Sima EXAMPLE

Line Break Analysis in Sima

Valid from Sima version 4.6

Sima Example

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1 Introduction

This document introduces an example model of an export system installation with line break scenario, as shown in Figure 1-1. There are 7 mooring lines and one Oil Offloading Line (OOL) line that are connected to an Oil Offloading Buoy (OOB). In the simulation, three mooring lines (line 1, line 2 and line 6) will be disconnected from the OOB.

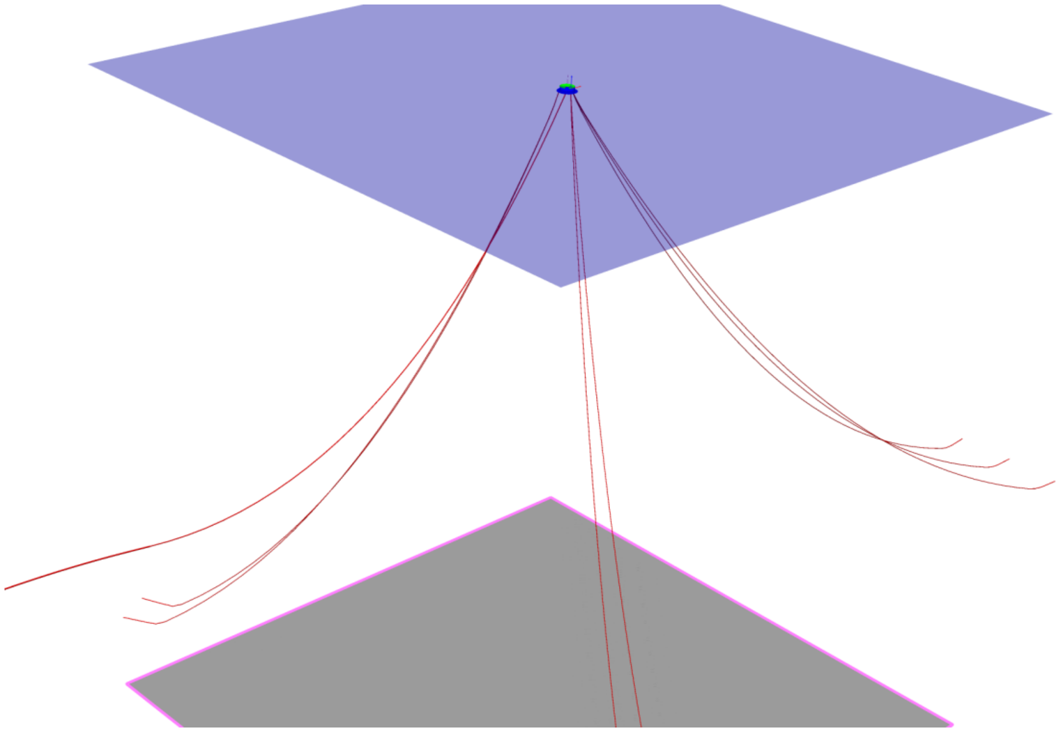

Figure 1-1 Line break analysis model's 3D view

To open the example model, create a new Sima workspace and import the "LineBreak.stask" file (*File → Import → Sima → Sima Task Archive (.stask)*). This will import a Riflex coupled analysis model containing the example.

