

Introduction to Hydrodynamic Analysis with Ansys Aqwa

Module 05: Aqwa Basics – Hydrodynamic Response

Release 2021 R2



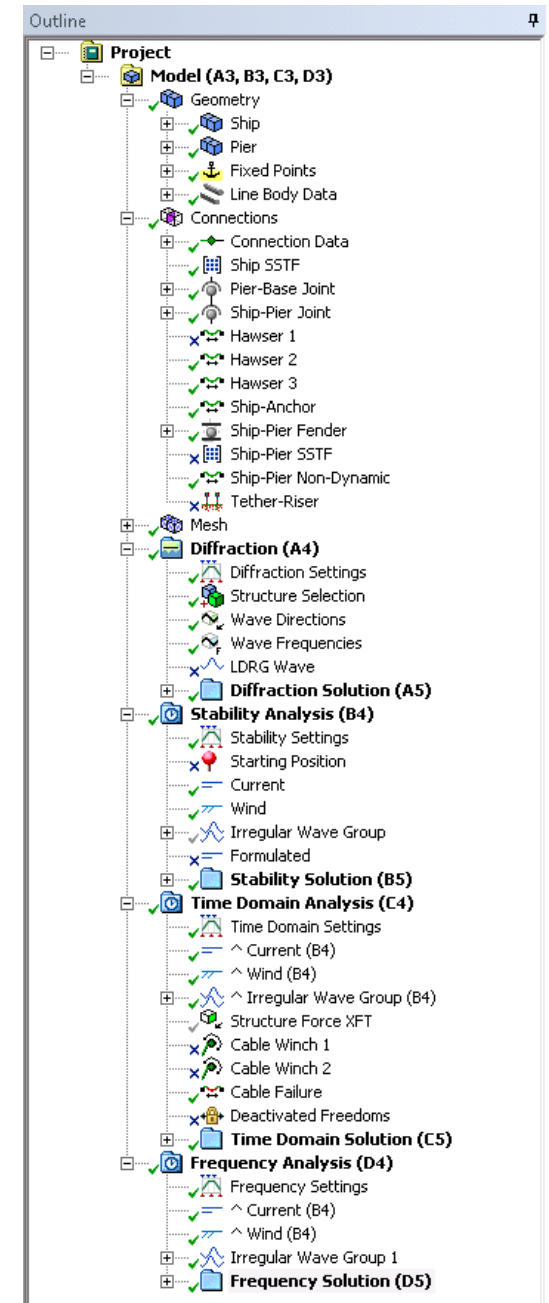
/ Hydrodynamic Response Basics

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:

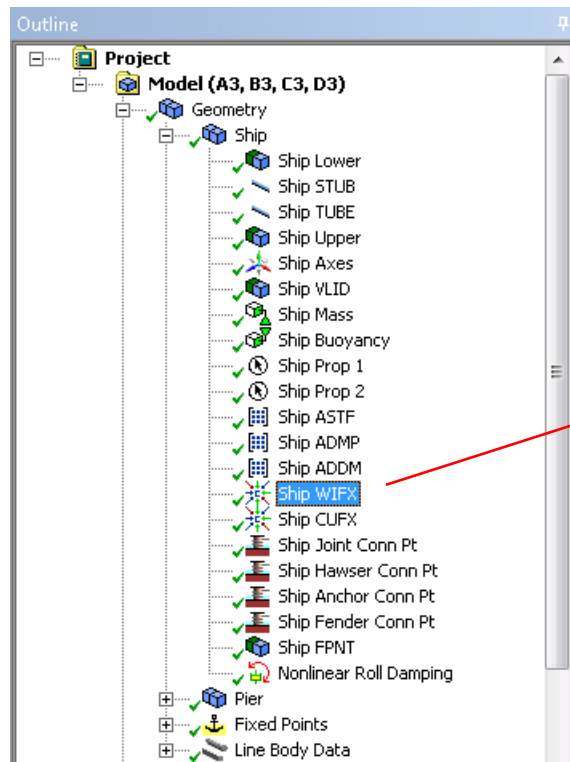
- Static stability – equilibrium position forms the starting position/conditions for subsequent HR systems
- Frequency domain dynamic response
- Time history dynamic response
 - With low frequency (drift) effects
 - With nonlinear incident/hydrostatic forces for survival waves

The Propagate function allows environment objects to be shared between a Stability Analysis and any subsequent Hydrodynamic Response analyses; linked copies ensure that the environment definition is consistent between systems.



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).

