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CORE SHEAR STRESS MODEL OF CARBON FIBER REINFORCED PLASTICS WITH ALUMINUM HONEYCOMB CORES FOR SPACE AND SURFACE MINING APPLICATIONS

Abstract

Sandwich composites offer an optimum structure for space mining vehicles due to their relatively high strength and stiffness compared to their weight. With the space mining market expected to continue its growth in the future with water, gold, and platinum as just a few of the resources that could be accessible in the Moon or in near-Earth asteroids, it is essential to continuously optimize design methods in order to achieve this mining capability. Expanding the use of composite material systems into the space and surface mining industries requires design charts that fully define the material system using accurate models that determine shear stress in the core. Currently, analytical models used to predict the core shear stress of a sandwich panel subjected to flexural loading are insufficient. The purpose of this paper is to introduce a novel core shear stress model for sandwich panels consisting of a carbon-fiber/epoxy with an aluminum alloy 5052 honeycomb core. The core shear stress model developed here is based off results from a Design of Experiments where numerous finite element models were solved. Input variables for the Design of Experiments are core thickness, core density, number of plies per facesheet, and facesheet stacking sequence. The output variable is core shear stress. Finite element results are further validated by experimental analysis using Digital Image Correlation. The Core shear stress model developed here will allow design engineers to more accurately determine the core density that is required to support the shear stress of a sandwich panel consisting of carbon fiber reinforced facesheets with aluminum honeycomb cores subjected to a known flexural load. This type of optimization will help facilitate wider use of sandwich composites in the space and surface mining industries and will allow for a more cost-effective design that allows for core density optimization. All content is unique and has not been presented on any other forum.