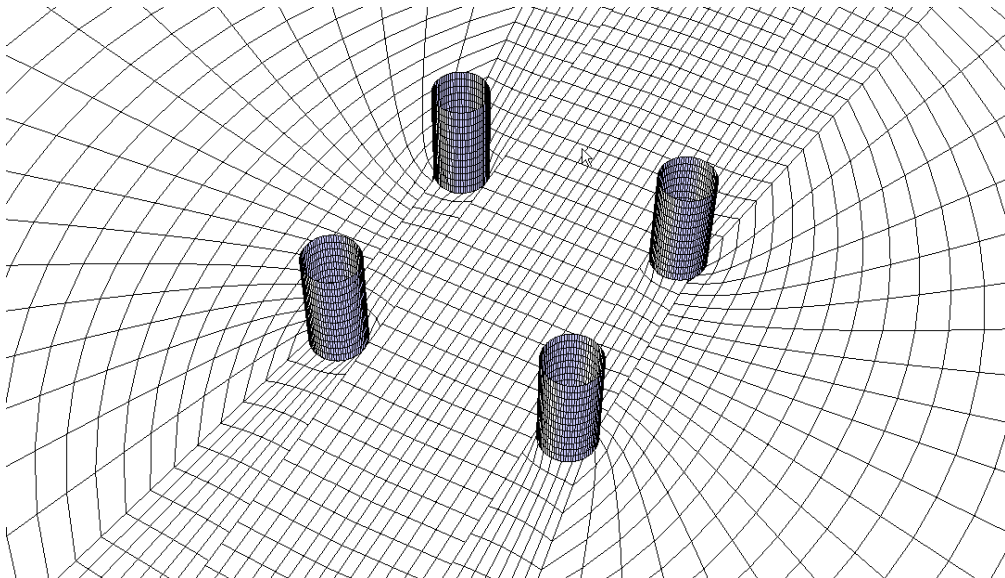




SESAM USER MANUAL

HYDROMESH



User controlled free surface meshing
for HydroD

DET NORSKE VERITAS

SESAM

User Manual

HydroMesh

User controlled free
surface meshing

1 June 2010

Valid for HydroMesh version 2.0

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DET NORSKE VERITAS

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Published by:

Det Norske Veritas Software
Veritasveien 1
N-1322 HØVIK
Norway

Telephone: +47 67 57 99 00

Facsimile: +47 67 57 72 72

E-mail, sales: software.sesam@dnv.com

E-mail, support: software.support@dnv.com

Website: www.dnvsoftware.com

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HydroMesh User Manual

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INTRODUCTION

1.1 Overview

HydroMesh is an alternative application to wasim_mesh, the mesh generating program for Wasim. The HydroMesh application computes both the model and free surface mesh. A graphical user interface called HydroMeshSetup is used to define/generate free surface mesh.

1.2 HydroMesh in the Sesam System

HydroMesh is integrated into the HydroD/SESAM system, it can also be run as a stand along program using input files created by Wasim or an XML file (free surface settings file) generated by HydroMeshSetup.

1.3 Terminology and Notation

LMB:	Left mouse button
RMB:	Right mouse button
PLN:	File format for sectional hull geometry
SSG:	File format for meshes
GEO:	File format for irregular meshes
FEM:	General SIF file format (irregular meshes)
XML:	File format for free surface mesh settings (waterline/split line coordinates, mesh-resolution etc.)
HydroMeshSetup:	User interface for HydroMesh for generating and editing free surface mesh configuration file.

2. HYDROMESH APPLICATION

This chapter provides an overview of the HydroMesh application.

2.1 Introduction

The idea about HydroMesh is to generate a free surface mesh for a section model, where the mesh parameters are controlled by the user. After reading in the waterline from an SSG file, automatically generated by wasim_mesh or HydroMesh, the free surface will be cut into user defined mesh patches. SSG/GEO/FEM/XML files will be used to store the final mesh data.

2.2 Command line arguments

HydroMesh execution:

HydroMesh.exe "filename" _fs.xml

This should generate the free surface and hull mesh files (SSG, GEO, FEM).

3. HYDROMESHSETUP APPLICATION

3.1 Introduction

HydroMeshSetup is used to read in waterline coordinates, divide the free surface into user defined patches and finally store the result in an XML file. This XML file could be read into HydroMeshSetup again for further editing.

