Aerospace Engineering Thesis Defense

On the Role of the Corner Radius in the Mechanical Behavior of the Hexagonal Honeycomb

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Abstract

The hexagonal honeycomb is a bio-inspired cellular structure with a high stiffness-to-weight ratio that has contributed to its use in several engineering applications compared to solid bodies with identical volume and material properties. This characteristic behavior is mainly attributed to the effective nature of stress distribution through the honeycomb beams that manifests as bending, axial, and shear deformation mechanisms. This work focuses on the influence of a corner radius present in naturally occurring honeycombs on the mechanical properties of a honeycomb structure subjected to in-plane compression loading. The local response at the corner node interface is investigated with the help of finite element simulation of a periodic unit cell within the linear elastic domain and validated against the best available analytical models. A parametric DOE model with the unit cell is defined with design points of varying circularity and cell aspect ratios towards identifying throw some light on the optimal combination of all geometric parameters that maximize stiffness per unit mass while minimizing the stresses induced at the corner nodes. The observed trends are then compared with compression tests of SLS 3D printed Nylon 12 honeycomb specimens of varying corner radius and wall thickness. The study concluded that the presence of a corner radius has a mitigating effect on peak stresses but that these effects are dependent on thickness while also increasing specific stiffness in all cases. It also points towards an optimum combination of parameters that achieve both objectives simultaneously.

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Zoom Link: https://asu.zoom.us/j/4039193519