Introduction to Hydrodynamic Analysis with Ansys Aqwa

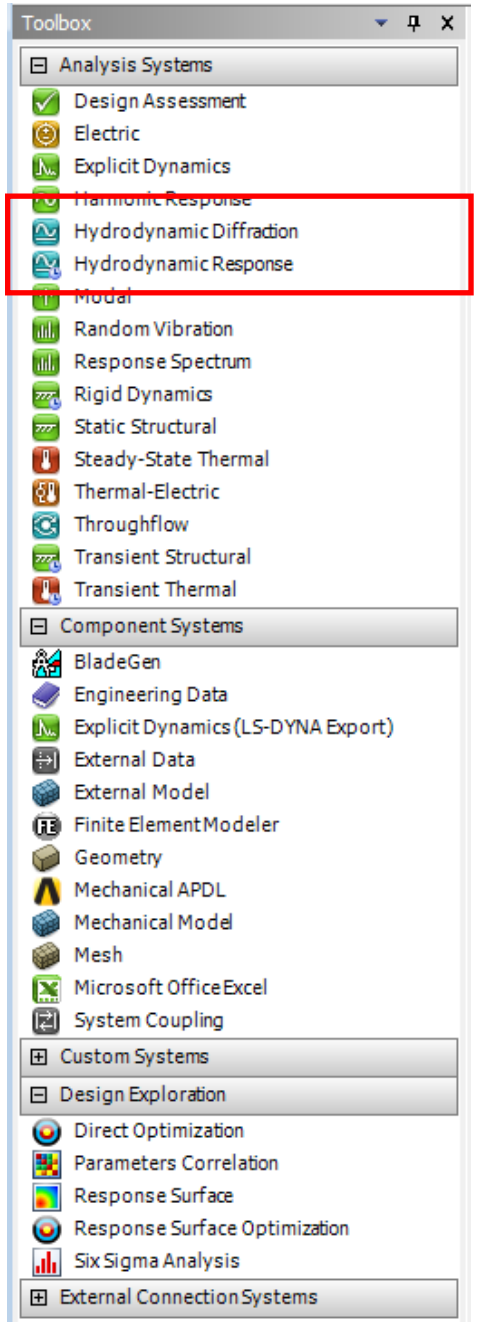
Module 04: Aqwa Basics – Hydrodynamic Diffraction

Release 2021 R2

Aqwa Workbench Basics

There are two Aqwa Workbench systems available:

- Hydrodynamic Diffraction (HD)
  - Analysis of a freely-floating structure or group of structures
  - Regular waves at defined frequencies analysed over defined wave directions
  - Provides the hydrodynamic coefficients for use in subsequent Hydrodynamic Response systems
- Hydrodynamic Response (HR)
  - Environment defined by wind, current, regular or irregular waves
  - Connections defined as cables, joints, fenders or tethers/risers
  - Estimation of equilibrium position, static and dynamic stability
  - Frequency domain statistical analysis
  - Time domain analysis



Aqwa Workbench Basics

Aqwa Workbench shares common conventions with other Workbench products, where appropriate.

The basic interface consists of a number of areas:

- Toolbars
- Analysis tree
- Details panel
- Graphical model representation and results presentation or textual results

