Femap®

Making the United States' largest crawler crane easy to transport

Analysis-driven design helps Manitowoc Cranes deliver new, highly mobile product

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MANITOWOC CRANES

In the design of its most recent heavy-lift model, Manitowoc Cranes had to make sure that upon completion it could get the huge crane where it was needed.

Engineers at Manitowoc Cranes felt overly constrained by analysis software that was solely geometry based. However, when they switched to EDS Femap®, a Unigraphics product, they found that they could easily work on the details of a finite element model — nodes, elements, properties, and loads — and when they needed it, Femap also met their toughest geometry and meshing requirements.

The business issue

Ensure that all components of the new crane can be shipped on standard tractor-trailer trucks

Comply with SAE (Society of Automotive Engineers) and ANSI (American National Standards Institute) standards

Complete the design within an accelerated timeframe

The approach

Adopt a new, highly modular design

Use finite-element analysis (FEA) to evaluate the new crane for compliance with standards

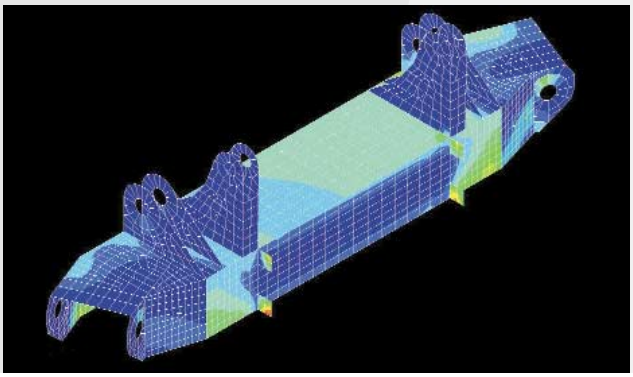
Perform FEA concurrently with the design to improve time to market

How it worked

The 21000's eight smaller crawlers are easily transported on tractor-trailer trucks

The design was validated according to SAE and ANSI requirements

By performing concurrent analyses, the company was able to go from a design concept to a finished, certified product in less than 18 months



EDS

TECHNOLOGY

Femap®, a Unigraphics product

PRIMARY BUSINESS

Manitowoc Cranes designs and manufactures customized lattice-boom cranes, excavators, and crane attachments used worldwide in heavy construction, surface mining, material handling, and other specialized applications.

LOCATION

Manitowoc, Wisconsin, USA

Fewer steps required

The use of Femap contributed to a faster cycle time by reducing the time between design-analysis iterations. It did this by permitting changes on the finite element model itself rather than requiring engineers to go back and modify the CAD geometry. Femap also made it possible for Manitowoc Cranes to take advantage of legacy data. Engineers were able to import existing Nastran models, modify nodes and properties, and run a new analysis without having to find and modify the original geometry.

Meeting and exceeding standards

Most large cranes are extremely difficult to transport. Even after a crane is dismantled, its individual pieces are still so large that moving them requires special routes, permits, and escort vehicles. Manitowoc Cranes wanted to solve this problem in the design of its new Model 21000 lattice-boom crane, the largest crawler crane ever built in the United States. Although this would require a radical departure from the standard two-crawler configuration, the competitive nature of the crane business imposed a tight time frame on this project. Engineers had to come up with a unique design meeting strict weight and size limits while ensuring that the first 21000 that was built complied with all pertinent SAE and ANSI standards.

Modular is better

The design team established a weight limit for each module of the crane (car body, rotating bed, boom, mast, counterweight, hydraulic pumps, hydraulic fluid and fuel tanks, etc.) based on transportation requirements. The modules were modeled in 2D in the company's CAD program. Then the top, front, and side views were transferred to the Femap FEA pre- and post-processor where the geometry was converted into a 3D model. The 3D model was converted to a finite element mesh using a combination of hand meshing and Femap's automatic meshing capability.

Information from the analysis was used to guide the design of the various modules, both to ensure that they could withstand the required loads, and also to look for areas where material could be removed to reduce weight. Engineers quickly went through six design-analysis iterations to achieve the ideal balance between weight and strength for each of the various modules.

Analysis was also used to validate the design of the 21000 according to SAE and ANSI requirements. Any problems that might cause the design to fail these tests were fixed digitally before the actual crane was built.

Lifting FEA to new heights

By performing analyses prior to physical testing, the company was able to ensure that the first 21000 that was built passed all the required tests. As a result, it was able to progress from a design concept to a finished, certified product in less than 18 months, a significant reduction from previous product development cycle times.

The 21000, which was introduced at Conexpo '99, features a new Octa-trac eight-crawler system. Rather than having two huge crawlers, as most large cranes do, the 21000's eight smaller crawlers are easily transported on tractor-trailer trucks. The 21000's other components all come under a reduced weight limit as well, giving the 21000 the ease of mobilization features the company wanted.

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