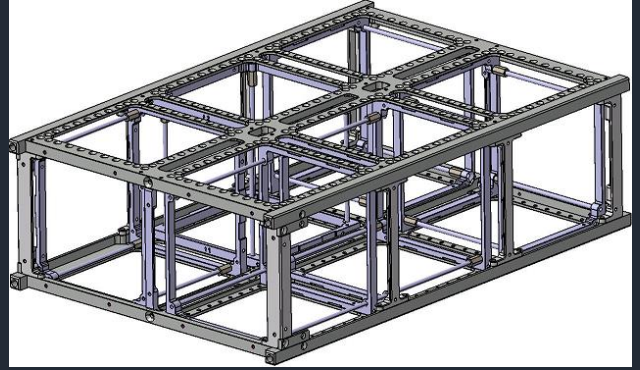
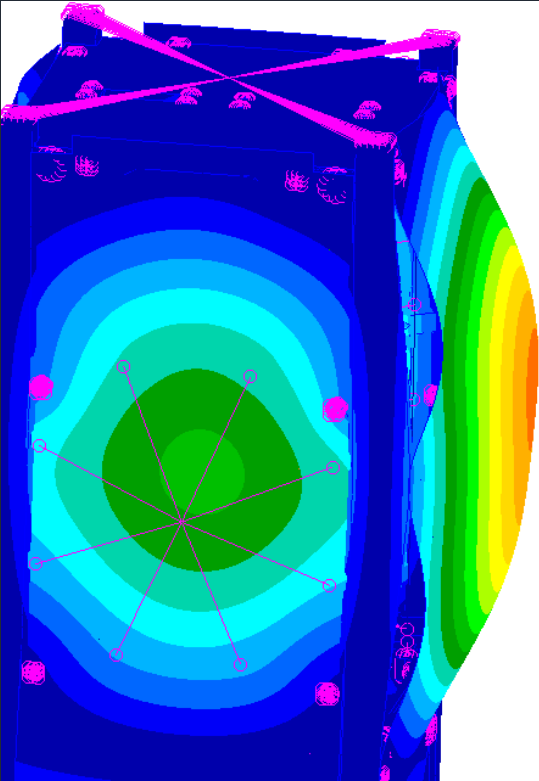
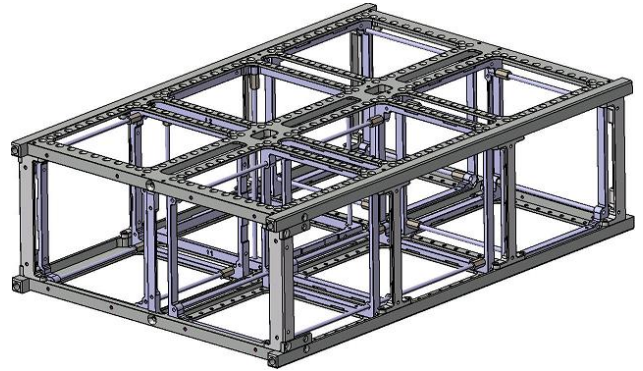


