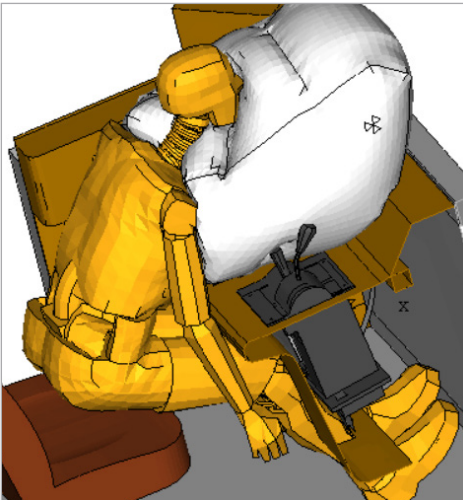


Developing an Innovative New Safety Systems for Rail Vehicles



Key Highlights

Industry

Rail / Transportation

Challenge

Develop a new safety system to protect rail engineers in the event of a crash

Altair Solution

Designed, tested, correlated and prototyped an new Engineer Protection System (EPS)

Benefits

- All performance targets met
- Minimal cost and weight added to the rail car
- System does not hinder exiting cab

Train on train collisions may not be common but when it happens the impact can be devastating, especially to the often unprotected rail engineer. The interior of the front rail car is built to withstand a moderate to severe impact, however, the engineer console is left virtually unprotected, leaving the engineer to withstand potentially life threatening impact injuries.

Sharma & Associates (SA), provides engineering solutions to the railroad industry. Specializing in railway mechanical and infrastructure engineering, as well as mechanical engineering projects in the automotive and consumer electronics industries. Since 1995, SA have delivered safe, effective and efficient solutions to its customers, which include the Federal Railroad Administration (FRA),

the Association of American Railroads (AAR), railroads and transit agencies, rail car builders and rail car component manufacturers.

SA work with the National Transportation agency (VOLPE), which helps the transportation community anticipate emerging problems with technical, operational, and institutional issues. As part of the U.S. Department of Transportation, the VOLPE partners with public and private organizations to serve the needs of the transportation industry. SA initiated the research into creating an Engineer Protection System (EPS) concept and submitted it to as a VOLPE funding initiative.

At the time, SA was not familiar with the necessary safety requirements, available systems, or overall performance tuning

Sharma & Associates Success Story



“The combination of Altair ProductDesign's expertise and the HyperWorks software suite were essential to our success in meeting 100% of our performance criteria in just two tests.”

Anand Prabhakaran
Vice President
Sharma & Associates

of impact environments and so needed a partner to help develop the new system. The team had already established a positive relationship with Altair through the use of its HyperWorks simulation suite, so approached the company to see if it could assist with its knowledge of crash scenarios and human injury criteria. SA enlisted the help of Altair ProductDesign for a research project to develop an EPS for rail cab cars, in order to better protect the engineer's head, chest, neck, and legs during impact with the rail cab's furniture in the event of a crash. To be considered successful, the EPS could

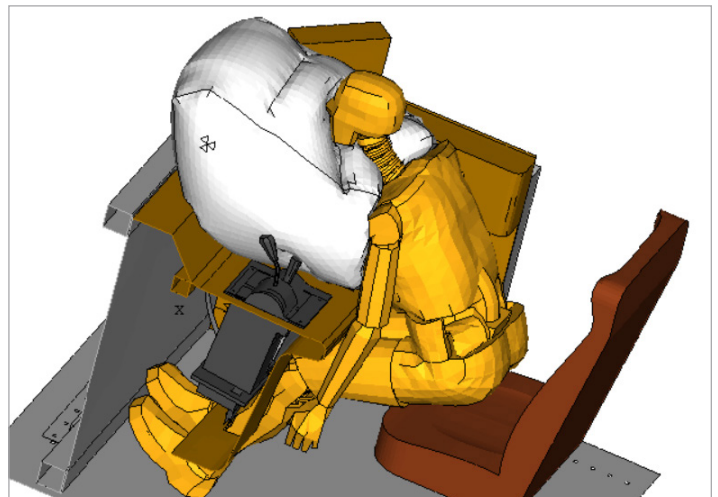
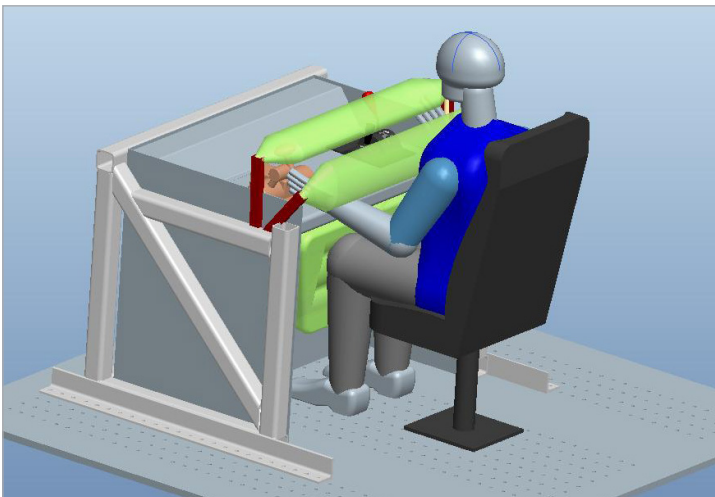
not be triggered by the engineer and could not interfere with the engineer exiting the control car.

