CASE STUDY

CERTIFIED PANORAMA THANKS TO SIMULATION

CUTTING COSTS AND DESIGN TIMES FOR LARGE-SCALE, COMPLEX LIGHTWEIGHT STRUCTURES

Background Information

When planning offices and foyers to showcase the hallmark values of their customers, many architects benefit from the open and inviting atmosphere of glass structures. Faraone, designer and manufacturer of such lightweight structures, used Altair solutions to analyze and redesign support structures for large-scale glass elements, which are the core business of the company. The results are topologically optimized and stiffer aluminum channels that can host the structural glass element. With cost reduction, shorter development times, and design efficiency, this use case from Faraone demonstrates the benefits of simulation technologies in accelerating product development.

About the Customer

Located in Tortoreto, Italy, Faraone is a manufacturer of high-end lightweight structures and glass systems offering half a century of experience and innovation in the world of transparent architecture. Specialized in developing and manufacturing glass staircases, facades, or canopies, Faraone has a proven track record of realizing tailored architecture. As Italy's market leader for glass balustrades, Faraone was one of the first companies in Italy to adopt the point-fixed glass system that allows architectural glass to be drilled and directly fixed on its bearing structure using mechanical connections and support structures.

18% ▼
WEIGHT REDUCTION

5% ▲
INCREASED STIFFNESS

40% ▼
TIME SAVINGS

Their Challenge

In the development of a new model of Faraone's best-known product NINFA, the engineering team had to start from zero. NINFA is an aluminum profile with a U-shaped channel that clamps on the structural glass panel. The system is fully adjustable for a lateral installation and allows for a frameless glass balustrade that offers superior view of the panorama.

The main challenge was to reduce the weight of the NINFA model, NINFA125, using topology optimization while at the same time ensuring the necessary safety measures by optimizing the load distribution. NINFA125 model is able to hold a glass thickness of 17.52mm and 21.52mm. NINFA125 measures 85 x 125mm. To solve the engineering challenges in the design of these architectural components, which have to meet several safety requirements and standards, Faraone used the most advanced simulation technologies.

Our Solution

For NINFA125 the team set up an integrated workflow starting with concept design and optimization in Altair Inspire™. The engineers first defined the available design space with Inspire by creating a simple U-section. This enabled them to run a topology optimization on the shape of the aluminum profile, with emphasis on weight reduction and stiffness improvement. Constraints included free spaces for the glass panel and glass fasteners, as well as for floor mounting.

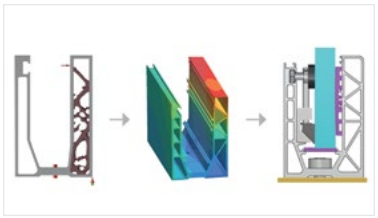
With these optimization results, Altair SimSolid™ was employed for fast and accurate validation in a second step. The geometry and refinement of the profile were analyzed and the results of the initial analysis were used as input for a stress analysis of the optimized profile. After implementing and re-analyzing the results, the team found the optimal stress distribution while preserving the integrity of the glass panel. Faraone was then able to transfer the 3-dimensional computer-aided design (CAD) model directly into SimSolid without having to simplify the geometry for the subsequent nonlinear analysis.

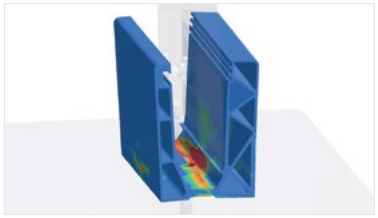
The deflection analysis of the profile resulted in a maximum displacement of 3.2mm under serviceability loading, which corresponded to the allowable displacement of 3.5mm. Lastly, the final prototype was converted into high-fidelity finite element method (FEM) models for a final validation analysis regarding stress, displacement, reaction forces and buckling.

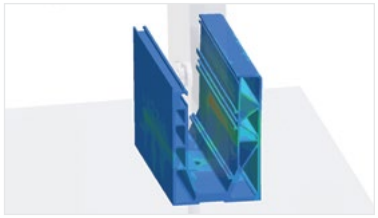
Results

Thanks to an integrated workflow that includes topology optimization and nonlinear simulation, NINFA125 is now by up to 18% lighter than previous aluminum profiles while increasing stiffness by 5%. In addition, SimSolid enabled Faraone to reduce the time needed for studying and redefining the design of complex glass structures to less than 30 minutes.

"The adoption of Inspire and SimSolid in our workflow has been transformational. We could reduce the entire design cycle of 40% and realize three validation analyses in less than 90 minutes, allowing us to design lighter and safer support structures," said Gabriele Romagnoli, head of structural engineering at Faraone. "Thanks to Altair's solutions, we could quickly find the optimal design layout for our NINFA models with Inspire and then verify the rationalized geometry with SimSolid. In addition, we can leverage SimSolid for the nonlinear analyses for our complex structural assembly of more than 1000 parts."







TOP: Optimization results, interpretation of the results and validation analysis. **MIDDLE:** First validation analysis; Subsequent to the optimization, NINFA125 V1 was validated using Altair SimSolid **BOTTOM:** Third validation analysis; The redesigned final version of NINFA125 profile was again validated using SimSolid, providing fast and accurate results.