Offshore & Dredging Engineering

Technische Universiteit Delft

Vibration Isolation for deck-mounted super structures

The majority of Cutter Suction Dredge (CSD) vessels (Figure 1) is equipped with rubber isolators for Operator Cabin (OC) vibration reduction. A small number of vessels is equipped with expensive gas springs. Of the vessels that have been equipped with rubber isolators, a number is experiencing large vibrations caused by what is assumed resonance between the OC and the vessel.

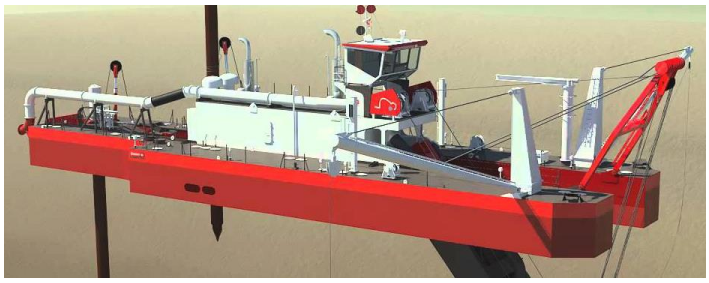

Figure 1, Cutter suction dredger

This research focuses on the development of an economically feasible solution to reduce vibrations for deck-mounted superstructures in CSDs.

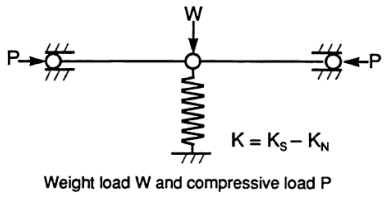

Figure 2, Negative stiffness mechanism

In the first part of the thesis the focus was placed on investigating the driving frequencies in CSDs and the natural frequencies of the coupled OC-vessel system. For this purpose, a model was developed and it was found that the large amplitude motions were in fact caused by resonance of the system in one of the driving frequencies. To solve this problem several solutions were studied. The initial investigation resulted in the proposal of a low-frequency vibration isolation using a load bearing spring combined with a Negative Stiffness Mechanism (NSM)(Figure 2).

The NSM was modelled to verify the behaviour of the NSM and the OC – vessel system and the design parameters were obtained. To validate the proposed concept, a prototype was constructed (Figure 3). The prototype shows that during the detailed design stage the influence of friction and the influence of tolerances have to be minimised.

Figure 3, Prototype

The next steps in the development of the NSM as a product will need to centre around a 6DOF prototype set up and the detailed design of the internal mechanism of the NSM. This includes material selection, profile selection and design of the hinge points.

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