Aqwa Workbench Basics

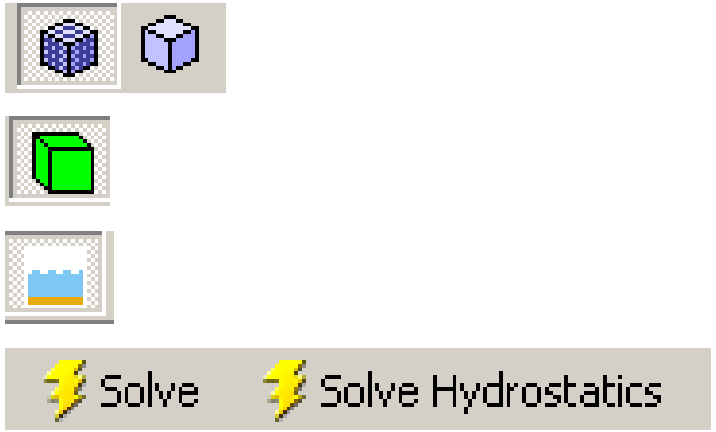
Standard Workbench Toolbars

View manipulation

Selection control

File shortcuts

Aqwa Specific Toolbars

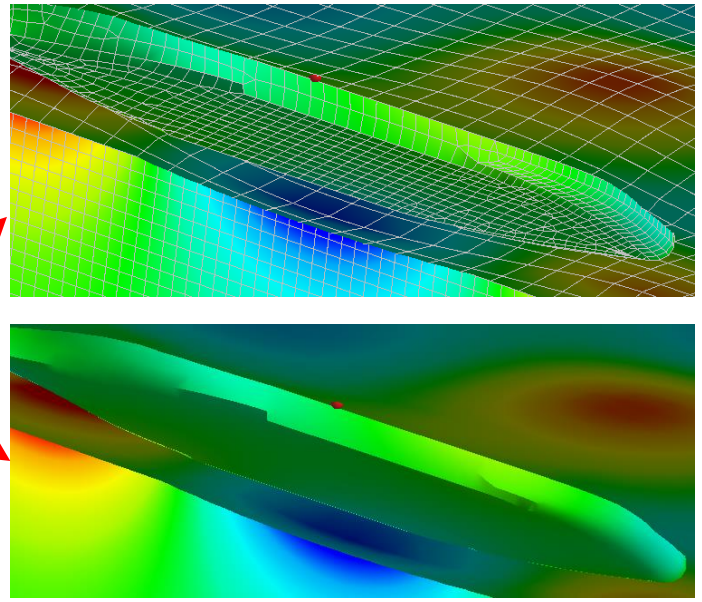


Show/Hide element boundaries

Turn on/off object highlighting

Show/Hide Seabed and Water Surface

Solve shortcuts

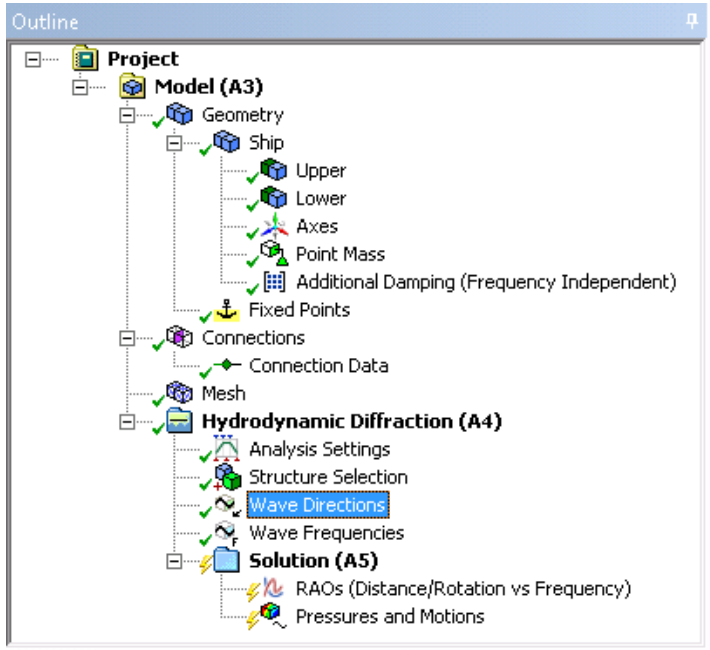


Aqwa Workbench Basics

Tree view

- As with other Workbench applications, the Outline tree and Details panel are used to define the organization of the simulation requirements and associated data.

- As a tree object is selected the data related to that object will be presented in the Details panel.



Details

Details of Wave Directions	
Name	Wave Directions
Visibility	Visible
Type	Range of Directions, Forward Speed
Forward Speed	3.2 m/s
Required Wave Input	
Wave Range	-180° to 180°
Interval	45°
Number of Intermediate Directions	7
Optional Wave Directions A	
Additional Range	Single
Start Angle	30°
Optional Wave Directions B	
Additional Range	None
Optional Wave Directions C	
Additional Range	None
Optional Wave Directions D	
Additional Range	None

