Streamline Investigation in Wind Tunnel

Streamline test in wind tunnel

Introduction

Reliable estimates for flow streamlines and wake fields on vessels are very important for naval architects and ship operators, especially in cases where problems such as noise and vibration have been encountered during trials.

Wake field measurements are normally carried out as a part of the model tests in the towing tank, but it can be difficult and time consuming to comprehensively map the flow field around a hull and evaluate the effects of flow correction devices. For thorough evaluation of streamline problems and corrections FORCE Technology use the wind tunnel as a supplement to CFD calculations, streamline tests and wake field measurements in the towing tank.

Basic concept

By utilising our high-speed wind tunnel we are able to operate at favourable high Reynolds numbers, which enables the tests to be carried out with very accurate results.

The maximum speed in the wind tunnel is approximately 80 m/s. The models used vary from 1.5 to 2.0 m in length.

In addition, model modifications in the wind tunnel are very rapid and easy, compared with towing tank models, facilitating rapid optimisation.

In order to minimise boundary layer effects along the windtunnel floor, the model is mounted on a base plate that is raised above the tunnel floor.

The streamlines are visualised by means of special paint, which is dragged along the surface by the high fluid velocities, thereby creating streamlines on the surface of the model.

During the wake field measurements the free stream velocity in the wind tunnel is measured with a pitot tube, and the local velocities at the propeller disc plane are measured with a hotwire anemometer.

Test Methodology

A typical test program will normally include the following steps:

- Streamline test and wake field measurement with original hull form. The data are analysed by experts who propose the best possible "cure". In many cases the best way of handling the problems will be fitting of vortex generators.
- Vortex generators are applied at appropriate locations, and the local velocities are measured in order to document the effect.
- When the optimum design and position have been found, the configuration is documented by means of new streamline tests and a new wake field measurement.
- The final design is finally corrected for Reynolds number effect, and the design and position are documented.

The assignment can normally be carried out in less than one week from order.

Streamline test in the windtunnel on model of an AFRAMAX Tanker.

Results from Tests

Below are shown typical results from an investigation on a tanker vessel, on which noise and vibration problems were eliminated. Furthermore, the improved wake field resulted in improved propulsion characteristics, so there was no penalty in the speed and powering performance with the vortex generator installed.

Streamline tests and wake field measurements for the original hull.

Streamline tests and wake field measurement for the original hull with the vortex generator installed. Note the dramatically improved wake field, with virtually no peaks.

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