

# M A E S T R O

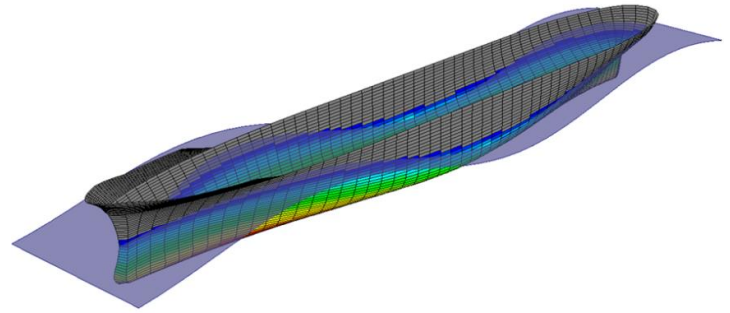
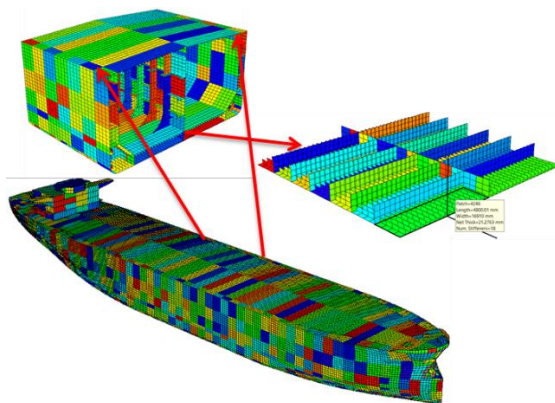


METHOD FOR  
ANALYSIS  
EVALUATION  
AND  
**STRUCTURAL**  
**OPTIMIZATION**

## MAESTRO Software for Ship Structural Design, Analysis, and Optimization

MAESTRO is a design, analysis, evaluation and optimization tool specifically tailored for floating structures that has been fielded as a commercial product for over 30 years with a world-wide user base. MAESTRO's history and process is rooted in rationally-based structural design, which is defined as a design directly and entirely based on structural theory and computer-based methods of structural analysis (e.g., finite element analysis, structural limit state evaluation, and multi-objective structural optimization). At MAESTRO's core is a structural design tool developed to suit the needs of ship designers and naval architects. MAESTRO provides a fully integrated solution for modeling, loading, analyzing and optimizing floating structures.

MAESTRO provides a faster, more flexible and more accurate software toolset for ship and floating structure analysis and design. MAESTRO is user-friendly to ship design teams and their naval architects and structural engineers. MAESTRO's methods and results reflect ship design practices and address the design specification and safety criteria invoked for ship design by commercial and naval design authorities. Furthermore, MAESTRO supports efficient shipbuilding practices as well as issues associated with structural engineering in support of in-service ships such as corrosion impacts on structural integrity, evaluation of in-service damage due to collisions and grounding, and development of safe operating envelopes (speed and heading limits versus sea state) to ensure safe operations of ships at sea.



### MAESTRO-Wave Time Domain Analysis

**Integrated Hydrodynamic Loading.** MAESTRO-Wave and its post-processors Extreme Load Analysis (ELA) and Spectral Fatigue Analysis (SFA) provide a fully integrated solution to the complex challenge of developing lifetime extreme loads for structural design of ships and other floating structures. The solution requires a seakeeping and wave loading analysis over the operational life of the ship and accurate mapping of the predicted hydrodynamic design loads to the finite element model for design analysis. The mapping task has proven to be a difficult problem to solve. Likewise, accurate, high-fidelity spectral fatigue analysis requires solving a large number of global finite element analyses for each combination of ship speed and heading in each incremental wave frequency in the ship's operating profile. This requires analyzing as many as 7200 load cases, caching the results, and post-processing element level stress Response Amplitude Operators (RAOs). Few high-fidelity solutions to this SFA problem exist worldwide, and accurate structural fatigue analysis is critical to designing a ship that will operate successfully through its planned service life.

