

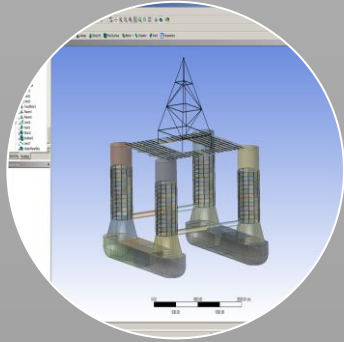
Introduction to Hydrodynamic Analysis with Ansys Aqwa

Module 09: Hydrodynamic Load Mapping from Aqwa to Mechanical

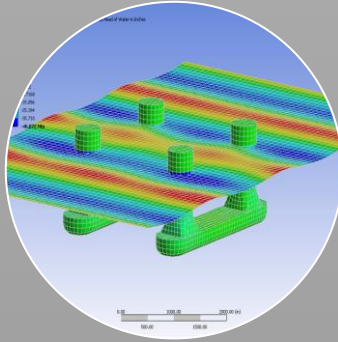
Release 2021 R2



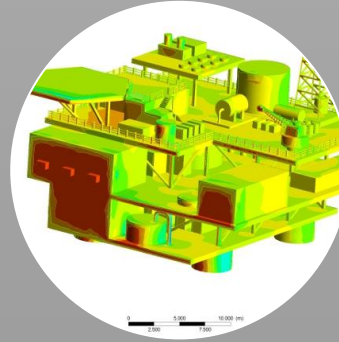
