

Altair HyperWorks Success Story



HITACHI

Fine-Tuning 300-Ton Haulers: HyperWorks at Hitachi Truck Manufacturing

Hitachi Truck Manufacturing sought ways of reducing materials costs for its mammoth mining trucks, while remaining within standard specifications. The company's first project using HyperWorks CAE tools enabled Hitachi to do this with accuracy. HyperWorks is now an integral part of the design process at Hitachi.





The Engineering Framework for Product Design™

The big rigid-body mining trucks that Hitachi designs and builds at its Guelph, Ontario plant go to distant sites – China, Colombia, Indonesia – wherever surface mining requires heavy haulers. It's part of a family of heavy equipment, from excavators to boring machines, made by Hitachi companies around the world.

The word big is not really adequate here. We're talking about rigid dump trucks that can be 30 feet wide with a 316-ton payload. With the bed tilted up to dump, the highest point of the largest truck is 47 feet from the ground. It is so large it must be shipped in sections and welded together on site. Loaded, it can weigh well over a million pounds. For the design engineers at Hitachi Truck Manufacturing (HTM), the challenges are clear: reduce materials costs, meet ISO specifications, and keep customers happy with payload performance. The Altair HyperWorks engineering framework is the key toolset in achieving these goals.



The Challenge: Predicting Structure Behavior

When Harry Tempelman, a HyperWorks expert, came to HTM as technical analysis manager in 2005, he brought HyperWorks with him. His immediate focus was reducing the mass of the welded steel cab structure, while still meeting the qualification of ISO 3471 ROPS (rollover protection system) and FOPS (falling object protection system) specifications.

Standards-based ROPS and FOPS behavior is a vital parameter for the big trucks Hitachi makes. During 24-hour mining operations, the possibility of accidents always exists. The cab must stand up to a variety of static, dynamic, and impact loads to protect the operator. Hitachi engineers had been meeting this challenge by iteratively designing the structure and running a finite-element analysis (FEA) to verify that it

would meet ISO 3471 specification. Tempelman took a different approach using HyperWorks.



"We modeled the nonlinear, uniaxial material and structure, and transferred the geometry native model directly into HyperMesh," said Tempelman. "Within a few days, we submitted the first structural analysis. We then used Altair OptiStruct to run multiple loadsets and learn where the steel should really be. We presented a report describing the potential weight saving, and the decision was to move ahead using HyperWorks tools."

"Reducing costs while keeping the customer happy with performance — HyperWorks is key to maintaining that balance."

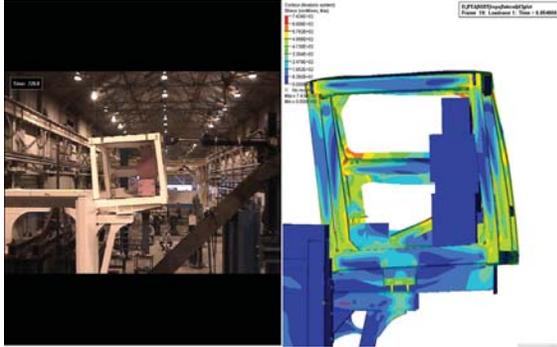
Harry Tempelman
Manager, Technical Analysis
Hitachi Truck Manufacturing

"We used LS-DYNA to run nonlinear explicit analyses on the structure. The beauty of the link between Altair and LS-DYNA is that we can easily modify the geometry, run another analysis, and redefine the structure through repeated what-if studies."

A few days and multiple iterations later, HTM had a structure that exceeded the ISO specification in calculation. When HTM ran the required physical tests on the prototype, they confirmed that all the nonlinear behaviors of the structure had been correctly predicted using HyperWorks tools.



Hitachi no longer waits weeks for traditional FEA and prototyping to show a design function. "We can run dozens of OptiStruct analyses in a tenth of that time," said Tempelman.



HyperView Makes Everything Clear

Tempelman has found Altair HyperView, a visualization environment for simulation and test data, to be extremely useful in sharing analysis results with HTM managers.

