

Validation case 17

Frequency domain analysis of the ISSC TLP structure



SeaFEM

Version
15.1.0

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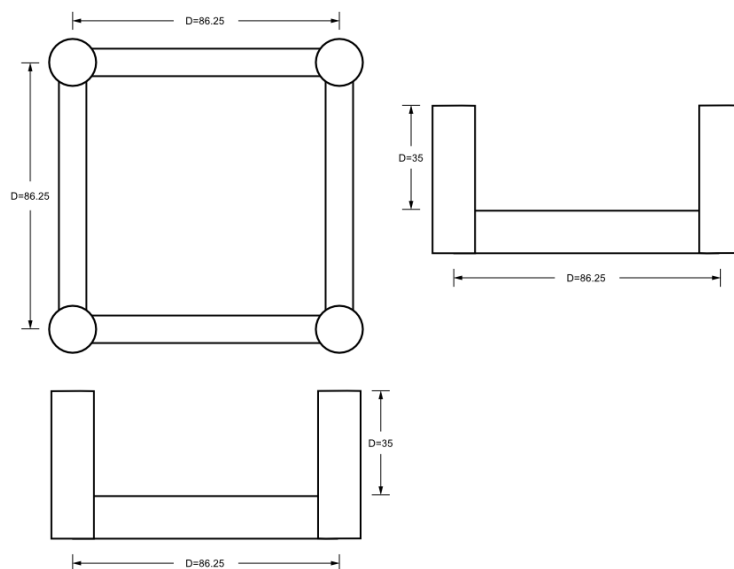
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1 Frequency domain analysis of the ISSC TLP structure

Problem description

This test case deals with the study of the response amplitude operators (RAO) of an ISSC TLP structure. Such an analysis was already undertaken in a previous tutorial using the time domain capabilities of SeaFEM [1-2]. Nevertheless, the analysis here is performed using the frequency domain tools available within the linear module of SeaFEM. For the sake of validation, the results obtained for the present analysis are compared against the results obtained with WAMIT and the results obtained with the time domain capabilities of SeaFEM.

The geometry of the ISSC TLP structure under analysis is shown in the following picture.



Body data reads as follows:

- Mass: 0.0 kg (so that the actual mass is calculated internally through the displacement of the body)
- Center of gravity: (0.0, 0.0, 3.0) m
- Radii of gyration: $R_{11} = R_{22} = 38.876$ m , $R_{33} = 42.42$ m

For the purpose of RAO's analysis, a white noise wave spectrum is used with the following characteristics:

- Shortest period: 8 s.
- Longest period: 15 s.
- Number of wave periods: 10

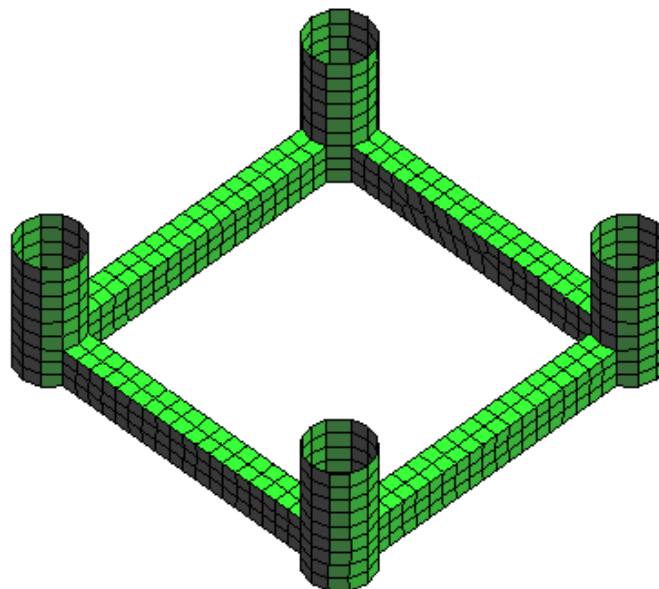
- Lower heading: 0 deg
- Upper heading: 90 deg
- Number of wave headings: 5
- Speed: 0 m/s
- Speed direction: 0 deg

Mesh

Mesh properties for the present analysis are summarized in the following table:

Mesh properties	
Min. element size	4
Max element size	4
Mesh size transition	0.3
Number of elements	1155
Number of nodes	1175

A global view of the resulting mesh is shown in the following picture.

