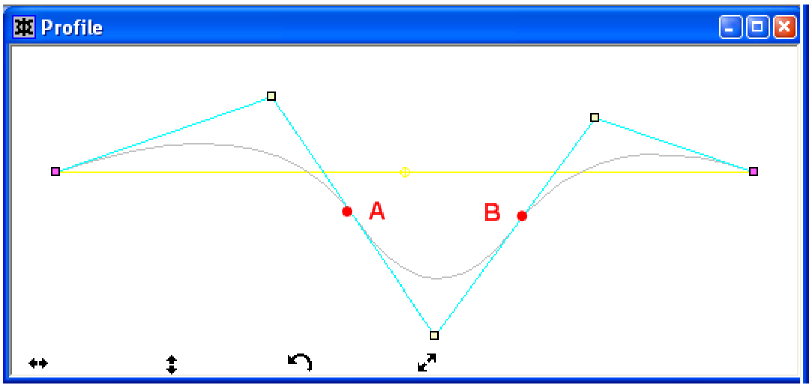
- **In the Assembly pane on the left, right click the surface 2D Curve and open the Properties dialog. (If the assembly plane is not visible, go to View | Assembly).**



Currently, the transverse surface stiffness is set to 2 (linear).

- **Increase the longitudinal surface stiffness to 3 (flexible).**

The curve now remains closer to the line between end control points. Note that the curve runs at a tangent to the control point net (blue) at the end points. This is true for splines of all stiffness orders. In the case of an order 3 spline, the curve is also tangential to the control point net at the midpoint of the net lines between successive intermediate control points (i.e. at points A and B below):



- **Undo (Ctrl + Z) and Redo (Ctrl + Y) the change in stiffness to best study the effect of the change**
- **Increase the longitudinal surface stiffness to 4, then 5**

Notice how the spline displaces less and less from the line between the end control points.

- **Try selecting a stiffness of order 6 from the longitudinal stiffness drop-down menu. What happens?**

A stiffness of 6 is not allowed because *the order of the surface stiffness in a given direction must be less than or equal to the number of control points in that direction*. Here there are 5 control points in a row so the maximum stiffness in the longitudinal direction is 5.

The reason for this relates to the mathematical definition of a spline of certain stiffness or order. If a polynomial has five constants, at least five points on the curve (or influencing the curve, like the control points) are required to solve the constants and define the curve.

> **Note:**
> Maxsurf will make sure the stiffness of the surface cannot be greater then the number on control points in that direction; i.e. if you have an order 6 surface and you reduce the number of columns from 6 to 5, Maxsurf automatically reduces the surface stiffness from 6 to 5.

Surface Stiffness – Procedures – 3D Surface

3D Surface

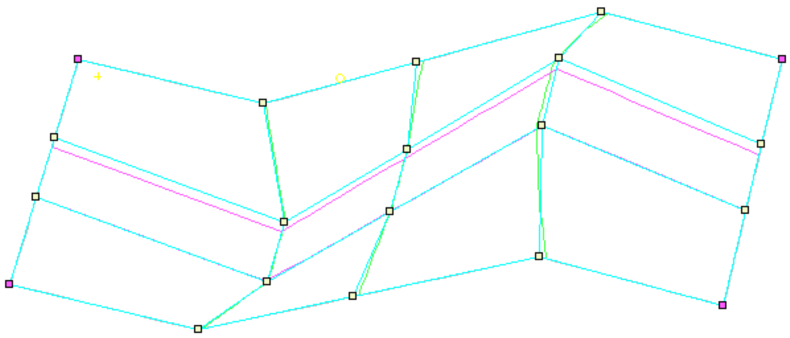
To extend the concept of surface stiffness from a curve to a surface,

- **Open SurfaceStiffness3D.msd. If prompted to locate the materials and shapes library, click Cancel.**

To best view the effect of changing the stiffness of the surface,

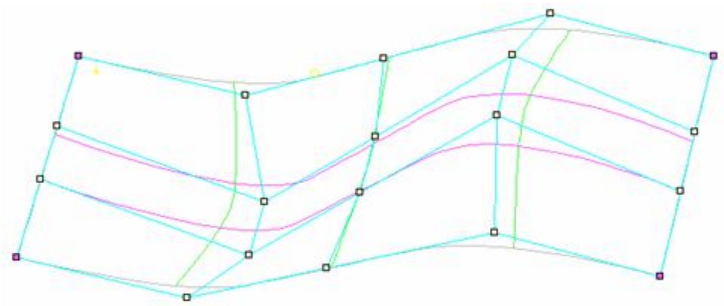
- **Maximise the perspective window.**
- **Set pitch to 0, yaw to 60 and roll to –60.**
- **Go to Display | Net and select Show Net to view all control points and the net.**
- **Go to Display | Contours and turn on sections and buttocks.**

The surface stiffness is initially set to 2 (linear) in both directions. Notice that the sections and buttocks follow the shape of the control point net perfectly.



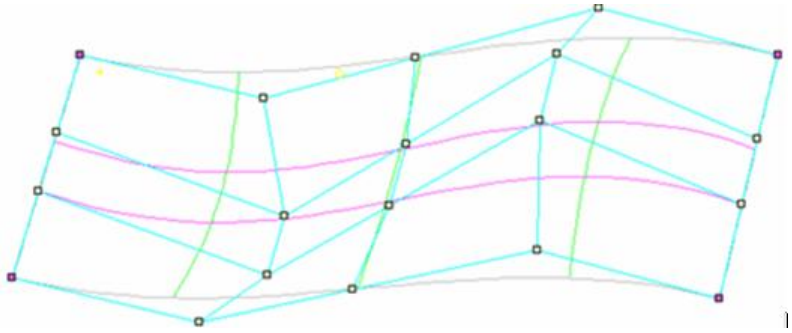
- **Change the stiffness is both directions to 3.**

Notice how the longitudinal surface edges and the buttocks, as well as the transverse surface edges and the sections have smoothed away from the control point net.



➢ **Change the stiffness in the transverse direction to 4 and in the longitudinal direction to 5 (the limits).**

Observe how the edges, sections and buttocks are even smoother and that the entire surface is more planar.



Continue with the section on Surface Precision.

Surface Precision

Surface precision - Concepts

In the previous sections you have learnt that NURB surfaces consist of control points and certain stiffness properties. In this section you will learn about what Maxsurf does with this surface information in order to display the shape of the surface.

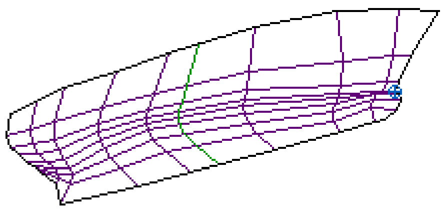
The NURB surface shape is defined **solely** by:

- **The surface stiffness**
- **The position of the control points**
- **The weight of the control points (recommended to leave at weight = 1)**

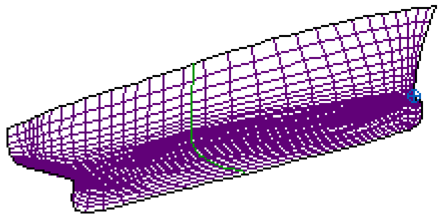
Based on these three ingredients, Maxsurf can calculate the shape of the surface at any given point on the surface. For example, Maxsurf can calculate the position halfway along one of the edges, or at any random location inside the surface. This way Maxsurf can theoretically turn a NURB surface into a point-mesh with infinite density. However, this calculation would take an infinite amount of time and saving this mesh to a file would result in a file of infinite size. Alternatively, Maxsurf can divide the surface up into a mesh with a specific number of segments along each edge (for example 16 segments). This would result in 16 x 16 = 256 mesh points which can be used to display the shape of the surface or exported into a data file. This mesh is called the “Parametric Mesh”. The number of segments in this Parametric Mesh is determined by the Surface Precision.

The number of segments used to display the shape of the surface is set by the Surface Precision.

Below you will look at the shape of the trawler sample design at different precisions:



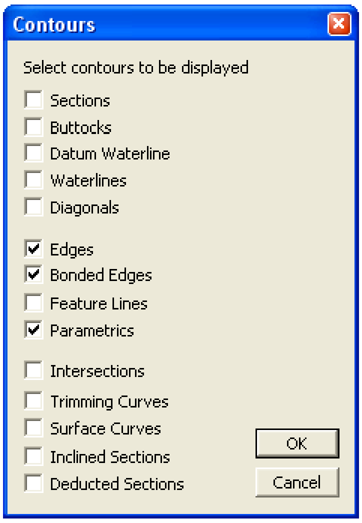
Surface mesh with 8 segments



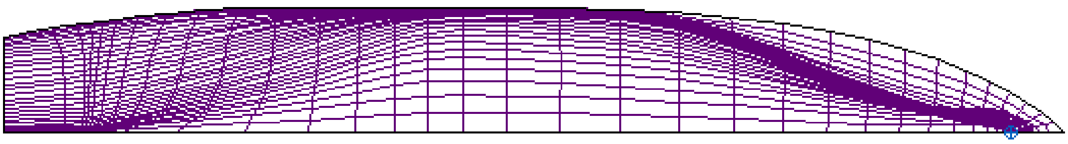
Surface mesh with 32 segments

Surface precision - Procedures

- **Open the Maxsurf Sample_Trawler.msd file from c:\Program Files\Maxsurf\Sample Designs**
- **Go to Windows | Plan**
- **Display | Precision | Medium**
- **Display | Contours | Parametrics or use the toolbar button.**

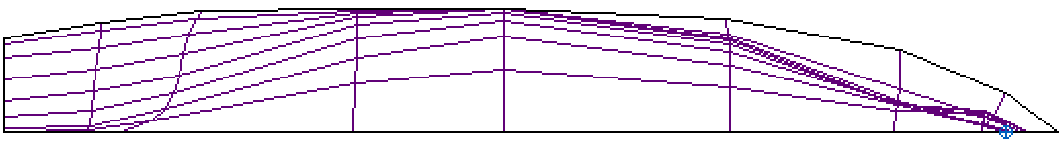


You should see something like this:



At Medium precision there are 32 line segments along each edge.

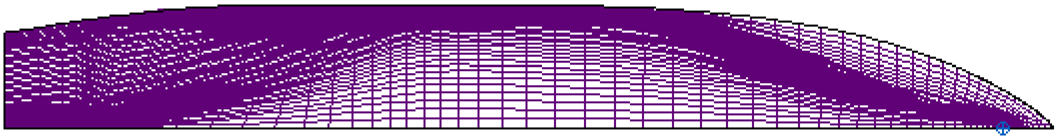
- **Now switch Data | Precision to Lowest:**



At lowest precision there are 8 line segments along each edge

Notice that each line segment is drawn by a straight line.

- **Now switch to Data | Precision | Highest**



Highest precision starts with 64 segments and inserts more where it needs to for greatest accuracy.

It is beyond the scope of the LearningMaxsurf training to go into details any further. All you need to remember is that the Precision setting does not change the **shape** of the surface (shape is determined only by stiffness and control points), but determines how many line segments are used to **display** the shape.

In the rest of the LearningMaxsurf training you will only work at the default precision (medium).

Continue with Chapter 5 Designing in Maxsurf.

Chapter 5 Designing in Maxsurf

When designing in Maxsurf, a naval architect has several options to choose from:

- **Use a similar existing design and modify it to design requirements**
- **Start from a new design scratch**

Which of these options is most cost efficient is difficult to predict and dependent on:

The required hull shape

The Maxsurf Sample Designs directory contains a wide range of hull forms that can be used as a starting point. If the shape of the intended design is close that of one the sample designs, it will save you a lot of time if you use the sample design as a starting point. It is definitely worth while familiarising yourself with the sample designs in: c:\program files\Maxsurf\Sample Designs.

The purpose of the surface model and surface type

If your model is used for production purposes then it will need to be created from a faired NURB surface, the user will have to think carefully about the surface topology of the intended design before starting. The reasons for this are explained further in the intermediate section of this training manual.

If the model is intended only for analysis purposes, then hull shape can be created as a TriMesh Surface. A TriMesh surface is a linear surface made up of triangular facets. It is not a NURB surface, it does not have control points, and it cannot be trimmed with NURB surfaces.

The TriMesh surface is not designed to be smooth – it follows the input data points exactly and is linear between the data points. The Markers should provide sufficient detail for the purpose to which the model is going to be put such as, for example, hydrostatic and/or seakeeping analysis in Hydromax, Seakeeper and Hullspeed.

For more information see the section on Generating a TriMesh surface in the Maxsurf User manual and Importing dxf Marker Data & Generating a TriMesh model Tutorial.

The user's experience in Maxsurf

An experienced user may get to a good starting point for a hullshape much faster than a new user. A new user to Maxsurf may feel more comfortable starting with a similar existing design, while a more experienced user can make a design completely to his own liking by starting from scratch.

Note that the dimensions and the design category (eg leisure vs. commercial etc) are not in the above list. A sailing boat hull shape may offer a good starting point for a frigate for example. Maxsurf offers a range of tools to quickly resize surfaces. In Maxsurf Pro there are even tools to change design coefficients such as LCB, Cb and Cm etc. Let's first get an idea of what is involved in starting a Maxsurf design from scratch.

Let's get started! Go to the Starting a Design from Scratch section.

Starting a Design from Scratch

When you start a design from scratch, you literally start with a blank piece of paper. Earlier in this training manual the use of Maxsurf was compared with a creative process like painting. Imagine that a painter wants to paint a portrait of a person in front of a backdrop of trees and mountains. How and where should the painter start painting? He can choose many different ways and each painter will chose differently. This is very similar in Maxsurf: the designer has a vision of a design and a blank piece of paper (or 3D space). His creativity as well as a good knowledge of the tools available to him will enable him to achieve his vision step-by-step. The order in which he does things and the tools he uses along the way are not pre-defined and can not be learnt from a book. This section of the training manual teaches you one particular way of starting a design from scratch and teaches you the use of several design tools along the way. This will help you achieve your vision of a design in your own creative way.

Start with the Starting a Design section.

Starting a Design

Starting a Design – Concepts

Before you can start modelling it is a good idea to create the environment in which the design will be created. Compare this to choosing the size and materials of a canvass in the case of the painter if you like.

Starting a Design – Video

Watch a short video that shows you the first steps of starting a design from scratch: Starting a New Design, Inserting a Default surface, techniques to add rows and columns of control points in different windows, saving your design. [Web | Disk]

Starting a Design – Procedures – New Design

New design

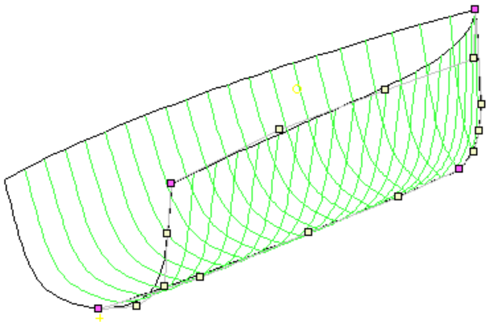
If you have an existing design open, first close it:

- **From the File menu select File | Close Design**

Now start a new design:

- **Select File | New Design from the File menu**

This will give you a blank workspace without any surfaces. In the following series of tutorials you will model a single surface monohull with a round-bilge hull form:



Starting a Design – Procedures – Adding a Surface

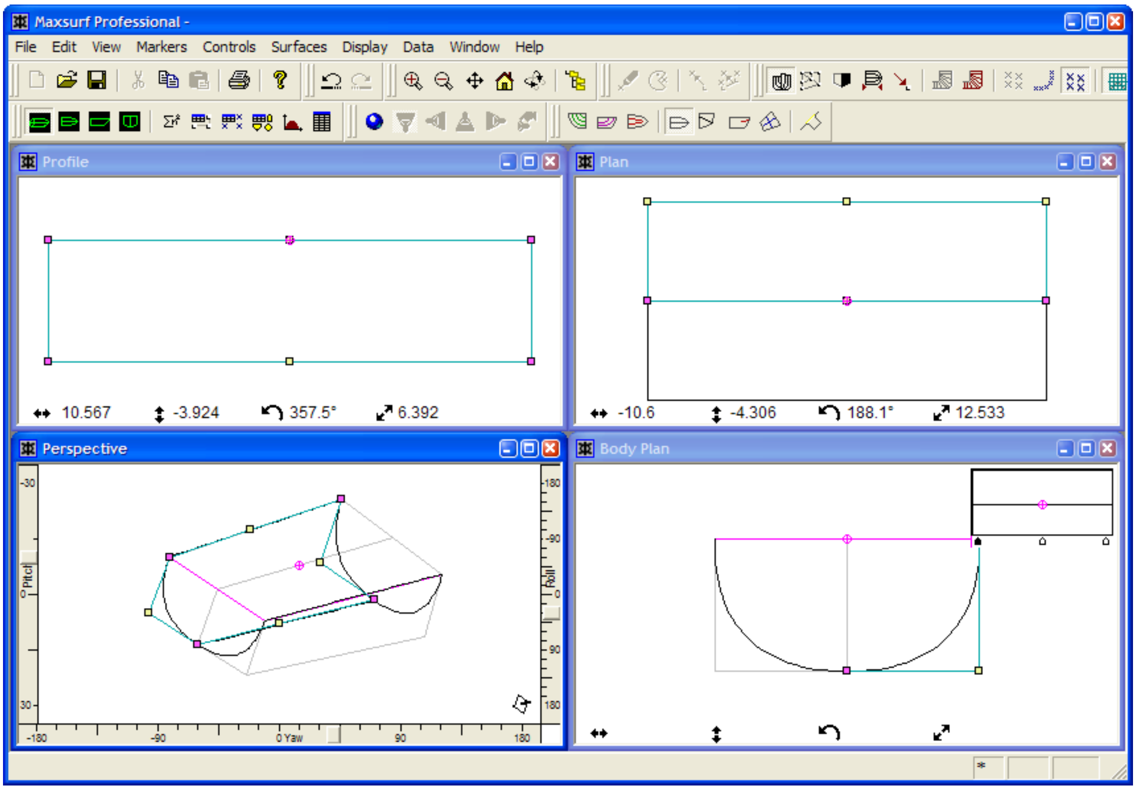
Adding a Surface

The first thing to do is add a surface, so that you can then manipulate this into the required shape.

- **From the Surfaces menu select Surfaces | Add Surface | Default**

The “default” surface is a good starting point for most designs.

The diagram below is similar to what should be shown on your screen (Note that the display may vary due to the display settings you are using):



Before you start modelling, you should set up the units and overall dimensions for your design.

Starting a Design – Procedures - Units

Units

Select the units you would like to use

- **From the Data Menu select Units**
- **Complete the dialog box as follows:**

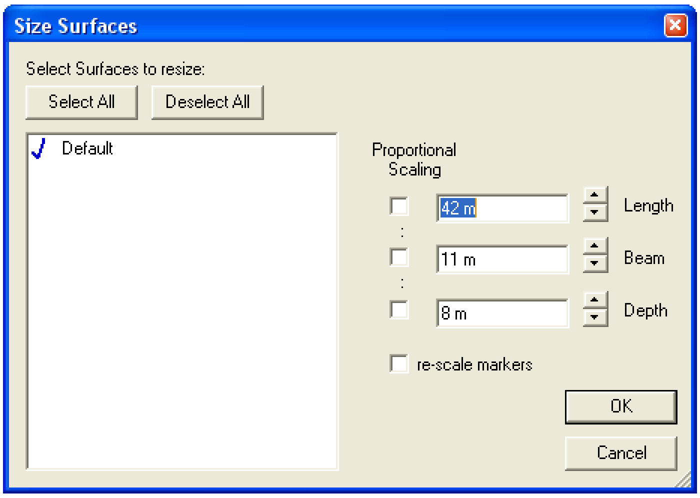
Note that the units you have selected are saved as Maxsurf preferences and are not stored with the design.

Starting a Design – Procedures – Sizing Surfaces

Sizing Surfaces

Now we can make the surface approximately the correct size for the design.

- **Select Surface | Size Surfaces**



This dialog may be used to resize one or a selection of surfaces in the design.

- **Place a tick next to the surfaces you wish to resize**
- **Enter the values as in the dialog image above.**

Starting a Design – Procedures – Saving

Saving Your Design

You now have a single surface that can be manipulated into the required design. At this stage it is a good idea to save your design. To do this, make sure that you have activated one of the View Windows and choose:

- **File | Save Design As, specify where you wish it to be saved and name the file MyFirstDesign_start.msd**

You should get into the habit of regularly saving the design before and after major design changes. This is easily done by clicking on the save icon  or by using the shortcut Ctrl+S.

Maxsurf only allows you to save your surface model when you have one of the View Windows (i.e. Body plan, Profile, Plan or Perspective) frontmost or "active". All Maxsurf applications work this way. You can see how this works by:

- **Switching to the Control Points window**

- **Going to the File menu**

Notice how the “Save Design” has changed into “Save Control Points”

- **Switch back the Body Plan window**

Starting a Design – Procedures – Adding Control Point Rows

Adding Control Point Rows

The default surface contains 3 rows and 3 columns of control points. To get the shape you desire, it may be necessary to increase the number of rows and columns in the surface. In this section we will take a closer look at how to add and remove control points in the net.

> **Tip:**
> Always try and use the minimum number of control points to achieve the desired surface shape. You will learn why this is in the section on Basic Fairing.

The number and position of the control point rows affects the surface’s shape in Body Plan view. Adding control point rows will give you more control over the section shape.

> **Note:**
> You can add and delete control point **rows only in the Body Plan window**.

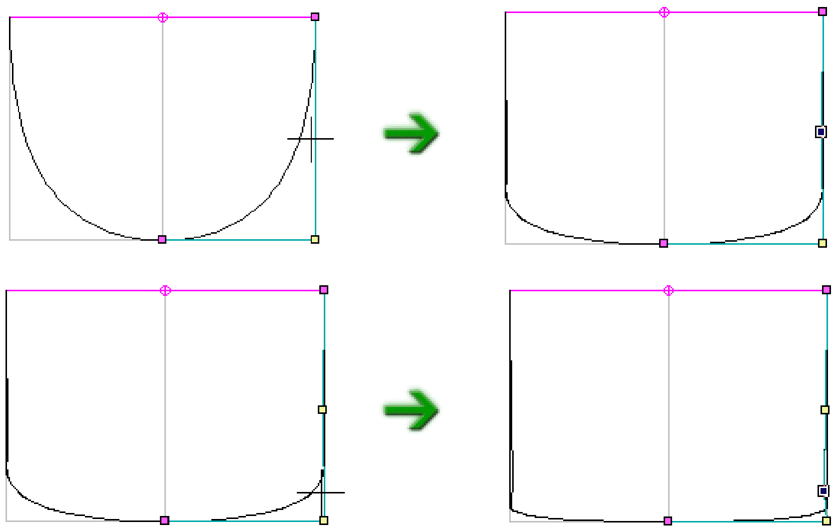
- **Switch to Body Plan view** 

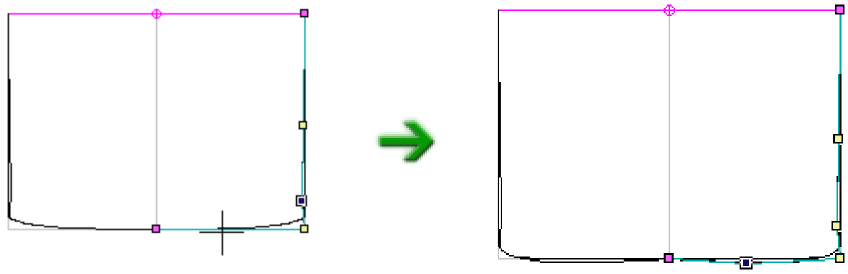
To add a control point row, it is best to turn off the net so that you can only see one control point column.

- **Make sure the net is turned off, you can do this from the menu (Display | Net) or** 

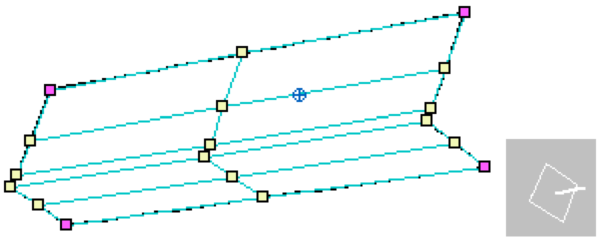
To add a row, go to the body plan view, select Controls | Add Row or click the  toolbar button. You will see a crosshair appear.

- **Insert a control point row as in the figures below**





- **Switch to Perspective view**
- **Switch the Net on, Half on, and Hide the Grid from the Display menu:**



Default surface with the extra rows.

Notice that the row is inserted into all the columns. Maxsurf will interpolate the insertion point in the other columns based on the position where you inserted the row into the current column.

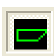
- **Remember to save your design regularly**

Starting a Design – Procedures – Adding Control Point Columns

Adding Control Point Columns

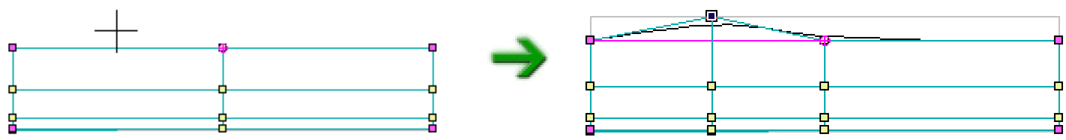
After adding the rows, you can now proceed to add some columns. Adding rows or columns does not have to be done in any particular order. The number of columns affects the shape of the surface in Profile and Plan view. Adding control point columns gives you more control over the waterlines and buttocks. Adding control point columns work exactly the same as adding rows, except it can only be done in Plan and Profile view.

Note:
You can add and delete control point **columns** in Plan and Profile window.

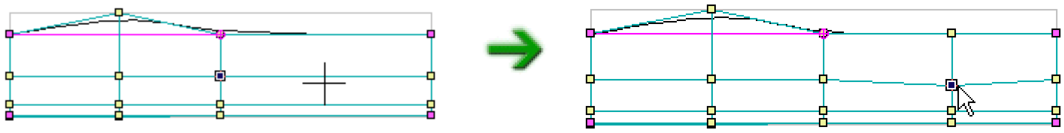
- **Switch to Profile view**  **and turn on the Net** **.**

Control point columns are added by clicking at a position on a row of control points. For example:

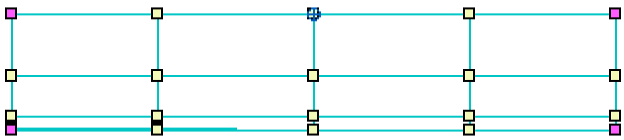
Clicking here: Will insert a column here:



Clicking here: Will insert a column like so:



➢ **Insert two columns of control points so that your design looks something like this in Profile view:**



Starting a Design – Procedures – Deleting Control Points

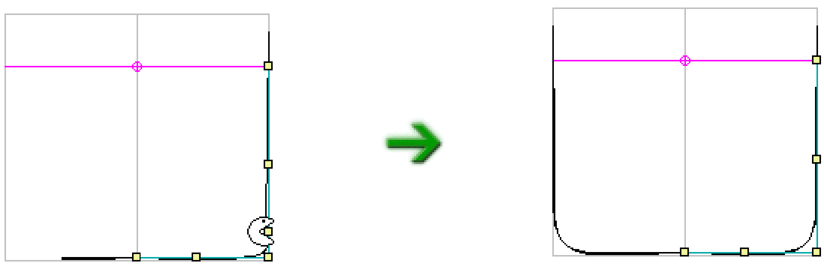
Deleting Control Points

Deleting a control points row or column is easy. In this section we will delete a control point row from the body plan view.

➢ **Switch to the Body Plan window and hide the net**

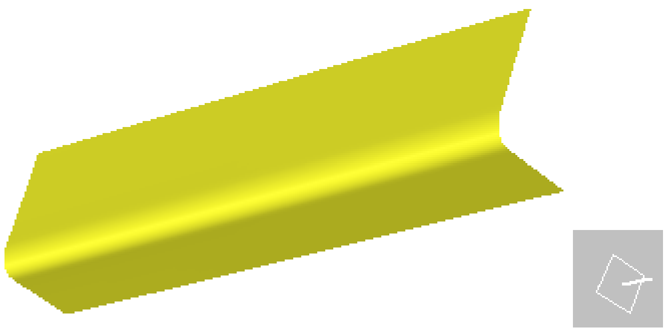
➢ **Select Controls | Delete Row or click the Pac-Man toolbar button**

➢ **Place the jaws of the Pac-Man over the control point row you wish to delete and click the left mouse button**



➢ **Switch to Perspective view**

➢ **Render the Surface in Smooth Shading:**



➢ **Save your design as MyFirstDesign_Start.msd**

Feel free to practise adding and deleting rows and columns. It may be a good idea to save your design first.

Continue Design Preparation.

Design Preparation

Design Preparation – Concepts

After you have setup your surface to be roughly the right size and inserted the number of rows and columns that you expect you will need to achieve the required shape, there are a few things you have to do before you can start manipulating the shape of the surface.

Note that the order in which things are done in this tutorial is not a set sequence of steps and you are free to do whatever you like at any point during the design process. The sequence in this tutorial ensures that you have for example your surfaces roughly the right size before you setup your grid so that you only have to do that once.

Design Preparation – Video

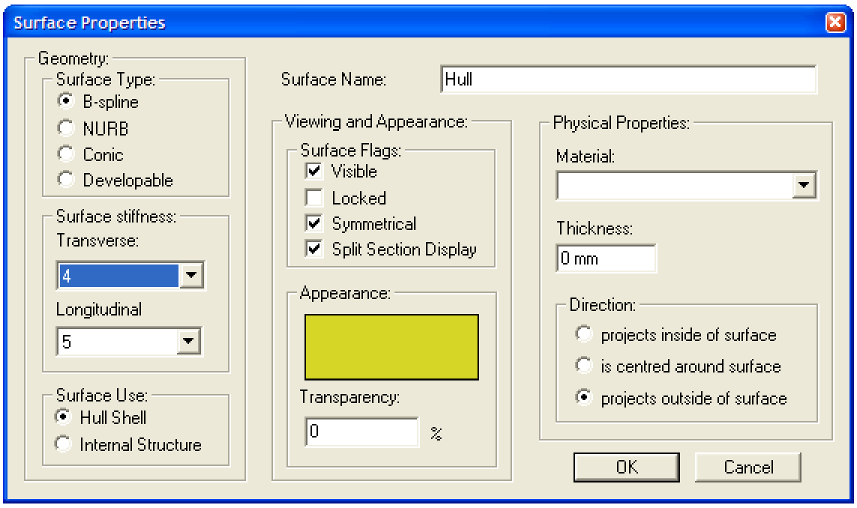
Watch a short video that shows you how to setup the Frame of Reference and the Zero Point and define the Grid. [Web | Disk]

Design Preparation – Procedures – Surface Properties

Set Surface Properties

Before moving the control points in your design, you should review the surface properties. In general, you should select a B-Spline surface with the maximum stiffness that will give you the surface you require. This will be an iterative process, since the number of control points defining the surface limits the maximum stiffness.

- **Rename the surface and set the surface stiffness to the values in the dialog below**



- **Make sure that the surface is symmetrical.**
- **Save your design as MyFirstDesign_Preparation.msd**

We will look at the other surface properties later, for the moment this is all you need.

Design Preparation – Procedures – Frame of Reference

Set Frame of Reference and Zero Point

Before proceeding to far into the design, you will want to set up a Frame of Reference and Zero Point from which measurements are taken.

➢ **First, select Data | Frame of Reference**

This will bring up the Frame of Reference dialog which allows you to position the zero point, datum waterline, baseline and fore and aft perpendiculars:

The dialog shows a profile view of the vessel with the zero point '+' and the Frame of Reference (forward and after perpendiculars, midships, baseline and design waterline). The dialog radio buttons, edit boxes and buttons are arranged in two groups: The first defines the longitudinal data for the frame of reference and the zero point and the second group defines the vertical. It must be remembered that all measurements shown are with respect to the "current" zero point: that is the zero point that was in effect when the dialog was opened.

First set the longitudinal position of the new proposed zero point, under the longitudinal datum:

➢ **Tick the <Other> radio button**

➢ **Press the <Aft extent> button**

This moves the longitudinal position of the new proposed zero point to the aft extent of the hull.

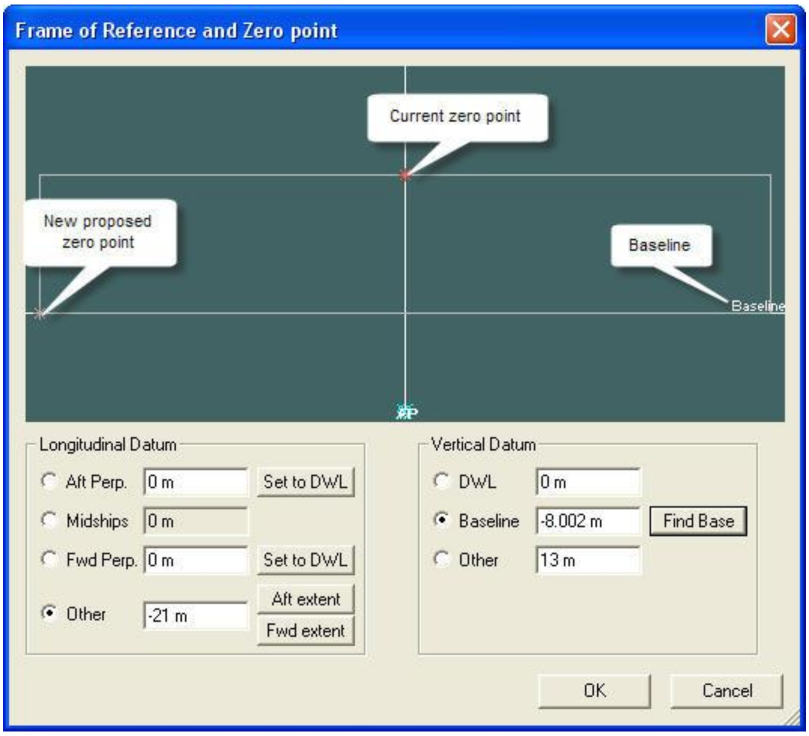
Now set the vertical position of the zero point, under the vertical datum:

➢ **Tick the <Baseline> radio button**

➢ **Press the <Find base> button**

This moves the vertical position of the zero point to the base line and then finds the baseline for the hull.

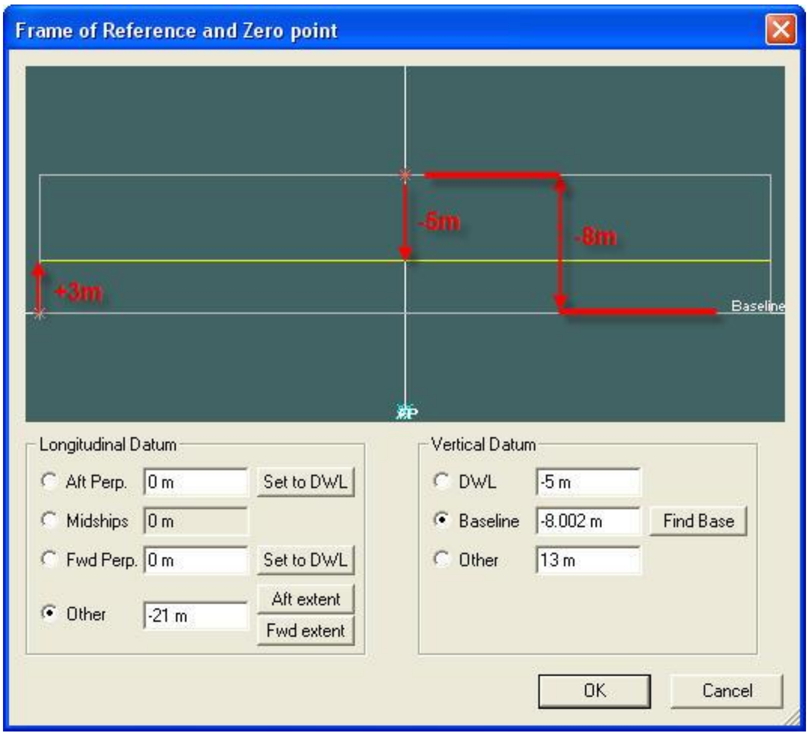
You will notice that in the Frame of Reference dialogue box the current zero point is drawn as well as the new proposed zero point. The new proposed zero point is drawn in a pastel shade of the current zero point.



Now set the location of the datum waterline. Note that this is relative to the current zero point. In the datum waterline box

- **Type in <-5m >**

This sets the datum waterline to a vertical distance of -5meters from the current zero point (+3m from the new proposed zero point)



Now to set the longitudinal locations of the forward and aft perpendiculars:

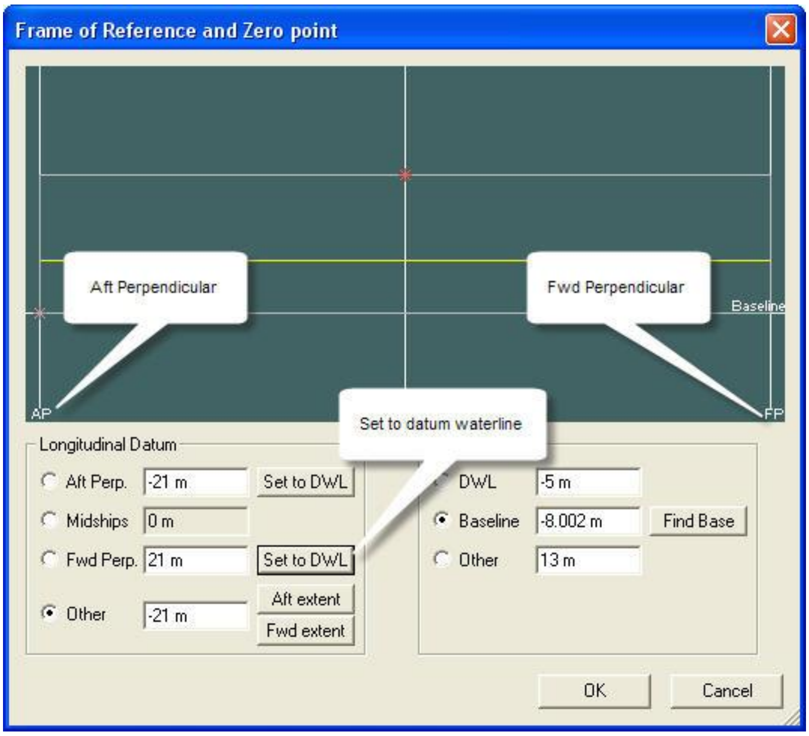
Under longitudinal Datum, next to the Aft Perp:

- **Press the <Set to DWL> button**

Under longitudinal Datum, next to the Fwd Perp:

- **Press the <Set to DWL> button**

This sets the forward and aft perpendicular to the current location of the datum water line.



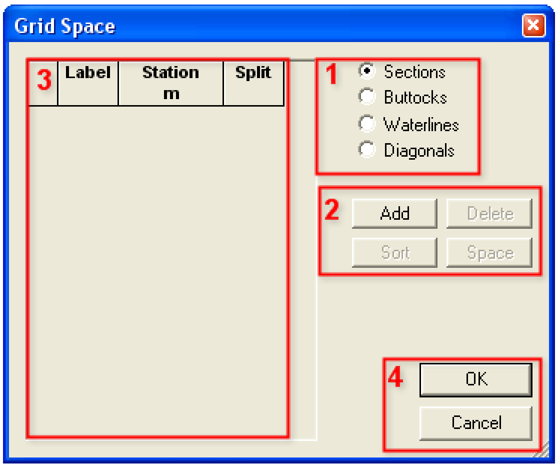
Design Preparation – Procedures - Grid

Insert a Grid

Before you can start modelling, you need some way to visualise the surface shape while you are modelling. At this stage of design it is therefore necessary to create a grid of sections, waterlines, buttocks and maybe also diagonals. These contours may then be displayed on the design while modelling.

