Measured vs calculated long-term Vertical Bonding Moments.

Numerical tools allow unusual structures to be designed and operated, where traditional ship building experience no longer applies. Despite the suggested accuracy of hi-tech computer software, the validity of results should never be taken for granted.

SMACS project investigates hi-tech software performance

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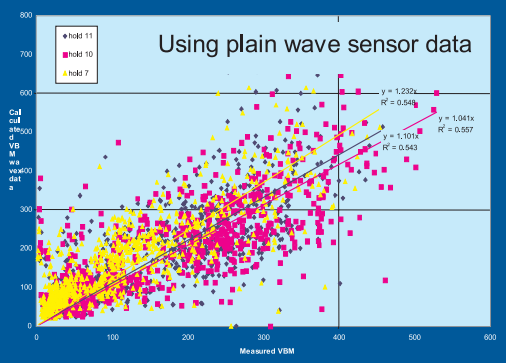
In a bid to get better insight into the reliability of calculated sea loads in early design stages and to gain environmental information during operational conditions, a working group has investigated this issue as part of the CRS work programme.

The group comprises, A P Moller, Bureau Veritas, Cetena, DNV, DRDC, Lloyd's Register of Shipping, Qinetic, Chantiers de l' Atlantique, the Royal Netherlands Navy, the Royal Australian Navy and MARIN.

The major targets of the Ship Monitoring Analysis and Comparative Studies' project, known as "SMACS", was to evaluate various wave sensor performances for operational onboard sea state monitoring and to compare measured structural sea loads with calculated loads from design software, using measured wave conditions as input.

Extensive long-term and short-term measurements were done onboard an A P Moller, M-class container vessel and the Canadian Navy destroyer, Nipigon. Measurements included sea loads on the hull using long-based strain gauges and the encountered wave environment using a vertical wave radar and a directional wave radar system.



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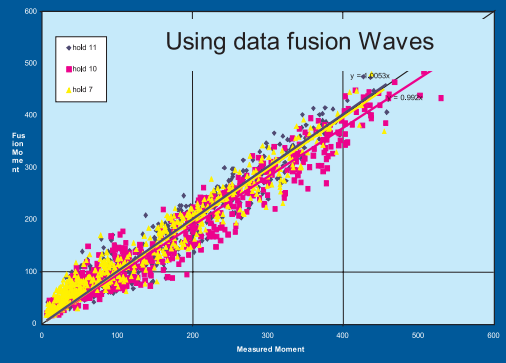

Data fusion

Evaluation of measured waves versus wave buoys along the track, hindcasts and crew observations, indicated that wave sensor systems appeared to have drawbacks under various operational conditions. A data fusion algorithm was formulated combining the directional wave data with measured ship motions and relative encountered wave height at the bow into a best estimate, full directional, wave height spectrum.

For long-term comparisons the measured sealoads were compared with computer predictions using the measured data and fusion wave data with the DRDC Shipmo, DNV Swan and CRS Precal codes. Correlation between the various codes was good but correlation with measured data was less evident. Using the data fusion sea states a remarkable improvement in the correlation between measured and calculated loads was found (as shown).

The SMACS project concluded the following:

- Good representation of the wave environment and the operational profile of the ship were the essential factors for reliable load estimates - both for design and operational conditions.
- The data fusion algorithm appeared to provide reliable directional wave spectra, combining directional wave radar, relative wave height sensor and shipmotions.
- The evaluated structural design codes (FEM) and numerical sea load prediction codes provide accurate design data when combined with reliable wave data.
- Reliable calculations of sea loads are possible with existing codes if wave conditions are known.

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