Prediction of propulsive performance

DESP

The computer program DESP predicts the resistance and propulsion characteristics of displacement ships. The predictions are based on formulas obtained from a regression analysis on results of model experiments and sea trials.

Applications

DESP can be used to estimate the speed and power in the early design stage. The level of confidence in the results can be improved by correlation with test or trial data of similar ships. These data can be used to derive an addition to the Correlation Allowance to be applied as input for the new design.

Input

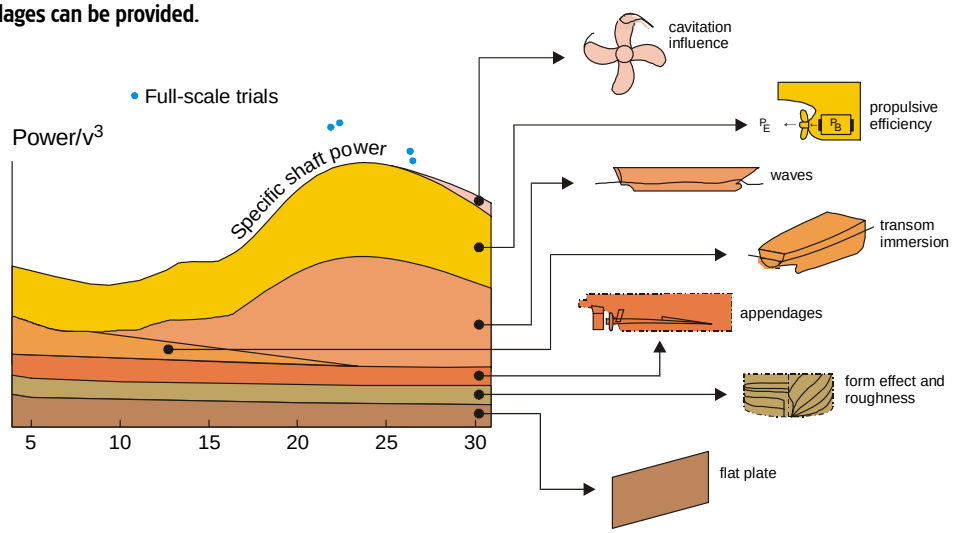
The input of DESP consists of the main dimensions of the ship, the displacement volume, the form coefficients CM, CWP LCB, the bulb particulars, the immersed transom area when at rest and various parameters related to the propeller arrangement. For the calculation of the drag of stream-lined, flow oriented appendages either the equivalent appendage drag factor and wetted surface area or a detailed description of the various appendages can be provided.

Output

The output consists of the resistance and efficiency components for the design speed or the design power, a review of the resistance, the thrust and the propulsive power as a function of the speed and tables of the pulling performance at both constant torque and at constant power.

Accuracy

As to the accuracy of DESP it is noted that both systematic and random deviations occur. The latter are about 8 per cent of the delivered power for large comparatively slow ships (Fn · 0.25) and tend to be larger in the steep, pre-hump range around Fn=0.3.
The accuracy in the post hump range is comparable with the accuracy at low speeds. Only when DESP is correlated with relevant model test data, an accuracy similar to model tests can be achieved.
Regarding the systematic deviations it is noted that DESP represents 'the average ship'. Optimised hull forms can perform 5-10 percent better than predicted by DESP. For special hull forms such as dredgers and barges DESP can be used only when checked first against results of similar ships. DESP cannot be used for planing craft.



Example of statistical power prediction

MARIN
P.O. Box 28
6700 AA Wageningen
The Netherlands
T +31 317 49 39 11
F +31 317 49 32 45
E info@marin.nl
I www.marin.nl

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Computational approach

DESP applies a simple hydrodynamic model for the resistance components according to the form factor method. As to the propeller-hull interaction statistical formulas were derived for the wake fraction, the thrust deduction factor and the relative-rotative efficiency. A propeller is preliminary designed by using the Wageningen B-series or Ka-series polynomials. The propeller can be designed either for a fixed speed or for a fixed power.

In addition, either the diameter or the rotation rate can be optimised within given constrains. Effects of cavitation on the propulsion, if any, are approximated. Applying DESP for optimising hull forms or hull form details is advised against since the performance effects of various parameters are modelled with limited accuracy.

References

- Holtrop, J.; "A Statistical Resistance Prediction Method with a Speed Dependent Form Factor", SMSSH 88, Varna, October 1988.
- Holtrop, J.; "A Statistical Re-analysis of Resistance and Propulsion Data", International Shipbuilding Progress 31, November 1984.

For more information please contact the department Maritime Simulation & Software Group;

T +31 317 49 32 37

E msg@marin.nl