STM STRUCTURAL DESIGN AND ANALYSIS

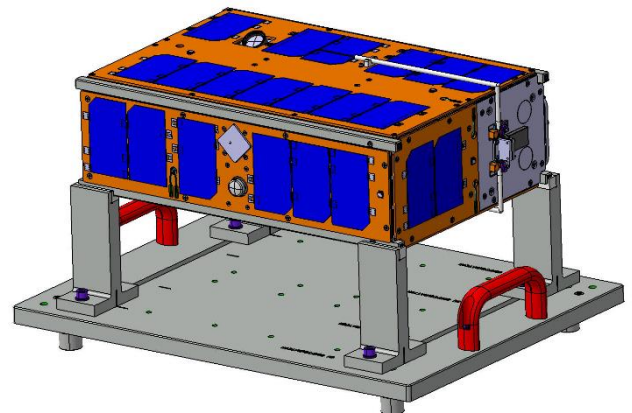
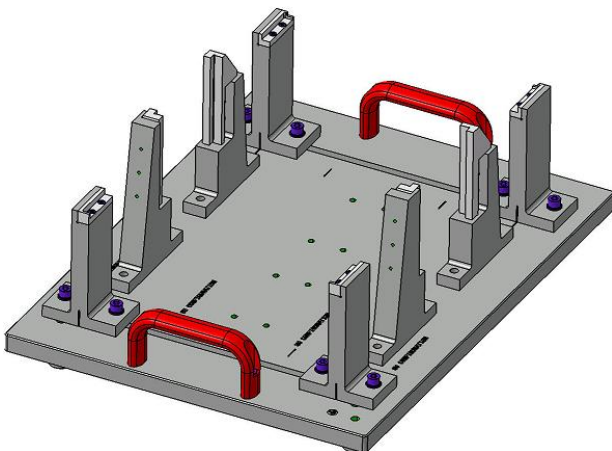
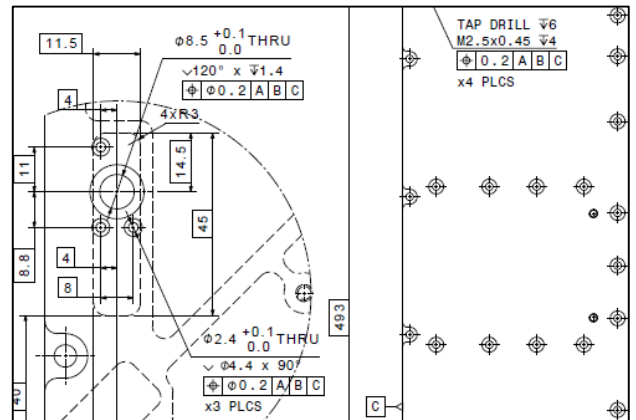


Structural Design

We create 3D models using parametric design and prepare technical drawings necessary for manufacturing and assembly, with the help of Computer Aided Design (CAD) software. We have standard and modular off the shelf mechanical designs for cubesats. Besides, we design custom structures at all sizes that are tailored to project's needs.



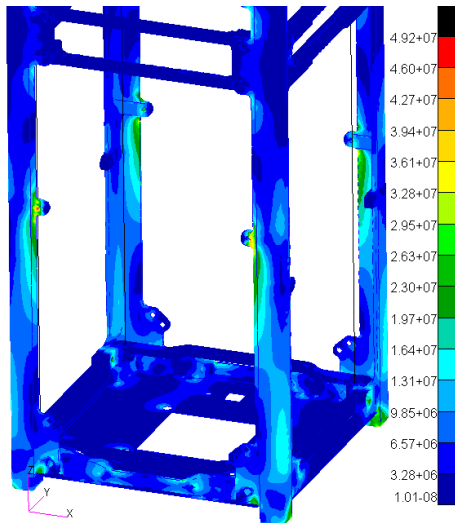
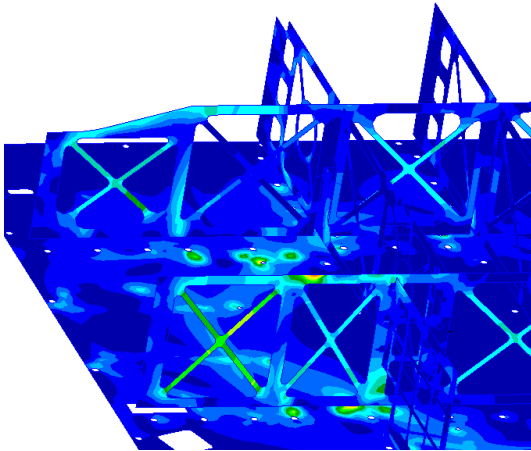
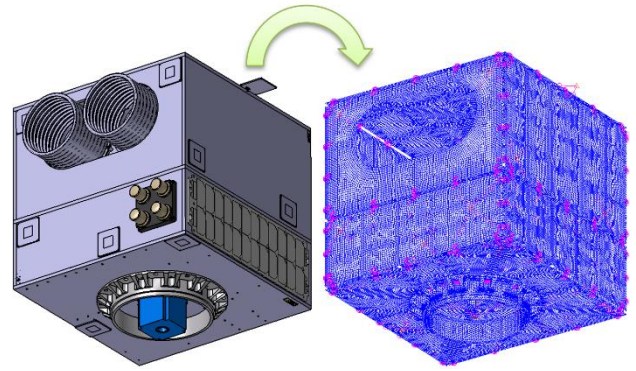
Materials and fasteners are selected aiming a lightweight structure. We also have experience on design of sandwich panels and inserts. Implementation of dimensional tolerancing ensures a proper manufacturing and a smooth assembly. We also design mechanical ground support equipment (MGSE) necessary for assembly and handling.



