Introduction to Hydrodynamic Analysis with Ansys Aqwa
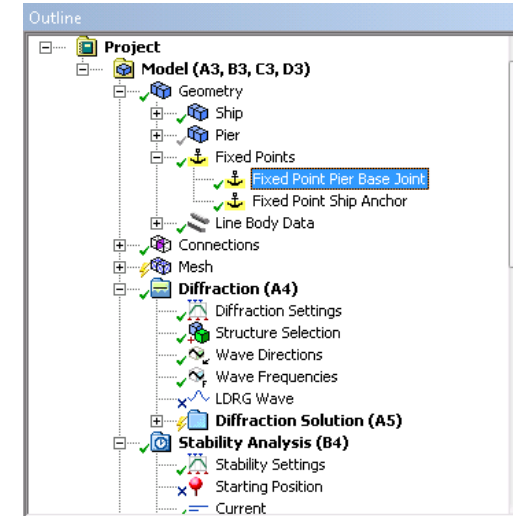
Module 06: Aqwa Cables, Joints, Fenders and Tethers

Release 2021 R2
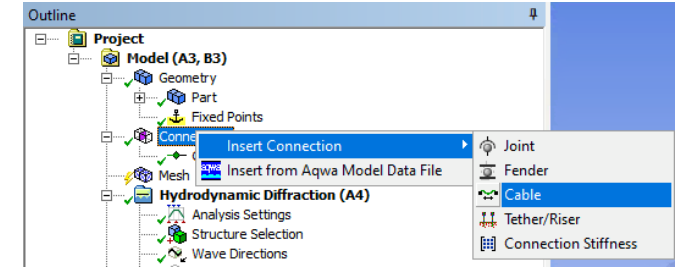
Ansys

Aqwa Attachment Points

- Cables, Joints, Fenders and Tethers ('Connections') require Connection Points and/or Fixed Points to be created.

- Defined by X, Y, Z coordinates or by selecting a vertex from the geometry.

- Connection Points are attachment points on a structure; they move with the structure.

- Fixed Points are attachment points fixed in space (for example, on the seabed).

- Connections may be defined:
    - Between structures (Connection Point to Connection Point)
    - Between the ground and a structure (Fixed Point to Connection Point)
    - Between Fixed Points (special case for Linear cables with Pulleys)

Aqwa Cables

- All connection types are added from Connections context menu

- Available cable types:
  - Linear
  - Nonlinear Polynomial
  - Nonlinear Steel Wire
  - Nonlinear Catenary

- Linear, Polynomial and Steel Wire cables are massless

- Nonlinear Catenary cables are composed of one or more Catenary Sections, with optional Catenary Buoys or Clump Weights between each section

- Linear cables may include Pulleys

- Linear and Polynomial cables may have a Cable Winch

- Any cable may be broken by a Cable Failure

Aqwa Joints

- Available joint types:
  - Ball and Socket (3 free rotational DoFs)
  - Universal (2 DoFs)
  - Hinged (1 DoF)
  - Rigid (locked)

- Stiffness, damping and friction may be associated with the joint freedoms

- Joint local axes can be defined to correctly orientate the connection

Aqwa Fenders

- Aqwa also offers the Fender (compression element) to model structure-to-structure or structure-to-ground interactions.

- Aqwa does not detect collisions between structures, or between a structure and the seabed, but fenders can be used to keep them separate.