/ Ansys Offshore – Design Integration



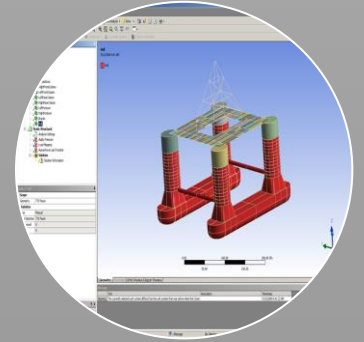
Geometry
modelling



Aqwa



CFX/Fluent

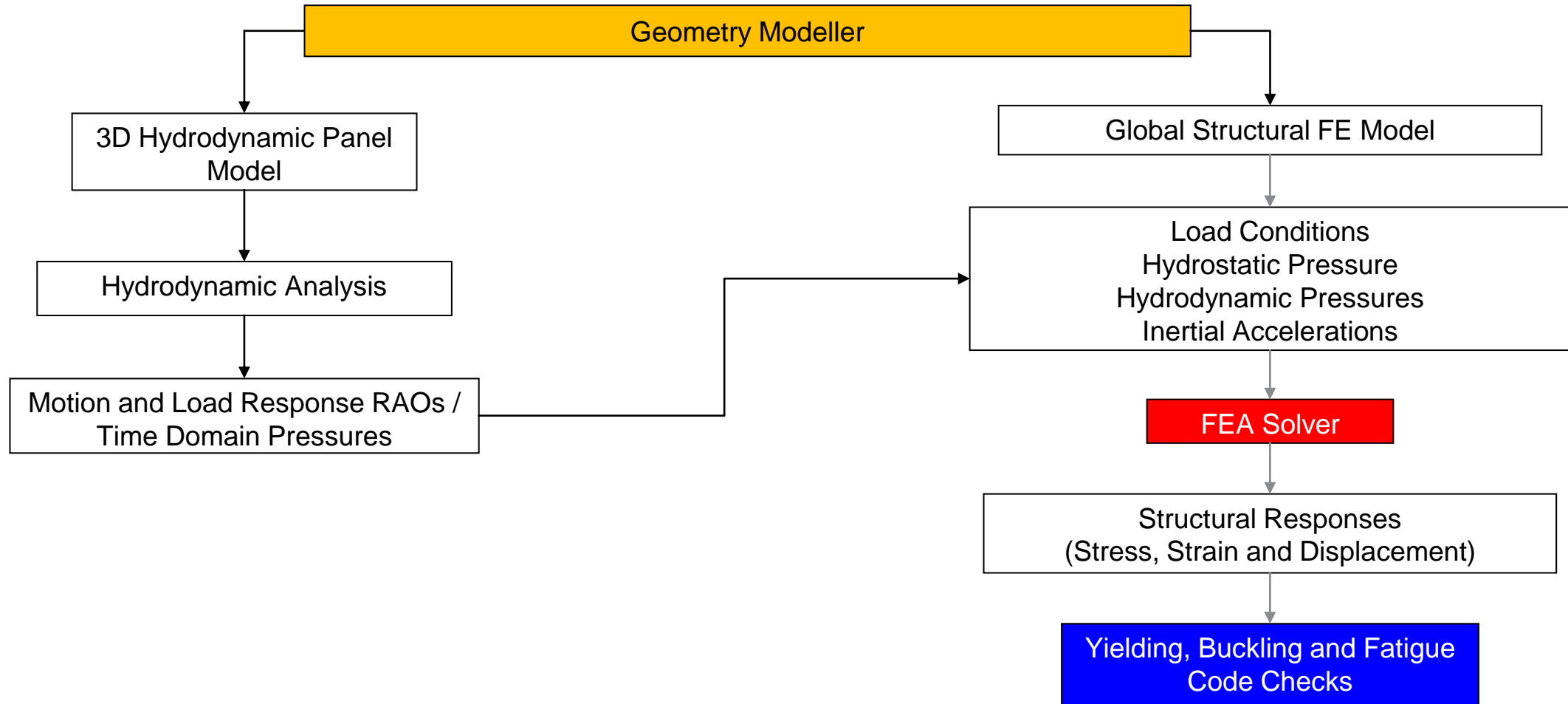


Mechanical



HYDRO-STRUCTURAL DESIGN


/ Load Mapping Process



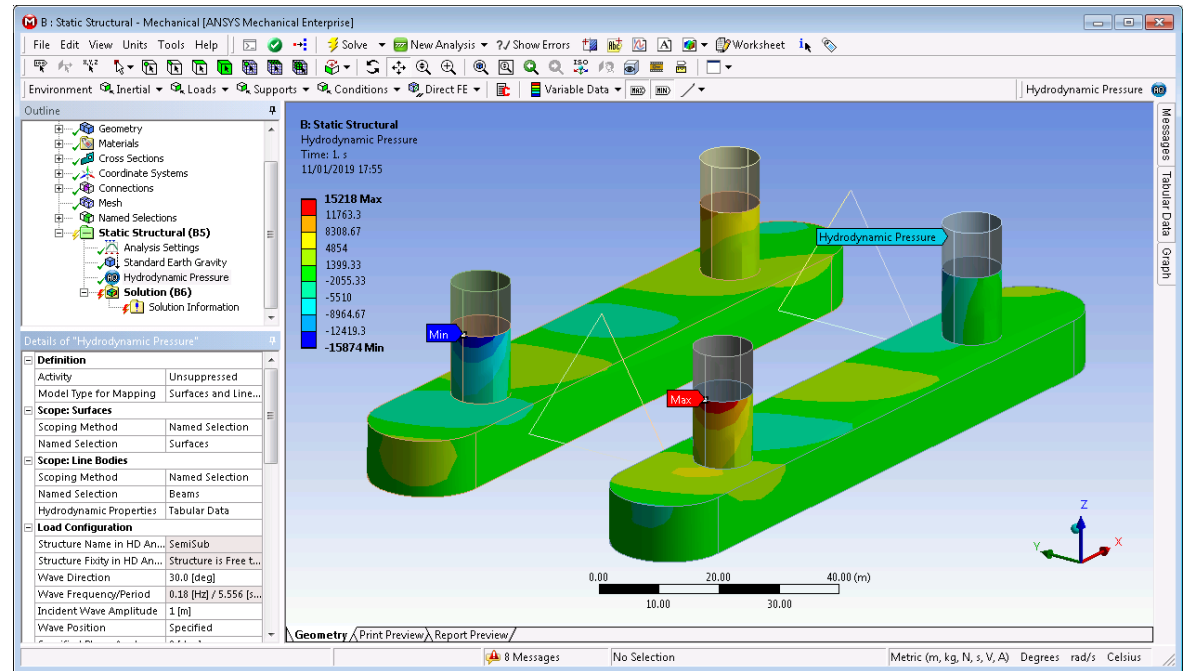
