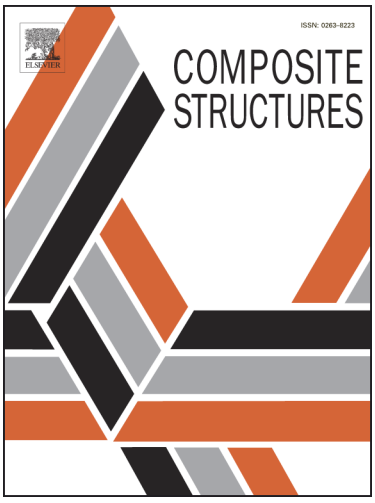

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In-plane crushing behaviors of piecewise linear graded honeycombs

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Abstract: The cell-wall thickness induced and cell-wall angle induced piecewise linear graded honeycombs (PLGHs) are presented and investigated under in-plane compression. Effects of cell-wall angle on the strength of honeycombs are discussed. Results reveal that the normalized crushing strength displays similar variety to that of the shape ratio within a given range. Based on this, traditional theoretical models of plateau stresses are improved. Comparative studies on different kinds of PLGHs are conducted. Quasi-static and dynamic deformation mode, strength and energy absorption capacity are intensively discussed. Both weak-to-strong and top-to-bottom layer-by-layer deformation mode are observed. Comparison of strain-stress curves shows that cell-wall angle induced PLGHs generally express lower level of stress than that of cell-wall thickness induced PLGHs under quasi-static compression, but the difference is insignificant as the crushing velocity increases. Theoretical prediction is also conducted to estimate the stress level under quasi-static and high crushing velocities. Both the constant velocity and initial velocity loadings are applied to studying the energy absorption capacity. It is interesting to note that cell-wall angle induced PLGHs shows a time saving characteristic as the normalized initial kinetic energy increases from 0.75 to 1, which has not been discovered in other types of honeycombs.

Keywords: piecewise linear graded honeycombs; crushing behaviors; cell-wall angle; cell-wall thickness; in-plane loadings; finite element method

1. Introduction

Cellular solids, the special structures or materials in the engineering field, have shown extraordinary properties during the last few decades. Inspired by nature, the ultra-light structures