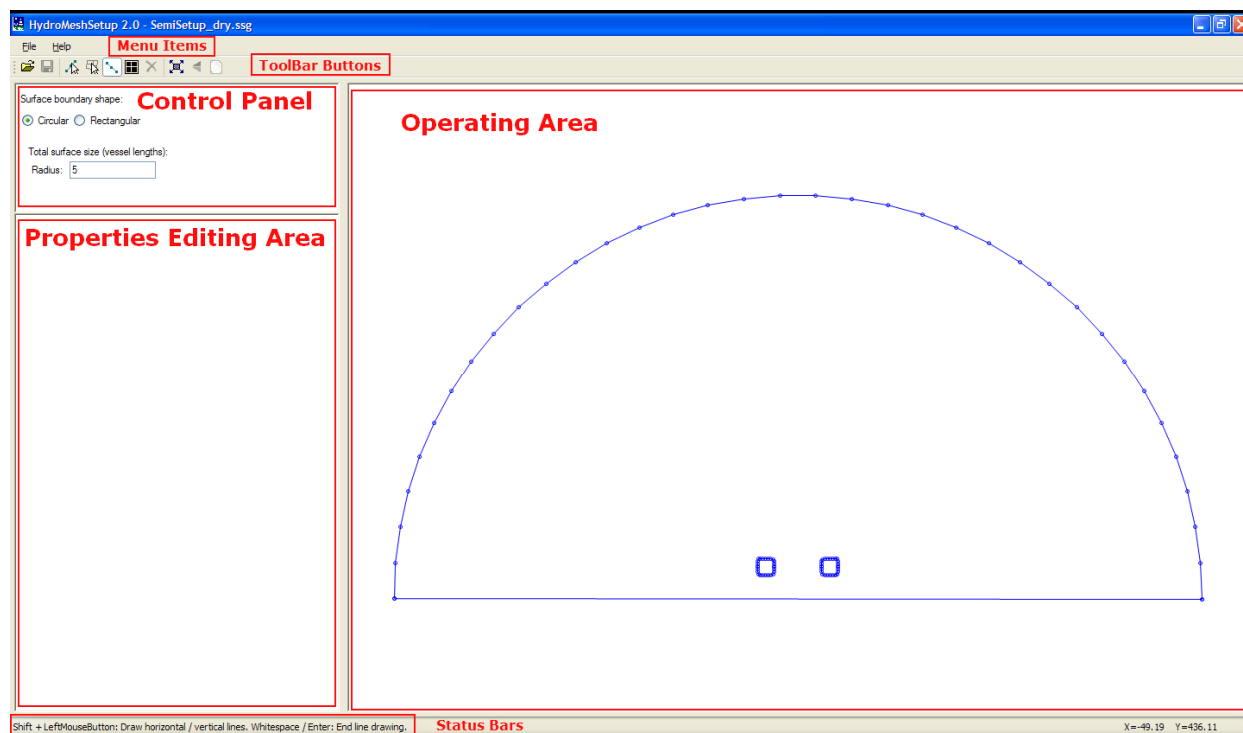
3.2 Command line arguments

HydroMeshSetup execution:

HydroMeshSetup.exe "filename"_dry.ssg "filename"_fs.xml

If the surface settings file exists, the settings will be imported, otherwise the file will be created.

