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FINITE ELEMENT MODEL FOR 3D-PRINTED SANDWICH STRUCTURES WITH LATTICE CORE

Abstract. Various manufacturing techniques have been used to produce sandwich panels with a corrugated core lattice structure. However, most methods are unable to obtain complex lattice models. With the advancement in 3D printing, the use of complex geometries as advanced core structures for novel sandwich panels has become possible. 3D printing technology has recently gained momentum for structural applications, thanks to its capability of creating complex geometries that may be difficult to achieve through traditional techniques. In this way, various performance advantages can be achieved, such as a reduction in mass with increased strength, depending on the application field. This study aims at developing a finite element (FE) model to investigate the mechanical behavior of 3D-printed sandwich structures. The sandwich structures were modeled using the ABAQUS/CAE software to investigate their behavior under three-point bending. A mesh convergence study was conducted to balance accuracy, computational cost, and time. The structure and testing machine were modeled using four-node shell elements (S4R) for the face sheets and core, with discrete rigid elements (R3D4) for the supports and the loading roller, and the contacts between the supports and the sample were defined as general contact. Bending loads were applied using a conventional three-point bending test with specific conditions established in the literature, aiming for model calibration and adjustment. The boundary conditions were selected to simulate experimental conditions, including fixation at one end and load application at the other, allowing only vertical movement. With the numerical simulation, it was possible to compare force vs. displacement curves with results found in the literature. A satisfactory model and testing environment were obtained, contributing to the understanding of the potential of 3D printing in the manufacturing of lightweight structures, with promising applications in various sectors. The study results show that the 3D-printed sandwich panel can be modeled and analyzed using the finite element method to gain insights into its mechanical properties.

Keywords: Structural simulation. Sandwich structures. 3D-Printed