Lecture 3: Aqwa Basics – Hydrodynamic Response

Introduction to Hydrodynamic Analysis with ANSYS Aqwa

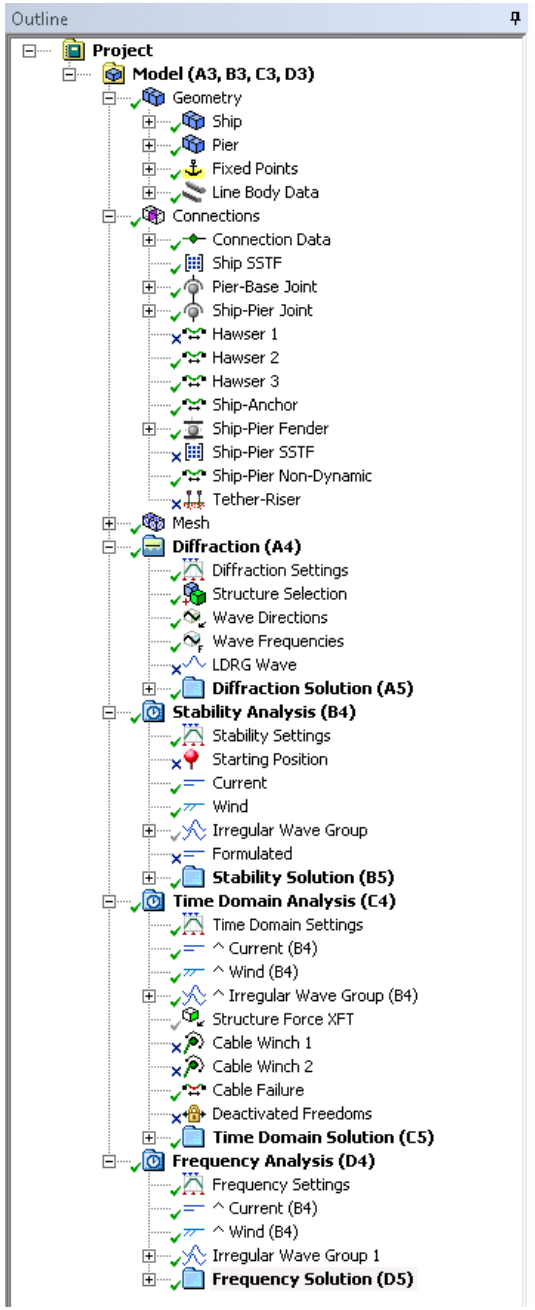
ANSYS Release 19.2

Hydrodynamic Response Basics

The Hydrodynamic Response system extends the functionality of the Hydrodynamic Diffraction system by allowing the use of connections (such as moorings) and environmental data (such as waves, wind and current).

The Hydrodynamic Response system allows for the following analyses to be selected:

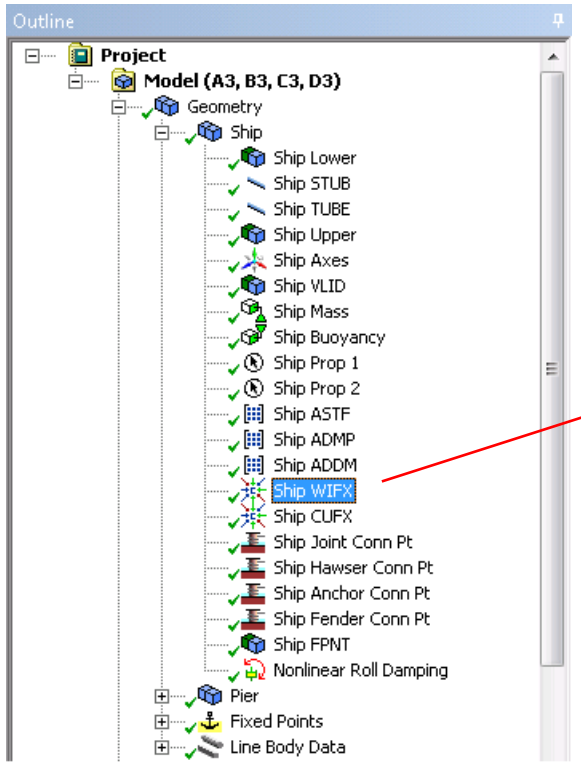
- Static stability
- Time history dynamic response
  - With low frequency (drift) effects
  - With nonlinear incident/hydrostatic forces for survival waves
- Frequency domain dynamic response



Hydrodynamic Response Basics

When applying current and/or wind loading (which are viscous effects), coefficients have to be provided that relate the relative current/wind velocity to the applied force on a vessel.

The rotational terms about X and Y allow the inclusion of the moment arising from the distance between the effective center of the loaded area to the vessel COG (where Aqwa applies the actual load).



