Prediction of ship resistance with the use of Full-scale CFD simulations

K. Niklas*, Pruszko H.†

* Gdansk University of Technology
Narutowicza 11/12, 80-233 Gdansk, Poland
e-mail: karol.niklas@pg.edu.pl, web page: http://www.pg.edu.pl

† Gdansk University of Technology
Narutowicza 11/12, 80-233 Gdansk, Poland
Email: hanna.pruszko1@pg.edu.pl - Web page: http:// www.pg.edu.pl

ABSTRACT

In recent years, the IMO has introduced new regulations to reduce the negative impact of ships on the natural environment. A particularly important step forcing technological innovations is the increasing requirement of ship energy efficiency. It is expressed by the Energy Efficiency Design Index (EEDI). Another important step towards green shipping is raising the required quality of fuel used for propulsion, the so-called Tier limits. Higher demand of Low Sulfur Fuel Oil resulted in its price rising up by 200% in the past two years. All these aspects increase the importance of ship fuel economy. As a result, the hull resistance reduction plays a significant role in the design process of new vessels. For vessels operating at sites with moderate and rough waves, the shape of the hull and, in particular, the bow section plays an important role. The paper presents results of some of the research carried out as a part of the "Smart Propulsion System" research project. The presented stage of the work includes a full-scale CFD simulation for a case study ship redesigned from an as-built V-shaped bulbous bow to three different innovative variants. Changes in the hull form were made in such a way that the redesigned hull versions preserved the main dimensions and hydrostatic parameters of the original design. The paper presents ship resistance analysis on calm water as a part of seakeeping analysis. The scope of the work was full-scale CFD simulations of four innovative hull forms in order to determine total resistance, dynamic trim and sinkage. The influence of bow and stern shape, wetted surface area and waterplane area on total resistance was investigated. Main conclusions were formulated for the novel hull forms being analysed. The scope of further work was formulated, and it included assessment of the combined influence of the ship's speed and waving conditions on the performance at a specific operational site. To reduce fuel consumption, the optimal design and operation of the ship are equally important and can be supported by full-scale CFD simulations.

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