Core Crushing and Local Stability of Aluminum Honeycomb Materials

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The quasi-static crushing behavior of aluminum honeycomb materials is evaluated using a combined experimental, analytical and numerical approach. Based on experimental characterization, the constitutive properties of the honeycomb cores under flat compression are approximated by an elastic perfectly-plastic material with inclusion of hardening after densification. Two different cell size materials are evaluated and compared, and the effect of strain rate on the maximal crushing stress is studied. The experimental results show that the crushing platen stress is directly related to the relative density of core materials and core local stability. A local stability model based on discrete analysis of restrained core walls and a variational formulation is proposed, and it is capable of predicting the core local buckling strength and critical buckled wave length. The predicted core local buckling strength and buckled wave length are used to correlate with the crushing stress and wave length of a simple physical model proposed by the authors [1] and compare with the experimental data and available formulas in the literature. It is observed that the crushing wave length is close to the cell size and related to the geometric dimension and strain rate. The folding mechanism is also measured by the ARAMIS system (a photogrammetry technique), and the measured von Mises strains are compared with the numerical results from LS-DYNA, demonstrating that the folding mechanism is initiated by two plastic hinge lines formed at the cell corners. The characterization of core crushing behavior and prediction of core local stability conducted in this study provides better understanding of the failure process of honeycomb materials and can be further employed to study energy absorption and impact response of sandwich structures.

***Keywords*:** Crushing; Wave length; Crushing stress; Elastic plastic behavior; Honeycomb; Core; Local stability.