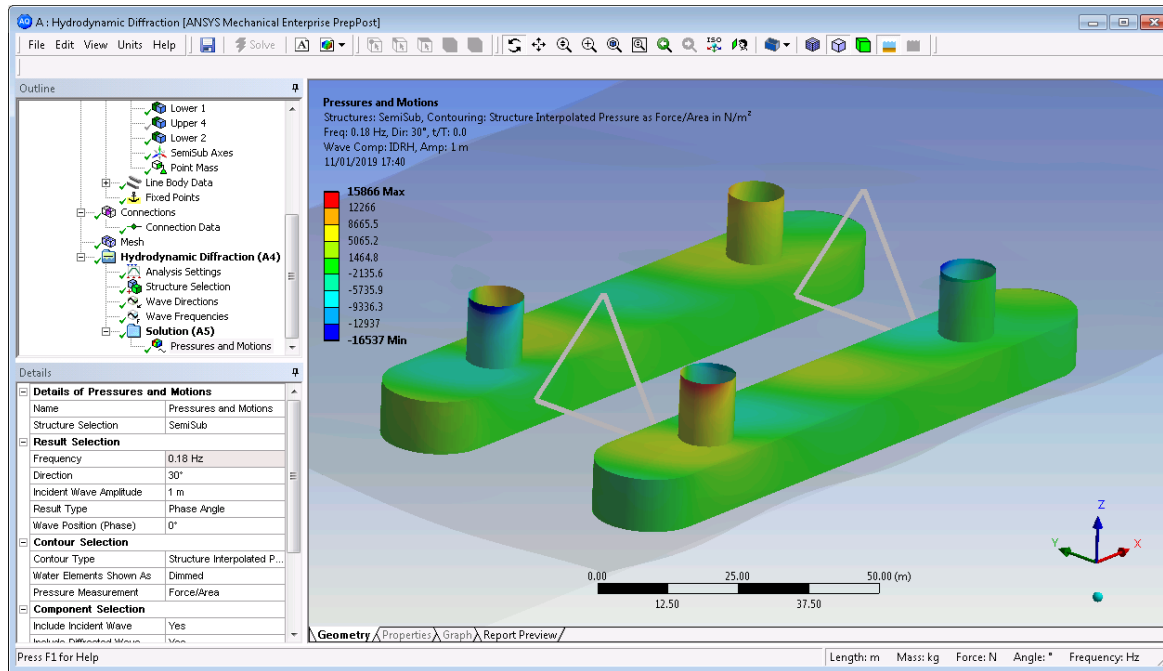
/ Load Mapping Process – Frequency Domain

Aqwa Hydrodynamic Database
3D Hydrodynamic Panel Model
Hydrodynamic Analysis
Motion and Load Response RAOs

Load Conditions
Wave Direction
Wave Frequency/Period
Phase Angle(s)



