

Structural Loading of Cross Deck Connections for Trimaran Vessels

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This work investigates the fundamental relationships of wave loading of cross deck structures for trimaran vessels. In contrast with a monohull ship, trimaran vessels experience several possible structural loading cases including: longitudinal bending, transverse bending, torsional bending, spreading and squeezing of hulls, inner and outer hull slam pressures, wet deck slam pressures, loading from ship's motions, and whipping of slender hulls. This work investigates wave loading cases that result in transverse and torsional bending of the cross deck structure.

The wave loading cases investigated include: side hull troughing and cresting in longitudinal waves, side hull torsion in longitudinal waves, and transverse hogging and sagging. For each of these load cases, a design load using a fully statistical sea state was derived using an analytical model of a trimaran represented by rigidly connected box barges. The design loadings with a reliability index of 5 for almost 500 trimaran configurations were calculated varying main hull length, side hull length, side hull transverse placement, and side hull longitudinal placement. The design loadings were curve fit to a fourth order polynomial in the four independent variables.

The load predictions of the analytical box model of a trimaran were applied to a trimaran vessel with a realistic hull form using the finite element ship structural analysis program MAESTRO. Given the number of approximations and assumptions in the analytical model, the forces predicted by analytical model agreed closely with the finite element model's results.

The fitted curve of design loadings allows an initial design stage loading estimate for cross deck structural loading given general characteristics of length and spacing of a trimaran's hulls. This estimate of structural loading combined with other characteristics of good trimaran design including stability, roll, and resistance characteristics will aid in optimizing an overall trimaran ship design.

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