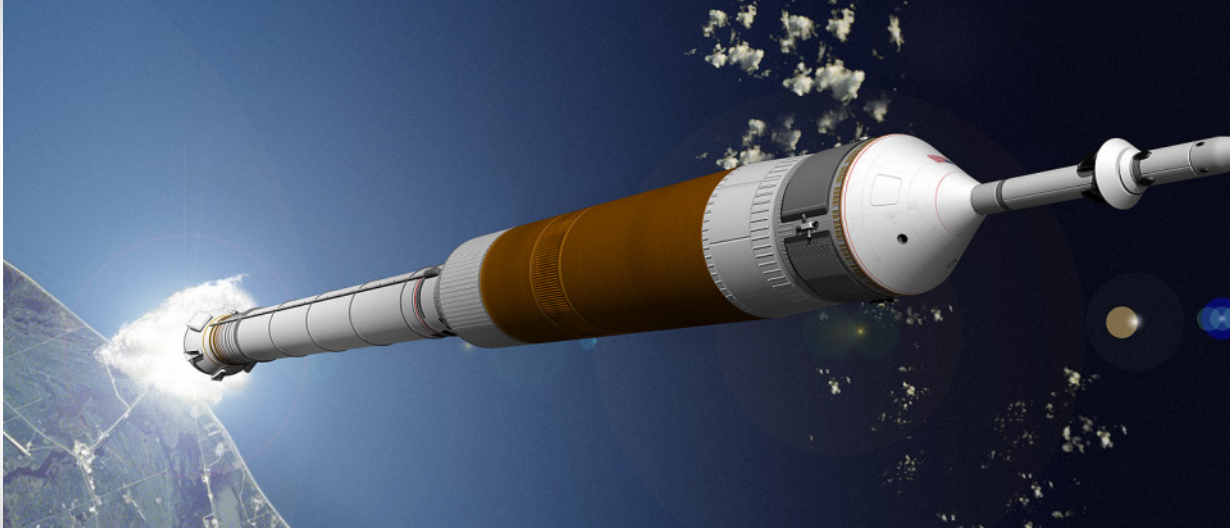
HyperSizer®

DESIGN | ANALYZE | OPTIMIZE



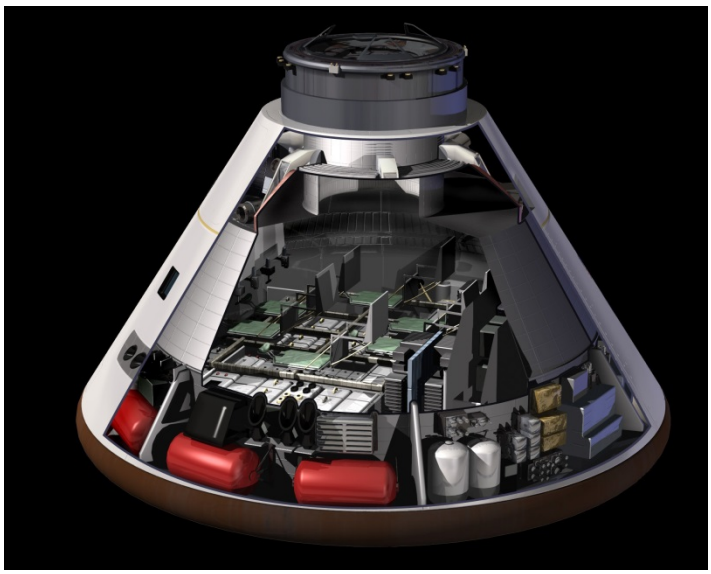
NASA Orion Alternative - Composite Crew Module

The Project

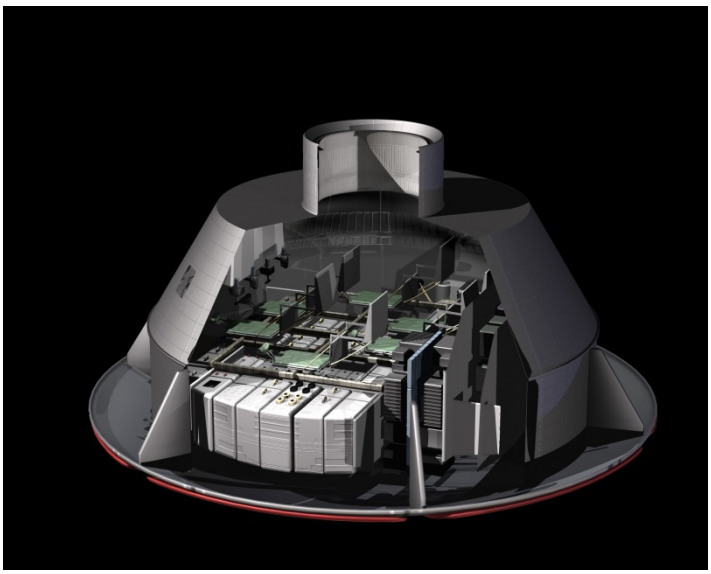
HyperSizer was an integral tool used by the NASA NESC Composite Crew Module (CCM) team, which was chartered to develop a Crew Module (CM) design tailored to composites. The team's mission was to characterize the design drivers such as geometry, mass, manufacturability, inspectability, repairability, damage tolerance, crashworthiness, micro-meteoroid and orbital debris, and radiation shielding. The CCM team constrained their scope to retain the reference design outer mold line, maintain the inner mold line within 1.5 inches of the reference design, and to maintain the interface points at the Launch Abort System and the Service Module. This was a parallel effort to the NASA and Lockheed Martin metallic crew module (CM) referred to as ***Orion*** (launched and interfaced with other hardware modules) shown below.

