SESAM EXAMPLE

Hydrodynamic and Structural Analyses of a Floating Box

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1 Introduction

This document explains how to do the following analyses of a floating box-like structure:

- Hydrodynamic motion analysis
- Structural analysis with hydrodynamic loads
- Hydrodynamic motion and structural analysis with flooding of some compartments

The box structure in hydrodynamic environment is shown in **Figure 1-1**.

The analysis workflow is set up in Sesam Manager, see **Figure 1-2**. To run the example create a new job (any name) and import the FloatingBox.zip file.

The following programs and versions are used: Sesam Manager version 6.6, GeniE 8.3, HydroD 6.1, Wadam 10.1, Sestra 10.16, Postresp 7.1 and Xtract 6.0.

Input to all program executions is provided as part of the imported workflow.

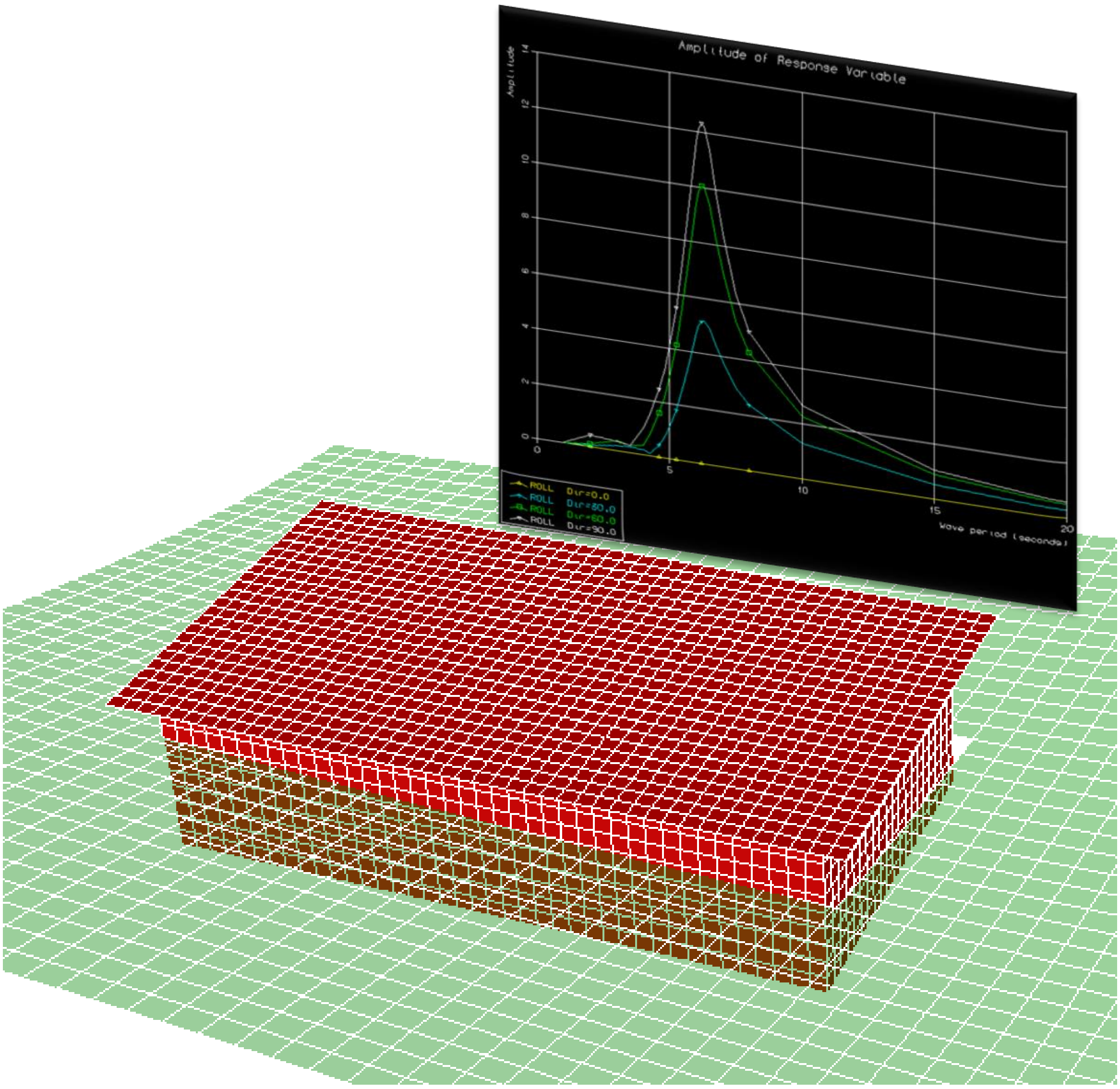

Figure 1-1 Floating box model with transfer functions for roll motion

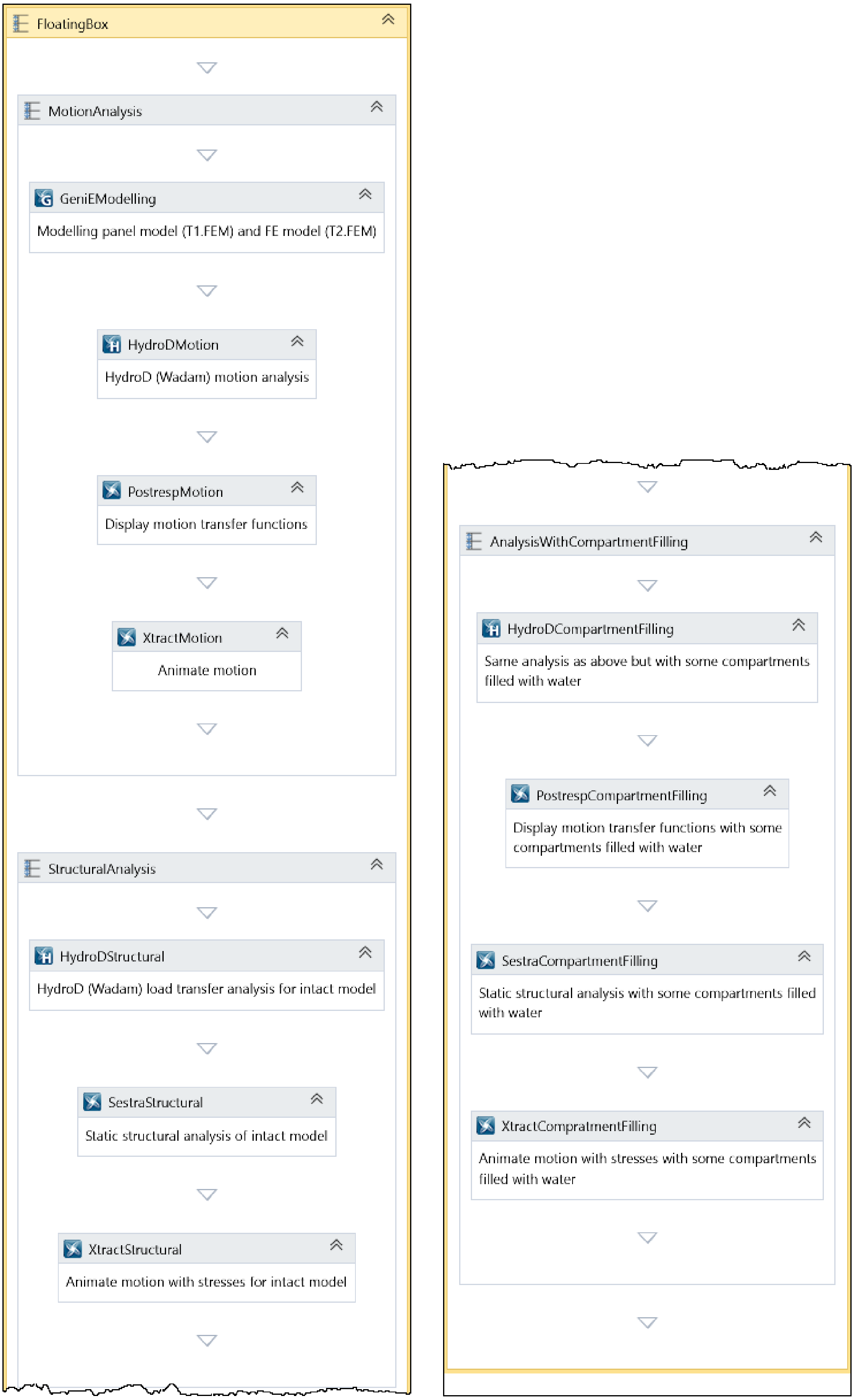

Figure 1-2 The Sesam Manager workflow

2 Hydrodynamic Motion Analysis

A sequence (a Sesam Manager collection of activities) named MotionAnalysis includes the following activities:

