CALIFORNIA STATE SCIENCE FAIR
2011 PROJECT SUMMARY

Name(s)

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Project Number

S0317

Project Title

Comparing Hydrodynamic Lift against Lead Ballast in Sailboat Performance

Abstract

Objectives/Goals

Equivalent sailboats using the proposed keel design producing hydrodynamic force to generate righting moment will outperform sailboats using conventional moveable lead ballast systems, both upwind and downwind.

Methods/Materials

Build a model with the two subject, canting and hydrodynamic keel configurations; using an open flow bench, monitor flow rate and measure the drag and the righting moments generated by each keel configuration for upwind and downwind sailing. Compare the mean force and drag when the model is configured for sailing upwind for both types of keel. Measure and compare the drag for each keel type with the model configured for sailing downwind.

Results

The results show that the hydrodynamic keel concept out performs the ballasted canting keel both upwind and downwind. Sailing up wind, the force (lift) to drag coefficient for the hydro keel is .3160 as opposed to .2889 for the canting keel. Test results also show a significant reduction in drag when comparing the relative performance of the downwind configurations. Mean net drag for the hydrodynamic keel downwind, was measured to be .0228 compared to .0913 Newtons for the canting keel.

Conclusions/Discussion

The hydrodynamic lifting keel concept may offer significant advantages in safety and performance over the ballasted canting keel. Preliminary analysis also supports significant reductions in structural loads and torque requirements. More detailed analysis and testing is required to refine the design concept and exploit any potential performance and safety benefits.

Summary Statement

Analysis and test results support that the proposed keel design significantly reduces structural loads, actuation torque requirements and overall weight, while improving performance and safety on any point of sail or sea condition.

Help Received

Materials furnished by Probiuld, OB Hardware and Schilling 3-d; display board provided by neighbor; lab equipment supplied by Point Loma HS; nieghbor helped with remote control test model.