3.3 Application Window



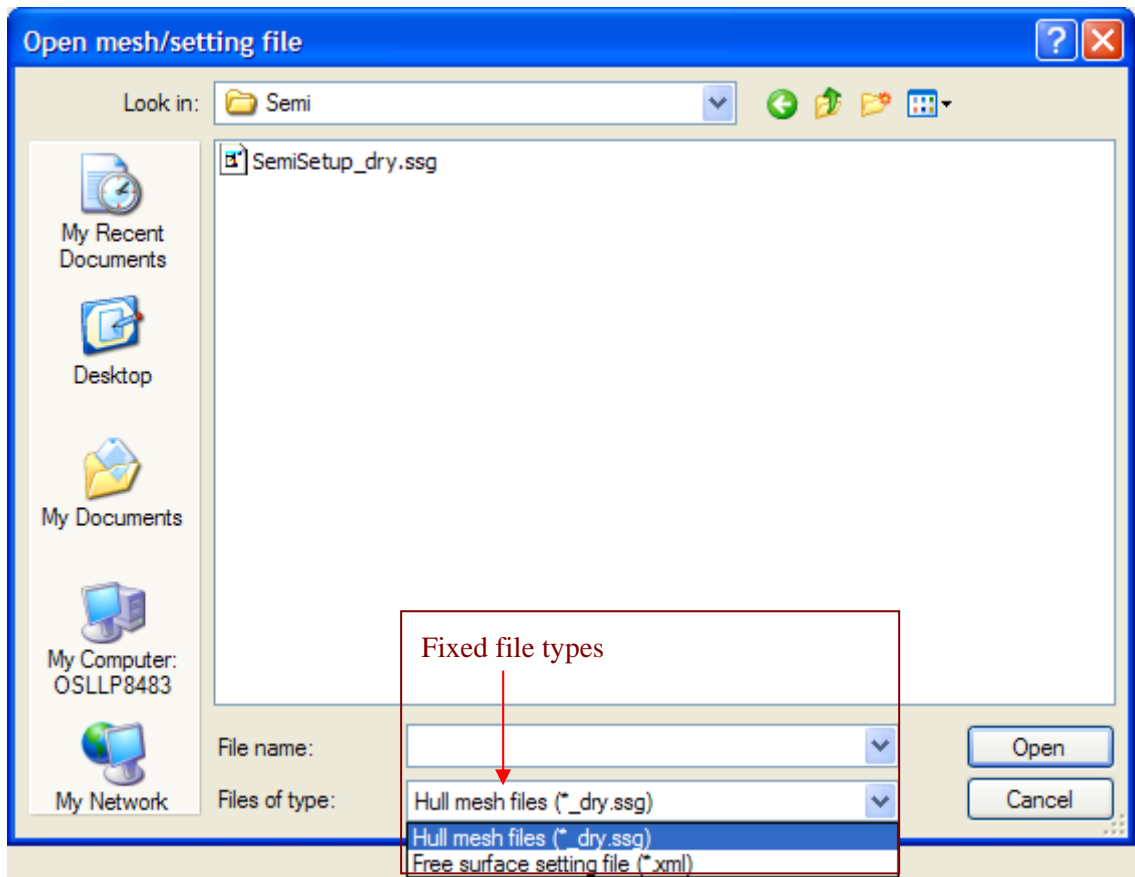
3.4 User interface

3.4.1 Menu Items & Tool Bar Buttons

- **Menu Items**

1. “Open ...” menu item

When choose “Open...” a file open dialog will appear, in which the file type is fixed.



2. “Save” menu item


Save the free surface setting into xml configuration file, the file name is ended with *_fs.xml.


3. “Exit” menu item


Exit the HydroMeshSetup.exe.


- **Tool Bar Buttons**









 Open file button. Shortcut: Ctrl + O

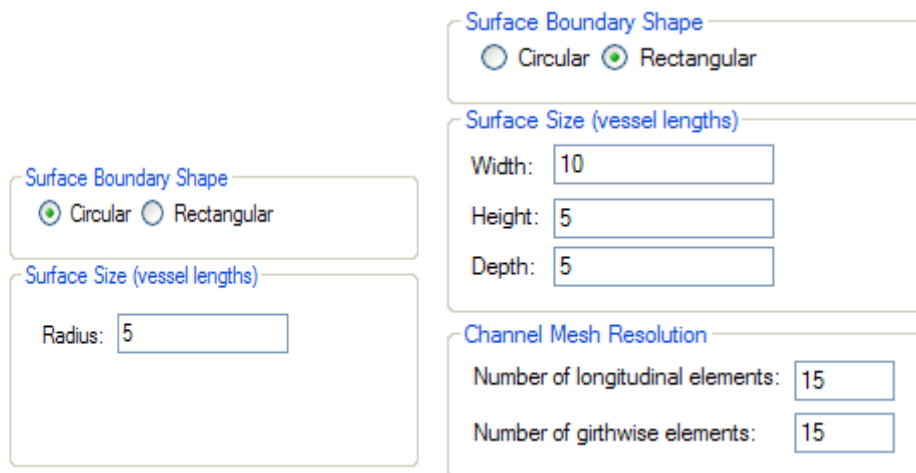
 Save file button, available only when changing has been made. Shortcut: Ctrl + S

 Select split line mode, click to select split line to edit its properties. Shortcut: S

 Select patch mode, click to select a patch to edit its properties. Shortcut: P

-  Draw lines mode button, click in operating area to draw a split line. Shortcut: D
-  Create patch mode button, click in closed region to create a mesh patch. Shortcut: C
-  Delete mode button. Delete selected patch or split line. Shortcut: E
-  Scale content to window button, click to zoom the free surface to fit the window. Shortcut: F
-  Mirror the model button, available only when the model is not symmetric. Shortcut: M
-  Clear mesh button, remove all user defined patches and split lines. Shortcut: L

3.4.2 Control panel



The control panel consists of three main sections:

- Surface Boundary Shape:** Contains two radio buttons: ☐ Circular and ☒ Rectangular.
- Surface Size (vessel lengths):** Contains three input fields: Width: 10, Height: 5, and Depth: 5.
- Channel Mesh Resolution:** Contains two input fields: Number of longitudinal elements: 15 and Number of girthwise elements: 15.

- **Surface boundary shape**

Select the shape of the free surface boundary condition shape, you could choose either circular or rectangular boundary shape.

- **Aspect Ratio Check**

You could check the aspect ratio of the free surface patch as follows:

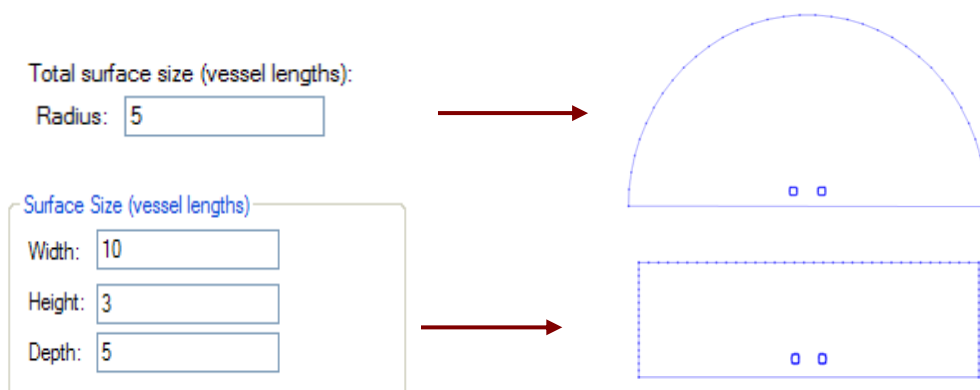


The dialog box titled "Minimum Aspect Ratio" has a text input field containing "0.03" and a "Check" button.

