IMPROVING THE SHIP BUILDING BLOCK ASSEMBLY METHOD: AN ENGINEERING APPROACH

Block construction is a modern shipbuilding method which involves the assembly of prefabricated modular sections. Cross-sections of the superstructure are pre-built in a shipyard, taken to the building dock, then hoisted into position and attached.

Block splitting and lifting schemes are largely devised after the ship design phase is completed, relying on empirical data and expertise to avoid costly and potentially dangerous failures during build-up. Advances in computer-aided engineering (CAE), however, now make it possible to plan ship build-up in the principal design phase, giving designers greater insights into block assembly process outcomes and reducing downstream risk through simulation.

The Block Assembly Method

How a ship's design is split into its individual components, or "blocks", and assembled in sequence play an important role in determining overall manufacturing cost, duration, and quality. Thorough understanding of block structural integrity, productivity factors, and welding deformation are crucial to determine the optimal assembly sequence.

Blocks are typically assembled in the shipyard in reverse position to enhance welding workability. "Block lifting" is performed to position each block from reverse to normal before being arranged to build the complete ship.

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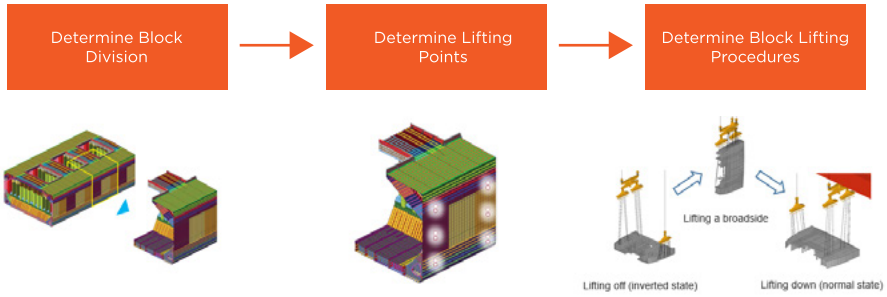


Challenges in the Block Assembly Method

The block lifting process requires careful design and extreme precision. Blocks can be damaged due to insufficient block strength or improper lifting procedures, which can greatly impact construction costs. If a part of the block buckles during the lifting operation, the block may collapse suddenly and lead to a major accident, potentially resulting in injury or loss life.

Highly skilled craftsmen have long relied on their expertise and empirical methods to ensure successful block assembly, but relying on experience alone, especially when faced with new ship designs, is not enough. Human error can lead to sub-optimal sequencing, especially when dealing with unfamiliar block assemblies composed of dozens of parts.

Finite element analysis (FEA) tools can analyze the assembly process, but there are shortcomings with these methods as well. Test data or significant experience is necessary to define realistic load cases, and importantly, this approach alone can only predict the structural integrity of individual blocks, not the entire assembly process.

Integrating Process Simulation with FEA for Block Lifting

A modern block lifting solution involves both a physics-based modeling and an understanding of how simulation results may affect the overall assembly process.

Altair Crane CAE Manager is a new process-based solution for evaluating and improving the block assembly method of ship building. CAE Crane Manager, which simulates the block construction process, is available as a set of macros that can be overlaid on the Altair HyperWorksTM CAE

