Abstract

The constantly evolving Additive Manufacturing (AM) technologies offer the possibility of manufacturing parts tailored to the user's needs, in a short period of time, minimizing resource losses, while keeping production costs relatively low. At the same time, they offer freedom in design, allowing the creation of complex geometries, enabling the design of lightweight parts.

Lattice structures are complex structures that can be easily produced with the use of AM technologies and are increasingly accepted. Low weight, high strength, good energy absorption, vibration reduction, combined with material savings, are some features of these structures that make them attractive for use in the fields of aeronautics, aerospace, automotive and medicine.

The present work presents the different categories of these structures and investigates the behavior under various loads of TPMS lattice structures, which are previously designed and manufactured. The test specimens were produced by SLA 3D Printing, utilizing three different types of TPMS unit cells (Schwarz Diamond, Schwarz Primitive and Gyroid) and three different porosity values (70%, 75% and 80%). The next step was to perform modal analysis, three-point bending test and compression test for all the specimens. The main objective was to compare their mechanical behavior and the influence of both the shape of the unit cell and the value of the porosity in it. With the increase of the porosity value, a degradation of the mechanical properties was observed, while for each loading, different types of unit cell seemed to be optimal. However, all the specimens showed good results for the measured mechanical properties and exceptional energy absorption in proportion to their weight, which seems to be related to the specific distribution of the material in the three-dimensional space.

Keywords

3D-Printing, Lattice structures, Modal Analysis, Three-point bending, Compression