Ansys Mechanical Model



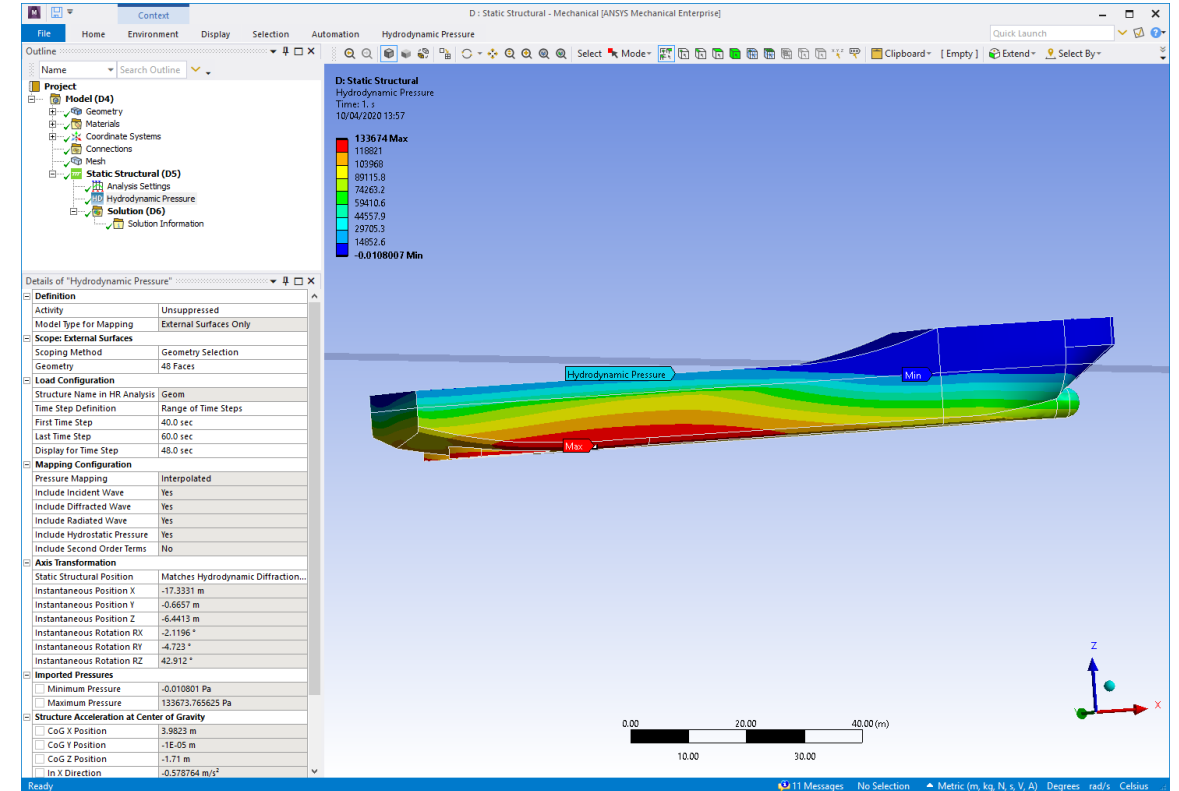
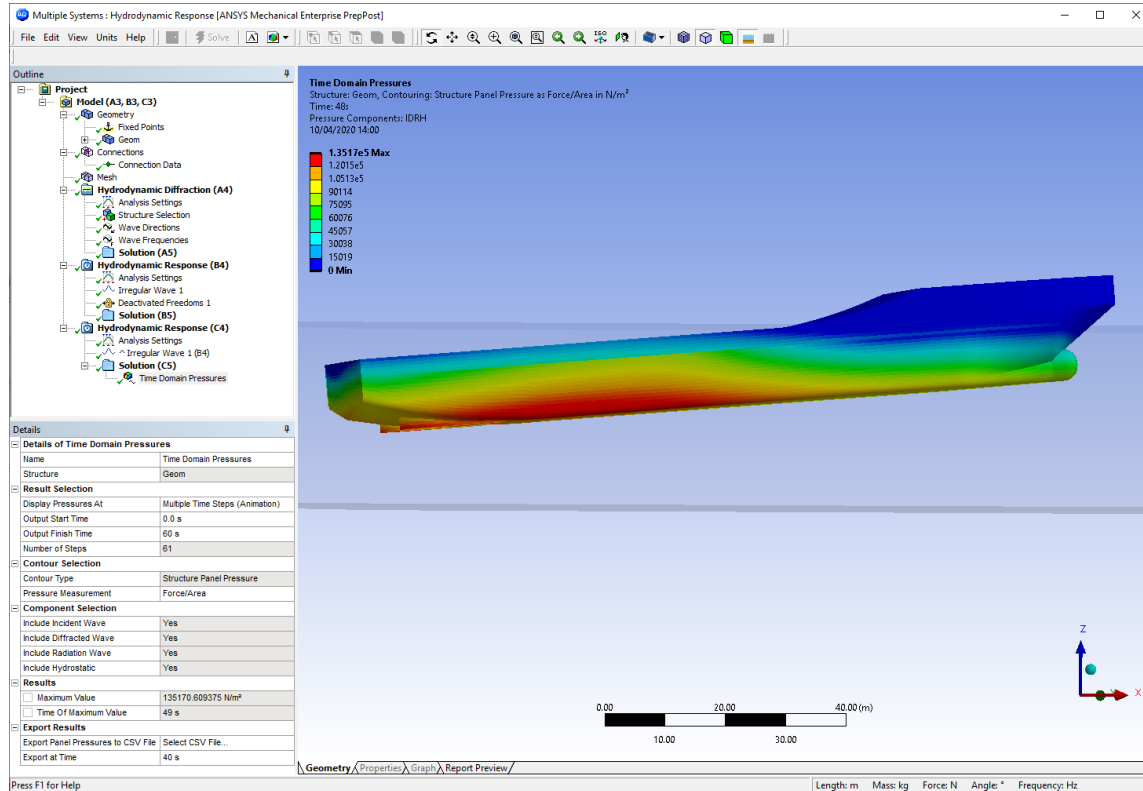
Load Mapping Process – Time Domain