- GeniEModelling – Modelling panel model (T1.FEM) and FE model (T2.FEM)
- HydroDMotion – HydroD motion analysis (running Wadam in the background)
- PostrespMotion – Display motion transfer functions
- XtractMotion – Animate motion

2.1 GeniEModelling

The input file for GeniE (property CmdInputFile) is GeniEModelling_input.js. The geometry (concept model) is created with unrealistically large plate thicknesses and small material density. This is a simplified way of modelling plates with stiffeners. This modelling technique is not necessarily recommended for a real analysis case but it is useful in this example intended to demonstrate the analysis process and typical program input.

No real loads are created in GeniE. However, several so-called dummy hydropressures are created to prepare for the subsequent hydrodynamic analysis in HydroD/Wadam:

- LC1 is dummy hydropressure for the outer skin (hull)
- LC2-LC33 are dummy hydropressures for the 32 compartments

The model is given statically determinate fixation, i.e. supported in three points: three translations fixed, two translations fixed and one translation fixed as shown in **Figure 2-1**.

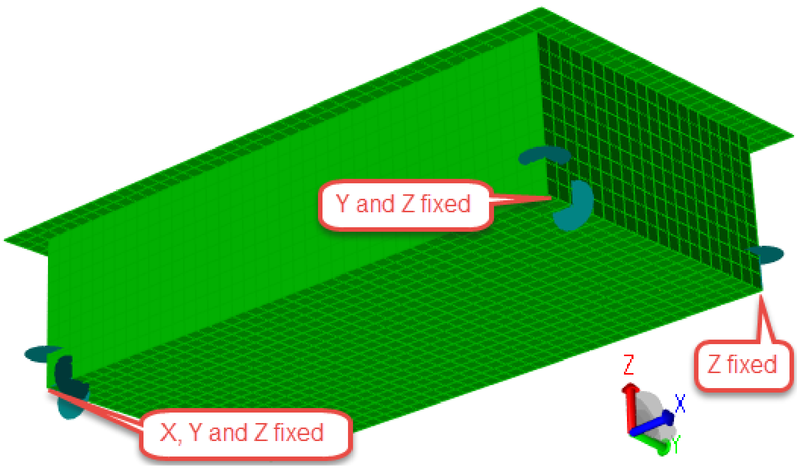

Figure 2-1 The FE mesh with boundary conditions displayed by GeniE

Two models are created based on the same geometry:

- T1.FEM – coarse panel mesh for the outer skin
- T2.FEM – fine FE mesh for the whole structure

T1.FEM and T2.FEM are copied by the default PostExecuteScript from the GeniE activity folder to the repository (<job_workspace>/_repository).

2.2 HydroDMotion

The input file for HydroD is HydroDMotion_input.js. Wave directions are defined at 30-degree intervals, i.e. 13 directions since both 0 and 360 directions are included. 27 wave periods are defined with small spacing near the eigenperiods (5 s for pitch and 6.2 s for roll). T1.FEM is defined as the panel model and T2.FEM as the mass model. The mass model in sea is displayed by HydroD in **Figure 2-2**.

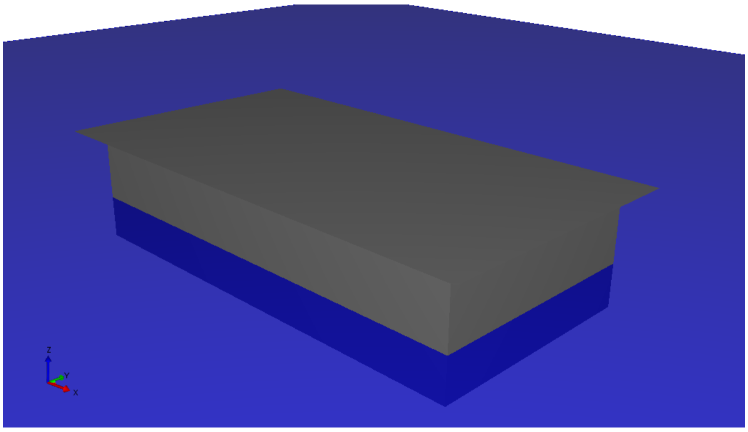

Figure 2-2 The mass model in sea displayed by HydroD

The motions are stored in MotionG1.SIF that is copied to the repository.

