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A novel hierarchical thermoplastic composite honeycomb cylindrical structure: Fabrication and axial compressive properties

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Abstract: Thermoplastic composite structures are being widely investigated due to their excellent properties such as recycling feasibility and high damage tolerance to meet the increasing demand for lightweight engineering components. A novel hierarchical thermoplastic composite honeycomb cylindrical structures (HTCHCS) with recyclability were designed and fabricated using interlocking assembly technique. The quasi-static axial compression tests were conducted to investigate the mechanical response and energy absorption of HTCHCS. The structural crushing force efficiency can be risen from 0.4 to 0.7 after optimizing the placement mode of axial ribs. The deformation of HTCHCS were experimentally studied and typical deformation modes were obtained. Different from the layer-by-layer collapse for HTCHCS with regular ribs, HTCHCS with staggered ribs showed negative Poisson' ratio deformation. After large imposed crushing displacement (at least 90%), excellent deformation recovery over 80% initial height was found and reloading carrying and energy absorption abilities can reach to 13% and 12% of initial ones respectively.

Keywords: Hierarchical; Thermoplastic; Cylindrical Structures; Negative Poisson's Ratio; Deformation Recovery.