Introduction to AQWA

**INTRODUCTION TO ANSYS**

**Hydrodynamic Diffraction (AQWA)**

*ANSYS* Hydrodynamic Diffraction (AQWA) is used for generating the fundamental hydrodynamic parameters required for undertaking complex motions and response simulations using a three dimensional wave radiation and diffraction analysis.

**Topics Covered in this tutorial**
- Geometry definition using ANSYS DesignModeler
- Creating and Meshing a Structure for AQWA
- Setting up Wave Information
- Performing Hydrostatic, Hydrodynamic, and Pressures & Motions Analyses

Start the tutorial by clicking here.

Begin by dragging a **Hydrodynamic Diffraction (AQWA)** Analysis System onto the Project Schematic.

Right-click **Geometry** and select **New Geometry**...
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Set your desired length unit to Meter.

DesignModeler is loaded.

We will work in the XY plane since it is recognized as the water surface in AQWA. Click XYPlane.

Notice that for large models you can enable large model support.
Click Circle.

Click Dimensions to open the Dimensions toolbox...

Click the origin for the center of the circle. Click elsewhere to define the radius length.

... And click Radius.
Click the circle to add a radius dimension.

Click elsewhere to place the dimension name.

Click Extrude.

Set R1 to 10 m.
In this case, the first Extent Type represents the height above water level.

Click the Blue Sphere to reorient the geometry to an isometric view.

Set Direction to Both - Asymmetric.

Extent Type 2 represents the distance below water level. We will set both Extent Type Depths to 20 m.
Notice the extents are used to define the extents of the cylinder.

Click Thin/Surface.

Click Generate.

Set Selection Type to Bodies Only.
Click the yellow field to enter selection mode.

Click Apply.

Set Thickness to 0 m.
This is crucial since AQWA only processes surface bodies and line bodies. Having a thickness of 0 creates a surface body.
Click Generate.

Now you should check the directions of the surface normals. We want them to be pointing outward. When you click on a surface it should become green. If it only becomes outlined, this means the surface normal is pointing inward.

To reverse the surface normals:
Click Tools > select Surface Flip > select the necessary bodies > click Apply in the Details View.

For Hydrodynamic Analyses, bodies need to be separated at the water line. To do this, we must slice our body along the XY plane.
Click **Tools** > select **Freeze**.
Bodies need to be frozen in order to be sliced.

Click **Create** > select **Slice**.

Click **XYPlane** to act as the slicing plane.

Click **Apply**.
Click Generate.

But first, let's rename these parts to Upper Hull and Submerged Hull. Expand the 2 Parts, 2 Bodies branch.

Notice that there are now two separate bodies and their normals are pointing outwards. However, AQWA requires that these be constituents of the same part.

Right-click the body > select Rename > enter Upper Hull.
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Similarly, rename the lower to Submerged Hull.

Hold CTRL > select both bodies > right-click them > select Form New Part.

Right-click Part > select Rename > enter Cylinder.

Close DesignModeler.
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- Right-click Model > select Edit...
- The geometry has been loaded into the *Hydrodynamic Diffraction* application.
- The object we've created is highlighted in green.
- The water surface is represented by a transparent blue surface.
The sea bed is represented by an opaque grey surface.

You can edit geometry details in the Details View.

Increasing Water Level raises the water in the +Z direction. Increasing Water Depth lowers the sea bed in the -Z direction.

Right-click Cylinder > select Add > select Point Mass.
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Set fxx and fyy to 9.3e9 kg.m^2, set fzz to 3.24e9 kg.m^2.

You can click Analysis Settings to view and edit the analysis and print options.

Click Mesh. Notice you can change the Max Element Size. However, for this tutorial, leave it at 5 m.

Click Wave Directions > set No of Intermediate Directions to 15. This will solve for 17 wave directions.
Click Wave Frequencies > set Total Number of Frequencies to 8. This will solve for 8 different wave frequencies.

Select Hydrodynamic Graph > set Line A Structure to Cylinder > set Type to RAOs > set Component to Global Y > set Direction to Direction 5 (-90°).

Insert results by right-clicking Solution > selecting Insert Results > selecting a result.

Insert one Hydrostatic, one Hydrodynamic Graph, and two Pressures and Motions results.

Select the first Pressures and Motions > set Frequency to 0.228 Hz > set Incident Wave Amplitude to 2 m > set Above Water Body Display to Zero Pressure.
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Select the second Pressures and Motions >
set Frequency to 0.228 Hz >
set Incident Wave Amplitude to 2 m >
set Result Type to Amplitude >
set Above Water Body Display to Zero Pressure.

Select Solution >
click Solve.

Click Hydrostatic Graph to view
the RAOs plot in the Output view.

Click Hydrostatic >
click the Properties tab to view
the AQWA Hydrostatic Results.
Click the first **Pressures and Motions**. Close the **Output** view, rotate, and zoom to get a better view of the contours.

Click on the second **Pressures and Motions** to view its plot.

You can examine the model here.

Close **Hydrodynamic Diffraction** and return to the **Workbench window**.
What Have We Learned?

- How to create a structure for AQWA
- How to mesh a structure for AQWA
- How to set up wave data
- How to analyze hydrostatic and hydrodynamic data
- How to analyze pressures & motions information