2.3 PostrespMotion

The input file for Postresp is PostrespMotion_input.JNL. It opens the MotionG1.SIF file in the repository and displays the transfer functions (RAOs or response variables) for roll for wave directions 0, 30, 60 and 90 as shown below.

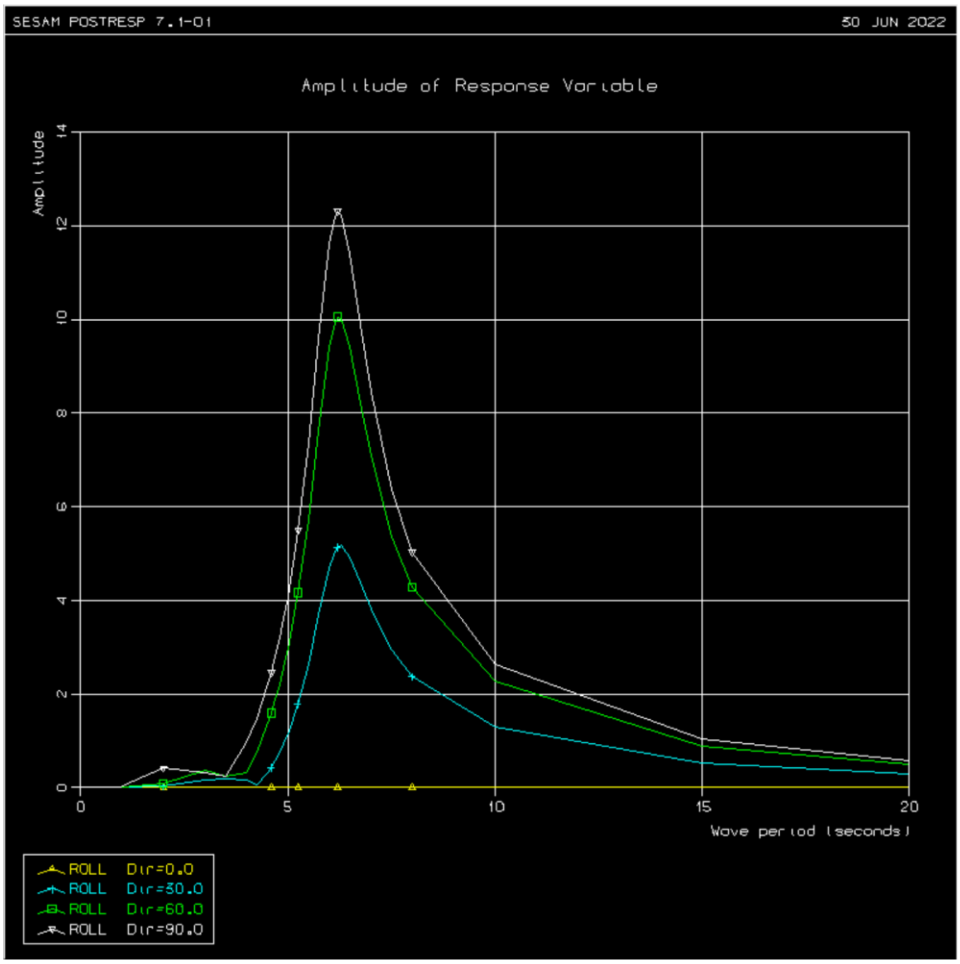

Figure 2-3 Transfer functions for roll motion displayed by Postresp

2.4 XtractMotion

The input file for Xtract is XtractMotion_input.jnl. It opens both the T2.FEM and MotionG1.SIF files, sets up an animation of the motion for a selected wave direction and period and runs the animation. A snapshot of the animation is shown below.

