innovations

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A second look at Foreship's cruise ship designs refined by real-world experience

Special Report

International Cruise Ship Industry

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‘In wave’ analysis software factors in sea state

The benefits of designing ships for the conditions they face at sea are self-evident, but using voyage simulations and historical data means design decisions can be optimised for vessel performance.

Finnish-based naval architecture and marine engineering company, Foreship has been leading the field in applying ‘in-wave’ analysis to factor in real sea states to hull form optimisation.

Notably, the company has used CFD analysis to support a case for the superior performance of bows featuring vertical stems over their bulbous counterparts at far lower wave heights than has previously been acknowledged. Real sea states have also provided useful input for Finite Element Method (FED) software when considering slamming and structural design issues.

However, CFD methods are only one part of Foreship’s strategy designed to introduce real-world experience at an early stage in ship design. The company’s continuing discussions with core cruise ship customers has been pushing forward with a completely new operability analysis and voyage simulation initiative to secure performance gains at the early design stages.

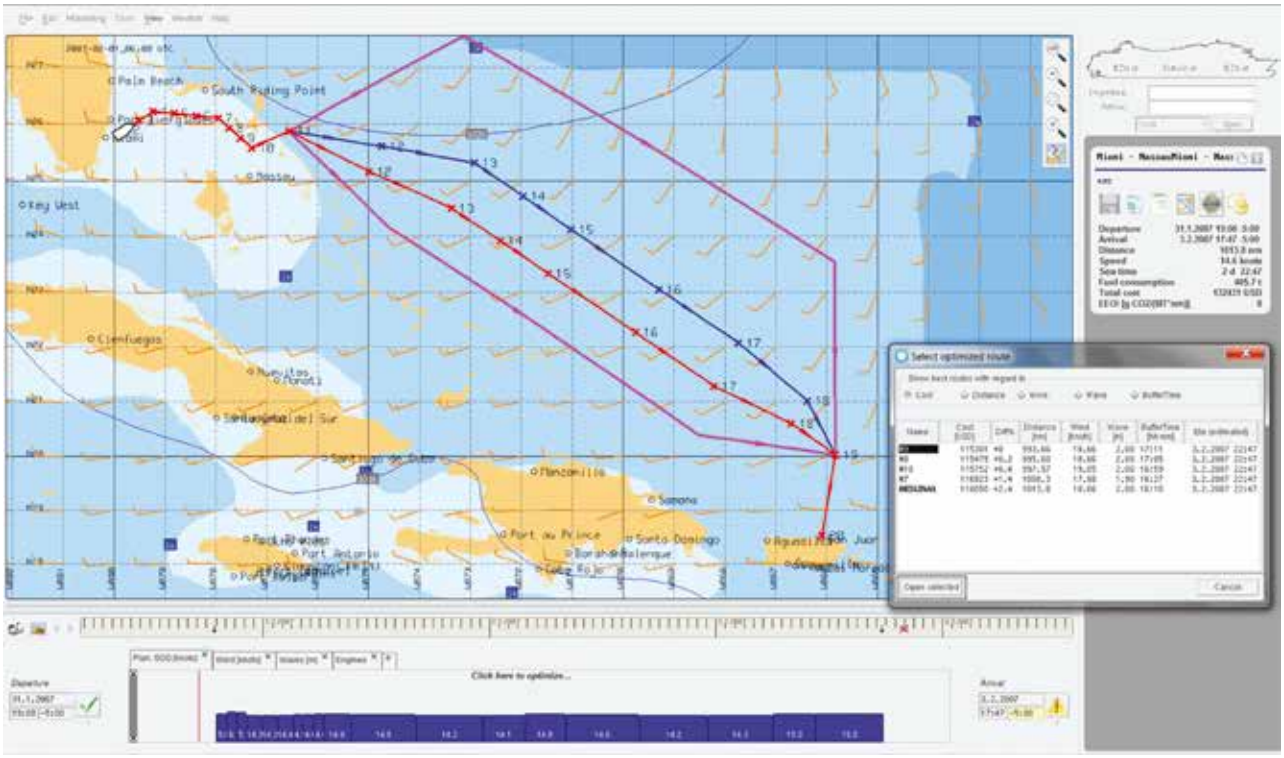

Matthew Patey

“We are optimising the ship design for the best performance in real operational conditions; and by performance I mean fuel consumption and comfort on board,” said Matthew Patey, Foreship Project Manager.

Data inputs include the hull, the propellers, the rudders, the general arrangement and the main engines to calculate fuel consumption and motions on board the vessel during simulated voyages. Voyages are from port to port, start on a given day at a given time and have a target arrival date and time, and an initial routing.

> Realistic conditions are created by using hind-cast environmental data of the wind, waves and currents on the actual route the vessel will follow and using simulations of how the vessel will be operated,” said Patey. “That includes decisions on the engines that minimise fuel consumption and what route to follow to avoid bad weather.”

It is easier and more accurate to assess the impact of design changes on fuel consumption and comfort using a single, consistent approach based on the same model and realistic weather conditions and a realistic route than to deal with these issues separately, Patey explained.



A weather analysis of a cruise ship voyage in the Caribbean. Rather apt with the hurricane intensity this Autumn.

Considered separately, each type of environmental data has inaccuracies, and there is a risk of inconsistency between analyses and communication failures between different design disciplines.

