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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 50 offices throughout 22 countries. Today, Altair serves more than 5,000 corporate clients across broad industry segments. To learn more, please visit www.altair.com.

About Altair Partner Alliance

One Platform. One License. One Source. **All Access.**

Altair's HyperWorks platform applies a revolutionary subscription-based licensing model in which customers use floating licenses to access a broad suite of Altair-developed, as well as third-party, software applications on demand. The Altair Partner Alliance effectively extends the HyperWorks Platform from more than 20 internally developed solutions to upwards of 60 applications with the addition of new partner applications. Customers can invoke these third-party applications at no incremental cost using their existing HyperWorks licenses. Customers benefit from unmatched flexibility and access, resulting in maximum software utilization, productivity and ROI.

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Altair Engineering, Inc., World Headquarters: 1820 E. Big Beaver Rd., Troy, MI 48083-2031 USA
Phone: +1.248.614.2400 • Fax: +1.248.614.2411 • www.altair.com • info@altair.com

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HyperWorks and the Altair Partner Alliance Streamline Testing of Truck Components at IVECO Australia



IVECO

Key Highlights

Industry

Automotive

Challenge

Reduce size, weight and solving time in FEA and improve durability of components

Altair Solution

nCode DesignLife, Altair HyperMesh, Altair OptiStruct

Benefits

- Cost savings
- Reduced weights
- Ease of manufacturing/assembly
- Ability to share FE models across IVECO divisions

Overview and Customer Profile

IVECO Australia manufactures and distributes light, medium, and heavy commercial vehicles for the Australian road transport industry. Formerly International Harvester and International Trucks, the company has been a part of Australia's way of life since 1902.

IVECO is wholly owned by CNH Industrial. CNH Industrial is a global leader in capital goods that implements design, manufacturing, distribution, commercial and financial activities in international markets. CNH Industrial's 12 brands make the vehicles that keep agriculture and industry growing, from tractors and combines to trucks and buses, as well as powertrain solutions for on-road, off-road and marine vehicles.

The local manufacturing plant has produced more than 230,000 truck and bus chassis since 1952. Today IVECO manufactures ACCO,

Powerstar, Stralis AS-L and AD/AT models and bus chassis at its plant in Dandenong, Victoria. In addition, it imports its Daily light commercial range, Eurocargo and Stralis ATi models from IVECO plants in Europe and South America.

IVECO Trucks Australia employs 600 people Australia wide, and the investment in the Australian truck market creates local employment for thousands more people in related industries, from operations to component suppliers.

The Challenge:

Physical durability testing is a must and before simulation, in some instances, IVECO must redesign the component which fails during the test. This unnecessary design loop pushes out the target release date and idle time of truck during repairs. Validating components through FEA eliminates this unnecessary design loop during the physical durability testing.

IVECO Trucks Success Story



“We use HyperWorks and nCode DesignLife to virtually test the component to determine the durability in a short period of time. We also achieve cost savings, weight savings and ease of manufacturing/assembly by developing different concepts that suit our requirements. Another benefit is that our parent companies use HyperWorks, this enables us to share FE models and develop a common platform among FEA groups.”

Larson Lawrence
Engineering Specialist
IVECO Australia

In today’s demanding world, the challenge is to answer the questions “how long will it last?” and “will it pass the test?” before you even have a prototype while also meeting strict cost and weight targets. Also, product development time has been shortened significantly to meet market demands and this can only be achieved by going beyond simple stress analysis to avoid over-designing your products.

In trucks, the battery box is typically mounted on the chassis and is influenced by different types and different levels of mechanical vibration primarily caused by road/load induced movements, engine/chassis vibrations and human interactions (like stepping on the battery box). Mechanical vibration is transmitted by the tires, body structure and transmission system. Such mechanical vibration (harmonics) can cause structural damage to

the battery box, such as the deformation and distortion of the structure of the battery box. The battery also has a range of acceptable vibration levels as leakage of battery fluids can hamper battery life.

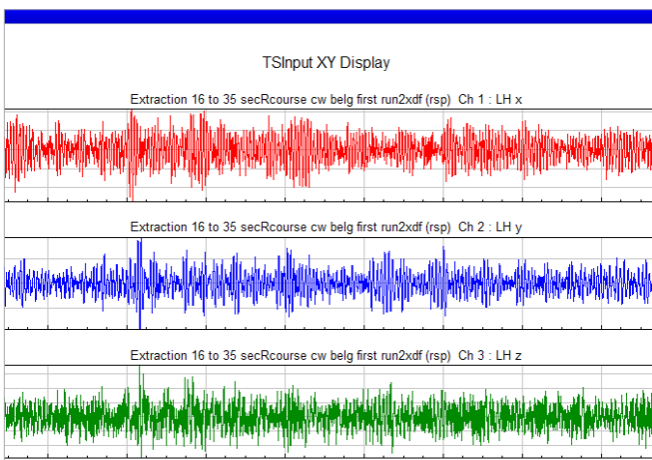
The Solution:

IVECO started using HyperWorks on the recommendation of their first CAE employee hired out of University who had used HyperMesh in school and recommended that IVECO adopt the software suite. They later discovered that their global parent companies, CNH Industrial and FCA Group were already using HyperWorks extensively. IVECO has now been doing simulation modeling for over eight years. Simulation has helped them cut down on testing time since many design concepts can be analyzed before a prototype is made. It has also enabled them to understand the behavior of a component or system under loading so

that concepts can be easily generated while keeping in mind the locations of stress concentrations.

