Paper ID: 66872
student

IAF MATERIALS AND STRUCTURES SYMPOSIUM (C2)
Advancements in Materials Applications and Rapid Prototyping (5)

Author: Mr. Mateus Sant'Ana
University of Brasilia, Brazil, mateus.s.santana.1@gmail.com

Mr. Pedro Alves
University of Brasilia, Brazil, pedrohenriquedf11@gmail.com
Prof.Dr. Manuel Nascimento Dias Barcelos Júnior
Universidade de Brasília, Brazil, manuelbarcelos@unb.br
Mr. Tiago Santos
University of Brasilia, Brazil, tiagorsantos97@gmail.com

TOPOLOGICAL OPTIMIZATION OF HONEYCOMB SANDWICH PANELS MADE FROM PRINTED CORE AND LAMINATED FACES

Abstract

Honeycomb sandwich panel consists of two faces interspersed by a hexagonal core and an adhesive material that joins the parts together. The hexagonal geometry of the core gives honeycomb properties such as high energy absorption, and makes it a good acoustic insulator, as well as low specific mass and high mechanical strength. The mechanical strength of this type of structure is tied to the cell size of the hexagons, thickness of the hexagons as well as the material employed. The faces of the sandwich panel give it resistance to normal stresses and shear stresses. The configuration of this structure, in general, has the faces more resistant to bending than the core, even though the greater thickness of the core contributes to a greater moment of inertia and therefore greater bending stiffness. Thus, for honeycomb sandwich panels to be more efficient the mass ratio between face and core should be 1. Another factor that directly influences the structural performance of honeycomb sandwiches is the adhesion between the core and face interface. The adhesive material is responsible for transferring the mechanical stresses suffered by the structure between its constituents besides supporting both shear and normal stresses. This paper aims to model and analyze honeycomb sandwich panels made from additive manufacturing - fusion and deposition of thermoplastic material - using Polylactic Acid (PLA) for the hexagonal core and composite material for the lamination of the fiberglass faces. PLA is chosen for the ease of printing the material and ease of purchase. Mechanical bending tests performed, as well as numerical analysis done pointed out that the best adhesion between the face and the core was the fiberglass. The numerical modeling aims to make comparisons with the experimental results of aluminum-aluminum honeycomb panels and the proposed configuration of thermoplastic and composite material. This numerical analysis enables the initial study for topology optimization in order to achieve a mechanical behavior close to the aluminum-aluminum structure both in mechanical strength and mass. Thus, it is possible to obtain a honeycomb panel made by 3D printing and laminated faces reducing the manufacturing cost and complexity.