SIEMENS

Marine

PaxOcean

Marine firm enhances the safety and reliability of its products using Femap with NX Nastran

Product

Femap

Business challenges

Verify rationale for early-stage structural design

Fulfill rigorous requirements for quality, safety and reliability

Meet analysis requirements for complex loads

Enhance efficiency of traditional verification methods

Reduce product delivery cycle

Keys to success

Use Femap with NX Nastran

Conduct structural analysis in virtual environment

Improve safety and reliability of shipping equipment

Results

Increased safety and reliability of shipping equipment

Lowered material costs by optimizing design

Discovered potential problems in early stages

Shortened R&D cycle

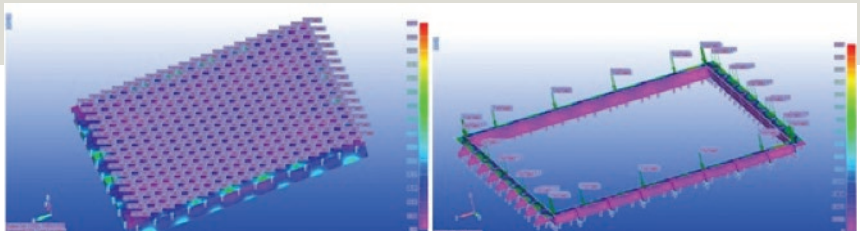
PaxOcean lowers material costs and optimizes design with Siemens PLM Software solutions

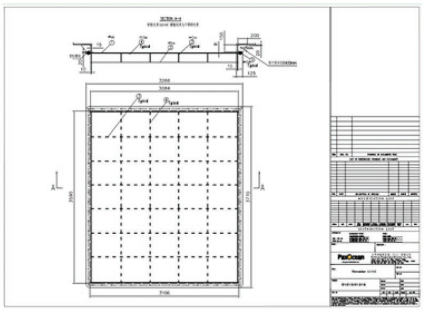
Boosting research and development

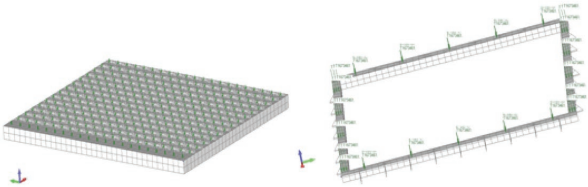
PaxOcean Engineering Zhoushan Co., Ltd. (PaxOcean), was established in 2006, and is a wholly owned subsidiary of Kuok (Singapore) Limited. It provides repair, conversion and new building services to the offshore and marine markets.

In 2011, the first bulk cargo carrier measuring 260 meters in length and 43 meters in width docked at the PaxOcean shipyard in Zhoushan, marking the opening of operations at that location. Since then, the company has received orders to build the world largest semi-submersible accommodation vessel for 750 persons, demonstrating that PaxOcean is growing in stature as one of the world's leading shipbuilders of offshore platforms and ships.

However, as the company began to build a growing variety of vessels, a string of research and development (R&D) challenges made it clear that PaxOcean needed a better approach to performing simulation and analysis. After a thorough evaluation of potential solutions, they chose Femap™ with NX™ Nastran® software from product lifecycle management (PLM) specialist Siemens PLM Software.







Femap is an advanced engineering simulation software program that creates finite element analysis (FEA) models of complex engineering products and systems, and displays solution results. Femap can virtually model components, assemblies or systems, and determine the behavioral response for a given operating environment. NX Nastran solves structural analysis problems for linear and nonlinear analysis, dynamic response, rotor dynamics, aeroelasticity and optimization.

"The management attaches great importance to the R&D department, especially with the creation of our structural strength finite element analysis team," says Feng Wengang, senior structure engineer at PaxOcean. "With Femap with NX Nastran, there have been no errors in our work with the ship design team. Femap with NX Nastran perfectly meets all of our simulation analysis requirements, and plays a huge role in guaranteeing ship quality."