"Sometimes when I'm talking about elastic/plastic or flow stress behavior," said Tempelman, "A manager will say, 'Explain this to me.' HyperView gives me a tremendous capability for displaying results to the people who approve funding for this work. Being able to pull these results out of this black box and share them with people who don't have the same level of technical knowledge is a great advantage. Five years ago, we had to write macros to reverse the screen and get a white background so we could display a JPEG image. Now we've got HyperView — the best post-processing studio out there."

HTM uses Altair MotionView and MotionSolve for multibody analysis of the entire truck. Applying motion analysis on a system level as well as to all subsystems – front axle, rear axle, frame, cab, engine, and body – gives HTM the loads they need to run detailed FEA analysis in Altair OptiStruct or LS-DYNA with excellent results.

Payload: It All Rests on the Tires

Hitachi hired Tempelman to implement HyperWorks for economic reasons. They wanted to reduce the mass of the truck to hold down steel costs and use tire loading as efficiently as possible.

"Everything depends on the tires," said Tempelman. "There are six of them, and each can handle only so much weight. So you want the lightest engine, body, and frame you can get so you can increase the gross

payload." Reduction of mass within the GMW (gross machine weight) specification is therefore a key element in HTM's engineering analysis, and the prime focus for the HyperWorks users at HTM.

"CAE absolutely drives the design of these trucks," said Tempelman. "A customer may want to run coal today and overburden tomorrow. The loads have different characteristics. Because we're working with the load capacity of the tires, we want to make sure that the center of gravity is between the two front wheels and the four rear wheels, so each tire is equally loaded. So we actually design the body and the frame on the fly for certain customers so they can have what works for them."

Because these haulers operate in remote areas, availability is a key feature. For that reason, Tempelman often finds himself in little-heard-of corners of the world with memory-efficient HyperWorks on his laptop.

"I head for the site, put on my overalls, and run some loadsets right there to find ways to mitigate specific stresses. I can then use HyperView to show what we did. Later, I can use the software to say, 'Here's the frame, here are the changes I made, and here's the stress report.'"

HyperWorks: Flexibility Matters

One reason for Tempelman's continued use of HyperWorks over many years is its ability to work with many solvers and data sources.

"The translators for bringing information into HyperMesh are awesome," said Tempelman. "And working with HyperMesh and HyperView lets me use LS-DYNA, ABAQUS, NASTRAN and other solvers in the background. I don't lose any of my toolsets. I build my knowledge and experience in one software suite.

"For example, we run what we call, static equilibrium, loads in OptiStruct. If we're looking at a hyperelastic material like a rubber damper, we use ABAQUS. If we're looking at steel structures, we use LS-DYNA, an explicit code. But we all work with HyperWorks, and that makes us a more efficient group."

"The other great thing about HyperWorks is our relationship with Altair," said Tempelman. "Too many companies come in and say, 'Here's the software. Call me if you have questions.' That doesn't work anymore. I know that if I call the Altair hotline, or type in hwsupport@altair.com, I will get a very good response. That's important to Hitachi and to me."

"My equation of success comes from having good people and good tools."



Altair HyperWorks Success Story

WORLD HEADQUARTERS

UNITED STATES

www.altair.com

AUSTRALIA

www.altairengineering.com.au

BRAZIL

www.altairengineering.com.br

CANADA

www.altairengineering.ca

CHINA

www.altair.com.cn

FRANCE

www.altairengineering.fr

GERMANY

www.altair.de

INDIA

www.altair-india.com

ITALY

www.altairengineering.it

JAPAN

www.altairjp.co.jp

KOREA

www.altair.co.kr

SWEDEN

www.altair.se

UNITED KINGDOM

www.uk.altair.com

Altair Engineering, Inc. strengthens client innovation and decision-making through technology that optimizes the analysis, management and visualization of business and engineering information. Privately held with more than 1,200 employees, Altair has offices throughout North America, Europe and Asia/Pacific. With a 20-year-plus track record for product design, advanced engineering software and grid computing technologies, Altair consistently delivers a competitive advantage to customers in a broad range of industries. To learn more, please visit www.altair.com.