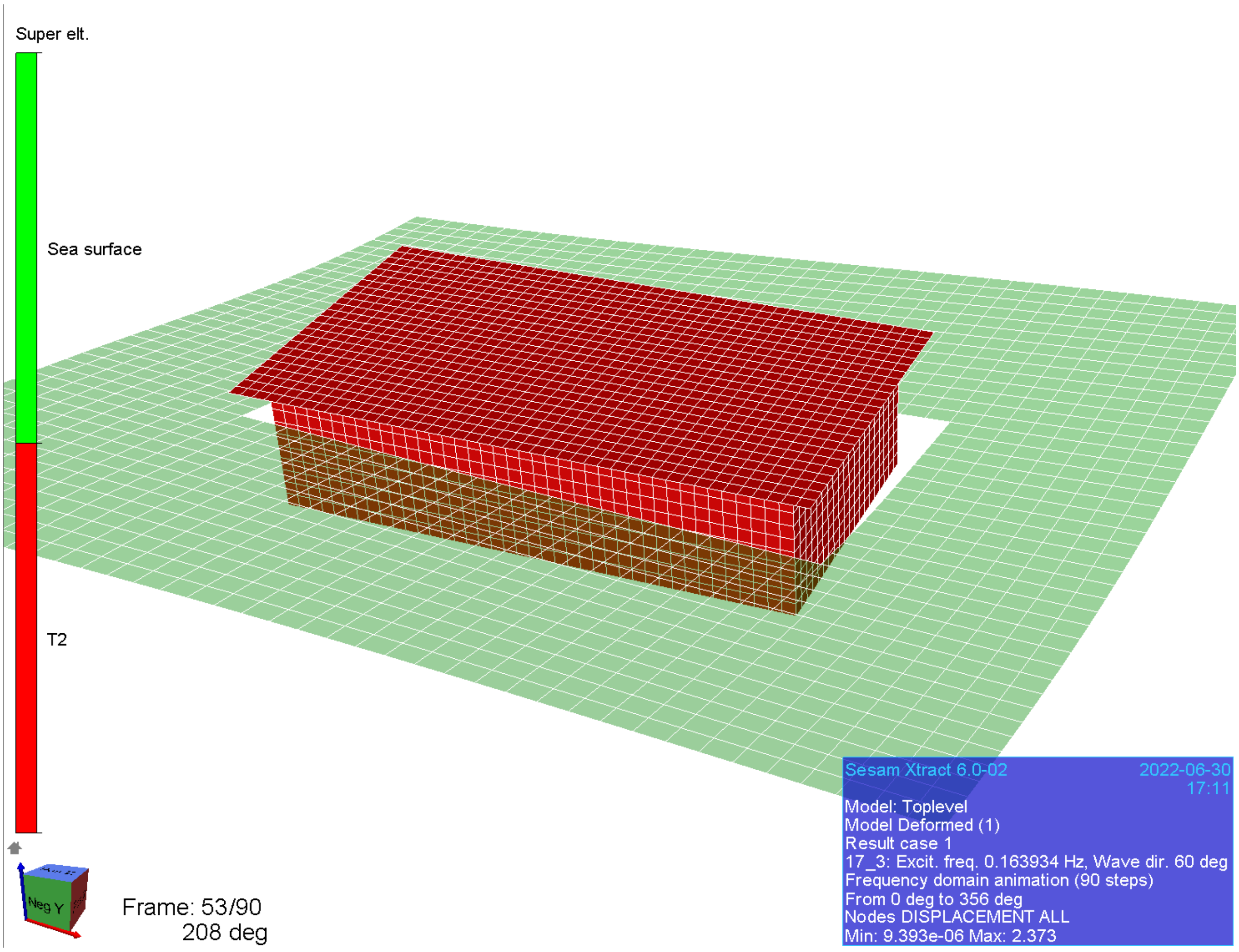

Figure 2-4 Snapshot from animation of box motion in sea by Xtract

3 Structural Analysis with Hydrodynamic Loads

A sequence named StructuralAnalysis includes the following activities:

- HydroDStructural – HydroD load transfer analysis for intact model (running Wadam in the background)
- SestraStructural – Static structural analysis of intact model
- XtractStructural – Animate motion with stresses for intact model

3.1 HydroDStructural

The workspace (folder) and database of this activity is set to be the same as the one for the activity HydroDMotion, see above. Moreover, the DatabaseStatus is set to Old. The reason for this is that we want to reopen the existing (old) HydroD database and merely add a Wadam run for load transfer calculation. The input file for HydroD is HydroDStructural_input.js. This input defines T2.FEM as both the compartment model and structural model and runs the load transfer analysis.

A PostExecuteScript named HydroDStructural_post.js is used to copy the files StructuralL2.FEM, StructuralS2.FEM and StructuralG1.SIF files pertaining to this analysis from the workspace to the repository.