Aqwa Workbench Basics

Tree view

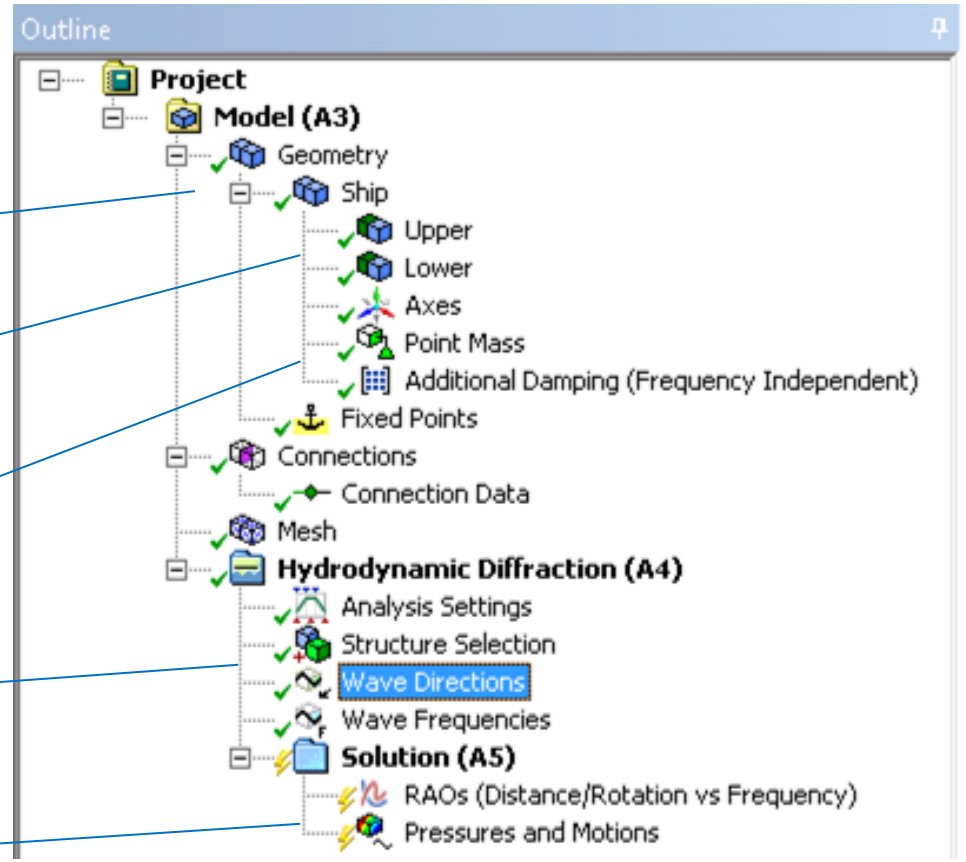
Each vessel/structure is associated with a Part – in this case “Ship”

Bodies make up a Part. These are defined in the CAD system (e.g. SpaceClaim)

Some Aqwa-specific geometry-based objects may be added directly within Aqwa Workbench

Objects that define the additional data required for undertaking the Hydrodynamic analysis

Results objects that may be added as required. When selected, they change the view in the main Graphics window



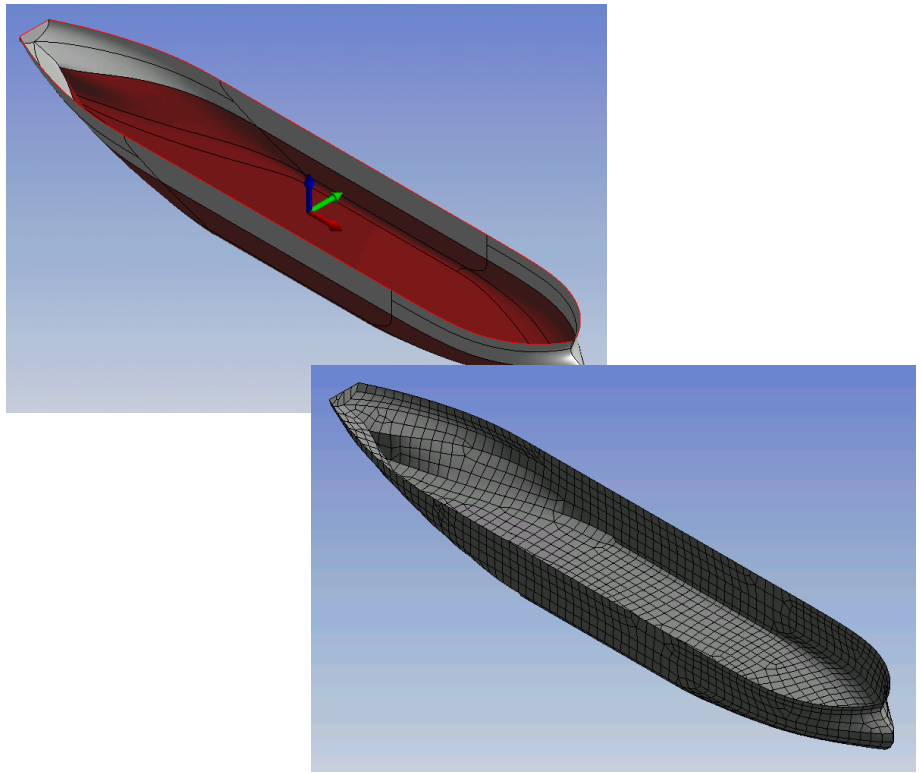
Object states:

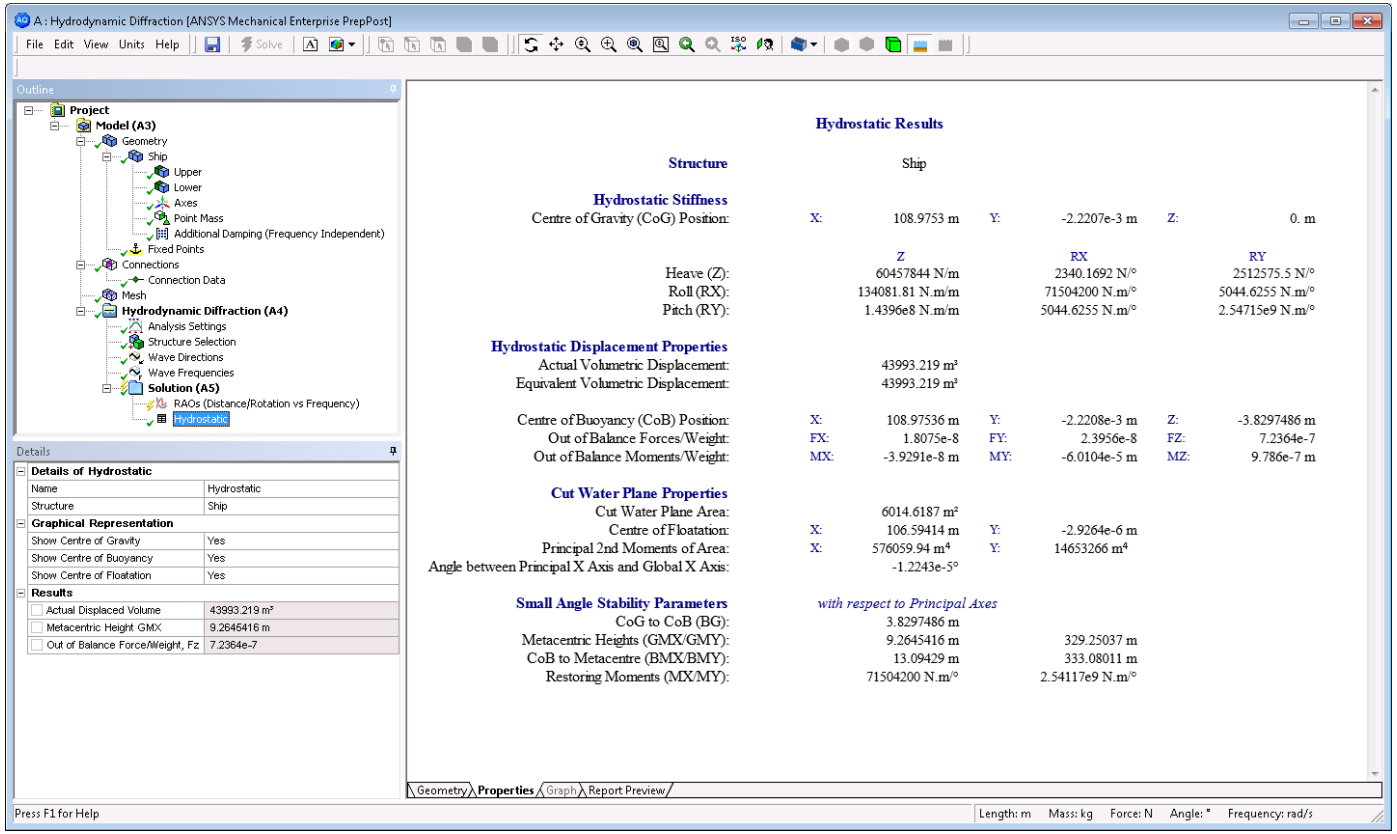
- Object excluded
- Object included, and up-to-date
- Object invalid or requires attention
- Object requires update
- Object is up-to-date for the Hydrostatics solve

