Analysis of failure loads and optimal design of composite lattice cylinder under axial compression

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Abstract: Application of large-scale composite lattice cylinders in aeronautic and astronautic engineering is an effective way to reduce structure mass and achieve high mass efficiency. In this paper, structural stiffness and critical axial force of the lattice cylinder are analyzed theoretically by equivalent continuum method. For the lattice cylinder under axial compression, there are four failure modes, which are global buckling, out-of-plane strut buckling, in-plane strut buckling and strength failure. Curves of load capacity and failure maps related to the variation of non-dimensional variables are plotted respectively. According to the failure maps, failure of the large-scale lattice cylinder is generally dominated by global buckling due to relatively small strut thickness of the lattice cylinder. Based on finite element simulations, influence of four key geometrical parameters on stiffness and critical buckling force of the large-scale lattice cylinder under axial compression is discussed. Strut thickness and number of oblique strut rows have relatively great effects on the stiffness and critical buckling force, while number of horizontal strut rows should maintain a relatively small value in order to achieve high mass efficiency. Aimed to minimize mass of a specific Kagome lattice cylinder in practical engineering, a multi-parameter