Designs grow in complexity

Shipping equipment for the hull – such as cranes, hydraulic systems and high-speed gear lifting structures – is required to handle more functions and larger tonnage than ever before, so the design concept has become more advanced, and the equipment structure is increasingly sophisticated. If the design is found to be unworkable after a ship has been completed, modifications will lead to additional manufacturing costs and workloads. Therefore, engineers must have a sufficient understanding of the hull's structural features in the early stages of design to avoid design defects.

Structural parts are subject to complicated buckling and shearing stress, damaged elastoplasticity, fatigue and fracture, which puts in doubt a ship's quality, safety and reliability. Any accident might threaten the crew's safety, and lead to huge financial losses. So it is essential to maintain the safety and reliability of equipment, which means setting high standards for shipping equipment materials and structural strength analysis.

The shipping equipment (including the hull structure) must be able to handle a variety of loads, and the overall hull analysis

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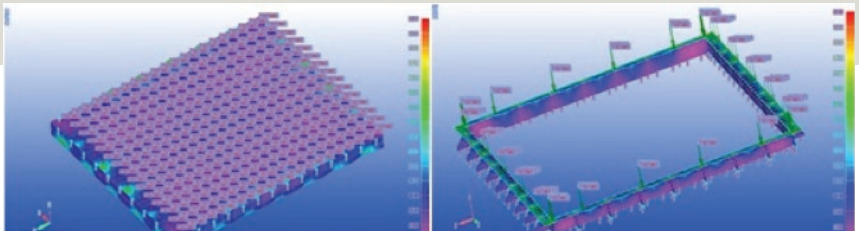


involves multiple disciplines, such as structural mechanics, mechanics of materials and hydromechanics. It covers numerous items requiring structural analysis and verification, including: localized stress computations; overall strength analysis, linear and nonlinear (geometric and material) structural statics analyses; small deformation and large deformation problem analyses. Therefore, the manufacturer can no longer meet all the requirements simply with empirical formulae and theoretical computation methods.

Shipping equipment for special marine resources exploration and mining requires high-precision, quality and performance. The most direct physical testing approach, though intuitive and having a certain amount of relevance, is costly and inefficient for developing complicated, large-tonnage shipping equipment.

Ultimately, shipbuilders need to be highly efficient at conducting R&D if they want to be able to deliver an order within the specified time while guaranteeing safety, reliability and quality.

Maintaining the hull's integrity

Given these challenges, the FEA approach is widely applied in ship structural analysis. FEA can be used to forecast the structure's response to loading in the most scientific and accurate way currently available in the field of hull structural analysis.

The FEA approach has become the most mainstream structural analysis method, and PaxOcean has established a special team devoted to structural FEA and verification. The company worked with Siemens PLM Software partner Hangzhou CareU Technology to implement Femap with NX Nastran software.

The PaxOcean FEA project mainly focuses on structural strength analysis and verification. Normally, the ship strength refers to the ability of the hull structure to resist all sorts of external forces so it won't suffer serious deformation or damage. The purpose of analyzing and verifying the hull strength is to guarantee that the ship is designed and manufactured so it can work safely and reliably when encountering all sorts of external forces.

"We attach great importance to the structural strength analysis and verification as we must guarantee the hull's structural strength," says Wengang. "The ship for which I am currently verifying the strength of the cover plate costs hundreds of millions of dollars to build, and has a capacity of 750 persons. If the cover plate isn't strong enough, it could cause significant structural damage, possibly leading to the ship sinking."

"Fortunately, we've got Femap, which provides a complete and powerful set of modeling and visualization tools, enabling me to create and verify the finite element model before doing analysis and computation."

