Mechanical performance of hierarchical metal honeycomb subjected to axial loading—numerical simulation

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Abstract

As the increasing demand of light-weight, high specific strength and stiffness on engineering equipment, the hierarchical structures with outstanding mechanical characteristics have been widely studied. Aiming to seek mechanical promotion, this paper combined the vertex-based hierarchy with honeycomb due to the superb crushing behavior of the latter for blending their merits. Primarily, the theoretical formulas were derived for the conventional honeycomb and the hierarchical one including equations of half-wave length as well as mean force. These formulas clearly explained the mechanical promotions in essence. More importantly, the Finite Element models of vertex-based honeycombs were constructed in terms of the different scale ratio (λ) by means of ANSYS code, which is widely applied to the study of cellular thin-walled structures. It was found that the structure with smaller λ can absorb more energy. The influence of the wall thickness on mechanical performance was also investigated in the case of the hierarchical honeycomb using numerical simulation. The results correspond with the theoretical ones well. All the investigations suggest that the vertex-based hierarchy markedly improved the crushing behavior of honeycombs.

Keywords: Finite Element method; Hierarchical honeycomb; Folded element; Dynamic response.