- **Go to Data | Grid Spacing**

You'll see the following dialog appear:

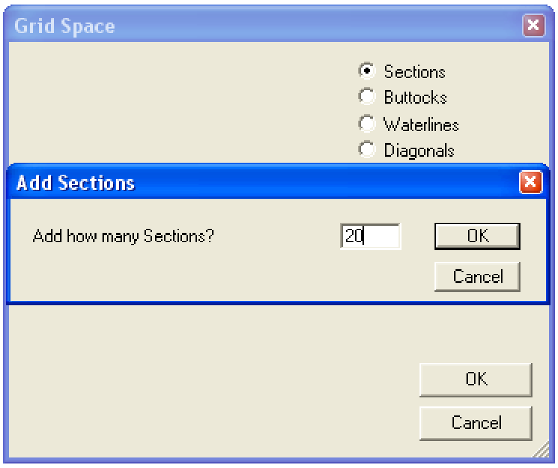


The dialog can be divided up into the following regions:

1. Select the type of grid you want to work on, i.e. Sections, Buttocks, Waterlines or Diagonals
2. Commands to Add, Delete, Sort or Space the grid type selected in 1.
3. Displays the current grid locations for the grid type selected in 1.
4. OK and Cancel to confirm or undo **all** changes made in the dialog.

- **Select Sections**

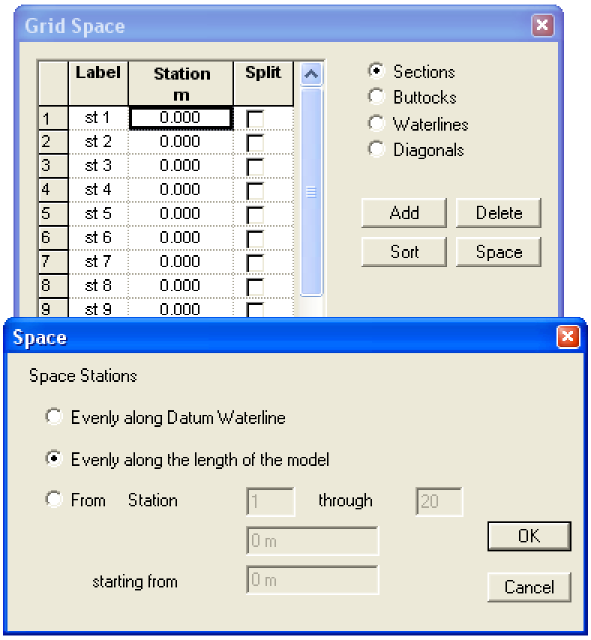
➢ **Click on the Add button to add Sections:**



➢ **Add 20 Sections and click OK**

This will return you to the Grid Space dialog, which now shows the Grid on the left (region 3 in the image of the Grid Space above). Next step is to specify the location of the Section lines. You can do that for each section individually by typing in region 3 directly, or – much faster:

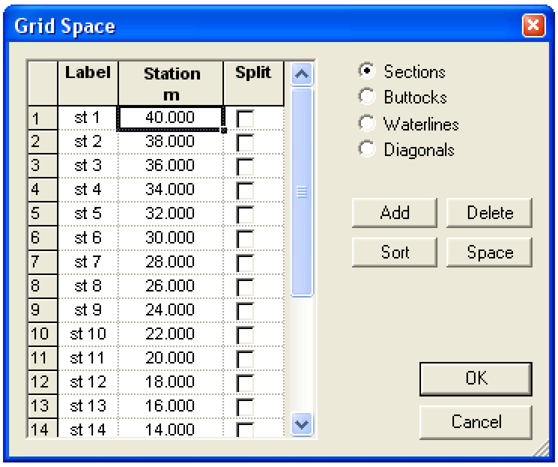
➢ **Click the Space button:**



The Space dialog allows you to Space any number of selected sections over any distance you specify. In the Maxsurf Intermediate training we will look at some more advanced use of this dialog, but for now:

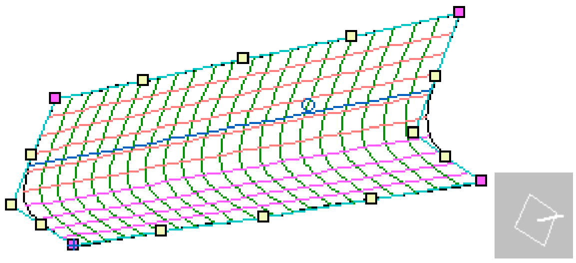
➢ **Space the Sections Evenly along the Length of the model and click OK**

Notice how all Sections are evenly spaced from 0 to 40 m:



Do NOT click OK in this dialog yet. You will first:

- **Insert 4 Buttocks spaced evenly along the width**
- **Insert 5 Waterlines spaced evenly along the depth**
- **Click OK now**
- **Go to Perspective window, switch the Net off, Half on, and display Sections, Buttocks and Waterlines:**



You can now also Toggle the Grid display on/off from the Display | Grid menu or using the toolbar button. Note that this adds a lot of additional lines to the display, especially in Perspective view, and may confuse you. Remember that efficient modelling is all about displaying the least amount of information necessary.

- **Remember to save your model**
- **Save your design as MyFirstDesign_Preparation.msd**

You now have a basic surface with a Zero Point, Frame of Reference and a grid. The surface is approximately the correct length.

Continue with the section on Modelling .

Modelling Corners and Edges

Modelling Corners and Edges– Concepts

After you have set up a surface with approximately the right size, stiffness and number of control points and have also defined a grid, zero point and Frame of Reference, you can start shaping the design. Again you can do this in any random order you like, but from the author's experience there is a particular sequence that works very well and it is recommended to follow this for now. The most efficient way to manipulate the shape of this surface is by working your way through the three types of control points from top to bottom:

- **Corner control points**
- **Edge control points**
- **Internal control points***

** If the difference between corner, edge and internal control points is not clear, read Chapter 2 of the Maxsurf manual.*

Following this order will prevent you from making unnecessary adjustments to internal control points and reduce the number of iterations you will have to do to achieve the desired hullshape.

Just to recap on the previous section in this training where we explored the User Interface, here are some tips and tricks that are worthwhile remembering when manipulating the shape of a design:

1. An adjustment to the shape in a 2D window influences the 3D shape and thus in the other 2D windows and Perspective window.
2. Alternate between different view windows regularly when modelling
3. When starting a new model, make big changes first whilst alternating between view windows and then slowly refine towards to required shape. Don't try to do it all at once in just one view window.
4. Arranging your view windows can improve your productivity. For example: you can show all four view windows at the same time and see how a change made in one window effect the hullshape in the other windows.

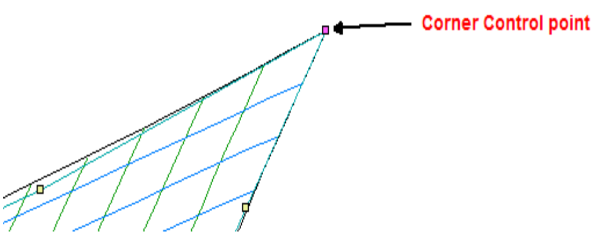
Modelling Corners and Edges – Video

Watch a short video that shows you how to set the 4 corner control points positions numerically, and then manipulate the edges in the different view windows. This video also shows how to use the Control Box in Body Plan view is used to activate different columns of control points. [Web | Disk]

Modelling Corners and Edges – Procedures – Corner Control Points

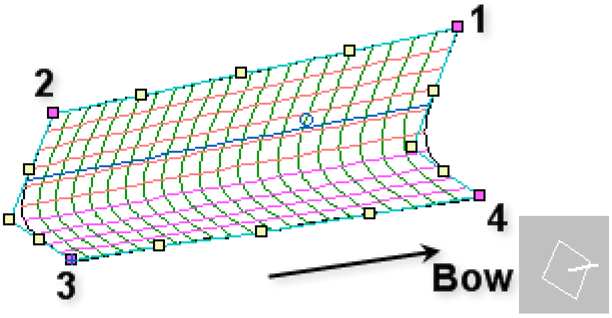
Positioning the Corner Control Points

Each surface consists of four corner control points. The corner control points can be recognised by their colour or by following the edges to the surface:



Note:
The location of the corner control point is the exact location of the surface.

For a design that consists of only one surface, the location of the four corner control points are more or less determined by the design's Length, Beam and Depth parameters as in the following table.



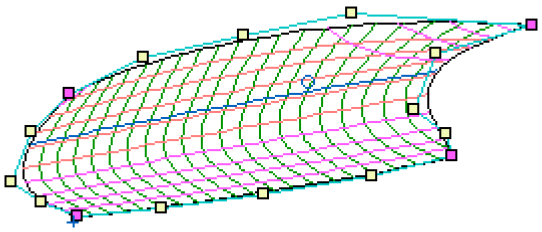
Corner control point	Position		
	Height	Offset	Longitudinal position
1	Top of bow	Centreline	Fwd extremity
2	Top of transom	Beam at transom	Transom aft position
3	Lower transom	Centreline	Transom aft position
4*	?	Centreline	?

* Corner control point number 4 is always very difficult to position.

- **Enter the following coordinates for the four corner control points by double clicking on each of them.**

Perspective is probably the best window to select the corner control points.

Corner control point	Position from zero point		
	Height	Offset	Longitudinal position
1	9	0	42
2	7.5	4	0
3	0.5	0	0
4	0.5	0	39



When you look at your surface now in the different view windows, it looks pretty messy. Don't worry about this at the moment and more importantly: don't try to fix it by starting to randomly drag control points around. Trust on the fact that the order of modelling: Corner control points ➔ Edge control points ➔ Internal control points will sort it all out for you. Let's continue modelling by manipulating the edge shapes.

- **Save your design MyFirstDesign_CornersEdges.msd**

Modelling Corners and Edges – Procedures – Edge Shape

Manipulate the Edge Shape

- **First read Chapter 3, section Moving Control Points of the Maxsurf manual**

To make sure you do not get confused by the large number of control points,

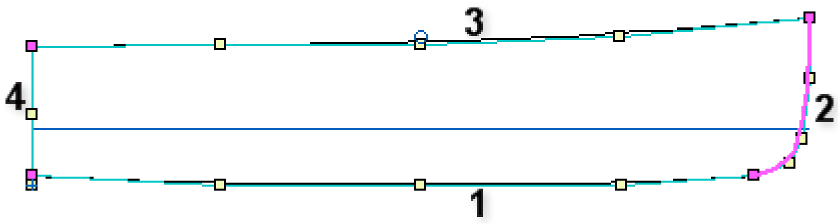
- **Hide the Net , switch buttocks off **

This hides the internal control points, so that you can concentrate on the shape of the edges. You can now begin to manipulate the default surface into the required design shape. This is simply a case of dragging the control points to their required positions. In general, it is best to define the edges in the following order:

- **Switch to Profile View**

When manipulating the edge shape in Profile view, move the control points primarily up and down. Out of edge 1, 2 and 3 in the image below you can start with any edge you like. Edge 4 (transom) will be adjusted in Body Plan view.

- **Drag the control points so that it looks something like this:**



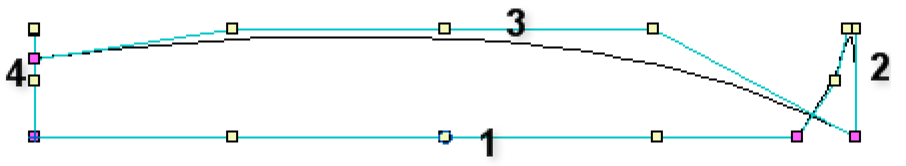
Tip:

Try not spending too much time on achieving the exact control point positions at this stage. Modelling is an iterative process where you increase the accuracy of the control points' positions as the design progresses.

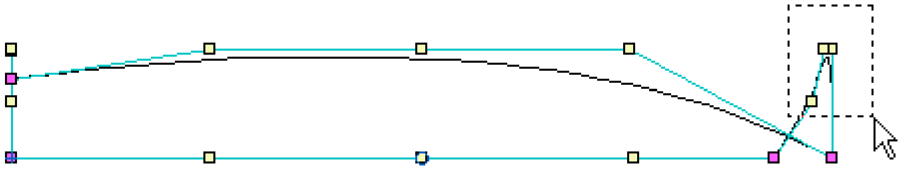
You can see that the surface edge contour does not go through the position of the edge control point. This means that typing in the numerical values of the edges is not very useful. Remember to imagine the surface being connected to the control points via little springs or rubber bands.

- **Switch to Plan View, switch waterlines off , Half off, Hide Net.**

In Plan view you shape the deck edge. You will see that your design currently looks something like this:

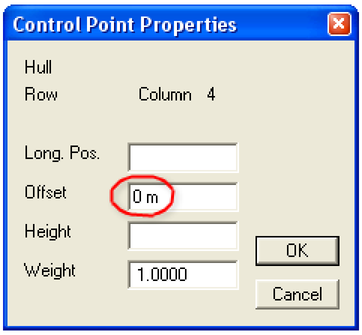


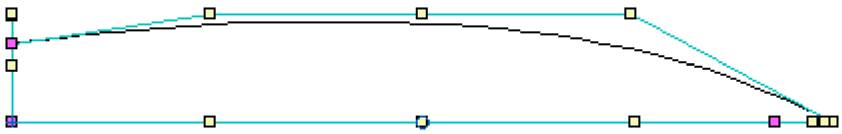
First thing we need to do now is use a multiple selection on edge # 2 (the bow) like this:



With these edge control points selected,

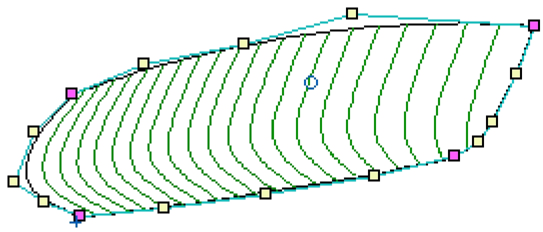
- **Controls | Control Properties**
- **Specify Offset = 0 and OK to move all control points to the centreline and close the bow**



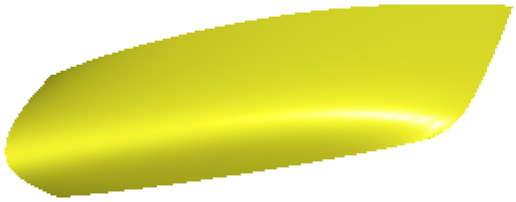


In the control properties dialog all properties that the selected control points have in common are displayed. In this case the selected control points do not share the same row number, longitudinal position, offset or height, but do all have a weight factor of 1.000 and are all in column 4 on the Hull surface.

- **Switch to Perspective view to check your work so far:**



Perspective view with sections displayed

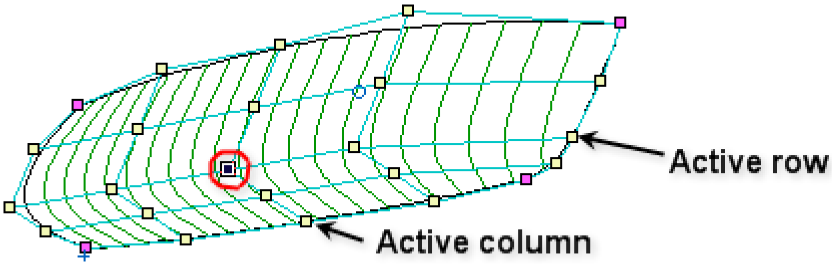


Smooth Shading rendering in Perspective view

Note:
When you are shaping your edges, do not: - touch your corner control points anymore - display your internal control points by showing the Net.

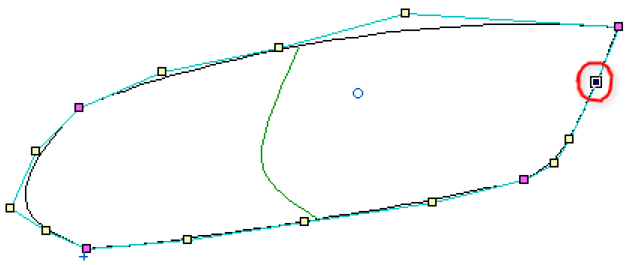
- **Switch to Body Plan View, Hide Net, Sections off, Half on.**

What you are looking at now is called the active column. When the Net is hidden in Body Plan view, the only control points you'll see in Body Plan view are the "active column" control points. Active column control points are the control points on the column that is associated with the control point that you selected last.

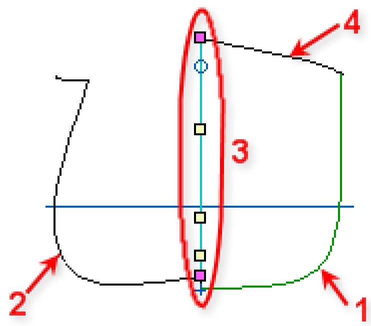


Let's have a look how this works:

- **In Perspective view Select the following control point in the bow column:**

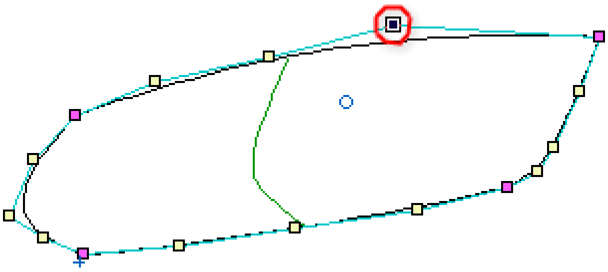


- **Switch back to Body Plan:**

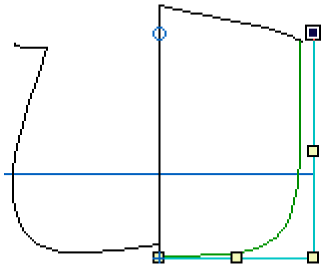


1 = Section, 2 = Transom edge, 3 = Bow column of control points, 4 = Deck edge.

➢ **In Perspective window, select this control point:**

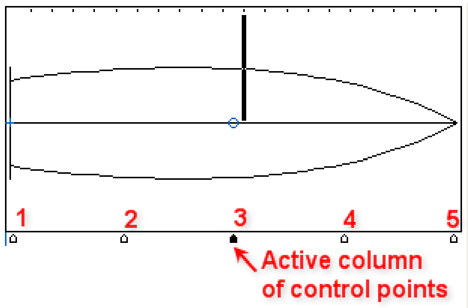


In Body Plan you'll see this column is now the active column and the deck edge control point is selected:



The column that is displayed in Body Plan view when the Net is Hidden is called the "active column". This is the column with the last selected control point in it.

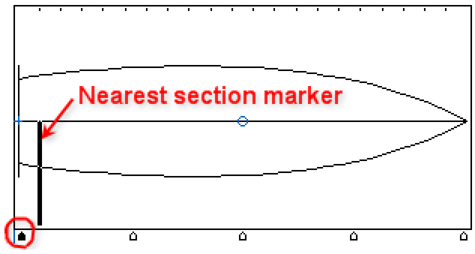
The active column is indicated in the Body Plan window control box:



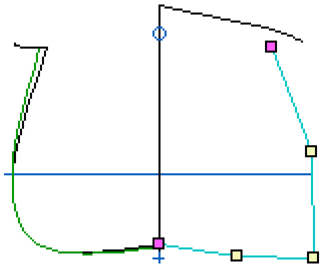
The control box shows that there are 5 columns on this surface of which the 3rd is the active column.

You can also switch active columns by clicking on the column indicators. When you do that, Maxsurf also displays the Section that is closest to the active column. This enables you to model on one column and its nearest section at a time.

➢ **Click on Column indicator #1 in the Control box in body plan view.**

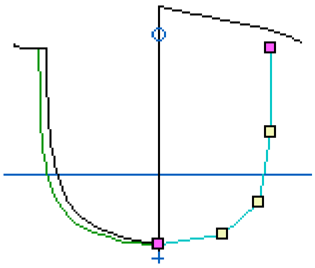


What you are looking at now is the Transom edge on the left and the transom edge control points on the right.



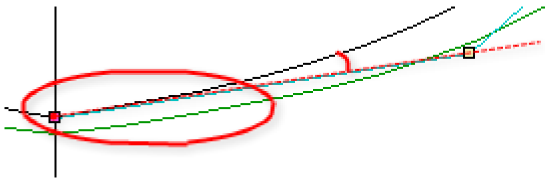
The Transom edge Control points

- **Drag the control points on the aft most edge so that it looks like this (do not move the corner control points):**



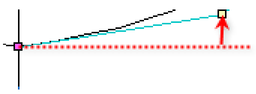
Let's take a moment to have a closer look at the transom shape:

- **Switch Half Off and zoom in on the centreline-transom point:**

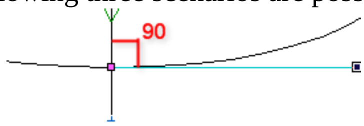


Notice how the transom edge is tangential to the control point net from the corner control point to the next adjacent edge control point. This is always the case for all edges and is very important to remember!

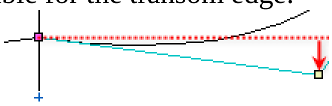
This means that the following three scenarios are possible for the transom edge:



"V-shaped"



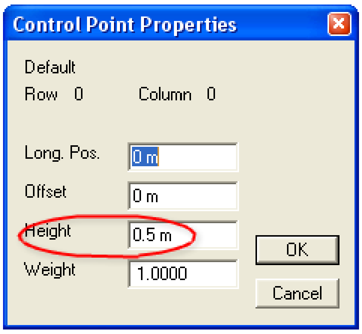
"Smooth"



"Tunnel bottom"

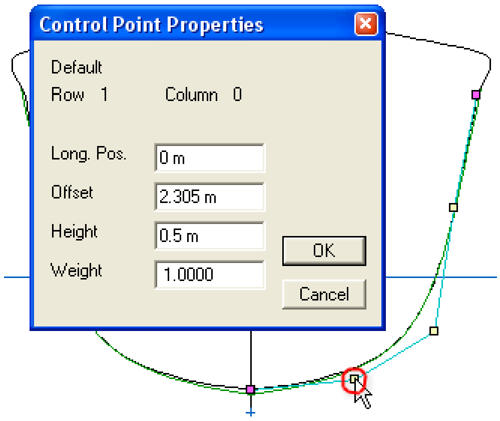
Let's shape the transom so that it is smooth:

- **Double click on the corner control point:**



The height of the corner control point = 0.5 m

➢ **Now double click on the adjacent edge control point of the transom and set the height to 0.5 m as well:**



You have now completed positioning the corner control points and modelling the edge shapes.

➢ **Save your design as MyFirstDesign_CornersEdges.msd**

Modelling Internal Control Points

Modelling Internal Control Points – Concepts

After having positioned your corner control points and shaped your edges, it is now time to shape the internal surface. It is at this stage important to force yourself not to make any more changes to any control point that is either a corner control point or located on an edge. If you think back about the analogy with the painter painting the portrait, you are now probably at the stage where you have positioned the object (the person) on the canvas with the right size and proportions and sketched the outlines or contours. From here the painter can fill in the rest of the portrait in any order and again each painter will have his personal preferences.

You can chose to change the position of the internal control points using any random window in any random order, but from the author's experience a good efficiency can be achieved using the Windows in this order:

1. Body Plan
2. Plan or Profile
3. Perspective

Also don't forget that modelling in 3D is an iterative cycle and you will cycle through steps 1 → 2 → 3 → 1... several times before achieving a reasonable result.

Modelling Internal Control Points – Video

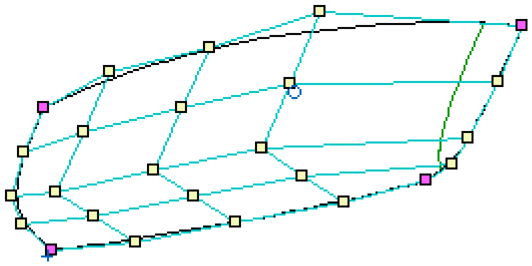
Watch a short video that shows you how the internal control points are positioned in Body Plan view while using the control box to switch columns. This video also shows how to use different view windows to track down any irregularities in the control point net. [Web | Disk]

Modelling Internal Control Points – Procedures - Smoothing

Smooth Internal Control Points

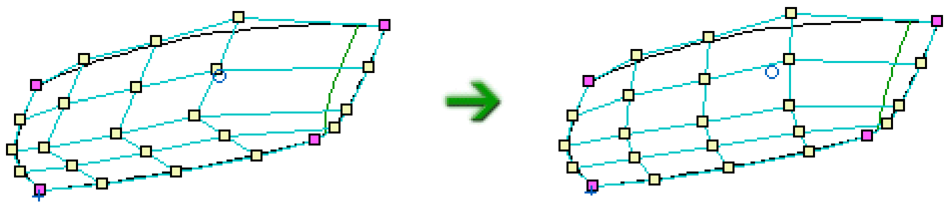
After fixing the corner control points and shaping the edges, it is now time to look at the internal control points.

- **Show the control point net**



Usually after you have not shown the internal control points for a while and made all sorts of changes to the edges and corner control points, the internal control point net can be quite messy. In this case it is actually not too bad as can be seen in the image above. There is a command available in Maxsurf that cleans up messy internal control point net by distributing the internal rows and columns evenly between the edge rows and columns in 3D. This usually provides a good starting point for further refinement.

- **Use the Smooth Interior Controls command from the Markers menu**



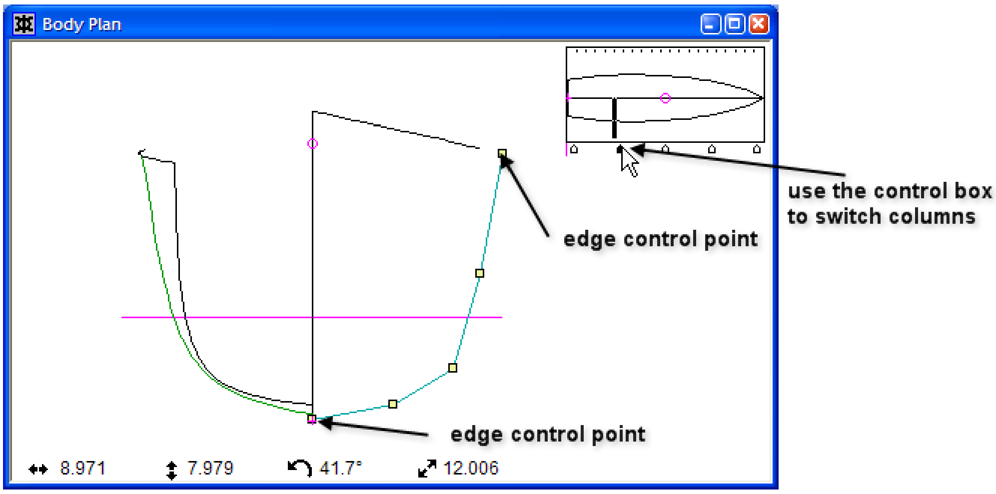
- **Save the design as MyFirstDesign.msd**

Modelling Internal Control Points – Procedures – Body Plan View

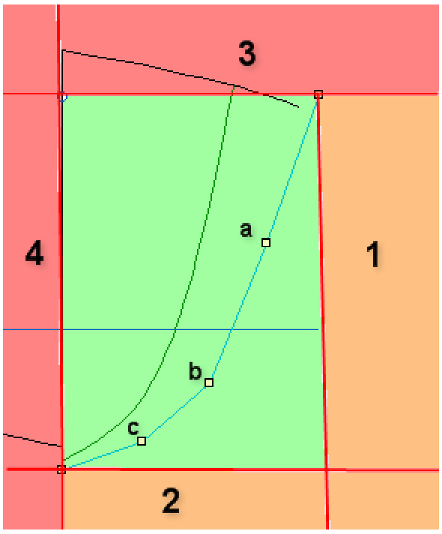
Body Plan

There are a couple of things you have to learn before we can model the internal surface in Body plan view.

Lesson 1: From this moment onwards you should no longer modify the corner or edge control points; you have already shaped these points in the previous stages. Note that all of the points in the aft most and forward most columns are either edge or corner control points so do not touch those!



Lesson 2: Because the edge control points are fixed, the internal control points a, b and c can – in general – only be located in the green area unless you want a "tunnel bottom" (area 2) or tumblehome (area 1). Having said that, as you get more experienced you will see that areas 1 and 2 sometimes have to be used to create specific shapes, but for now it is recommended to only use the green area in the middle.



Internal control points should *never* be positioned in areas 3 and 4.

Lesson 3: Moving internal control points does not influence the shape of the edge of the surface.

Tips:

- In general: Always try to minimise the amount of data (Contour lines, Markers, Control points etc.) displayed on your screen.
- When you are working in body plan view it is easiest to work at one column at a time. It is important however to realise that the 3D shape of the vessel results from all columns and rows being fair in 3D. This means that even though a section might look fair in 2D Body Plan view, this does not necessarily mean it is fair in 3D. When working in a 2D window, always try to think about the 3D shape surrounding the area of the 2D section you are working on.

o In a 2D window the movement of a control point is strictly restricted to movement in the plane of the window. For example: in Body Plan you can only move control points in the Y-Z plane and movements in the X direction (Fwd or Aft) is not possible. Movements in the X direction should instead be done in either the Plan or Profile view. Moving control points in Perspective view is also possible, but a little more complicated and will be discussed further on in the training manual.

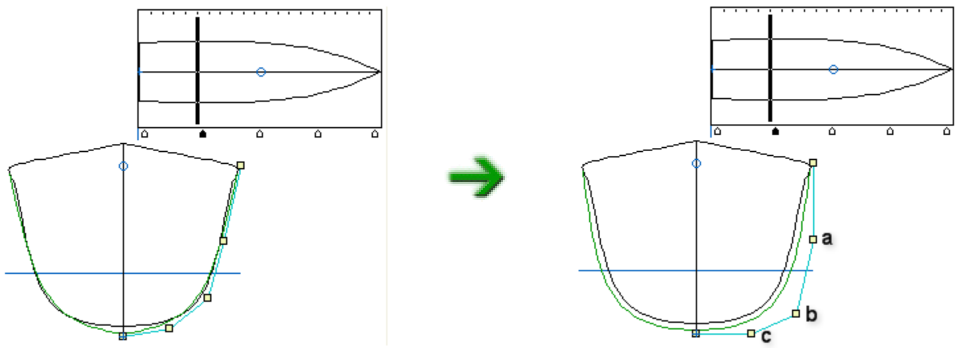
- **Hide the Net**
- **Switching between the columns using the control box, position the control points of each column to shape the internal surface.**

There is no particular order you should do this in, but in this tutorial

- **Start with the 2nd column from aft and work your way towards the bow**
- **You can use your own creativity for the position of the internal control points, or use the suggested locations in the table below:**

Internal Control point	Suggested location
a	**Directly below deck edge for vertical walled hull/deck**
b	**Drag outwards for more voluminous hull**
c	**Same height as centreline edge control point for smooth transition across centreline**

➢

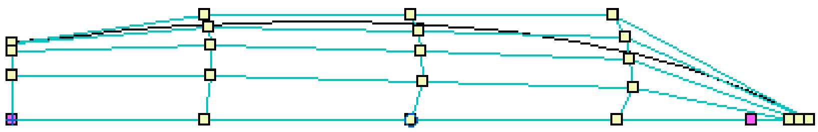


- **Switch to Plan view to check your adjustments**

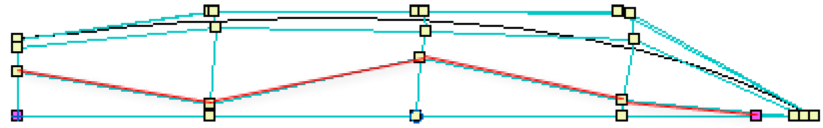
Modelling Internal Control Points – Procedures – Plan or Profile View

Plan view or Profile view

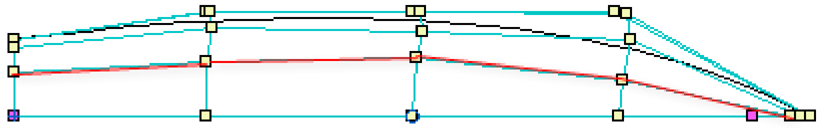
After you have roughly positioned the control points in Body Plan view, check the position of the control points in Plan and Profile view.
Show the Net
Before you made changes in Body Plan it looked like this:



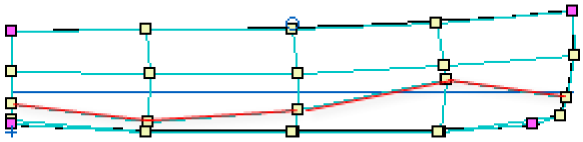
It may now look more like this:

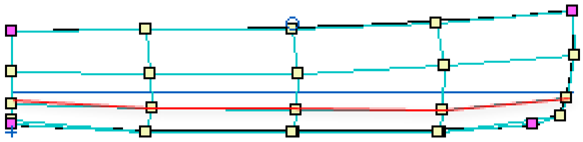


Boats usually don't get built with zigzags in the hullshape, so try to avoid these zigzags in the control point net as well:



Instead of zigzags, try looking for "bananas": smooth curves.
Do the same in Profile view





Continue to make adjustments where necessary. Your aim should be to make all control points rows and columns "flow" in smooth lines, remembering that a smooth control point net results in a smooth surface.

Shaping the internal surface is a highly iterative process. Switching between columns in Body Plan view and switching to the other view windows often, will slowly make the design fairer. This fairing takes some experience and will be discussed later in the training material.

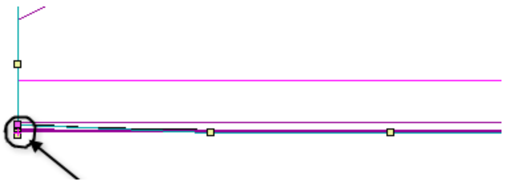
Modelling Internal Control Points – Procedures – Perspective View

Perspective view

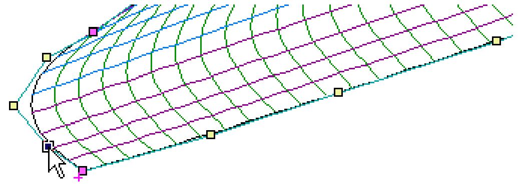
By rotating the model whilst showing the Net, all irregularities in the control point net become visible.

Making adjustments to the control points net in Perspective view is not recommended for inexperienced users.

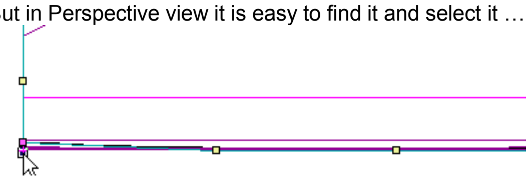
The perspective window can also be used to find and select a control point that is difficult to select in one of the 2D view windows because it is hidden by other control points. In Perspective view you can rotate the model and find and select the control point you need. A selected control point in any view window in Maxsurf will also be selected in the other windows. For example:



In case you want to select this control point in Profile view..

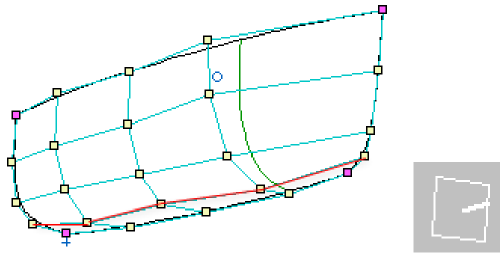


But in Perspective view it is easy to find it and select it …



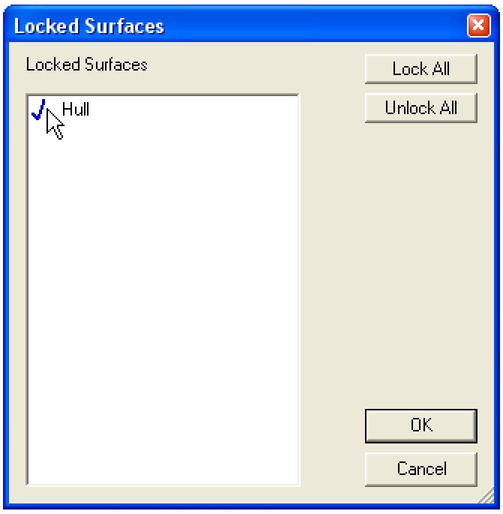
And in Profile view the control point is selected as well.

- **Show the Net**
- **Check the control point net in the Perspective window by rotating the model**



A minor zigzag can be seen in perspective view at particular orientation angles. Generally you will want to investigate this and fix it in the 2D view windows. You will learn more about this in the basic fairing section of this training manual.

Don't spend too much time on the internal control points at this stage. When you are done with the model you can lock the surface from Surfaces | Locking:



- **Go Surfaces | Locking and place a tick next to the Hull surface.**

You can also use Right click on the surface in the Assembly Pane, or use the Surface Properties dialog to lock the surface. Locking the surface will lock and hide all control points, preventing any unintended changes.

- **Save your design as MyFirstDesign.msd**

Congratulations! You have created your first design by starting a new design and inserting and modifying a surface from the Maxsurf surface library. The next section in this training manual will take you through an alternative option to starting a design: Modifying an Existing Design.

Modifying an Existing Design

Previously you have learnt how to model a design from scratch by inserting a pre-defined surface from Maxsurf's surfaces list and then modifying it.

As mentioned earlier in this training manual, there are different options to start a new design and you can – as an alternative to starting completely from scratch – start a new design by changing an existing design from the Maxsurf Sample Designs library. With an extensive collection of designs from small yachts to container ships, you are likely to find an existing design that you can modify to produce the design you have in mind.

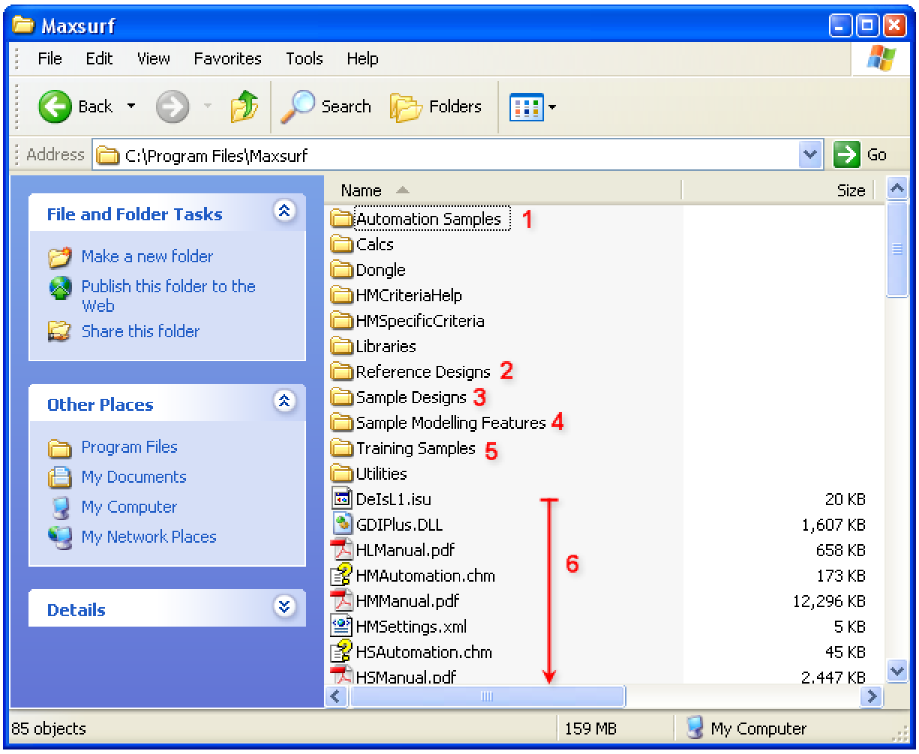
Let's first have a look at a few of the sample designs that get installed with Maxsurf before we continue and look at some tools to make modifications to an existing design.

Start with the section on Exploring Sample Designs Directory.