Aqwa Hydrodynamic Database
3D Hydrodynamic Panel Model
Hydrodynamic Analysis
Instantaneous Pressures and Accelerations

Load Conditions
Time Step(s)

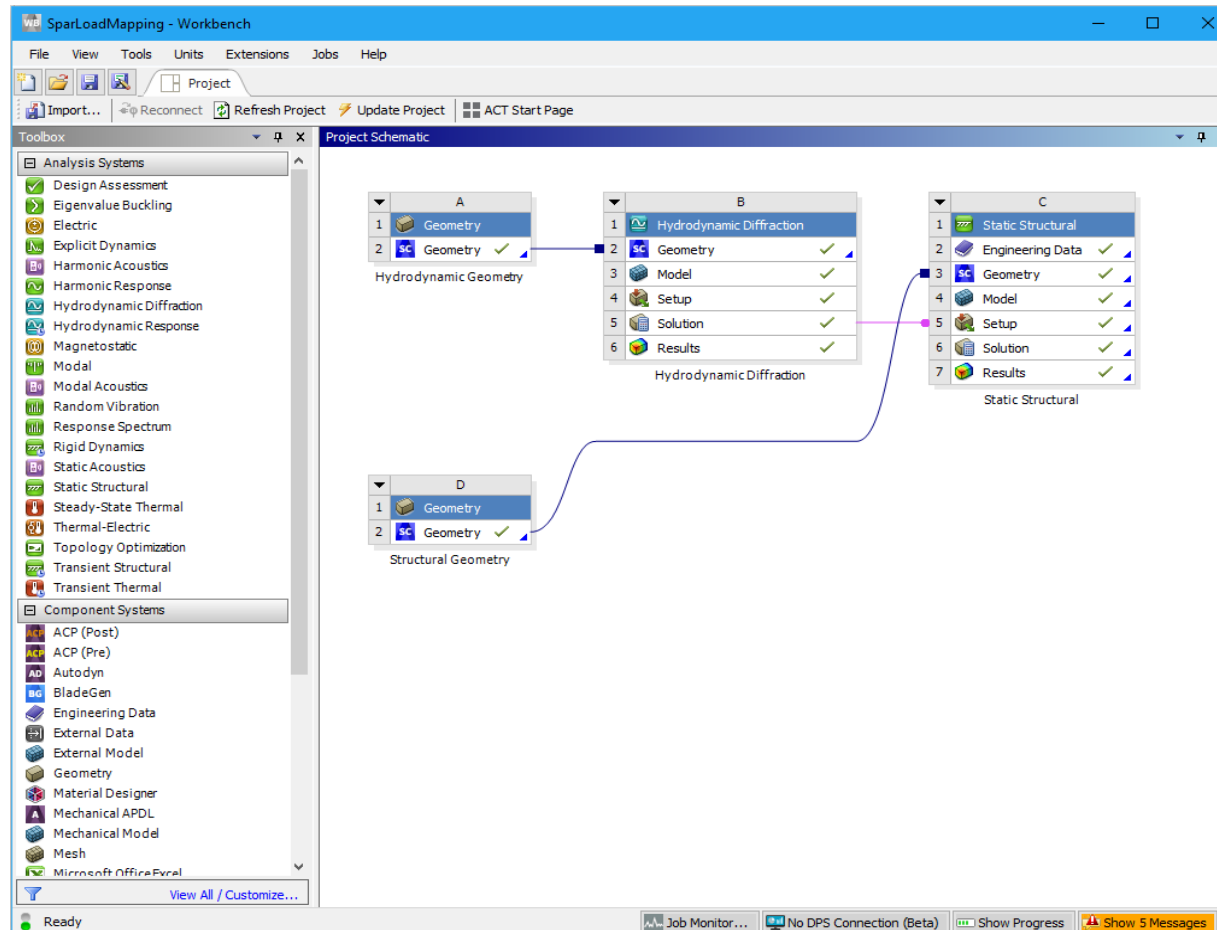


Ansys Mechanical Model



Load Transfer Requirements

- Hydrodynamic and Structural Models
- Definition of Load Cases by Load Mapping ACT Extension



Details of "Hydrodynamic Pressure"	
Definition	
Activity	Unsuppressed
Model Type for Mapping	Surfaces Only
Scope: Surfaces	
Scoping Method	Named Selection
Named Selection	Selection
Load Configuration	
Structure Name in HD Analysis	Part
Structure Fixity in HD Analysis	Structure is Free to Move
Wave Direction	30.0 [deg]
Wave Frequency/Period	0.12 [Hz] / 8.333 [sec]
Incident Wave Amplitude	1 [m]
Wave Position	Specified
Specified Phase Angle	0 [deg]
Mapping Configuration	
Pressure Mapping	Interpolated
Include Incident Wave	Yes
Include Diffracted Wave	Yes
Include Radiated Wave	Yes
Include Hydrostatic Pressure	No
Include Hydrostatic Varying	Yes
Include Second Order Terms	No