When you press the “Check” button, any invalid patch whose aspect ratio is less than the value specified in the above TextBox will be highlighted in red color.

- **Total surface size (vessel lengths)**

The surface size value decides the size of the free surface, by default the radius is 5 vessel lengths, the width is 10, and the height is 5, the depth is 5.



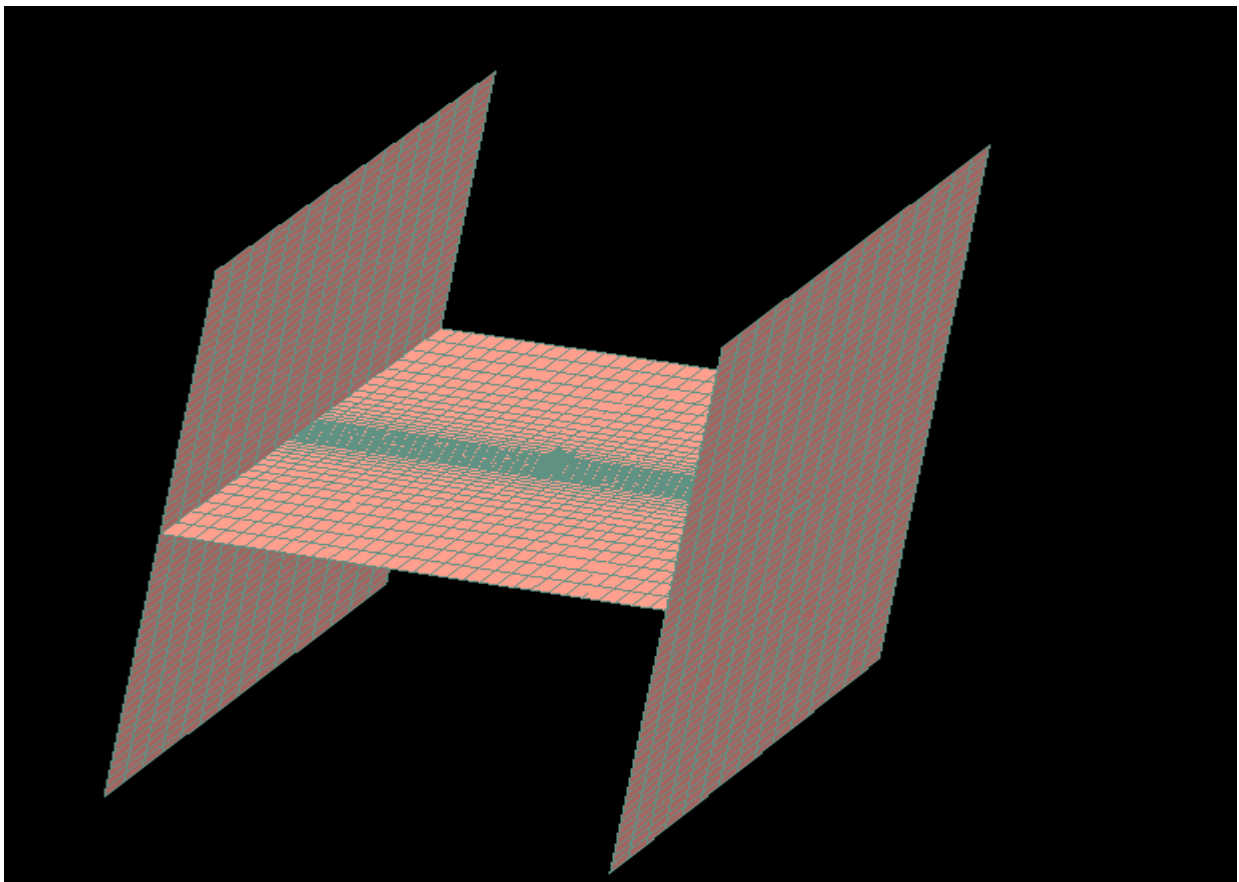
- **Channel Mesh Resolution.**

This could change the mesh resolution for the both sides of channel at the girth wise and longitudinal direction, you could only examine the mesh resolution visually from HydroD:

Channel Mesh Resolution

Number of longitudinal elements:	<input type="text" value="15"/>
Number of girthwise elements:	<input type="text" value="30"/>