3.2 SestraStructural

This activity is a static (quasistatic) analysis of superelement 2. AnalysisType is set to Static, InputFilePrefix is blank, and both LoadFilePrefix and OutputFilePrefix are set to Structural. This involves that T2.FEM, StructuralL2.FEM and StructuralS2.FEM are input files while Structural R2.SIN is output file from Sestra. The reason for using file prefixes is to avoid conflict with file names of subsequent steps in this analysis workflow.

3.3 XtractStructural

The input file is XtractStructural_input.jnl. It opens both the R2.SIN and G1.SIF files, sets up an animation of the motion for a selected wave direction and period and runs the animation. This is the same animation as in the previous activity XtractMotion except that structural stress results are included. A snapshot of the animation is shown below.

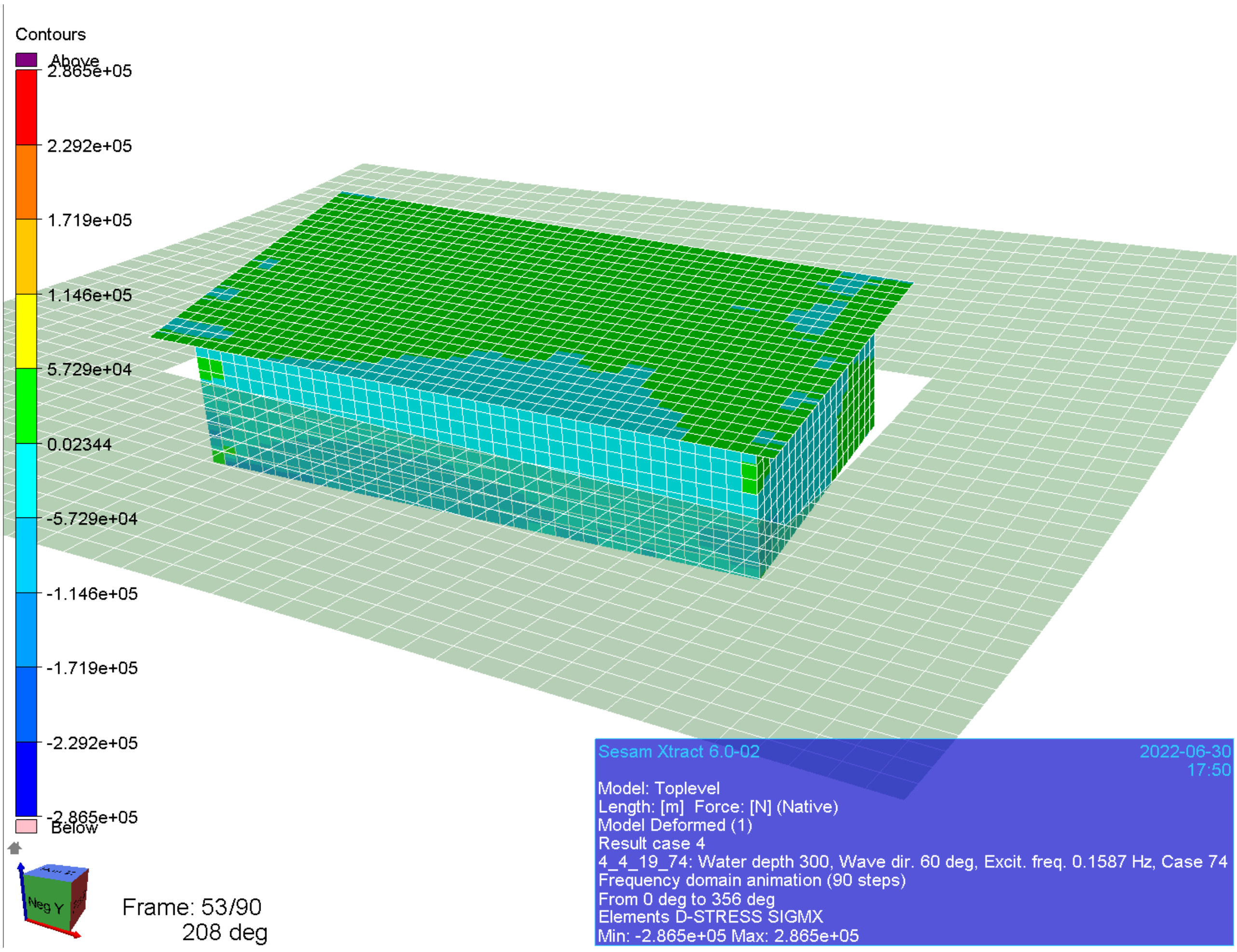

Figure 3-1 Snapshot from animation of box motion with stress contours by Xtract

4 Hydrodynamic Motion and Structural Analysis with Flooding of Some Compartments

A sequence named AnalysisWithCompartmentFilling includes the following activities:

- HydroDCompartmentFilling – Same analysis as above but with some compartments filled with water
- PostrespCompartmentFilling – Display motion transfer functions with some compartments filled with water
- SestraCompartmentFilling – Static structural analysis with some compartments filled with water
- XtractCompartmentFilling – Animate motion with stresses with some compartments filled with water

4.1 HydroDCompartmentFilling

The input file is HydroDCompartmentFilling_input.js and is essentially the same as before only now:

- The structure is damaged causing two compartments in a corner to be 90% filled with seawater.
- Motion analysis and load transfer is done in a single Wadam run.

A PostExecuteScript named HydroDCompartmentFilling_post.js is used to copy the files CompartmentFillingL2.FEM, CompartmentFillingS2.FEM and CompartmentFillingG1.SIF to the repository.

4.2 PostrespCompartmentFilling

The input file for Postresp is PostrespCompartmentFilling_input.JNL. It opens the CompartmentFillingG1.SIF file in the repository and displays the transfer functions for roll for wave directions 0, 30, 60 and 90 as shown below.

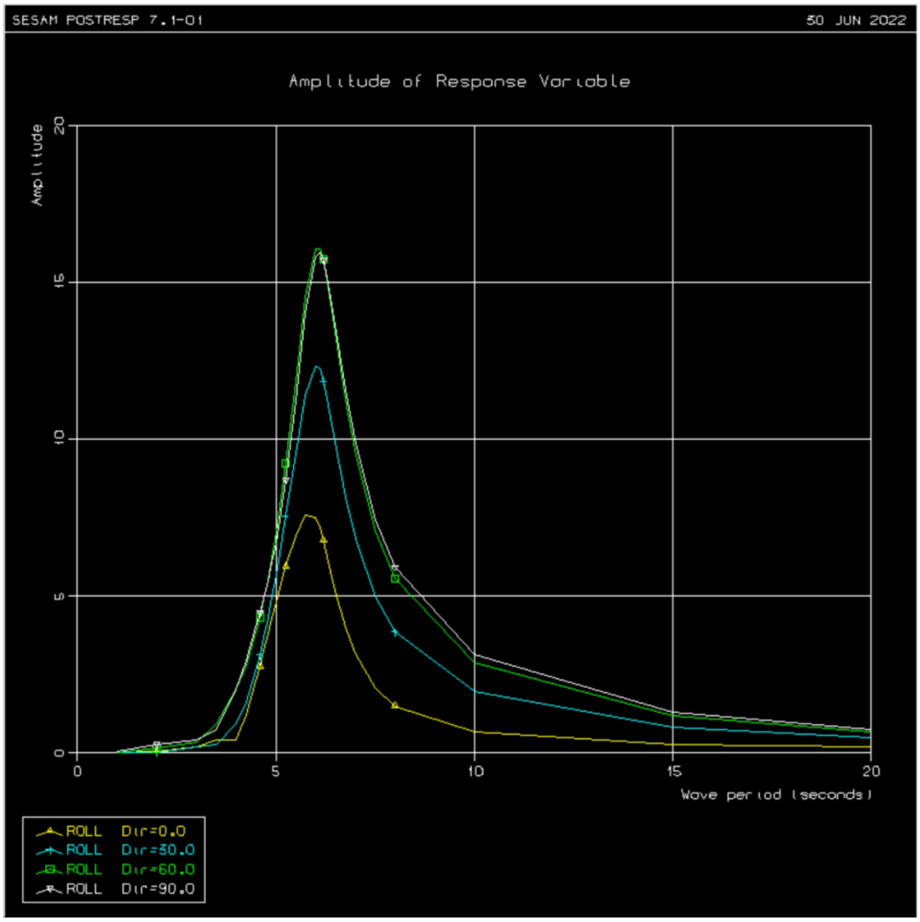

Figure 4-1 Transfer functions for roll motion after flooding compartments displayed by Postresp

4.3 SestraCompartmentFilling

This is a static analysis similar to the one of SestraStructural above. The InputFilePrefix is blank, and both LoadFilePrefix and OutputFilePrefix are set to CompartmentFilling.