Structural Analysis

Finite Element Modelling

Finite element model (FEM) is created based on product's solid model (CAD). From fasteners to sandwich panels all structure is modelled using proper element types and isotropic, orthotropic and composite materials, to represent the mechanical behavior correctly. Control analyses are performed to show there are no modelling errors.



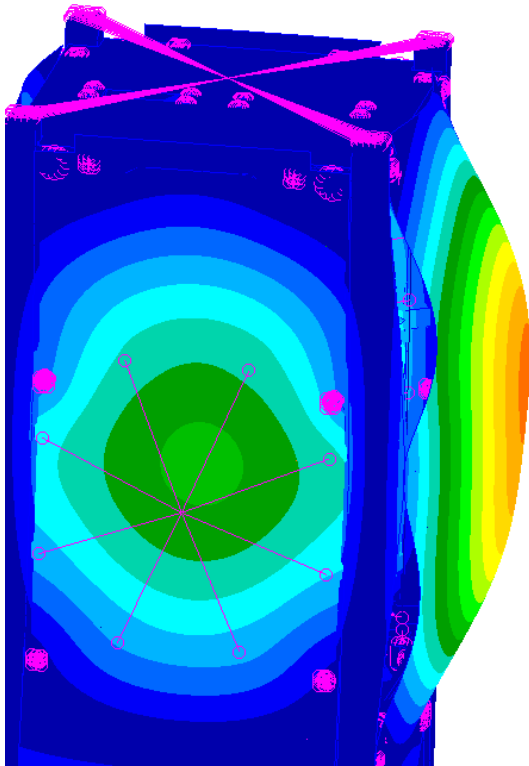
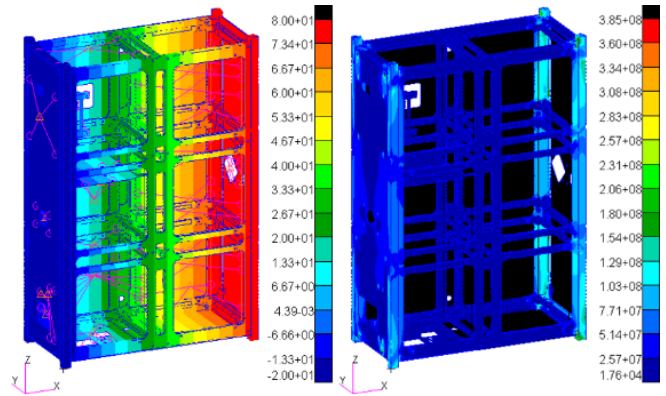
Static Analysis

Deformation, stress, strain, load flux, fastener loads, safety margins and failure indices for composites, which occur under constant force, moment and acceleration, are calculated by linear static analyses. Cases, which include one-way conditions like contact, are covered by nonlinear static analyses.

Structural Analysis

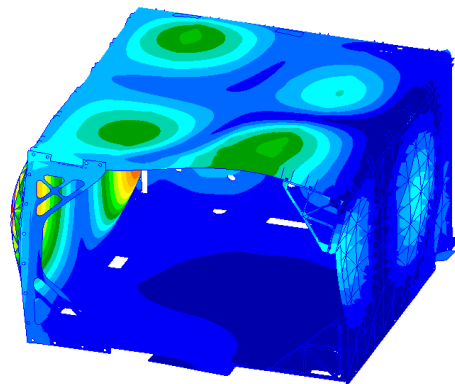
Thermoelastic Analysis

To estimate the mechanic behavior, which occurs as a result of temperature changes at the structure, thermoelastic analyses are performed. For different temperature loads, stresses, fastener loads, deformations and line of sight deviations for directional equipment, can be foreseen by thermoelastic analyses.



