Altair HyperWorks Success Story

HyperWorks at Changchun Railway Vehicle Co., Ltd.: Accelerating Design and Analysis of High-Speed Railcars

Asia's largest railway vehicle manufacturer, Changchun Railway Vehicle Co., Ltd. (CRC), was looking for ways to increase development efficiency through streamlined CAE processes. By implementing HyperWorks, Altair's engineering framework for product design, CRC was able to reduce modeling cycle time by up to 50 percent. In addition, simulations were more accurate as a result of better model quality.

Altair Engineering

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Altair® HyperWorks®

The Engineering Framework for Product Design™

At Changchun City, 500 miles northeast of Beijing in China's Jilin province, Changchun Railway Vehicle Company (CRC) is refining its technology and expanding its horizons. Formed in 2002 from two domestic organizations, CRC is already a major player in the global railcar industry. It has 8,000 employees, massive manufacturing facilities and strong relationships with industry giants such as Bombardier and Alstom. CRC is currently working on cars that will operate at close to 200 MPH. Its products move passengers on railways from Zimbabwe to Sri Lanka, from Iran to Bangladesh, and it is the dominant designer, builder and exporter of railway and urban rail vehicles in the enormous China market. CRC's use of Altair HyperWorks technologies has helped fuel the company's technological growth.

CAE technology: Catching up and moving ahead

Conditions in China in the 1980s and even the early 1990s did not lend themselves to early adoption of CAE technology. CRC, in its earlier life as Changchun Car Company, continued to design its products in traditional ways, using CAE sparingly. But in 1998, government funding enabled the company to acquire ANSYS software and make finite-element analysis (FEA) part of its product design process.

Things started changing rapidly in 2001. The Chinese government was moving ahead with a rail transport program that demanded faster trains. High-speed railcar designs required more intensive use of CAE analysis. The newly organized Changchun Railway Vehicle Company added more CAE engineers and acquired HyperWorks CAE tools. There was an immediate increase in productivity.

"We were primarily looking for a really good pre-processor, so HyperMesh was our prime reason for acquiring HyperWorks," said Dr. Xuedong Yan, chief information officer of CRC. "We found the HyperMesh interface excellent."

Using ANSYS alone, a CRC engineer could build up and analyze a passenger railcar model in two months, and roughly six weeks of this time was spent in modeling. Using HyperMesh, engineers can now build a whole-car model in three weeks and complete the design cycle, including analysis, in four weeks. But reduced design cycle times is not the only reason Yan likes HyperMesh.

"It's not just that we can build up a HyperMesh model more quickly," said Yan. "Of all the CAE software that I've used or seen, HyperMesh delivers the finest model quality."

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Ramping up CAE analysis with the HyperWorks Suite

Today, the group at the CRC Technology Center has grown to 10 engineers, including two Ph.D.s. They use a range of CAE design analysis techniques, including static and modal analysis, multi-body dynamics (MBD), fatigue analysis, crashworthiness, airflow (using computational fluid dynamics), and NVH (noise, vibration, and harshness). They build models of leading-edge passenger railcars with carbon steel, stainless steel or aluminum alloy bodies. CRC constructs these cars using manufacturing technology from Italy, Korea, Japan, and other countries.

The greatest design challenges the group faces today, from the standpoint of CAE methodologies, stem from the demand for railcars that operate at higher speeds, such as magnetic levitation cars. The higher speeds intensify requirements such as noise abatement, aerodynamic performance and crashworthiness, and all these aspects of the design must be resolved in combination with each other.

The engineering group is using MBD analysis to deal with this complexity. In addition, to optimize designs more effectively at the system level, the engineering team has already received training in the use of OptiStruct, a powerful structural analysis and optimization tool that is part of the HyperWorks CAE suite, and will soon be implementing it as an integral part of design analysis.

The high-speed future: International collaboration and high-speed trains

CRC has been successful in attracting technology transfer and joint-venture participation from foreign technology leaders in the railcar industry. They have formed a joint-venture company with Bombardier, and are collaborating with French manufacturer Alstom on design engineering for a 124 MPH electric multiple unit (EMU) train design. The CRC purchases whole-car designs from its technology partners, but its goal is to develop rail technology design capability that equals any in the world, and to design and market CRC's own brand of products.

An example is CRC's collaboration with a leading European rail technology company on a 186 MPH car that requires ultra-precise modeling of bogies — the carriages or trucks on which railcars ride. The bogies on high-speed cars are extremely complex structures, designed to very tight tolerances.

"Modeling the bogies was very challenging," said Yan. "We found it a tricky and demanding process to produce a high-quality design for the assembly because the structure is so complex. But we were very successful in the end because of the way we were able to use HyperMesh.

"It was equally challenging to develop each of the highly complex components of the bogie assembly, such as the shaft box. But HyperMesh enabled us to handle that complexity in a very effective way.

"Our product quality equals that of the global industry leaders," said Yan. "In terms of CAE technology, we are still refining what we do in terms of design details and engineering management, and we are expanding our use of HyperWorks software. Our CAE expertise should soon equal that of any rail industry manufacturer.

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