Breaking Wave Impact on a Platform Column: An Introductory CFD Study

Theslamming of breaking waves on the legs of large volumeoffshore platforms has received increased attention over recent years. Toinvestigate this problem, MARINTEK's Wave Impact Loads JIP has, inone of its sub-tasks, focused towards an idealised model testsetup of a rectangular cylinder in breaking waves. The modelconsists of a vertical column with a fragment of ahorizontal deck attached. The model is fixed at a distanceL ahead of the wave maker. Physical scale model testexperiments of the block in regular waves and in wavegroups have been carried out in Phase 1 of theJIP (2008). The objective of this study is the CFDsimulation of a long crested breaking wave and its impacton the aforementioned cylinder and deck structure in order tofind out the feasibility of the numerical reconstruction of suchevents. The commercial CFD tool Star-CCM+ V5.03.0056 (www.cd-adapco.com [1]) is usedin this study. This paper considers results from the testsetup, and compares the measured wave elevation against results fromthe CFD code. The position of the cylinder in relationto the breaking wave front is investigated in the numericalsimulation in order to analyze its effect on the slammingforce. Use of an unsteady wave boundary condition, matching theexact motion history of the wave-maker with the measured freesurface elevation at the wave maker gives an almost exactmatching between the computed wave profile and the measured waveprofile. The improvement in the numerical tool of Star-CCM+ whichmakes it possible to use higher order time integration schemefor VOF significantly decreases the numerical diffusion of the wavepropagation. This new scheme also enables the use of atime step 10 times larger than the first order schemewhich reduces the computational time. Because a large time stepcan be chosen it is important that the time stepis small enough to capture the correct time evolution ofthe physical phenomena of interest. Capturing the pressure evolution ata slamming event demands very high spatial resolution. Spatially averagedslamming pressures look fairly similar to the model test observations,while further work is needed for a more detailed comparison.

Author Name:
Csaba Pakozdi
Timothy E. Kendon
Carl-Trygve Stansberg
Industries:
Oil and Gas [2]
Products:
STAR-CCM+® [3]
Conference Location:
Rotterdam, The Netherlands

Pages:
645-654

Conference Date:
Sunday, June 19, 2011
Paper Reference:
OMAE2011-49976
Publisher:
ASME
Volume:
1: Offshore Technology; Polar and Arctic Sciences and Technology
ISBN:
978-0-7918-4433-5
DOI:
http://dx.doi.org/10.1115/OMAE2011-49976
Conference Name:
ASME 2011 30th International Conference on Ocean, Offshore and Arctic Engineering (OMAE2011)