**Automated Structural Engineering/Optimization.** MAESTRO's optimization capabilities leverage the entire MAESTRO paradigm for rational or first-principles structural design. Because MAESTRO can efficiently develop full ship FE models, load the models with realistic static and hydrodynamic loads, and automatically compute and evaluate the stress and limit state responses for each of the required design load cases, MAESTRO's optimization facility can be invoked or applied to groom the structure

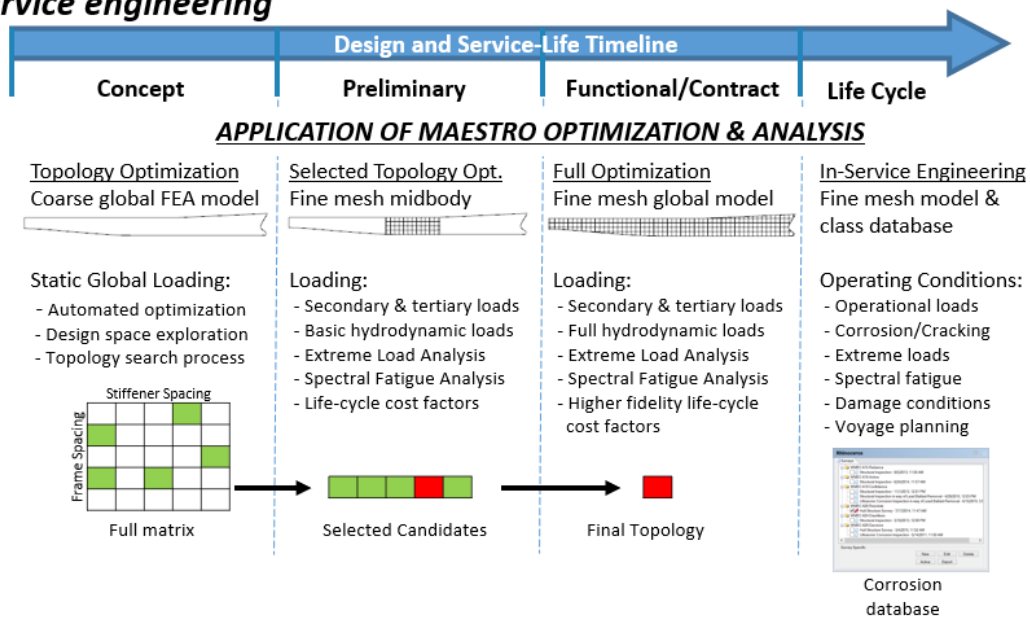
through a multi-level, collaborative optimization process. This process iterates the structural design scantlings (dimensions, e.g., breadth, depth, thickness) to add strength where safety criteria are being violated, to reduce scantlings where excess safety factors exist, and simultaneously move the design toward a lighter weight structure and one

that is more producible to reduce fabrication costs and improve shipbuilding process throughput. MAESTRO's optimization process generates a final structural design that complies with design and safety criteria and meets improved shipbuilding production requirements.



## MAESTRO Design Life-Cycle Applications

**MAESTRO's capabilities are applied to support high-fidelity structural design, optimization, and life-cycle fleet asset management across the entire structural design spectrum from early-stage design through in-service engineering**



### Key MAESTRO Benefits:

- ❖ Finite element analysis and limit-state evaluation results address structural specification and safety criteria invoked for ship design by commercial and naval design authorities. H
- ❖ High fidelity hydrodynamic loading for Dominant Load Parameters (DLPs) and for Spectral Fatigue Analysis (SFA) are fully integrated, accurate and efficiently applied by the structural naval architect.
- ❖ A final structural design that complies with design and safety criteria, reduces structural weight, improves structural performance, and enhances the shipbuilding production process.

Learn more: [altair.com/maestro](http://altair.com/maestro)