Axis Transformation	
Static Structural Position	Differs from Hydrodynamic Diffraction...
Structure Position Offset X	0 [m]
Structure Position Offset Y	-15 [m]
Structure Position Offset Z	-6 [m]
Structure Rotation Offset RX	90 [deg]
Structure Rotation Offset RY	0 [deg]
Structure Rotation Offset RZ	-30 [deg]
Imported Pressures	
<input type="checkbox"/> Minimum Pressure	-7584.7 [Pa]
<input type="checkbox"/> Maximum Pressure	770.43 [Pa]
Structure Acceleration at Center of Gravity	
<input type="checkbox"/> CoG X Position	-0.32044 [m]
<input type="checkbox"/> CoG Y Position	4.3634 [m]
<input type="checkbox"/> CoG Z Position	0.18501 [m]
<input type="checkbox"/> In X Direction	-0.066994 [m sec ⁻¹ sec ⁻¹]
<input type="checkbox"/> In Y Direction	-0.5552 [m sec ⁻¹ sec ⁻¹]
<input type="checkbox"/> In Z Direction	0.02196 [m sec ⁻¹ sec ⁻¹]
<input type="checkbox"/> About X Axis	0.001323 [rad sec ⁻¹ sec ⁻¹]
<input type="checkbox"/> About Y Axis	0.008607 [rad sec ⁻¹ sec ⁻¹]
<input type="checkbox"/> About Z Axis	0.004012 [rad sec ⁻¹ sec ⁻¹]