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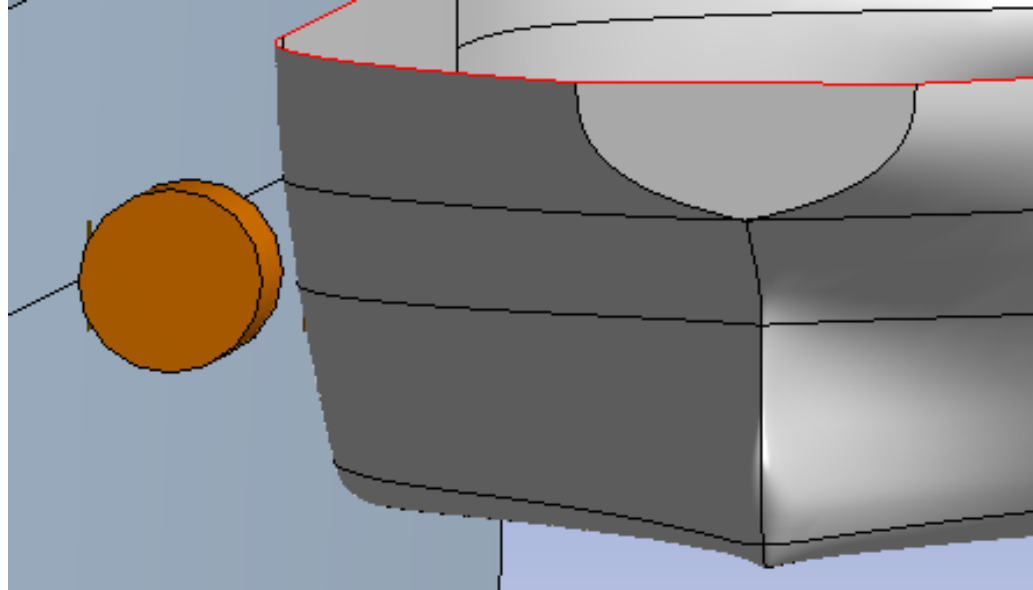
Aqwa Fenders

There are three types of fender:

- Fixed, Omni-Directional – The fender is connected to one of the structures (or ground) and contact with the second structure may be anywhere on the surface of the fender (assumed spherical).

- Fixed, Directional – The fender is connected to one of the structures (or ground) and contact with the second structure is assumed to act in a given direction.

- Floating – The fender is not connected to either structure. Contact with either structure acts in a given direction. Note that the fender is vertically located at the still water level.
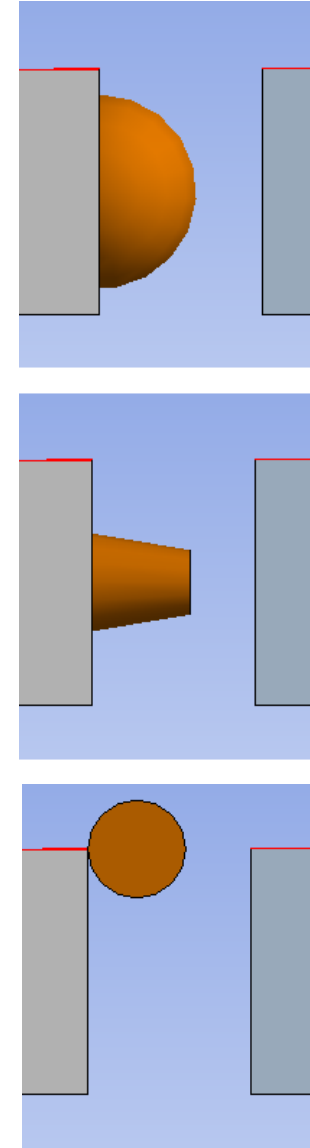
Aqwa Fenders

Fender data consists of:

- Connectivity

- Type

- Action

- Contact Points, using previously defined Connection or Fixed Points

- Fender Properties:
  - Damping Coefficient
  - Friction Coefficient
  - Size
  - Nonlinear stiffness coefficients

- Two sets of fender local axes, to define the fender direction and contact plane normal

Aqwa Tethers

- Tethers are specifically intended for TLP analysis – calculations are most accurate when nearly vertical

- Finite Element calculations are performed for given material properties

- Defined by one or many Tether Sections

- Stiffness or Encastre conditions at each end

- Optional constraints between sections

- May also be used to model Risers with internal fluid