Buckling and post-buckling analysis of auxetic cellular structures

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Abstract

Numerical simulations and experimental tests are performed in this contribution to investigate buckling and failure modes of auxetic cellular structures as well as sandwich panels with auxetic cores. Various Poison's ratios and densities are employed to assess their effects on the deformation mechanisms under uniaxial compression. The numerical simulations are achieved using the Riks method while accounting for geometric nonlinearity and plasticity. The results reveal that negative Poison's ratio and structure density have significant effects on buckling critical stress and failure mechanisms of cellular structures. While the inversed honeycomb and the double arrowhead with different Poisson's ratios display similar load capacity, the facesheet failure is more marked with the conventional inversed honeycomb. This outcome is due to the dominant effect of the facesheet on the load evolution. The impact of cell-wall thickness and facesheet thickness on the buckling load is discussed based on the FE model.

Keywords: Buckling, Auxetic Sandwich Panel, Failure mode, compressive tests, Riks Method.

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