/ Load Transfer Requirements - General

Pressure Mapping

- For a freely-floating body there will be no explicit boundary conditions
- Wave pressure should be balanced by inertial loading
- Mass information used in Aqwa should be the same as that computed from the structural model
- The Hydrodynamic Pressure ACT Extension automatically checks the structure mass properties for consistency
- Internal tank pressures must also be mapped if the hydrodynamic model includes Internal Tanks

/ Load Transfer Requirements – Frequency Domain

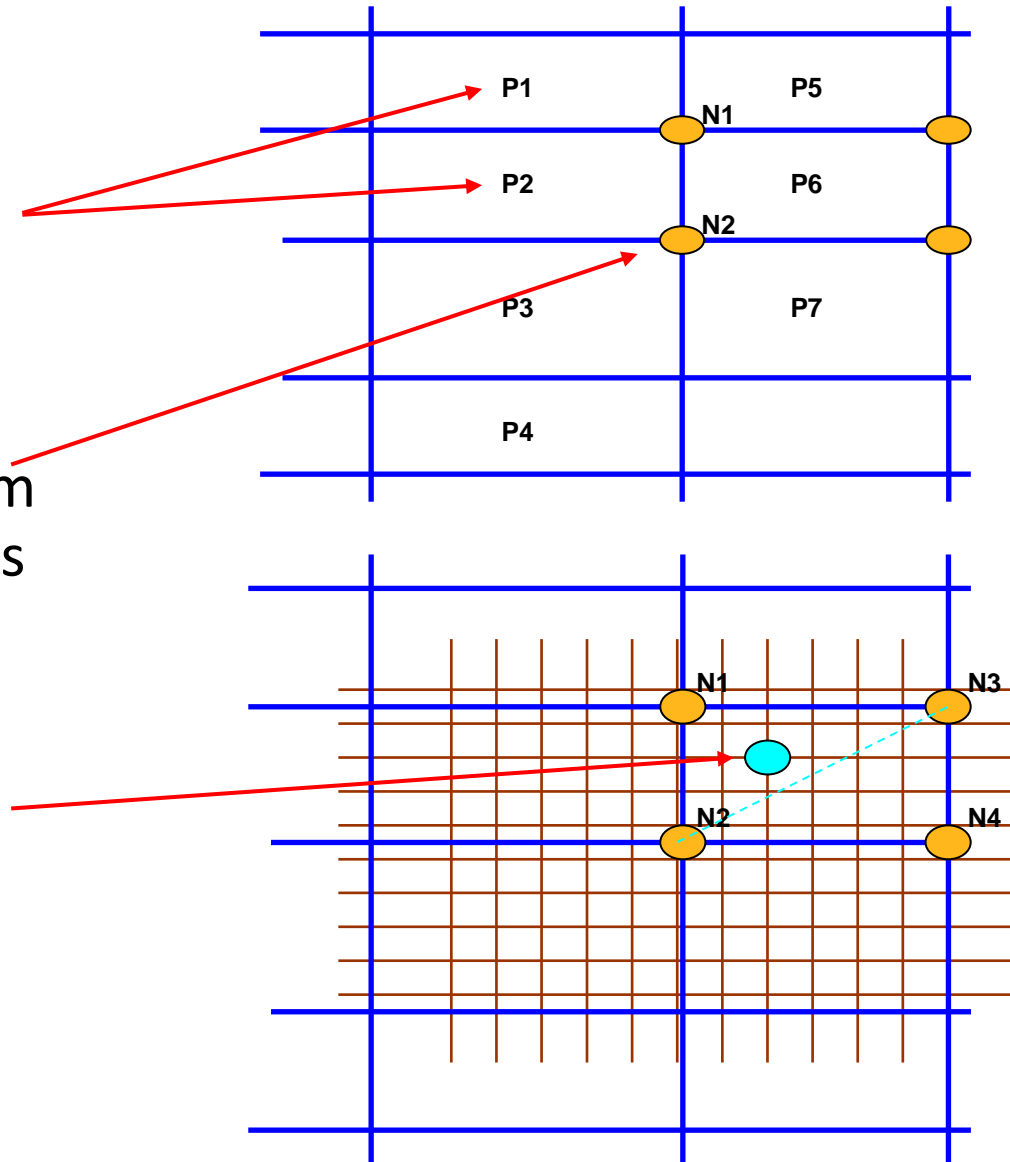
- Mapping can be performed at a single wave phase, or a sequence of phase angles, in a single analysis
- Mapping can be performed for a single wave frequency/direction combination, or many combinations
- Nonlinear drag forces can be included on Morison elements
- Forward speed corrections may be included
- Pressures can be mapped:
 - ✦ Using an interpolation method
 - ✦ By directly evaluating the diffracting panel source strengths at each structural mesh node (more accurate, but cannot be used with Morison elements or forward speed)