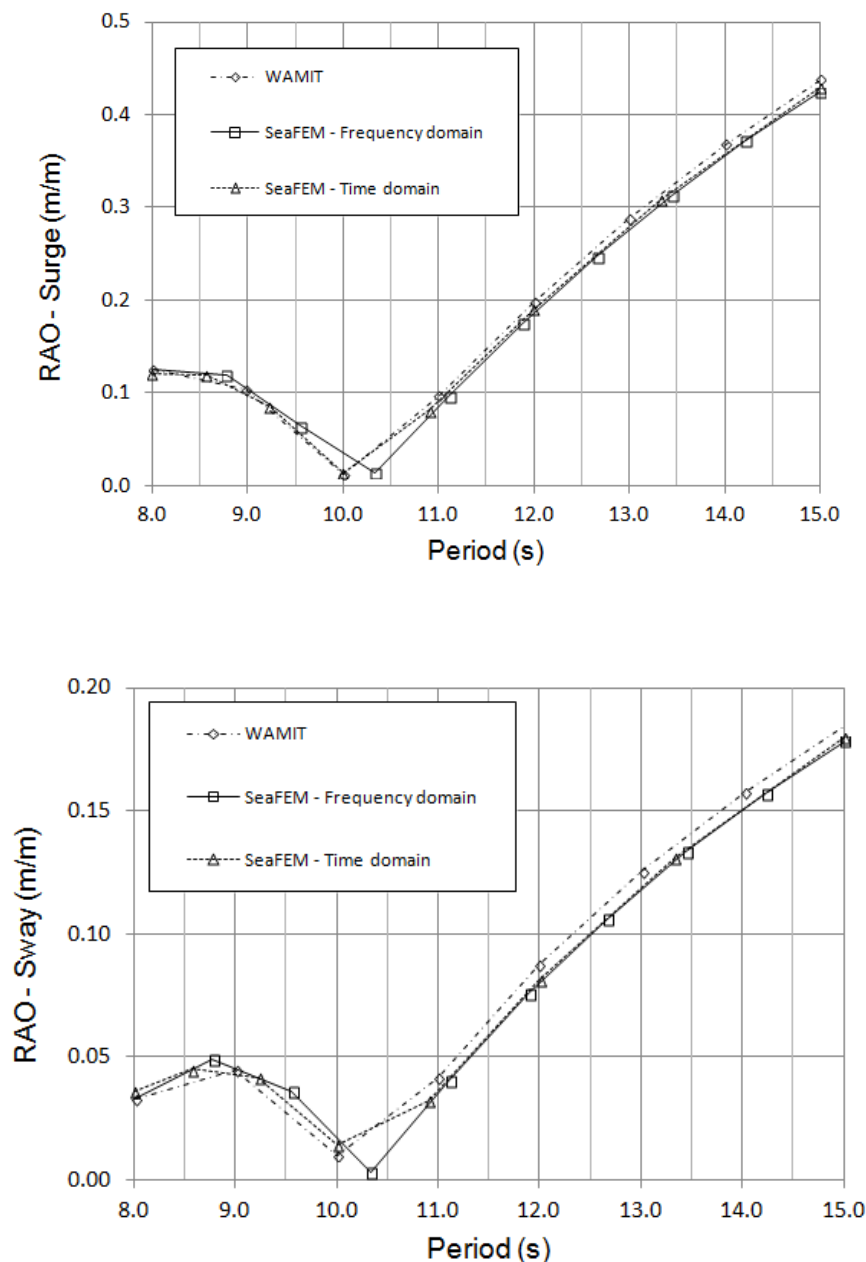


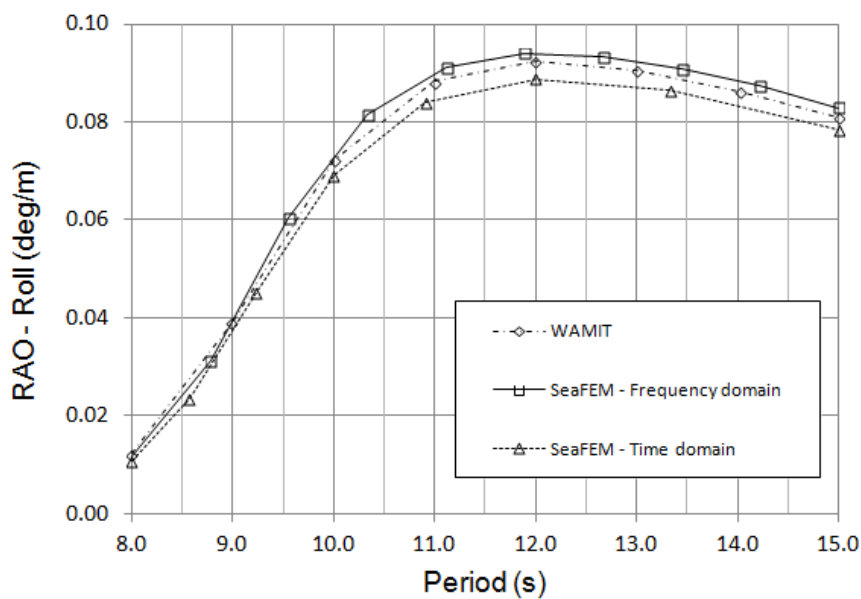
