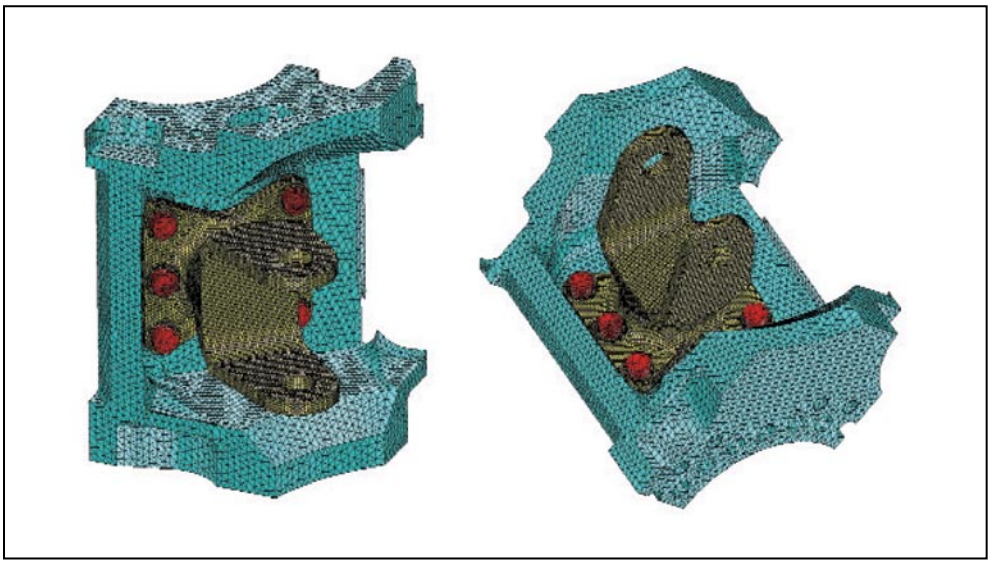
Sikorsky Aircraft Uses MSC.Nastran 2004 Implicit Nonlinear to Reduce Design Bottlenecks



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Customer:
Sikorsky Aircraft Corporation
www.sikorsky.com

Software:
MSC.Nastran™ 2004 Implicit Nonlinear

Summary:
Sikorsky, a world leader in the design and manufacture of advanced helicopters, reduces design bottlenecks by using MSC.Nastran Implicit Nonlinear (Solution 600) for contact analysis. Integrating the solvers of MSC.Nastran and MSC. Marc, MSC.Nastran Implicit Nonlinear is speeding up the nonlinear analysis process by enabling engineers to skip the creation of a separate model in MSC.Marc Mentat. The MSC.Nastran Implicit Nonlinear capabilities allow users such as Sikorsky to do contact analysis and get an accurate estimate of the true buckling strength of a structure - without any training in MSC.Marc.

Sporadic use of advanced finite element analysis (FEA) software, such as nonlinear analysis by design engineers, can result in either excessive refresher training time or a bottleneck while in the queue for an analyst. The cause is a result of different types of solvers requiring different models. Commercially available translators can help, but still require significant amounts of cleanup. However, by integrating solvers in MSC.Nastran 2004 Implicit Nonlinear (Solution 600), the same model in the familiar MSC.Nastran format can be used for both linear and MSC.Marc nonlinear analysis.

"We use nonlinear simulation primarily for contact analysis," says Dr. Michael R. Urban of Sikorsky Aircraft's Structures Research department. "In the past, when engineers had a contact problem and needed a better understanding of the issues involved, they created a second model in MSC.Marc Mentat for analysis in MSC.Marc or another nonlinear program. If the engineers had not been trained to use nonlinear analysis programs, they sent the model to an analyst, thus creating a bottleneck in the design process." Previously, MSC.Nastran users who wanted to perform analyses studying complex materials, small deformations, large strain, and 3D surface-to-surface contact had to learn how to use MSC.Marc and its Mentat interface because MSC.Marc nonlinear analysis had been developed to solve models created with the Mentat pre-processor and view the results in the Mentat post-processor. Therefore, intermittent users of MSC.Marc had to either review the nonlinear training material whenever they needed to run a nonlinear analysis, or send the problem to an analyst to be run and wait for the results to be returned.

