Harmonization at Bombardier brings Design and Analysis together

"[MSC.MasterKey] gives us total flexibility in the way we use our software."

Customer:
Bombardier, Inc.
www.transportation.bombardier.com

Software:
MSC.Nastran™, MSC.Patran®, MSC.MasterKey™

Summary:
Bombardier Transportation has benefitted from the implementation of the MSC.Software product portfolio on a centralized server using the MSC.MasterKey licensing system. Integrating the software across all Bombardier sites enables collaboration both within and between divisions, thus increasing the ability to share technology and methods. Using MSC.Software tools to perform analysis early in the process to make sure that designs fulfill the requirements, Bombardier can eliminate a significant amount of physical testing and the number of physical prototypes, thus saving time and reducing costs.

Bombardier Transportation is a market leader in the rolling stock industry for short- and long-haul, passenger, and freight rail transportation. Its wide range of products includes passenger rail vehicles and complete rail transportation systems. When the company acquired Adtranz in 2001, Bombardier also took over a software harmonization project in design and structural analysis at Adtranz's Center of Competencies (CoC) at Kalmar in Sweden. "The Adtranz harmonization was almost completed regarding structural mechanics," said Micko Björck, the thenmanager of the CoC. "I showed Bombardier the benefits of the MSC.MasterKey Licensing System, and at the same time it became clear that MSC.Software and IBM/Dassault Systemes had developed a closer relationship. Since CATIA was the principal CAD tool in use in the former Bombardier, it was only logical to standardization on MSC.Software products and CATIA."

Bombardier had been using CATIA V4 in production, planning to move to CATIA V5 during 2004. This migration had significant strategic importance and Bombardier was confident that V5 could offer all the features they needed. By licensing MSC.Patran, MSC.Nastran, MSC.Marc, MSC.Dytran, and MSC.Fatigue through the MSC.MasterKey System, Bombardier has access to all the appropriate software tools whenever they are needed.

"Without question the most important feature of the MSC.Software offer for us is the token-based licensing which gives us total flexibility in the way we use our software," said Björck. "MSC.Software products are easy to use; the analysts like the interface and are very comfortable using the system."

Among the different analyses performed on rail products are normal analyses to ensure that stresses and deformations are kept within reasonable limits, as well as analysis for buckling, eigenfrequency, crash, fatigue and thermal effects. In addition, Bombardier has internal requirements for handling of carbodies during production, such as lifting stresses. There are also a number of international and national standards to which they have to comply.

MSC Software

> *"The harmonization is starting to yield significant business benefits. The software provides us with an opportunity to make sure that the designs fulfill all requirements before we start to make the first unit."*
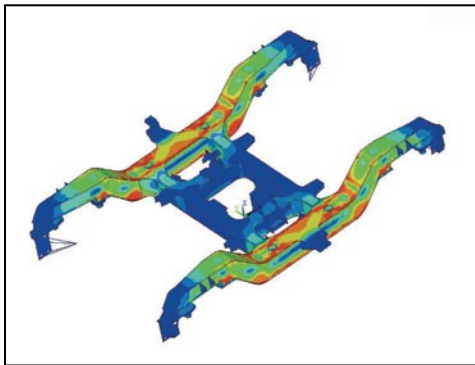
The analysis procedures used by Bombardier have been developed over a number of years, and output from one analysis tool is regularly used as input for another. MSC.Nastran results are postprocessed with MSC.Patran and Bombardier uses the static results as input to their own fatigue tools. Bombardier plans to harmonize fatigue tools in a next phase. One of the impediments to fatigue harmonization is the fact that so many different international and national standards are involved.

"We tend to post-process the analytical runs using MSC.Patran and home-grown post-processors," said Björck. "Our own post-processors are used mainly for fatigue and for sorting load cases. For a normal carbody there are about 100 load cases, and maybe 1,000 components - our own post-processors are used to sort out this vast amount of data and to seek out the problem areas. This is more a sorting process than a graphical display process. The output is a sorted list, which

highlights areas for further investigation. Each country has their own requirements with regard to reporting procedures for regulatory authorities, so there is no such thing as a standard report structure."

Design and analysis are closely linked at Bombardier, and the interaction between designers and analysts is on a daily basis starting from the very early stages of design. On projects where there are very experienced designers, the task is much simpler for the analysts because many of the load cases are satisfactory in the first design loop. While CATIA is the primary CAD tool at Bombardier, the kind of geometry imported from CATIA is different from site to site. Some sites don't have access to CATIA yet and therefore they generate the geometry for the analysis themselves using the preprocessors. Bombardier has different ways of filtering the CATIA data to accommodate the different analyses. Solid geometry is fairly straightforward; the CATIA model can be imported directly and meshed with standard meshing tools. When a mid-surface model is required, then either an analyst produces it or, at some sites, the designer makes a copy of the CAD model and transforms it into a mid-surface model for the analyst to ensure congruent surfaces for the analysis. It also allows small details which would upset the meshing algorithms, such as holes and small radii, to be removed without compromising the master CAD model.

While most Bombardier sites use MSC.Patran for meshing, there are still some sites using the CATIA meshing module. Meshing is another area that Bombardier is hoping will benefit from the cooperation between MSC.Software and IBM/Dassault and the adoption of the CATIA V5 architecture as its common platform for the simulation environment of the future.

"The mere act of harmonizing the software across all our sites means that collaboration both within and between the divisions is much easier and the ability to share work and components is significantly increased," said Björck. "This collaboration also extends to human resources. If everyone is using the same software, analysts can move around to respond to increasing workloads in different locations. Due to this flexible

approach, Bombardier can save between 10 and 20 contractors per year. This represents about 10 percent of the human resource budget for analysts."

Harmonizing the software has also made it easier for engineers and analysts to discuss upcoming issues, which has a direct bearing on quality. Because of the greater interdivisional involvement and discussion arising from the harmonization exercise, Bombardier has discovered some anomalies in certain analytical procedures at some sites.

Because Bombardier is using numerical methods and simulating testing in the computer, the company has been able to reduce the number and sometimes the size of physical prototype tests. "We do physical impact tests on the plastic fronts of the rail carbodies by shooting missiles made from steel cubes at the vehicles," said Björck. "If you can simulate this, most of this physical testing is not necessary. Crash testing is another example of where we, thanks to simulation, rarely do full-scale testing these days - we only do it occasionally to verify the analysis."

By doing analysis early in the project, Bombardier can eliminate a significant amount of physical testing. Sometimes as a result of early analysis, the engineers set up a physical fatigue test on particular components, especially bogies. This testing runs in the background as analysis continues. Each new product series is monitored throughout its life to measure and document its fatigue response.

"We are very satisfied that with MSC.Software products we have made the right choice of CAE software," said Björck. "The harmonization of the software across all divisions is starting to yield significant business benefits. The software provides us with an opportunity to make sure that the designs fulfill all requirements before we start to make the first unit."