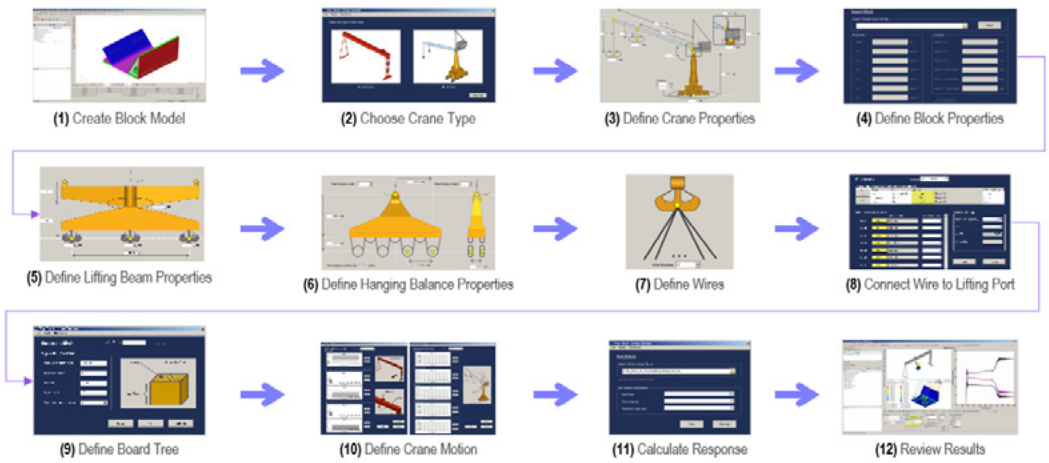
technology platform. Engineers in dockyards who finalize and execute the sequence for the block assembly of ships can leverage CAE Crane Manager to help evaluate and improve the associated operations to ensure the process achieves its intended goals effectively and without failure.

The Altair Crane CAE Manager was jointly developed by Altair with four ship building companies in Japan, Shinkishima Dock, Namura Shipbuilding Co., Ltd., Sanoyas Shipbuilding Co., Ltd., North Nippon Shipbuilding Co., Ltd., and General Incorporated Foundation Nippon Maritime Association.

The Altair Crane CAE Manager Workflow

This physics-based environment for block lifting allows engineers to model and analyze the entire block lifting operation, evaluate the safety of planned maneuvers, and improve overall system behavior.

The solution is applicable to all ship types, guiding the user through a series of pre-defined steps, from model creation and process setup through result review.



Altair's leading simulation tools are embedded into the CAE Crane Manager solution:

- Altair HyperMesh™ provides mesh generation, material definition, thickness settings, and modeling for modal analysis
- Altair MotionView™ creates the block lifting model using modal analysis bulk data
- Altair OptiStruct™ leverages motion and modal data to provide modal analysis results
- Altair MotionSolve™ executes the block lifting analysis
- Altair HyperView™ post-processes data for result review

The result is a new approach for block assembly capable of analyzing the entire block lifting process, and computing block structural integrity, while also allowing the user to vary design parameters to improve the overall process.

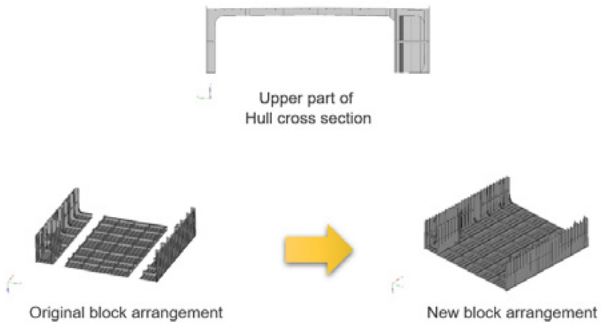
Altair Crane CAE Manager in Action

Strength Study of a Hull Block for a Car Ferry

With an upgrade to the plant facilities, the crane lifting capacity was increased. Altair Crane CAE manager was used to analyze how block lifting would be affected and to optimize the process.