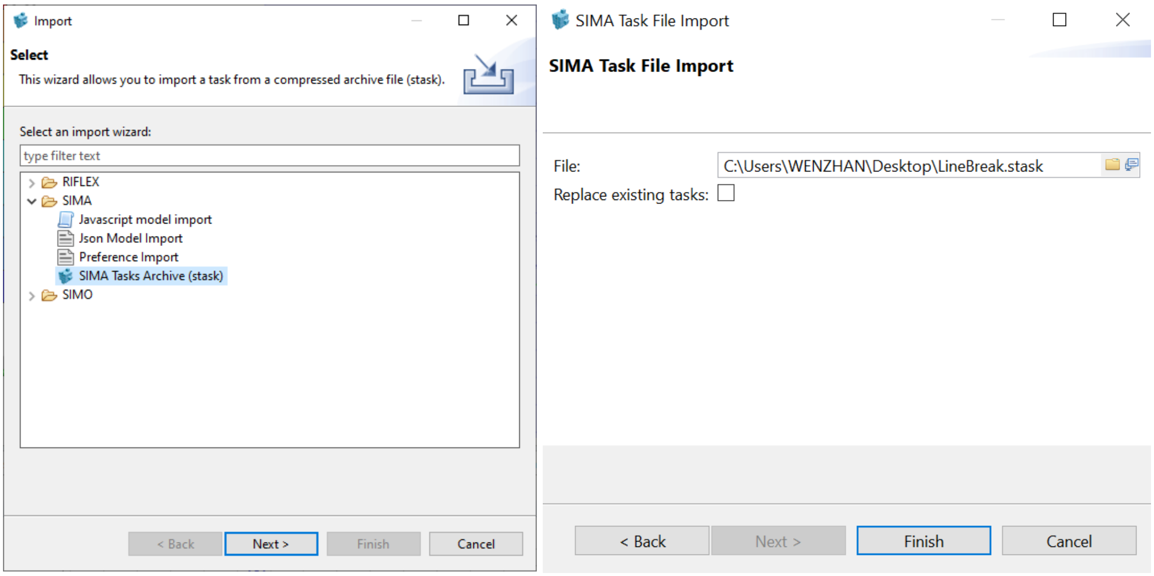

Figure 1-2 Importing the stask file

2 About the Model

The model consists of several objects: the Oil Offloading Buoy (**OOB**), the mooring lines (**Line#**) and Oil Offloading Line (**OOL**). The content of the OOL line has been defined in the Slender System / Components folder in the Sima navigator (**oil**). Apart from these, line break points and timings are defined in: Dynamic Calculation – Boundary change. The objects are shown in Figure 2-1.

