

Experimental and numerical study of dynamic loads on marine propellers operating under near-surface and partially submerged conditions.

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ABSTRACT

The main topic of this study is the dynamic loads of propellers operating near the free surface or under partially submerged conditions. In order to investigate the influence of the free surface on the propulsion performance, the propeller forces and moments as well as the blade forces and moments were measured during the model tests in the Marine cybernetics laboratory (Mc-lab) at NTNU and determined by numerical calculations (CFD). The comparison between the CFD calculations (STAR CCM +) and the model tests shows that several parameters (e.g. the time step) have an influence on the numerical results. The CFD calculation of the final model shows good agreement with the model tests. The comparison served to validate the numerical calculations and to identify and understand different ventilation mechanisms based on the dynamic loads on the propeller blades. In addition to the dynamic loads on the propeller blades and the propeller, the excitation forces of the shaft were also analysed by the calculation model of the propeller shaft. The aim of this study was to determine the worst-case scenario for the shaft excitation force and whether the influence of the free surface on the propeller performance can increase the risk of damage to the propeller shaft bearings, as described by DNV (2023) in a technical note, see Fig. 1 below.

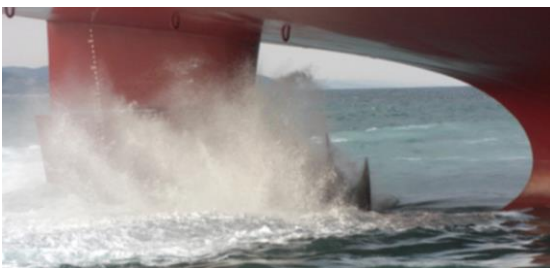


Fig. 1. Incomplete immersion of the propeller, which according to Det Norske Veritas technical note, DNV (2023) increase the risk of propeller shaft bearing damage on vessels typically 10 years or older.

References

DNV (2023), “How to reduce the risk of propeller shaft bearing damage”, <https://www.dnv.com/news/how-to-reduce-the-risk-of-propeller-shaft-bearing-damage/>.