Modal Analysis

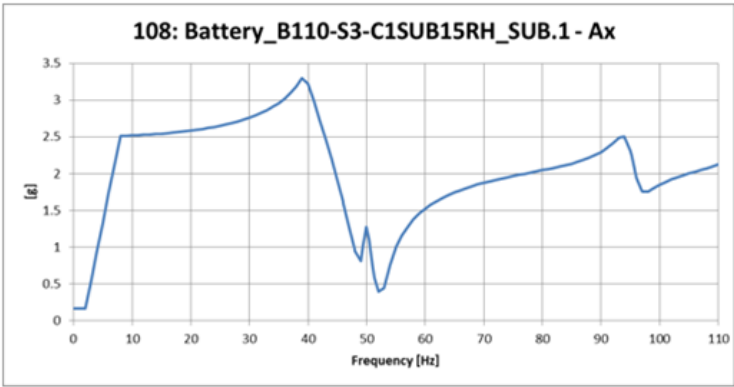
Modal analyses identify natural frequencies, which are one of the important indicators in many aspects of the design. Frequencies, modal shapes and effective masses of mechanical vibrations of the structure in the frequency range of interest, are calculated by modal analyses.



Structural Analysis

Dynamic Analysis

Dynamic analyses determine the response of the structure to sinusoidal and random vibration loads. By applying loads at the frequency range of interest, frequency responses at both structure and equipment levels are examined. In case of need, appropriate damper is selected and placed to have vibration isolation. Calculation of notched vibration profiles and micro vibration analyses are performed in scope of dynamic analyses.



| Equipment Name | Mass [Kg] | Data Unit | X excitation | | | | | |
|-------------------------|-----------|-----------|--------------|------|-------|------|-------|------|
| | | | X max | Freq | Y max | Freq | Z max | Freq |
| PROPULSION_UNIT.1 | 7.8 | [g] | 2.8 | 39.0 | 0.5 | 95.2 | 0.5 | 50.0 |
| FSS-Assy_SUB_wBRACKET.1 | 0.0 | [g] | 2.6 | 39.0 | 9.5 | 50.4 | 0.3 | 50.0 |
| S-BAND_ANTENNA.7 | 0.1 | [g] | 2.6 | 93.3 | 10.0 | 49.4 | 0.1 | 49.4 |
| S-BAND_ANTENNA.8 | 0.1 | [g] | 2.6 | 97.1 | 3.7 | 49.4 | 0.1 | 50.0 |
| X-Band Transmitter | 1.0 | [g] | 2.7 | 39.0 | 4.6 | 49.4 | 1.4 | 49.4 |
| OBC_ACC_SUB.1 | 0.9 | [g] | 2.9 | 39.0 | 7.3 | 49.4 | 1.7 | 50.0 |
| PCU_SUB_18.1 | 1.8 | [g] | 3.6 | 39.0 | 4.2 | 54.0 | 1.1 | 49.4 |
| Battery_SUB.1 | 3.0 | [g] | 3.3 | 39.0 | 4.7 | 50.0 | 1.5 | 50.0 |
| Battery_SUB.2 | 3.0 | [g] | 2.8 | 39.0 | 3.3 | 50.0 | 1.6 | 50.0 |
| Magnetometer.1 | 0.3 | [g] | 3.0 | 39.0 | 0.8 | 49.4 | 0.3 | 50.0 |

Design Optimization

Thanks to topology and sizing optimization with static and dynamic behavior objectives, including manufacturing constraints, mechanical requirements can be met by a more lightweight structure. Especially in cases that 3D manufacturing techniques will be involved, quite advantageous designs can be made.



Structural Tests

Based on results of structural analyses, planning of structural tests and instrumentation are done. In scope of structural test planning, mechanical and thermal tests to be performed, test sequence and load levels are defined. Components like accelerometer and strain gauge, which are selected regarding measurement level estimations, are placed. Tests are performed at the test facility according to the test planning document.

Following the tests, all measurement data is examined, results are assessed and reported. Design and analyses of test adapters, mechanical ground support equipment (MGSE) and hoisting parts, which will be necessary during the tests, are also done in scope of structural tests. Structural design team has expertise in static, vibration, acoustics, shock and thermal vacuum test types.



STM Savunma Teknolojileri Mühendislik ve Ticaret A.Ş.
Mustafa Kemal Mahallesi 2151.Cadde No:3/A 06530
Çankaya / Ankara / TÜRKİYE

t : 0 312 266 35 50 f : 0 312 266 35 51

www.stm.com.tr

© STM
All Rights Reserved