Challenging wind and waves

Linking hydrodynamic research to the maritime industry

MOONPOOL JIP

Background

Moonpools are used on many types of vessels: cable-laying vessels, exploration and drilling vessels, production barges, research and offshore support vessels. They are used to launch and retrieve equipment, divers or diving bells, or lay cables or risers. These operations are only possible in case the water inside the moonpool remains calm. However, waves and the corresponding motions of the vessel or simply forward speed in calm water can induce oscillations inside the moonpool. In resonant condition, the oscillations can reach as much as three to four times the wave height. Besides the fact that it is impossible to work under these circumstances the motions are sometimes so vigorous that damages occur and water ends up on the working deck.

A very critical case of oscillation is observed in transit when the moonpool bottoms are left open. This can occur even on a perfectly calm sea, as the excitation mechanism arises from the flow velocity in the vicinity of the opening. Besides the risk of damage, these oscillations during transit cause a tremendous increase in resistance and vessels are usually not able to reach their expected transit speed.

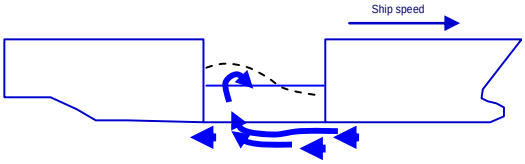
With large oscillations, the vessel will also start to heave and surge, which may induce further issues onboard, up to structural excitations. Despite the research effort conducted on the subject, most of the solutions to dampen the oscillations in the moonpool are still found and validated experimentally, or discovered on full scale. Furthermore, the solutions (such as wedges, plates, overflow chambers, doors, and perforated walls) often reduce the workable area of the moonpool or are too vulnerable or are only effective for a certain speed range.

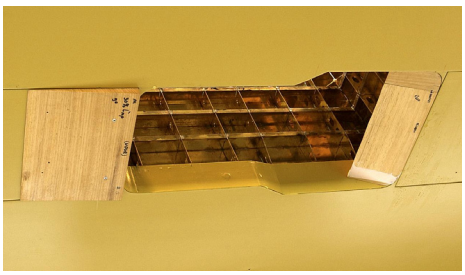
Objective

The aim of this initiative is to provide more insight into the excitation mechanism and prove the feasibility of using non-stationary CFD calculations to investigate potential problems and to find solution at the early design stage. The study should provide a design methodology for moonpools and damping devices.

Scope

The excitation mechanism will be studied by means of a combination of model tests and calculations. To visualise the motions of the water inside the moonpool use will be made of Particle Image Velocimetry technique (PIV). The tests will be conducted for different moonpool geometries, ship sizes, ship draughts and water depth, on free sailing ship models.





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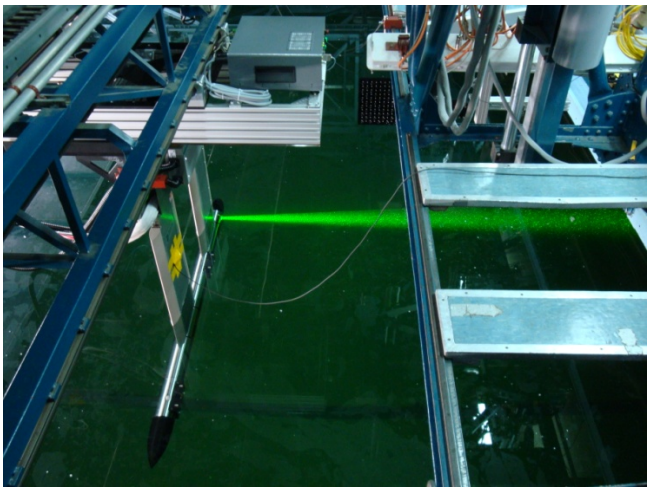
The results will then be used to validate non-stationary CFD computations. Ultimately, a coupling between local CFD calculations to catch the excitation and ship motion potential code to obtain the ship behaviour in surge and heave will be performed. Understanding of the underlying physics and systematic variations with calculations will allow deriving simple guidelines to spot possible issues and investigate possible solutions.



PIV test set-up

Organisation

MOONPOOL will be conducted as a 2-year JIP in close co-operation with owners, operators and yards. MARIN will act as JIP manager, sign participation agreements with members and issue subcontracts. All participants will be represented in the MOONPOOL JIP Steering Group with meetings hosted by one of the members every 6 months. Presentations, reports and other relevant info will be posted on the confidential project website.

Deliverables

The JIP will provide:

- Insight into the mechanisms which excite moonpool oscillations
- Design guidelines for moonpool openings in relation with vessels' particulars
- Design methodology for moonpools and damping devices
- Applicability of non-stationary CFD and PIV measurements

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