Use of CFD to study Hydrodynamic Loads on Free-Fall Lifeboats in the Impact Phase

In the past, testing of lifeboat design has been carried out solely by experimental means.However, due to the large number of factors which influence the loads on the lifeboat. structure and its occupants, optimization studies by experimental means have become both time-consuming and expensive. In addition, many eects cannot be studied at laboratory scale due to the inability to match all similarity requirements.

Recent advances in computational fluid dynamics (CFD) have made it possible to analyze the lifeboats performance under realistic conditions. By not being dependent on a physical model, investigation of a larger range of hull shapes at a variety of launch conditions can be done more easily and cost-efficient.

This thesis explores the possibility of using the CD-adapco's CFD-software STARCCM+ (STAR) to predict the performance of free-fall lifeboats during the impact phase. The thesis focuses on verification and validation of the software by studying water impact of dierent two and three-dimensional rigid and elastic wedges.

For the two-dimensional case, 2-D rigid wedges with constant vertical velocity and varying deadrise angles (4 to 81 degrees) are studied with respect to various slamming parameters presented by Zhao and Faltinsen (1992). In the study, good agreement is found between the solution predicted in STAR and the presented numerical and analytical solutions. It is found that the slamming pressures are strongly dependent on the deadrise angle; from 300 Pa for the 81 wedge, to 275 000 Pa for the 4 wedge. It is seen that as the deadrise angle is decreased, better resolution in grid size and time step is required to capture the peak pressures.

The three-dimensional case includes both rigid and elastic wedges. For the rigid case, a 3-D wedge is modeled so to represent an experimental study conducted by Yettou et al. (2006). It is found that STAR predicts a lower impact velocity than what is found in the experimental study. Following, the pressures predicted are too low. The difference is however moderate, and STAR is able to predict the displacement and velocity-time histories of the wedge in a satisfactory manner. It is noted that the reason for the discrepancy lies in the prediction of motion through air - and not in the simulation of impact and motion in water. It is also noted that renements in grid size and time step are not of great importance if only displacements and velocities are to be studied.

For the elastic wedge case, four dierent elastic wedges are studied to explore STAR's possibilities and limitations related to fluid-structure interaction (FSI). No verification or validation with existing theory or experimental data is performed. A qualitative assessment of the results is however carried out and it is found that STAR predicts displacements,velocities,accelerations, pressures, deflections and stresses in asatisfactory manner.

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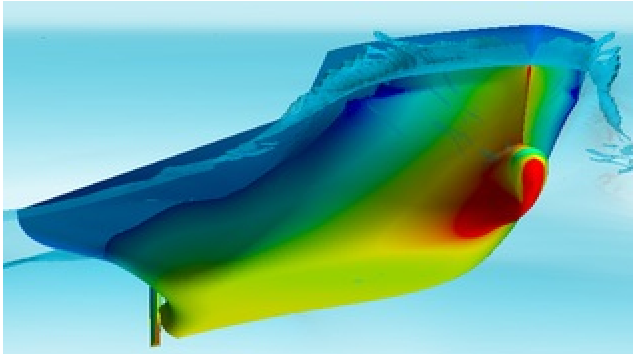

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