1. Mesh Resolution Setting from HydroMesh



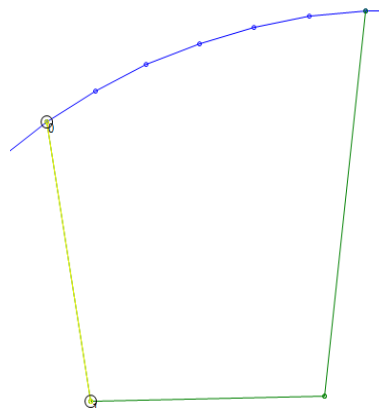
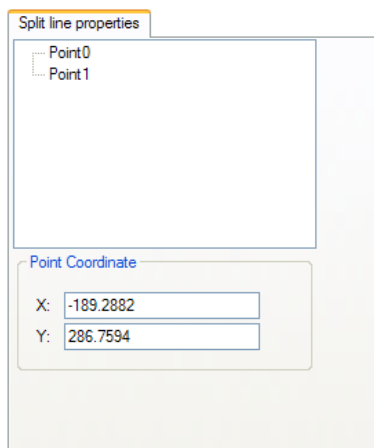
2. 3D Mesh Visualization in HydroD

3.4.3 Properties Editing Area

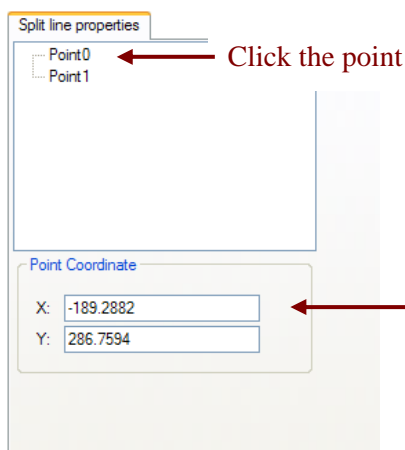
The properties editing area contains two editors: Split line properties editor and Patch properties editor.

- **Split line properties editor**

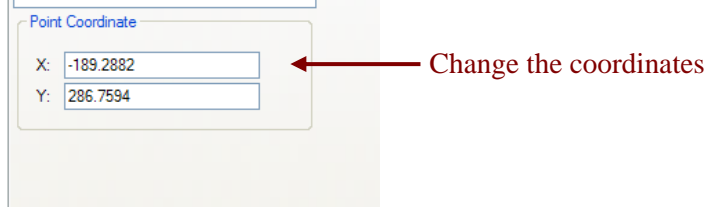
Select a split line (high lighted in yellow), the editor will show in the properties editing area.



The coordinates of any point could be changed manually, simply by clicking the point on the list then enter the new coordinates in the textboxes.



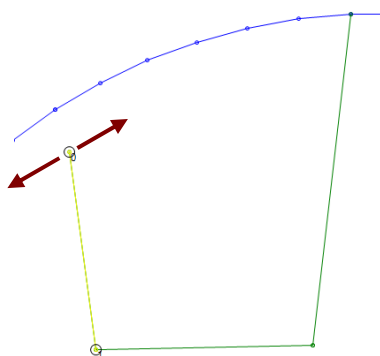
Click the point



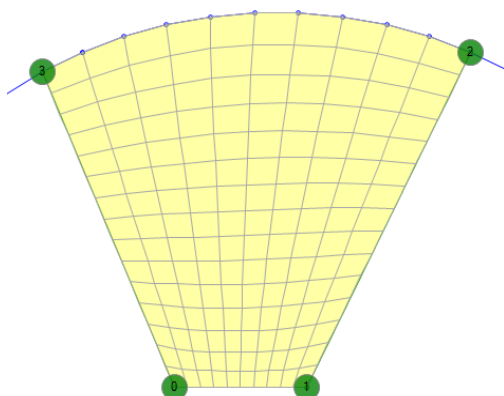
Change the coordinates

The point's location can be changed by dragging it as well.

Select the point and drag



- **Patch Properties Editor**

Patch Resolution

When a patch is selected in the operating area, the patch properties editor will show up.

Patch Resolution Stretch Condition Poisson

Mesh Resolution

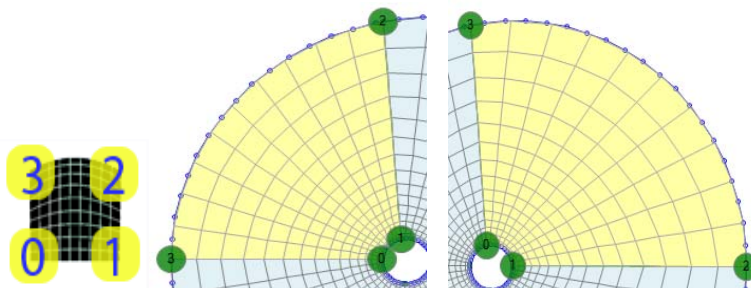
3 2
0 1 15
10 Rotate Patch

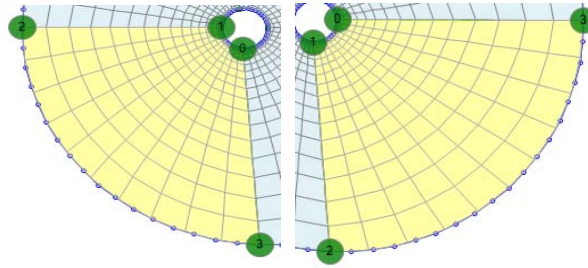
Corner Points

Point 0	(-93.02, 113.16)	Point 1	(26.85, 113.16)
Point 2	(176.40, 412.70)	Point 3	(-212.68, 395.23)

Mesh resolution can be changed by input new values in the textbox as shown in the picture above. The corner points' group box shows corner points coordinates (not editable).

