Close cooperation in China

In the last decade China became the largest shipbuilding nation in the world and cooperation with MARIN increased rapidly. This article highlights some recent projects MARIN carried out together with Chinese partners.

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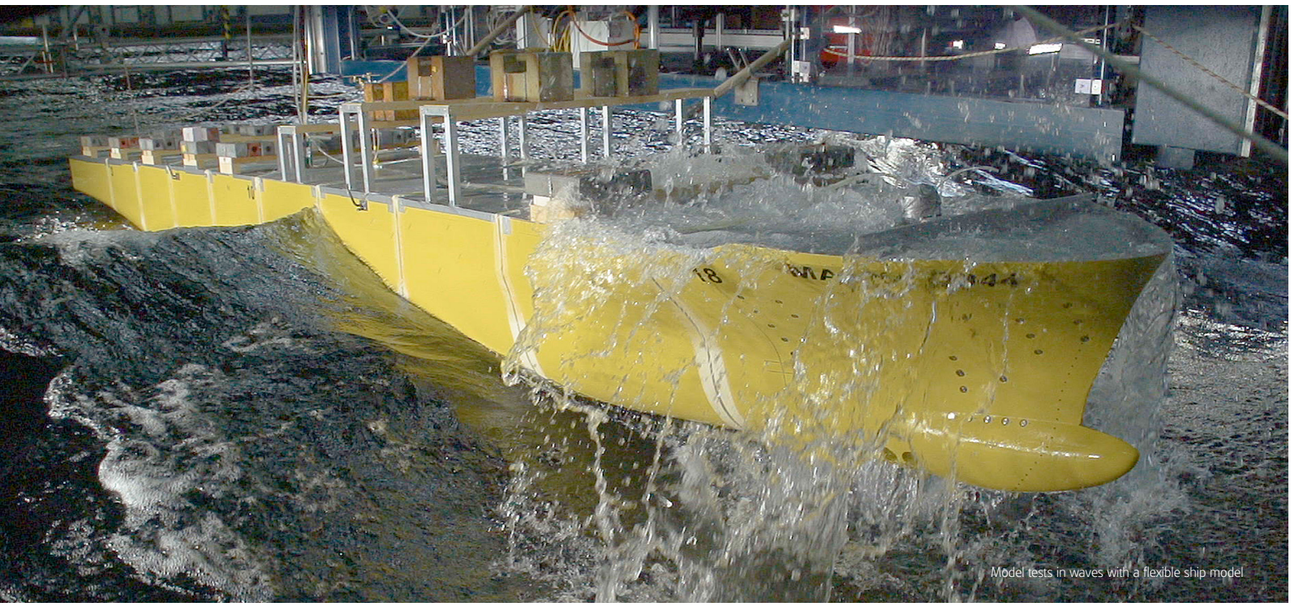


Model tests in waves with a flexible ship model

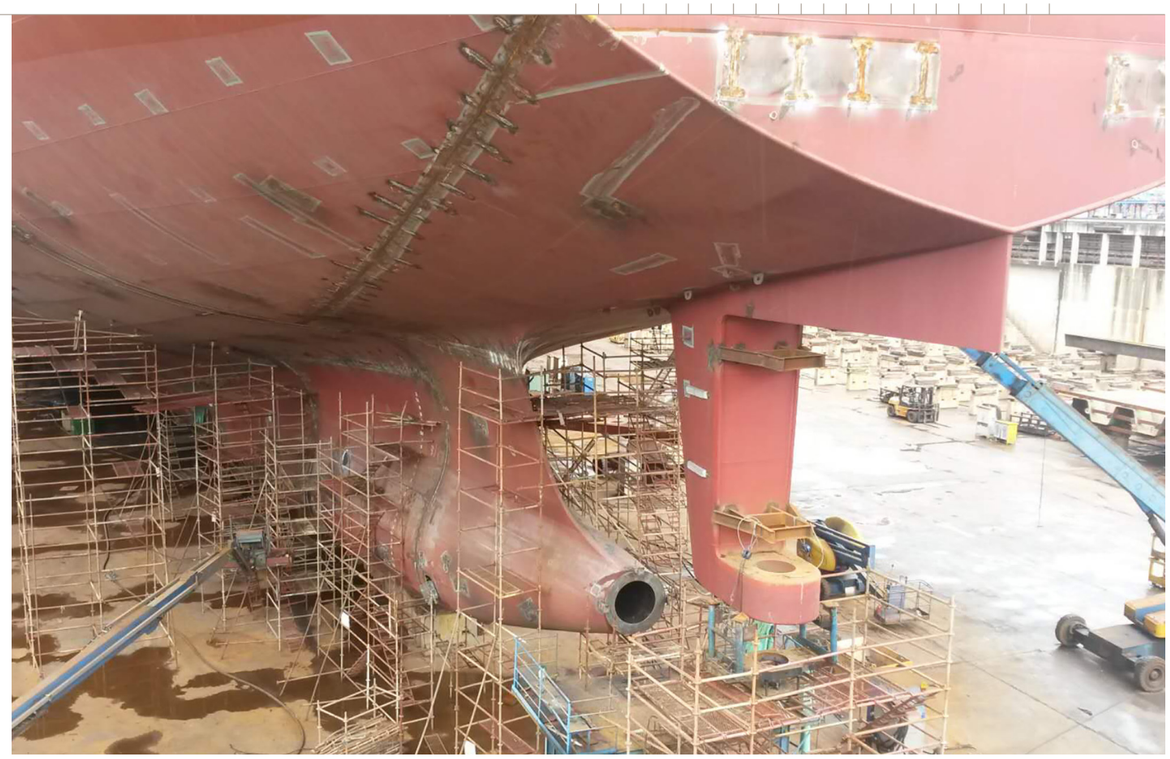
MARIN has had a long cooperation with the Marine Design & Research Institute of China (MARIC) on the hydrodynamic design of merchant vessels.