Exploring Sample Designs Directory

- **In windows explorer, navigate to c:\program files\Maxsurf ##, where ## is the version number.**

Depending on which Maxsurf applications you have installed, you will see something like this:

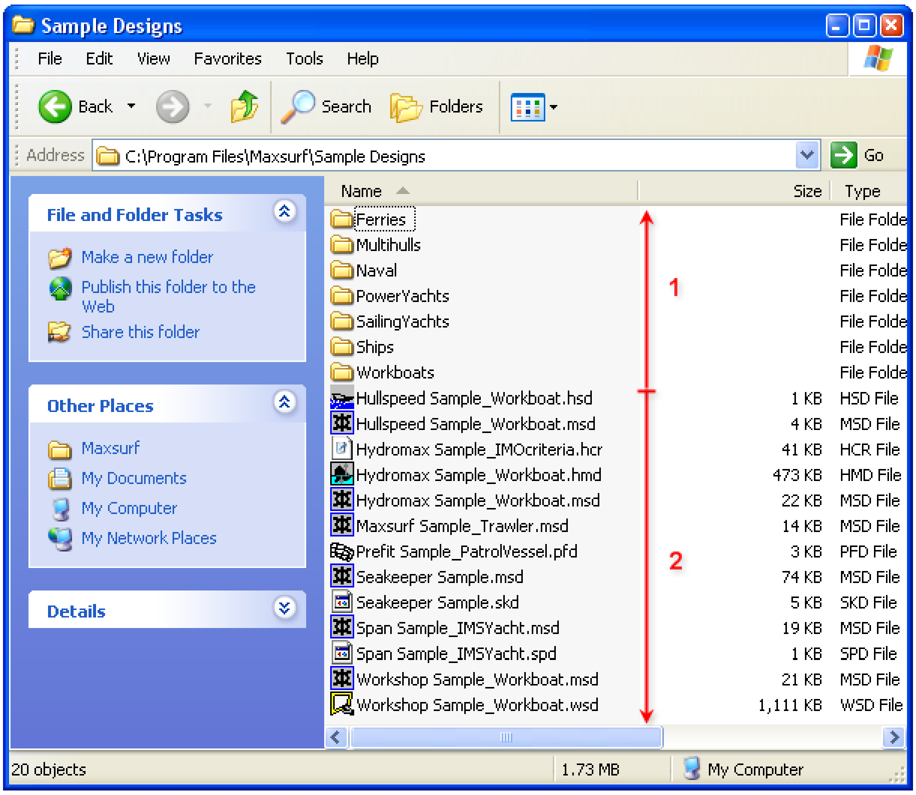


The following items in this folder are worth mentioning at this stage:

1. Automation Samples are for the advanced users only and contain for example sample spreadsheets with Macros that drive Maxsurf or other applications of the Maxsurf suite from the spreadsheet.
2. Reference Designs are designs that have been used to benchmark some of our analysis software like Seakeeper.
3. **Sample Designs** contains a library of different samples. We will have a closer look at this folder below.
4. Sample Modelling Features folder contains parts of a ship that have been modelled a specific way; for example a propeller or the stern of a ship.
5. Training Samples folder contains all samples that are used in training documents.
6. A long list of files containing the manuals, applications, libraries, supporting DLLs etc. Don’t ever change anything to this list unless you know what you are doing!

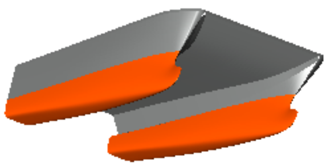
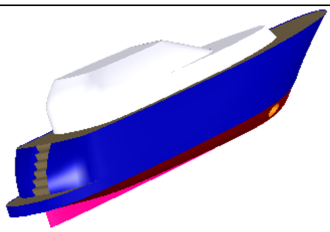
➢ Open the Sample Designs Directory

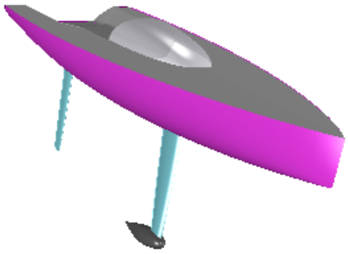
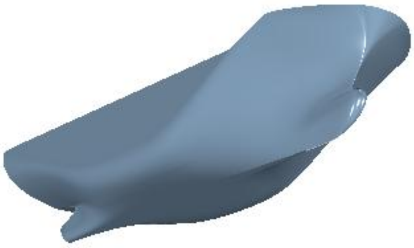
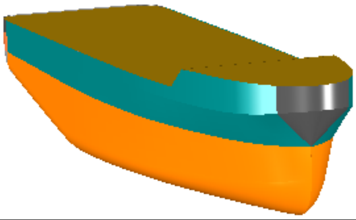
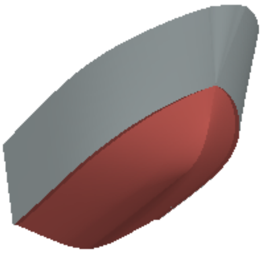
Depending on which Maxsurf applications you have installed you’ll see something like this:



1. All samples in the Sample Designs directory have been sorted by ship type.
2. This list consists of several sample designs; one for each application of the Maxsurf suite.

Some examples:

	**Catamaran Ferry** Shows a complex surface topology specific to catamarans.
	**Wave piercing catamaran** Another example of complex surface topology for a catamaran. This wavepiercer has an integrated superstructure.
	**Patrol vessel** The hull of this model shows a good distribution of control points and is faired very nicely. The decks and keel trim the hull.
	**Motor yacht** This model features numerous bonded as well as trimmed surfaces. There is a video on the website that shows the different techniques used to model this vessel. This video is only available to users of Maxsurf with current subscription.

	**Fast yacht** This model uses numerous trimming surfaces and consists of NACA keel (incl. bulb) and rudder and has a cockpit and coach roof. Good starting point for any sailing yacht.
	**Container ship** This model shows a surface topology that can be used for large ships such as containerships with flat of sides, bowcone, stern bulb and bulbous bow. Uses a trimmed deck / sheer line.
	**Anchor handling vessel** This simple looking hull can be used as a starting point for many workboats such as OSVs, tugs etc. The model features many bonded surfaces allowing each surface to be developed separately to minimise plate forming production cost.
	**Workboat** There are several workboats in the sample design library; each one with different number of surfaces and features. This one uses bonded surfaces and consists of a bowcone, topsides, bottom and chine. Good starting point for crew boats but also some open deck fishing vessels.

Now it is time to learn how to make Simple modifications.

Simple modifications

Simple modifications – Concepts

Let's face it: most ships all look the same. This means that in most cases it is possible to take an existing design and, for example by simply resizing it, get reasonably close to a customer's requirements. In Maxsurf, resizing and/or a simple parametric transformation (eg increasing the displacement) can all be done without touching control points. This means that if you for example have a fair design that was built 30 m long with a displacement of 44 tonnes you can have a 35 m ship with a displacement of for example 54 tonnes in a matter of minutes. And even better: the fairness quality of the surface model will be maintained during the modification.

Simple Modifications – Video

Watch a short video that shows you how to resize the trawler sample design and apply a simple parametric transformation on your own MyFirstDesign file: increasing the displacement whilst keeping the draft the same. [Web | Disk]

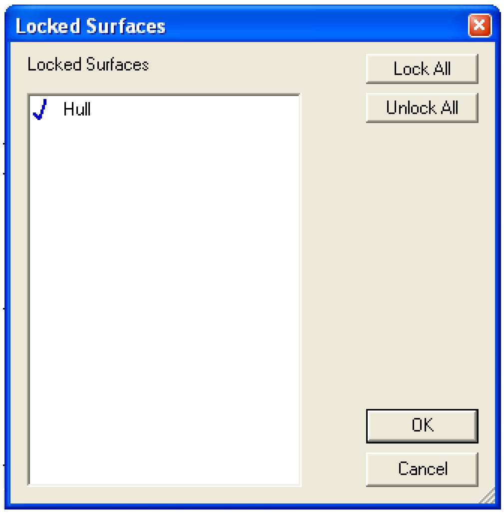
Resizing

To modify an existing design, you will first need to unlock the relevant surface(s) that you wish to make modifications to. We will return to the sample trawler model as it is a simple single-surface model.

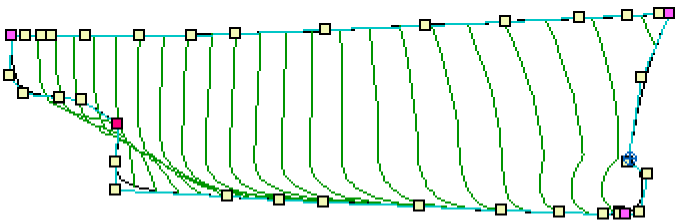
- **Close any currently open design by going to File | Close Design.**
- **Select Open from the File menu.**
- **Navigate to the Maxsurf program file directory (C:\Program Files\Maxsurf\Sample Designs**
- **Open the design called Maxsurf Sample_Trawler.msd.**
- **Display the Sections and the Grid**

To modify the design in any way, the applicable surface(s) have to be unlocked. If a surface is locked, its control points cannot be moved and are hidden.

- **Go to Surfaces | Locking**



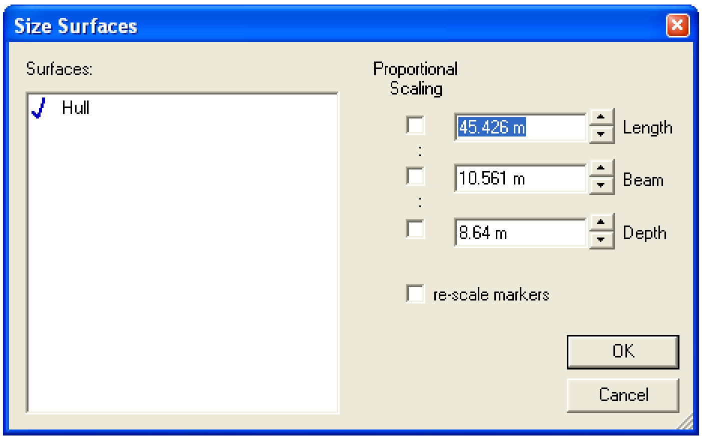
- **Remove the tick next to the Hull surface by clicking it with the left mouse button.**



Note: you can also resize the surfaces using right clicking in the Assembly Pane.

Suppose we wish to resize the trawler from an overall length of approximately 45 m down to 25 m.

- **Go to Surfaces | Size Surfaces**



When resizing a surface, it is necessary to decide which, if any, of the dimensions should be scaled proportionately. Use this proportional scaling if you have a basis design of which you wish to maintain the beam:depth ratio, length:depth ratio and/or length:beam ratio. To scale two or more dimensions proportionately, place a tick next to the items that should remain in proportion. For example, to maintain length:beam ratio, place a tick in the proportional scaling boxes of length and beam; if you would like to keep all dimensions in proportion, place a tick in all three boxes.

- **Place a tick in all three proportional scaling boxes.**
- **Enter 25m for Length.**

Observe how the beam and depth values automatically update to maintain the L/B and L/D ratio.

- **Click OK.**

Simple Modifications – Procedures – Parametric Transformations

Parametric Transformations

Please read the Using Parametric Transformations topic from the Manual (it is only necessary to read up to the Parametric Transformations Restrictions heading. Example exercises do not need to be performed).

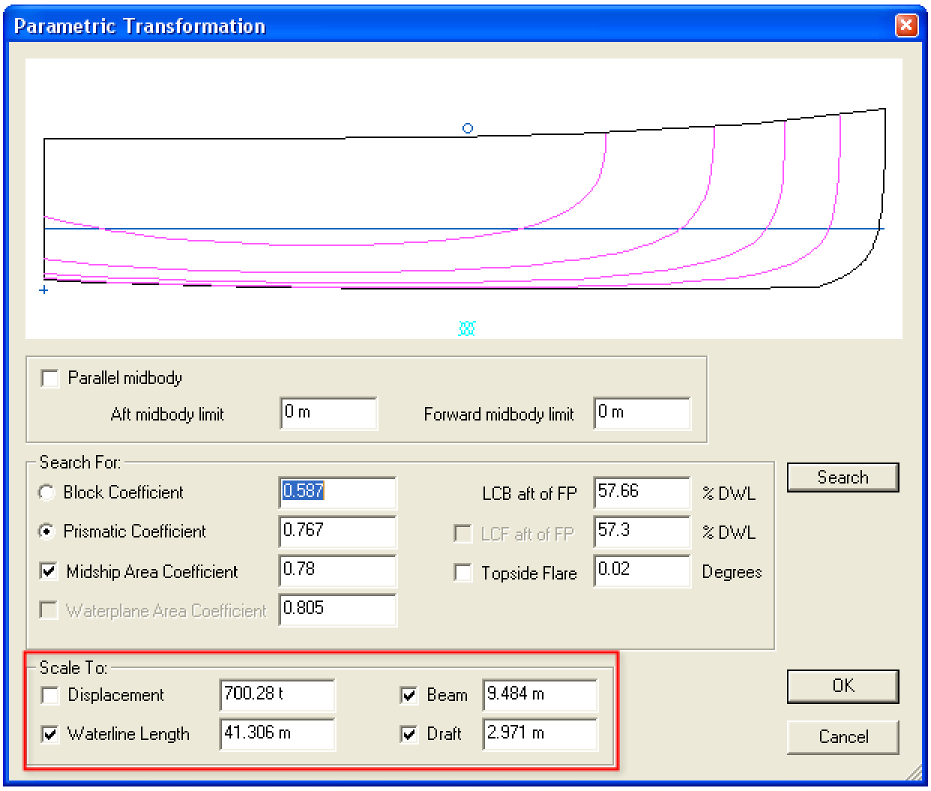
- **Open your own MyFirstDesign.msd file.**

Alternatively, you can open a copy of the file from the C:\Program Files\Maxsurf\Training Samples directory.

- **Save the design as MyFirstDesign_transformed.msd**

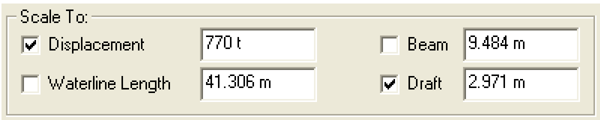
It is generally good practice to save to another filename before doing a parametric transformation or working with the standard sample designs.

- **Go to Data | Parametric transformation**



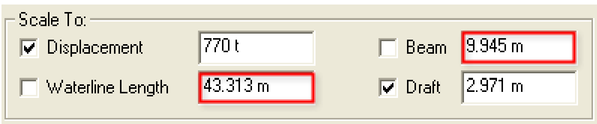
- **Tick the Displacement and Draft boxes**
- **Change the displacement to 110% of the current value. Leave all other values as they are.**

This will search for an increased displacement by varying the Lwl and Beam, but keeping the Draft the same. If you used the supplied MyFirstDesign.msd from the C:\Program Files\Maxsurf\Training Samples directory, the Scale To box should appear as follows:



- **Press Search and wait for the hourglass to disappear**

Note that the waterline length and beam have both increased and that the increase in length is reflected in the profile view of the model in the dialog.



- **Press OK to accept the new hullshape**

Note:

'Immersed depth' is equivalent to the draft in the parametric transformation dialog; 'Lwl' denotes waterline length and 'Beam wl' the waterline beam (the maximum width of the waterplane).

- **Go to profile view and do a Ctrl+Z to undo the parametric transformation and a Ctrl+Y to redo it. This quickly gives you an idea of the changes.**
- **Resave the transformed model.**

Continue with the section Other Options to Start a New Design.

Other Options to Start a New Design

Previously you have learnt that you can start a project by starting from scratch or by using an existing design and modify this to match design requirements. Generally, the naval architect is confronted with a variety of projects with different combinations of input data and output requirements. For example: a customer only provides paper drawings of a ship and needs to have the stability booklet re-issued after a modification to one of the tanks. This means that a Maxsurf model has to be created so that this can be used in Hydromax for Hydrostatic analysis. Another example may be that the customer has a DXF CAD drawing and wants to build a similar ship with minor modifications to the sheerline. In this case a Maxsurf model has to be setup in such a way that the surface model is useful in Workshop to expand plates, define stiffeners and frames and other primary construction parts. Both examples above have different input data and require very different surface models to deliver output that satisfies quality standards. Deciding the most cost effective way to handle the examples above requires a fair amount of experience and is thus not within the scope of this training manual. Extensive documentation on this topic is available to users with current subscription.

Continue with the next section where you will learn some Chapter 6 Basic fairing techniques and concepts.

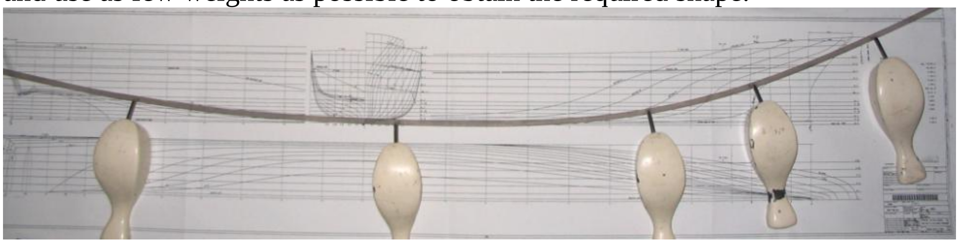
Chapter 6 Basic fairing

In this tutorial you will learn some background information on surface fairing and how several display and fairing tools in Maxsurf can be used to help you obtain a fair design.

Start by reading the section on the Fairing Concept.

Fairing Concept

To really understand the concept of fairing surfaces it may be helpful to look at how lines fairing was done historically. The draftsman would use a rod (or: batten), bend it and place weights on it to fix its shape. The more curvature was needed, the more weights were needed to hold the rod in position or a more flexible rod had to be chosen. Adding more weights on top of the rod, would also make it easier for unfairness (i.e. inflexions in the curve) to arise. To prevent that, the draftsman would lift each weight up, let the rod “relax” and put the weight down again. With this procedure, he would iterate to obtain the required shape. Instead of adding more weight to areas of high curvature, the draftsman could also choose to use a rod with less stiffness. The disadvantage of that is that the flexible rod would make it very difficult to fair parts of the curve with less curvature. Ultimately, the experienced draftsman would look for the stiffest rod and use as few weights as possible to obtain the required shape.



In Maxsurf, a B-spline surface can be seen as the rod and the control points as the weights. (See Chapter 2 of the Maxsurf manual on the Basic Principles).

Start learning fairing in Maxsurf in the section on Displaying Curvature.

Displaying Curvature

Maxsurf has a range of tools to display curvature on curves or contours (eg a buttock) as well as on surfaces.

In this section of the training manual you will learn the different display tools and also get a feel what makes a line/surface fair or unfair by manually removing control points from a curve or adjusting their position. In the next section you will then learn different tools and techniques that Maxsurf offers to assist you improve fairness.

Start with the section on Display Curvature on a Curve or Contour.

Display Curvature on a Curve or Contour

Display Curvature – Concepts

In this section we will look at some tools to display the curvature on curves and surfaces. We will go through a number of steps displaying the curvature on a curve and making simple modifications to the curve to improve the fairness.

- **In Maxsurf, go to the Profile view window**
- **Open the BasicFairingSpline_Start.msd file**

You will see something like this:

You can see that the left side of the curve only contains a few control points, while the right side has the control points much more densely spaced. A lot of the control points on the right can be removed without changing the shape of the curve while improving the fairness of the curve. But how do you actually judge the fairness of this curve? This is where you need some display tools like Curvature porcupines and compress.

Display Curvature – Video

View a video that will show you the different curvature display tools for curves such as Curvature porcupines and Compress view. The video will also show some steps to manually improve the fairness of this curve. [Web | Disk]

Display Curvature – Procedures - Properties

Curvature Porcupines

The curvature on contours may be displayed in the form of porcupines.

- **Select the spline curve**

- **Now select Show Curvature from the Display | Curvature menu or using the toolbar button below:**

You will see something like this:

- **Read about curvature porcupines in the Maxsurf manual.**

Note: The value of the smallest radius (tightest bend) on a given curve is displayed numerically at the end of the porcupine located at the corresponding position on the curve.

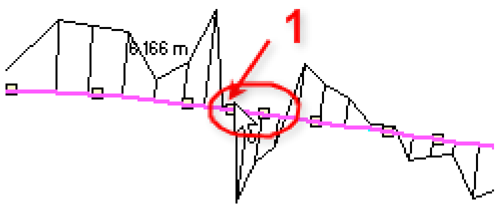
You can also see that the curvature porcupines change sides from the upper to the lower side of the curve. This means that the curvature direction changes from positive to negative or visa versa. Changing of the curvature direction may be classified as an inflection. There are a number of inflections in this curve:

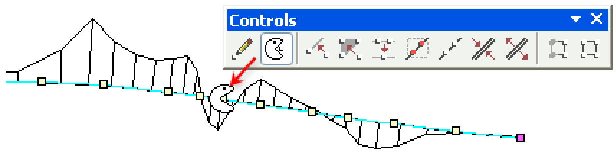
Inflection 1 may be classified as unfairness, whilst inflection 2 may be a feature of this curve.

- **Increase the longitudinal stiffness of the curve from 3 to 4 using the Surface Properties dialog from the Surfaces menu.**

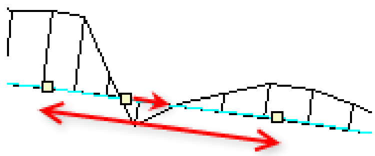
By increasing the stiffness the curvature discontinuity is reduced.

- **Remove one control point from the inflection area**



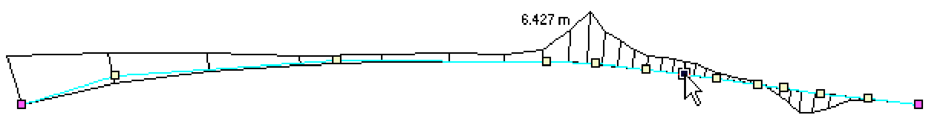


- **Space the control points in the area so that they are evenly distributed by moving the middle control point as shown below.**

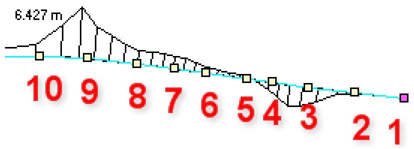


- **Adjust the height of the middle control point to remove the inflection and produce a continuous curvature along the curve in this area.**

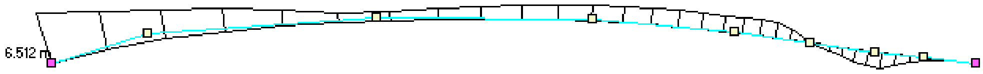
You should now see something like this:



The surface fairness can be improved by increasing the surface stiffness, removing control points and spacing the control points evenly.



- **Now continue removing control points nr 4, 6, 8 and 9**



This again leads to a dramatic improvement of the fairness. See BasicFairingSpline_EndCurvature.msd file.

You should use the stiffest spline and minimum number of control points that will give the desired shape.

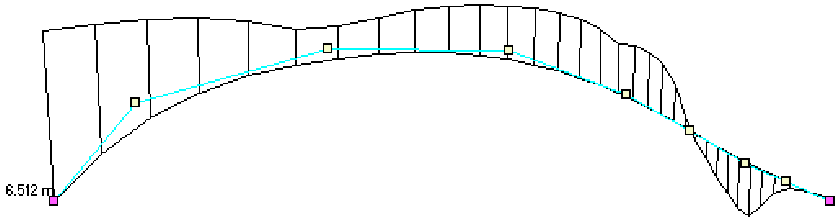
Now let's use the compress curvature display tool to further improve the fairness of this curve.

Display Curvature – Procedures - Compress

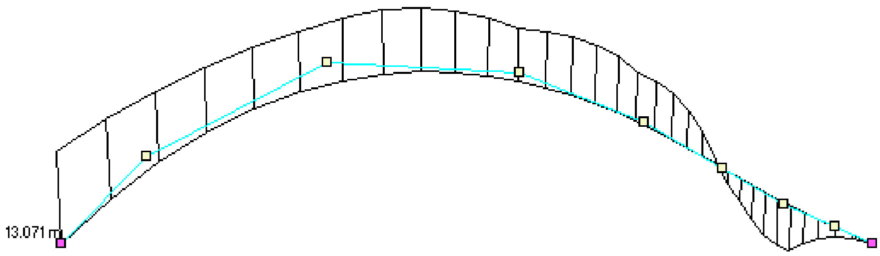
Compress

This expands the transverse and vertical axes in relation to the longitudinal axis in the plan and profile views. This can be helpful when fairing long, slender hulls.

- **In Maxsurf Profile window, open BasicFairingSpline_EndCurvature.msd**
- **Select Compress from the Display menu**



We can now see that the fairness can be further improved by distributing the amount of curvature along the length of the curve better so that we end up with something like this:

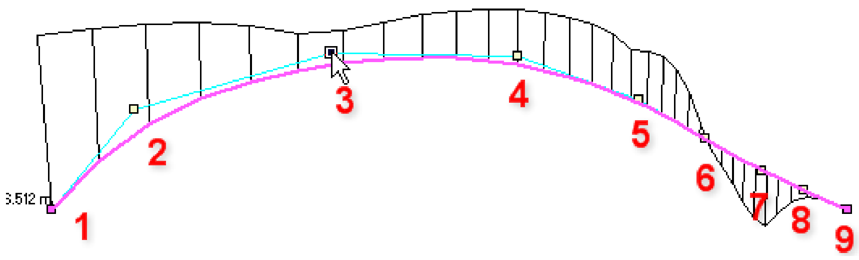


Exercise: Try fairing the curve by using the compressed view to produce a curvature distribution similar to the one above.

A few pointers:

- **Whatever you do, don't touch the corner control points (1 and 9)!**
- **Distribute the control points evenly long the curve, with a steadily reduced space between the control points on the right side of the curve**
- **Move the control points up and down in small increments**

Tip: you can use the arrow keys of your keyboard to move a control point up and down 1 mm at a time.



Continue with the Display the Curvature on a Surface section.

Display the Curvature on a Surface

Surface Rendering – Concepts

You can colour shade or render a surface to display the shape and curvature. Maxsurf has different rendering types available. Each rendering type can be used for different purposes.

See the Maxsurf manual section on Rendering a surface for more information on the different rending options.

We will explore the following surface rendering options:

- **Simple Shading**
- **Smooth Shading**
- **Longitudinal curvature**
- **Transverse curvature**

The other rendering options you will see in the Rendering dialog are not useful to display the fairness of the surface and will not be discussed in the Learning Maxsurf training manual.

Surface Rendering – Video

View a video that will show you the different rendering options in Maxsurf. [Web | Disk]

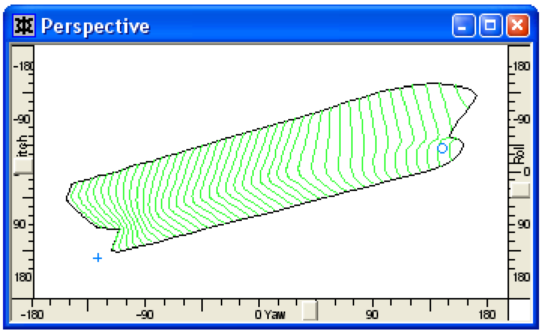
Surface Rendering – Procedures

Surfaces can only be rendered in the Perspective window.

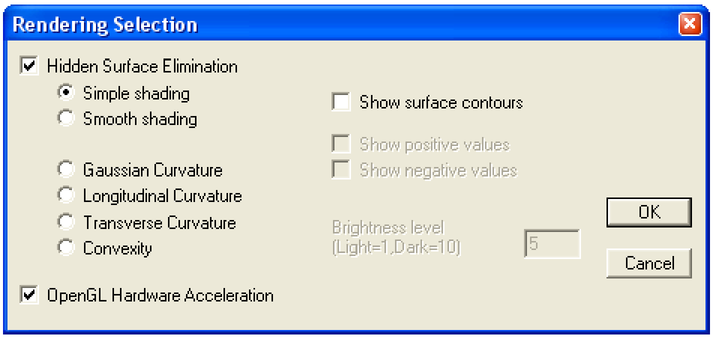
➢ **In Maxsurf, switch to the Perspective View window**

➢ **Open the BasicFairing_SurfaceRender.msd file**

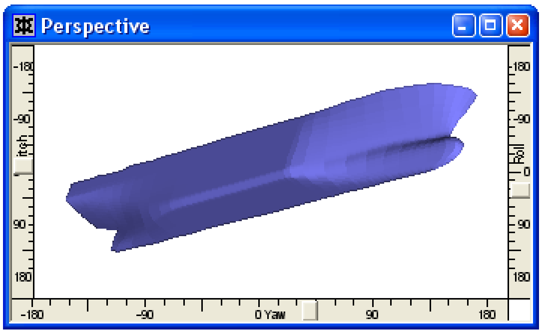
Depending on which contours you have displayed, you should see something like this:



➢ **Select Display | Render and select the Simple Shading option from the Rendering Selection dialog:**



You should now see something like this:

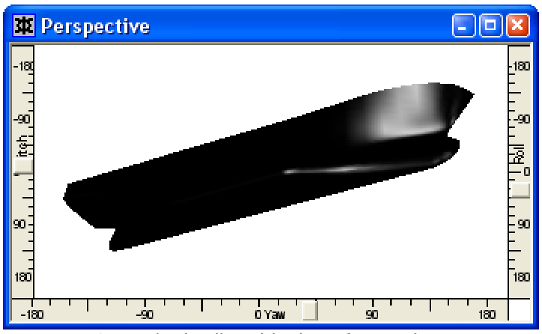


Simple shading

Note that even though it provides you with good information about the 3D shape, this is not very useful to evaluate the curvature or fairness of the design. Let’s try the next rendering option.

➢ **Switch to Smooth Shading in the Rendering Selection dialog**

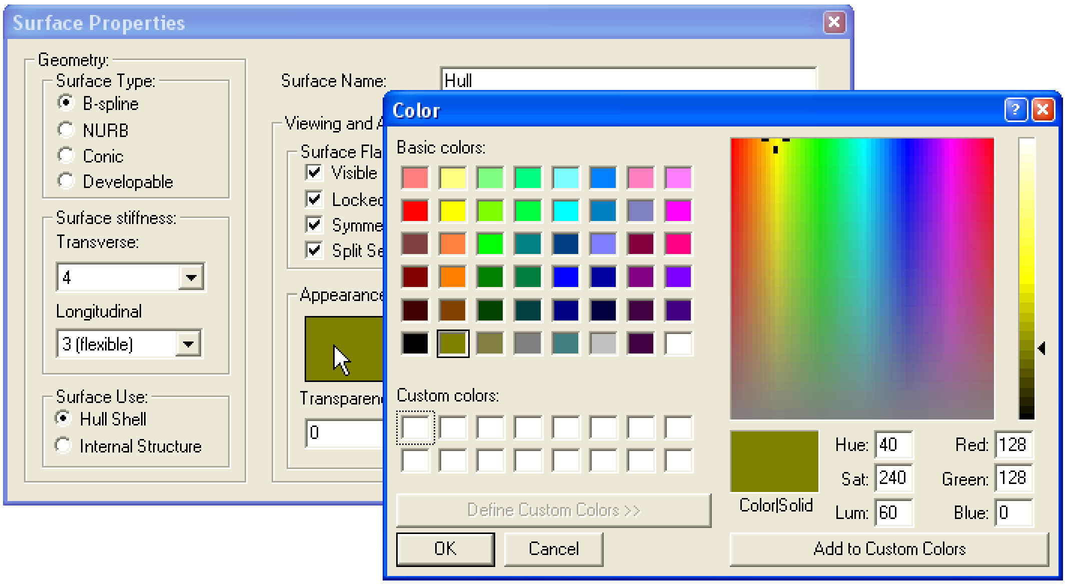
You will now see something like this:



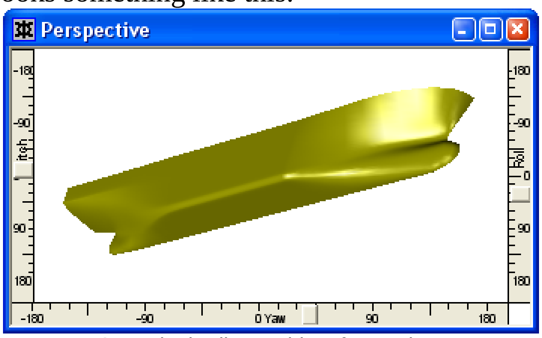
Smooth shading, black surface colour

This is a lot more useful display to visualise the curvature. Use the slider bars and/or free rotate buttons of the Perspective window to rotate the model and look closely at the light reflecting off this surface. This gives you immediate feedback if there are any lumps or inflections. We can do better though:

- **From the Surfaces | Surface Properties, change the colour of the surface to gold by double clicking in the "appearance" square which brings up the colour picker dialog.**



Now the surface looks something like this:

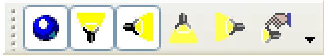


Smooth shading, gold surface colour

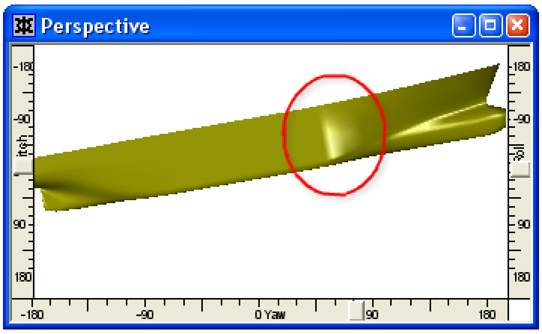
This is again a lot more useful to visualise any unfairness. The gold colour of the surface reflects a lot more light than the black colour.

Some colours are better than others to visualise surface curvature.

- **In rendered mode, you can switch lights on/off. Experiment with switching lights on/off. Ignore the button with the hand icon on the far right.**
- **Finally, set them as in the image below:**

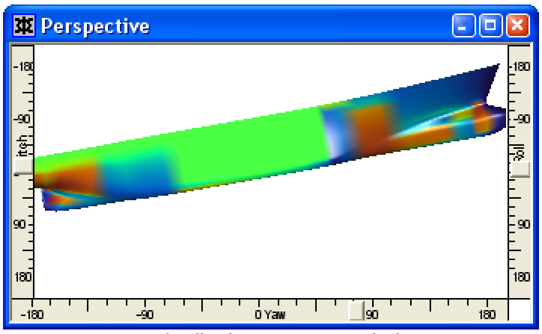


- **Again rotate the model in Perspective view so that you get something like this:**



By rotating the model and switching lights on/off we have visualised an areas with discontinuous curvature. Let's have a look at the actual curvature of the surface in this area now:

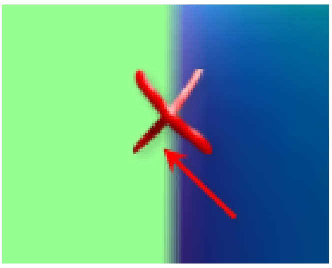
- **In the Rendering Selection dialog, select Longitudinal Curvature**



Longitudinal curvature rendering

As you may have read in the Maxsurf manual, the green areas have zero curvature (read: run along a straight line in longitudinal direction) and – if the surface normal has been setup correctly – the blue areas are positive curvature (convex) and the red areas are negative (concave).

What you are looking for are the transitions between for example green and blue or red. Where the colour changes rapidly, there is a rapid change in curvature which usually means unfairness. Changes from blue into red without any green in between are generally undesirable.

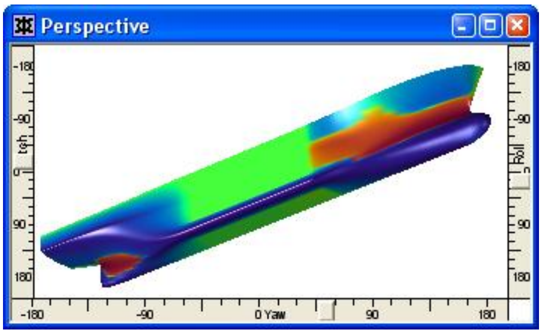


Rapid transition from Green into Blue

A more blurry transition between Blue and Green

Finally let's have a look at the transverse curvature:

- **Switch to Transverse Curvature in the Rendering Selection dialog**



Transverse curvature rendering

Notice that this does not show the same areas of green, blue and red. This is because we are now looking ONLY at the curvature in the longitudinal direction. What is clearly visible with this rendering on this model is the transition from the flat of sides to the bilge radius. It is debatable whether – in this case – this is unfairness or a feature of the design.

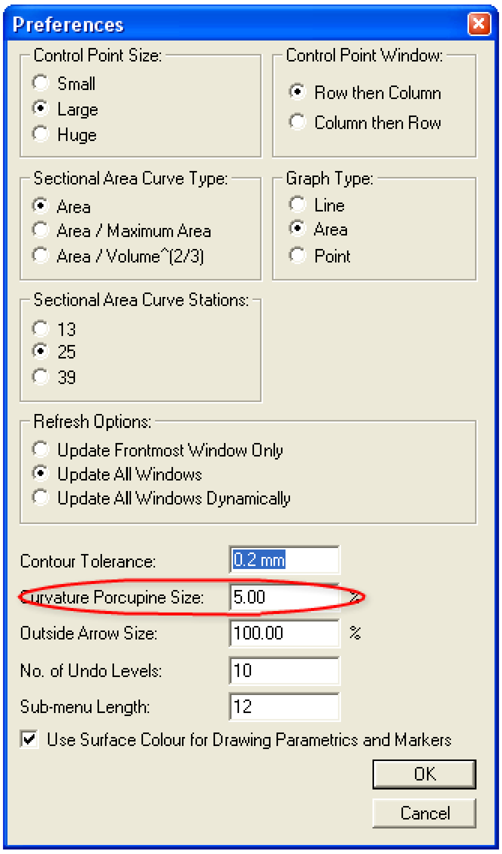
Exercise:

- **Switch rendering off by clicking on this toolbar button:**

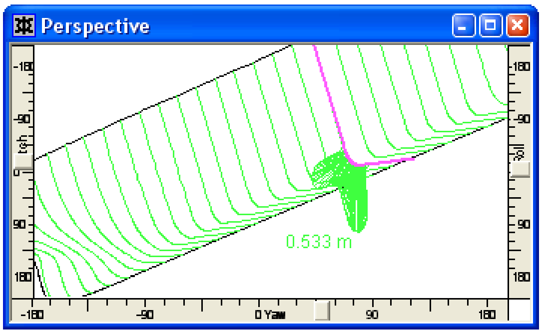
- **Switch all contours off except for Edges and Sections**
- **Select one of the sections in the midship**
- **Select Display | Curvature | Show Curvature**

This looks a bit messy! Let's scale down the curvature porcupines

- **Select Edit | Preferences and set the Curvature Porcupine size to 5%:**



You should now see something like this:



Using a combination of renderings and curvature porcupines you can get a good understanding of the curvature of the surface.

This completes the section on **displaying** fairness on a curve or surface. Now let's have a look at some basic **fairing tools** in Maxsurf that help you **adjust** the fairness of a design.

Next: Basic Fairing Tools & Techniques.

Basic Fairing Tools & Techniques

In this section we will use different fairing display techniques from the previous section and learn how to use simple fairing tools to make improvements to a curve (eg an edge of surface) and surfaces or parts of a surface.

Continue with Straightening Control Points.

Straightening Control Points

Straightening Control Points – Concepts

Maxsurf has a straightening tool that will straighten:

1. all control points on a row or column between two selected control points on the same row or column:

•

2. all control points on a surface patch defined by two diagonally opposite selected control points:

This straightening can be done either:

1. From the current view direction. You will only see the control points on a straight line from the current view direction, but they will not be straightened from the other view directions.
2. In 3D. The control points will be straightened in 3D; regardless what view direction you are looking from.

In the procedures below you will learn how this command can be used for specific purposes as well as its side effects.

