Contribution ID: **75** Type: **Paper**

Numerical and Physical Modeling of Ship Impacts on Fenders

Friday, 17 June 2022 14:55 (20 minutes)

The increase in the size and mass of ships reduced transportation costs but, it created new problems associated with operational aspects of large ships. For instance, further development and testing is required to improve the berthing process of large ships under various environmental conditions. Numerical models properly developed, validated, and calibrated are a valuable tool in the design process of berthing structures. The validation process of such models requires reliable data to be collected in situ or measured in scale-model tests. These tests do provide relevant information and results about berthing processes. The goal of this work is to assess and compare berthing forces obtained with a 1:100 scaled physical model with the ones obtained with a numerical model.

The physical tests were conducted in an area of 4 m x 4 m of a 22 m x 23 m (width x length) tank of the Ports and Maritime Structures Division of the Hydraulics and Environment Department of the National Civil Engineering Laboratory (LNEC) using a scale model of an oil tanker. Different loading conditions, speeds and angles of approach were tested. Ship's velocity and heading were recorded using an Optitrack® multi-camera motion capture system, the impact forces were registered by four force sensors and a Quantum MX data-acquisition system with CatmanEasy® DAQ Software.

The numerical modelling was performed with the MOORNAV module of the software package SWAMS – Simulation of Wave Action on Moored Ships, developed at LNEC. The MOORNAV module includes two numerical models, namely WAMIT and HYDRO/BAS, which are able to estimate ship movements and forces on mooring lines and fenders, using time-domain formulations.

This comparison allows a better understanding of the variables related to the ship and the fenders, namely the magnitude of impact forces on fenders and their sequence. Furthermore, the suitability of numerical modeling of ship impacts on fenders can be assessed and the validated.

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Session Classification: 7B

Track Classification: Experimental hydrodynamics