Established software

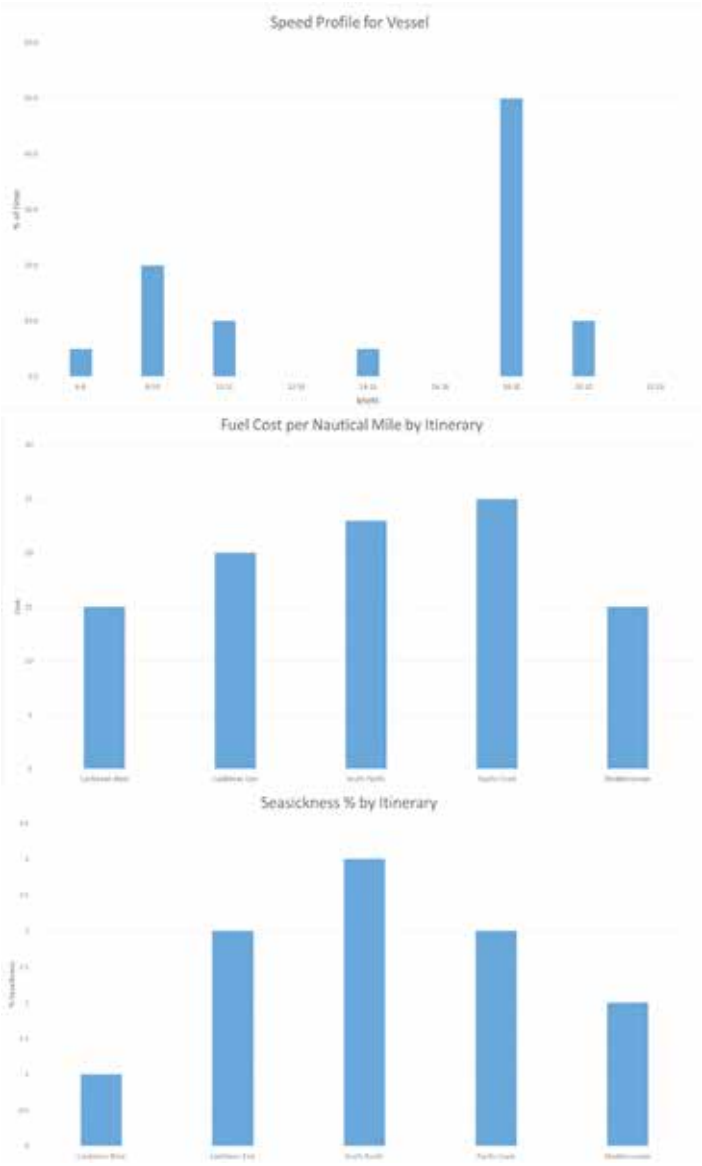
Foreship's initiative relies on established ship design and construction software, but introducing operating data such as voyage route planning at an earlier stage than is customary.

> Even though we are using well-known software in this application, we are not aware of anyone doing this sort of study at any stage using any system," Patey claimed. "There are organisations with voyage simulation software which don't design ships and there are designers who don't include operational simulations. It's also the case that some software packages in use are limited, and simply cannot consider weather routing."

The effects of design decisions on fuel consumption and comfort on board can be evaluated quickly and realistically to give the most accurate picture possible of how the ship will perform before it actually goes into service.

"From hind-cast data we get the wind, current and wave conditions during the voyage," said Patey. "These are used in the fuel consumption and motion calculations. The engine operating mode and the route the vessel follows are optimised for minimum fuel consumption and minimum motions, which would reflect the decisions made by the crew on board the vessel to save fuel and keep the vessel safe. With many years of data we can simulate voyages simply by changing the departure date."

Using this approach, the full impact of a design change can be considered in a single analysis. If the widening of the hull were being considered, for example, the effects on fuel consumption, speed, engine profile and passenger comfort could be simulated, and the different possibilities for engine configurations investigated very quickly. "We could assess any change in the design – for example the size of fin stabilisers and bilge keels from both the fuel consumption and comfort perspective – but also how best to operate the vessel and how this would change with changes in the vessel design," Patey added.



Analyses of the parameters to be taken into account.

Simulation approach

The voyage simulation approach establishes the operational profile of the vessel and the weather conditions under which it can safely, comfortably and most profitably operate. It includes any design or operation decision that affects fuel consumption and comfort on board in the same analysis, and requires formal responses from designers to operational questions which – in their heart of hearts - may formerly have been considered of either indeterminate weight, or even background noise. These might include:

- When is the best time to cruise the South Pacific?
- Do we need to make the vessel bigger to extend the operating season?

- What should this itinerary's departure and arrival times be?
- What combinations of engines do we really need?
- How long will it take to return to port if we lose one propeller?

Even if the design is fixed, the use of voyage simulations will give owners a much more realistic picture of the operational capability of the vessel than has previously been possible.

Patey explained; "The operability analysis can also be easily updated throughout the entire design process as the design changes and new performance data becomes available. The model can be tuned further as data from on board systems is compiled from the operation of the vessel. This feedback from operations will help in the decision-making process during future newbuilding and conversion projects. In fact, this is the most valuable design data you can get and should be used in future designs."

Patey reported that a number of its well-known cruise ship clients have expressed interest in Foreship's new operability analysis service and that at least one has sanctioned a full scale operability study, as part of its latest new construction projects.

> Because we see the effects of changes more easily, it is easier to make changes and optimise the design," he said. "This will result in a better ship in the end because operability analysis can be used to give practical and accurate answers about the effect early design decisions will have on the fuel consumption and comfort."