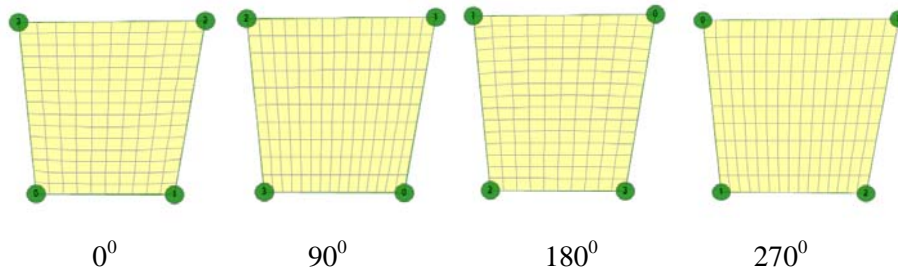
It's highly recommended that the corner order of the currently edited patch in the operating area matches exactly as the corner order displayed in the Patch Resolution tab as follows:





As above pictures shows, the edge marked from 0 – 1 for each four patches in four different quadrants are near the centre of the free surface physical domain.

In order to achieve this, you could click the “RotatePatch” button; it will rotate the corner 90° around the counter clockwise direction for each click as follows:



The edges tab page shows how many points are from waterline on each edge.

Stretch Condition

Patch Resolution **Stretch Condition** Poisson

Stretching condition on each edge

Edge	P	Q	Reverse Orientation
0 — 1	1	1	<input checked="" type="checkbox"/>
1 — 2	1	1	<input checked="" type="checkbox"/>
2 — 3	1	1	<input type="checkbox"/>
3 — 0	1	1	<input type="checkbox"/>

“Stretch Condition” tab page could define the point distribution (stretching) for a specified edge. The stretch function HydroMesh uses is:

$$s = P\eta^* + (1 - P)\left(1 - \frac{\tanh[Q(1 - \eta^*)]}{\tanh Q}\right)$$

The following is the definition for each column:

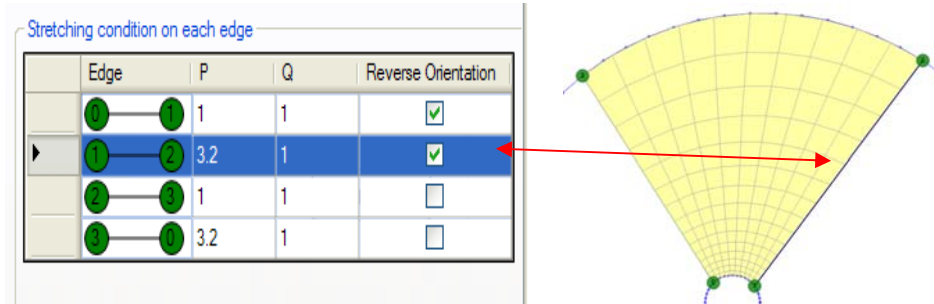
Edge: List the four edges which you could define stretch condition for.

P: This parameter controls the slope of the distribution, usually you could choose a value between 2 ~ 5 inclusive.

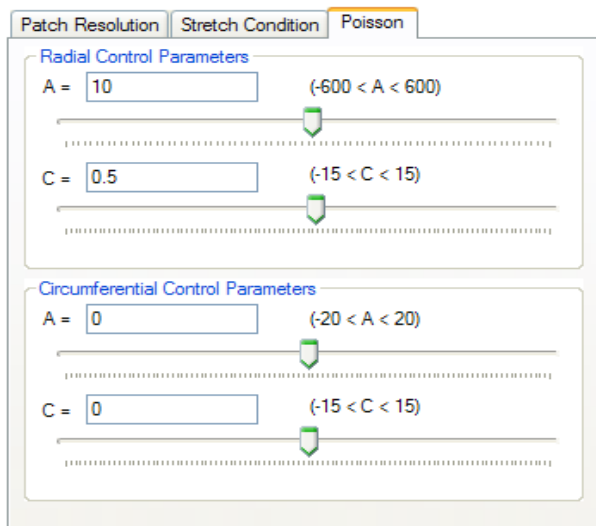
Q: This parameter controls the departure from linearity, by default, HydroMesh use linear spline interpolation to equally divide the patch edge based on the mesh resolution you set from the “Mesh Resolution” tab page.

Reverse Orientation: This could which direction / orientation the point distribution should follow.