Straightening Control Points – Video

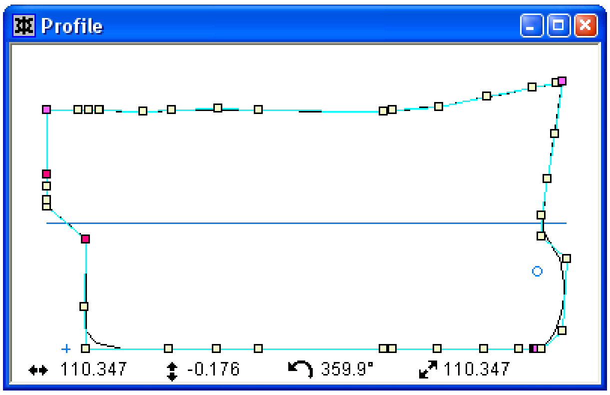
View a video that shows you how to use the straighten command to straighten control points on the deck edge of a containership followed by straightening the Flat of Sides area of the hull. [Web | Disk]

Straightening Control Points – Procedures – Row or Column

Straightening a row or column

- **Open the BasicFairing_FairingToolsStart.msd in profile view**
- **Hide the Control point net**
- **Switch the Compress display on**

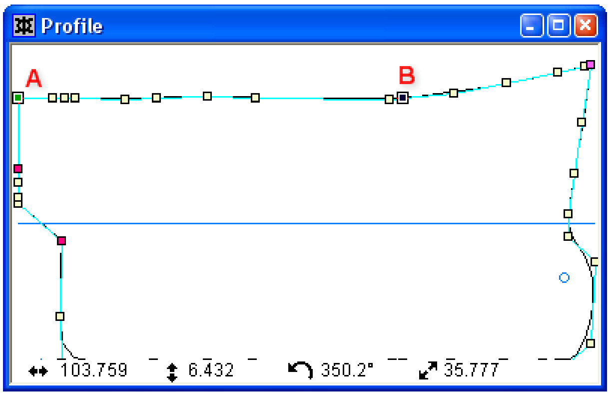
You should now see something like this:



Notice how the compress display suddenly shows that the top edge of the surface is not a straight line whereas in normal view this was difficult to see.

Let's straighten this top edge:

- **Select the aft corner control point**
- **While holding the Ctrl or Shift key down, select the top edge control point located at 68.5 m fwd of Aft Perpendicular (column 9)**
- **Use the Controls | Straighten Controls | In Current Plane only command.**



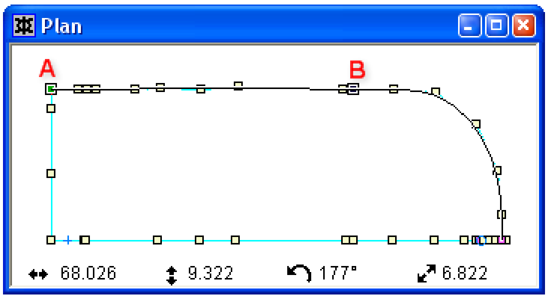
This results in a movement of the control points that lie between the two selected control points (A and B) in the direction perpendicular to a straight line connecting A and B onto that straight line. This straight line can be straight in 3 dimensions or a straight line from the current view direction only.

To straighten just one row or column, A and B have to be on the same row or column respectively.

- **Now switch to Plan view**
- **Notice how this deck edge is not straight in this view direction**

We can fix this by repeating the command above for this view direction, or using a straighten command in 3D.

- **Undo the straighten command by using Ctrl+Z or reloading the design from the start of this section.**
- **In plan view, select the Aft corner control point (A) and the edge control point at 68.5 m fwd of Aft Perpendicular (column 9) (B) again.**



- **Use Controls | Straighten | In Three Dimensions**

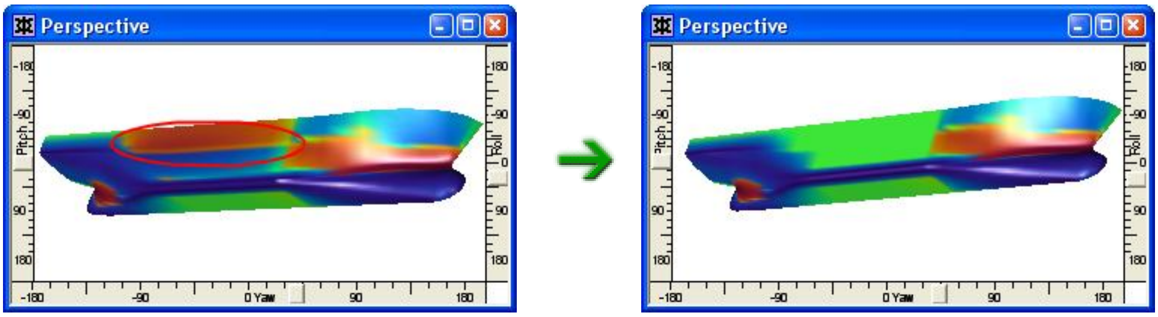
Notice how this has straightened all controls points between A and B in both Plan view as well as in Profile view. When you use Straighten in Three Dimensions, it does not matter which view window you are in as opposed to when using Straighten in Current Plane which only straightens in one direction.

Straightening Control Points – Procedures – Surface Patch

Straightening a Surface Patch

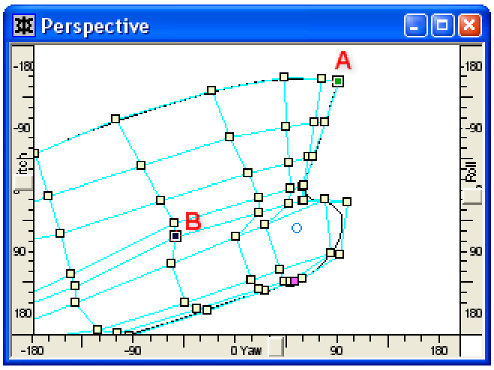
The previous section you learnt how to straighten a row or column of control points

- **Continue with the model from the previous section, or open the BasicFairing_FairingToolsBowStraight.msd**
- **Switch to Perspective view**
- **Use the Transverse Curvature rendering**
- **Rotate the model so that you see something like in the image on the left:**



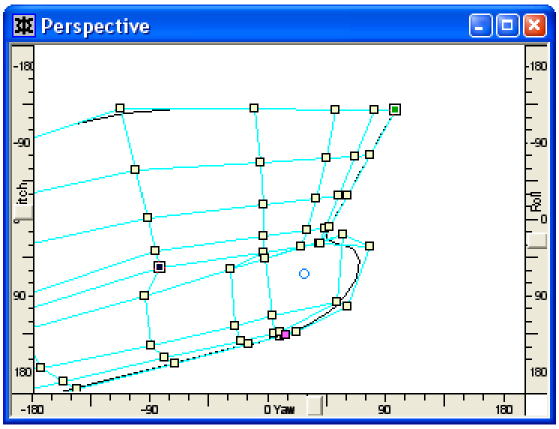
You can see that there is a transition from red into blue without any green in between at about midship. This should be the flat of sides (FOS) and thus coloured green (green = no curvature = flat). We can use a straighten command to straighten this panel. First let's see how the straighten command works on panels, by making a "mistake".

- **Switch rendering off and zoom in to the bow area**
- **Switch the net on**
- **Select the bow corner control point and a control point in the middle of the bow area like below:**



- **Use the straighten in three dimensions command**

You'll see something like this:

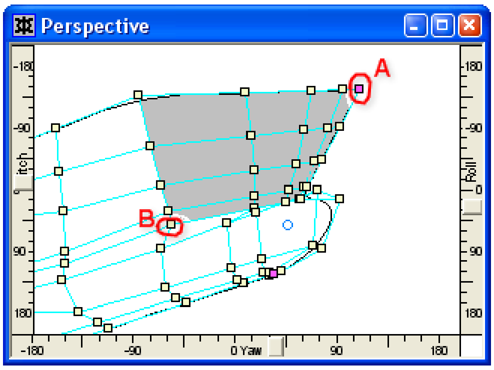


This model can be viewed by opening BasicFairing_FairingToolsBowStraightEnd.msd

In the background, Maxsurf has done the following steps:

Step 1:

The area that the straighten command is applied on is determined from the selected control points. This can be called a patch of control points:



Step 2:

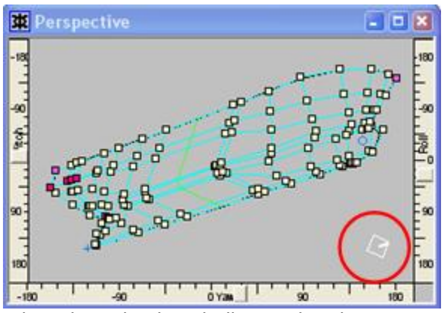
All four corner points of this patch are fixed in space and will not move. Patches selected by selecting two points on the Net are always four-sided and have four corner control points.

Step 3:

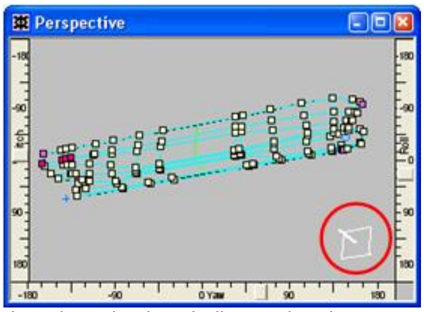
The edge control points are straightened between the corner points*

Step 4:

The internal control points are straightened between the edge points* *same as for straightening a row or column, this can be done either in three dimensions or in the current plane only. The current plane in Perspective view is determined by the orientation of the model. In the bottom right hand corner of the Perspective window, there is a little orientation icon that indicates the current working plane. It is important to rotate the model in such a way that you have the correct current working plane when using the “Straighten in Current Plane Only” command as it will affect in which direction the control points are straightened.



The orientation icon indicates that the current working plane is Body Plan view.



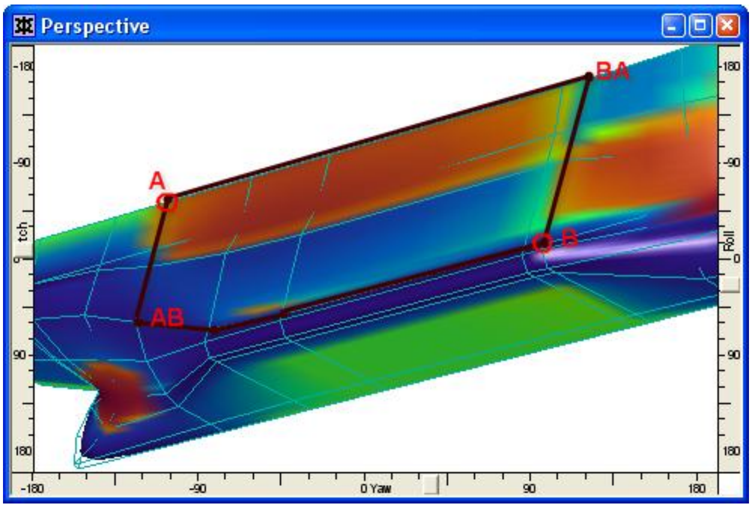
The orientation icon indicates that the current working plane is Profile view.

Now let’s use what we have learnt so far to straighten the flat of sides panel:

- **Undo the last straighten command so that you get your regular bow shape back or load the BasicFairing_FairingToolsFOSStraight.msd file.**

First we have to determine which control points we have to select in order to get a straight patch.

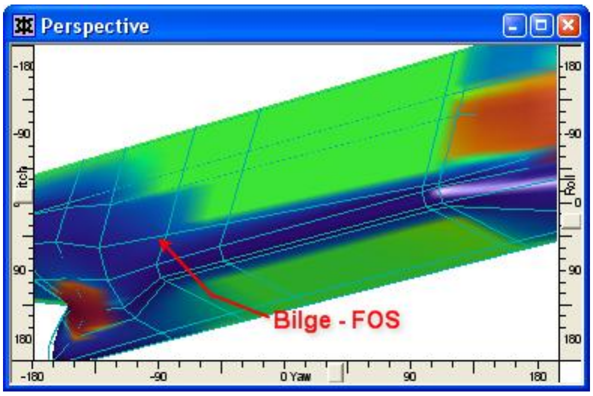
- **Switch transverse curvature rendering on and zoom in so that you can see the stern and midship.**



Remembering what Maxsurf does in the background when straightening a patch of control points in step 2 (fixing the corner control points), it is important to know the location of the corner control points before using the straighten command:

- **Double click on all corner points of the patch as in the image above: A, AB, B and BA. Notice that they are all offset from the centreline by 9 m. This means that all four corner points are planar which is what we want for this flat of sides panel.**

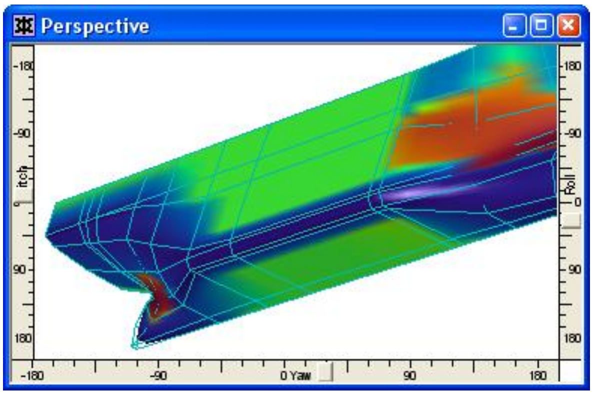
- **Switch rendering off in order to select the patch corner points A and B**
- **Apply the Straighten in Three Dimensions:**



We clearly see the flat of sides appearing after applying a straighten command

Notice how the shape of the control point net that forms the bilge-FOS line (from AB to B) has now become a straight line. This is not what we want.

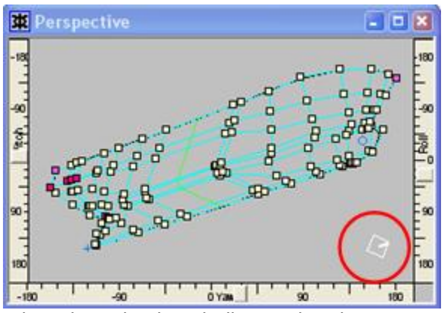
- **Undo the straighten command**
- **Rotate the model similar to the image below and switch rendering off**
- **Selecting the same patch as before, now use a Straighten In Current Plane Only command:**



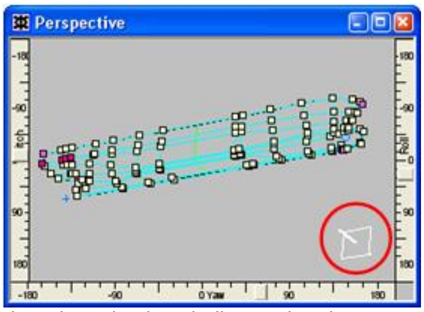
This model can be viewed by opening BasicFairing_FairingToolsFOSStraightEnd.msd

You can see how the Straighten in current plane command maintains the shape of the Bilge – FOS line. This is because, when you rotated the model to the orientation as in the image, the current working plane was set to Body Plan.

- **Read the text directly below step 4 (above) again**
- **Undo the change you just made**
- **Rotate the model around the “Yaw” axis so that the orientation icon indicates that Profile view is the current working plane:**

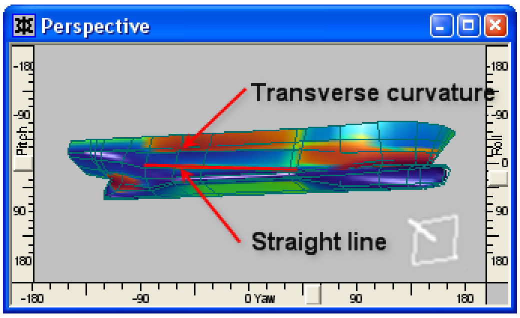


The orientation icon indicates that the current working plane is Body Plan view.

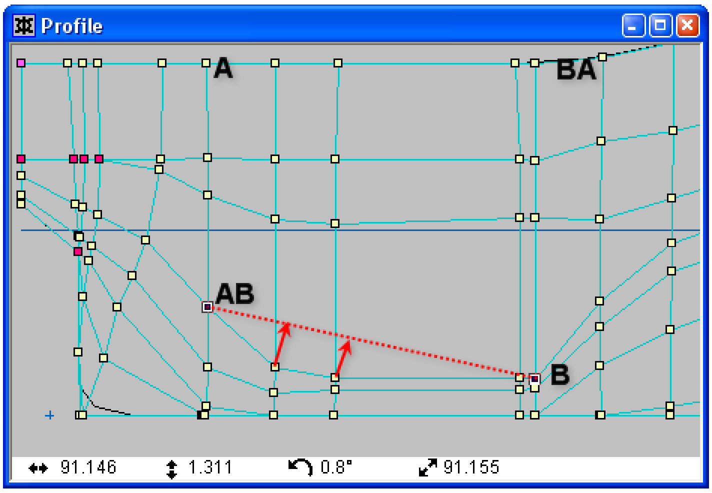


The orientation icon indicates that the current working plane is Profile view.

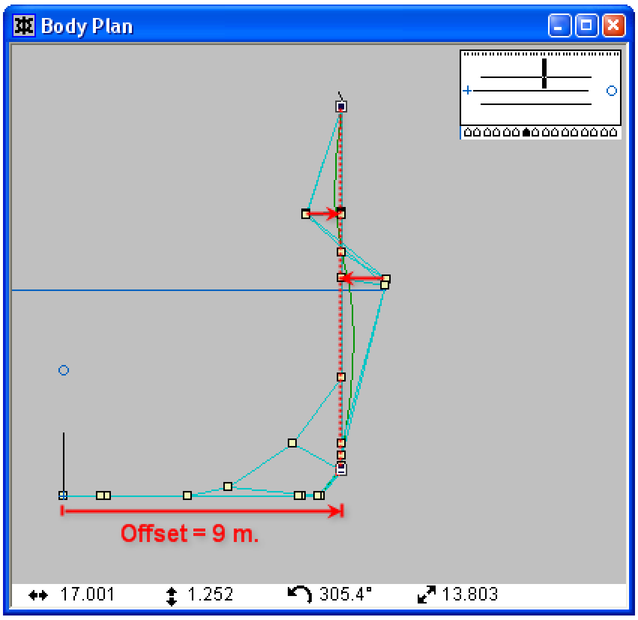
- **Now repeat the Straighten in Current Plane only command on the same control points A and B as before.**
- **Notice how the Bilge – FOS lines is now a straight line and the transverse curvature transition is still there:**



Although this is complicated to understand - and it is not expected that you do at this stage of the training -, perhaps the following images help you understand why the result of a Straighten in Current Plane is different when the current working plane is Body Plan view or when it is Profile view:



When the current working plane is Profile view, the control points between the corner points of the patch (in this case between AB and B) will move onto the straight line – as seen from Profile view - between AB and B perpendicularly.



Whereas, when the current working plane is set to Body Plan view, the control points snap to a straight line as seen from Body plan view and – in this case because all four corners were at 9 m offset from the centreline and the straight line is thus vertical – the control points all move horizontally inwards and outwards.

In case after reading the above, you still don't understand (which is OK) just remember that:

- **You can use a Straighten command in Three dimensions and in the Current Plane only.**
- **When you use the Straighten command in Current Plane only, the current working plane determines the outcome of the result.**

If the result is not like you expected it you may want to try using another working plane by switching window, or rotating the model in Perspective view.

You may wish to repeat this tutorial a couple of times to work your way towards fully understanding this command.

Continue with the section on Smooth Control .

Smooth Control Points

Smoothen Control Points – Concepts

Smooth control points works exactly the same as straighten controls, except now instead of straightening the control points Maxsurf now projects the control points onto a smooth curve or smooth patch. Smooth control points moves the control points in all directions and cannot be restrained to one working plane.

Smoothen Control Points – Video

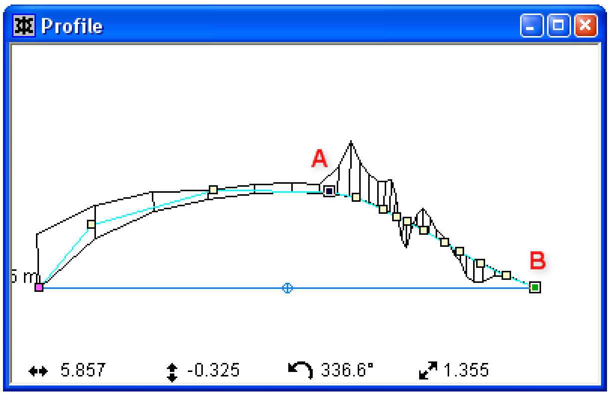
View a video that demonstrates the use of the Smooth Controls command to smoothen out the hull surface of a trawler. [Web | Disk]

Smoothen Control Points – Procedures – Smooth Curve

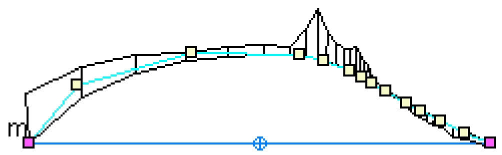
Smoothen a curve

- **Open the BasicFairingSpline_Start.msd file in Profile view**

- Switch Compress view on and set your porcupines size to 50% from the Edit | Preferences dialog.
- Select control points A and B as below

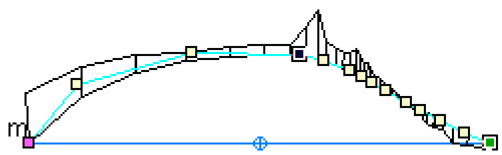


- Use the Controls | Smooth controls | Flexible



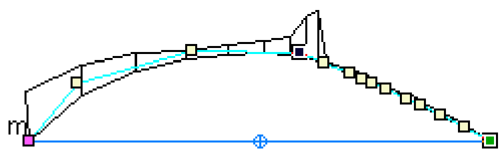
Flexible

- Undo the last command and now use Smooth Controls | Medium on the same selection of control points:



Medium

- Undo the last command and now use Smooth Controls | Stiff on the same selection of control points:



Stiff

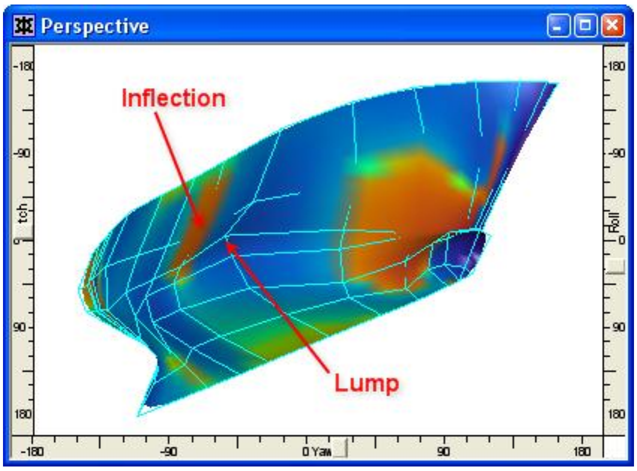
You notice that, especially when you smooth the control points to a Stiff curve, any irregularities in the curvature (eg inflections) disappear. Now let’s apply this to a patch of control points.

Smoothen Control Points – Procedures – Surface Patch

Smoothen a surface patch

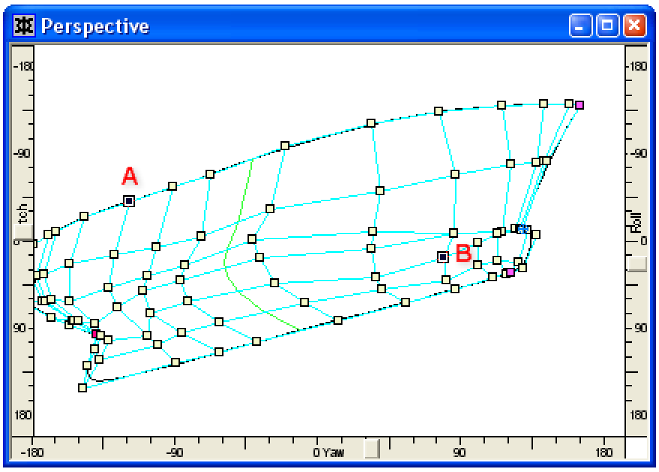
- Open the BasicFairing_FairingToolsSmoothStart.msd file in Perspective view

➢ **Switch on Longitudinal Curvature rendering**

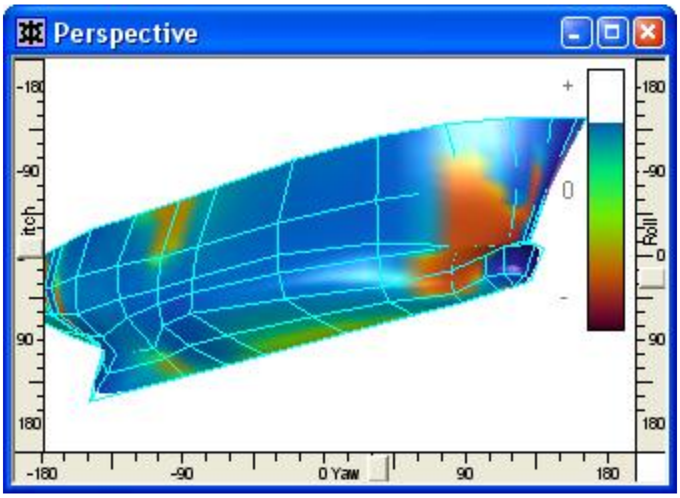


We will use the Smooth Controls command to fair this model.

➢ **Select a fairly large patch by selecting control points A and B as shows below:**



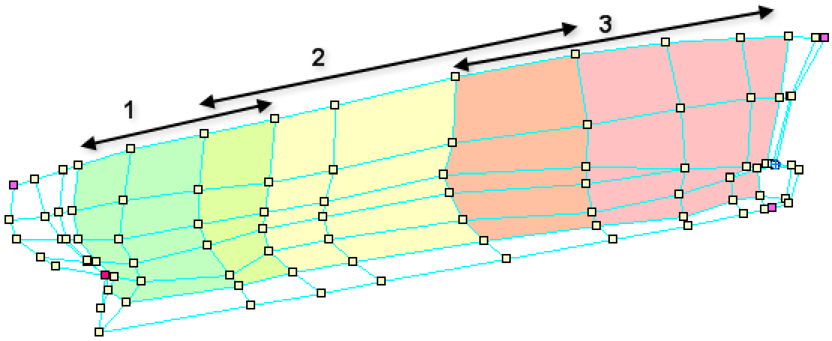
➢ **Use a Smooth Controls | Medium and render the model:**



Longitudinal curvature rendering after a smooth control points

It is very difficult to explain and/or learn how the smooth control points command works. Best way to learn about this command is by trial and error; aided by the following tips:

- **The larger the number of control points in the selection the better**
- **Use medium first and evaluate the result. Use Stiff in case you need more drastic correction or use Flexible if Medium changed the model too much.**
- **Stiff, Medium and Flexible may give the same result depending on the surface stiffness and the number of selected control points.**
- **You cannot use the smooth command on a selection with only 3 control points**
- **Good results can be obtained by using overlapping patches:**



This is an example only, individual patches would have to be bigger for good results

- **Switching between smoothing just one row or column and smoothing a patch can give good results**
- **Best results can be achieved when all of the above is used in combination with manual control point movements.**

Exercise:

- **With the model from this section, experiment using the Smooth Control Points command.**
- **Use what you have learnt so far to fair your design that you created yourself "from scratch" earlier on in this training manual.**

Continue reading the Control point net & surface stiffness guidelines section.

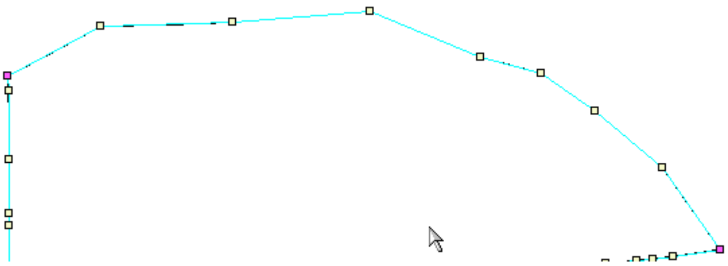
Control point net & surface stiffness guidelines

From what we have learnt in the prior sections we can extract a few fairing guidelines. These are outlined in the following paragraphs.

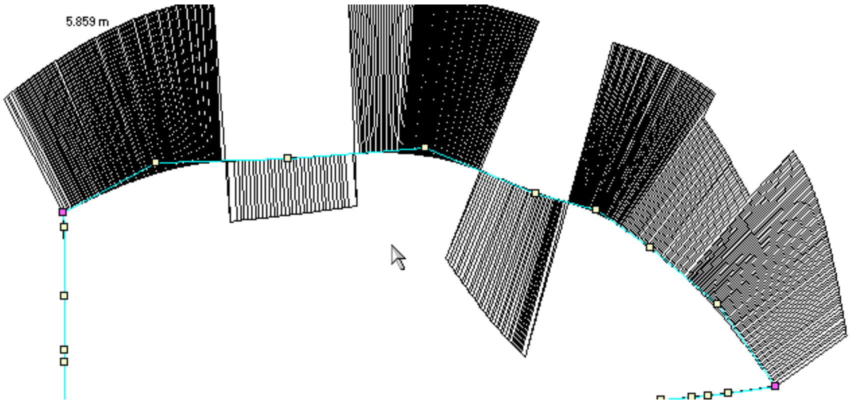
Start with reading Surface stiffness guidelines.

Surface stiffness guidelines

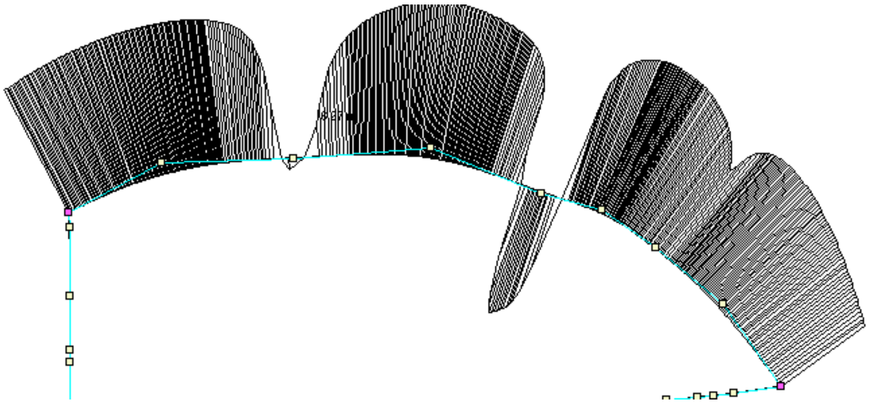
As has been demonstrated in the Surface Stiffness tutorial, the spline stiffness (or order) has a considerable effect on the surface's curvature. Ideally you should have reasonable curvature continuity and smoothness along the contours. The curvature can be made smoother by increasing the stiffness. This is illustrated in the images below:



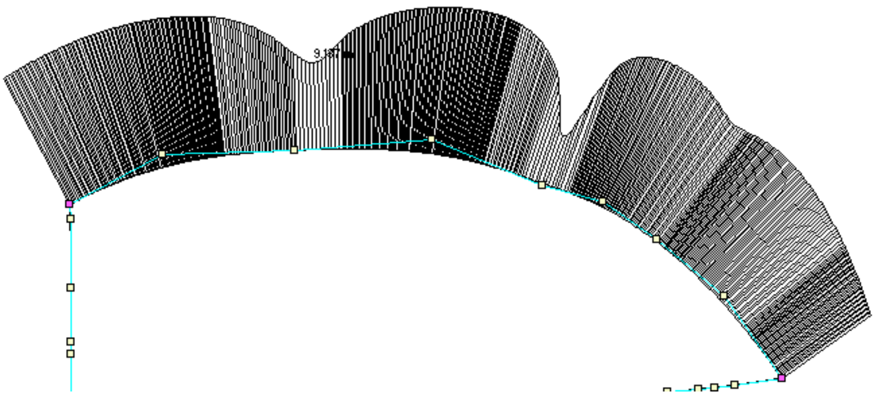
Stiffness = 2 (linear): Continuous position, discrete slope, zero curvature.



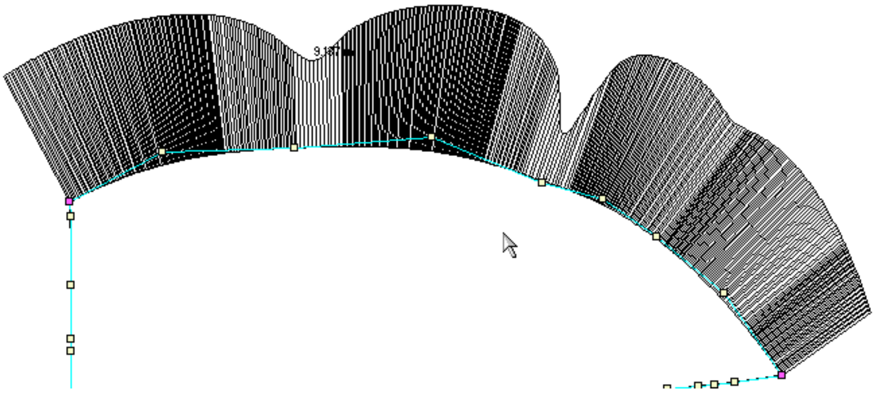
Stiffness = 3 (Flexible): Continuous position and slope, discrete curvature.



Stiffness = 4: Continuous position, slope and curvature, discrete change of curvature.



Stiffness = 5: Continuous position, slope, curvature and change of curvature.



Stiffness = 6 (Stiff): Smoothest curvature plot, surface is continuous to 4th derivative.

Because ships generally have more curvature in transversely than longitudinally, the longitudinal stiffness can be higher than the transverse stiffness. Experience shows that good models usually use longitudinal stiffness 4 – 6 and transverse stiffness 3 – 5, where unfair models use lower stiffness eg: longitudinal 3-4 and transverse 3.

Use the stiffest surface that allows you to achieve the desired shape.

Continue reading Number of control points.

Number of control points

The number of control points along a spline determines the amount of control you have over the surface shape. In the same way that the spline's numerical stiffness reflects the stiffness of the physical fairing rod, the number of control points is equivalent in a physical sense with the number of weights that are used to hold the rod in place. The more weights you use in one particular area of the rod, the more control you have over its shape. At the same time it is much more difficult to achieve a smooth curve without any unintended inflections in areas with a lot of weights.

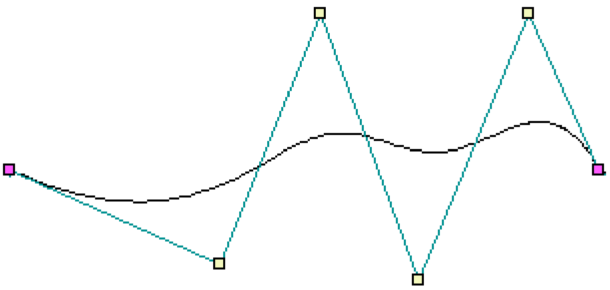
Use the minimum number of control points that allows you to achieve a desired shape.

Continue reading Fair Net Equals Fair Surface.

Fair Net Equals Fair Surface

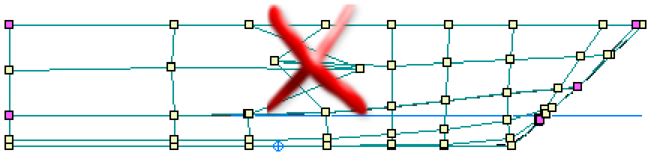
When looking at the control point net in perspective view and rotating the model, one can immediately recognise a fair design. There are some important guidelines to keep in mind when modelling a surface regarding control point net fairness:

1. You should always aim to have a regular and "fair" net. The net amplifies errors in the surface; the surface is always more fair than the net.

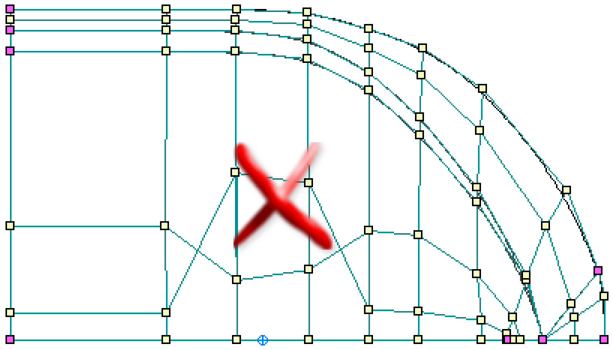


The advantage of using NURB surfaces in general is that even when the control points are very unfair, the resulting surface is always fairer; especially for high stiffness surfaces.

2. The rows and columns should not overlap as this makes further fairing of the surface much more difficult.

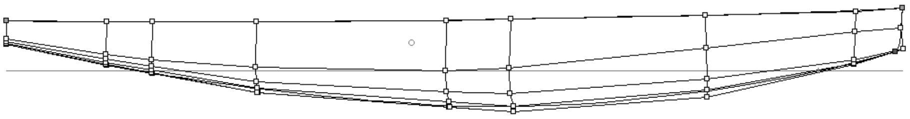


Overlapping rows in profile view

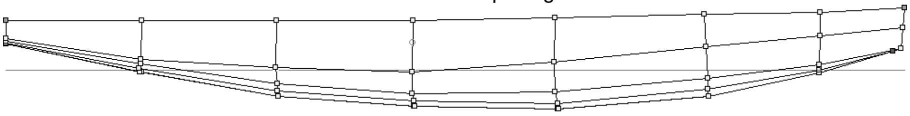


Overlapping columns in plan view

3. One area that is often overlooked when using Maxsurf to design a hull is the longitudinal spacing of the columns in the net. It is possible to create hard corners in Maxsurf by moving several control points close together and this characteristic is commonly used to create chines and knuckles in a design. A side effect of this is that if the columns of control points in a design are irregularly spaced the surface can show irregular rates of change of curvature. In general, try to make sure that the columns of control points in a surface change their spacing smoothly.

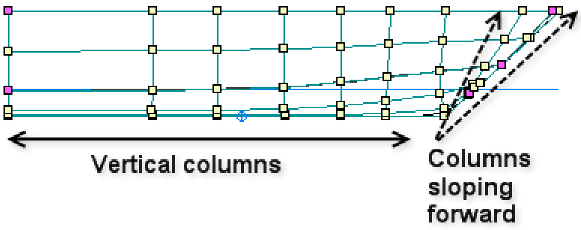


Poor column spacing

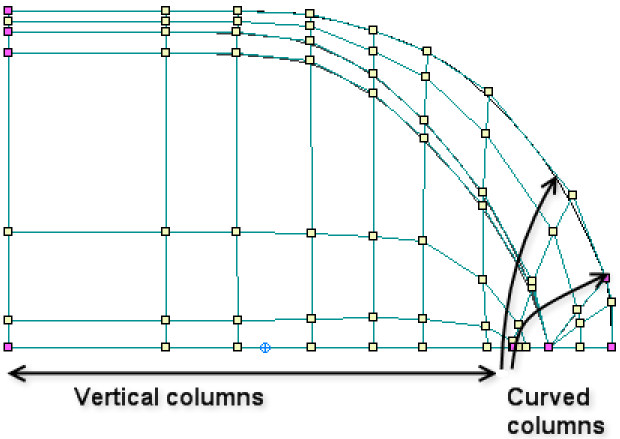


Good column spacing

4. It is helpful if the rows and columns are near orthogonal, it is especially beneficial to try to keep the columns as vertical as possible since this makes manipulation in the body plan view much simpler.



Recommended control point net in Profile view



Recommended control point net in Plan view. Often it can be recommended for the curved columns to be approximately orthogonal to the centreline as well as to the outer surface edge.

Note that these are guides only and should not be considered rigid constraints (except that the net should be reasonably regular, and rows and columns should not cross other rows or columns, though they may become compacted).

Finally, continue reading the Basic Fairing Summary section.

Basic Fairing Summary

An understanding of the historical background to surface fairing can help you produce fair surfaces in Maxsurf.

Maxsurf has tools to visualise (un)fairness:

- **Curvature porcupines, curvature on one or more curves**
- **Compress, especially useful for long slender hulls**
- **Rendering, longitudinal and transverse surface curvature**

Fairing is mostly a manual process and Maxsurf has tools to help you do that:

- **Straighten**
- **Smooth**
- **More… these are discussed not discussed in this training manual.**

There are several modelling guidelines that will help you achieve a fairer design. Most importantly:

- **Use the stiffest surface and the minimum number of control points that allows you to achieve the desired shape.**
- **The surface is always fairer than the control point net, so make sure your control point net is nice and regularly and fair.**

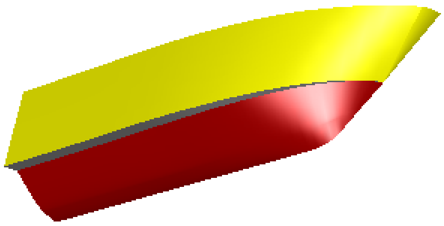
You have completed the chapter about fairing. Next you will learn about Chapter 7 Modelling Discontinuities.

