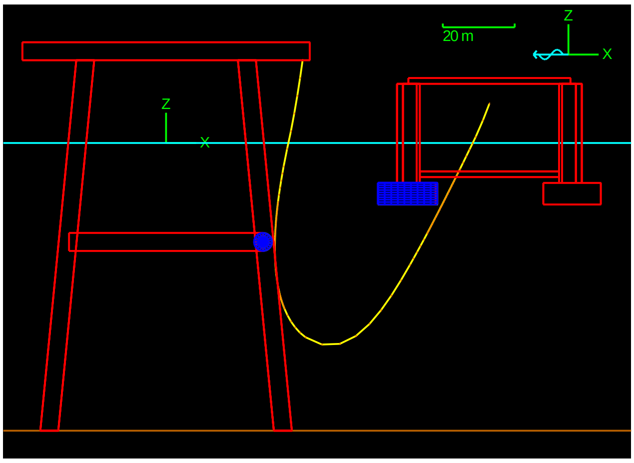
H02 Jacket to semisub



A cable catenary is suspended between a semi-submersible rig and fixed jacket. It is analysed in a random sea.

Building the model

Both the jacket and the semi-submersible are modelled as vessels. Although the jacket does not move, representing it as a vessel allows the vertex and edge or shaded drawing facilities to be used and objects to be attached to it. To ensure it does not move, the jacket primary and superimposed motions are set to *none*.

From the model browser, select *Cable*. Note that the Semisub connection has the *end orientation gamma* angle set at 90°. When torsion is not applied, gamma can be used to define the orientation of end x and y about z, which may be useful when extracting results. In this example, setting gamma to 90° makes the x-axis of the end connection normal to the semisub side, and y parallel to it. This matches the x and y orientations at the jacket end. Select the view and press *CTRL+Y* to show the line end axes, then *CTRL+ALT+Y* to show the line's node axes. Press *CTRL+Y* and *CTRL+ALT+Y* again to turn them off.

The main concern in this example is clashing between the cable and the jacket structure. This is best assessed visually. There are two different ways to model this type of contact in OrcaFlex; one uses contact between lines and shapes, the uses line on line clashing. We will first consider which is most appropriate for this example.

Contact between lines and shapes occurs at the line nodes. This means that fine segmentation is often necessary for modelling contact between lines and shapes. In this case, the cable is likely to wrap around the jacket member during a long contact, and fine segmentation will be needed in this region anyway, to allow the cable to follow the curvature of the jacket member's surface. Friction effects can also be included in contact between lines and shapes.

The second option, line on line clashing, considers contact between line segments, and allows smooth modelling of sliding contacts. Using segments for clashing interaction also means that fine line segmentation is not automatically necessary to model clashing accurately. However, line clashing does not include friction between two objects in contact, and is not available during a static analysis.

The units of line clashing stiffness are kN/m, which is intended as a change in reaction force with increasing depth of penetration between two line segments. No dependence on the length of line in contact is included, because it is assumed that the line segment length is longer than the line diameter. This implies that line on line clashing is expected to occur only between individual segments along each line in contact, and not multiple segments of one line simultaneously.

Because this simulation involves one line wrapping around the other, using line to shape contact is more appropriate for this situation. The cable line segmentation is already required to be quite fine in order that the cable can follow the member surface accurately, so enough segments are present for well-modelled shape contact. In this example, we also want to include the effects of friction between the cable and the jacket member, therefore we will use the line-shape contact method.

In the model, a jacket strut has been made from a cylindrical *elastic solid shape* (called *Structure Shape*) and has then been attached to the jacket vessel. Friction has been included between the cable and the jacket member shape, click on *friction coefficients* in the *model browser* to see how this is applied.

Finally, some contact between the cable and the edge of the semi-submersible pontoon was noted, and so a second *elastic solid shape* was placed at this location. The line segmentation is refined to capture curvature caused by contact at this sharp edge.

In models where impacts are occurring between objects, it is important to make sure that the time step and integration scheme used are appropriate for the events that are being modelled. Impacts are transient events, and therefore require a short timestep to capture them accurately. If using the implicit integration scheme, then a sensitivity study should be performed on time step size to determine how short a time step is needed to produce accurate results. Comparison with results given by the explicit scheme is particularly useful for this purpose. In some cases, where the implicit scheme requires extremely small time steps to be accurate, and as a result the computation time increases significantly, the explicit scheme becomes the more efficient option and should be used instead.

Results

Open the workspace *H02 Jacket to Semisub results.wrk* to see time histories and range graphs of the contact events. However, for this type of analysis, it is often sufficient to watch a replay.

Workspace *H02 Jacket to Semisub shaded.wrk* shows one view of the whole model, and one close up of the clashing regions. You can observe the clashing while the simulation replay is running – although it may be necessary to zoom in further on the view.

OrcaFlex colours clashing objects in white by default, to identify whether contact has occurred as easily as possible. The clashing with the large jacket line is easy to see, whereas the clashing between the cable and pontoon shape is harder to spot. Note that the colour used to show the contact can be changed on the line data form, *drawing* page.

In this example we have reduced the logging interval to 0.01s (from the default 0.1s). In other words the results are logged 100 times per second. This is so that we can capture the instant of contact without any significant phase shift. The logging interval is set on the *general* data form, *dynamics* page – note that increasing the frequency that the results are logged will increase the size of the simulation file that stores those results.