CRS projects examine the impact of waves

Wave impacts on ships have been studied for many years, but have not yet resulted in practical prediction methods. Such methods are required to study fatigue loads on the structure. Additionally, extreme loads can be affected by the dynamic load of the wave impact.

A string of projects has been carried out in the Cooperative Research Ships, focusing on the prediction of impulsive load due to wave impacts. The focus was on the global elastic response of the ship's structure on the impacts. Early on in the project it became apparent that the seakeeping software suite needed a complete overhaul. Both the six rigid body motions and an additional number of deformation modes needed to be solved, the latter resulting from a finite element modal analysis. These deformation modes are used in the simulation model to compute the whipping response due to an impulsive load. As expected, the calculation of the impulsive load was the most demanding aspect of the project.

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2D & 3D Two models have been developed; a 2D approach based on a non-linear Boundary Element Method and a 3D momentum approach. The key problem in both methods is the prediction of the rise of the water surface next to the hull. It appears to be crucial to include the effect of the stationary bow wave at the actual draught of the bow. This is especially important in cases where the upper part of the bow is relatively blunt.

Validation of the impulsive load methods is done through a comparison with model tests. For this particular case a unique model was built consisting of 10 segments in the bow area (see picture). Each segment was connected to an open steel structure via a 6-component load cell to measure the forces and moments. In addition, pressure gauges in the hull were used to quantify the relative motions and velocities.

A comparison of the results of calculations and experiments is still in progress. A result from a calculated pressure distribution on the hull is illustrated clearly showing the high pressures in the pile-up region (just above the undisturbed incoming wave).

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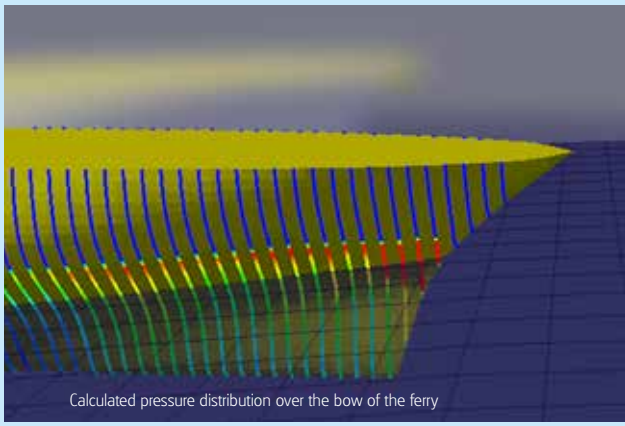
Model of a ferry with 10 segments in the bow area


Calculated pressure distribution over the bow of the ferry