Chapter 7 Modelling Discontinuities

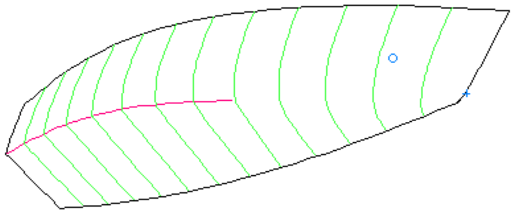
In the previous section you learnt how to use several fairing tools that help you display and adjust the shape of curves or surfaces and reduce any unwanted inflections, bumps or unwanted discontinuities. In this section we will look at ways to purposely model modelling discontinuities in a curve or surface.

One can distinguish different types of discontinuities that can exist in a ship's hull surface:

Knuckle or chine

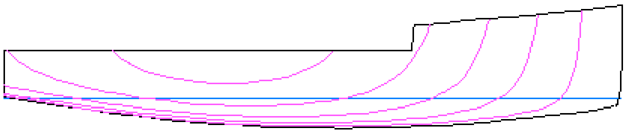


A chine that runs along the **full length** of the ship



A knuckle running along **part of the length** of the vessel

Deck edge discontinuities



A step up in the deck edge to create a forecastle

Interior surface discontinuities (openings)

An opening in the surface creates a bow thruster.

For each type of discontinuity there are different modelling methods that you can use:

- **Compacting control points**
- **Bonding, we will discuss this later but it is basically stitching the surface edges together.**
- **Trimming, also discussed later but can best be described as a feature where you use one surface to cut a portion out of another surface.**

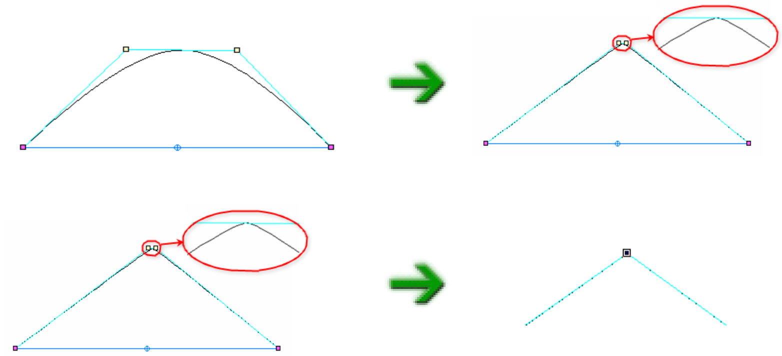
Discontinuity type	Method		
	Compacted Control Points	Bonding	Trimming
Chines & knuckles	✓	✓	Not recommended
Edge cuts	Not recommended	✗	✓
Openings	✗	✗	✓

Go to the section on Compacting Control Points.

Compacting Control Points

Compacting Control Points - Concepts

As you may have already learnt in the previous sections in this training manual, the closer you move control points together the more rapid the change in curvature. A discontinuity in a curve or surface can be modelled using this principle: when certain conditions are satisfied, a knuckle can be created by moving two control points on top of each other:



In this section you will learn how to use compacted control points to model chines or knuckles in a surface and what conditions have to be satisfied in order to be able to do this.

Compacting Control Points – Video

This video shows how a knuckle can be created in a curve by compacting control points. This video also shows the advantage of grouping compacted control points together. [Web | Disk]

Compacting Control Points – Procedures

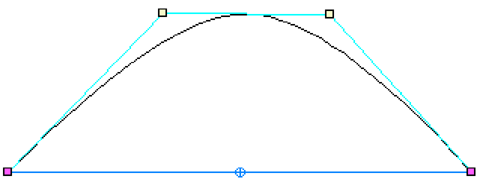
Compacting Control Points on a spline or curve

First we will use a simple spline to illustrate the effect of compacting control points.

➢ **Open the CompactCP_Curve_Start.msd design in the Profile window**

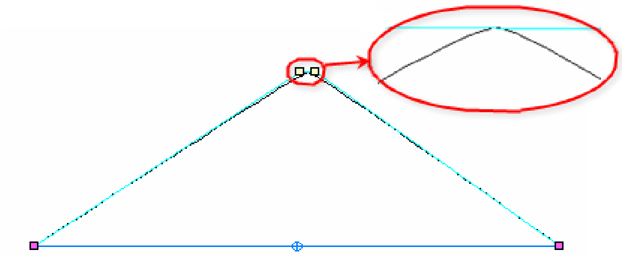
- **Switch Data | Precision to highest.**

You should see something like below:



- **Move the two middle control points closer together and watch what happens to the shape of the curve.**

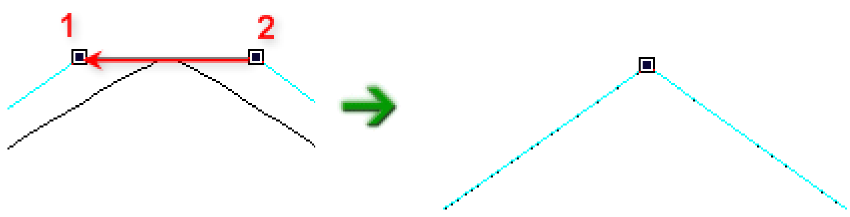
Tip:
Hold down the shift key while dragging. This will restrict the control point movement to move only horizontally or vertically.



From this you can see that where the control points are close together a knuckle is forming, but when you zoom in to that point it is still a smooth transition. Note that where the curve touches the control point net, both lines are tangential to each other. Let's see what happens when you now put the control points directly on top of each other.

- **From the two control points in the middle select the one on the left first and then the one on the right while holding shift key down.**
- **Now use the Controls | Compact command (or use the Ctrl+K shortcut key on your keyboard)**

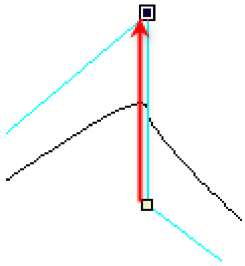
You should see the control point on the right being moved on top of the one on the left.



The control point that is selected 2nd will move on top of the control point that was selected 1st.

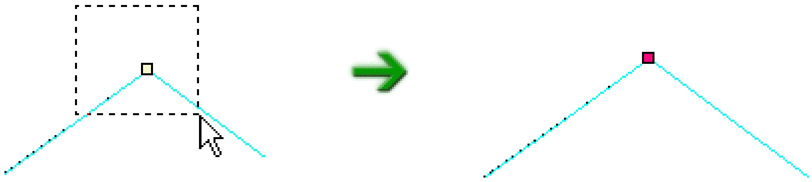
- **Click anywhere in the screen to clear the current selection.**
- **Select the compacted control point by left clicking on it (don't use a selection box)**

- **Drag it upwards**



Notice that the compacted control points –while they shared the same coordinates - are still being treated as individual points. Often it is convenient to group a number of compacted control points so that they get treated as one entity or group. In Maxsurf you can group control points using the Group command:

- **Using Ctrl+Z, undo the drag move until both control points are compacted again.**
- **Now use a selection box to select both points**
- **And use Controls | Group or Ctrl + G to group the control points**



- **Now try to drag just one control point (you won't be able to).**

You'll notice that the control points are now treated as one and cannot be moved separately anymore. You notice that the colour of the control points has changed to red.

Tip:
Ctrl + K = Compact control points Ctrl + G = Grouping control points

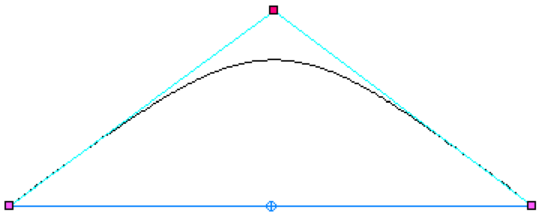
Compacting Control Points – Procedures – Over Compacting

Over Compacting

When using compacted control points to model a discontinuity, there is a very important relationship between compacted control points and surface stiffness.

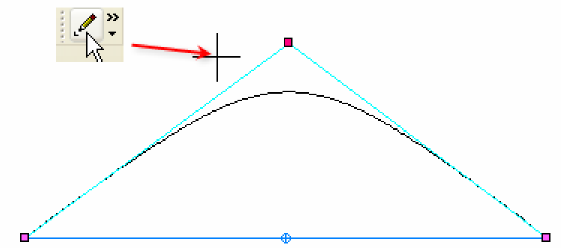
- **Use the curve from the previous steps or the CompactCP_Curve_Compacted.msd model**
- **Set Longitudinal curvature from the surface properties for this curve to 4.**

You will now see something like this in Profile view:



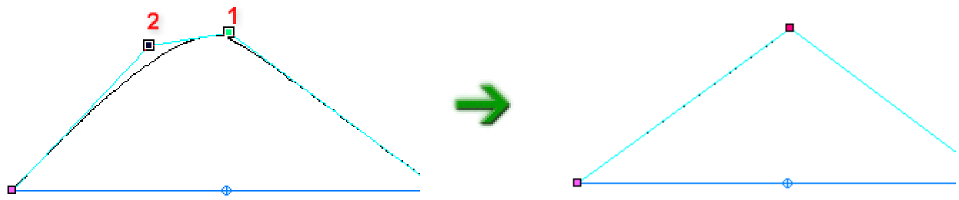
The knuckle in the curve has disappeared after increasing the stiffness to 4.

- **Insert a control point just to the left of the grouped control points (red).**



You'll see that this situation is very similar to the situation before where the curve is tangential to the control point net where they touch.

- **Select the grouped control points first followed by the newly inserted control point while holding shift key down**
- **Ctrl + K and Ctrl + G to compact and group**



You have now compacted 3 control points on top of each other to create a knuckle in the curve with a stiffness of 4.

To create a knuckle you need to compact (n-1) control points where n = surface stiffness.

Never compact more control points than (n-1).

For more information on compacted control points, see the Compacted control points section in the Maxsurf manual.

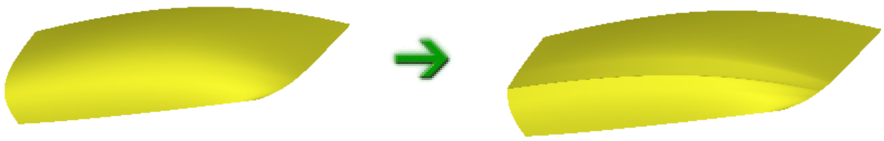
Compacting Control Points – Video

View a video that shows how to model a chine or knuckle line in a surface by compacting control points. [Web | Disk]

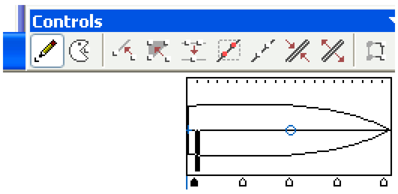
Compacted Control Points – Procedures – Model a Chine

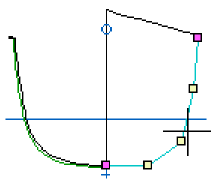
Using Compacted Control Points to Model a Chine

You are now ready to use compacted control points on the design created in the "Starting a Design from Scratch" section of this training manual and transform it from a round bilge into a chined hull design.

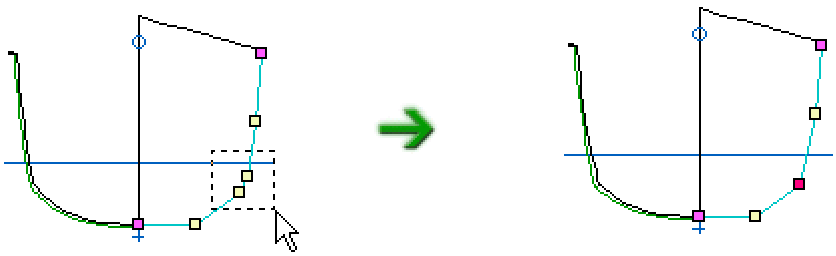


- Open the MyFirstDesign.msd file
- Save it as… MyFirstDesign_knuckle.msd
- To make it easier to model a knuckle, reduce the transverse surface stiffness to 3 (this way you only have to compact 2 control points).
- Switch to body plan view,
- Hide the net, Unlock the surface, Display | Half
- Use the Control box to switch to the aft most column of control points
- Insert a row control point in the position as displayed in the image below:

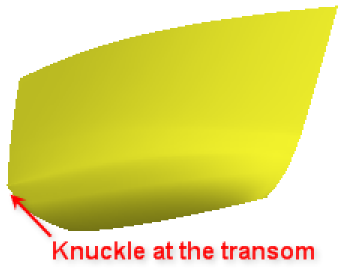




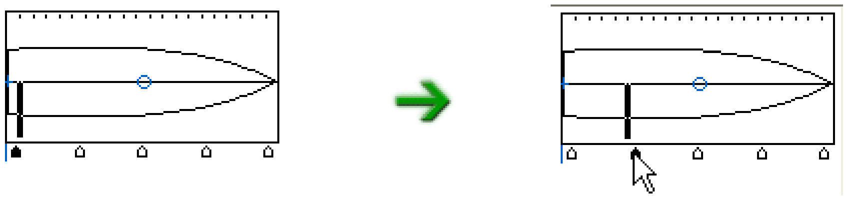
- Use a selection box to select the control points that are close together,
- Compact and Group the control points



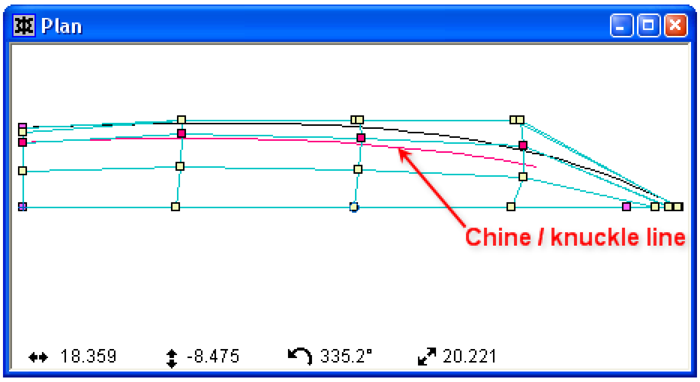
- Switch to Rendered Perspective view to check your work:



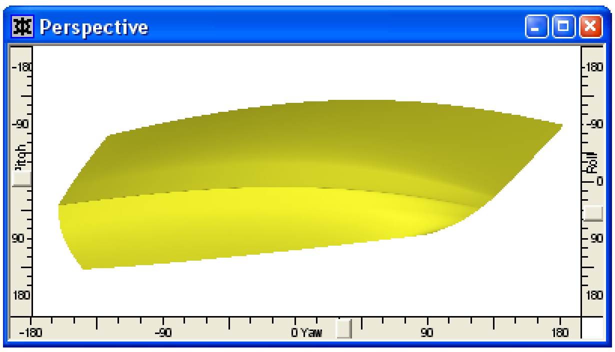
- Back in Body Plan view, use the control box to switch to the column in front of the Aft most column:



- Repeat the select → Compact → Group commands for all columns in the design except for the front most column (we don't want to create a knuckle in the bow profile).
- Switch to Plan view and show the Net,
- Display | Contours | Feature lines or use the  toolbar button to display the knuckle you have just introduced.

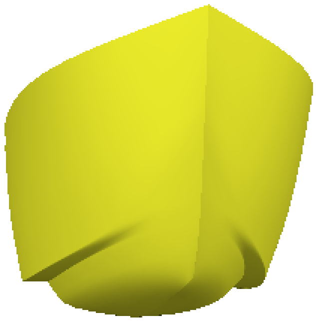


And in Perspective view:

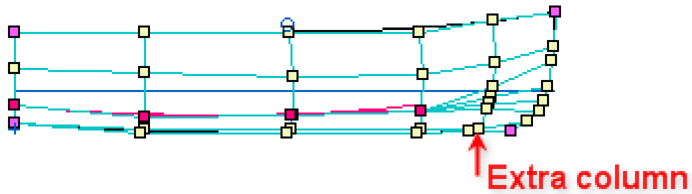


- Save your design as MyFirstDesign_Knuckle.msd

 Exercise: insert another knuckle line so that you get something like in the image below:



You will see that you have to add an additional 2 rows of control points. Having so many control points close together in the bow now, makes it quite difficult to maintain a reasonably fair bow area. Inserting an extra column in the bow may give you more control over this area:



This design is available for download as MyFirstDesign_DoubleKnuckle.msd

Continue with the section on Using Linear Surfaces to Model a Chine.

Using Linear Surfaces to Model a Chine

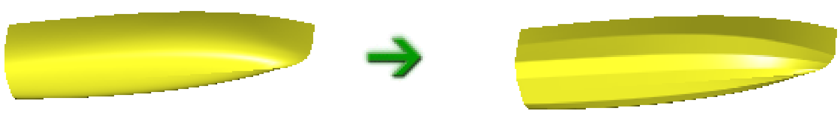
Linear Surfaces – Concepts

A surface is called linear when the stiffness value is 2.

As we have learnt in a previous section, you can create a knuckle by compacting (n-1) control points on top of each other when n is the surface stiffness in that direction. So for example when a surface has transverse stiffness 3, you only have to compact 2 rows of control points. Similarly, if the surface has a longitudinal stiffness of 4, you will need to compact 3 columns of control points. In this section you will quickly learn that when you have a linear surface (stiffness = 2) you do not need to compact any control points and the surface simply follows the shape of the control point rows and columns.

Linear Surfaces - Procedures

- **Open the MyFirstDesign.msd file**
- **Save it as MyFirstDesign_Linear.msd**
- **Switch the transverse stiffness of the hull surface to 2 (linear):**



Transverse stiffness 2 surfaces show feature lines (knuckles) at every row of control points.

- **Also switch the longitudinal stiffness to 2:**

Completely linear surfaces have knuckle lines at every row and column.

- **Save the design**

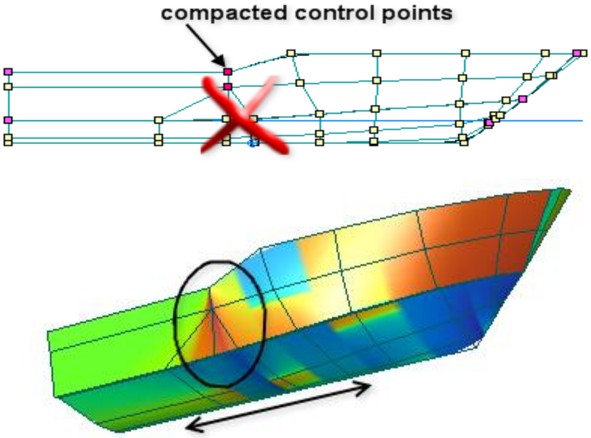
From this you can see that creating knuckles using linear surfaces is very easy. However, in practice this method is not used often. The reason for this is that a ship design usually consists of at least some areas with curvature which can not be achieved with linear surfaces.

Continue reading the section on When Not to Use Compacted Control Points.

When Not to Use Compacted Control Points

As mentioned at the start of this section on modelling discontinuities, there are different methods to model discontinuities dependent on which type of discontinuity you wish to achieve. We have seen that chines and knuckles can be created easily using compacted control points. In the section on bonding surfaces we will look into using bonding surfaces to create a knuckle or chine.

Do **not** use compacted control points to model a discontinuity in a surface edge. e.g. cut-away sheerline. You can end up with more control points than you really need which makes fairing very difficult or impossible.



Using compacted control points to model a discontinuity in an edge results in difficulties achieving a fair hullshape.

This concludes the chapter on modelling discontinuities. Next section is Chapter 8 Trimming Surfaces.

Chapter 8 Trimming Surfaces

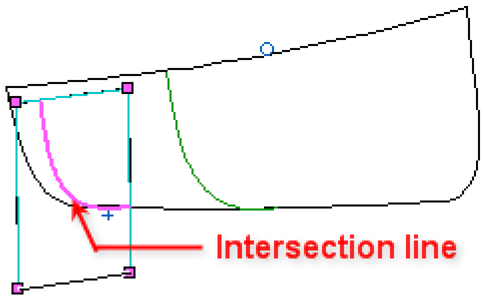
Up to this point we have worked with only one surface at the time. Maxsurf Pro allows you to insert any number of surfaces. Maxsurf Plus allows the use of up to 6 surfaces and Maxsurf/T allows 3 surfaces. By combining surfaces, complex models can be created.

Before you proceed and use trimming surfaces to make some more modifications to your design, read the section trimming surfaces from the Maxsurf manual. From this you should remember:

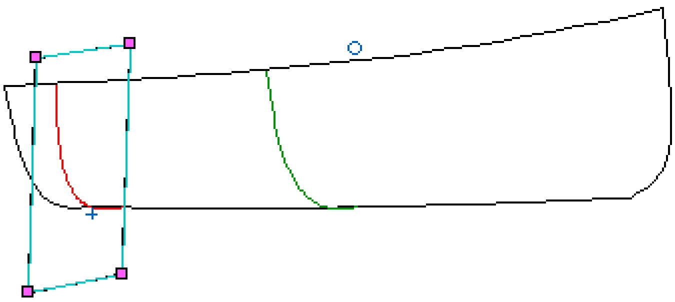
Trimming – Concepts – Trimming rule

Trimming Rule #1

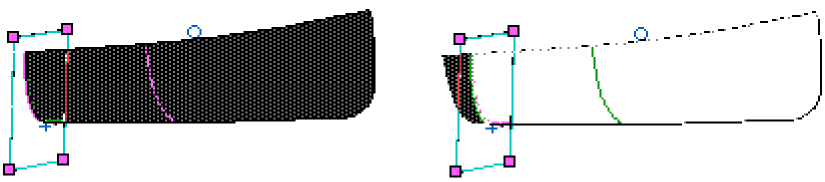
The trimming rules in the manual are very important. For this section of the training manual we will only highlight the importance of rule #1: closed intersection lines. In order to be able to trim a surface, the intersection line that divides the surface that you wish to trim up into separate regions has to be closed.



The intersection line does not go all the way up to the deck edge. The hull surface can therefore not be trimmed to this transverse surface….



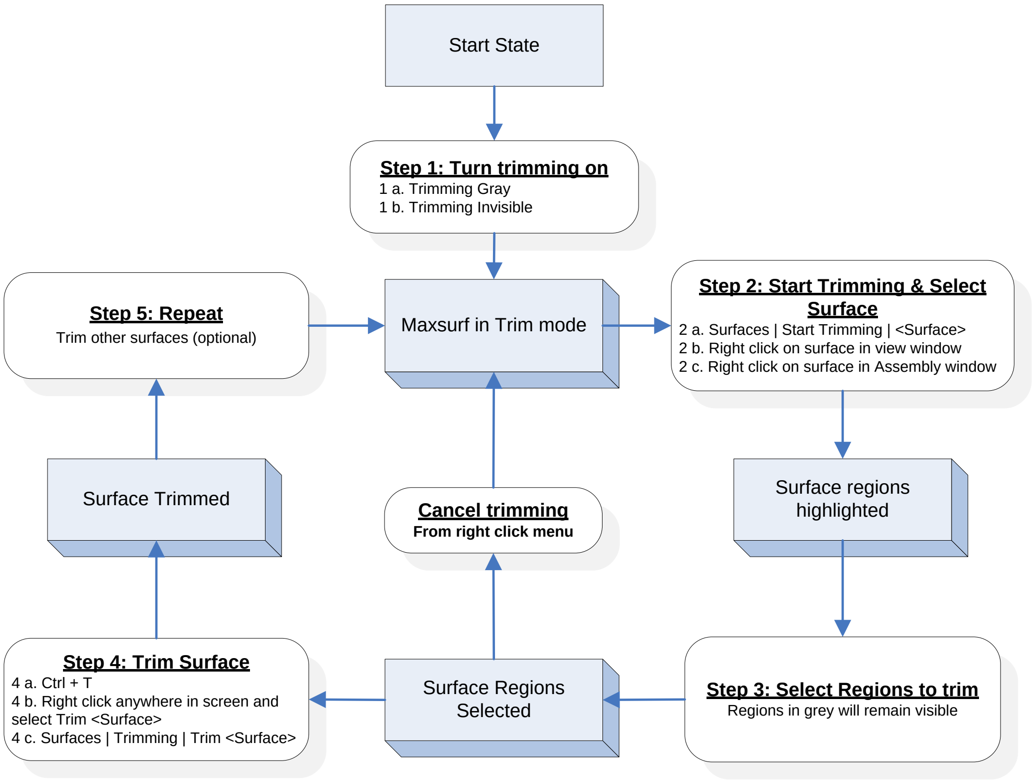
… whereas now the intersection line divides the hull up into two separate regions:



Trimming – Concepts – Trimming Sequence

Trimming Sequence

The following diagram is also useful to see again in this training manual:



Note

It is important to note that after doing step 2, you have to do steps 3 and Step 4 as well. Maxsurf will continue to ask you to select your regions and trim the surface until you finished Step 4.

Continue with the first application for trimming: Trimming a transom.

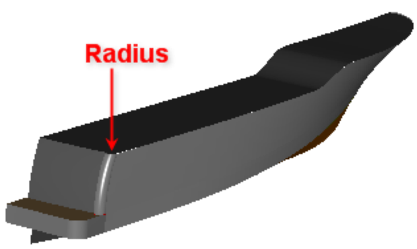
Trimming a transom

Trimming a transom – Concepts

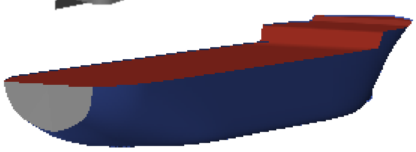
A transom can be added to a design in two ways.

- **Bond the transom to the hull**
- **Intersect the transom with the hull and trim the surfaces**

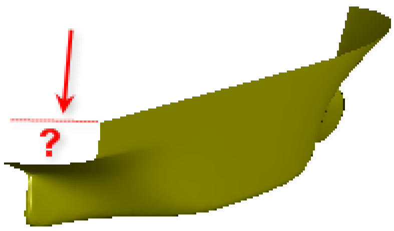
The recommended method is dependent on the shape of the transom and the transom-hull transition. For example:



The transom is blended into the hull with a fillet radius. In this case it is impossible to use trimming and you should use bonded surfaces.



The transom on this ship almost literally cuts off the hull. In these cases trimming is recommended.



In some of the sample designs supplied with the program, you will see examples of ships that have no transom at all. A model does not "need" a transom when:
- the model is used for hydrostatic calculations
- transom shape is planar
- transom orientation is vertical and orthogonal to the centreline.

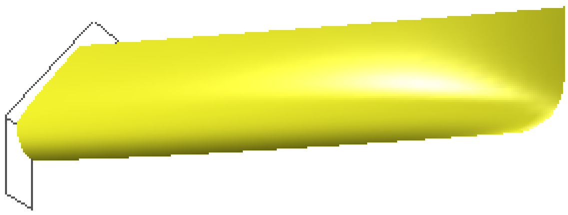
In general it is good practice to close the model completely (adding a transom and a deck to make it a "closed box").

Trimming a transom – Video

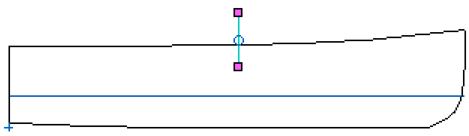
View a video that shows you the use of trimming after inserting a transom surface. This video also shows how the trimmed surfaces automatically update to changes in surface shape or position. [Web | Disk]

Trimming a transom – Procedures

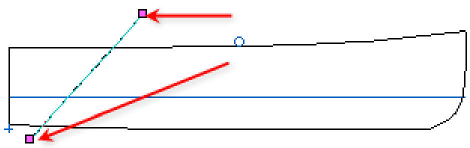
In this section you will insert a 2nd surface in your MyFirstDesign model and use that as a trimming surface to trim the hull to a transom.



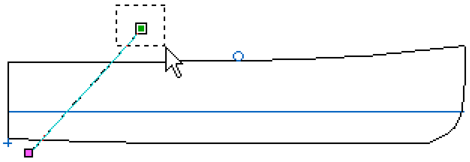
- **Open MyFirstDesign.msd and Save it as MyFirstDesign_TrimmingTransom.msd**
- **Lock the Hull surface**
- **In Profile view window, Insert a Section plane surface from Surfaces | Add Surface:**



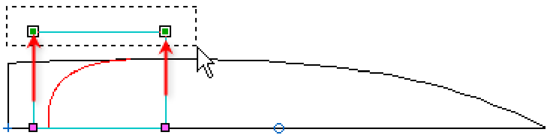
- **Change the name of the Transverse surface to "Transom"**
- **Show the Net, Hide all Contours except edges, and Display | Contours | Intersections or use the toolbar button**
- **Drag the control points to as displayed in the image below:**



You may have noticed that there are two corner control points directly behind each other in Profile view and thus they appear to be only one control point. Use the selection box to make sure you select both:

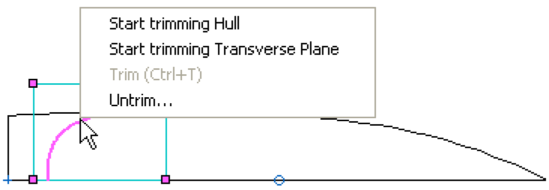


- **In Plan view, drag the outer column further outwards:**

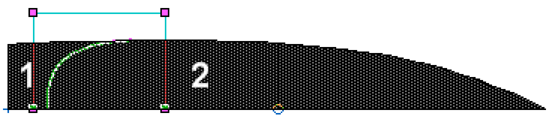


You can see the intersection line (red in the image above) dividing the hull into two separate regions. This means you are now ready to trim the hull. If you refer back to the Trimming – Concepts – Trimming Sequence
Trimming Sequence on page 117 you'll see the steps we have to take:

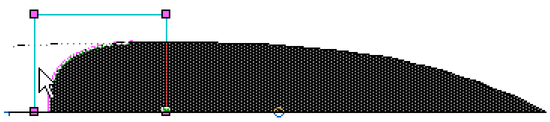
- **Step 1: Switch trimming on: Display | Trimming | Trim Invisible**
- **Step 2: Select the Surface to trim. There are several ways to do this, but the fastest way is probably by right clicking on the intersection line and select Start trimming Hull:**



This will highlight the currently visible (read: "untrimmed") regions of the selected surface. There are 2 regions separated by the Intersection line.

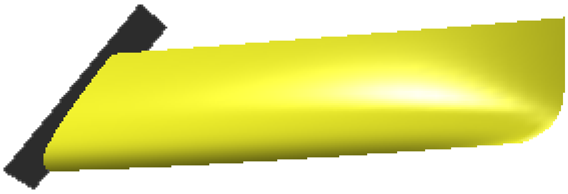


- **Step 3: Select trimming region: Click inside area 1. This will hide this area (read: "this will trim away this area").**



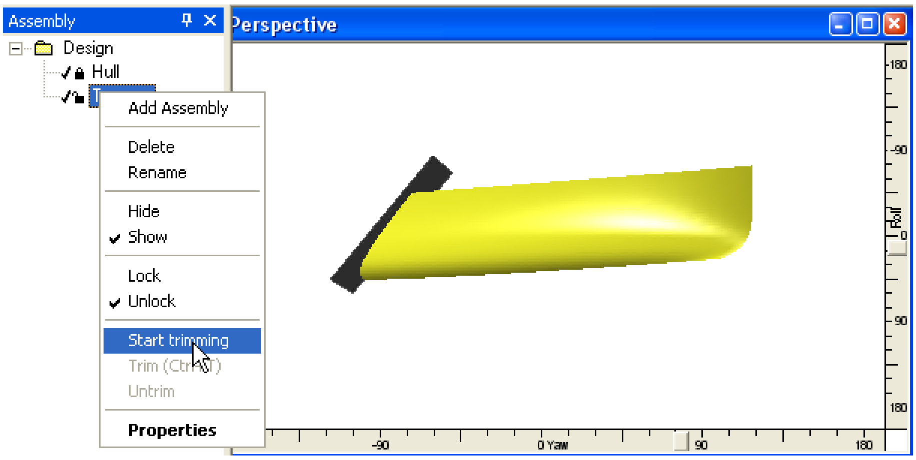
- **Step 4: Trim the Surface: There are also many different ways to do this step, but probably fastest is to either hit "Ctrl+T" on your keyboard or right click anywhere in the screen and select "Trim (Ctrl+T)".**

➢ **Switch to Rendered Perspective view to check your work:**



The transom is not making the model look very nice at the moment. You can trim away the surface completely:

➢ **This time Right click on the Transom surface in the Assembly tree and select "Start Trimming":**

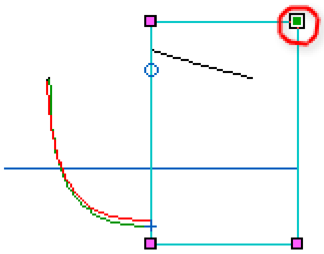


➢ **Go through steps 2, 3 and 4 to completely trim the Transom away.**

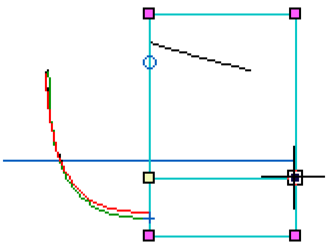
Note: You may have noticed that you could not select different regions on the transom. This is because the intersection line does not form an enclosed region. Trimming the Transom only "hides" the trimmed region of the Transom. The surface is still there and the trimming can be undone at any point.

Now let's make the shape of the transom a little bit more interesting:

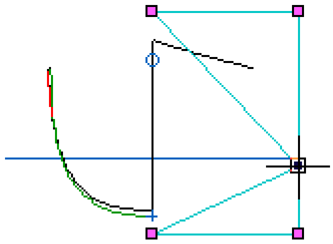
➢ **In Body Plan view select this control point:**



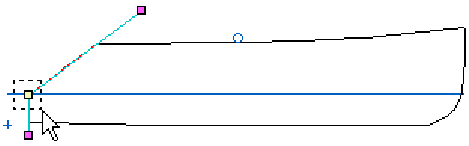
And then insert a Row of control points here:



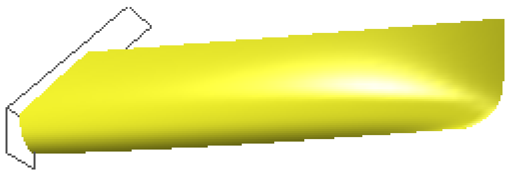
The reason for first selecting the control point in the Right Top corner is that otherwise you may get unexpected results when inserting this row such as:



- **Switch to Profile view and drag the control points backwards:**

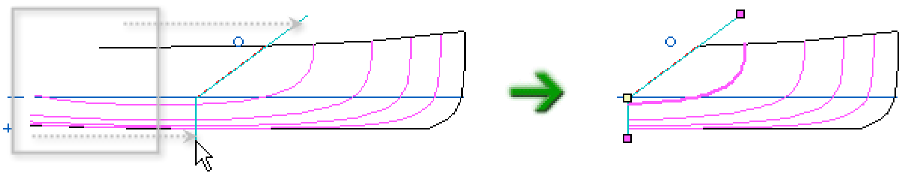


- **Check again in Perspective view:**



Notice that the shape of the trimmed hull has automatically been updated to the new shape of the Transom. As long as the intersection line between the surfaces remains intact (read: closing off the trimming regions) you can make changes to both the hull and the transom and the trimming will automatically update.

- **Try moving the Transom Fwd and Aft and check that the trimming is updated continuously. The best way to do this is probably in Profile view with Buttocks displayed.**



The advantage of using trimming is that you can fair the hull surface and model the shape of the transom completely independently. This gives you a great freedom of what shape you wish to make the transom. It does mean that you have to extend the hull aft of the transom. For example if you wish to model a 40 m yacht, you will have to model a hull of 41 m long and insert a transom surface 1 m fwd of the Aft Extremity of the hull.

Congratulations! You have performed your first trimming operation. In the next sections we will practice this some more by also inserting a deck surface and a bowthruster.

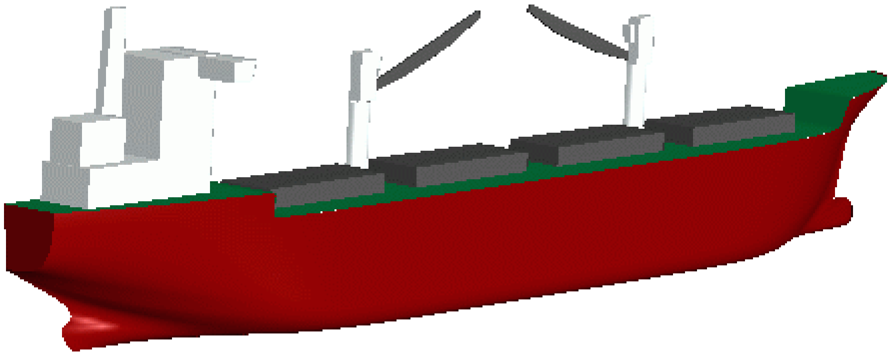
Continue with the next section Trimming a Deck and a Bowthruster.

Trimming a Deck and a Bowthruster

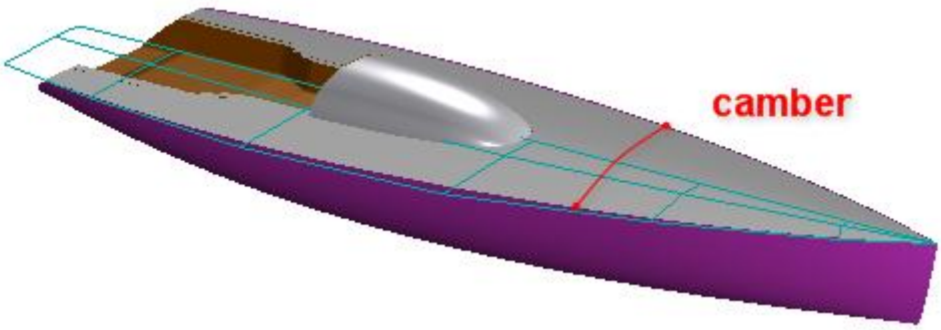
Trimming a deck – Concepts

Decks are very similar to transoms in that a deck also closes the hull. Usually in Maxsurf you do not want to model a fillet radius between a deck and the hull (that is unnecessary detail for hydrostatic calculations) and therefore a deck is added to a model using trimming in most cases.

One of the advantages of using trimming when adding a deck is that the deck can be shaped completely independently from the hull and have completely different properties (i.e. stiffness). If you were to use bonding the deck and the hull would have to share the same degree of stiffness in the longitudinal direction (you will learn this later). Some examples of a deck that has been added using trimming:

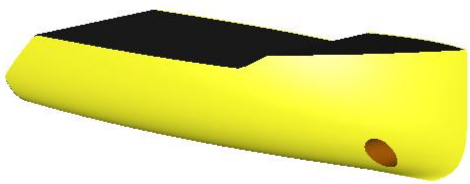


The deck of this bulker has several step ups at the poop deck and F'castle. Several hatch coamings, cranes and a superstructure have also been added and are also trimmed to the deck.



The deck of this sailing yacht has camber in transfers direction and has a cockpit opening trimmed out as well as a coachroof on top of it. All this is very easy to do with trimming.

In the previous section you learnt how to use trimming to trim the hull to a transom. In this section we will practice what you have learnt and insert a deck surface as well as bowthruster.

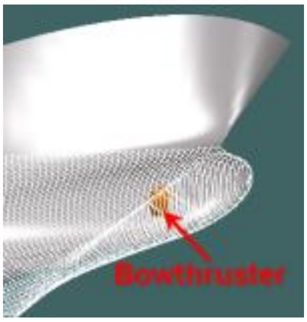


Trimming a bowthruster – Concepts

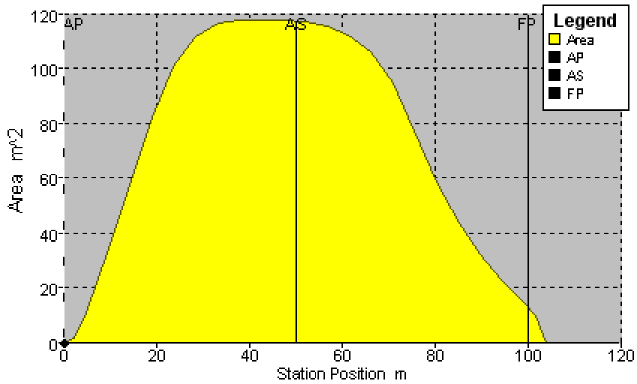
A bowthruster is a cylindrical opening in the hull. A bowthruster can be modelled for different reasons:

1. Realistic rendering or image of the design. Use highest precision to get best rendering results.

2. The production geometry. In particular the intersection line of the cylindrical bowthruster surface and the hull.
3. Hydrostatic volume of the hull. The volume of the bowthruster is not part of the buoyant volume of the hull. Hydrostatic calculation software, such as Hydromax, use transverse sections to calculate the volume of the hull. The volume of the bowthruster is calculated using the same transverse sections as for the hull. Since the hull is generally much bigger than the bowthruster and the spacing of the transverse sections is dependent on the length of the hull, the bowthruster volume can not always be calculated accurately because there are only a few sections intersecting the bow thruster.



