Numerical simulation of pressures on rigid cylinder subjected to slamming loads

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I. Introduction

Wave impact or slamming load on offshore structures is a critical design load which is characterized by high local peak pressures (10 bar and above). These pressures are highly

contact between cylinder and free surface. In this work, it is intended to numerically resolve the peak pressure incident on a cylinder surface during slamming and compare with the experimental data [2].

II. Numerical Modeling

For numerical modeling and solving of Navier-Stokes equation (Equation 1), three commercial codes are tested: 1) Fluent (Implicit), 2) LS-DYNA (Explicit), and 3) LS-DYNA (Smoothed Particle Hydrodynamics (SPH)). In case of implicit code, a moving mesh is used and triangular mesh elements at the bottom of the mesh are used to control the skewness caused due to the mesh motion, and the volume fraction of air and water is controlled by the volume of fluid (VOF) method. In case of explicit code, different phases are represented by multi-material groups (MMGs) and advection time step is used to model the transport of the element-centered variables. SPH is mesh-free method and hence lagrangian particles are used to define fluid and solid domains. Fig.1 shows the different mesh configurations.

$$\frac{\partial \vec{V}}{\partial t} + \left(\vec{V} \cdot \nabla\right)\vec{V} = -\frac{1}{\rho}\nabla P + \nu \nabla^2 \vec{V} \qquad (1)$$

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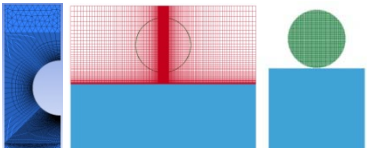

SPH respectively

III. Results and Conclusions

Table 1 summarizes the peak pressures calculated in all the three codes. Experimental peak pressure for an impact velocity of 3.4m/s is 9.59 bar. It is to be mentioned here that the mesh refinement used in implicit and explicit is same. Decreasing the smallest element size resulted in increased peak pressures. Thus, implicit and explicit procedures are not converging on pressure values and SPH has to be investigated further.

Table 1: Peak pressures in different codes

Peak pressures	*Rigid*
Implicit	4.40 bar
Explicit	5.67 bar
SPH	11.54 bar

References

[1] Sun, H. and O.M. Faltinsen, *Water impact of horizontal circular cylinders and cylindrical shells.* Applied Ocean Research, 2006. **28**(5): p. 299-311.

[2] Lin, M.-C. and L.-D. Shieh, *Flow visualization and pressure characteristics of a cylinder for water impact.* Applied Ocean Research, 1997. **19**(2): p. 101-112.