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BALLISTIC AND RADIATION SHIELDING CAPABILITIES OF FOAM-CORE SANDWICH PANELS WITH COMPOSITE AND ALUMINUM FACESHEETS

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ABSTRACT

Satellites are vulnerable to hazards such as micrometeoroid and orbital debris (MMOD) impact and space radiation. As a result, satellites must be designed to withstand these threats to carry out their functions during the course of their missions. Recent research by the University of Manitoba Orbital Debris Research (UM-ORDER) group has resulted in a better method to protect satellites from the impact of MMOD using foam-core sandwich panels (FCSP). In addition, the University of Manitoba's Composite Materials and Structures Research groups have developed a multifunctional hybrid composite radiation shield that is lighter than currently used Aluminum panels. The results of both investigations are merged in this work to create a single multifunctional sandwich panel with both MMOD and radiation protection capabilities. Two panel designs were evaluated: 1) an aluminum bumper placed at a distance from an open-cell aluminum foam panel with aluminum facesheets, and 2) an aluminum bumper placed at a distance from an open-cell aluminum foam panel with hybrid composite plates as facesheets. Both designs' ballistic and radiation performances were evaluated to create a radiation panel with outstanding ballistic capability. Morphologically accurate model of open-cell aluminum foam and relevant material models, developed and validated by ORDER group were used in AUTODYN to study the ballistic performance against hypervelocity impact (HVI) of 6-mm spherical projectile particles travelling at 7 km/s. Also, one-dimensional radiation analyses were performed on both panel designs using the Multi-Layered Shielding Simulation Analysis tool (MULASSIS), which is integrated into ESA's SPACE ENvironment Information System (SPENVIS). The use of open-cell aluminum foam provided ballistic protection (without perforation of the back facesheet), better than traditionally used honeycomb core. Ballistic performance of panel with composite face sheets is underway and results will be discussed during the conference. Furthermore, a preliminary radiation study for both systems demonstrated comparable radiation protection capacity. The comprehensive ballistic and radiation analysis results will be presented and discussed at this conference.