HyperWorks Helps to Develop Race-Winning Yacht for Volvo Ocean Race 2009

Overview

The CAE suite HyperWorks has been used by ABstructures to structurally design and optimize the winning yacht in the Volvo Ocean Race, Ericsson 4. The yacht, skippered by Torben Grael, claimed victory in the Volvo Ocean Race on June 27, 2009 in St. Petersburg, Russia, after 8 months and more than 37,000 nautical miles sailed around the world under the harshest conditions. The HyperWorks simulation suite was already used in the development of Ericsson 3 (coming in 4th in 2009). ABstructures has extensively employed HyperWorks to design and optimize the carbon structures of both Ericsson yachts and has achieved fundamental structural improvements compared to the older-generation yachts that competed in the 2004 edition of the Volvo Ocean Race. The combination of cutting-edge CAE technology and the extensive hands-on experience of ABstructures' designers has enabled the engineering company to deliver the best design for lightweight structural projects in all regions of the world.

Business Profile

ABstructures provides innovative design solutions for lightweight structures, both in advanced composite materials and high performance metal alloys. ABstructures is a company that relies on more than a decade of experience of operating on the highest level in international yacht racing - from America's Cup to 'round-the-world yacht races, such as the Volvo Ocean Race. Additionally ABstructures is providing its services to the aerospace industry and to development teams of racing cars. From project brief to concept development and product delivery, ABstructures follows the optimized lightweight approach all the way. For more information, please visit: www.abstructures.com.

Challenge

To develop a structurally optimized racing yacht in a preset time frame, considering the boundary conditions of the Volvo Ocean Race challenge such as the Volvo Open70 Rule, which defines for example parameters of the keel weight to be between 6.0-7.4 tons and the overall weight of the yacht to be close to 14 tons.

"The Volvo Open 70 Rule is intended to produce fast, single mast monohull keelboats, suitable for long distance racing offshore at the highest level of the sport. The need for safety and self-sufficiency is paramount. The Rule is intended to foster gradual design development leading to easily driven, seaworthy Boats of high stability, requiring moderate crew numbers. Any development that is contrary to this may give rise to a Rule change." Taken from THE VOLVO OPEN 70 RULE, v3, March 16th, 2010, www.volvooceanrace.com.

[AB]structures

Ericson 4, race winning yacht at the Volvo Ocean Race 2009

Original picture courtesy of Volvo Ocean Race (C). HyperWorks design model provided by ABstructures

"We have been using HyperWorks for a long time, in many projects," said Dr. Fabio Bressan, managing director ABstructures. "What we like about the software suite is that it enables us to handle most of the development tasks in structural design within one user interface and under the same license agreement. Thanks to HyperWorks, we could achieve a weight reduction of about 10 percent on all the structurally most important parts of this campaign's Ericsson yachts. This could not have been possible in the set time frame without the technology provided by Altair."

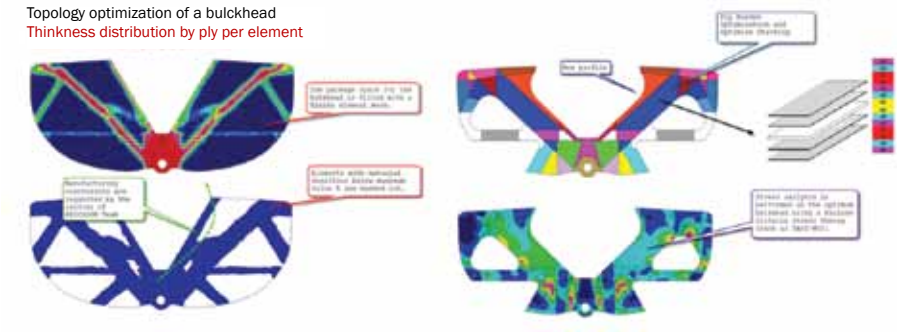
Solution

Full structural design and structural multilayer optimization for maximizing performances like strength, stiffness, minimum weight (with topology optimization in carbon fibre materials) by using cutting edge CAE technology, such as Altair's suite HyperWorks for FE-analysis and the optimization of all structurally relevant parts of the yacht. This included the keel fin sections, the cant mechanism and the associated structure. Through the application of advanced optimization concepts, the process for designing composite laminates has been streamlined for efficiency. This was done by identifying the three key phases involved in the design process (concept design synthesis, system level design & detailed ply level design) and then coupling them with various optimization techniques (topology, free size, ply sizing & ply stacking sequence). Composite free size optimization allowed the synthesis of concepts that utilize all the potential of a composite structure – designing the structure and material simultaneously. With free size optimization, the thickness of each ply of a particular fiber orientation was varied throughout the structure. Additionally, manufacturing constraints to control individual ply thicknesses, total laminate thickness, percentage of ply orientations can all be incorporated at the concept design synthesis stage.

Design process of Ericsson yachts.

OptiStruct added a unique and comprehensive suite of capabilities for composite design and optimization to ABstructure's design process.

The ply sizes (or thicknesses) generated at the concept stage from free sizing optimization were fine tuned by applying a detailed ply sizing optimization for design performance and manufacturing requirements. The ply stacking sequence optimization enabled the determination of the optimal stacking sequence of the composite laminate while ensuring that design performance and manufacturability based on ply book rules were preserved.



Full multilayer optimization of the ship's bulkhead with HyperWorks.

Picture of the real bulkhead, weight 100 kg

Results/Benefits

By applying HyperWorks to the design process of the structural parts of the Ericsson 3 and 4 yachts ABstructures could:

- Handle most of the development tasks in structural design within one software environment and under the same license agreement.
- Achieve a weight reduction of 10% on structurally most important parts of the yacht
- Save time by shorter development cycles
- Use on site site repair options by defining and optimizing the structure of a panel before it was build

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