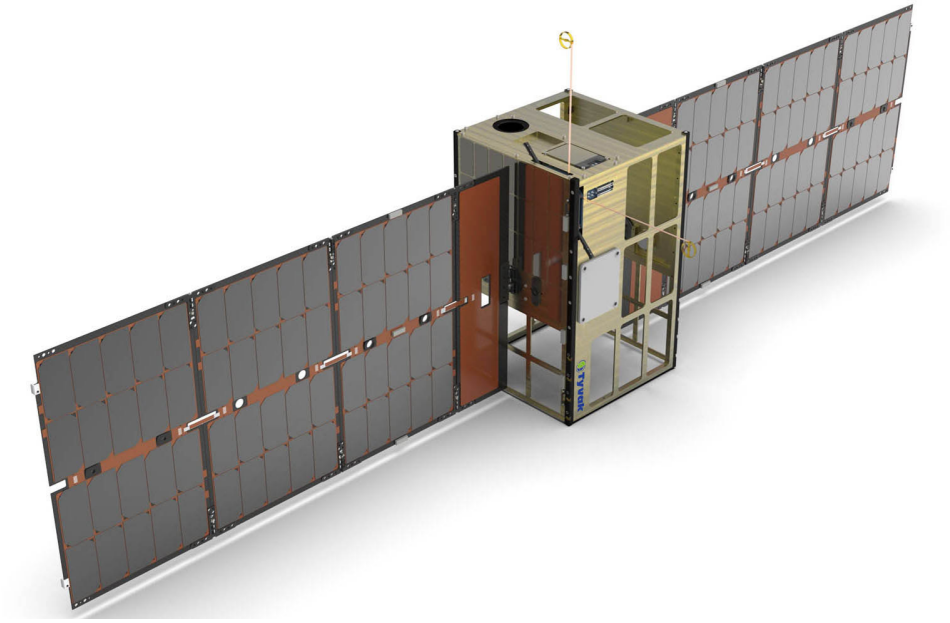
HEXAGON | MSC Software

Case study

Tyvak Nano-Satellite Systems, Inc.

Tyvak engineers use MSC Apex to reduce satellite mass by 5 to 10 percent



Tyvak considered and evaluated MSC Apex because of its "smart" nature, ease of use, and seamless compatibility with MSC Nastran. When utilizing MSC Apex for pre-/post-processing an FE model, engineers conveniently achieved first-run-success in simulations.

Tyvak Nano-Satellite Systems, Inc., a Terran Orbital corporation, specializes in spacecraft development, launch services, and on-orbit operations to deliver nanosatellites and microsatellites for critical civil, defense, and commercial missions across a variety of mission applications in LEO, GEO, and beyond Earth orbit. Since the Company was founded, Tyvak has developed numerous nanosatellites and microsatellites. The Terran Orbital brand has enabled more than 75 end-to-end missions and launched more than 215 small satellites worldwide.

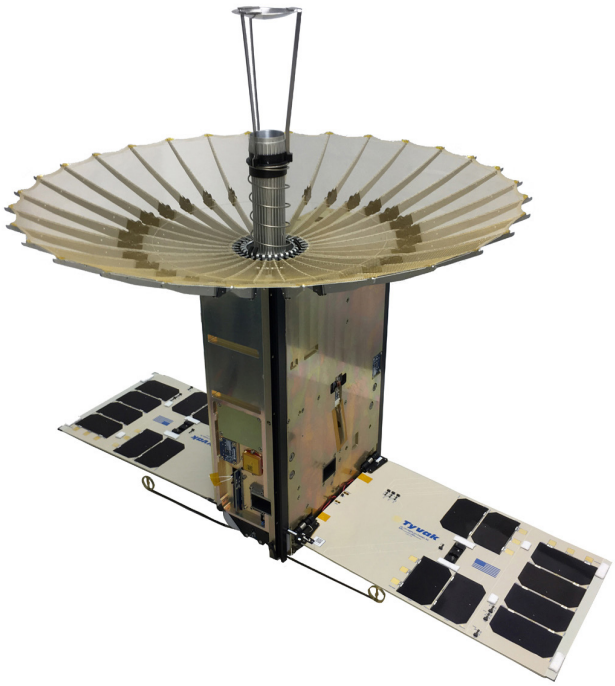


Figure 1. The RainCube flight system with the solar panels and radar antenna deployed.

Challenge

Designing and manufacturing nanosatellites is an elaborate and complex process. Launch costs are a large motivator for Tyvak customers. With the design mass being critical to the cost of launch, Tyvak engineers work diligently to minimize the mass of their satellites. At a technical level, it is essential to ensure satellite structures perform reliably across numerous launch scenarios and environments. In order to achieve this, Tyvak utilized virtual prototyping to enable their research and development. However, to deliver a reduced mass satellite, Tyvak recognized more design variations should be investigated within the same amount of time. Therefore, Tyvak was interested in new productivity CAE tools to construct their finite element (FE) models.

Tyvak aimed to reduce the design cycle, which is typically a time-consuming process. The process begins with existing design geometry and generally involves simplifying the geometry, removing unnecessary features, and creating a high-quality mesh. Verifying the performance of the new design relies on material assignment, application of constraints and loads, and ultimately solving. During this workflow, the majority of the time is spent on simplifying the CAD geometry and creating a mesh that will deliver accurate simulation results. Existing tools and methods at Tyvak required extensive utilization to construct run-ready finite element models. There was a desire to expedite the process and allow more design iterations to be performed while minimizing mass in the same timeframe.