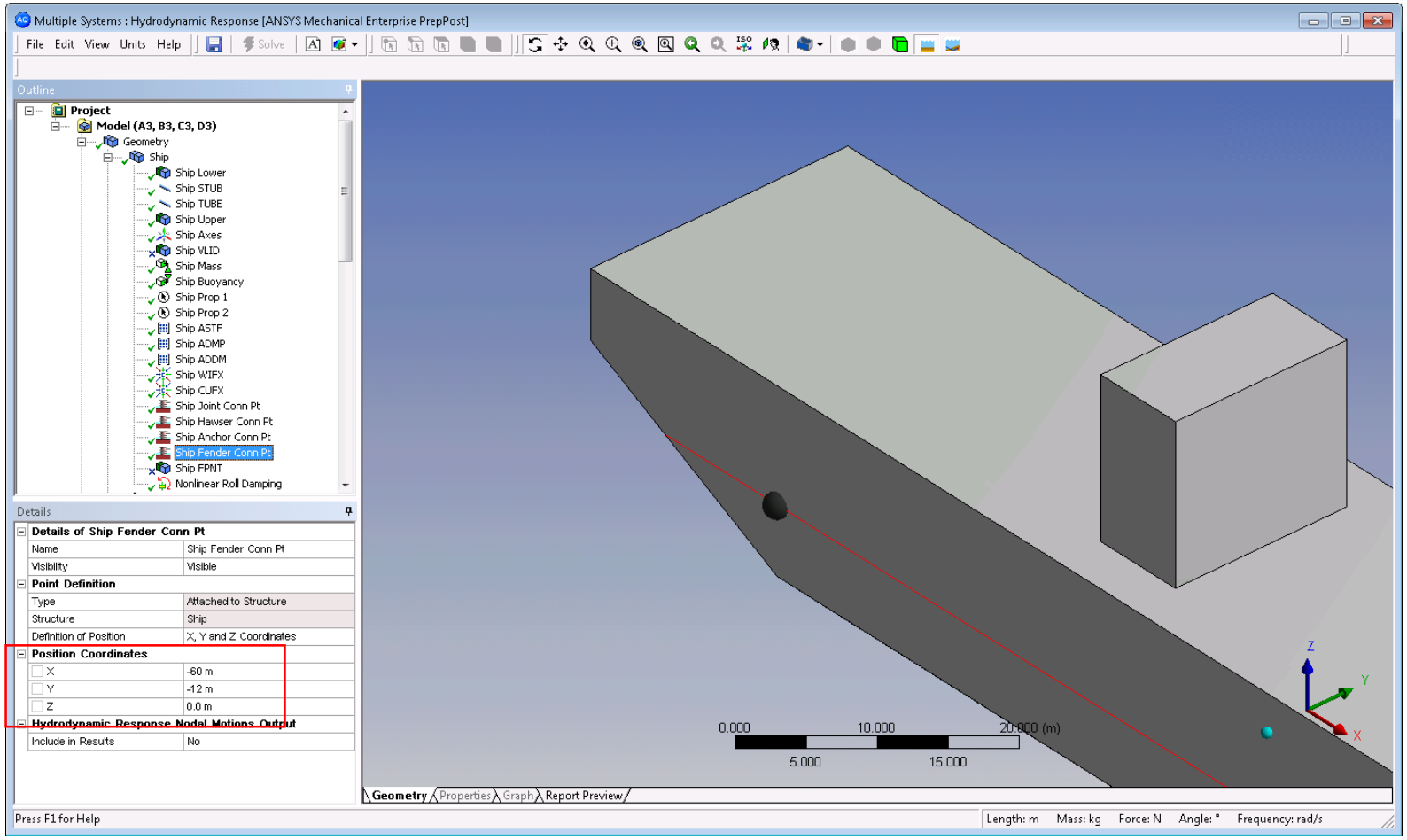
Coefficient Data

Direction (°)	X (N/(m/s)²)	Y (N/(m/s)²)	Z (N/(m/s)²)	RX (N.m/(m/s)²)	RY (N.m/(m/s)²)	RZ (N.m/(m/s)²)
-180	-2500	0.0	0.0	0.0	0.0	0.0
-160	-2349.23	-855.05	0.0	0.0	0.0	0.0
-140	-1915.11	-1606.97	0.0	0.0	0.0	0.0
-120	-1250	-2165.06	0.0	0.0	0.0	0.0
-100	-434.12	-2462.02	0.0	0.0	0.0	0.0
-80	434.12	-2462.02	0.0	0.0	0.0	0.0
-60	1250	-2165.06	0.0	0.0	0.0	0.0
-40	1915.11	-1606.97	0.0	0.0	0.0	0.0
-20	2349.23	-855.05	0.0	0.0	0.0	0.0
0.0	2500	0.0	0.0	0.0	0.0	0.0
20	2349.23	855.05	0.0	0.0	0.0	0.0
40	1915.11	1606.97	0.0	0.0	0.0	0.0
60	1250	2165.06	0.0	0.0	0.0	0.0
80	434.12	2462.02	0.0	0.0	0.0	0.0
100	-434.12	2462.02	0.0	0.0	0.0	0.0
120	-1250	2165.06	0.0	0.0	0.0	0.0
140	-1915.11	1606.97	0.0	0.0	0.0	0.0
160	-2349.23	855.05	0.0	0.0	0.0	0.0
180	-2500	0.0	0.0	0.0	0.0	0.0

