Ship-Jacket Impact Advanced Finite Element Analysis

Overview

Z-Subsea Advanced Analysis team have successfully delivered sophisticated ship-jacket collision analysis to clients.

A Ship-jacket platform collision analysis is used to assess the consequences of impact to an offshore platform to assess the:

- Structural damage to the platform or vessel
- Collision energy loss mechanisms
- Collision forces time-history

Jacket FE Model

The jacket model can be based on beam elements. However, the location of collision can be refined by shell elements to obtain better insight into impact local effects (Figure 1).
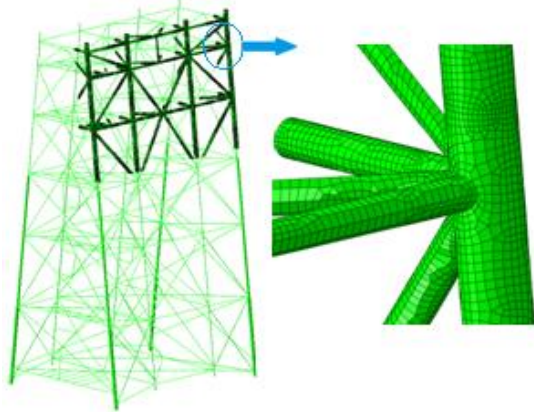

Figure 1. Jacket global beam and local shell elements

The mass/added mass of jacket, gravity, plasticity and other important parameters are considered. To simplify the model, jacket topside can be included as a mass located at its center of gravity.

Ship FE Model

The ship model can be based on beam and shell elements depending on the level of details required (Figure 2).
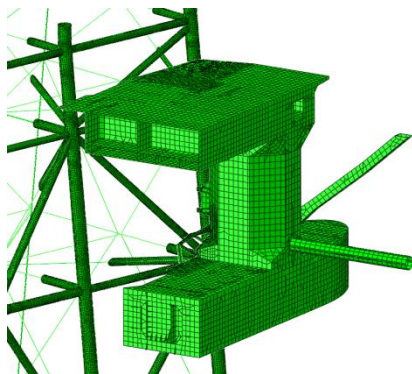

Figure 2. Ship FE model

The structural symmetry or lump mass is usually used to simplify the model. In simplified models, mass-spring-dashpot system can be used as representative of the vessel. Alternatively, rigid surface with concentrated mass, added mass, and rotational inertia located in accurate coordinates can be used.

Dynamic Analysis Method and Achieving Solution Convergence

Choosing between explicit and implicit dynamics requires considerations to have computationally economic analysis while maintaining accuracy and solution convergence. For example, mass scaling, time steps, plasticity or failure models, and contact modeling algorithm are important parameters that can affect the accuracy, solution time and analysis convergence. It is good practice to run both methods for comparison (Figure 3).
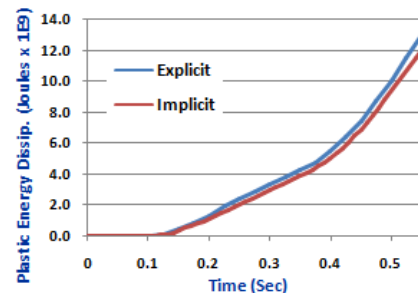

Figure 3. Comparison of Explicit and Implicit dynamics

The difference between explicit and implicit dynamic analysis results depends on e.g. analysis settings, material models, impact energy etc. and can be reduced if more accuracy is required.

Collision Analysis Results

Analysis results provide an assessment of structural damage level upon a ship impact with various ship velocities and impact energies and locations (Figure 4). The jacket overall status, dent size, damage to jacket or vessel, impact energy dissipation mechanisms etc. can be extracted.
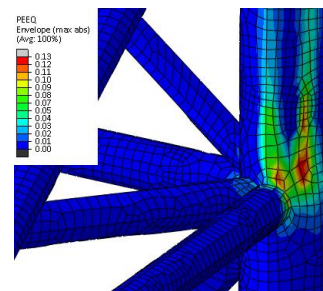

Figure 4. Local damage to jacket structure

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