Another requirement in the CAE tool selection process was compatibility with existing simulation tools. During the life of the structure, the satellite and its deployer systems are subjected to multiple loading scenarios during the process of transit, launch, deployment, and on-orbit operations. Tyvak engineers leveraged MSC Nastran, the most trusted finite element solver, to help them investigate structural response under hundreds (and sometimes thousands) of load cases. This includes analysis such as vibration and shock testing. Therefore, the Tyvak team had a requirement that any new CAE tool selected must be 100% compatible with MSC Nastran.

Tyvak considered and evaluated MSC Apex because of its “smart” nature, ease of use, and seamless compatibility with MSC Nastran. The goal was to expedite the virtual prototyping process by evaluating more design iterations in fewer working hours, and ultimately, to minimize the structural mass of satellite designs in an efficient and productive manner.

Solution

Tyvak engineers evaluated the use of MSC Apex in their existing CAE workflows to achieve these goals. The results of the evaluation showed great promise and motivated Tyvak to select MSC Apex for FE modeling and analysis.

One of the most beneficial capabilities of MSC Apex was the application’s geometry editing and meshing functionality. This enabled analysts to take existing design

geometry and construct FE models faster than traditional tools and methods. The meshing capabilities are especially useful when making changes to an existing FE model. For example, in root cause analysis, a failure may be observed during environmental testing. If this is the case, the source of failure must be identified and the FE model must be updated to avoid the failure. Simulations must also be performed to validate the issue has been resolved. Therefore, the ease at which geometry and mesh changes were performed determined the time spent to eliminate the structural failure through multiple design changes and simulation verifications.

Another positive characteristic of MSC Apex was the integrated analysis capabilities and its compatibility with MSC Nastran. Tyvak engineers were able to use MSC Apex to study stress and strain results after performing stress and deformation analysis on satellite and deployer systems. The MSC Apex analysis capabilities, coupled with the dynamic geometry and meshing updates functionality, enabled Tyvak engineers to make and evaluate design changes substantially more frequently within the same period. With the increased number of design iterations evaluated, analysts were also able to explore more design variations to further minimize the structural mass than previously possible. The compatibility with MSC Nastran also meant that MSC Apex can be seamlessly integrated into existing workflows and the productivity benefits are immediately recognized. When utilizing MSC Apex for pre-/post-processing an FE model, Tyvak engineers conveniently achieved first-run-success in MSC Nastran.

Tyvak also appreciated MSC Apex's stylish and user-friendly environment. As Amir Damansouz, Senior Structural Analyst at Tyvak, said, "The agile user interface environment of MSC Apex allows Tyvak to set up FE analysis trade studies in a short amount of time without the need for frequent prototyping."

> **"Tyvak optimizes component and system mass using geometry modification tools available in MSC Apex. Typically, a 5 to 10 percent mass reduction is achieved within a few rounds of iteration."**
>
> **Amir Damansouz,** Senior Structural Analyst, Tyvak Nano-Satellite Systems, Inc.

Key Highlights
Product: MSC Apex
Industry: Aerospace
Benefits:
Tyvak engineers use MSC Apex to reduce satellite mass by 5 to 10 percent with a few round of iterations.

Results

The use of MSC Apex produced significant productivity gains at Tyvak. Tyvak engineers have expedited the virtual product development to further minimize the mass of designs and can preclude failure earlier in the design process. As Damansouz stated, "Tyvak can optimize component and system mass using dynamic geometry modification tools available in MSC Apex. Typically, a 5 to 10 percent mass reduction is achieved within few rounds of iteration."

About Tyvak Nano-Satellite Systems, Inc., a Terran Orbital corporation

Founded in 2013 and headquartered in Irvine, California, Tyvak Nano-Satellite Systems, Inc. is an industry leader, delivering optimized, end-to-end small satellite solutions. Trusted by civil, defense and commercial organizations, the Company leverages expertise, low-cost operating infrastructure, and the limitless opportunities of satellite miniaturization to achieve timely and economical mission success. Through its global ground station network, Tyvak provides worldwide coverage for on-orbit operations around the clock. The Terran Orbital brand has enabled more than 75 end-to-end missions and launched more than 215 small satellites worldwide. For more information, please visit www.Tyvak.com or follow the Company @TyvakNanoSat

Hexagon is a global leader in sensor, software and autonomous solutions. We are putting data to work to boost efficiency, productivity, and quality across industrial, manufacturing, infrastructure, safety, and mobility applications.

Our technologies are shaping urban and production ecosystems to become increasingly connected and autonomous – ensuring a scalable, sustainable future.

MSC Software, part of Hexagon's Manufacturing Intelligence division, is one of the ten original software companies and a global leader in helping product manufacturers to advance their engineering methods with simulation software and services. Learn more at mscsoftware.com. Hexagon's Manufacturing Intelligence division provides solutions that utilise data from design and engineering, production and metrology to make manufacturing smarter.

Learn more about Hexagon (Nasdaq Stockholm: HEXA B) at hexagon.com and follow us @HexagonAB.