An Evaluation of Tanker Resistance Prediction Accuracy in NavCad

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This report evaluates the use of NavCad for the resistance prediction of tankers. A discussion of the unique prediction challenges for modern tankers - and their solution - is presented.

THE PROBLEM

Due to a modern tanker's full form and its operation at relatively slow speeds, a large portion of its resistance is viscous. Viscous resistance (made up of a frictional and a "form" component) does not scale from model to ship in the same way as the wave making resistance, which is directly proportional at both model and ship scale. Therefore, hulls with large viscous resistance must separate the "form" component out of the traditional "residuary" resistance, and isolate this from the wave making resistance. This means that tankers should utilize the three-dimensional ITTC-78 Cw-based (wave-making) model-ship extrapolation method. Values of the "1+k" form factor frequently in excess of 1.3 underscore the need to use this approach. Experience has shown that the use of a two-dimensional Cr-based (residuary) extrapolation can overpredict resistance by as much as 10%.

The value of the form factor generally varies with the overall hull parameters (L/B, B/T, Cb), where finer ships have lower values. The wave making resistance, on the other hand, has been shown to be most influenced by the bow shape - notably the half angle of entrance and the bulb characteristics [Tagano, 1974].

THE SOLUTION

NavCad has two algorithms that can be successfully used with tankers - the BSHC method and the Holtrop-1984 method. Both methods include recent revisions by HydroComp to improve the specific evaluation of bulbous bows. A more analytical "complete" algorithm for the wave-making coefficient replaces the previous "simple" design-oriented algorithm in the BSHC method [Kostov, 1991]. A slightly revised bulb resistance algorithm replaces the previous formula in the Holtrop-1984 method [Holtrop, 1988]. The previous Holtrop algorithm significantly overpredicted the added pressure resistance with large-area, high-centered bulbs often found on modern tankers.

CONCLUSION

The Holtrop-1984 method provides good quality, consistent prediction of resistance. While applicable to a broad range of hull parameters, it does seem to slightly underpredict (2% to 5%).

The BSHC method shows excellent correlation to tests when all parameters are within the range of data set values. However, the accuracy of applying this method to hulls with parameters out of range is generally poor. It appears that the method is most sensitive to the half angle of entrance and block coefficient hull parameters.

With either method, extrapolation to full scale should always be made with the ITTC-78 form factor approach.

As a final note, it is important to remember that water density and viscosity change with water temperature (as might be found in tankers operating in the Middle East). An inaccuracy in viscosity could significantly affect the viscous resistance, and therefore the total resistance.