Hydrodynamic Response Basics

Mooring lines require Connection Points on both the vessel geometry (fairleads) and at anchor locations (for moorings connected to ground).

Vessel connections are defined underneath the associated structure geometry. Connection Points can either be defined explicitly (as X, Y, Z coordinates in the FRA), or as offsets from geometric vertices in the model.

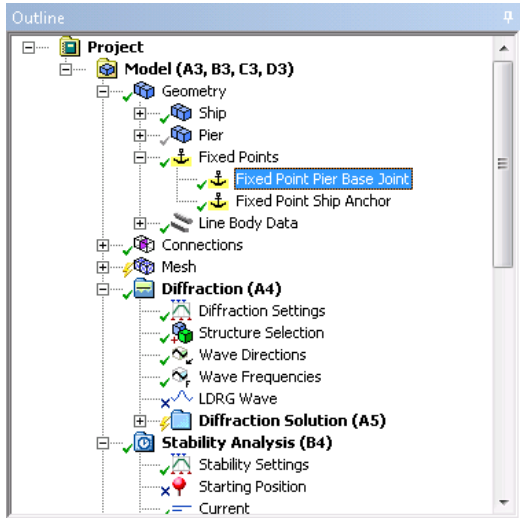


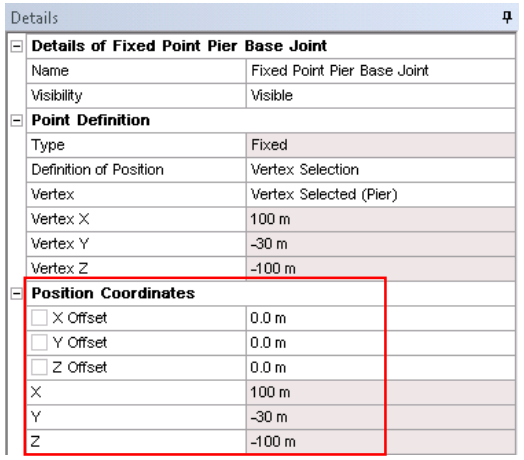
Hydrodynamic Response Basics

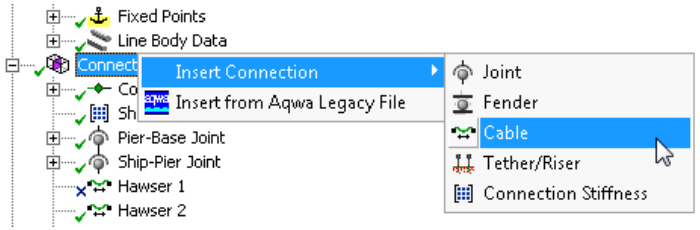
Fixed Point (anchor) locations are defined at the Geometry level. Coordinates are always in the FRA.

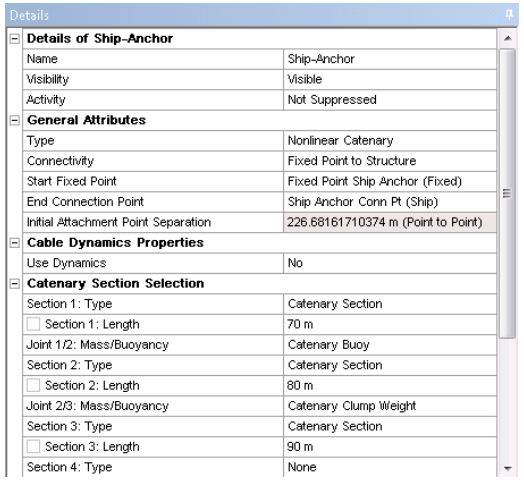
Mooring lines can then be added from Connections. These lines can be between two structures, or from a structure to a Fixed Point.

The Connection Stiffness shown here is typically used to model the effects of mooring lines in the Hydrodynamic Diffraction system, where moorings cannot be explicitly utilized.









Defining the Environment

Environmental data can consist of:

- Current
  - Constant
  - Varying with depth
  - Formulated
- Wind
  - Constant
  - Time-dependent
  - Formulated
- External structural forces
- Wave (either regular or irregular, depending on the analysis type)