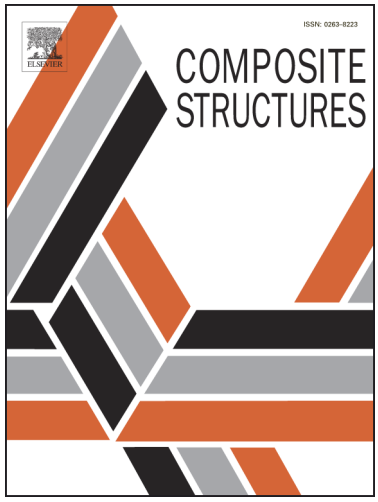

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Low-velocity Impact Response of 3D-printed Lattice Structure with Foam Reinforcement

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Abstract

This paper presents an experimental study on low-velocity impact response of bi-material structures (BMS). BMS is a structural composite consisting of a 3D-printed lattice structure filled with a reinforcement material. In this study, BMS is made of polylactide (PLA) lattice structure and polyurethane (PU) foam for an enhanced impact resistance. Three different PU foams, including one rigid foam and two flexible foams, are selected for BMS. The impact tests are conducted to compare the impact attenuation, stiffness, toughness, and strength using the measured rate of change of acceleration (known as "jerk"), displacement, energy absorption, and the maximum acceleration, respectively. The results show that flexible foams have more positive effects on the impact properties than the rigid foam. The maximum reduction of jerk is about 9% compared to the baseline structure without foam reinforcement. The maximum displacement is increased by 17%; the maximum energy absorption is increased by 23%. The maximum acceleration remains similar for all samples. In conclusion, a proper selection of foam filling can significantly improve the impact properties.

Keywords: low-velocity impact; composite; 3D Printing; bi-material structure

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