The composite crew module (CCM) was designed to the same loading environment as the metallic crew module. A primary intent by NASA was to gain experience designing, analyzing, and testing flight weight composite structures for potential future space missions.

The CCM team developed three concepts: geometrically stiffened laminate, stiffened sandwich (utilizing the aluminum-lithium aeroshell) and monocoque design. HyperSizer was used as a primary tool by NASA to design and analyze the composite variant of the metallic Orion crew module which houses the astronauts throughout the flight mission from launch to ocean splashdown.



The metallic crew module with the aeroshell and heatshield shown.

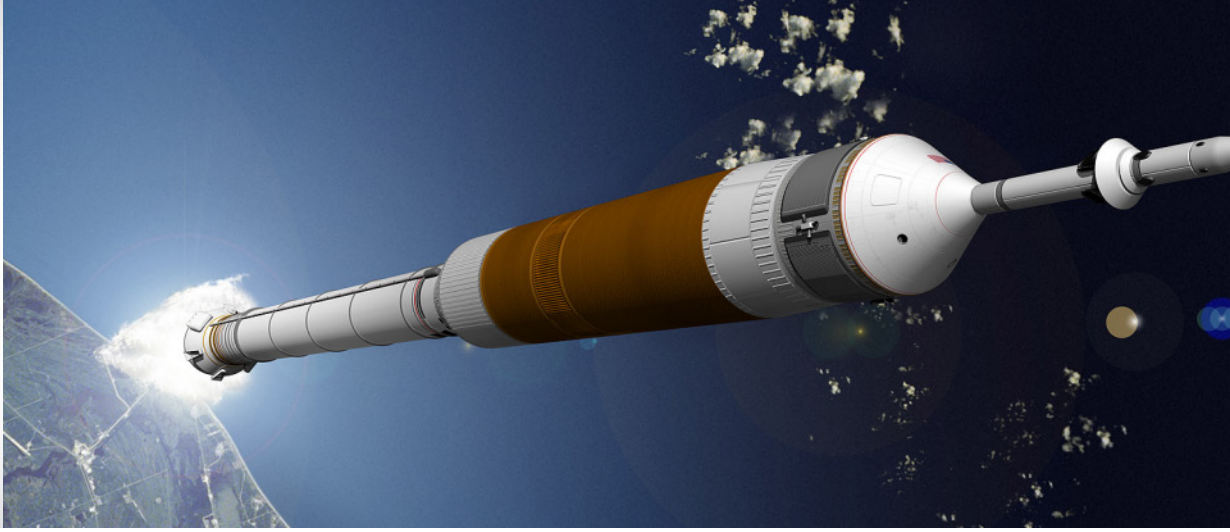


A cutaway view of the metallic pressure shell and heat shield carrier panel

www.HyperSizer.com
Phone:(757) 825-0000

HyperSizer®

DESIGN | ANALYZE | OPTIMIZE

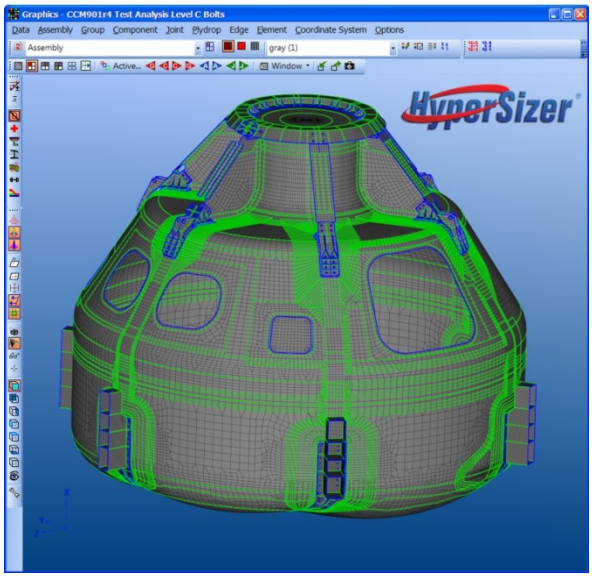


NASA Composite Crew Module

Optimization

HyperSizer was used by the NASA CCM team to perform **structural analysis and margins of safety predictions** for the testing of the Composite Crew Module. HyperSizer software was used throughout the three-year project to optimize the design, weight, and manufacturability of the CCM, which is constructed of honeycomb sandwich and solid laminate composites. **HyperSizer predictions matched all test measurements performed by NASA.**

"I've been working with composites for 25 years and the CCM is the most complicated structure I've ever dealt with,"* said Jim Jeans, chief architect for NASA on the project. *"The fact that it passed these tests with flying colors is a credit to HyperSizer, which we used in every phase of the project. The sizing and strain predictions all held up as the software predicted."



Full scale static testing of the NASA Composite Crew Module was performed at Langley Research Center. HyperSizer was used by the NASA team to perform structural analysis and margins of safety predictions.

***"Since the structure is designed to minimum margins in many areas, the ultimate test exercised the structure close to the minimum material properties and I assure you there was celebration amongst the team when we achieved that critical milestone!"* Mike Kirsch, NASA CCM Project Manager**

This was a milestone achievement for HyperSizer software, the NASA Composite Crew Module design team, and the nation's plans for future use of composites in space vehicles. The CCM constructed of honeycomb sandwich panels and solid laminates is weight optimized to over fifty loading scenarios. Three of these loadings were selected for test validation: internal pressurization, parachute pull, and abort launch system thrust force. In every load case tested, HyperSizer accurately predicted the structural response strain gage readings of the composite material under loading, and more importantly, achieved the required loading without structural failure.

HyperSizer

www.HyperSizer.com
Phone:(757) 825-0000