Extended Abstract

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Title: Full-scale measurements to assess squat and vertical motions in exposed shallow water

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FULL-SCALE MEASUREMENTS TO ASSESS SQUAT AND VERTICAL MOTIONS IN EXPOSED SHALLOW WATER

by

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The shipping traffic to the Belgian and Dutch ports located at the Western Scheldt estuary and the river Scheldt follows an access channel of which the depth is restricted. As a result, deep-drafted vessels cannot always sail 24 hours a day on the River Scheldt. The period in which these vessels may proceed inbound or outbound is called the tidal window. The Common Nautical Authority (CNA) calculates these tidal windows and gives permission for the vessels to proceed. For the calculation of tidal windows, the CNA is in the process of adopting a probabilistic access policy to determine the tidal windows.

In a probabilistic approach the expected vertical ship motions (resulting in a dynamic draft) are estimated based on ship particulars and environmental conditions, in order to define a safe value for the under keel clearance [1]. In this respect an accurate prediction of ship squat and dynamic vertical ship motions is of utmost importance. In order to validate the squat and seakeeping calculations applied in the probabilistic calculation, a full-scale measurements campaign was executed.

The full-scale measurements focused on seven inbound cape-size bulk carriers (drafted approximately 16.5 m) to the port of Flushing. The voyages of this type of vessels corresponded with small under keel clearances (to a minimal value of 16%) and exposed wave conditions (with a wave height up to 2.6 m).

Seven full scale measurements were provided by the Dutch Pilotage by means of positioning data from three RTK-GPS antennae that where mounted on both bridge wings and at the bow. These data were processed to determine the motions of the vessel in 6 degrees of freedom at 5 Hz. By referring the ship motions to a static measurement (at near-zero speed), the vertical ship motions at sailing conditions could be referred to the water level. Special attention was paid to an accurate reproduction of the tide along the trajectory in order to obtain an accurate measurement of the dynamic draft. The vertical ship motions were divided into steady motions (related to squat) and dynamic motions by means of a frequency filter.

In addition to the squat, the ship speed through water was determined based on position measurements and hindcast calculations of the current carried out by Rijkswaterstaat. The under keel clearance and the

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blockage were also determined using the most recent survey data at the time of the measurements. Furthermore ship meetings were obtained from an AIS analysis.

In order to evaluate the relation between dynamic ship motions and wave conditions, the ship motions were compared to directional wave spectra available at the Belgian coast (source: Meetnet Vlaamse Banken).

Processing of the above-mentioned data clearly revealed the influence of ship speed and under keel clearance on squat and the influence of swell on dynamic ship motions. Furthermore the data could be applied for direct comparison to the dynamic draft calculation by CNA, in order to validate the safety margins corresponding to a probabilistic accessibility approach.

First, the paper gives a detailed introduction, presenting the aim and scope of the project. Secondly, the processing methods applied to obtain ship motions, tide, current, AIS, bottom depth and waves are described and illustrated. Then the results of environmental parameters and vertical ship motions are presented and discussed. The paper concludes with a summary of the most important observations and propositions for future research.

[1] Vantorre, M., Laforce, E., Eloot, K., Richter, J., Verwilligen, J., Lataire, E., 2008. Ship motions in shallow water as the base for aprobabilistic approach policy. In: Proceedings of the ASME 27th International Conference on Offshore Mechanics and Arctic Engineering OMAE2008, Estoril, 15-20 June 2008.