

Scania

Transportation & Mobility Case Study



Challenge

Leading commercial vehicle maker Scania Group wanted to further refine their heavy truck and bus powertrain and drivetrain components to meet stringent emissions standards while ensuring quality and reducing testing.

Solution

Tosca Structure optimization software provided design concepts, early in the product development process, that demonstrated the potential to reduce material weight while maintaining, or even improving, rigidity and durability.

Benefits

Tosca Structure delivered material savings of 30%, stress reduction of 26%, and maintaining efficient manufacturability—along with significant time savings. By optimizing vehicle component structures with Tosca Structure, Scania was able to reduce expensive testing and produce lighter-weight vehicles that consume less fuel and produce fewer emissions. This enabled them to meet the Euro 6 standards before deadline while fulfilling their customers' needs.

As the European Union adapts to Euro 6—legislation that sets the highest-ever pollution regulations on trucks and buses—leading commercial vehicle maker Scania Group is finding new ways to meet the challenge.

Over the 20 years since Euro 1 was instituted the Swedish-based, global company has had an ongoing program to develop vehicles and engines with a host of innovative technical solutions that have radically cut emissions. For additional design refinement of powertrain and drivetrain components, they have added the optimization software Tosca Structure to their computer-aided engineering (CAE) toolkit.

The software creates design concepts, early in the product development process, to show potential to reduce material weight while maintaining, or even improving, rigidity and durability. Such optimized structures have helped Scania build lighter-weight vehicles that consume less fuel and produce fewer emissions, helping them meet the Euro 6 standards that have applied to all new trucks registered in Europe since January 1, 2013.

Integrating the CAE environment seamlessly with Tosca Structure

Scania's engineers work in a mixed CAE environment, using a variety of design tools. For optimization they use Tosca Structure from FE-DESIGN—since May, 2013, part of the Dassault Systèmes 3DEXPERIENCE technology portfolio under the SIMULIA brand. SIMULIA Tosca Structure is a flexible, modular software system for non-parametric structural optimization of topology, shape, and bead design using finite element analysis (FEA). With its open interfaces to FEA industry-standard solvers, Tosca Structure allows for easy integration into any existing CAE environment. This lets engineers work in their accustomed IT environment with their existing FEA models.

Scania's primary finite element analysis (FEA) solver is Abaqus, also from SIMULIA. Using Tosca Structure along with their own FEA

"Tosca Structure fits seamlessly into our CAE-environment and is an important tool for our work with a simulation-driven product development process."