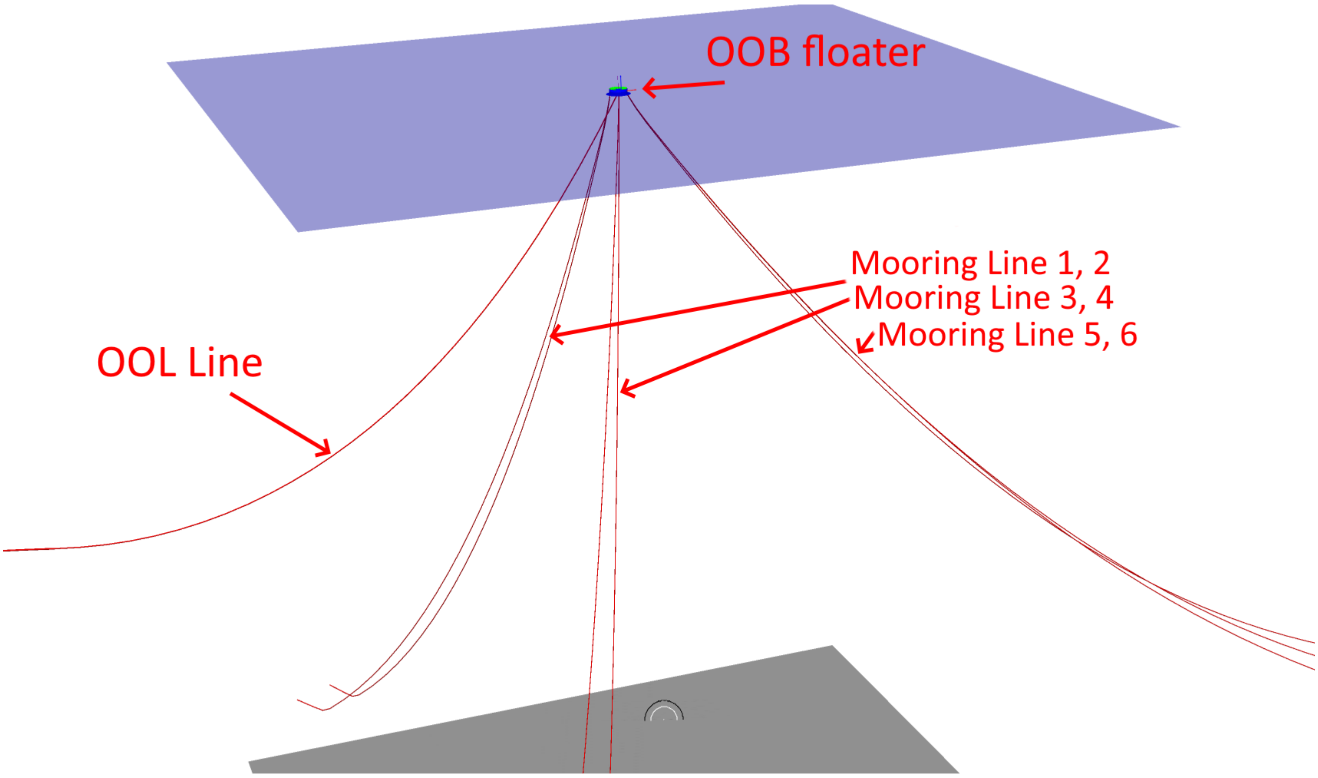

Figure 2-1 The objects in the model

The OOB is a 742 tons cylinder shaped floater that connects to 7 mooring lines and 1 OOL line. The water depth is 1100 m. JONSWAP wave spectrum is used with significant wave height (Hs) = 0.2 m and peak period (Tp) = 1.8 s, JONSWAP swell spectrum is used with Hs = 4.5m and Tp = 17.0 s. No wind being implemented and depth dependent current with 0.3 m/s surface velocity is applied as environmental loads.

The 3 groups of mooring lines distributed evenly every 120 deg. Mooring line 1 and line 2 will be disconnected from the OOB fair lead at 10 s and mooring line 6 will break at segment 2, node 34 (this is done by including a ball joint between the two segments, and then specifying a point of time for release when running Sima) at 25 s. The OOB floater will drift away from the design position after line break as shown in Figure 2-2 .Please note that a line segment connected to a ball joint needs to have bending stiffness, therefore we change the section of the segments connected to the ball joint to release_chain and release_wire.

Since the line after breaking will curl as it sinks towards the seabed, it needs to have a fine mesh and/or a small time step for the analysis to run through. However, generally user does not need to calculate on the broken line. We have used the option of boundary change to fix the boundary condition of the end node of the Wire segment five seconds after the release, as shown in Figure 2-3.

More information about boundary change in both static and dynamic analysis can be found here:

https://Sima.sintef.no/doc/4.6.0/howtodo/How-to-do-make-a-coupled-model.html#_change_boundary_condition_on_master_node_in_static_analysis