When you select edge from the “Stretch Condition” tab page, the corresponding edge will be highlighted in the operating area:



Poisson




In “Poisson” tab page, you could control the interior mesh orientation both at radial and circumferential direction, HydroMesh uses the following Poisson control function for both radial and circumferential mesh control:

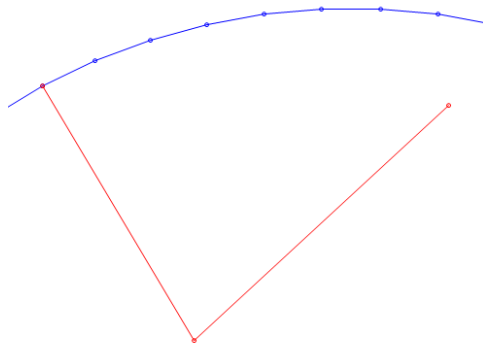
$$P = Q = -ae^{-c}$$

3.4.4 Operating Area

Draw Lines mode

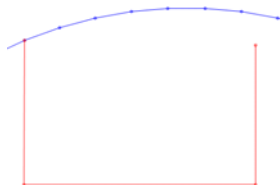
You can go to the “Draw Line Mode” by press the  button in the toolbar.

- Draw split line (see 3.4.1 Button bar)

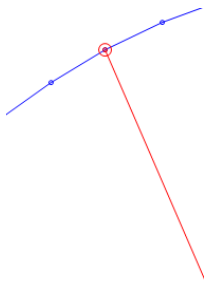


* Split line shows in red when creating, and will not take effort before “Enter” or “whitespace” key is pressed.

- Draw orthogonal (horizontal or vertical) split lines by pressing shift key when moving the mouse to draw the lines as follows:




- The program will automatically snap to the intersecting points when you move the mouse near those points as follows:



* The red circle will be displayed when point are snapped.

Select Split Line Mode

You can go to the “Select Split Line Mode” by press the  button in the toolbar.

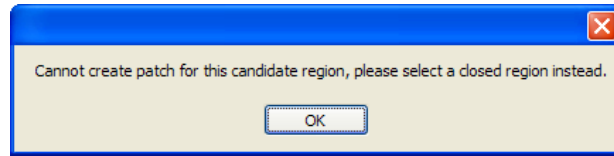
- Move split line nodes (see 3.4.3 Split line properties editor)
- Select split line using mouse
- Delete selected split line[s] by either pressing “delete” or “e” key or press  button in the toolbar.
- Multi select split lines by pressing “shift” key, then subsequently use mouse to select lines.

Create Patch Mode

You could go to the “Create Patch Mode” by clicking the button in the toolbar.

Then you could use mouse to select to closed regions to create patch.

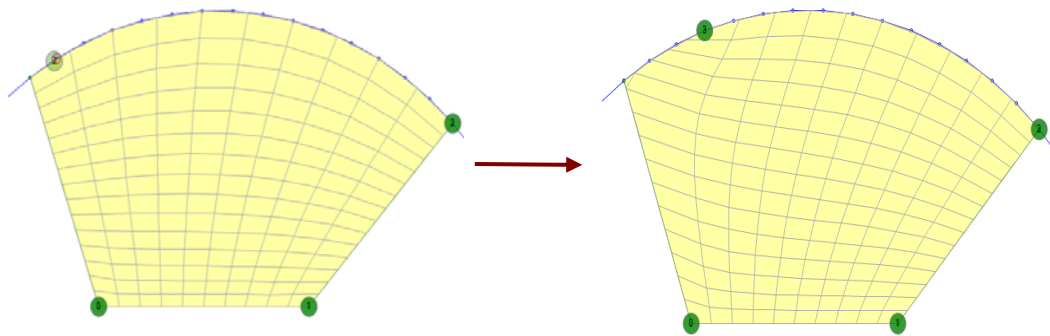
* You could select a closed region; otherwise no patch will be created, and a dialog will be popped up to inform you:



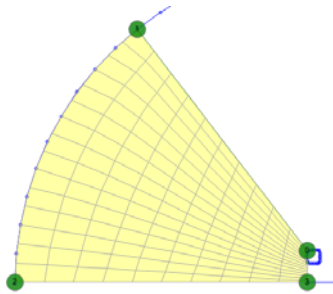
Select Patch Mode

- Moves patch corner points.

You could drag one of the patch corner points to the desired intersecting points for the patch, when you drag the corner near a specified point, a red circle will be displayed as following left hand side picture shows, when you could release the mouse, the program will automatically update the patch as the following right hand side picture shows:




* Sometimes the mesh doesn't like nice as follows:



One simply way to fix this issue is going to the patch property editor, select "Mesh Resolution" tab page (see 3.4.3 "Patch Resolution" for further reference). Then you could try change the order of the corner points by continuously click the "RotatePatch" button until the The edge marked as 0 – 1 is near the centre of the free surface.

Another way to fix this issue is go to the "Poisson" tab page (see "3.4.3 Poisson" for further reference) to control the circumferential and radial control parameters.

