A MODEL FOR MULTIDISCIPLINARY DESIGN OPTIMIZATION OF CONTAINERSHIPS

by

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(ABSTRACT)

This thesis describes a multidisciplinary design optimization approach to containership design. The method employs widely accepted regression equations for computing resistance, weights, building costs and operating costs. The current regulations governing freeboard and the Coast Guard wind heel criterion are included.

The measures of merit used are the required freight rate and the return on investment. The system is flexible enough to allow changes in trade routes, shipyard and port parameters, and fuel costs.

The weight-displacement balance is maintained by including draft as a design variable and imposing an equality constraint on weight and displacement rather than introducing an internal loop to calculate draft at each iteration. This speeds up the optimization process.

The process takes into account the discrete container stowage issue. The carrying capacity (number of containers) is expressed as a continuous function of the principal dimensions by using a linear response surface fit that in turn makes the objective function continuous.

Speed is a design variable. The optimum speed takes into account the compromise required between higher speeds that imply higher revenue and lower speeds that imply lower fuel costs.

The optimizer used is the Design Optimization Tools (DOT) program from Vanderplaats Research and Development, Inc. Results employing the three different techniques provided in DOT have been obtained and compared.

The optimum ship tends to be the largest ship in terms of length and beam. An optimum speed is identified. The three techniques provided in DOT give fairly consistent results, but once a good optimum point is identified in the design space, the sequential linear programming algorithm is found to be the most consistent method to converge to a local optimum.

The objective function is found to be flat in the vicinity of the optimum that indicates that the designer is not confined to a severely restricted design space and has some freedom in designing the optimum ship.
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