200 transverse sections along the length of this Containership.
Only a few intersect the bowthruster.



The curve of areas only uses up to 36 transverse sections. The volume of the bowthruster can not be seen in the curve because none of those sections intersect the bowthruster.

When an accurate hydrostatic volume is required, it is recommended to model the bowthruster as a non-buoyant volume compartment in Hydromax rather than using trimming to create an opening in the hull.

In this section of the training document we will insert a cylindrical shape that consists of two half-cylinders. Then we will trim that to the hull and visa versa in order to get a produce a rendering of the hull.

Trimming a deck and bowthruster – Video

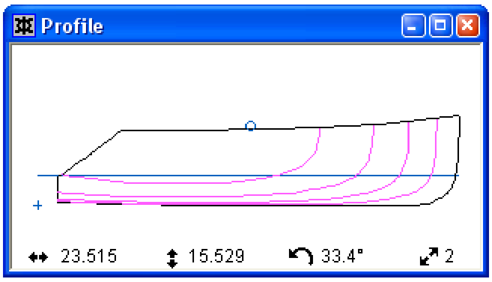
View a video that shows you how to quickly model a step in a deck surface, insert a bowthruster and use right click trimming. [Web | Disk]

Trimming a Deck – Procedures

- **Use the model from the previous section or open MyFirstDesign_TrimmingTransom.msd**
- **Save the model as MyFirstDesign_TrimmingComplete.msd**

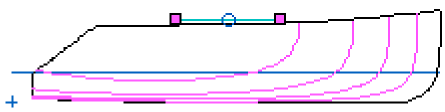
- **In Profile view, lock all surfaces, display Buttocks and switch trimming on (Display | Trimming | Trim Invisible).**

You should see something like this:

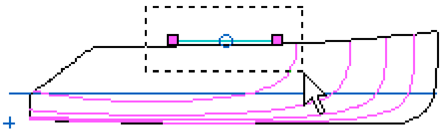


Start with adding a deck surface:

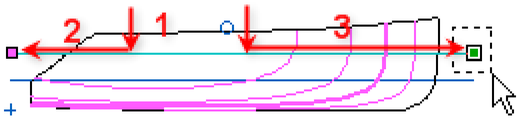
- **Surfaces | Add Surface | Waterplane**
- **Using the Assembly Pane (View | Assembly) rename the Waterplane → Deck**



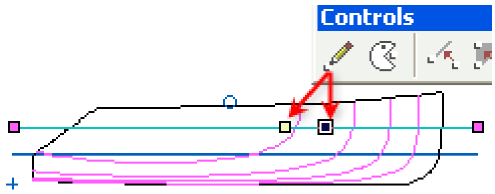
- **Use a Selection box and drag the control points down**



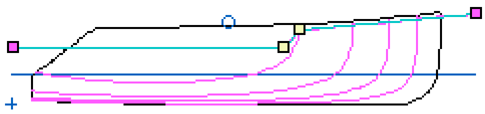
- **After dragging them down (1), Move the aft edge of the Deck well Aft of the transom (2) and extend the fwd edge of the Deck beyond the bow (3)**



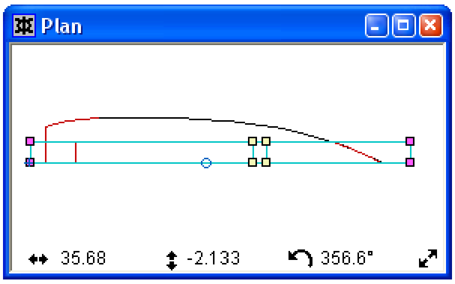
- **Insert two rows of control points**



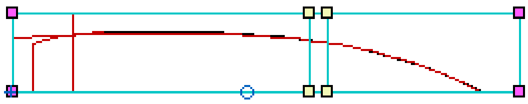
- **Model the Deck surface so that it looks like this. Keep using the Selection box every time you move the control points, else it will become a mess quickly!**



- **Display intersections**
- **Switch to Plan view:**



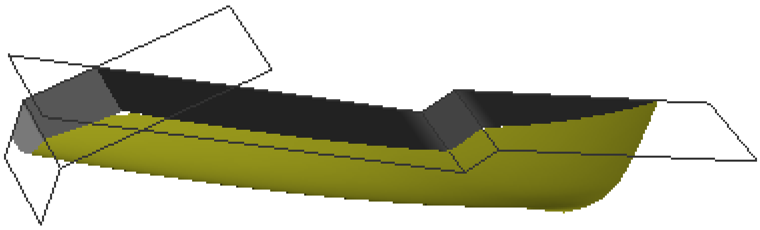
- **Drag the outer edge of the Deck surface well beyond the maximum beam of the hull. Tip: Use a selection box and hold the shift key down while dragging outwards so that the control points do not move fwd or aft unintended.**



Deck surface extended well beyond Hull surface to form a closed intersection.

You are now ready to trim the Deck surface to Hull and Transom, the Hull to the Deck and Transom, and the Transom to the Deck and Hull.

- **Use Plan view to trim the Deck**
- **Use Body Plan view to trim the transom**
- **Use Profile view to trim the hull**
- **Use Perspective view to check your work:**

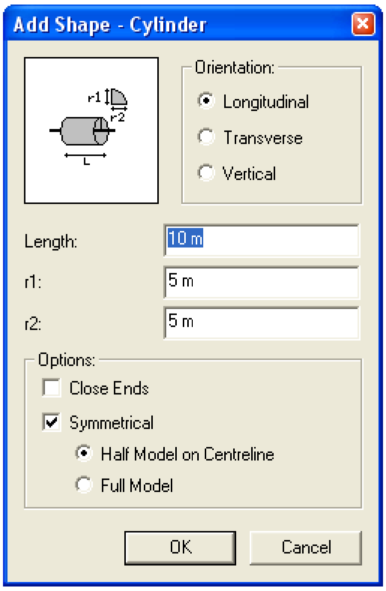


The black lines along the edges of the Transom and Deck become visible when the surfaces are unlocked.

- **Save your design**

Trimming a Bowthruster – Procedures

We are going to insert a cylindrical bowthruster with a 1m radius (not very realistic, but makes it more visible) and then trim the hull to the bowthruster and visa versa. Rather than creating a cylindrical surface ourselves, we'll use the inbuilt shapes generator in Maxsurf:

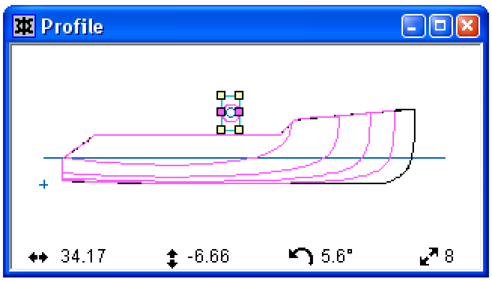


This dialog automatically generates a cylindrical shape of any size in any orientation.

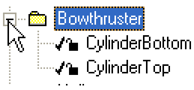
- **Lock all surfaces, Hide intersections**
- **Surfaces | Add Shape | Cylinder**

This brings up the dialog above.

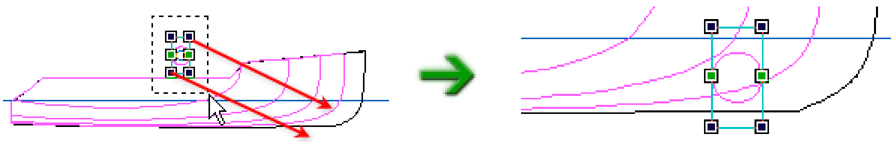
- **Set the Orientation to Transverse, specify a 6 m length, a 1m radius and tick the Symmetrical half model on Centreline model option. You do not need to close the ends of the bowthruster.**
- **Click OK**



- **In the Assembly Pane, rename the assembly called "Transverse Cylinder" → "Bowthruster".**
- **Open the Bowthruster assembly folder and notice that there are 2 surfaces in there:**

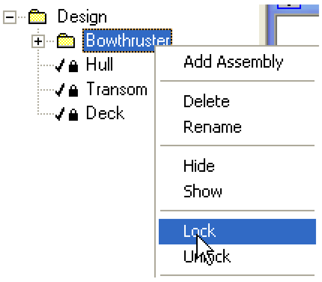


- **Making sure you have the Net displayed and using a selection box, drag all control points to the bowthruster position (use your own creativity, but preferably below the waterline).**



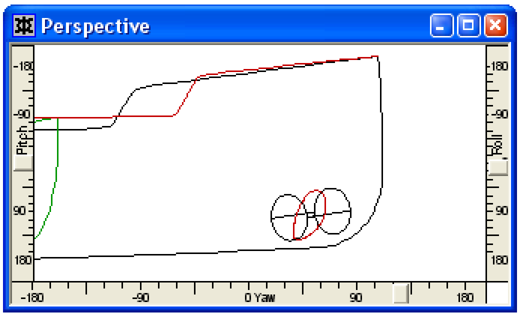
We'll now use perspective view to trim both surfaces to each other:

- **Switch to Perspective view, rendering off, hide buttocks, display intersections**
- **Lock the Bowthruster assembly using a right click command:**

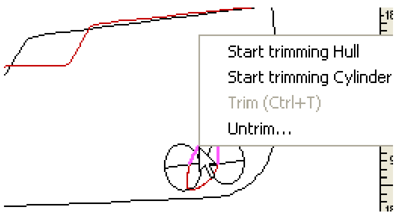


The Assembly tree allows you to lock groups of surfaces.

- **In Perspective window, zoom in to the bow and rotate your model so that you can clearly see the intersection line and the bowthruster surface edges:**

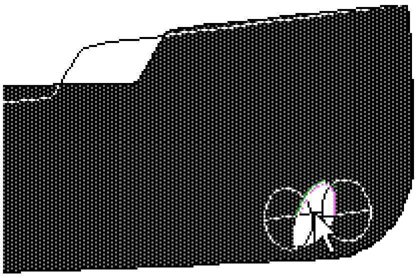


- **Now select the Hull-Bowthruster intersection line with your left mouse button and then use right click trimming on the Intersection line:**



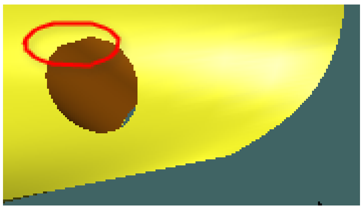
Right clicking on the intersection line is a quick way to trim both surfaces

- **Trim the Hull, the Cylinder Top and the Cylinder bottom surface**



Trimming the hull by clicking inside the Intersection region with the bowthruster

When you are done trimming, your model should finally look like this in Rendered Perspective view:



You may notice some rectangular rendering around the cylindrical opening. This is purely a rendering/drawing artefact and nothing to worry about; it will not influence any calculations.

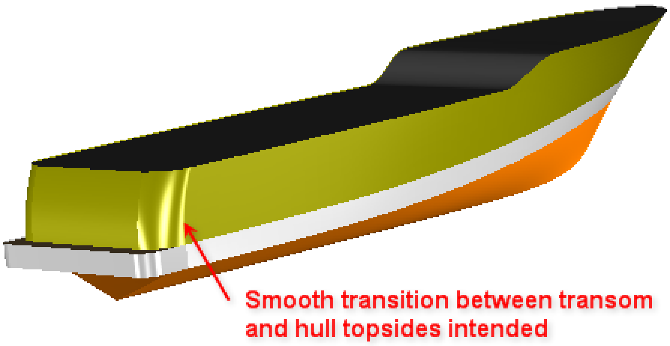
- **Switch to highest precision to improve the quality of the rendering.**
- **Save your design as MyFirstDesign_TrimmingComplete.msd**

Finished!

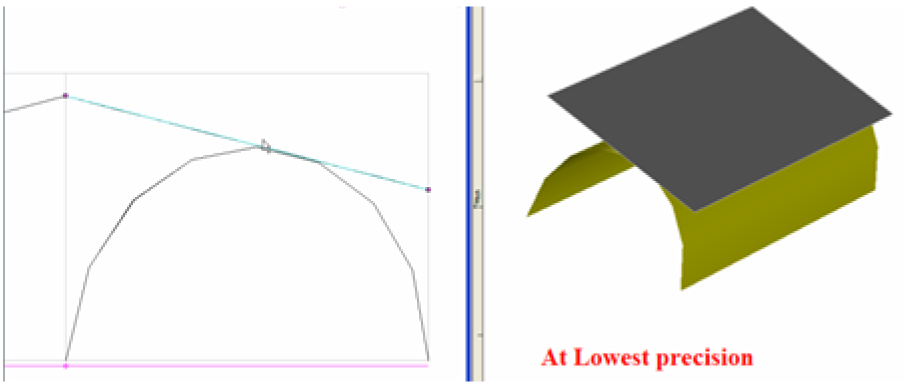
Continue with the section on When Not to Use Trimming.

When Not to Use Trimming

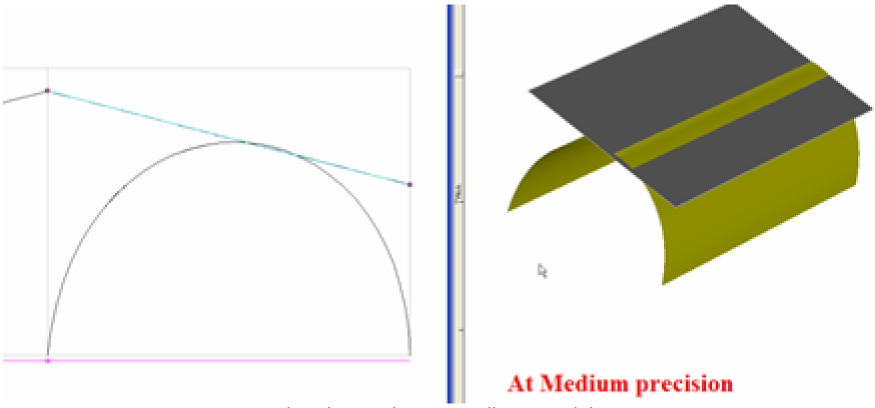
Try to avoid using trimming for a transom that has to blend in with the hull:



What happens when you do try to this is that you get a “shallow intersection” between the hull and transom surface which usually means that the intersection line changes shape rapidly or is even broken when a small change to any of the surfaces is made. It may also cause problems when you switch to a higher precision and the intersection line is calculated differently:



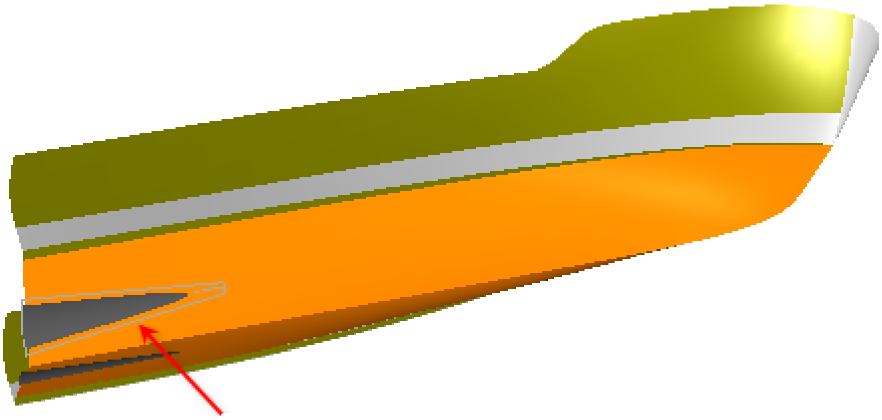
No trimming region at lowest precision



Trimming region at medium precision

Use bonding for these cases instead.

The only case where you cannot avoid using a shallow intersection trimming surface is when you want to model a propeller tunnel:

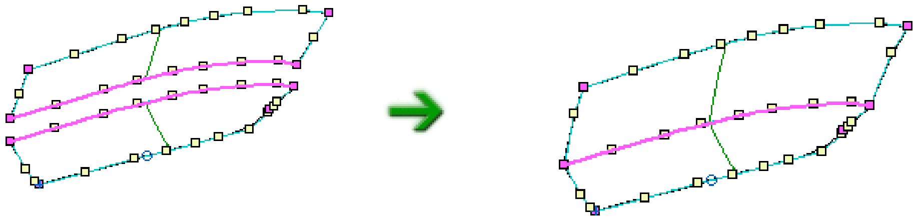

You need the shallow intersection for minimum disturbance of the water flow towards the propellers.

This is very difficult to model properly because it is difficult to get the shape of intersection line right and often the trimming fails when switching between different precisions. How to do this is not covered in the LearningMaxsurf training manual.

You have learnt all the basics about trimming and can now continue to the section on Chapter 9 Bonded Surfaces.

Chapter 9 Bonded Surfaces

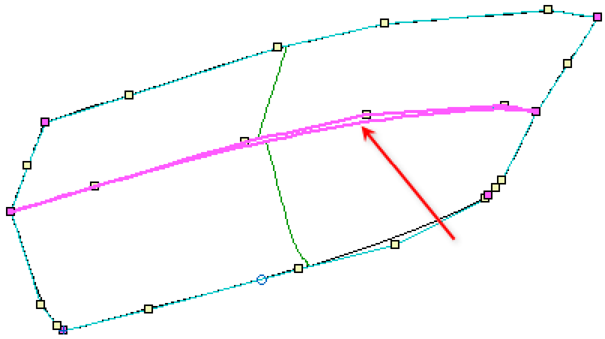
Maxsurf allows you to bonding two surfaces together. Surface bonding can be seen as gluing two identical edges together.



In order to get two identical edges, both edges need to have:

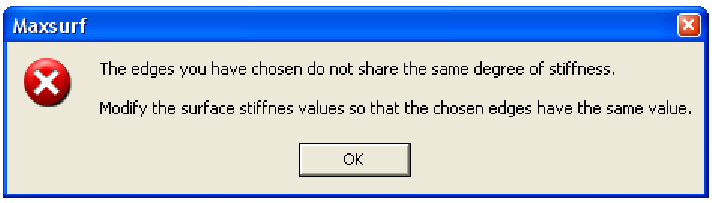
- **The same number of control points**
- **The same degree of stiffness**

If either of the above is different, then both edges can by definition not have the same shape which would result in gaps between the surfaces.

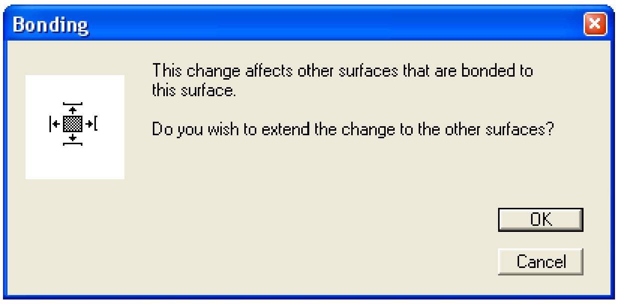


Two edges with matching control points, but different stiffness. This causes gaps to appear between the surfaces.

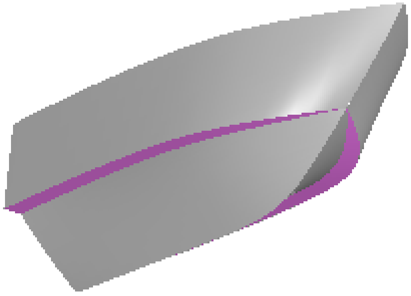
Maxsurf checks that both edges have the same stiffness and number of control points prior to bonding and will notify you if the edges cannot be bonded together:



After you have bonded two surfaces, Maxsurf will make sure that the surfaces that share the bonded edge are treated more or less as one and apply any changes to one surface to the other bonded surface as well. For example when adding a control point to the edge:



In this section you will bond several surfaces together and learn about the different bonding types you can apply. You will also learn that the duplicate surfaces command is a quick way to ensure that both surface edges share the same properties.



Continue with the section Designing a Simple Multi-Chine Hull using Bonding.

Designing a Simple Multi-Chine Hull using Bonding

Multi-Chine design – Concepts

A multi-chine hull may consist of for example topsides, spray rail and a bottom panel. The properties of these panels can be very different. For example: where the spray rail can be a linear panel (zero curvature transversely), the topsides and bottom may have some curvature. Especially when the design is built out of aluminium or steel and all panels will have to be expanded into flat plate stock for cut production geometry, it is therefore often a good idea to use separate surfaces for each panel. Bonding is used to weld or glue the panel (read: surface) edges together.

Multi-Chine design – Video

Watch a video shows the procedure of bonding two surface edges and shows what happens when you try to bond two edges without matching stiffness. This video also shows how to use the Duplicate Surfaces command to ensure that both surface edges share the same properties. [Web | Disk]

Multi-Chine design – Procedures - Start

Start

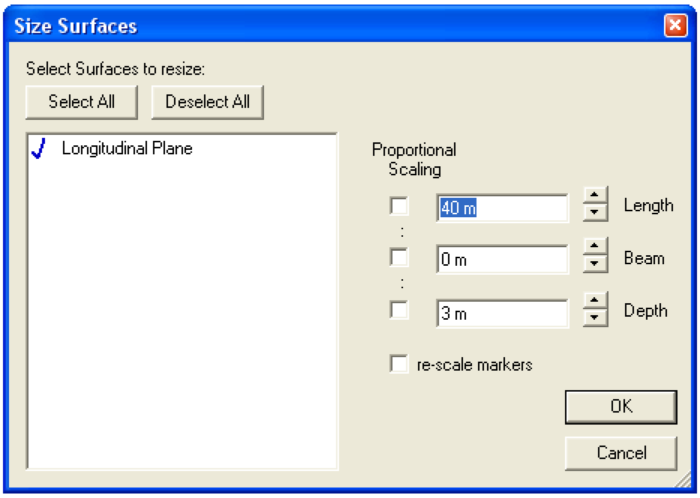
In this section we will again start a design from scratch. If you have an existing design open, you will have to close it first.

- **Select File | New Design.**

We will start by inserting a flat, longitudinal plane which will become the Topsides surface:

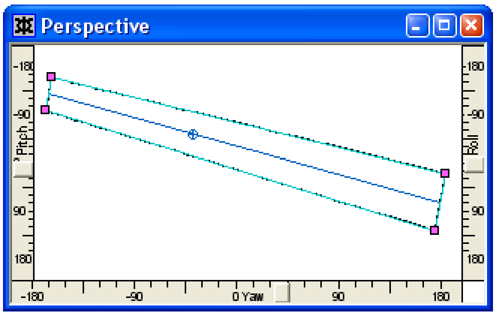
- **Surfaces | Add Surface | Buttock plane**

➢ **Resize the surface to have a length of 40 m and a depth of 3 m.**

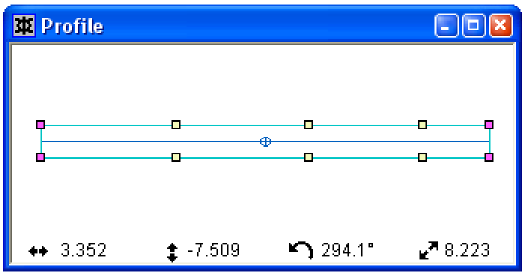


➢ **Save the design as Bonding_Start.msd.**

The surface should look like this in the perspective window:



➢ **In the Profile window add 3 control point columns. Try to distribute the columns as in the image below:**



Control point distribution with increasing density towards the right (which will become the bow).

➢ **In the Surface Properties dialog, name the surface "Topsides" and set the longitudinal flexibility to 4.**

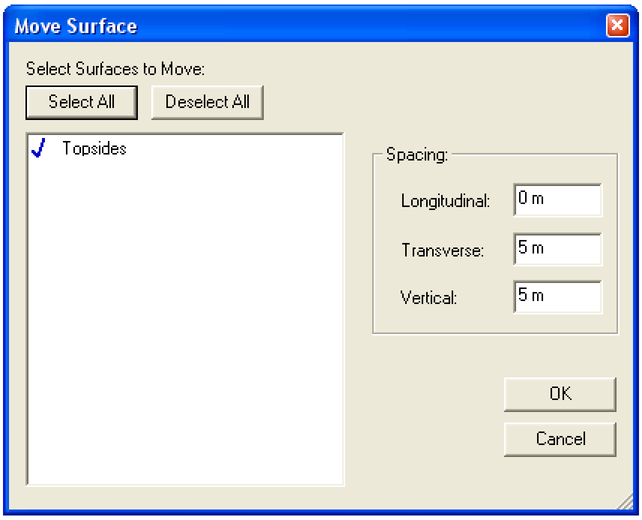
Remember that there are several ways to get to the Surface Properties:

- **Surfaces | Surface Properties …**
- **Double click on the surface in the Assembly Pane**
- **Using the right click menu from the Assembly Pane**
- **The Properties Pane**

➢ **Save your design**

➢ **Move the surface 5m to starboard and 5 m up.**

You can do this for example by using the Surfaces | Move Surfaces | Numerical menu option, or setting all control points on the surface offset position to 5 m.

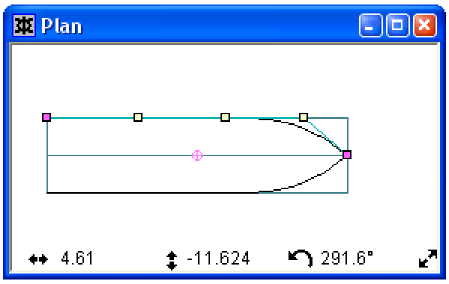


Moving the selected surface 5 m transversely to starboard and 5 m up.

- **Close the bow by moving the fwd-most column of control points transversely to the centreline. Do not change their longitudinal position.**

One way of doing this is by selecting both control points in the fwd-most column and then setting the Controls | Control Properties to 0 m offset. Another way would be to use a selection box in Plan view to select both control points on the fwd-most column and then drag them to the centreline while holding the shift key down. Tip: when a surface is symmetrical, you can drag control points past the centreline (to the portside of the centreline) to snap them to the centreline.

You should now see something like this in Plan view:



- **We do not need to see the Grid, so Display | Hide Grid**
- **Save your design.**

Let's leave the Topsides surface for what it is now and move on to inserting a chine surface.

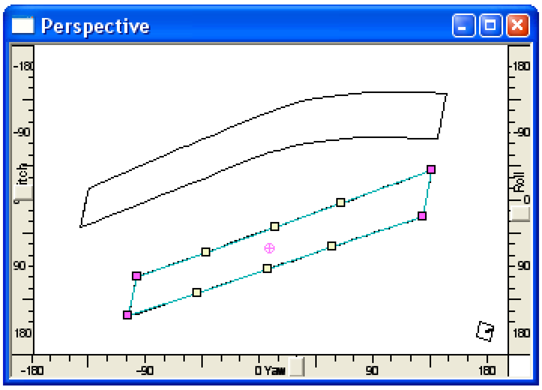
Multi-Chine design – Procedures – Insert Chine

Inserting the Chine

- **Lock the Topsides surface**

Repeating almost all of the steps above:

- **Insert another Buttock plane, resize it to 40 m length by 3 m depth, insert 3 columns of control points in roughly the same longitudinal positions, change the colour and rename this surface to Chine.**



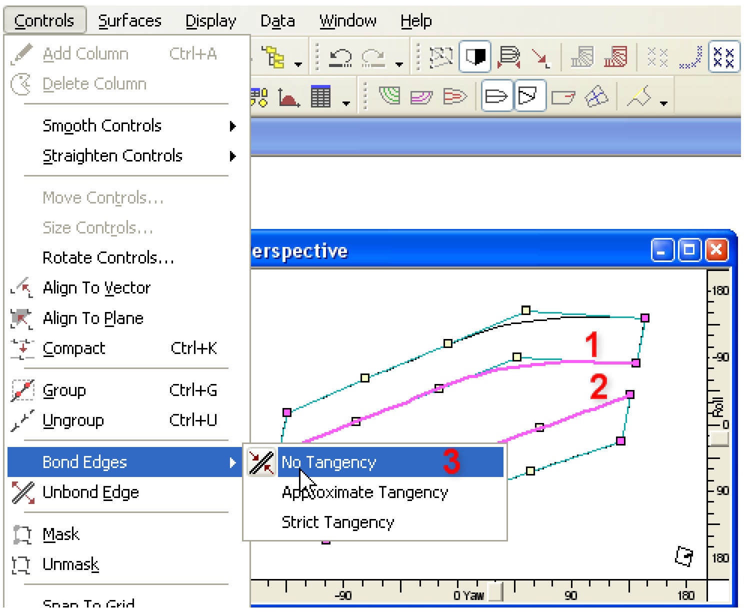
- **Unlock the Topsides and save your design as Bonding_Chine.msd**

You are now ready to bond to bond the lower edge of the Topsides with the upper edge of the Chine.

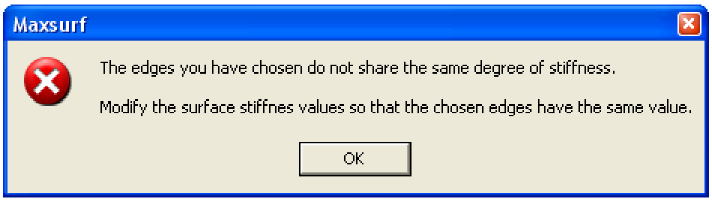
- **Switch to Perspective window**
- **Make sure you have Display | Contours | Bonded edges switched on**
- **Read the section on Bonding Surfaces in the Maxsurf user manual up to the "Bonding with Tangent Continuity" section.**

In this tutorial we will use the edge selection method to bond the edges. We could have chosen to use the edge control points with exactly the same outcome.

- **Select the Lower Topsides edge (1)**
- **Holding the shift key down, select the Upper Chine edge (2)**
- **Now select Controls | Bonding | Non-Tangency (3)**



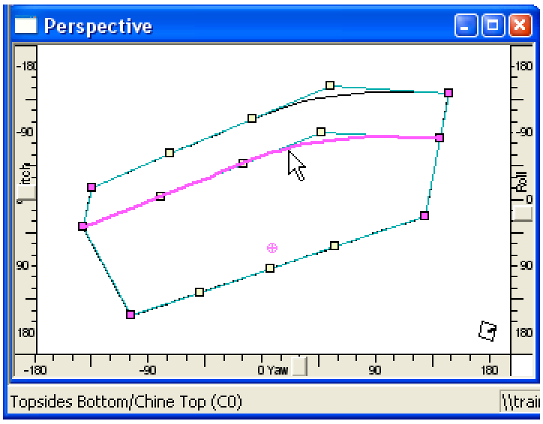
You will see the following error message:



This is because we have “forgotten” to set the Chine’s longitudinal stiffness to 4 (the same as the Topsides).

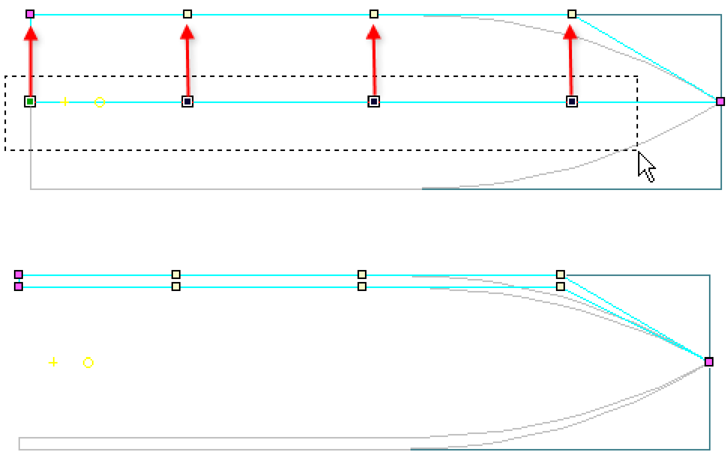
- **Set the longitudinal stiffness of the Chine to 4 and repeat the 3 bonding steps above.**

You should now see something like this:



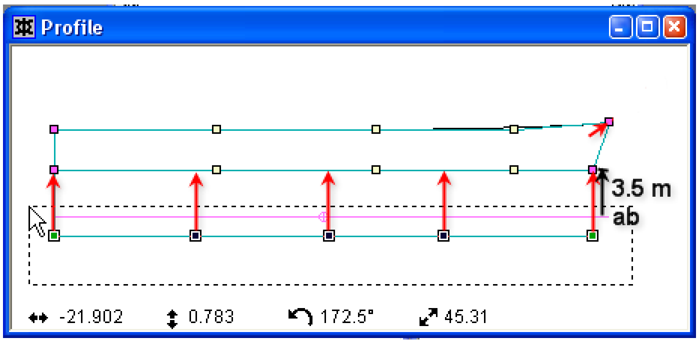
Notice how the Chine Top edge was moved towards the Topsides Bottom edge. This is because we selected the Topsides Lower edge first. Also notice how the names of the two bonded edges are displayed in the lower left hand corner of the Maxsurf application window. This means that Topsides Bottom and Chine Top edges have been bonded with a non-tangent (C0) transition.

- **Switch to Plan view**
- **Select the aft 4 control points on the centreline row of the Chine surface with a selection box.**
- **Holding the shift key down, drag the selected control points outwards until the roughly the required chine shape is obtained (something similar to that shown below).**

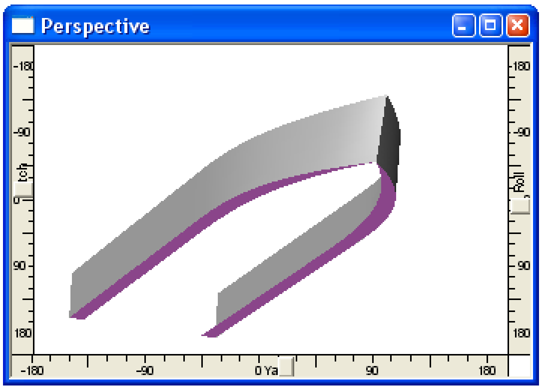


Plan view

- **Switch to Profile view**
- **Set the Height in Control Properties of the lower edge of the Chine to 3.5 m and Move the Fwd Top corner control point of the Topsides surface to shape the bow:**



You should now see something like this in rendered Perspective view with Display | Half off.



- **Save the design**

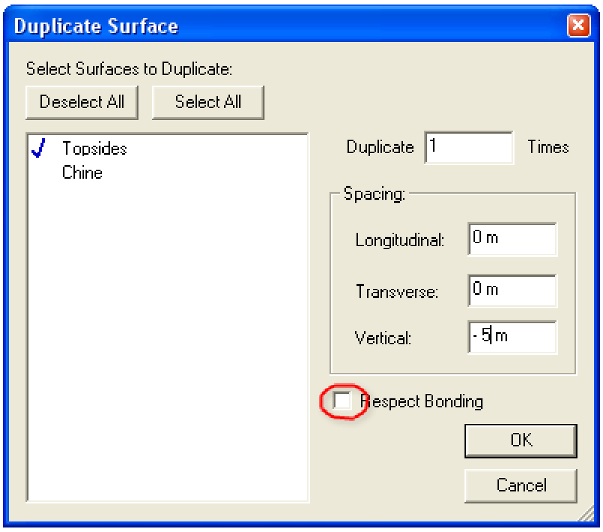
You are now ready to insert the bottom surface.

Multi-Chine design – Procedures – Inset Bottom

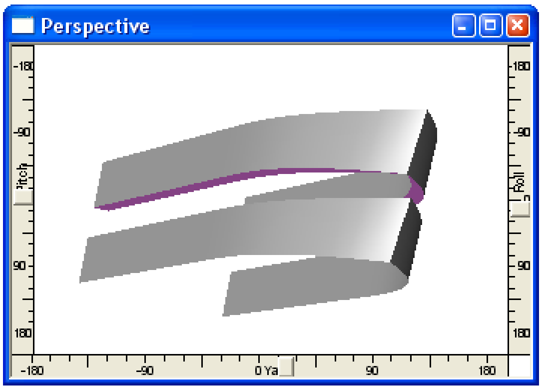
Inserting the Bottom

The final surface we want to create is the Bottom surface. Instead of creating this surface from scratch and set it up so that its edges match that of the Chine and the Topsides, it is much faster to duplicate for example the Chine surface or the Topsides surface and use that. This then automatically gives us a surface edge with identical stiffness and number of control points.

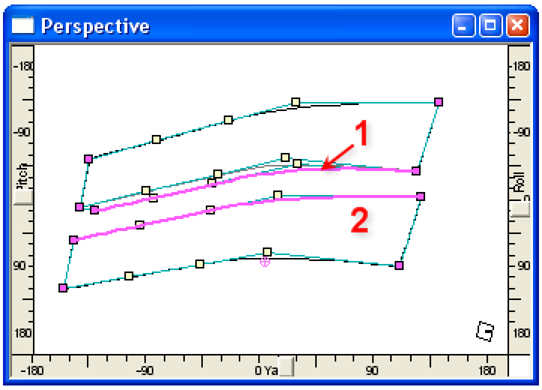
- **Surfaces | Duplicate**
- **Try to select just the Topsides surface. Notice how the Chine is also selected. This is because they are bonded.**
- **Untick the Respect Bonding and deselect the Chine**
- **Space the duplicate surface 5 m below the Topsides:**



- **Rename the duplicate surface Hull Bottom. In the perspective view you should end up with something similar to the following:**

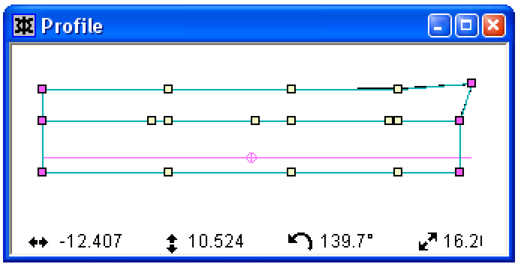


- **Rename the Copy of Topsides surface to "Bottom"**
- **Save the design as Bonding_Bottom.msd**
- **Switch rendering off and Display | Half**
- **Select the Bottom edge of the Chine (1)**
- **Select the Top edge of the Bottom (2)**
- **Bond the two together using non tangent transition (3)**



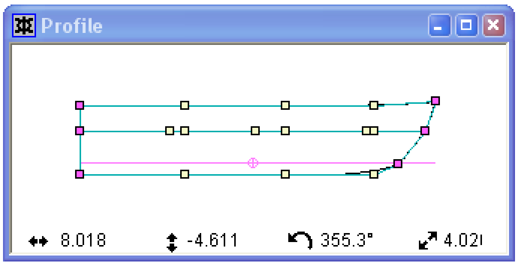
Make sure you don't accidentally select any of the Topsides edges. You can do that by hiding the Topsides surface or switching bonded edges off temporarily.

- **Switch to Profile view**

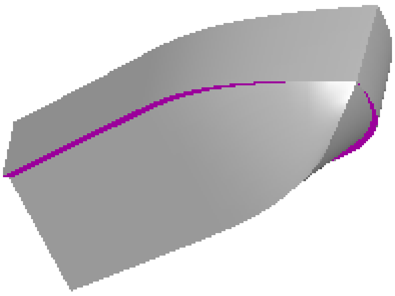


➢ **Set all the Bottom surface's Bottom edge control points' offsets to 0.**

➢ **Model the Bottom surface's Bottom edge so that it looks like this:**



In rendered Perspective view with Half display off you should see something like this:



➢ **Save your design as Bonding_Bottom.msd**

Done! This is basically a very simple starting point for any hullform with a spray rail or chine. Continue with the next section where you will be making Refinements to the Multi-Chine Hull Model. This revisits a lot of steps from the tutorial where you modelled your first design as well as fairing tips.

