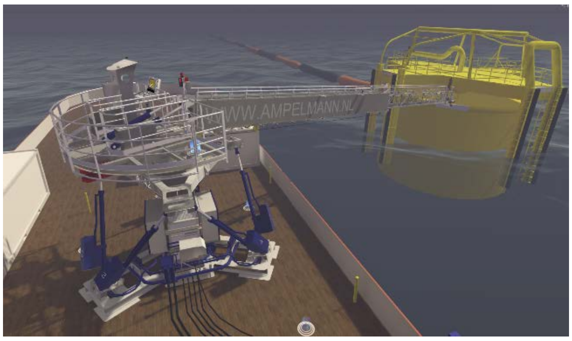
Technische Universiteit Delft

Offshore & Dredging Engineering

Determine the impact on the workability affected by dynamic interaction of an Ampelmann system connected to a CALM buoy

The diversity of offshore structures is increasing nowadays, as more and more offshore structures are floating. To study the opportunity for Ampelmann to expand to the floating market it is necessary to see if working with floating structures requires a new way of operating. A potential market for Ampelmann is transferring maintenance personnel to catenary anchored leg moored (CALM) buoys. These on- and offloading buoys for tankers are stationed relatively close to shore and are connected to an onshore storage facility.

The current method of connecting the Ampelmann system to an offshore structure is done by applying a constant force on the target structure to keep the gangway connected. There is a dynamic interaction between the Ampelmann system and the floating structure, which potentially can influence the motions of the floating structure and the workability of the Ampelmann system.



The current method of calculating the workability is based on a kinematic approach where dynamic interaction is not included. The effect of the dynamic interaction between the Ampelmann system and the CALM buoy has been studied by a numeric, coupled, time-domain model. Using this model the response of the coupled system will be compared with and without the dynamic interaction of the gangway forces acting on the buoy.

An analytical approach is used to perform a sensitivity study of the parameters exerting the total damping forces on the CALM buoy. This study showed that the hydrodynamical damping of the buoy is the governing factor. According to diffraction data of the buoy, the hydrodynamical damping can vary significantly in the frequency spectrum. For low- and high-frequency waves the hydrodynamical damping of the buoy is much lower than in the mid-frequency spectrum. The damping forces caused by the gangway are of bigger impact when the hydrodynamic damping of the buoy is low. This is used to create a case-study for regular, low-frequency waves to study the influence of the gangway damping forces on the motions of the buoy. This case study is used in the numerical model of aNySIM, and in a numerical model based on the analytical approach in Python. Both showed that the amplitudes of the motions of the buoy are reduced by the damping forces of the gangway.

A workability study has been performed by creating time series of the dynamic interaction using the 3D aNySIM model and then comparing it to the operational limits using a MATLAB model. The operational percentage and statistics of each sea state results in the total workability. The workability obtained with a dynamic approach is improved by 1% compared to the workability obtained with a kinematic approach.

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