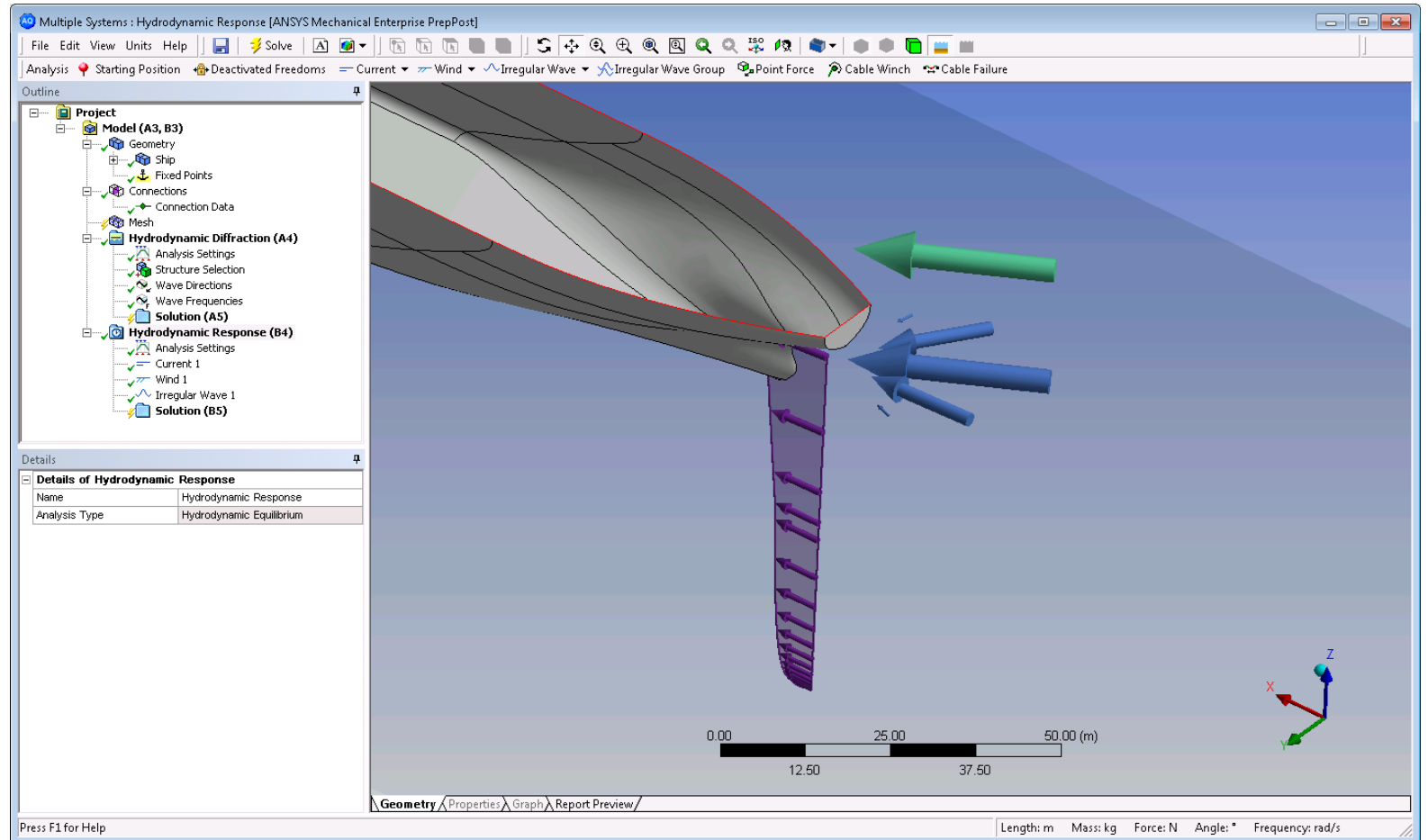


Coefficient Data						
Direction (°)	X (N/(m/s) ²)	Y (N/(m/s) ²)	Z (N/(m/s) ²)	RX (N.m/(m/s) ²)	RY (N.m/(m/s) ²)	RZ (N.m/(m/s) ²)
-180	-2500	0.0	0.0	0.0	0.0	0.0
-160	-2349.23	-855.05	0.0	0.0	0.0	0.0
-140	-1915.11	-1606.97	0.0	0.0	0.0	0.0
-120	-1250	-2165.06	0.0	0.0	0.0	0.0
-100	-434.12	-2462.02	0.0	0.0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

Defining the Environment

Environmental data can consist of:

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



/ Multiple Seastates

- Ocean waves with different frequencies and directions are difficult to model mathematically.
- A single irregular wave definition will create a long-crested wave form; however, this does not necessarily lead to a conservative result. The interaction effect between waves from different directions may be important (constructive interference).
- Aqwa can make use of multi-directional (short-crested) irregular waves, either by a formulated wave spreading or with multiple spectrum definitions.



/ Multiple Seastates

To define multiple irregular waves we use the Irregular Wave Group to bring together the constituent irregular wave definitions.

Wave spectral groups can include one or more of the following:

- Single spectrum
- Main spectrum + cross swell (as shown here)
- Imported wave elevation time history
- Carpet spectrum
- Spread seas



Details	
Details of Irregular Wave 1	
Name	Irregular Wave 1
Visibility	Visible
Activity	Not Suppressed
Wave Range Defined By	Frequency
Wave Spectrum Details	
Wave Type	Pierson-Moskowitz
<input type="checkbox"/> Direction of Spectrum	135°
Wave Spreading	None (Long-Crested Waves)
Spectrum Presentation Method	1D Graph
Seed Definition	Program Controlled
Number of Spectral Lines Definiti...	Program Controlled
Omit Calculation of Drift Forces	No
Start and Finish Frequency Defi...	Program Controlled
Start Frequency	1e-3 rad/s
Finish Frequency	3.4 rad/s
<input type="checkbox"/> Significant Wave Height	1.5 m
<input type="checkbox"/> Zero Crossing Period	9 s
Export CSV File	Select CSV File...
Cross Swell Details	
Wave Type	Gaussian Spectrum
<input type="checkbox"/> Direction of Spectrum	0.0°
<input type="checkbox"/> Significant Wave Height	0.5 m
<input type="checkbox"/> Peak Frequency	0.4 rad/s
<input type="checkbox"/> Sigma	1 rad/s