TGM Helps Customers Go Faster to Market with Topology Optimization

TGM Lightweight Solutions is an engineering services company with a focus on lightweight design and strategic weight optimization for aircraft, rail cars, road vehicles, and marine vessels. In a recent project, TGM had to reduce the weight of a car shell structure and used Altair HyperWorks™ for topology optimization to reach the target weight. TGM does not design the new part in detail but is providing suggestions in the form of design proposals and visualizations of ideas. Based on these concept designs, the customer can then choose to move forward in the development and design of the part. The biggest challenge TGM faces is convincing their customer to make the required changes. This is sometimes resisted by the engineers and designers who already invested time and effort into the original project.

Their Challenge

In development projects, TGM is either involved from the start or is called to "put out a fire" when the targeted weight is already exceeded. In either case, TGM pursues a holistic approach which includes lightweight system design and function integration, aiming to gain an understanding of the vehicle's architecture, and identifying areas and parts where weight can be reduced. To support the ideas it presented to customers, TGM uses HyperWorks for structural analysis. OptiStruct helps TGM to make suggestions on a calculated and factual level, to convince designers or management of the solution. Usually, TGM receives CAD models from customers to further develop and study first drafts for optimization. TGM relies on tools from HyperWorks including Altair Optistruct™ for finite-element analysis (FEA) and optimization, Altair HyperMesh™ for mesh creation, and Altair HyperView™ for post-processing.

TGM follows an approach in order from system, to structure, to innovative material, ending with lightweighting. Advanced manufacturing methods like 3D printing paired with topology optimization, play an important role in the process. Topology optimization helps implement an optimal lightweight design strategy in early project phases. This method reveals optimized load paths depending on the specified mechanical boundary conditions.

Industry
Engineering Services

Challenge
Weight reduction of a railway container

Altair Solution
Topology Optimization helps to identify weight saving potentials

Benefits
- 20% weight reduction and material savings
- Met tight development schedules
- Cost savings

TGM's goal is to reach maximum usage of the optimized structures and to remove unnecessary material. This allows for the development of structures which align with the required boundary conditions while being as light as possible. To be cost effective, this process must yield results quickly.

In a recent railway project, TGM had to optimize the structure of an equipment container. These containers are placed on the vehicle roof or the underfloor area of the car shell. This is where air conditioning systems or electrical components are installed. The project focused on finding out whether the thrust field construction method known from lightweight design methods would lead to the desired weight reduction. A main challenge was to design the required node structures in the corners of the container. This was difficult because there are special stiffness corridors that are required for the thrust field in some directions, while in other directions they must be compliant.

Our Solution

Using topology optimization, TGM was able to quickly increase material efficiency and optimize the wall thicknesses, which resulted in an optimal solution that activates the thrust fields and does not weaken other areas. By downsizing beams without having to attach another material, the experts for lightweight challenges could quickly identify a high weight-saving potential. Ultimately, TGM achieved a weight reduction of 20 percent, which added up to savings of 600 kg for an entire vehicle.

"While the designers also know how to gain excellent results, it would take them significantly longer to get there. We provide the speed that is necessary to make these projects successful, and topology optimization helps us in doing so," said Julius Winkler, TGM, Lightweight Design Engineer. "Simulation helps us to provide a design proposal, to determine load paths, and to discover which structure in the model offers weight saving potential and requires optimization. For us, such results are worth their weight in gold, simply because the probability of implementation is significantly higher in the end. Overall, the customer sees that it is not an imaginary proposal, but that there are calculation results supporting this proposal."

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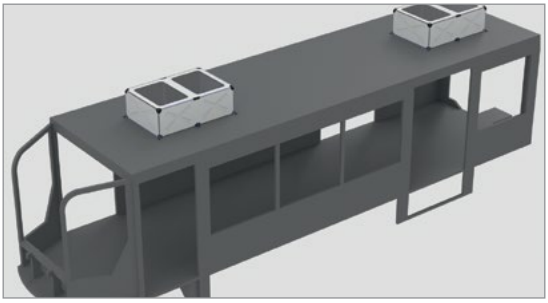
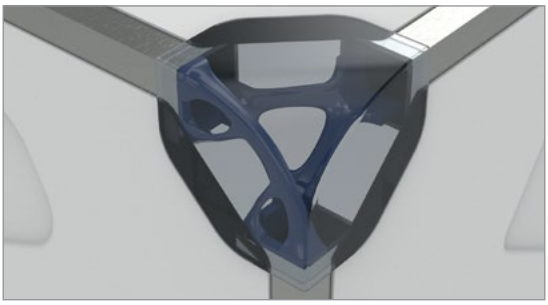
Results

Before TGM used HyperWorks, its consulting was based on the team's experience, expertise, and comparisons with previous projects. Using OptiStruct, TGM took a large step forward providing significant quality improvement of its consulting services. Thanks to FEA calculation, TGM now supports its proposals and concepts for weight reduction with meaningful research, and provides verification and validation under tight deadlines. "Altair HyperWorks has become an important factor and a valuable support for our business," said Wolfgang Hirsch, TGM Lightweight Solutions GmbH, Head of Sales.

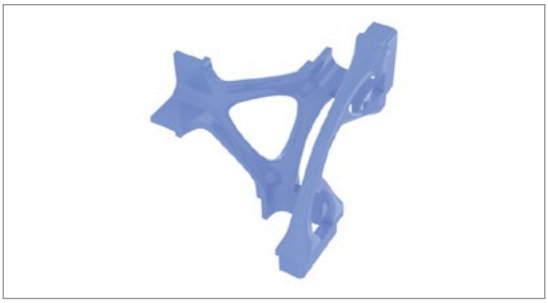
"The deep understanding of a structure and the results we gain from HyperWorks provide a strong foundation for our consulting services. It helps us to find affordable solutions fast." In addition to increasing speed, through optimization TGM offers an increased maturity level of products leading to customer acceptance. While topology optimization and structural analysis with HyperWorks will continue to play an important role, TGM sees great potential in Altair Inspire™. As an easy-to-use environment, it will allow design engineers to rapidly explore and assess designs without the need for expert simulation knowledge.



Using topology optimization, TGM reduced the weight of an equipment container by 20 percent.



Node structures in the corners of the container



Simulation helped TMG to increase material efficiency and to quickly provide design proposals.

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