Design of a Trailer Capable, Open Ocean Sailing Yacht

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Abstract

A design is developed for a small sailing yacht capable of being towed, launched, and recovered with a standard-sized truck or sport utility vehicle, while retaining capability for extended, open ocean transits. A review of factors affecting small yacht seaworthiness is presented, and relevant design parameters are proposed. Design requirements pertaining to trailer capability, seaworthiness, and vessel intended use are developed, and a multi-criteria decision-making method is employed to down-select to preferred options in key functional areas of the design. From there, an iterative point-based design approach is employed to converge on a design that satisfied requirements. Major design work encompassed developing a suitable hull form; keel and rudder design; selection and validation of appropriate scantlings; designing a composite mast and spars; determining a sail plan and rigging schema; engine selection, propeller design, and off-design propulsion analysis; arrangements layout; detailed weights and stability assessments; and sailing performance predictions. The design meets or exceeds all developed requirements, including exceeding International Standards Organization (ISO) stability and buoyancy requirements on Stability Index (S.I.) and Righting Energy for the highest design category classification, which pertains to vessels expected to experience significant wave heights up to 7 m and up to Force 10 winds. A 1:7 scale model of the hull was constructed with a fused deposition modeling 3D printer and used to measure upright resistance of the yacht in towing tank experiments, for comparison to resistance predictions generated from the Delft Systematic Yacht Hull Series.

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