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# In-Plane and Out-of-Plane Buckling of Architected Cellular Plates: Numerical and Experimental Study

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**Abstract**

In this article, the nature of instability in architected cellular materials is explored through computational modelling and experimental testing. The in-plane and out-of-plane buckling as two major instability mechanisms in cellular materials are distinguished and the effects of their microarchitectural parameters on the buckling behavior are demonstrated. Different architected cellular materials in the form of cellular plates are analysed with a finite element method (FEM) by eigen buckling and nonlinear analyses, while a few samples of elastomeric architected cellular materials are prototyped and experimentally tested to corroborate our numerical predictions for the buckling load. We show that an appropriate gradient of cell architecture within the cellular plates could lead to an increase in both out-of-plane and in-plane buckling loads. The experimental tests conducted on the casted cellular plates with uniform and graded microarchitectures, made of a two-component silicone elastomer, confirm that different buckling mode shapes can be observed by tailoring the microarchitectures of cellular plates. This idea can pave the path for devising advanced reconfigurable materials, for shape matching and energy absorption applications, whose

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