CASE STUDY

DRIVING A SUSTAINABLE RAIL CARGO SOLUTION

SIMULATION HELPS TRANSANT MEET WEIGHT AND WELD CERTIFICATION REQUIREMENTS

Background Information

While rail is the most environmentally friendly means of transport, freight trains today do not look much different from those in the last century. To reach the climate and energy targets of the European Union (EU) while achieving higher payloads and a better return on investment in a highly competitive logistics industry, the railway sector needs an innovation boost to build more efficient and sustainable rail freight wagons.

About the Customer

TransAnt GmbH, a joint venture with ÖBB Rail Cargo Group and voestalpine Steel Division, was established to bring more efficient and sustainable rail freight solutions to the market. With its innovative concept based on modularity and lightweight design, once operational the company seeks to revolutionize the market as a full supplier of freight wagons, creating new capacities in the market and helping customers to efficiently use the limited infrastructure that exists today. Currently, the company is planning the production facility in detail, and the wagon platform is optimized for serial production.

Their Challenge

Rail requirements are very demanding. Both design and construction of rail freight platform wagons must be feasible and long-lasting, as the vehicles are expected to operate for 30 years and under harsh conditions. Additionally, companies in the rolling stock industry are subject to strict regulations, codes, and norms such as FKM and Eurocode-3 that address standards specific to welding, making weld quality and certification a major task.

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20% ▼
WEIGHT REDUCTION

UP TO
4 TONS
PAYLOAD ADVANTAGE

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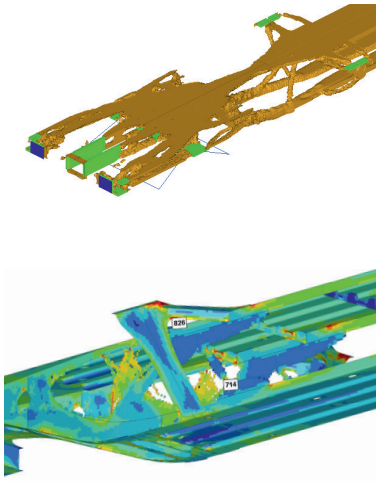
The TransANT project started in 2019 as a cooperation of ÖBB Rail Cargo Group, voestalpine Steel Division and the systems solution provider PJM, with the aim of building the TransANT as a lightweight and flexible wagon using high-strength light-weight steel. The core idea of this concept is the modularity of the wagon, consisting of a platform and a superstructure. The platform is also built from a modular kit where two standardized headpieces can be combined with a central beam to achieve different wagon lengths. Modularity is key for a lean, highly-automated production to standardize as much as possible to lower manufacturing costs and ensure serial production.



To handle fatigue assessment and pass the necessary tests for norm-based weld certifications, the TransANT needed an innovative concept design to optimize their weld structures. The challenge was to minimize the weight of the wagon while achieving a durable, in this case a welded, structure with laser cut steel parts, with limited deformations under loading. While the design goal was to develop an innovative freight wagon that met various complex requirements including optimum weight and maximum safety, the team also had to keep the manufacturing process as simple as possible to allow for serial production.

TOP: Topology-optimized result based on previous definition of space and all relevant loading scenarios **MIDDLE:** Detailed structure optimization to realize welded structure from laser cut high strength steel parts **BOTTOM:** Optimizing the thickness of steel panels

Our Solution

The design process of the TransANT wagon, a welded construction, started with a concept study defining the basic design and opting for a central beam-based construction. After that, the head piece, which is the basis for many length variations, was designed. The first step was to define all relevant scenarios for the topology optimization to ensure all loads are considered in the optimization process, and to enable the final structure to withstand these loads. A design space defining the maximum size of the wagon was loaded with all relevant loads and the optimization was performed with different constraints. Depending on these constraints and the settings of the optimization a variety of different solutions were found. Subsequently, the design of the wagon consoles was analyzed and resulted in a consistent modular system. The project engineers used Altair® HyperWorks® for topology optimization – in particular Altair® HyperMesh® – to realize the transition to a weldable structure, Altair® HyperView® for pre- and post-processing, and Altair® OptiStruct® for finite element (FE) analysis (including local buckling) and optimization.

After some iterations with finite element modeling (FEM) simulation, the final structure was used in a finite element model for the strength and fatigue assessments that were required for the verification procedure of the wagon (norm-based weld certification). Finally, the computer-aided design (CAD) model derived from the final finite element shell model could then be used to produce the prototypes.

Results

The innovative design of the TransANT took full advantage of topology optimization, reducing the weight of the wagon platform by up to 20% while providing maximum safety and flexibility. Combining the modularity of the flexible wagon concept with Altair topology optimization for sheet metal weld structures, the TransANT is now ready for a lean, highly-automated production while also ensuring flexibility to adapt to customer specific needs. Altair solutions significantly contributed to the TransANT passing the required weld certification.

"Thanks to Altair solutions, we were able to solve typical issues in the weld verification process relevant for the approval process while making our series design lightweight and more efficient to manufacture," said Andreas Tomschi, Development Engineer for the TransANT.

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