



TO THE TOP WITH ALTAIR INSPIRE™

TOPOLOGY OPTIMIZATION IMPROVES GONDOLA LIFT STATION BUILDING

Background Information

In modern passenger transport systems, a flawless operation, comfort, and safety are key engineering criteria for design. To guarantee these key performance indicators, demanding fatigue tests are performed to ensure a component's performance and strength.

Today, advanced simulation methods can help to achieve an optimal design and ensure that components meet even the highest safety requirements. Doppelmayr, a manufacturer of ropeways and innovative transportation systems for ski areas and urban areas, used Altair solutions to analyze and redesign a structural component.

Using Altair Inspire, Doppelmayr built a design that passed the safety test, and optimized the gondola station to be lighter, safer, and more durable than requested. This case study demonstrates how Altair solutions and support enabled Doppelmayr to develop with confidence.

About the Customer

Doppelmayr/Garaventa Group is an international manufacturer of ropeways and innovative transportation systems for ski areas, urban transport, amusement parks, and material handling systems. Doppelmayr was founded 1893. By merging with the Swiss Garaventa AG in 2002, the Doppelmayr/Garaventa Group is now the world's leading ropeway manufacturer. As of 2020, the group has realized more than 15,100 installations in 96 countries worldwide.

3,5m ▼

LESS WELDING SEAM
PER COMPONENT

FATIGUE-LIFE
INCREASED BY FACTOR

4 ▲

Since 2017, it has used Altair solutions like Inspire for the topology optimization of its design parts to reduce material usage, product weight, and to increase durability. More recently, Doppelmayr started using Altair SimSolid™ to explore its designs and create structural efficient concepts for large models and complex assemblies.

Their Challenge

The Doppelmayr engineers had the task of optimizing a bracket of a Doppelmayr lift station building. Since the seam weld of this bracket had failed a critical fatigue test, it was necessary to improve the design of the component for increased strength and fatigue-life of the connection.

The main challenge for the new design was to pass the critical fatigue test. This procedure tests the bracket, by considering the maximum forces which can occur during ropeway operation, while measuring defined parameters like vibration and material strain. To meet the high-safety standards of the gondola transport system, the construction has to withstand 100 Mio load cycles, Doppelmayr engineers had to find a solution that would enable them to realize high-precision components while considering material usage, manufacturing constraints, and time and budget constraints.

From previous successful projects, the team had already gained a lot of experience with Altair solutions. With Inspire and the expertise of Altair engineers, the Doppelmayr team was confident they would achieve a weight-reduced bracket with increased lifetime and endurance to pass the critical vibration test.

Our Solution

Using the test parameters, Doppelmayr engineers were able to create a full-scale simulation scenario. In the first step of the optimization process, the engineers specified the requirements of the new bracket design and generated the CAD model. As the initial tests revealed overstressing in one part, the aim was to redesign for a better stress distribution and relocate the stress concentration outside the weld seams.

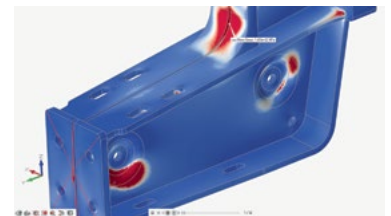
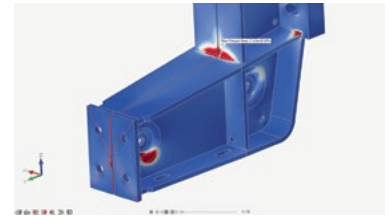
The original CAD data was then imported to Inspire and the team defined both the external and internal clearance, design space, and manufacturing method. After two iterations in Inspire, the engineers were able to find the optimal design. The final design solution was a welded insert with a flame-cut profile and weld preparations. This ensured that the stress remained outside the weld seams, creating a better stress distribution and an increased lifetime.

Altair enabled the Doppelmayr engineers to develop a multi-step process, accurately predict the critical area of the first design that had failed the test, and find the proper design modifications. Thanks to Inspire, Doppelmayr was able to generate an optimal design in a reasonable amount of time that met performance targets and was lighter than the original.

Results

Thanks to optimization using Inspire, the engineers were able to increase the lifetime of the seam weld while reducing the length of each component's weld seam by 3.5 meters. As a result, the component passed the vibration test and the component's fatigue-life was increased by factor 4 – from fatigue limit design to fatigue cut-off limit. In addition to meeting the safety targets, Doppelmayr also reduced manufacturing time and costs by approximately 10% for the new design. Long-term results also include reduced maintenance costs due to the increased lifetime of the bracket.

“Thanks to working with Altair, we are now able to accurately match our components to stringent quality and safety requirements,” said Philipp Schneider, head of structural calculation department of Doppelmayr. “The experience we have gained by working with Altair's engineers will help us to continuously provide our customers with safe and comfortable transport solutions.”



TOP: Doppelmayr was able to create an optimal design of a lift station building bracket using Altair Inspire.

MIDDLE: The design with the overloaded area at the weld seams.

BOTTOM: The optimized design with welded inserts using Inspire.