4.4 XtractCompartmentFilling

The input file for Xtract is XtractCompartmentFilling_input.jnl. It sets up and runs the same animation as above only now for the damaged structure with two compartments filled with seawater. A snapshot of the animation is shown below.

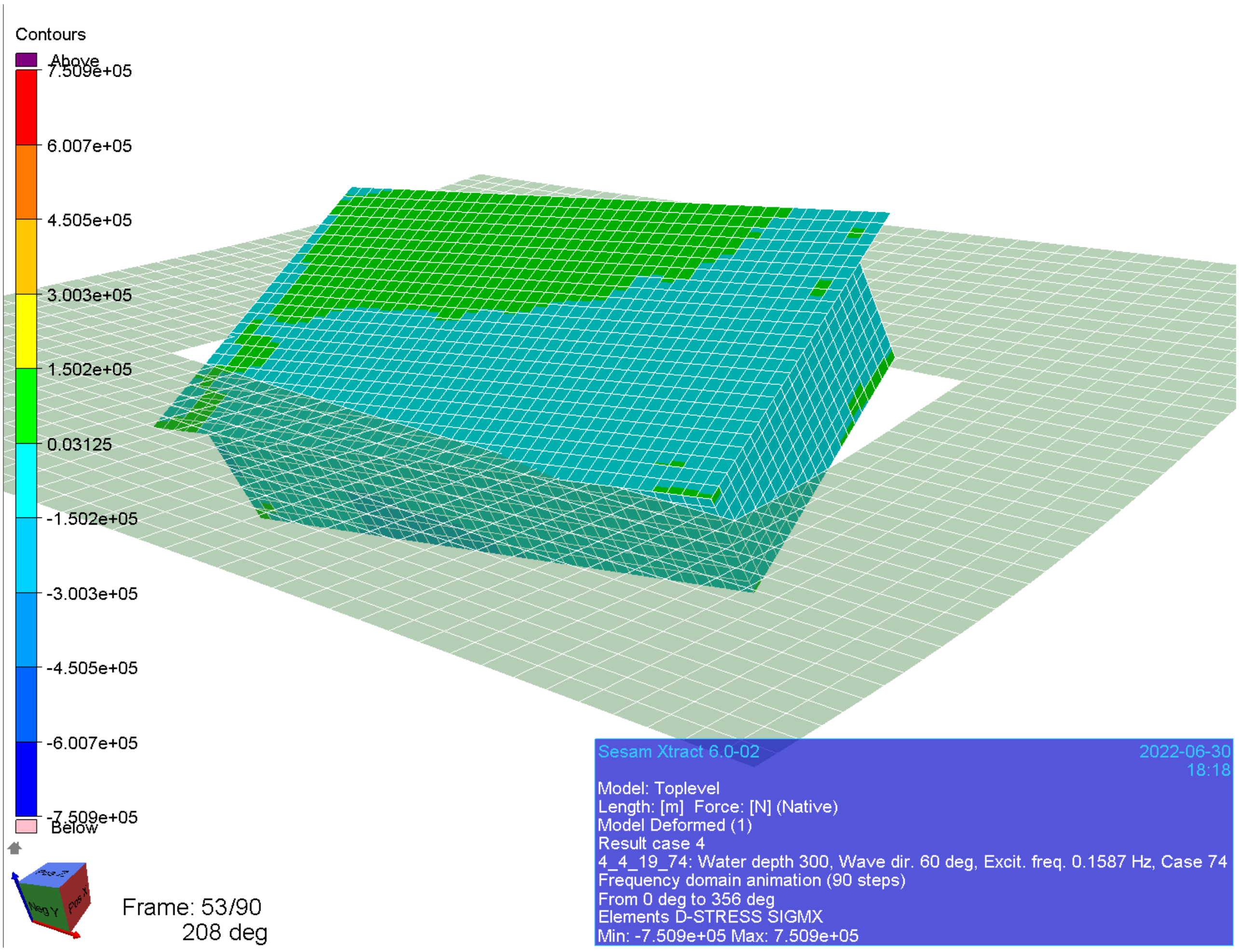

Figure 4-2 Snapshot from animation of box motion after flooding compartments by Xtract

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