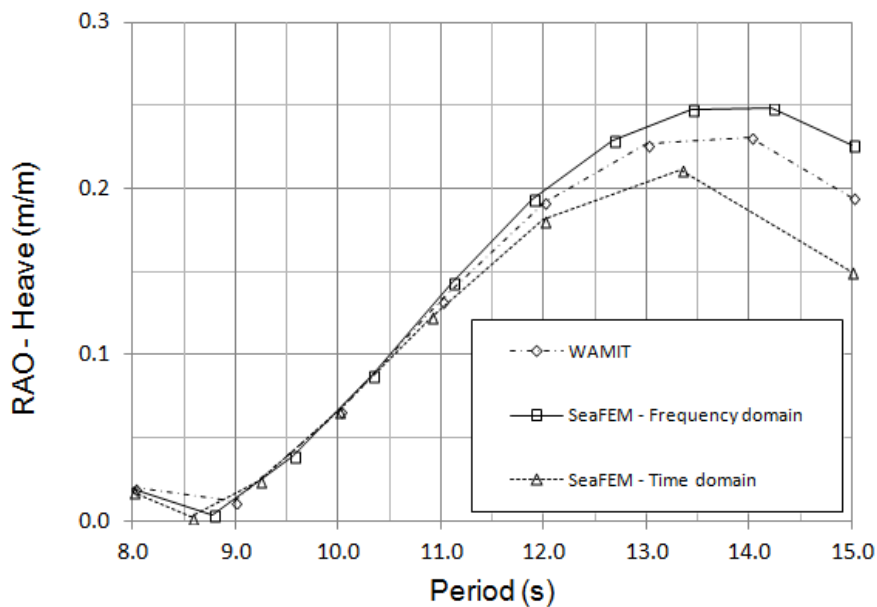
Results