Aqwa Workbench Basics

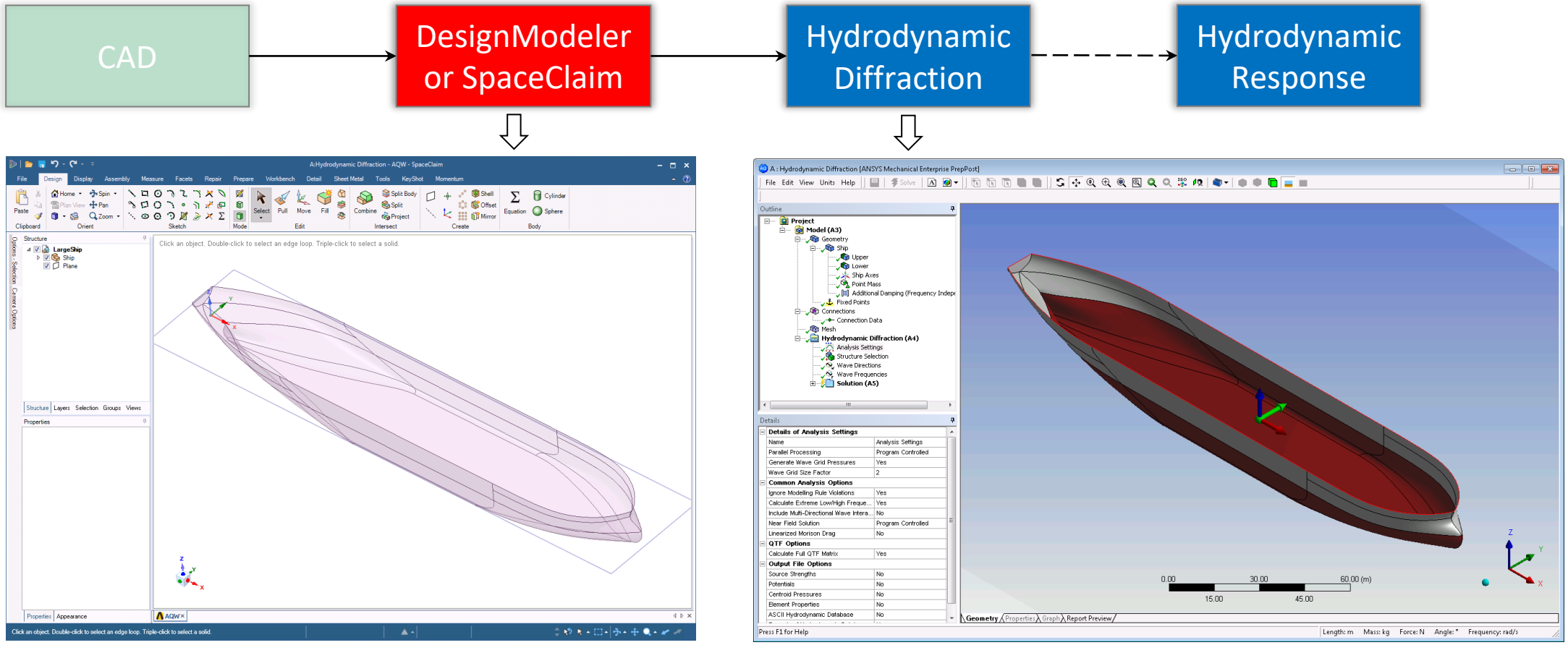
The main graphical area responds to what is selected in the object tree

- If geometry or mesh-based information is selected, this will show a visualization of the information requested on the Geometry tab.
- If textual results are requested (such as Hydrostatic information) these will be shown on the Properties tab.