Refinements to the Multi-Chine Hull Model

FOR, Zero Point and Grid

First, let's set the Frame of Reference (FOR), zero point and insert a Grid:

➢ **Set the DWL to 3.5 m above the Baseline and set the Aft and Fwd perpendiculars in the Frame of Reference Dialog.**

➢ **Set the zero point to Aft Extremity and Baseline.**

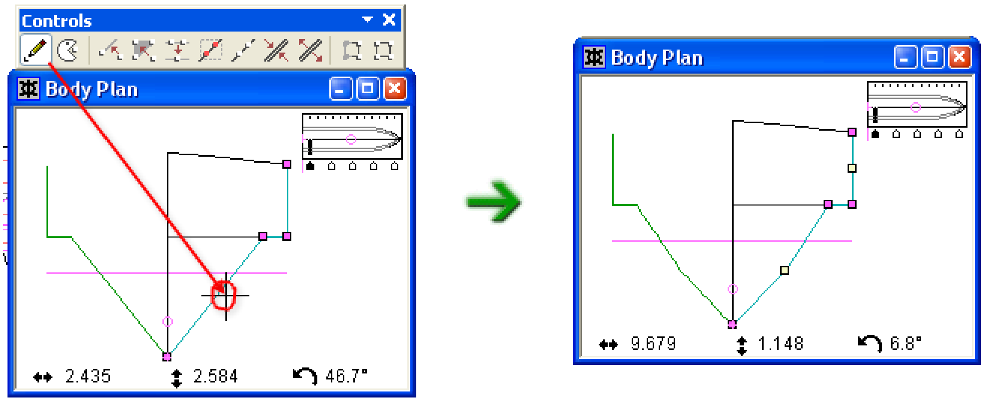
Also make sure the Locked Zero Point check box is unchecked so that the zero point will change with the aft perpendicular if it is moved. In case you don't quite remember the steps to doing this, please see Design Preparation – Procedures on page 54 of this training manual.

- **Insert a Grid of 12 sections, 5 waterlines and 4 buttocks all evenly spaced along the length, depth and width of the model respectively.**
- **Save your design as Bonding_Refinements.msd**

Modelling in Profile view

Next step is to shape the forefoot in the Profile window. First we must set the flexibility of the Topsides and Hull Bottom surfaces to 3, to do this there must be at least 3 rows of control points in each surface:

- **Switch to Body Plan view and Hide the Net, Display | Half, turn Sections off.**
- **Use the control box to select the Aft-most column of control points:**
- **Add a middle row to the Bottom and the Topsides surfaces:**

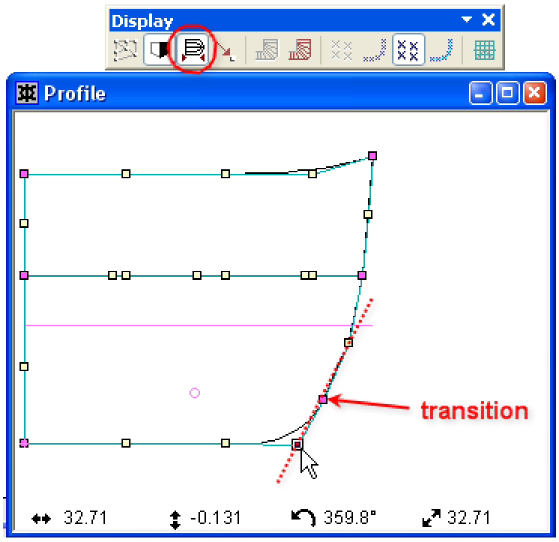


- **Now set the transverse flexibility values to 3 of the Topsides and Bottom.**

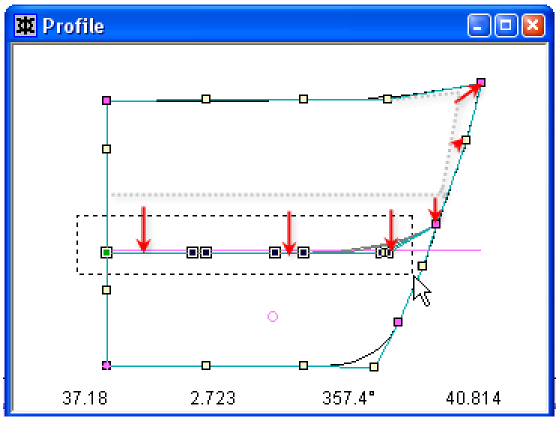
Notice that in the Transverse direction, the stiffness of the Chine and the Topsides and Bottom do not have to match. This is because the surfaces are not bonded along an edge in the Transverse direction.

- **Switch back to the Profile view.**
- **Shape the forefoot by moving the Control points to positions that give the required shape.**

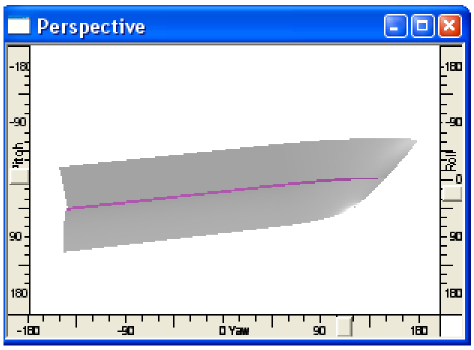
Tip: In order to get a smooth transition across the Lower Fwd Bottom corner control point, you have to make sure that the two adjacent edge control points and the corner control point are all on one line. Also: when shaping in the Profile and Plan views it is usually helpful to compress the view  :



- **Continue shaping the bow and as well as the Chine Profile so that it looks like this in compressed Profile view:**



- **Check your work in Perspective view:**

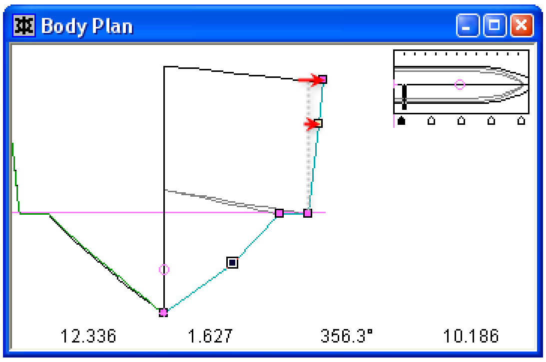


- **Save your design as Bonding_Refinements.msd**

Modelling in Body Plan view

Currently the Topsides are wall sided. Best way to change that is in Body Plan view:

- **Switch to Body Plan view, Hide the Net and turn Sections off**
- **Starting from aft, use the Control Box to move the control points in each column and give the Topsides an outward slope:**

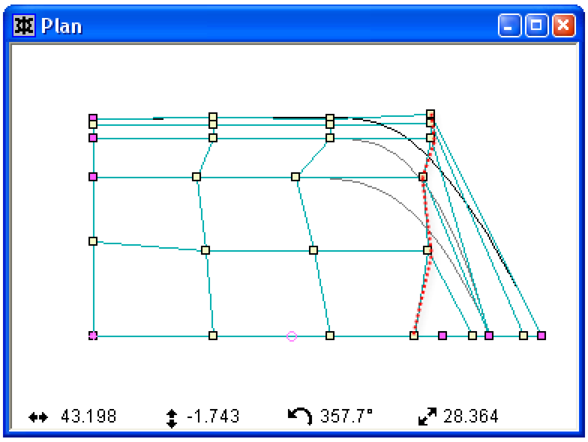


Giving the Topsides some outward slope in Body Plan.

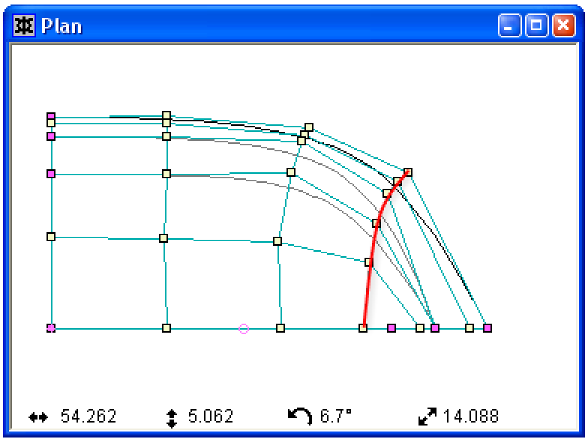
- **Save your design**

Modelling in Plan view

- **Switch to Plan view, hide the waterlines and display the Net**
- **Clean up any Zigzags and turn them into Bananas, especially in the bow area:**



Zigzags in Plan view with Compressed view turned on



Better: bananas towards the bow

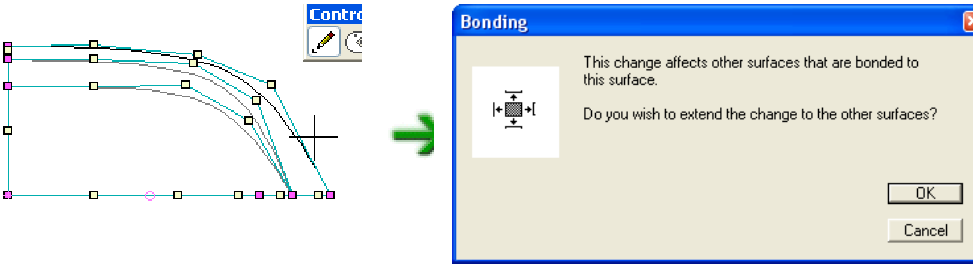
Remember that, even though the shape of the design may not change that much, improvements to the control point net will improve the fairness of the underlying surface. See Fair Net Equals Fair Surface on page 103 of this training manual for some reminder information.

- **Check your work in Perspective view and the other 2D view windows.**

Remember that modelling is an iterative process and you may therefore want to make several runs through the Profile → Body Plan → Plan → Perspective views etc.

Finally we will see one of the nice things about bonding:

- **Insert a column of control points in Plan view in the Topsides surface in the bow area:**



Inserting a control point column across bonded surface edge will affect all bonded surfaces

- **Click OK**

Notice that the control point column has been inserted in the Chine and Bottom surface as well. Another change that will be applied to all surfaces is a change to Surface stiffness.

- **Check the stiffness settings for the Bottom surface**
- **Increase the longitudinal stiffness to 5 for the Topsides surface**

Notice that the longitudinal stiffness for the Bottom surface has automatically been increased to 5 as well.

- **Save your design as Bonding_finish.msd**

Congratulations! You have finished the Bonding tutorial. You should have learnt from this:

- **In order to be able to bond two edges they must share the same number of control points and degree of stiffness.**
- **When bonding, the 2nd edge you select moves on top of the 1st edge you select.**
- **Duplicating a surface is a quick way to ensure that both surface edges to be bonded share the same properties.**
- **After bonding, all bonded surfaces are treated more or less as one surface.**

Chapter 10 Calculations

Maxsurf allows you to quickly assess the model's upright hydrostatic properties. In order to be able to calculate the hydrostatics, you need to make sure:

- **Frame of Reference and the Zero Point have been defined**
- **Trimming is turned to Invisible or Grey in case you have used trimming**

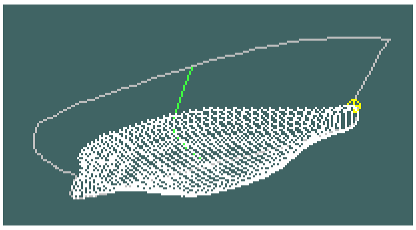
Note
Surface trimming affects the hydrostatic results.

Start learning about calculations in Maxsurf in the section on Calculating Hydrostatics.

Calculating Hydrostatics

Calculating Hydrostatics – Concepts

Maxsurf's Upright hydrostatic calculations use trapezium integration method on a given number of transverse sections up to the Datum Waterline. The number of sections depends on the precision setting from the Surfaces menu. Medium precision uses 50 sections and highest precision uses 200 sections. Skin thickness is not included in upright hydrostatic calculations. (Use Hydromax for this).



The sections used for calculations are displayed in the view windows while the Calculate Hydrostatics dialog is displayed.

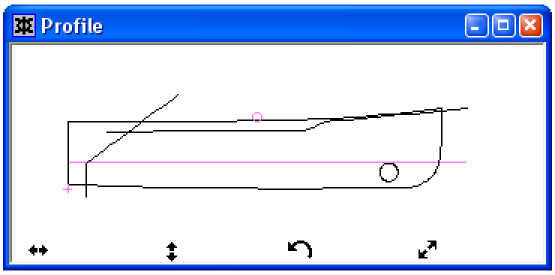
Calculating Hydrostatics – Video

View a video that shows you how to carry out Upright Hydrostatic calculations, view the Curve of Areas and calculate different Surface Areas. [Web | Disk]

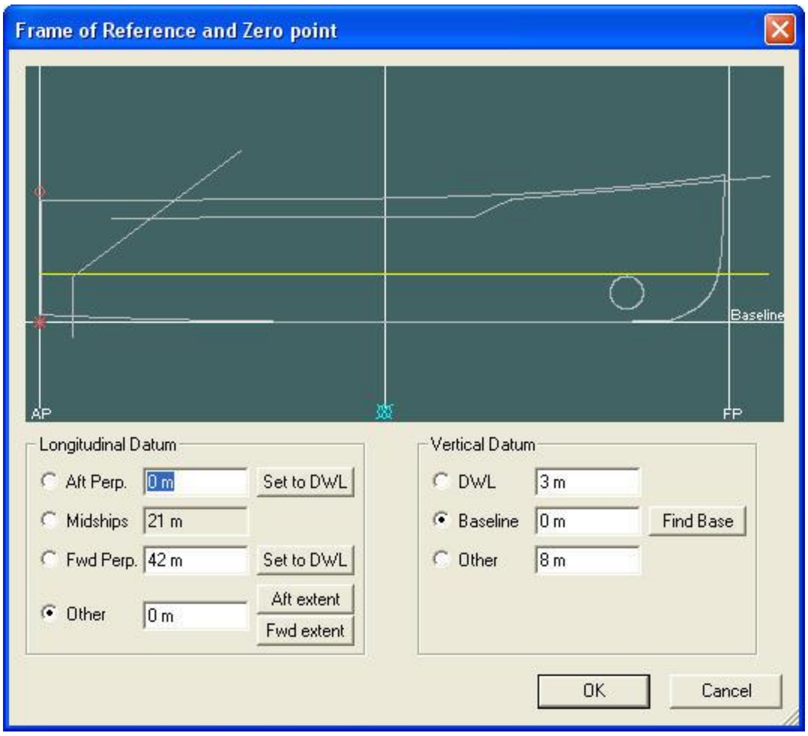
Calculating Hydrostatics – Procedures

➢ **Open the MyFirstDesign_TrimmingComplete.msd design that created earlier.**

In Profile view you should see something like the image below (Trimming off, Surfaces Locked, Buttocks hidden):



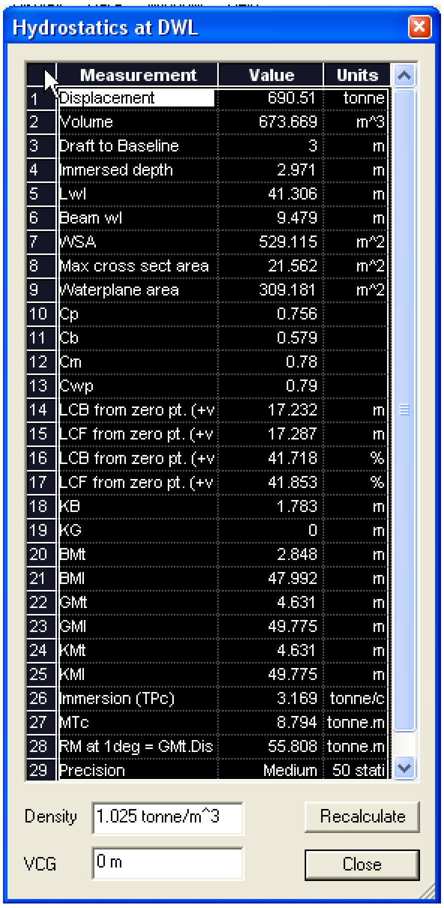
- **Check the Frame of Reference:**



In the Frame of Reference of this design the Fwd Perpendicular is not set correctly. Click "Set to DWL" to fix.

- **Go Data | Calculate Hydrostatics**

The following dialog should appear:



Hydrostatics at DWL

	Measurement	Value	Units
1	Displacement	690.51	tonne
2	Volume	673.669	m^3
3	Draft to Baseline	3	m
4	Immersed depth	2.971	m
5	Lwl	41.306	m
6	Beam wl	9.479	m
7	WSA	529.115	m^2
8	Max cross sect area	21.562	m^2
9	Waterplane area	309.181	m^2
10	Cp	0.756	
11	Cb	0.579	
12	Cm	0.78	
13	Cwp	0.79	
14	LCB from zero pt. (+v	17.232	m
15	LCF from zero pt. (+v	17.287	m
16	LCB from zero pt. (+v	41.718	%
17	LCF from zero pt. (+v	41.853	%
18	KB	1.783	m
19	KG	0	m
20	BMt	2.848	m
21	BMl	47.992	m
22	GMt	4.631	m
23	GMl	49.775	m
24	KMt	4.631	m
25	KMl	49.775	m
26	Immersion (TPc)	3.169	tonne/c
27	MTc	8.794	tonne.m
28	RM at 1deg = GMt.Dis	55.808	tonne.m
29	Precision	Medium	50 stati

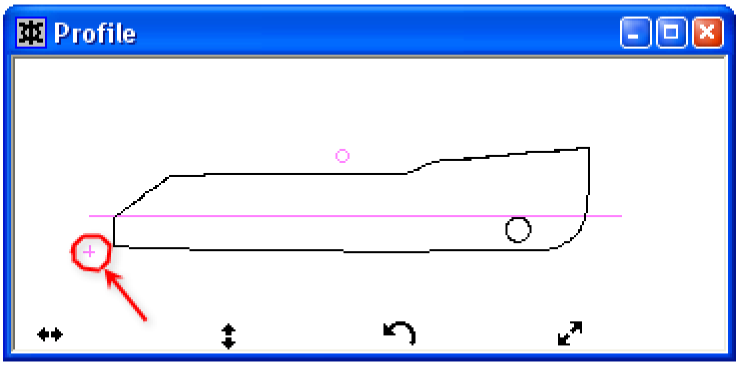
Density 1.025 tonne/m^3 Recalculate

VCG 0 m Close

- **Click in the Top left corner of the results dialog to select all cells**
- **Press Ctrl + Shft + C**
- **Start MS Excel and Paste the results into a worksheet**

Let's now compare these results with when we switch trimming on.

- **Set Display | Trimming | Trim Invisible**



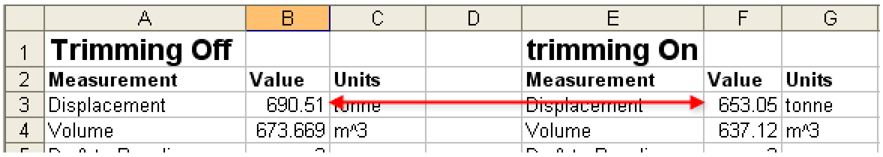
Zero point locked at Aft Extremity

- **Check the Frame of Reference again**
- **Adjust the Fwd and Aft Perpendicular and Set to DWL.**

Notice that the zero point is locked at the Aft Extremity of when this model was first created. It is now time to adjust the zero point to the Aft Perpendicular.

- **Set the zero point to the Aft Perpendicular**
- **Data | Calculate Hydrostatics**

- **Copy and paste the results into Excel worksheet next to your previous results.**

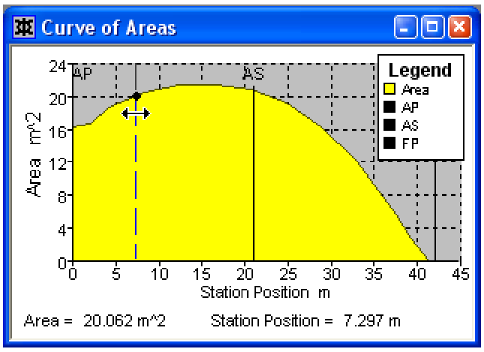


	A	B	C	D	E	F	G
1	Trimming Off				trimming On		
2	Measurement	Value	Units		Measurement	Value	Units
3	Displacement	690.51	tonne		Displacement	653.05	tonne
4	Volume	673.669	m^3		Volume	637.12	m^3

With trimming on the displacement is less than when calculating with trimming off.

After calculating the Hydrostatics, you can also display the Curve of Areas graph:

- **Window | Curve of Areas**



The vertical line may be moved with the mouse to read off the sectional area at any longitudinal position. By doing this for a number of different drafts a set of Bonjean curve data may be collated. The curve of areas uses 25 sections along the length of the hull by default. You can change this number from the Edit | Preferences menu.

Continue with the section on Calculate Areas.

Calculate Areas

Calculate Areas - Concepts

Maxsurf can also quickly calculate the Surface areas for you. This information may be useful when you are trying to estimate a steel weight for a surface (3D surface area) or the windage area of the model above the waterline (2D projected lateral area). All this data is available in one dialog.

Calculate Areas - Procedures

- **Read the Calculate Areas section of the Maxsurf manual.**
- **Calculate the 3D true surface area for your MyFirstDesign_TrimmingComplete.msd**
- **Do this with trimming on / off to see the difference**

In case you wish to calculate the total 3D true surface area for all surfaces except for, for example the Transom, you can hide that particular surface.

- **Hide the Transom and Calculate the Areas**

You'll see that the transom is now not included in the Surface area list.

The last short section in this training manual is on Chapter 11 .

Chapter 11 Creating a Maxsurf Model from Existing Data

This section explains and provides examples on how to get different types of data into Maxsurf and how to create a Maxsurf model from the data.

There are a number of tools available for bringing existing data into Maxsurf and creating a Maxsurf model. The best method to use depends on the existing lines plan data type and what you want to do with the Maxsurf model.

Lines Plan Data Type & Import Options

- **Read the Input of Data section in the Maxsurf manual.**

Maxsurf can import a range of data formats to assist you in creating a Maxsurf design to match existing data. Essentially the options are:

- **Importing a Background image into Maxsurf**
- **Importing Data as Markers**

Importing a Background image

Maxsurf has the ability to display background images in each of the design views. Maxsurf can load image files of the type jpg, gif, bmp and png.

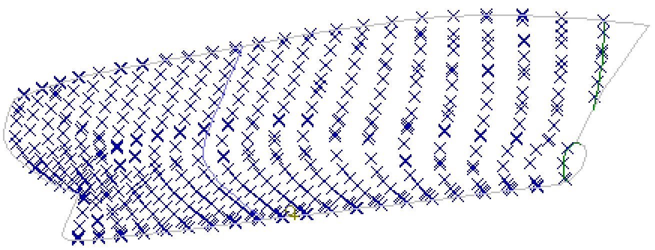
Note:
If the Line plan is a paper version then you can scan it and import the scanned image into Maxsurf.

For more information including tips on how best to scan a paper lines plan, see the Importing background images section of the user manual. The Importing Background Image 7 Scaling an existing Design tutorial below explains the process of importing a background image

Importing data as Markers

- **Read the Working with Markers section in the Maxsurf manual.**

Markers are reference marks displayed on the screen at a specified longitudinal, transverse and vertical position in space.



Example of Markers defining the starboard side of a round-bilge vessel with bulbous bow.

Once the markers are in Maxsurf there are a number of tools available to create the 3d Maxsurf model using the marker data.

Creating Markers in Maxsurf

Marker data may come from a variety of sources such as:

Offsets table data

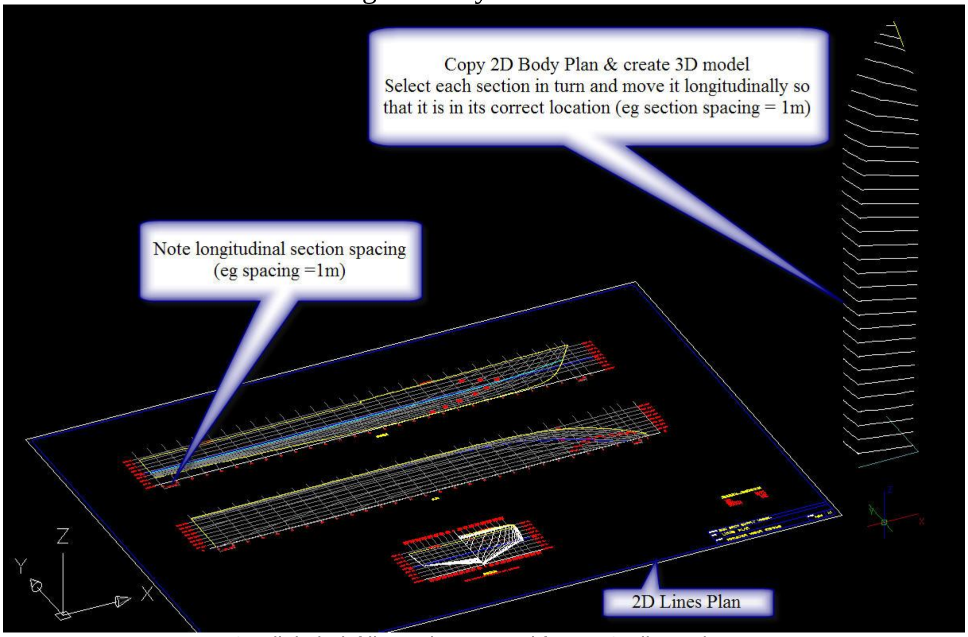
Offsets tables can be manually input or copied and pasted into the Maxsurf marker window (switch to the Marker window in Maxsurf and select markers | Add Marker).

3D DXF

If the existing lines plan is in 3D DXF format, it can be read directly into Maxsurf and markers generated automatically. To do this, start a new design, select File | Import | Import DXF markers, select the file and then specify the orientation of the design in the DXF file. Note that when importing the DXF file all nodes of all lines and poly-lines are converted to markers. It is normally easier to delete all unnecessary lines in the DXF file rather than trying to delete the unwanted markers in Maxsurf. All that is required in Maxsurf are the markers that define the hull shape.

2D DXF

If you have a 2D DXF lines plan, it is normally quite easy to generate a fairly comprehensive 3D DXF model. This is done in a standard CAD package such as AutoCAD. Start by extracting the body plan and noting the longitudinal positions of each of the sections that are defined in the body plan. Select each section in turn and move it longitudinally so that it is in its correct location.



3D digital .dxf lines plan created from a 2D lines plan

Maxsurf Model Requirements

If the Maxsurf model is required for production purposes then the Maxsurf model will need to be created from a faired NURB surface. Chapter 4 NURB Surfaces. However, if the Maxsurf model is required for the purposes of analysis, for example Hydrostatic analysis in Hydromax, then the Maxsurf model can be simply generated as a TriMesh surface. See Importing dxf Marker Data & Generating a TriMesh model Tutorial.

Creating a Maxsurf Model from Existing Data Tutorials

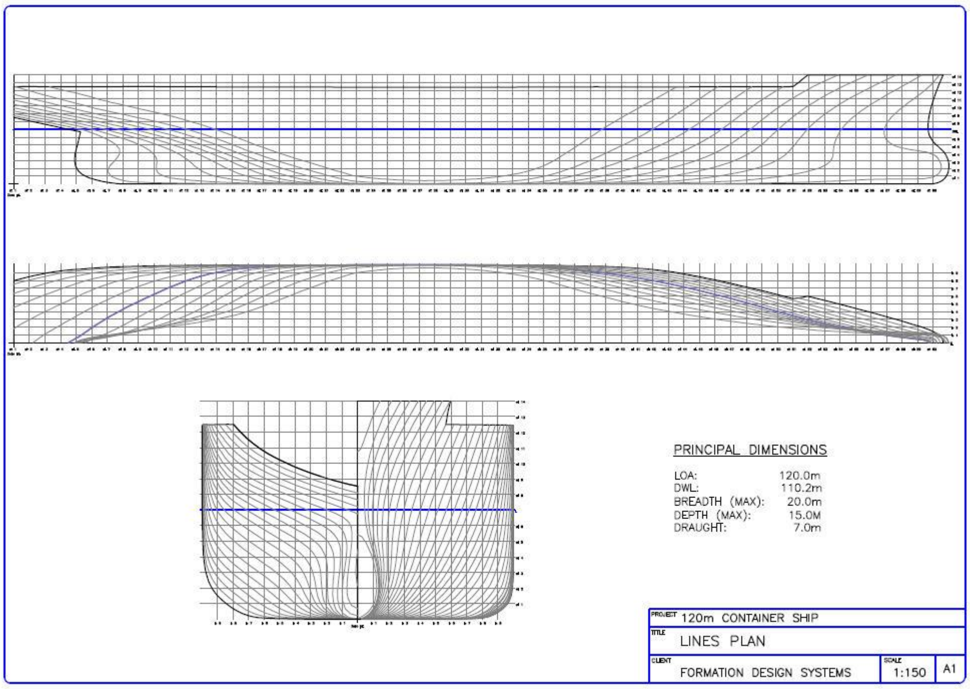
The following tutorials provide example of creating Maxsurf models from exiting Data:

Importing Background Image Tutorial
Importing dxf Marker Data & Generating a TriMesh model
Importing Marker Data & NURB Surface Models

Importing a Background Image & Scaling an Existing Design Tutorial

Maxsurf allows you to import one background image in each view window. This means that a typical lines plan image (example below) will need to be split up into 3 separate images; one each for Body Plan, Profile and Plan view.

Importing a Background Image & Scaling an Existing Design – Procedures



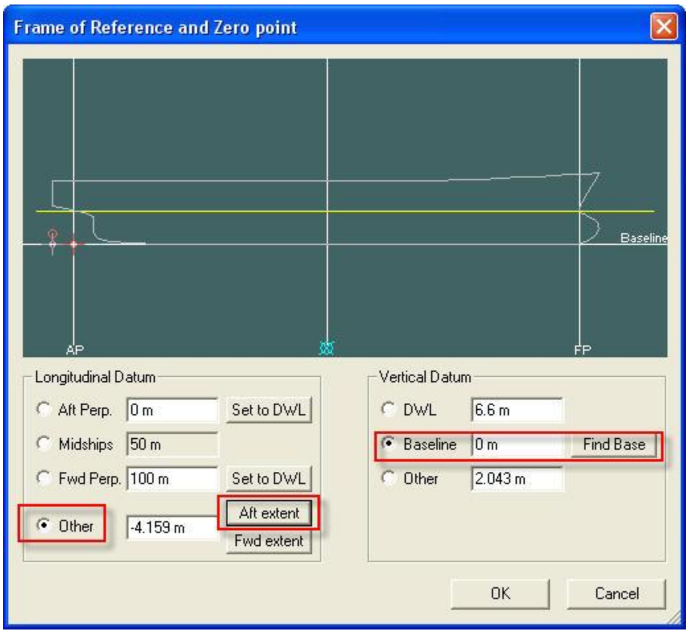
Typical lines plan image of a Container Ship.

- **In Maxsurf, open the ContainerShip.msd sample model.**
- **Display only edges and lock the surface for now. Hide the grid.**

This design is similar to the design in the lines plan image and we will use it as a starting point. It is always a good idea to open a design first before importing images. This helps when try to make the zero points of the model correspond to that of the lines plan model.

The zero point of the lines plan is at the Aft extents and the Baseline. Therefore set up the Containers ship Maxsurf model with the zero point at the Aft extents and the Baseline.

- **Switch to Profile view window**
- **Go to Data | Frame of Reference**
- **Set the Zero Point to Aft extents & Baseline**

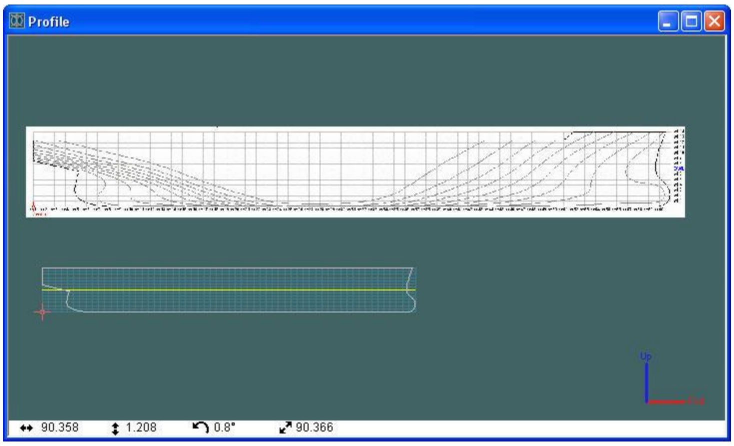


Set the Frame of Reference of the Maxsurf model to correspond to the Lines Plan.

Now import the background image.

- ➢ **Switch to Profile view window**
- ➢ **Now go File | Import | Image Background and select the Containership Image - Profile.jpg file.**

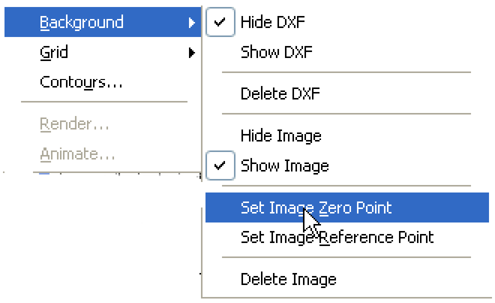
You will now see something like this:



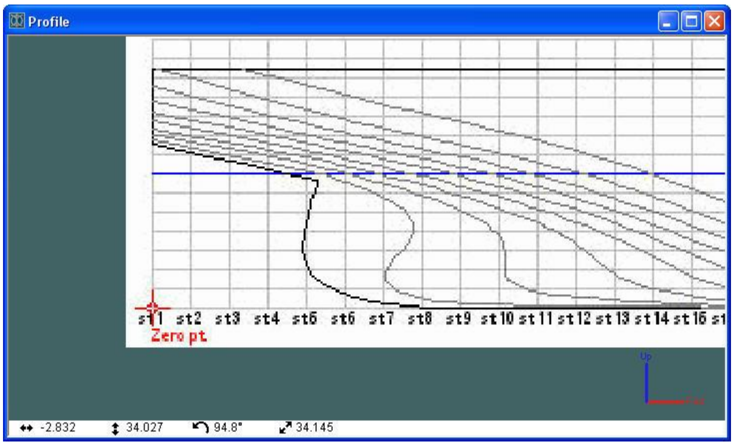
The zero point of the image and the scale still needs to be adjusted.

You can now set the zero point of the image:

- ➢ **From the Display menu, select Set Image Zero Point**



- **Zoom in on the Zero pint of the Lines Plan image:**

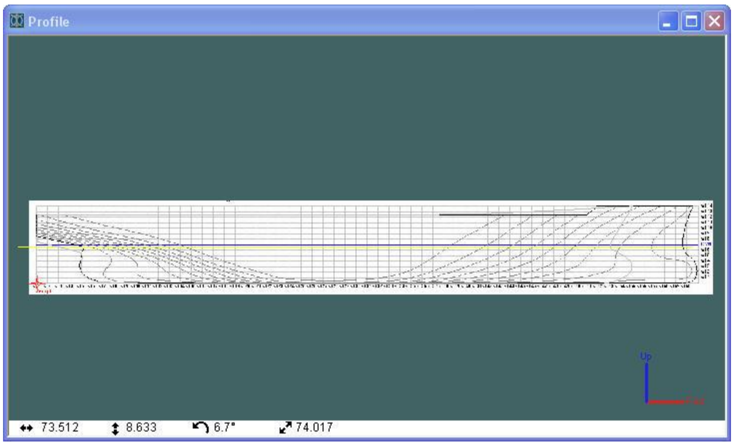


Setting the zero point of the background image

- **Set the zero point with the tip of the mouse cursor by clicking on the Zero point of the lines plan image.**

- **Zoom out by pressing the Home view button.**

The zero point of the image has been matched with the zero point of the model



Zero point of background image set

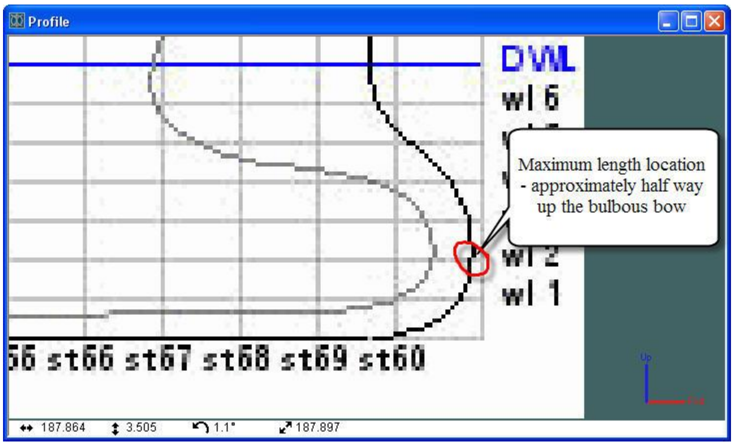
Next step is to scale the image to the Maxsurf coordinate system. I.e. when the ship is 120m long in real world, we can scale the image so that it is 120m in Maxsurf space. In Maxsurf you can do this by specifying a reference point. This point can be for example the Fwd extremity, the deck height or any other point of which the horizontal or vertical distance to the zero point is known.

In this case, we know from the lines plan that the LOA (length Overall) is 120m. We can scale the image by telling Maxsurf where the Maximum length of the lines plan image is.

- **Zoom in on the position of the maximum length location – approximately half way up the bulbous bow.**

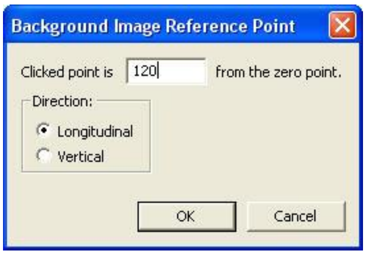
- **Display | Background | Set Image Reference Point**

- **Set the Reference point with the tip of the mouse cursor by clicking on the maximum length location – approximately half way up the bulbous bow:**



Set reference point

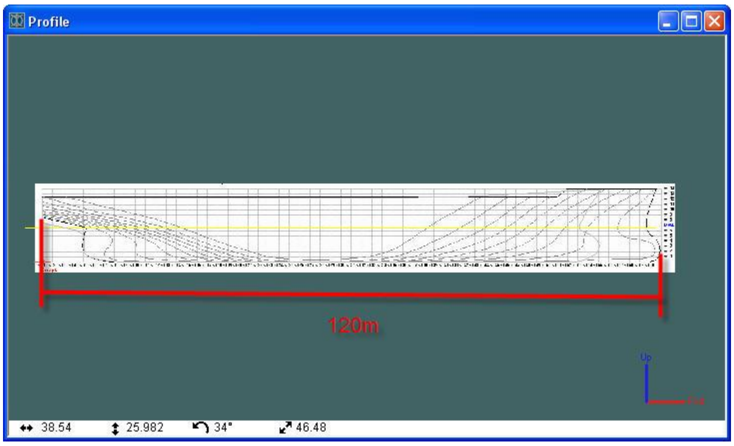
This brings up the Background Image Reference Point dialog:



Input reference point length

- **Specify 120m in longitudinal direction and click OK**

This will scale the background image:



Scaled background image

- **Save the design as ContainerShip_Image.msd**

Now we can do this in Plan view as well:

- **Repeat the steps above but now in Plan view window with the image file Containership Image - Plan.jpg. The zero point is of course on the Centreline and at Aft extremity.**

Once you have completed that, you can also import the Containership Image - Body.jpg.

- **Repeat the steps above, but now in Body Plan view. You will need to specify a Reference point. The Maximum Beam for the lines plan is 20m. Therefore for the reference point of the maximum beam is 10 m from the zero point (on the centreline) in the transverse direction.**
- **Save the design**

The next step is basically starting a surface fitting process by resizing the start-model (ContainerShip.msd file in this case) to match the background image size.

- **Unlock the Hull surface and resize it to a length = 120, depth = 15.0 m and beam = 20 m**
- **Check your work in the different view windows.**
- **Save your design.**

Now, theoretically, in all view windows you should see the surface model roughly match up with the background image in overall size (not shape yet). In any case, what should not happen is that your surface model is smaller than the background image in for example Profile view but bigger in Plan view. This means that you have set the zero and reference points of the background image inaccurately in either (or both) of the view windows.