Using Simulation Technology to Explore New Safety Systems

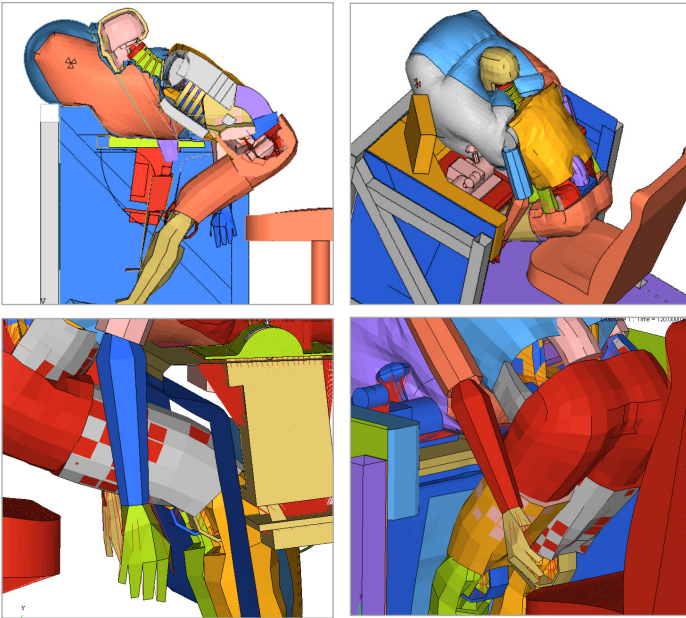
Altair ProductDesign's first task was to create accurate finite element (FE) models of the interior of a standard rail operators cabin which the team did using HyperWorks pre-processor, HyperMesh. Next, the team brought in a human dummy model into the environment and positioned it into the engineer's seat facing the control panel.

Altair ProductDesign's crash specialists were then able to experiment with a wide variety of airbag types, sizes, positioning and flow rates, along with developing a new deformable knee bolster to absorb impact forces during a crash.

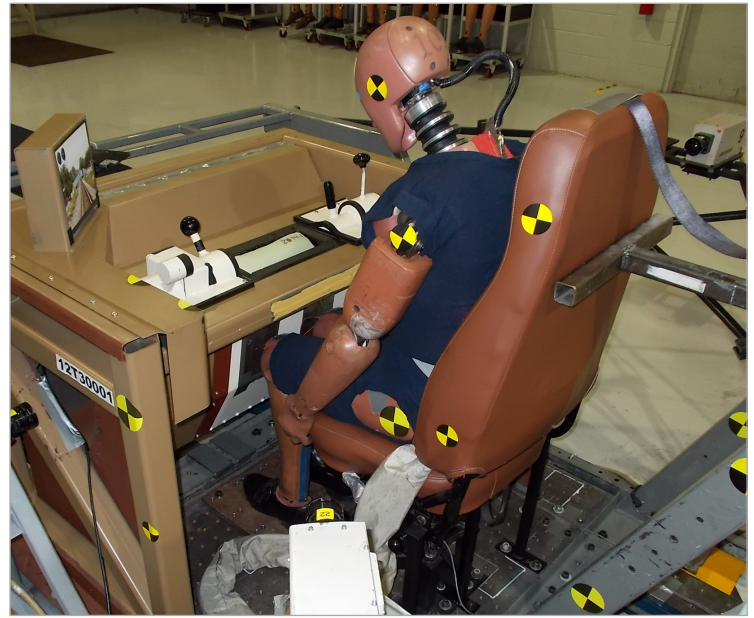
Data for several off the shelf airbag inflators and housing geometry details were provided by Key Safety Systems (KSS) and airbag geometry, rolling/packing details, and leakage were tuned jointly between Altair ProductDesign and KSS to ensure the final solution was possible to manufacture and



