Elliott Bay Design Group
Architectural & Engineering Services for the Marine Industry

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HULL OPTIMIZATION IMPROVES VESSEL PERFORMANCE

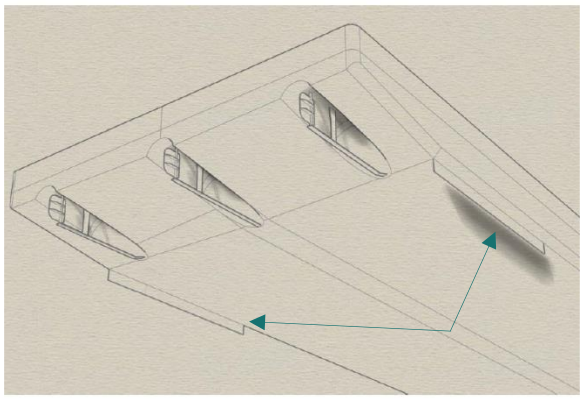
Elliott Bay Design Group (EBDG) has completed a hull optimization project for Avalon Freight Services (AFS). Several months ago, AFS approached our team of engineers to explore different keel options to improve the directional stability of their landing craft, CATALINA PROVIDER.

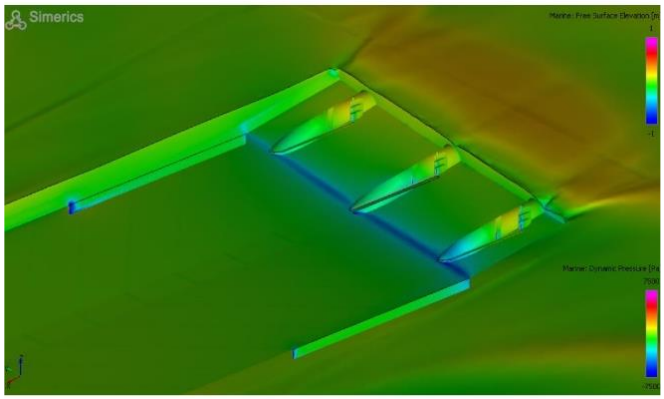
Our team worked closely with AFS leadership to understand the vessel's particulars, operation and route, detailed project objectives and determine a project plan. Multiple keel designs were considered as viable options for the 150' landing craft. EBDG then conducted a computational fluid dynamics (CFD) analysis to estimate the effects each keel arrangement would have on directional stability and overall vessel performance.

> *What is Computational Fluid Dynamics?*
> CFD is a computer-based analysis method that solves fundamental equations of fluid flow numerically within an analysis domain. Different aspects of fluid flow can be examined, resulting in an in-depth understanding of the underlying mechanics of the fluid (water).

The analysis also considered the impact the keels would have on the vessel's low-speed maneuverability. After the analysis was concluded and the results studied, EBDG recommended moving forward with 18" deep by 30' long keels located on the vessel's chine.

Pictured below, you can see the new custom-designed keels and output of the CFD simulation.





EBDG developed a fabrication and installation drawing to guide the selected shipyard, Al Larson Boat Shop, with the keel additions. The CATALINA PROVIDER is now back in service, experiencing exceptional results with the hull modification.

As reported by the Captain of the CATALINA PROVIDER and management at AFS, overall vessel performance has improved with the addition of the new keels. Specifically, while transiting to Catalina, the vessel's tracking has significantly improved, resulting in considerably less required rudder angle. This

reduction is creating less vibration and stress on the rudder bearings, thereby extending their life. The vessel has also gained a half knot of speed with an expected improvement in fuel economy and preferred low-speed maneuverability characteristics. "Actual results are very similar to test results," reports Tim Bombard of Avalon Freight Services, "we anticipate improved performance and an extension of life on all related rudder components."

"It is rewarding to see the application of our engineering effort pay off for our client with such positive results," states project manager, John Petersen.

AVALON FREIGHT SERVICES

Avalon Freight Services provides year-round freight transportation from the Port of Los Angeles to Catalina Island. The 150' CATALINA PROVIDER makes the 21 nautical mile voyage each business day to support commerce on Catalina Island.

ELLIOTT BAY DESIGN GROUP

Elliott Bay Design Group is a full-service, employee-owned naval architecture and marine engineering firm that supports owners, operators and shipyards. Our team of naval architects, engineers, designers and analysts have expertise with designing, supporting and proving the feasibility of marine transportation.

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