With MSC.Nastran 2004, specific translators were developed between MSC.Nastran and MSC.Marc, called "Solution 600." Transparent to the user, the MSC.Marc solver does the number crunching for advanced nonlinear analysis using existing MSC.Nastran models and providing results in the familiar MSC. Nastran format. "Solution 600" actually consists of two translators. One of them translates MSC.Nastran input data for MSC.Marc to analyze. The second translator converts MSC.Marc results into MSC.Nastran formats for post-processing. For the user, "Solution 600" significantly expands nonlinear capabilities within Nastran and opens up new application arenas.

MSC Software

"By integrating solvers in MSC.Nastran 2004 Solution 600, the same model in the familiar MSC.Nastran format can be used for both linear and MSC.Marc nonlinear analysis."

Most engineers at Sikorsky do not work with contact or other nonlinear analysis on a daily basis, and Dr. Urban points out, "It's difficult to use a program sporadically, because you have to relearn it every time you use it. The capabilities of Solution 600 speed the nonlinear analysis process by enabling engineers to skip the creation of a separate model in MSC.Marc Mentat. Instead, by just clicking on the nonlinear preferences in MSC. Patran, engineers can perform nonlinear contact analysis in a program with which they are familiar."

Ed Dickerson, manager of MSC.Nastran/MSC. Marc Integration for MSC.Software, points out that the use of nonlinear analysis is important for describing the real world. "If an engineer is running linear analysis and sees stress and strain results that go past the yield point, or see deformation that causes contact, they need to run nonlinear analysis," he says. "Solution 600 is very useful for the MSC.Nastran user because, having obtained the initial linear results, he only has to change the solution card from linear static to Solution 600, add some data to describe the contact, and then run the nonlinear analysis."

Dickerson notes that the kinds of contact problems can include simple, all point contact, including self contact, which can result from severe buckling when the material comes into contact with itself. "Alternately, engineers can enter elements where contact will occur against other elements," Dickerson says. "In either case, automatic entry of the MSC.Nastran input will speed up the MSC. Marc portion of the run." Dr. Urban of Sikorsky agrees that in his company's tests of the software, some time savings have been realized. But, he says, "The main value is that people who are trained in MSC.Nastran and MSC.Patran can now do contact analysis with virtually zero training in MSC.Marc. They are up and running, and can run contact analyses that would have required training in MSC.Marc and MSC.Marc Mentat in the past. When they use Solution 600, they only have to remember the few steps they need to modify the model settings to run the contact analysis. It means that many more engineers can now run contact analysis." The goal of "Solution 600" is to make it as easy as possible for the average engineer to perform nonlinear analysis. Toward that goal, says Dickerson, "MSC.Software has worked very carefully to set up defaults to help inexperienced users get good results." The company also offers twoand three-day training seminars to bring new users up to speed about when and where to employ nonlinear analysis. Dickerson reports, "Solution 600 is gaining interest, because so many applications have nonlinear effects."

Among the new applications "Solution 600" brings to MSC.Nastran users, says Dickerson, are studies of:

- Deformation of laminated composite materials, and their behavior when they come into contact with themselves and other materials;
- Enforced displacement such as that resulting from squeezing together two cylinders with rigid tops and bottoms;
- Analysis of spring-back, which can occur when vacuum-formed sheet metal develops plastic strains;
- Viscoplasticity studies for creep analysis;
- More accurate buckling analysis.

"Linear analysis can help a user predict the buckling strength of a structure - but nonlinear effects can affect that strength," Dickerson says. "Typically, the buckling strength of a stiff structure would be between 50% and 90% of the theoretical critical buckling strength. Before nonlinear analysis tools were widely available, people - particularly in aerospace applications - would find out the linear buckling strength and use 60% of that as a working limit for a rule-of-thumb approximation. That might or might not be a good approximation. Now, using nonlinear analysis tools, anyone who follows the proper procedures for running the analysis can get a quite accurate estimate of the true buckling strength and do it within MSC.Nastran."

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