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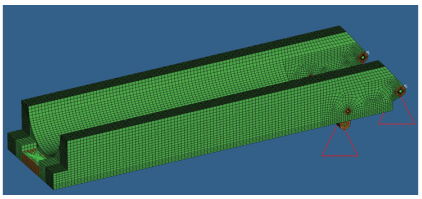
Design and Optimization of a Launch Vehicle Transporter/Erector/Launcher

Case Study

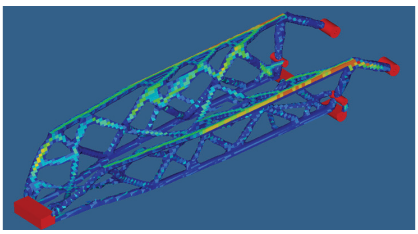
OVERVIEW

Antares is a two-stage vehicle that provides low Earth orbit launch capability for payloads weighing over 5,000 kg. ATA Engineering and its engineering and manufacturing partner Martinez & Turek were selected to design, engineer, manufacture, install, and test the highly optimized Transporter/Erector/Launcher (TEL) system for the Antares. Among other critical operational functions, the TEL serves as an assembly and integration platform for the Antares rocket. Once the rocket is assembled, the TEL is placed on heavy load transporters and serves as the transport vehicle to the launch site. Upon arrival, the TEL becomes the platform used to erect the Antares rocket, place it on the launch mount, secure it in position until fueled, and finally disconnect and pull away when it is launched. ATA provided design and analysis support for the entire system.

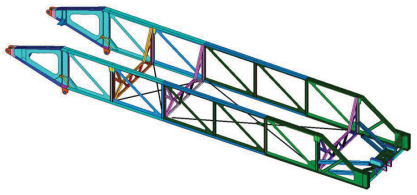
The process used to optimize the design of the structural backbone of the TEL, known as the strongback, is an example of ATA's analysis-driven design methodology: topological optimization was used to rapidly explore various concepts for the strongback, achieving the stiffest, lightest structure by using the full chordal height available in the design space along the structure's entire length. A trade study was then performed on the resulting truss system and an ANSYS parametric design study was undertaken for global geometric design variables and to fully optimize design details such as plate thicknesses, web and flange widths, and tapering. Multiple configurations of the system were simulated under various loading conditions, resulting in significant weight savings and a substantial decrease in material cost for the strongback and its associated lifting equipment.



Meshed design space of strongback



Topological optimization results



Final truss design