The Hydrodynamic Diffraction Simulation Process



Creating Geometry for Import to Aqwa Workbench

Aqwa Workbench imports geometry from SpaceClaim or DesignModeler, which is used to create the majority of the Aqwa model (using either the generation capabilities of SpaceClaim/DesignModeler directly, or importing from an external CAD system)

- Hull definition
- Morison elements

For Aqwa-specific geometry this is input via the Aqwa Workbench user interface

- Point masses/buoyancies
- Disc elements

The main requirements for an Aqwa Workbench analysis can be summarized as follows:

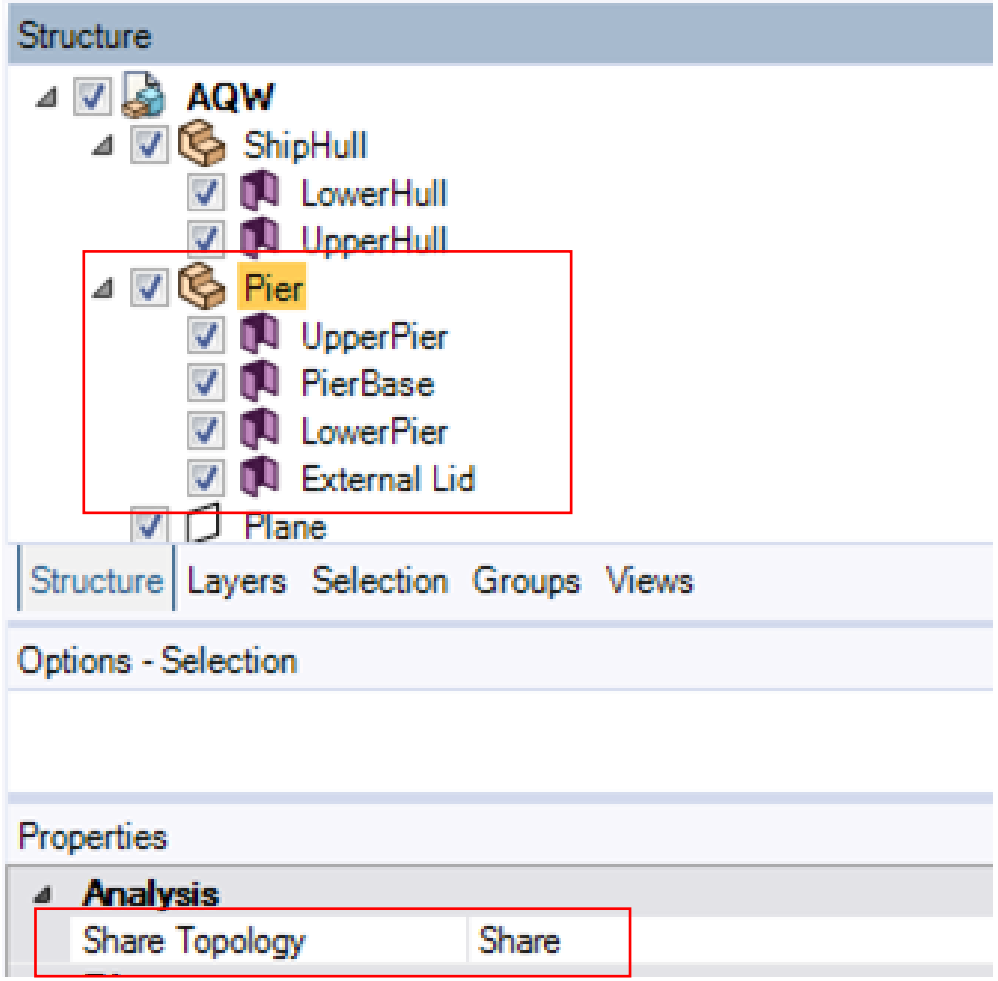
- Each vessel (or structure) is represented as a component with shared topology, as generated in SpaceClaim/DesignModeler.
- Only a surface definition of the panel model is required, there is no thickness associated with the hull(s)
- The panel model must be such that the mesh is up to the waterline.
- The water line defines the global vertical origin for the analysis.

Vessel/Structure Definition

Each vessel or structure may consist of one or more bodies, but must be contained within a component with shared topology.