1

Block Arrangement



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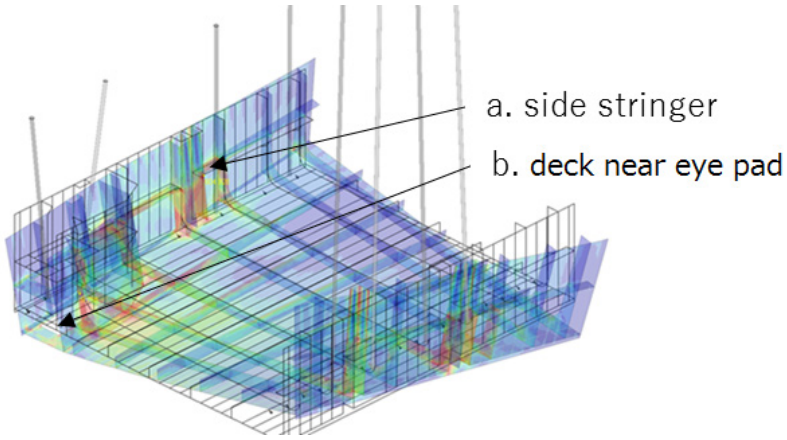
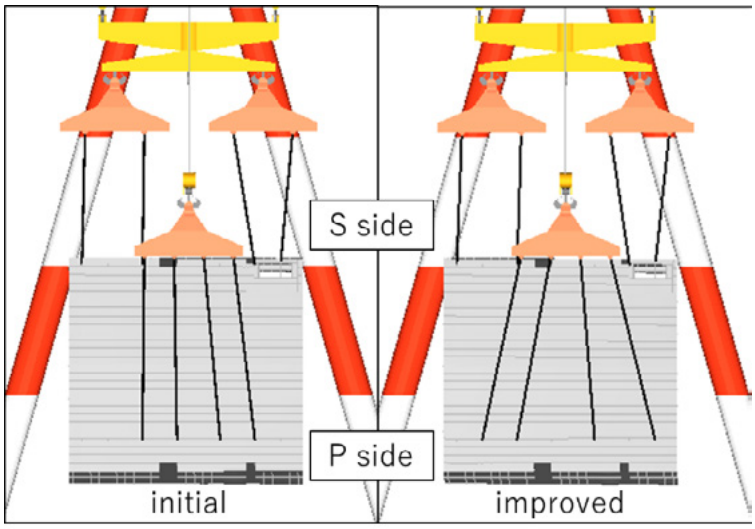
Block Lifting Process

3

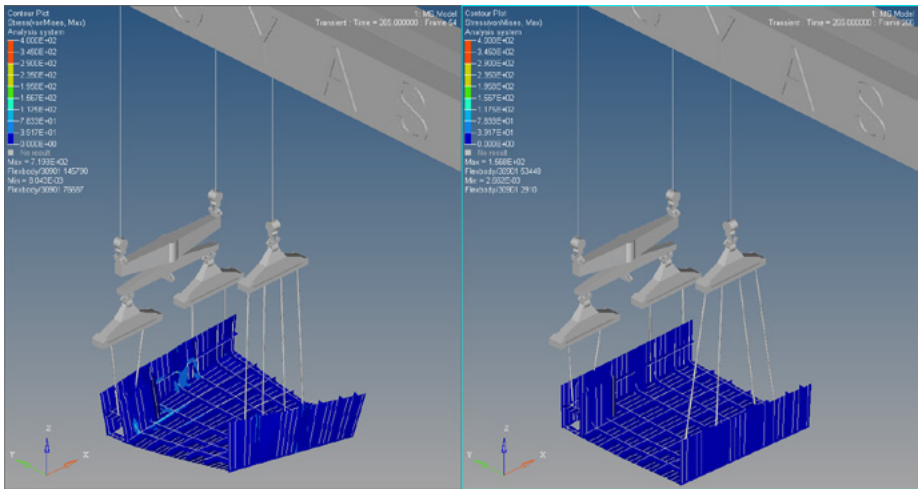
Initial Simulation Results



4 Reconsidering the Eye Pads Arrangement



5 Simulation Results Before and After Eye Pads Rearrangement



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From the design and manufacture of small recreational crafts and large oil tankers to the most technologically advanced aircraft carriers, Altair has assisted the world's leading shipbuilders and boat designers to develop higher performing, safer and lower cost vessels through the application of simulation technology. Altair helps naval architects address complex engineering challenges and mitigate environmental risks associated with seagoing loads including structural, hydro, dynamic, thermal and fatigue, as well as above surface and underwater weapon threats for the military and homeland security.

Learn more at altair.com/marine