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Design-oriented Crushing Analysis of Hexagonal Honeycomb Core under In-plane Compression

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Abstract: The square honeycomb core is compressed quasi-statically and dynamically in order to investigate the mechanical properties of it. The plastic collapse stress under static compression is mathematically discussed by investigating the collapse mechanisms of cells from numerical simulations. Results show that the plastic collapse stress in the *y* direction is larger than that in the *x* direction under multi-cell condition, which agrees with the conclusion of numerical simulations. This difference is insensitive to the relative density within a specific range under quasi-static compression. However, it turns to be insignificant when the crushing velocity reaches or exceeds a critical velocity. A reverse method is proposed to estimate this critical velocity. For the euqi-biaxial compression analysis, deformation process of the honeycomb is defined to three modes, and the deformation map is drawn. Compared with true stresses in both *x* and *y* directions in uniaxial compression, performances of them in equi-biaxial compression are reinforced. To represent the true stress in mathematical way, empirical formula for high velocity compression is derived. The energy absorption capacity is also enhanced, and the process is smoother around the stage of full densification than that under uniaxial compression.

Keywords: In-plane compression; hexagonal honeycomb; deformation process; plateau property; energy absorption; finite element method

1. Introduction

Cellular materials, such as honeycombs, foams, have undergone research and development for decades. This kind of material shows several interesting mechanical characteristics and attracts many engineering applications, e.g. packaging, automobile, aviation and military etc. [1-4]. For instance,