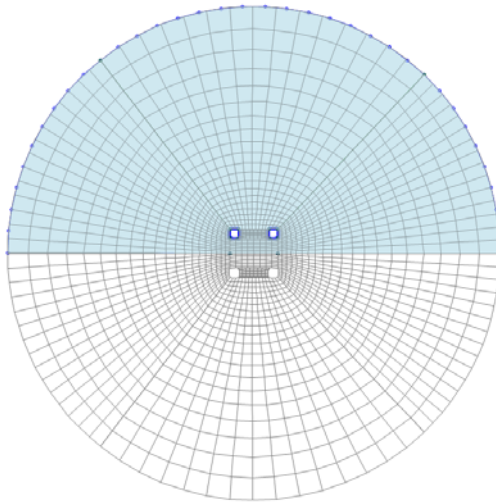
- Delete selected patch by either pressing "delete" or "e" key or press  button in the toolbar.
- Create patch. You could create patch in "Select Patch Mode" by pressing shift key, then use the mouse to pick up a closed region to create patch, after the patch is created, it will be in selected mode. Then you could do further operations on it such as redefining corner points, stretch condition and Poisson control parameters.
- Select patch edge for stretch condition definition.

When a patch is selected, you could move the cursor near one of its patch edge to select the edge, then the “Stretch Condition” tab page will be displayed, the subsequent operation is the same as specified in 3.4.3 “Stretch Condition”.

- Copy & Paste patch properties.

If you want to share patch property settings across different patches, you could select a source patch first, then press CTRL + C to copy those patch properties into clipboard, then select another patch, press CTRL+ V to paste the patch properties to the destination patch, then the two patches will share the same patch property settings.

-  Show Mirrored Mesh (only when section model is symmetric, see 3.4.1 Button bar)



- * The mirrored patches are displayed in white colour.

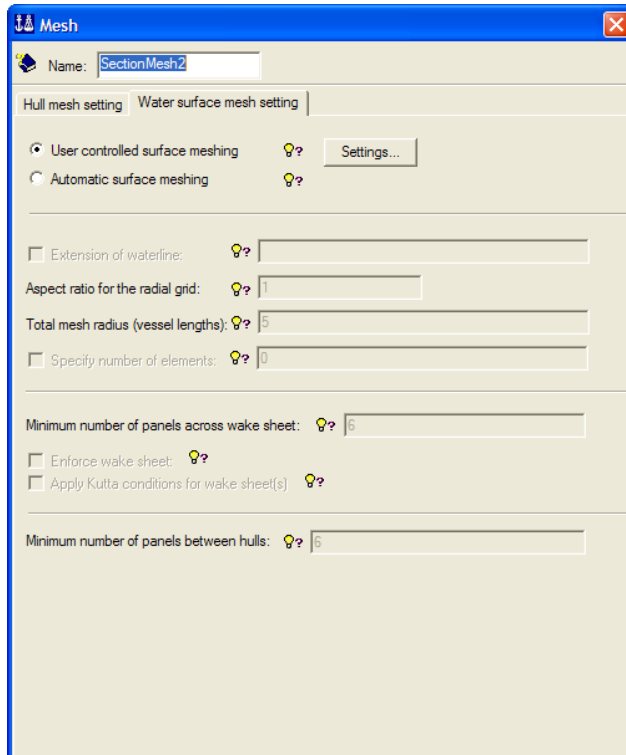
3.4.5 Status Bar Area



- The left hand side of the status bar shows the “helper message” telling you the different operations you could perform in each mode, “Draw Split Lines” mode, “Create Patch” mode etc.
- The right hand side of the status bar displays the coordinates of cursor position.

3.5 Integration with HydroD

- **Alternative 1**



The “Settings...” button starts the HydroMeshSetup application, and generate “filename”_fs.xml file after quit, then HydroMesh will read the XML file and generates data files (see section 3.6).

- **Alternative 2**

An existing SectionMesh can also be edited by selecting the “Edit surface mesh settings...” item on the right click menu. This will start the HydroMeshSetup program, and regenerate the mesh when the program finishes.

3.6 Data organization

3.6.1 HydroMeshSetup input/output files

- **Input**

“filename”_dry.ssg: dry hull mesh file.

“filename”_fs.xml: user defined free surface mesh setting file.

- **Output**

“filename”_fs.xml: user defined free surface mesh setting file.

3.6.2 HydroMesh input/output files

- **Input**

“filename”.pln: section model hull geometry file.

“filename”_fs.xml: user defined free surface mesh setting file.

- **Output**

Dry hull mesh file: “filename”_dry.ssg and “filename”_dry.geo (irregular mesh file)

Wet hull mesh file: “filename”_wet.ssg and “filename”_wet.geo (irregular mesh file)

Free surface mesh file: “filename”_fs.ssg and “filename”_fs.geo (irregular mesh file)

Combined mesh file (free surface & wet hull)

“filename”.ssg and “filename”.geo (irregular mesh file)

Files using SIF file format:

T7301.FEM (Dry hull)

T7302.FEM (Wet hull)

T7303.FEM (Free surface)

T7310.FEM (T7301 + T7302 + T7303) + mirror images in the case of symmetry

T7320.FEM (TT7301 + T7302)

T7373.FEM (Mesh of free surface in global coordinates system)

T7374.FEM (Symmetric free surface mesh, it will be generated only when the model is symmetric)