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A Modified Periodic 2D Cellular Re-Entrant Honeycomb Model to Enhance the Auxetic Elastic Properties

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Abstract : Materials or structures that contract laterally on the application of a compressive load and vice versa are said to be Auxetic materials which exhibit Negative Poisson's Ratio (NPR). Numerous auxetic structures are proposed in the literature. One of the most studied periodic auxetic structure is the re-entrant honeycomb model. In this paper, a modified re-entrant model is proposed to enhance the auxetic behavior. The paper aimed to investigate the elastic behaviour of the proposed model to improve Young's modulus and NPR by evaluating the analytical model. Finite Element Analysis (FEA) is also conducted to support the analytical results. A significant increment in Young's modulus and NPR can be achieved in one of the two orthogonal directions of the loading at the cost of compromising these values in other direction. The proposed modification resulted in lower relative densities when compared to the existing re-entrant honeycomb structure. A trade-off in the elastic properties in one direction at low relative density makes the proposed model suitable for uni-direction applications where higher stiffness and NPR is required, and strength to weight ratio is important.

Keywords : 2D model, auxetic materials, re-entrant honeycomb, negative Poisson's ratio
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