/ Load Transfer Requirements – Time Domain

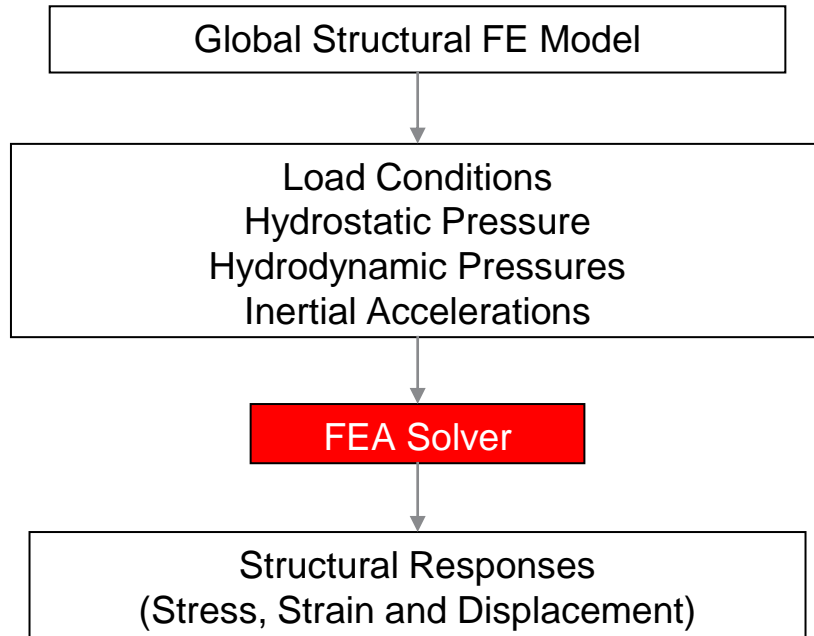
- Mapping can be performed at a single time step, or over a range of time steps, in a single analysis
- The structure must be freely-floating – no additional forces (cables, thrusters etc)
- Pressures are mapped by an interpolation method

/ Interpolated Mapping

- Panel pressures are extracted from the hydrodynamic database
- Nodal values are computed from weighted averaging of pressures of connected panels
- Finite element nodal pressures computed from weighted averaging of hydrodynamic nodal values



Structural Analysis



Ansys Mechanical offers two facilities to undertake a freely-floating model analysis:

- Inertia Relief – computes accelerations based upon structural model
- Weak Springs – automatically removes free body singularities (preferred method, as weak spring Force Reactions can be reported in Mechanical)

