COMPARISONS OF PIANC AND NUMERICAL SHIP SQUAT PREDICTIONS FOR BREMERHAVEN PORT

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Nautical Aspects of Ship Dynamics, 3rd Squat-Workshop
University of Applied Sciences, Elsfleth, Germany
21./22. October 2009

Abstract

The additional sinkage and trim of ships due to speed, also called ship squat, is an important phenomenon to consider in the design of fairways. As ships get bigger, channels have to be dredged deeper and maintenance costs increase. Dredging costs would be minimized if ship squat predictions could be improved for every ship using the channel.

Although many ship squat formulas exist, none of them is able to predict squat with satisfactory accuracy for all ship types and channel configurations. Most use a squared speed function, following Bernoulli's law. However, it has been observed that squat sometimes increases much quicker, especially when the ship is in very restricted water. The present Working Group N° 49 (WG49) of PIANC is revising the guidance on ship squat that was originally provided in 1997 in its report entitled 'Horizontal and Vertical Dimensions of Fairways'.

A numerical modelling system was developed at the Centre d'Etudes Techniques Maritimes Et Fluviales (CETMEF) to calculate ship squat. It couples three numerical models to reproduce the physics of squat. The first model calculates the hydrodynamics around the hull, the second moves the ship according to the principles of mechanics, and the last one updates the mesh to prepare a new iteration of the system.

This numerical model will be compared to several PIANC formulas for Panamax and Post-Panamax containerships that frequent Bremerhaven Port. The River Elbe can be characterized by unrestricted or open channel cross-sections along most of its length due to its relatively wide cross-section. However, there are some sections where restricted channels with dredged trenches and canal cross-sections are more appropriate. In this paper, predicted ship squat from the PIANC empirical formulas will be compared with the numerical predictions. We will discuss ship and channel parameters and their respective formulas which are most appropriate for squat predictions in this waterway.

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