Multiple safety systems and airbag configurations were considered before proceeding with the final design (right)



Analyzing airbag and knee bolster performance



Simulation results correlated extremely well with physical tests

correlated to component level prototype airbag drop tower tests. In addition, Altair ProductDesign correlated the initial finite element safety models with analytical MADYMO (Mathematical Dynamical Model) results provided by KSS to provide a baseline for the models. The FE models could then be tuned to obtain the proper performance metrics for the project. Altair ProductDesign correlated FE component level details with the airbag itself and the stiffness of the knee bolster bracket quickly and efficiently, allowing the team to tune the complete safety system to maximize performance.

The EPS system that the team developed used an automobile passenger style airbag system in combination with a crushable knee bolster to keep injuries to a minimum, while also meeting compartmentalization, egress, and functionality requirements for an unbelted occupant.

Correlating to Physical Test

The development effort used analytical modeling at the system and sub-system levels, in combination with a series of quasi-static and dynamic sled tests using

HyperWorks' RADIOSS solver, to develop and demonstrate system level performance. With the new safety system design working well in the virtual world, Altair ProductDesign brought in KSS again to build a prototype of the cabin to test, and provide critical details of available safety hardware needed for further simulations. A sled test was conducted and the forces sustained by the test dummy were recorded.

The first test revealed that the virtual model built by Altair ProductDesign accurately predicted trends and ATD (anthropomorphic test device) response was around 75%-85% accurate compared to the physical crash result for the most critical injury responses with some minor variations in kinematics of the ATD, an impressive level of accuracy for a first test. Using these results allowed the team to make some minor improvements to the models to better correlate the analytical performance model to the physical testing. A second sled test was conducted to confirm the performance matched the new virtual design and this time, no kinematic issues were found and critical injury response accuracy improved further to 85%-95%.

Improved Safety for Rail Engineers

The project demonstrated the feasibility of developing a protection system that can effectively protect cab engineers by applying modern occupant protection technologies, through the use of state-of-the-art analytical techniques and test methodologies.

Designed and ready to be installed in current rail control cars and adaptable to work with new designs the EPS system is currently waiting to be used and implemented by rail manufacturers to increase the safety for their engineers from secondary impact.

The partnership between SA and Altair continues to be a strong one with SA continuing the use of HyperWorks and Altair ProductDesign services when necessary.

Find out more at:

www.altairproductdesign.com

Visit the Altair ProductDesign library of
Success Stories
at www.altairproductdesign.com

About Altair

Altair is focused on the development and broad application of simulation technology to synthesize and optimize designs, processes and decisions for improved business performance. Privately held with more than 2,600 employees, Altair is headquartered in Troy, Michigan, USA and operates more than 45 offices throughout 24 countries. Today, Altair serves more than 5,000 corporate clients across broad industry segments.

About Altair ProductDesign

Altair ProductDesign is a global, multi-disciplinary product development consultancy of more than 800 designers, engineers, scientists, and creative thinkers. As a wholly owned subsidiary of Altair Engineering Inc., this organization is best known for its market leadership in combining its engineering expertise with computer aided engineering (CAE) technology to deliver innovation and automate processes. Altair ProductDesign utilizes proprietary simulation and optimization technologies (such as Altair HyperWorks) to help clients bring innovative, profitable products to market on a tighter, more efficient time-scale.

www.altairproductdesign.com

About HyperWorks

HyperWorks is an enterprise simulation solution for rapid design exploration and decision-making. As one of the most comprehensive, open-architecture CAE solutions in the industry, HyperWorks includes best-in-class modeling, analysis, visualization and data management solutions for linear, nonlinear, structural optimization, fluid-structure interaction, and multi-body dynamics applications.

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