IVECO uses Altair HyperWorks and nCode DesignLife via the Altair Partner Alliance for fatigue analysis. HyperMesh has helped them mesh intricate and complicated models and has handled larger models with ease. Stress analysis for fatigue is done in OptiStruct and then the models are imported into nCode DesignLife to calculate the fatigue. For testing, nCode DesignLife is used for digital signal processing (DSP) of measured acceleration, strain, force, pressure and displacement data.

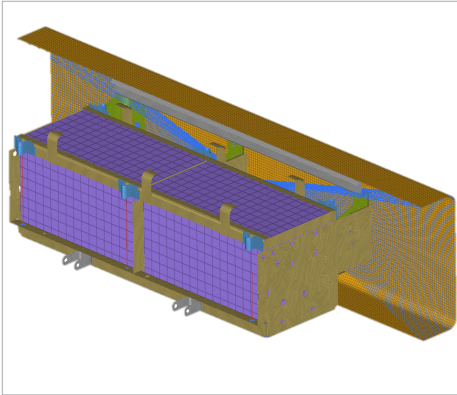
For the battery box, a mesh model was created in HyperMesh and then modal analysis was performed in OptiStruct to evaluate the battery box design. The design structure was evolved based on the mode shapes to achieve acceptable levels of



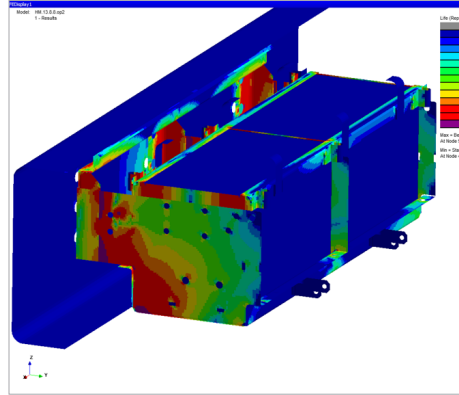
Acceleration measured on chassis from Belgian block pavers at IVECO test tracks used to excite the CAE model



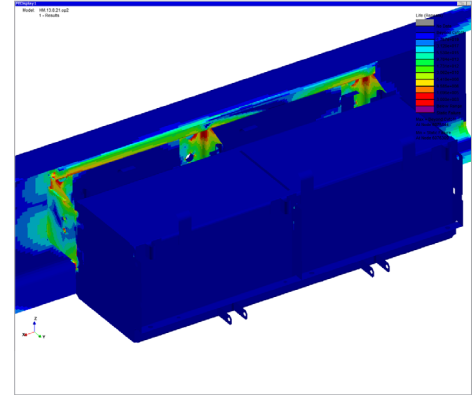
Belgian block paver test track



Battery box CAE model.



Existing battery box - transient modal fatigue life at 24 Hz with areas of concern and static failure.



Target achieved and areas of static failure eliminated

natural frequency. APA software, nCode Design Life was used to correlate stress from the field to the FE model. The final design was then evaluated for fatigue using dynamic analysis with nCode DesignLife. Acceleration measured on chassis from Belgian block pavers at IVECO test tracks was used to excite the CAE model and damage was calculated based on each mode and modal participation factor of the frequencies of interest.

Transient modal fatigue life was tested at a first mode of 24 Hz. The simulation performed in nCode DesignLife reveals several areas of concern where static failure (stresses exceed UTS of steel) will occur on the existing battery box design. The virtual strain gauge tool is then used in nCode DesignLife to correlate stresses from the field with the FE model.

Conclusions and Outlook:

IVECO's work in HyperWorks and nCode DesignLife resulted in an improved battery box structure. The first natural frequency of the box increased from 24Hz to 74.3 Hz, strain energy significantly reduced in areas

of concern, stresses exceeding the UTS of steel were eliminated and the required fatigue life was achieved.

"We use HyperWorks and nCode DesignLife to virtually test the component to determine the durability in a short period of time. We also achieve cost savings, weight savings and ease of manufacturing/assembly by developing different concepts that suit our requirements. Another benefit is that our parent companies use HyperWorks, this enables us to share FE models and develop a common platform among FEA groups," explained Larson Lawrence.

HyperWorks and nCode DesignLife have saved IVECO a lot of time now that they can validate several concepts before they are released for physical testing. IVECO enjoys utilizing the Partner Alliance to access software from multiple partners without leasing or buying them. "Accessibility to the wide range of Altair Partner Alliance tools such as nCode DesignLife has helped us to enhance our virtual simulation capabilities without investing exclusively for these tools with long term commitment. This has also helped us to reduce the design cost and lead

time, enabling us to bring our products faster to the market with greater confidence," said Larson Lawrence. They have also used Total Materia and CADdoctor through the Partner Alliance. In the future, IVECO plans to explore more advanced options to simulate FE models in HyperMesh. They look forward to achieving additional time savings using advanced options in nCode DesignLife for fatigue analysis and plan to explore OptiStruct optimization for structures.