Feng Wengang
Senior Structure Engineer
PaxOcean

Dominating the shipping market

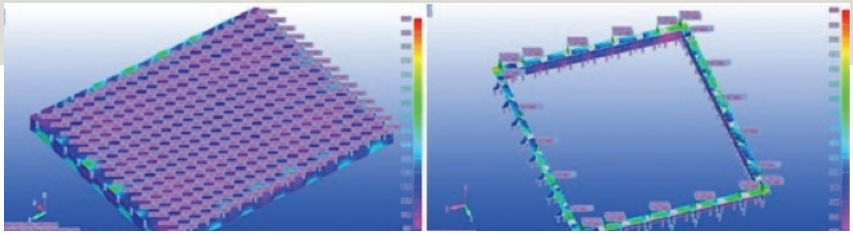
Wengang notes that Nastran, a solver for structural analysis, is the primary FEA software used in the shipping industry; while Femap, as a high-end finite element pre- and postprocessor, provides in-depth and high-quality support to NX Nastran. The combination of NX Nastran and Femap with strong structural analysis capabilities, he explains, can help PaxOcean meet functional requirements, such as linear and statics, normal modes, buckling and nonlinear analyses.

"We're also using Femap with NX Nastran at our Singapore headquarters," says Wengang. "So using it in Zhoushan helps the whole company to achieve accurate and efficient data communication. The experience of other large shipping equipment manufacturers has proven that Femap with NX Nastran is well-suited to provide accurate and efficient structural analysis."

This includes calculating the strength of areas encountering heavier loads, such as chassis, grillage, reinforcing ribs, large steel structures and the cover plates at the hull bottom.

Avoiding costly mistakes

PaxOcean uses Femap to establish a 3D model, perform meshing and material definition and then define the loading and boundary conditions. An accurate definition of the loading and boundary conditions will



have a direct impact on the usability of the computational results.

"I have to pay close attention to the loading and constraint definition during every analysis, and take all possible kinds of loads and constraints into consideration for any mistake could lead to serious consequences," says Wengang. "For example, if the strength is computed with an incorrect load that seems to meet the requirement, while in fact the strength is inadequate, an accident will occur. It puts a lot of pressure on me.

"Fortunately, we've got Femap, which provides a complete and powerful set of modeling and visualization tools, enabling me to create and verify the finite element model before analysis. With Femap, the loading and boundary conditions can either be defined directly on the geometric model, or defined on finite elements after meshing. I can flexibly define the loading and boundary conditions according to my preferences and the model's features."

In order to analyze whether the structural strength meets the requirement, the main items to be computed include structural displacement, buckling stress and shearing stress. Femap can be used to customize these analysis processes and automatically carry out repeated analyses. It can also be used to configure other analysis content through self-definition on the same user interface according to requirements. In addition, Femap with NX Nastran can be used to solve tougher engineering problems in ship structural analysis because the software can be used to perform advanced nonlinear analysis.

After the structural analysis is complete, the results are analyzed to make sure that the buckling stresses and shearing stresses are within allowable limits. Since the hull structure is continuous, if one area exceeds the limit, the whole structure will be damaged. Since the postprocessing function of Femap can display the displacement and stress images, engineers can readily understand and use the analysis results to find dangerous areas with the largest displacement that are under the greatest stress.

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Solutions/Services

Femap with NX Nastran
www.siemens.com/plm/femap

Customer's primary business

PaxOcean is a wholly owned subsidiary of Kuok (Singapore) Limited. The company repairs, converts and provides new building services to the offshore and marine market.
www.paxoceanzhoushan.com

Customer location

Zhoushan City, Zhejiang
China

Partner

Hangzhou CareU Technology

Extending CAE technology

The company's technical team points out that by using Femap with NX Nastran for computer-aided engineering (CAE), PaxOcean has enjoyed a number of benefits, including increased confidence that its hull structures are safe and reliable; early diagnosis of structural design problems, reducing the additional cost caused by later changes; the ability to analyze, compute and compare different design schemes for key parts, identifying the optimal design for reduced material costs; conducting fewer tests and reducing testing expenses via simulation and analysis supplemented by physical testing; and advancing the quality, safety and reliability of shipping equipment while shortening the R&D cycle so the company can meet its delivery deadline.

"Although we only conduct strength analysis for part of the ship structure at the moment, I believe that we will further the application of CAE technology in our company," says Wengang. "Someday, Femap with NX Nastran will be extended from local structural analysis to overall structural analysis, from static to dynamic response analysis, and from single-discipline to multi-discipline coupling analysis.

"This will enable us to solve more complicated problems, transforming simulation-verified design to simulation-driven design."

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