

Weight Optimization of a Sandwich Superstructure of a High-Speed Ferry

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1 Introduction

The defence industry has been in the forefront in making use of composites, finding innovative composite applications for the last half century. Since 1950, naval applications of composites have increased significantly. This is mainly due to reduced maintenance costs, better operational performance due to reduced weight, and enhanced stealth properties. Some of the noteworthy applications of composites have been in fast patrol boats, mine counter-measure vessels (MCMV), and corvettes. More recently, civil shipping has also been attracted to the advantages offered by composites. Small to medium-sized luxury boats (up to 75 m) are designed in composites. Due to low hull girder stiffness, ships longer than 100m cannot be made out of composites yet, but sections of a ship (like bulkheads, superstructures, doors, and decks) are already being made of light-weight materials to save weight. There are potential weight reductions of 30-50%, e.g. Smith and Monks (1982), Mäkinen et al. (1988), Remen (1992), Goubalt and Mayes (1996), Mouritz et al. (2001), by using composites instead of the more conventional materials like steel and aluminium.

The LASS Project investigates the application of composites in the commercial marine industry. One of the tasks in the project is to investigate the possibility of having a sandwich superstructure for an aluminium catamaran. Four design concepts are analysed in LASS:

- A. Composite hull, composite superstructure
- B. Aluminium hull, composite superstructure
- C. Steel hull, composite superstructure
- D. Steel hull, aluminium superstructure

Here, we discuss option B., i.e. a composite superstructure on an aluminium hull. The Swedish ship operator Stena operates several passenger ferries in Europe. In the early 1990s, Stena pioneered the development of high-speed aluminium ferries, including the HSS ships, unique aluminium catamarans of maximum length of 124m. Stena 1500 remained the longest aluminium structure in the world for more than 10 years, until the 'Bencehinjigua Express' (127m) of Austal shipyard overtook it in 2005. HSS 900 or 'Stena Carisma', <http://www.ferry-site.dk/ferry.php?id=9127760&lang=en>, is an 88m long catamaran, operated between Gothenburg (Sweden) and Fredrikshavn (Denmark). Hull and superstructure of this vessel are made of aluminium. A composite sandwich superstructure would reduce the weight of the ship, thus increasing its cargo carrying capacity, while reducing maintenance costs.

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