Here we have a ship and a pier:

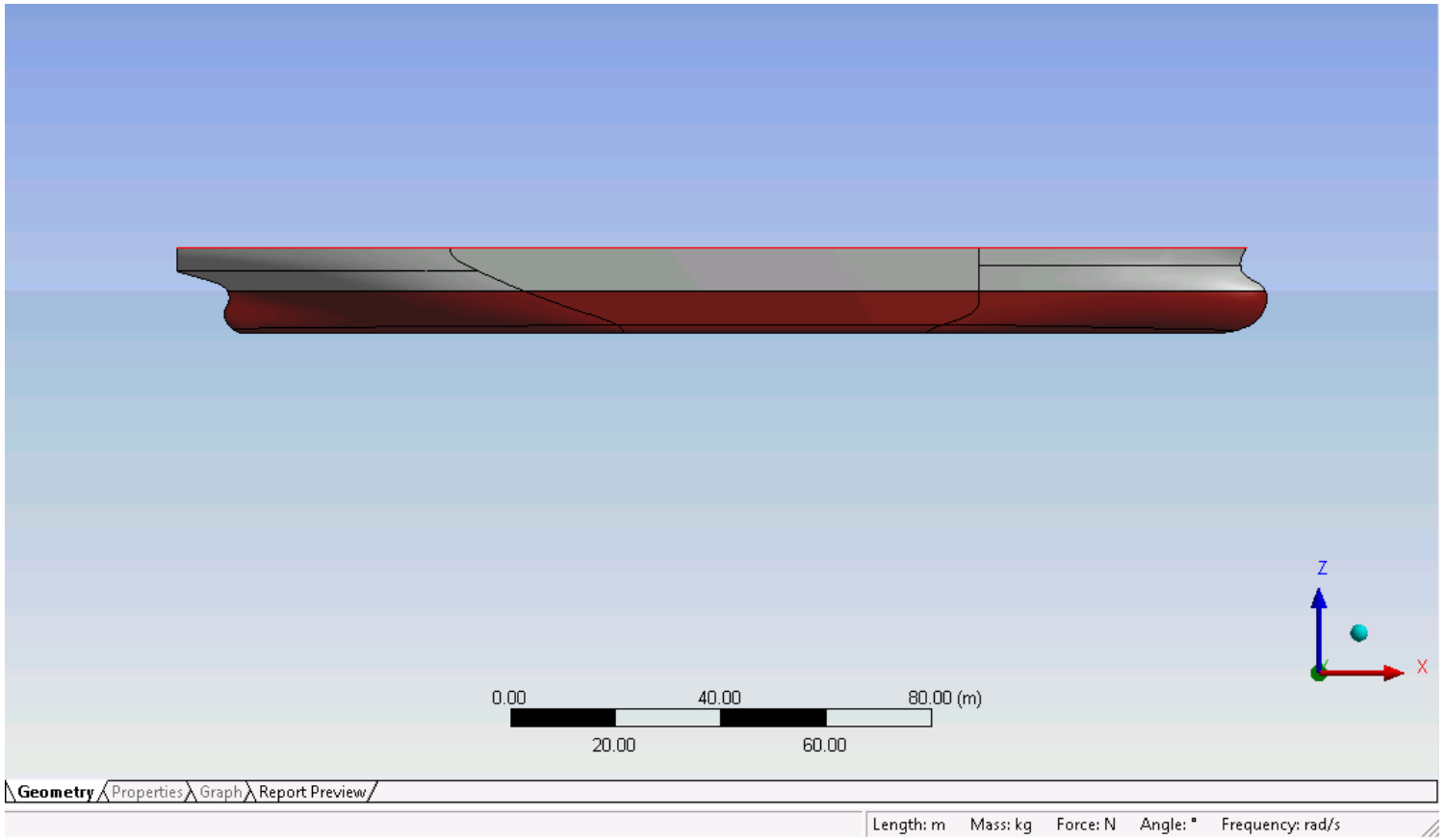
- The ship consists of two bodies – one above the water line, and a second below the water line.
- The pier has three bodies, defining the above and below water sections, plus the base, which has special considerations (more on this later).



Global Axis System in Aqwa

The water line defines the Aqwa Fixed Reference Axes (FRA)

The geometry is divided at this point to allow meshing above and below the water line



Radiation/Diffraction Analysis Stages

The Hydrodynamic Diffraction analysis consists of the following stages:

- Insert Hydrodynamic Diffraction system and associate Geometry/Mesh on the Project Schematic
- Add Aqwa-specific elements (Point Mass etc) in the Aqwa Workbench editor
- Define general Aqwa-specific parameters
  - Water Geometry
  - Part properties
- Set up Hydrodynamic Diffraction analysis
  - Analysis Settings
  - Structure Selection (interacting structure groups)
  - Wave Directions (optional forward speed correction)
  - Wave Frequencies
- Mesh
- Solve
- Post-processing