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MARITIME

GUIDELINES FOR THE DESIGN OF ALUMINIUM STRUCTURAL COMPONENTS

Joint Industry Project (JIP) involving ASRANet, University of Pusan and DSTO Australia

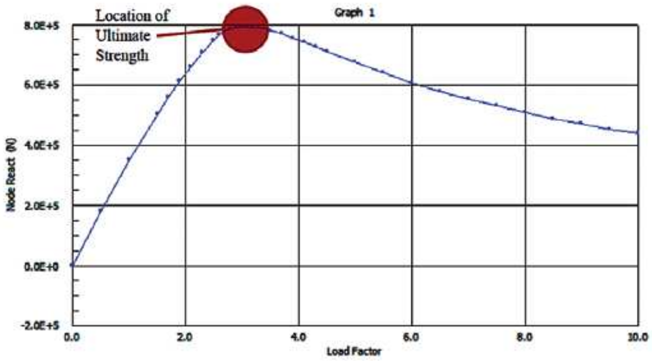
This Joint Industry Project focused on the development of a guideline document for the design of aluminium marine structures, using deterministic and probabilistic methods.

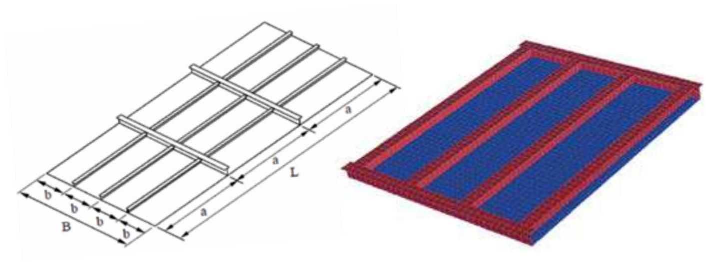
Background

Aluminium is being used increasingly for many structural applications in the marine industry, in particular for cruise ships, yachts and naval vessels. Driving this growth is primarily its inherent corrosion resistance and high strength-to-weight ratio. The JIP "Guideline Document on Design of Aluminium Structural Components for Application to Marine Structures based on Deterministic and Probabilistic Methods", initiated in 2013 by ASRANet Ltd., followed a cooperation of DNV GL and ASRANet with the aim of creating the foundation for a reliability-based framework to develop structural rules for ships.

Project contribution

The objective of the project is to build up a database of limit-state functions for structural components (stiffened and unstiffened plates, beams and beam columns) made of aluminium for use in reliability analyses. This includes the establishment of statistical properties for basic variables (e.g. material properties, initial imperfections, load) and the determination of the model uncertainty by comparing experimental data with results obtained by finite element analysis (FEA). The project integrates the application and design of aluminium structural members as well as structural reliability analyses.





To establish model uncertainties, test results were compared with calculations

Project results

The following structural members were investigated: ties, beams, columns, beam columns, unstiffened plates and stiffened plates.

Limit-state functions (or safety margin equations) were developed based on recognized design methodologies. For almost all of the above-mentioned structural members (except stiffened plates), DNV GL formulations were found to be the most accurate and effective. Based on the functions, variables were identified and statistical properties of these variables were obtained from documented engineering experience. In addition, model uncertainty factors were determined.

Reliability analyses were carried out initially based on a loading of 50 percent of the ultimate strength of the structural member. Sensitivities of the variables on the reliability index of the different structural members were determined, and conclusions as well as a guideline for reliability analysis and design of the considered structural members are included in the final report.

The results obtained here can be used in further studies for the calibration of partial safety factors in DNV GL rules to ensure safe and reliable designs. While the results are obtained for structural members made of aluminium, the methodology can also be applied to similar members made of steel.

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