



This Volvo hauler truck is equipped with a lightweight aluminum Alutip tipper bed that tilts back to unload vehicle contents. The unique semicircular bed is designed by Axis Developments Ltd.

Heavy-Duty Lightweight

An innovative aluminum design gives a truck-body manufacturer the competitive edge in the worldwide construction industry.

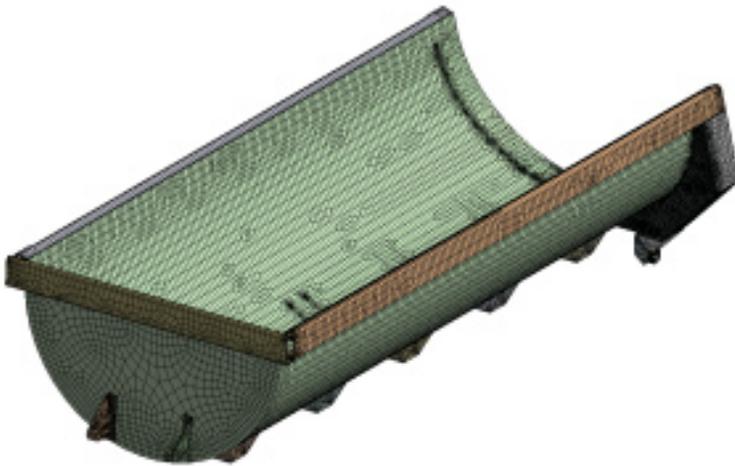
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In developing hauler trucks, every extra pound of vehicle weight increases manufacturing costs, lowers fuel efficiency and reduces vehicle payload capacity. So Axis Developments Ltd. had an idea for making one of the largest parts of the vehicle out of lightweight aluminum: the tipper body bed that tilts back to unload soil, rock, debris or other contents.

A designer and manufacturer of trailers and truck bodies for the worldwide highway transportation and construction industries, South Africa-based Axis is known for its Alutip series of aluminum tipper beds, which weigh considerably less than comparable steel bodies. Developing these structures is an engineering challenge, however, since body strength must be maintained with aluminum material, which has different properties than steel; the amount of material must be minimized as much as possible for further reduction in weight and cost;

and there is the additional desire to get new designs released quickly without numerous physical prototype testing cycles.

In redesigning an existing tipper body having a capacity of 15 cubic meters, Axis addressed these issues upfront in the design cycle with software from ANSYS, Inc. by readily evaluating stress levels for different configurations. Geometry of the existing design was imported from Autodesk Inventor, a computer-aided design (CAD) package, into ANSYS DesignModeler software, which has functions for preparing design models specifically for simulation. The engineering team used a mid-surface extraction tool in ANSYS DesignModeler to convert the solid model of the tipper body's 10-mm-thick plates to a simpler surface representation. This simplification enabled the software to model the structure with a minimal number of shell elements for greater solution speed while still retaining information on plate



Using aluminum materials saves weight but presents a new set of challenges. The first step in redesigning the tipper body was importing existing geometry into ANSYS DesignModeler software. Axis Developments' engineers modeled the truck body with shell elements and parameterized so models could be readily modified by changing a few key parameters, instead of rebuilding the entire model from scratch.

thickness throughout the simulation. Additionally, the model was parameterized so engineers could quickly modify the geometry of the model by changing only a few key parameters, instead of having to rebuild the entire model from scratch.

Next, design geometry passed from ANSYS DesignModeler to ANSYS Professional software for structural analysis. Since the two modules both operate on the ANSYS Workbench platform, transfer of data occurred with a menu pick, allowing switching between design and analysis without having to open and close different applications. In this way, Axis Developments' engineers quickly developed a mesh and performed stress analysis in ANSYS Professional software; they then were able to appropriately modify the geometry in ANSYS DesignModeler and immediately perform another analysis to ensure that stress concentrations were eliminated.

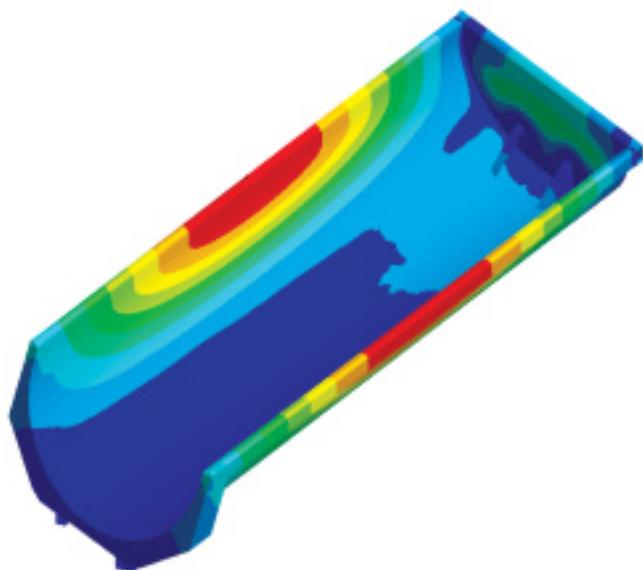
Using this approach, engineers quickly arrived at an optimal design by performing three iterations, with a total solution time of only five minutes per iteration. By experimenting with different types of designs, Axis Developments determined that the

traditional support beam configuration could be replaced with a more effective semicircular design having a reinforced rib structure and end plate for additional stiffness. As the only manufacturer employing this unique design shape, the Axis bodies are easily recognizable on the road and quickly are becoming the company's trademark. Body weight was reduced 25 percent yet provided the additional

strength needed for higher payload capacities — a benefit for customers and, thus, a definite competitive advantage for Alutip in the hauler truck market. The material cost savings paid for the company's software investment within only 10 truck bodies.

Axis Developments' engineers had no previous experience with finite element analysis, yet they were productive after only two hours of training. The tipper body design was completed in less than two days, which would have been unfeasible using conventional hand calculations. Moreover, the design was refined with fewer hardware prototypes. Reduction in prototype testing was a huge benefit, since these large structures are extremely time-consuming and expensive to build and test. With the success of this tipper body redesign, Axis Developments now uses a simulation-based product development approach in which all new design concepts are evaluated, "what-if" scenarios are studied, problems are fixed and designs are refined before detailed CAD work is started. ■

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Stress distribution contours (from ANSYS Professional software) plotted on the Axis tipper body structure