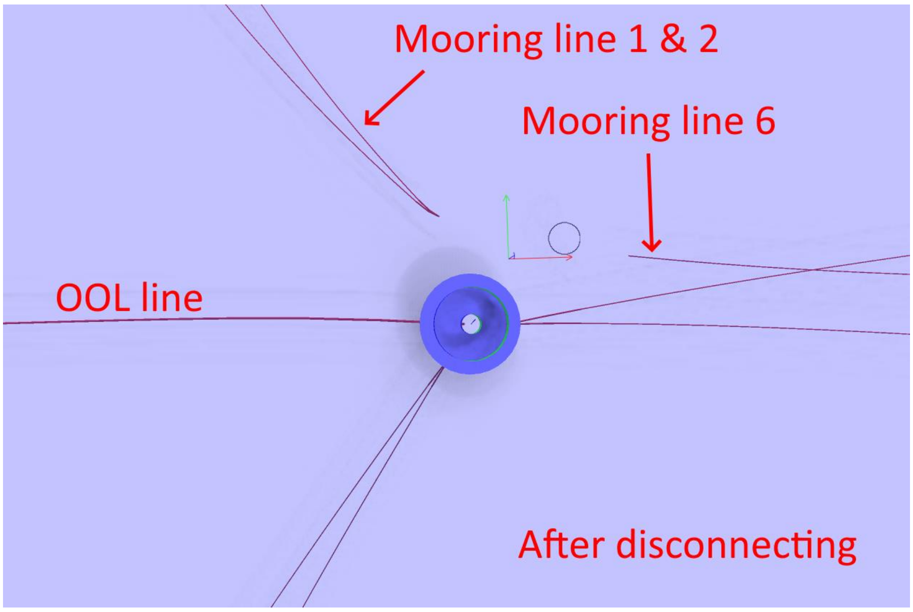

Figure 2-2 Mooring configuration after disconnecting from OOB

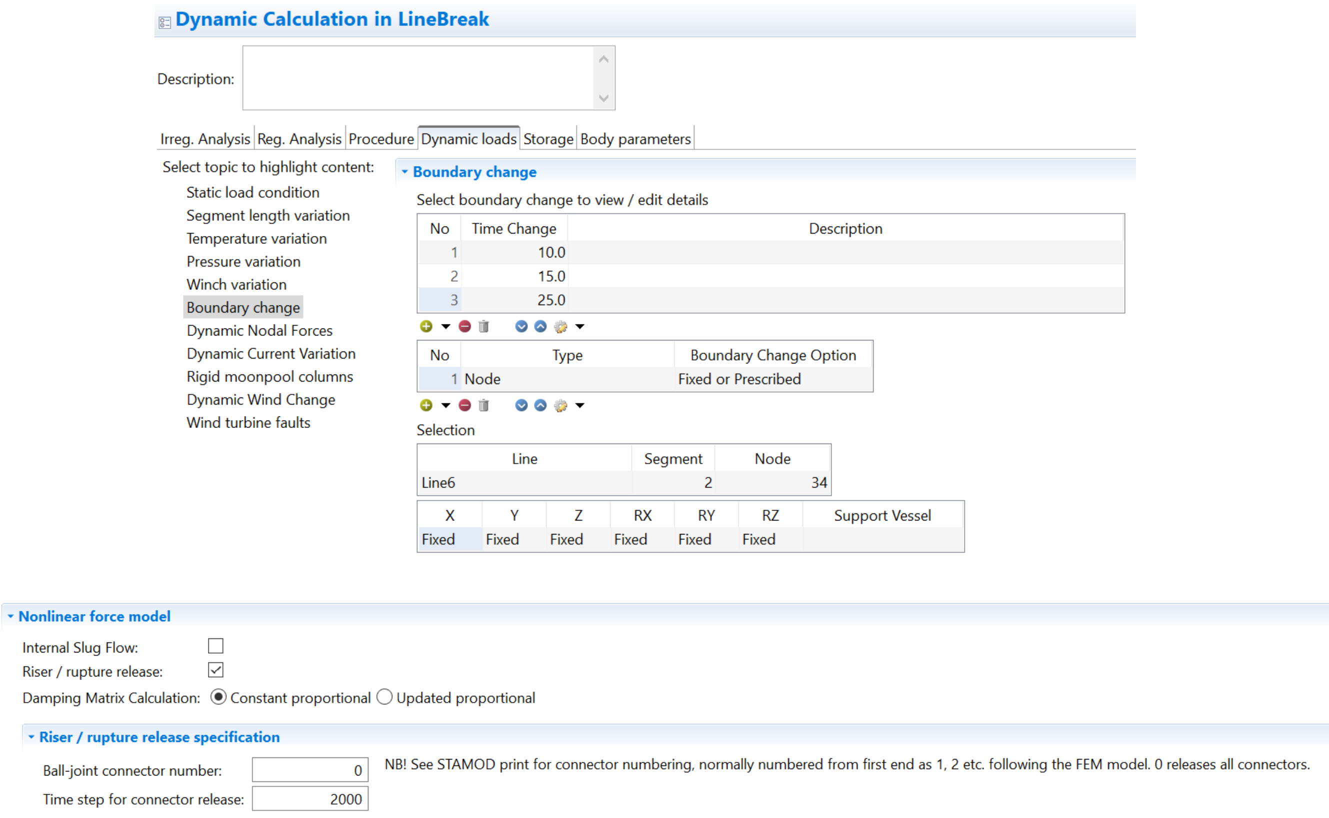

Figure 2-3 Line break settings in Sima dynamic calculation

3 Results

To run the simulation, run the dynamic analysis in the Initial condition. The simulation length has been set to 50 s with 0.01 s time step just for demonstrate purpose. In your own analysis, you may set longer simulation length. Some results are already set to be stored in the model. For example, mooring lines / OOL line top end displacements, force response of mooring lines and OOL line, OOB body movements and the 3D visualization of dynamic analysis etc.

The OOB surge and sway motions during the line break simulation are shown in Figure 3-1. You may see that it drifts away from the design location. You may also check the tension on mooring line 1 before and after disconnecting at 10 s, as shown in Figure 3-2 and tension on one of the remaining mooring line 4 before and after disconnecting mooring line 6 at 20s in Figure 3-3.