Design for operation In recent years several successful container vessel designs were made with the main focus concentrating on reducing fuel consumption. Multi-objective optimisations were done for a range of draughts and speeds, to achieve the lowest fuel consumption for the operational profile (Hooijmans et al., 2014)[1]. By using dedicated CFD tools, systematic hull form variations and smart algorithms, the optimal hull form can be found for each ship operator.

Another challenge given the increasing size of container vessels is the hydro-structural design of the vessel. For a 21,000 TEU container vessel, recently designed by MARIC, model tests in waves were carried out with a flexible ship model. A highly advanced, segmented ship model with a backbone was designed and manufactured in order to accurately model and measure the vertical and horizontal bending responses of the vessel (see Report magazine 124, pages 10-11). The results of these tests help to better understand the forces acting on the hull and to optimise the structural design of future vessels.

Increasing number of passenger vessels While the orders for container vessels, tankers and bulk carriers have been slowing down due to the worldwide market situation, the passenger vessel sector is growing rapidly. China has now stepped into this market given its large shipbuilding capacity.

One of the first, large European passenger vessels to be built in China is the fast ferry for the Swedish shipowner AB Gotland. Guangzhou Shipyard International Company Ltd. (GSI) and MARIN closely cooperated for this project. An extensive model test campaign was performed to optimise the propulsive performance of the vessel. The propeller and rudder cavitation and manoeuvring capabilities of the vessel were also evaluated and optimised. In early 2018 full-scale trials were performed on the first vessel that was delivered. The trials were in line with the model test predictions.



Aframax tanker with asymmetric aftbody under construction at GSI

Minimum power requirements To reduce the emissions of the shipping industry, vessels need to comply with the Energy Efficiency Design Index (EEDI). This is beneficial for the environment, however in some cases the safe operation of the vessel might be at stake. One of the measures to reduce the EEDI is to lower the installed power on board the vessel. For some full block vessels, this can compromise the safe operation of the vessel when sailing in adverse weather.

Together with Shanghai Waigaoqiao Shipbuilding Co., Ltd. (SWS) a study was recently done on the minimal power requirements for a VLCC. In order to determine the minimum power requirement according to MEPC.1/Circ.850/Rev.1, a Quadratic Transfer Function of the wave added thrust was determined by means of wave added thrust tests in regular waves. The minimum required power was determined and checked with the available power.

Asymmetric aftbody Together with Guangzhou Shipyard International Company Ltd. (GSI) MARIN recently developed an asymmetric hull for an Aframax tanker (Dang et al., 2015)[2]. An asymmetric aftbody is a type of Energy Saving Device (ESD) which can generate a pre-swirl in the propeller wake to improve the interaction with the propeller, but without adding additional appendages on the hull. To maximise the energy efficiency of the vessel, the hull form and propeller were designed simultaneously. By using a RANS-BEM coupling, thousands of hull form variations and propeller geometries were evaluated overnight, resulting in a fully-integrated, hull-propeller design (Ploeg & Foeth, 2013)[3]. Calm water model test results showed more than a 6% reduction in required shaft power compared to an optimised symmetric hull form. Cavitation observations, hull pressure measurements and manoeuvring model tests were also carried out and showed normal behaviour compared to the symmetric tanker. Finally, feedback from full-scale measurements confirmed the findings of the model tests.

The overview shows that the Chinese market is interested in high-end development of knowledge and ship design supported by MARIN. We are looking forward to continue cooperation with Chinese shipyards and design offices in the future.

1 Hooijmans P.M., van der Meij K.H., Greening D., Yu L. (2014). Traditions Broken in Modern Container Ship Design. Design & Operation of Container Ships, London, UK.
2 Dang J., Chen H., Rueda L., Willemsen H. (2015). Integrated Design of Asymmetric Aftbody and Propeller for an Aframax Tanker to Maximize Energy Efficiency. Fourth International Symposium on Marine Propulsors, smp'15, Austin, Texas, USA.
3 van der Ploeg A., Foeth E-J., (2013). Optimization of a chemical tanker and propeller with CFD. Proceedings of ECCOMAS International Conference on Computational Methods in Marine Engineering V, Hamburg.