Full Speed Ahead

"Tailored to the shipbuilding engineering process flow, the program's functionality is saving time – up to 30% – and cost, and increasing quality."

Customer:
Germanischer Lloyd, Germany
www.gl-group.com

Software:
MSC.Patran®

Summary:
The German classification society Germanischer Lloyd is using MSC.Patran as the foundation for their industryspecific solution GL/ShipModel. Through customization based on the MSC.Patran pre-processor, GL/ShipModel enables pattern-based semi-automatic modeling of ship structures while taking into account specific shipbuilding modeling needs. Tailored to the shipbuilding engineering process flow, the program's functionality is saving time-up to 30%- and cost, and increasing quality. VPD tools from MSC. Software are helping Germanischer Lloyd meet safety requirements, and tight schedules while maintaining acceptable profit margins.

Today, the business of operating the world's large ships has a harsh reality: tight schedules, tight profit margins, and increasing competitive pressures. The bigger the ship, the more serious the effects of a disaster at sea, including the loss of human life and serious consequences in sea ecology and affected coastal countries.

Inspection Authority for Ships
Classification societies, long an inspection authority for ships, are today taking on a monitoring function as well. Independent of ship manufacturers and liable to strict legal requirements, the societies control the design and repair of vessels, check construction plans and materials, and carry out the classification of a vessel. These classifications are the basis of insurance rates and thus freight costs. Although a classification is not mandatory, vessels without one would have little chance to operate competitively in international maritime shipping. One of the most well-known classification societies is Germanischer Lloyd (GL), located in Hamburg, Germany. The company also offers a multitude of engineering and support services including safety and quality surveillance. Germanischer Lloyd's expertise is being put to use on ships requiring sophisticated engineering, such as container and multi-purpose ships, as well as tanker and passenger vessels.

With the ultimate goal of getting ships, their cargo, passengers, and crew safely through heavy storms, Germanischer Lloyd is increasingly turning to computer-aided engineering methods for the design and classification of ships.

Standard Stability Analysis
Scenarios such as hurricanes and other extreme weather situations are codified in technical regulations and considered in the design and construction of a vessel. Most shipyards go far beyond the mandatory requirements. In many of these cases, Germanischer Lloyd serves as a technical consultant and uses the comprehensive experience and technical knowledge of its engineers to meet high safety standards while simultaneously achieving profitability.

MSC Software

"The ability to model in parallel to the engineering process by splitting the geometry and property input is a clear improvement."

Time is short at the design departments of shipyards. Conventional engineering methods cannot meet the short timeframes. Therefore, shipbuilding companies are taking advantage of modern computational technologies and simulating extreme cases using finite element mesh (FEM) software before setting the first frame. FEM analysis offers a variety of possibilities to simulate durability behavior as well as the operating status of components and assemblies in the computer.

In shipbuilding, stability studies have top priority. A considerable number of these investigations are limited to the analysis of design details with clear dimensions. But more shipbuilders are beginning to study the complete system. First, the deformation of the complete steel hull structure is calculated based on the design loads and rules for various load conditions. Highly detailed statements can be made by combining theoretical load conditions with the different heavy sea loads and wave situations that are calculated by specific programs. Using 40 to 60 resulting load cases, the structural loads in all possible extreme situations are calculated, and corresponding buckling and fatigue/durability analyses are carried out.

Aside from this standard stability analysis, Germanischer Lloyd's customers are now continuing investigations into other areas, including vibration calculation and acoustic simulation. These help to formulate statements on the optimal design of the main structures or on the vibrational behavior of machine foundations as well as machine and wave shaftings. Vibration and acoustic simulation is increasingly being used for predicting the sound propagation in the ship structure, especially for passenger ships. Typical acoustic applications are the calculation of the noise exposure in the passenger and crew areas and the optimization of the machine foundation.

FEM Modeling of Ship Hulls

For many years, Germanischer Lloyd has employed numerical analysis, which is now one of their key competencies. For calculation purposes, they rely on in-house programs running on Solaris and SGI-Unix. For modeling, they use a pre-processor specifically optimized for shipbuilding demands. For data preparation and mesh generation, they use GL/ShipModel and MSC.Patran running on a Linux-Cluster on an HPx 4000 double processor computer.

In FEM analysis, the largest amount of time is spent on preparing the geometry and mesh generation. The modeling of the entire steel structure of the ship hull easily may take up to four-man weeks and involves particular, specific problems. Solely on the basis of these dimensions, it is not possible to generate a model with the required level of detail that is also suitable for various calculation jobs (durability, vibration, and structure- borne noise). A fast and structured model is all the more important as FEM analysis progressively becomes a part of the ongoing design and engineering process. Delays may have direct effects on the entire project period, especially if the FEM models are the first 3D representations of the steel structure, which is often the case.

With more FEM experience and more complex calculation models, it became apparent that standard commercial solutions would not adequately meet the demands of geometry and meshes preparation. To make FE modeling as efficient as possible, Germanischer Lloyd required the development of a pre-processor tailored to the company's specific needs. During the two-year project, the focus was on two items: specific customization of geometry processing and meshing for shipbuilding, and functionality for decreasing the amount of time spent inputting data.

MSC.Patran from MSC.Software was used as a foundation for the targeted solution, providing both a high basic functionality and, with its open architecture, the best conditions for GL's plans. The result is a system that offers scheme/pattern-based semi-automatic modeling of ship structures while taking into account specific shipbuilding modeling needs. The use of CAD geometry is possible but not mandatory.

Pattern Thinking in Shipbuilding

To systemize and simplify geometry and structure input, a pattern system is used to describe all main functional components (e.g., decks, transverse bulkheads, longitudinal walls). Minimizing data input has top priority at GL. For the description of a deck, the specification of the geometric track and the corresponding coordinate is sufficient. The input of the scheme definition data is in alphanumerical order and restored as an ASCII file. The generated surfaces are automatically blended with each other along their penetration curves and form a FEM suitable modeling frame, which in itself is consistent. In both MSC.Patran or GL/ShipModel, these structural elements are described as main groups, which allow for controlled access to the respective surfaces and relevant information (sheet thickness, stiffening information, etc.).

The FEM-compatible preparation of the imported CAD data often takes up a large amount of modeling time. In most cases, the CAD surface data are not suitable for direct meshing. The CAD data imported into GL/ShipModel, such as the shell plate, are blended with the predefined pattern tracks. With the help of these pattern tracks, the existing CAD surfaces are automatically modified for further FEM analysis. The component properties are attributed to the geometric objects within the main groups. Due to their size, the properties of the main group elements often consist of different distinct properties - entailing, for instance, in the case of holes, the provision for various sheet thicknesses. These properties are assigned as attributes to the corresponding surfaces, allowing for optimal clearness and traceability. Special algorithms offer the calculation-specific summing up of assumptions made, which are easily traceable and modifiable with the respective templates. By selecting such a main group, this area is presented in a standard view, showing the attributes in the respective surfaces.

Through the customization based on the MSC. Patran pre-processor, GL/ShipModel is an industry-specific solution. The ability to model in parallel to the engineering process by splitting the geometry and property input is a clear improvement, which GL finds particularly important. Tailored to the shipbuilding engineering process flow, the program's functionality is saving time - up to 30% - and cost, and increasing quality.

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