The next step in the surface fitting process would be to set up a grid that matches the buttocks, waterlines and sections of the lines plan image. After that, you can start shaping your surface to match the lines of the image; remembering the following order:

- **Corner control points**
- **Edge control points**
- **Internal control points**

Importing a Background DXF

A note that is worth including here is that DXF backgrounds work in much the same way as Image backgrounds except for:

- **No need to specify scales or zero point (these are inherited from the CAD drawing)**
- **You can only import one DXF background in Maxsurf (instead of one for each view window). It is therefore recommended to convert your 2D DXF into a 3D DXF in your CAD application prior to importing.**

Importing dxf Marker Data & Generating a TriMesh model Tutorial

- **First read the Generating a TriMesh Surface section in the Maxsurf manual.**

If the Maxsurf model is required for the purposes of analysis, for example Hydrostatic analysis in Hydromax and NOT for production purposes then the Maxsurf model can be simply generated as a TriMesh surface

A TriMesh surface is a linear surface made up of triangular facets, it is not designed to be smooth – it follows the input data points exactly and is linear between the data points. The TriMesh surface is designed to be used where an approximation to the vessel is required with sufficient accuracy for hydrostatics to be calculated. It is NOT designed to be a smooth surface model from which the vessel could be built.

Start

In this section we will again start from scratch. If you have an existing design open, you will have to close it first.

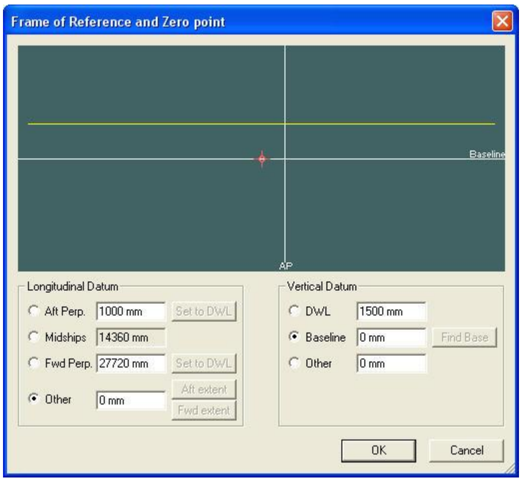
- **Select File | New Design.**

It is important to set the units in Maxsurf to be the same as the units of the dxf. For this example the dxf is in mm.

- **Select Data | Units**
- **Set units to mm**

It is recommended to Set the Zero point and frame as per the original lines plan. For this example set the frame of reference up as follows;

- **Select Data | Frame of Reference**
- **Set the Zero Point to be at the aft extent and the baseline**
- **Set the Aft perpendicular & Fwd perpendicular to be at 1000mm 27720mm respectively.**
- **Set the DWL to be at 1500mm**

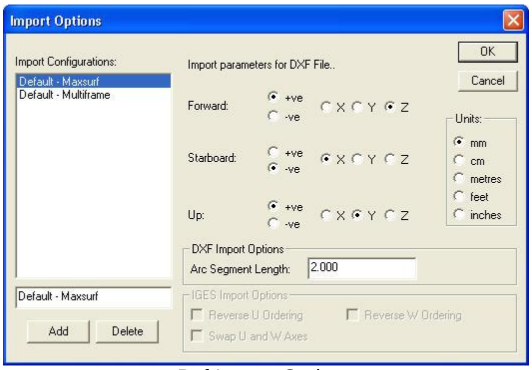


Zero point and Frame of reference

Now import the dxf as markers

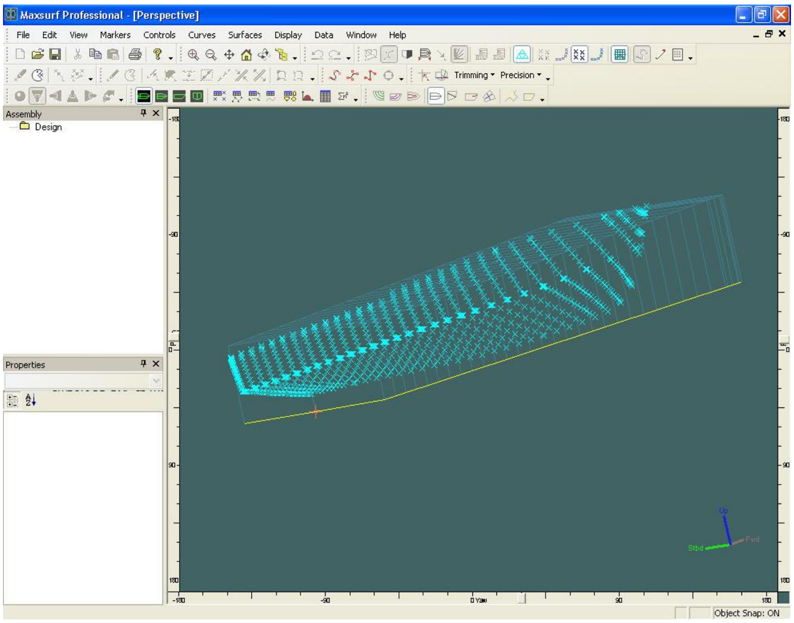
- **Select File | Import | Dxf Markers**
- **Select the 'Import dxf Markers-Generate TriMesh-Supply Boat example.dxf' file**

You will then be asked to specify the units and the orientation of the markers. This will be the same orientation used in the dxf program, for this example Forward is +ve Z, Starboard is -ve X and Up is +ve Y. As follows



Dxf Import Options

You can now view the imported markers in Maxsurf. Look at the Markers in all the views to check that you have brought the markers in using the correct orientation.

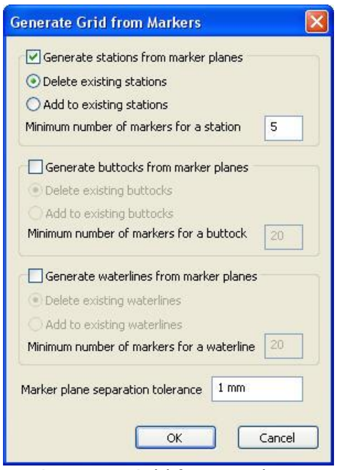


Dxf markers in Maxsurf (perspective view)

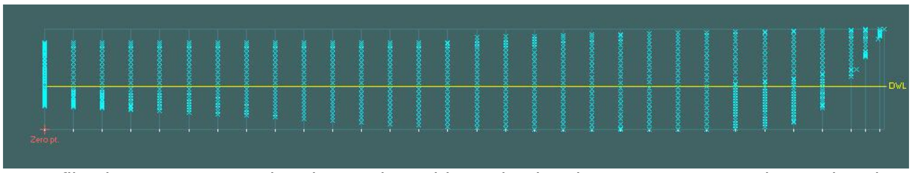
Before you can generate a TriMesh from the Markers it is first necessary to order the markers. It is essential that the markers are grouped by section and that, on each section, the markers are ordered in a consistent manner.

The Imported Markers represent the sections. The stations share the same longitudinal properties. The Generate Grid from Markers command can be used to automatically generate the grid of sections (as well as buttocks and waterlines) based on the marker data and also associate markers with the correct marker station index. For more information read the Generate Grid from Markers section in the Maxsurf User manual.

- **Select Markers | Generate Grid from Markers**
- **Set the generate stations up as follows and click OK:**



Generate Grid from Markers

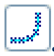


In Profile view you can see that the section grid spacing has been set up as per the marker data

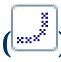
Now that the Markers have been assigned to the same Station Index they can now be sorted for each station.

- **Select Markers | Sort Marker stations**

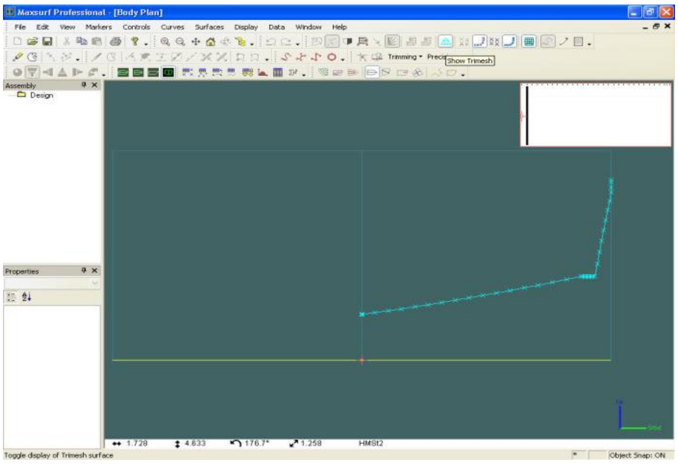
To view the connectivity (and ordering) of the markers

- **Select Display | Connect Marker Station: (Ctrl+J,)** **.**

This is best done in the Body Plan view with current Station option selected

- **Go to the Body Plan view**
- **Select Display | Markers for Current Station option selected (****).**

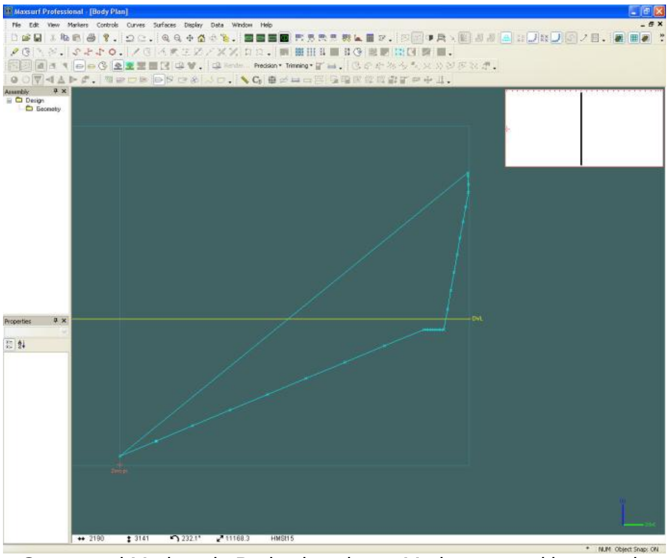
You will notice that the first marker on the section is shown in bold



Connected Markers in Body plan view, note the first marker on each section is shown in bold

Using the station control box in the top right corner and the cursor keys 'walk' through the sections to check that they have formed correctly and that the first (bold marker) is always at the keel.

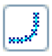
The automatic Marker sorting uses a nearest neighbour sort, which works in most instances, but can be confounded if the section shape is complex and/or the spacing between markers varies significantly. For example if you section looks like this;

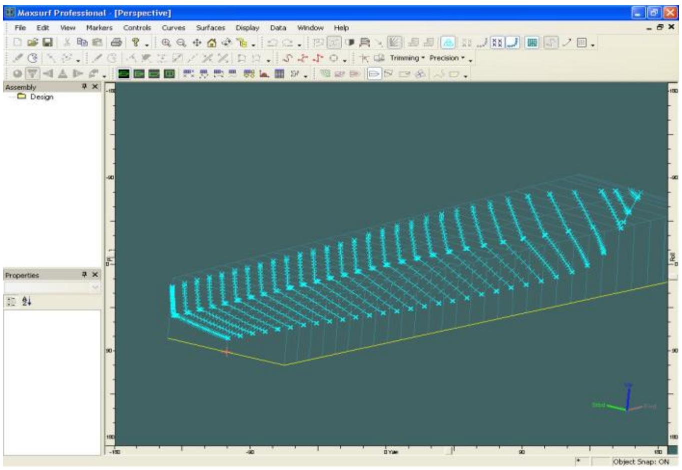


Connected Markers in Body plan view – Markers sorted incorrectly

Then the Markers have not been sorted correctly and will need to be reordered. For more information on sorting Markers see the sorting Markers section of the Maxsurf User manual.

To see all the connected markers look at the perspective view.

- **Go to the Perspective view window**
- **Select the show all markers icon**  **and the Connect Marker Stations icon**  **.**



Connected Markers in Perspective view, note the first marker on each section is shown in bold

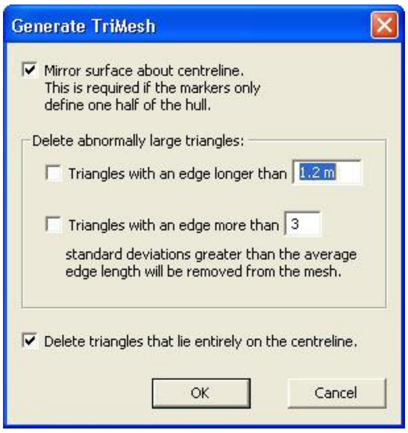
It is also recommend to use the Delete duplicate Markers function. In most cases duplicate markers cause problems. This function will delete any duplicate markers within a specified spacing of each other from a selected group of markers.

- **Select all the markers**
- **Select Markers | Delete duplicate markers**

- **Set the tolerance to 1mm and click OK**

Now with the markers all organised we can now generate the TriMesh surface.

- **Select Markers | Generate TriMesh Surface for Markers**



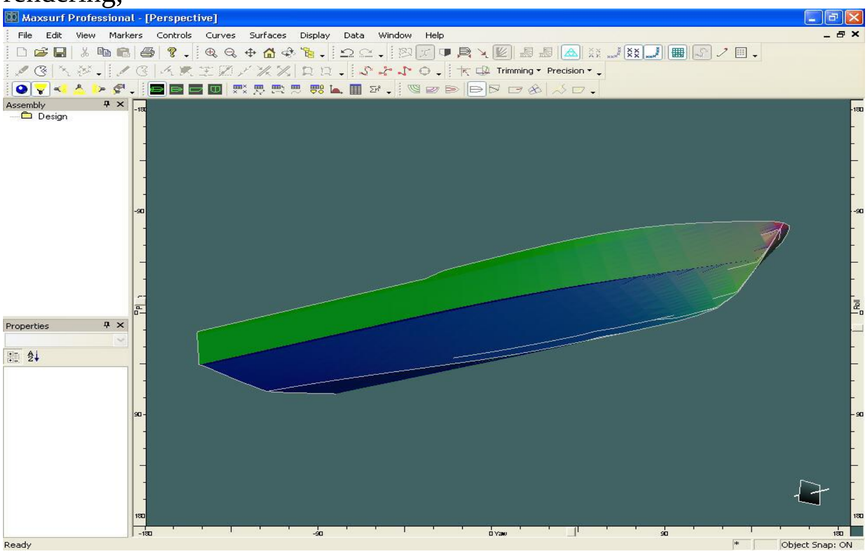
TriMesh surface dialog

- **Leave the default options & Click OK. |**

For more information on the Generate TriMesh options see the Generating a TriMesh Surface section in the Maxsurf User manual.

TriMesh surface can be hidden or made visible using the show TriMesh command .

To View the rendered TriMesh surface go to perspective view and turn on the rendering;

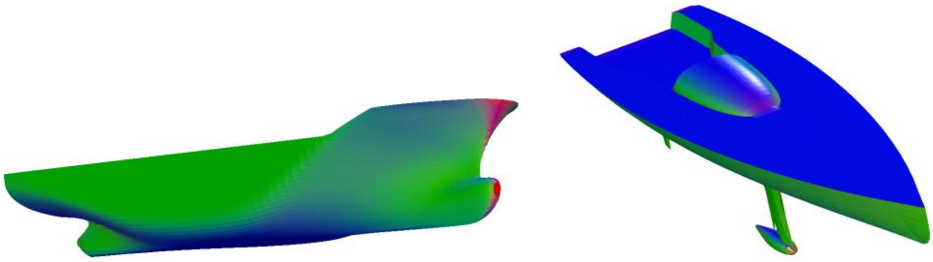


Rendered TriMesh surface in perspective view

As for NURB surfaces you can display all regular contours on a TriMesh surface. The TriMesh surface can be easily deleted and re-generated using the options in the Markers menu.

Note:
The accuracy of TriMesh surface is purely dependant on the Marker data, so if you require a more accurate model then you will need more Marker data.

The picture below gives some idea of the types of vessels that can be generated with a TriMesh surface:



Other TriMesh examples can be found in C:\Program Files\Maxsurf 14\Training Samples\Trimesh Samples

The TriMesh surface model can be saved in Maxsurf as normal (.msd file) and read directly into Hydromax, Seakeeper and Hullspeed for analysis.
For modelling complex tanks and compartments in Hydromax additional NURB internal structure surfaces can be defined with the TriMesh model in Maxsurf.

Fitting a NURB Surface to Marker Data Tutorial

If the Maxsurf model is required for production purposes then the Maxsurf model will need to be created from a faired NURB surface.

Maxsurf has a number of options available to help create a NURB surface model from marker data.

- **First read the Surface Fitting section in the Maxsurf manual.**

Fitting surfaces to Marker data is an iterative process. The following simple example shows the fitting of the default yacht surface to marker data and highlights the basic procedures.

Fitting a NURB Surface to Marker Data - Video

This video illustrates the basic procedure for fitting a NURB surface to Marker data. [Web | Disk]

Fitting a NURB Surface to Marker Data - Procedures

Start

In this section we will again start from scratch. If you have an existing design open, you will have to close it first.

- **Select File | New Design**
- **Set units to meters Data | Units**

Now open the Marker data

- **Go to the Marker window | File | Open Markers**
- **Select the 'Yacht Markers - Surface fitting to markers.txt' file**

If you go to the perspective view window you will see that marker data in Maxsurf. Now import a surface to fit to the marker data, for this example we will use the Simple yacht surface

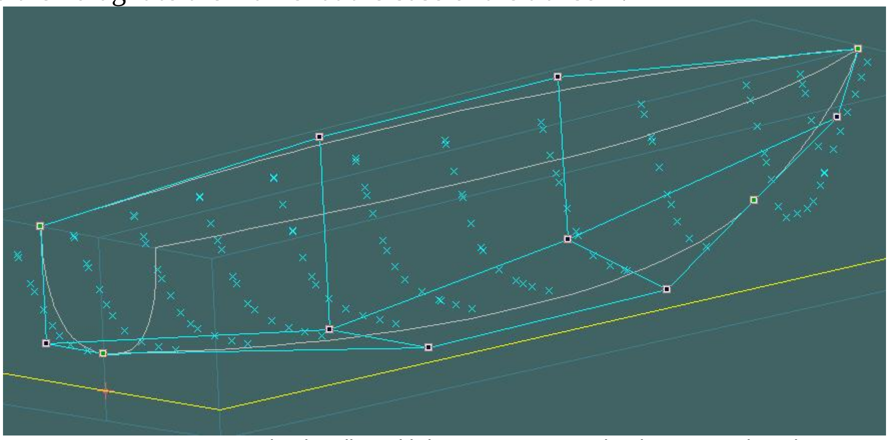
- **Go to the Perspective view window**
- **Select Surfaces | Add surface | Simple Yacht**

The simple yacht surface can now be manipulated to fit the marker data.

Firstly we will approximately size the simple yacht surfaces and then move it to an appropriate location.

- **Select Surfaces | Size surfaces**
- **Select the simple yacht surface and size to length 10m, Beam 3.5m & Depth 1.5m.**
- **Now move the simple yacht surface so the transom of the surface lines up with the Markers for the transom.**

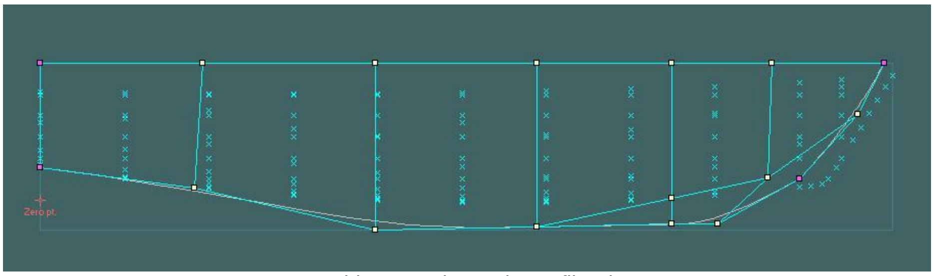
A quick way to do this is by turning on the snap settings (F5), selecting all the surface control points then moving the control point at the base of the transom and then drag it to the marker at the base of the transom.



Lower transom control point align with lower transom marker in Perspective View

The simple yacht surface control point net contains 3 rows and 4 columns of control points. We will need to add more rows and columns to the surface control point net to get the required shape.

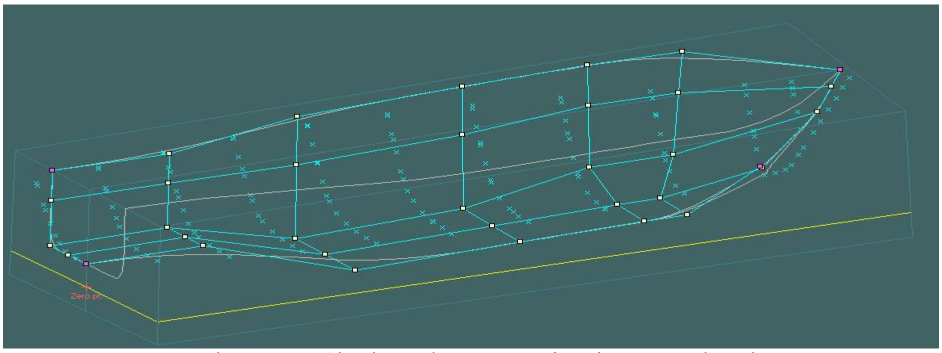
- **Go to the profile view and add 3 more columns; one aft, one in the middle and one near the bow.**
- **Space the columns evenly along the length of the hull.**



Add extra columns in Profile View

- **Now Go to the body plan view and add 2 Rows; one along the bottom and one up the side of the control point grid**

Your model should now look something like this:



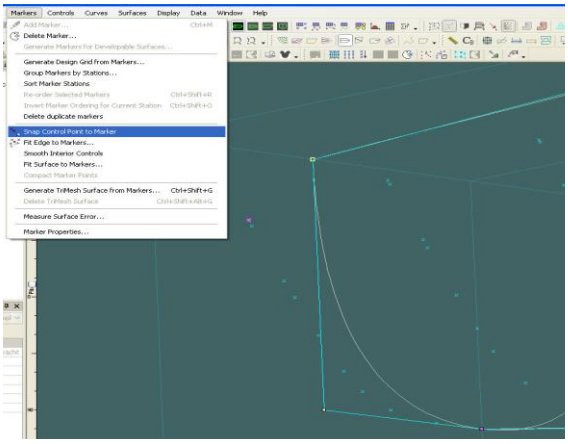
Marker Data & Simple Yacht NURB surface in Perspective View

It now it is time to do a manual fit of the surfaces to the marker data. The order in which you should fit a surface to markers is strictly from top to bottom:

- **Corner control points**
- **Edge control points**
- **Internal control points**

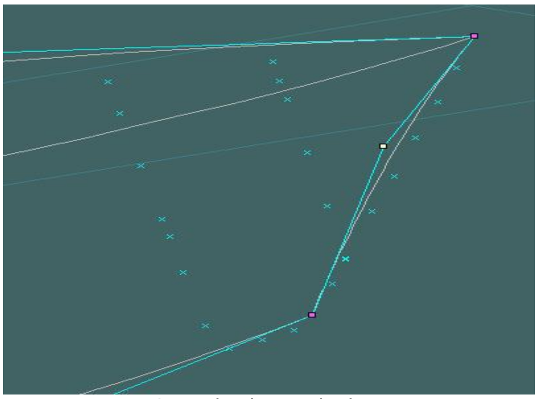
So we will start by moving the corner control points. This can be done by either using the snap control point to marker function or by simply dragging the control point to the marker with the drawing snap settings turned on.

- ➢ **Select the transom top corner Marker**
- ➢ **Whilst holding down the shift key (to select multiple objects)**
- ➢ **Select the transom top corner control point**
- ➢ **Select Markers | Snap control point to marker** 



Control points at the Transom

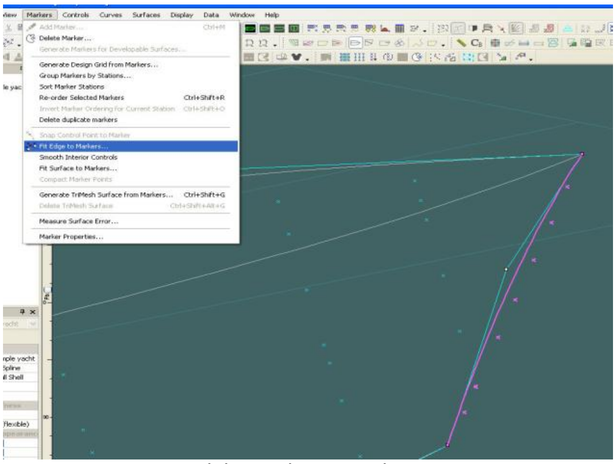
- ➢ **Now do the same for the top and bottom corner control points at the bow.**



Control points at the bow

Once the surface corner control points have been moved to the correct location we can now fit the surface edges to the Marker data using the 'Fit edge to markers' command.
Starting at the bow:

- **Select the Markers that make up the bow stem, (hold down the shift key to select multiple objects)**
- **Select the surface edge to be fitted to the markers**
- **Select Markers | Fit edge to markers** 



Fit bow edge to Markers

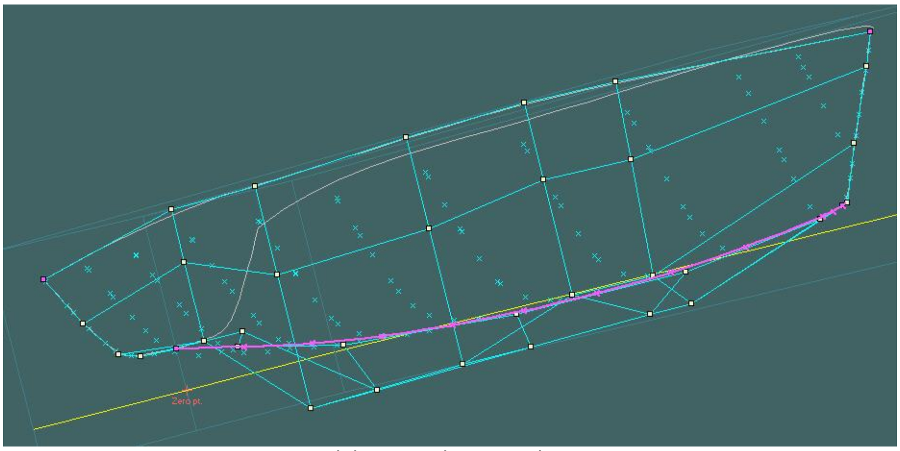
- **Select 'Yes' to leave to leaving the edge corner points where they are.**
- **Select Sort by vertical position.**

You will see that the surface edge is now fitted to the markers.

- **Now follow the same procedure for edge that makes the transom, the deck and the hull bottom (as per the example video).**

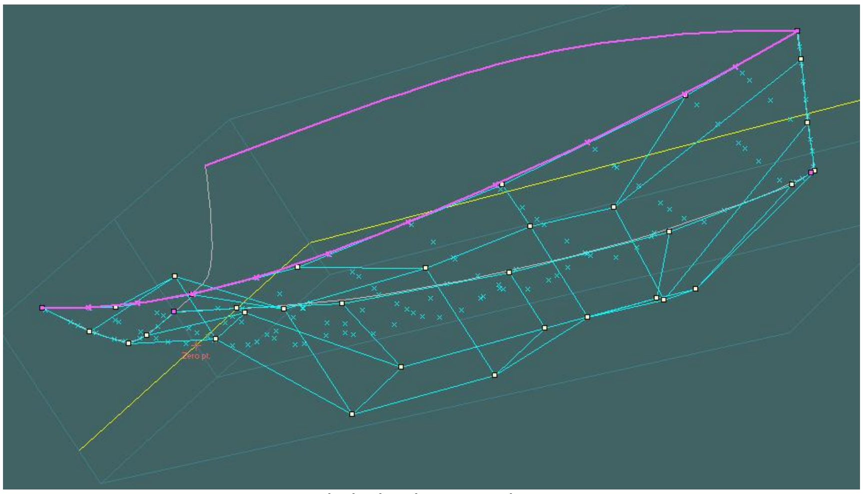
Note:
By switching views as well as locking the surfaces will make it easier to select the markers points and the surface edges. The surfaces will then need to be unlocked again prior to fitting the edge to the markers.

- **Now using the same procedure fit the surface bottom (or keel) edge to the Markers.**



Fit bottom edge to Markers

- **Now fit the surface top (or deck) edge to the Markers.**

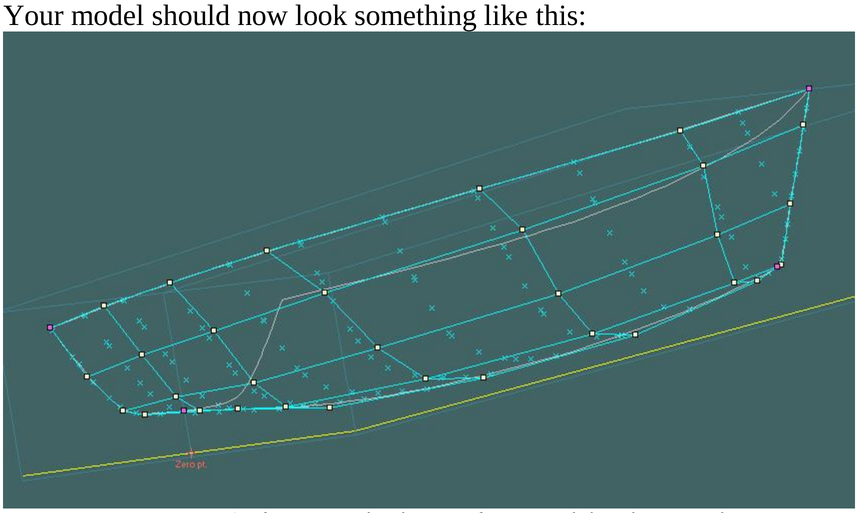


Fit deck edge to Markers

You will notice that the interior control points, displayed by turning on the surface net, may be very irregular. The Smooth surface interior command can be used to smooth the surface's interior control points to follow the shape defined by the surface's edges. This will give you a much better starting point for faring

- **Select Markers | Smooth interior Controls**

Your model should now look something like this:

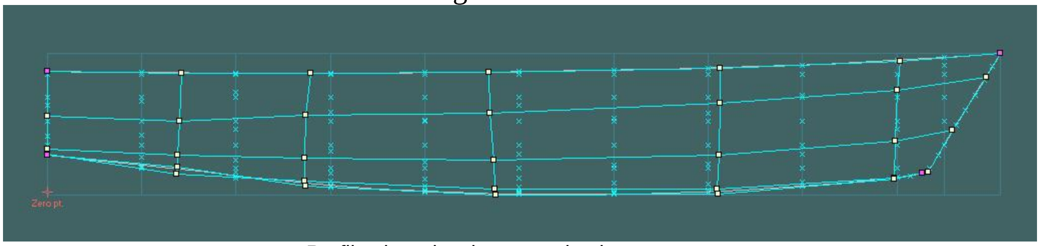


Surface control point net after smooth interior controls

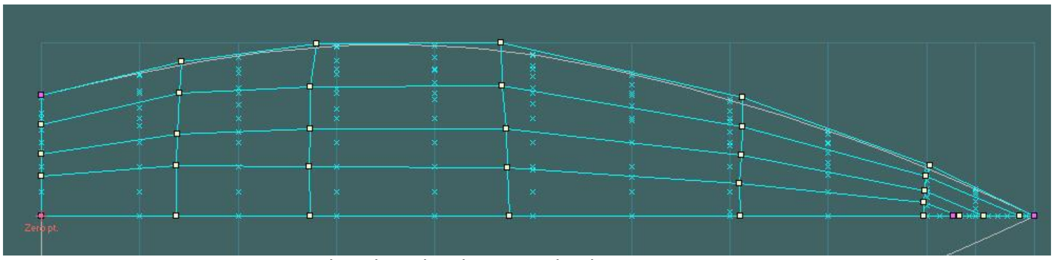
As mentioned in the chapter on Basic Fairing a Fair Net Equals Fair Surface, It is helpful if the rows and columns are near orthogonal and it is especially beneficial to try to keep the columns as vertical as possible since this makes manipulation in the body plan view much simple. However, tiding up the control point net will mean moving the surface edge control points, when doing this make sure that the surface edge doesn't deviate too far from that marker data. Note that fitting a surface to markets is an iterative process.

- **In Plan and Profile views go through and tidy up the control point net.**

You model should now look something like this:



Profile view showing control point net



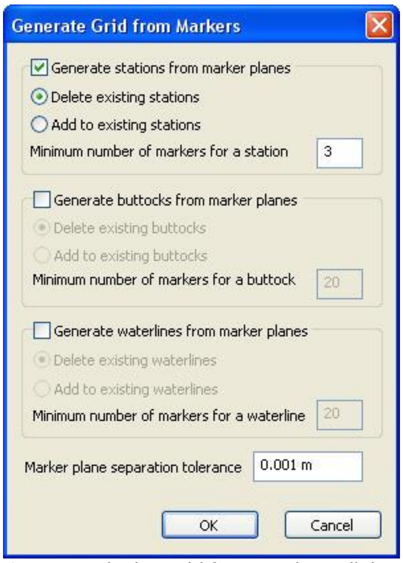
Plan view showing control point net

Now that the surface corner and edge control points are in the correct location and you are happy with the surface control point net. It is now time to move the internal control points to fit the surface to Marker data. This can be done manually or automatically using genetic algorithm surface fit function enabled by Prefit.

Prefit is a program that automatically fits surface to Marker data. It can be used as a stand alone application or as a plug-in to Maxsurf so you can take advantage of the tools in Maxsurf and Prefit to fit a surface to Marker data.

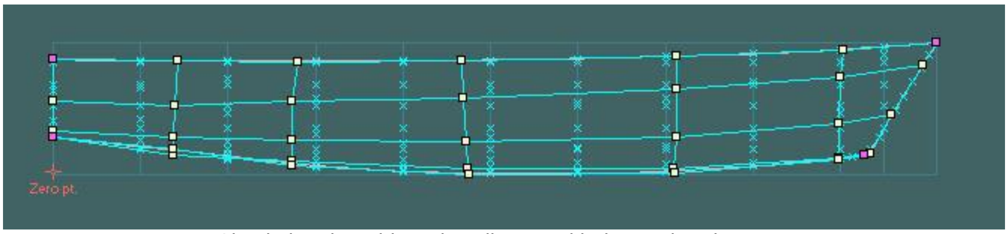
To manually fit the surface to Marker data you will need to set up a design grid that matches the Marker data. This can be quickly done by using the generate design grid from markers command.

- **Select Markers | Generate design grid from Markers**
- **Set the minimum number of markers for stations to 3**
- **Set the Marker plane separation tolerance to 0.001m & click ok**



Generate design grid from Markers dialog

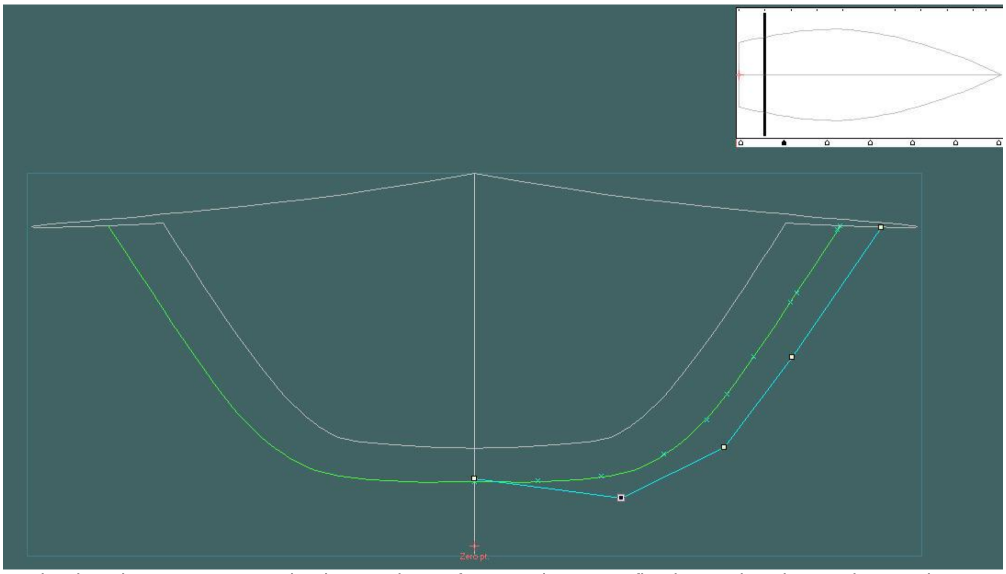
- **Select the Profile view**
- **Turn on the design grid** 
- **Check that the grid sections line up with the Marker data**



Check that the grid sections line up with the Marker data

Now the control points will be manually moved to make the surface section curves fit to the marker data. The best way to do this is in the body plan view and using the net control box go through each control point column and manipulate the control points so that the sections fit the Marker data.

- **Select the Body Plan view**
- **Turn off the sections** 
- **Turn off the Control point net** 
- **Select show markers for current station** 
- **Select the first control point net column using the net control box**
- **Move the control points so that the surface section curve fits the marker data at that section.**
- **Repeat the process for the next control point net column**

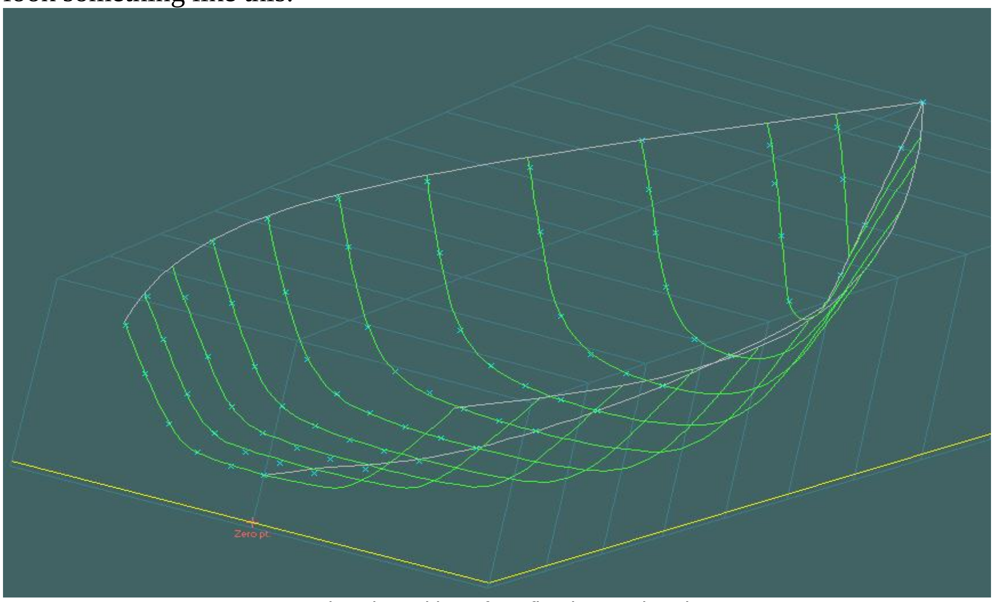


Body Plan view - move control points so the surface section curve fits the marker data at that section

You will notice that moving the internal control points at one station effects the whole surface, hence it will effect the shape of the surface section curve at another station. The process of fitting the sections to the Markers is an iterative process; you will need to go through the control point columns a few times in body plan view whilst also checking the model in the other views to manual fit the whole surface to the markers.

When fitting the surface to Markers as the same rules apply to Fairing a hullform, for more information see the chapter on Basic Fairing.

When you have finished fitting the surface to the Markers your model should look something like this:



Perspective view with surface fitted to marker data

Continue with the section on Data Export.

Data Export

Once you have created a NURB surface model there are many different data output options depending on the type of task you need to carry out. For example in case you wish to create a lines plan in CAD drafting package like AutoCAD you can export DXF lines. If you wish to continue modelling in another NURB surface modeller you can use the IGES export option.

In case you wish to analyse this design in the other modules of the Maxsurf suite, you can simply save it in the Maxsurf file format (.msd) and load it in to, for example, Hydromax. This allows you to make changes to the hull model and quickly update your Hydromax model without the need for an intermediate data exchange file.

- **Read the section on Data Output from the Maxsurf manual.**

Congratulations! You have finished the LearningMaxsurf training.

If you wish to uninstall the LearningMaxsurf installer, use Control Panel | Add or Remove software and select LearningMaxsurf.