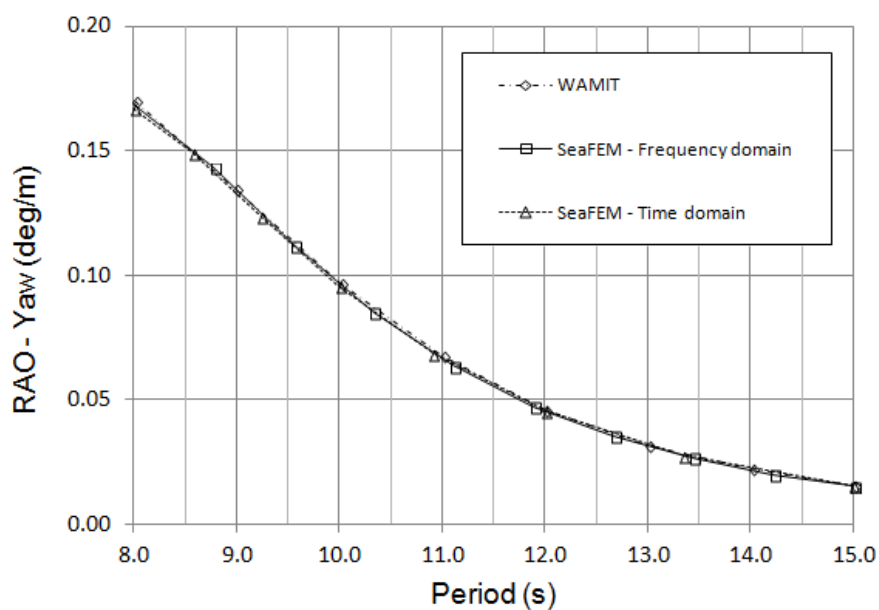
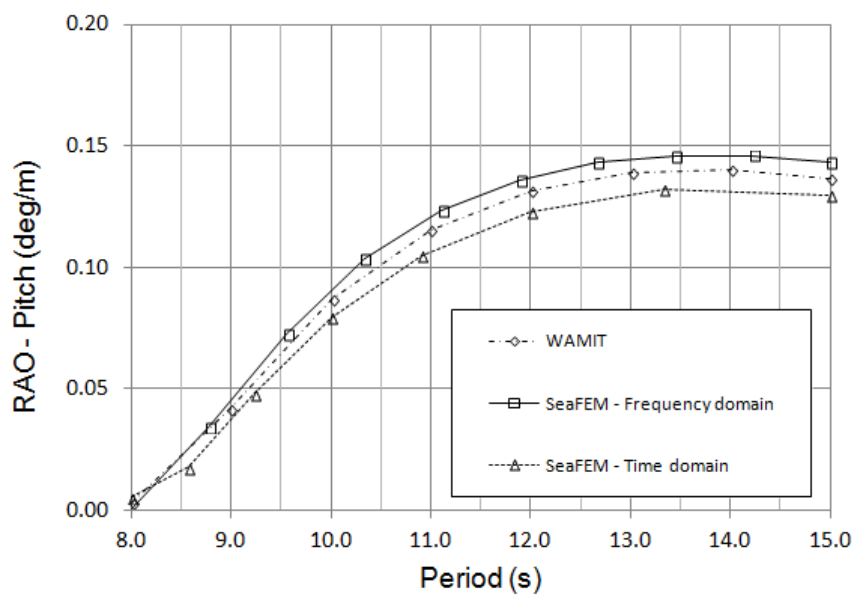
In this section the results obtained using the frequency domain capabilities of SeaFEM are

presented and compared against WAMIT and also against the corresponding time domain results of SeaFEM. In particular the results corresponding to a heading direction about 22.5 degrees are compared in detail. For proper comparison, SeaFEM RAOs results concerning rotational degrees of freedom must be multiplied by the characteristic length of the model. This is so because WAMIT results are provided in non-dimensional form [3], while the output of SeaFEM is not. In this particular case, the characteristic length of the model is half the distance between the legs of the TLP structure, and is about $L = 43.125$ m.

RAOs results calculated using both, SeaFEM and WAMIT are shown in the following figures for a heading of about 22.5°.







References

- [1] SeaFEM validation models. http://www.compassis.com/downloads/Manuals/Validation/SeaFEM-v13.1.0-ValTest3-ISSC_TLP_structure.pdf, CompassIS, (2014)
- [2] SeaFEM tutorials. <http://www.compassis.com/downloads/Manuals/SeaFEMTutorials.pdf>, CompassIS, (2014)
- [3] WAMIT user manual, ver.7.0, WAMIT Inc., Chestnut Hill, MA, USA (2013)

Validation Summary

CompassFEM version	15.1.0
Tdyn solver version	15.1.0
RamSeries solver version	15.1.0
Benchmark status	Successfull
Last validation date	27/11/2018