Mikael Thellner, Technical Manager, Scania

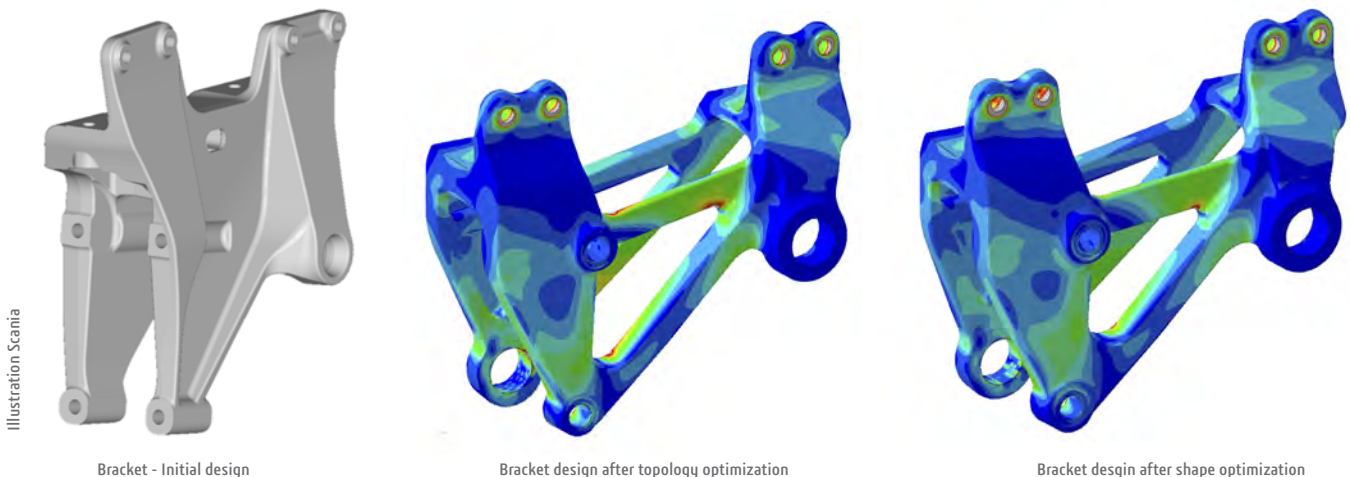
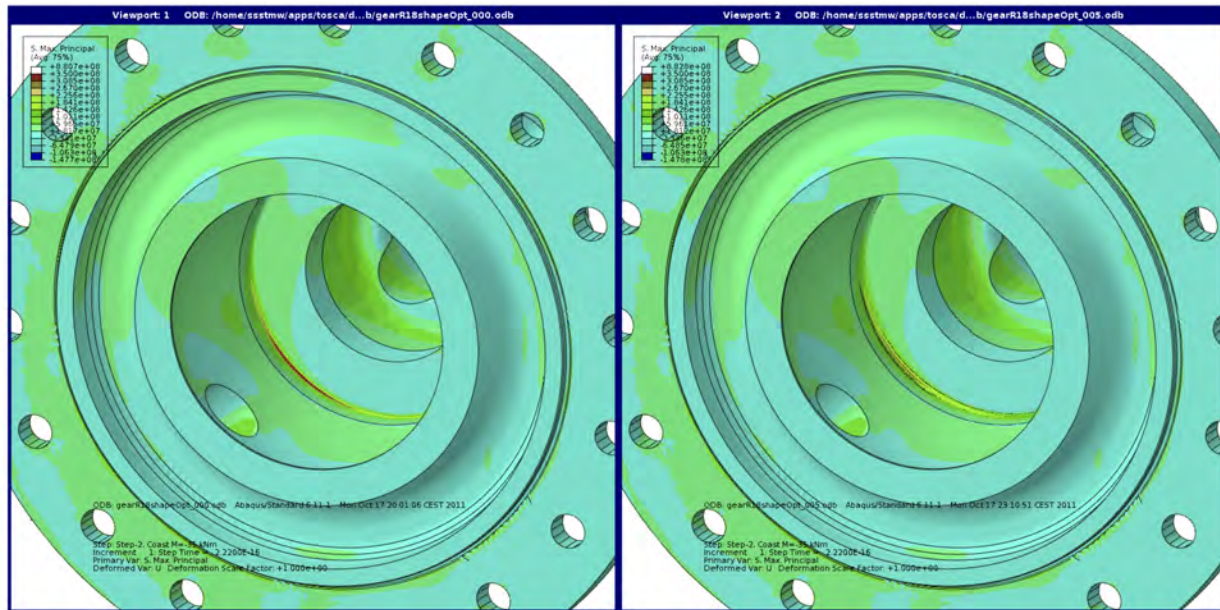


Illustration Scania

Bracket - Initial design

Bracket design after topology optimization

Bracket design after shape optimization



Rear axle: Initial design

Rear axle: Optimal design

models and knowledge base enables the engineers to exploit the full potential of optimization because they can employ all the advanced simulation capabilities of Abaqus—such as material and geometrical nonlinearity (useful when modeling large deformation and contact)—in their optimization runs. This gives them design flexibility without time-consuming parameterization. As a result, they frequently apply Tosca Structure in the Scania product development process.

“Tosca Structure fits seamlessly into our CAE-environment and is an important tool for our work with a simulation-driven product development process,” said Mikael Thellner, Technical Manager, Scania.

Tosca Structure optimizes a cast iron bracket: material savings and manufacture-oriented design with stress limits fulfilled

The objective of a recent bracket design optimization project at Scania was to reduce the mass of the initial cast iron design using Tosca Structure software.

First the design domain was defined. Functional areas and joint spaces to connecting areas were determined to be “frozen.” Three load cases and a limit on maximum stress were considered. Stiffness requirements for each load case helped ensure that material was eliminated in the “right” places.

To build a manufacture-oriented design, the minimum required member size was ensured during optimization and possible

undercuts were avoided. As a consequence, the optimal design was also feasible for an efficient production process.

Following the topology optimization, a shape optimization was carried out, and the new bracket design generated 30% in material savings while fulfilling the required stress limits. The weight reduction of components contributed significantly to a reduced weight of the vehicle itself. This benefited in an increased load-carrying capacity, or a lower fuel consumption, and fewer CO₂ emissions.

Shape optimization: a rear axle challenge

Another example of successful optimization at Scania using Tosca Structure was a rear axle application. This time an optimization analysis was considered in a later phase of product development. Improvements in terms of durability were required to pass physical testing and only small changes were allowed to be made in the design of the component/part. A shape optimization approach was chosen to investigate possible stress reductions without any major design change. The main objective of the analysis was to minimize von Mises stresses while considering the turning constraint.

Following the optimization task, the new design of the rear axle showed a significant stress reduction of 26%. Transferred into damage values, this resulted in a 233% increase in fatigue life. Tosca Structure delivered a final result that fit into the overall product strategy and generated considerable time savings in comparison to a trial-and-error approach with conservative test runs.



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