Figure 3-1 Surge and sway motions of OOB

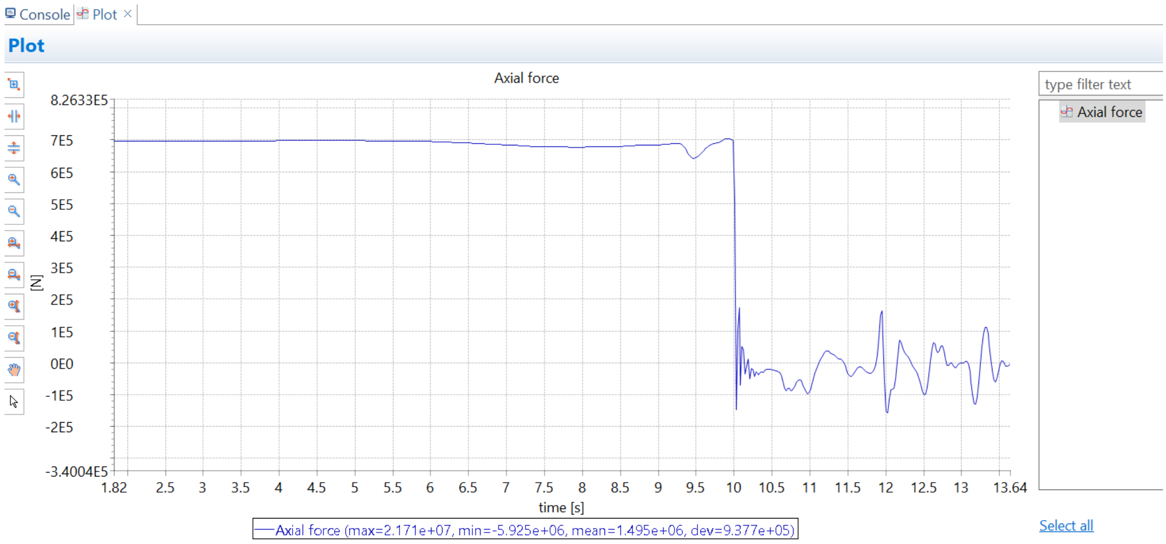

Figure 3-2 Mooring line 1 tension before and after disconnecting at 10 s

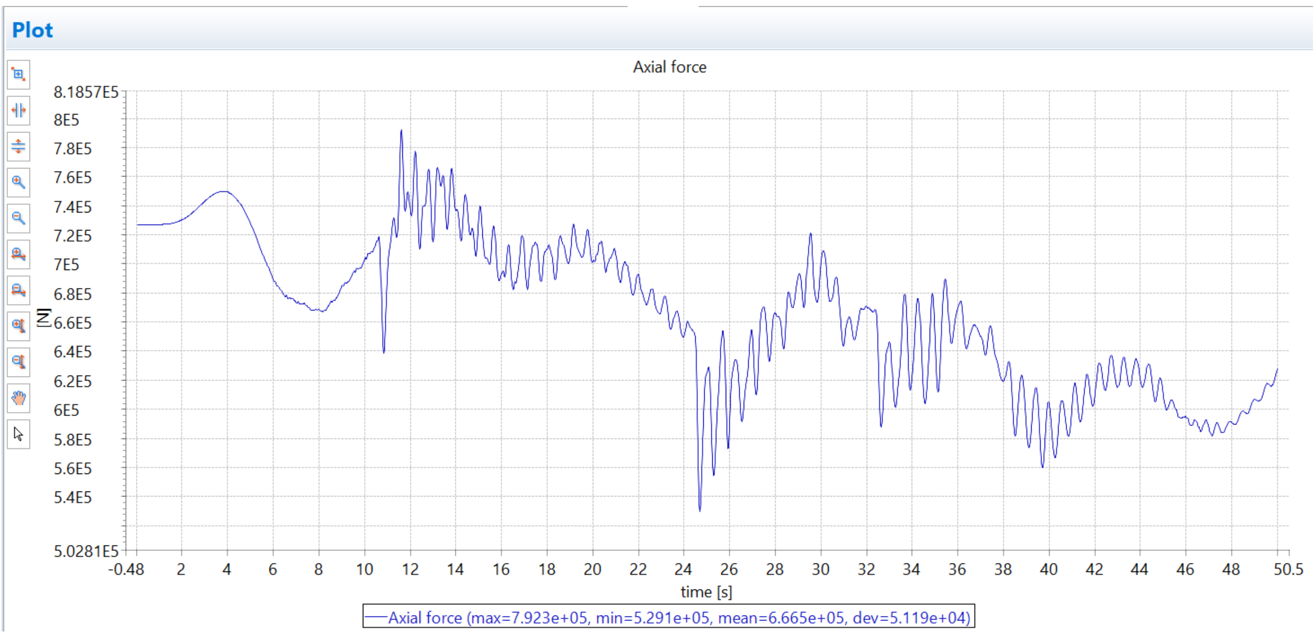

Figure 3-3 Mooring line 4 tension

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