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ON THE EVALUATION OF THE YOUNG'S MODULUS FOR A LAMINATED PERIODIC COMPOSITE STRUCTURE BASED ON AUXETIC MATERIALS

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ABSTRACT

In this paper, the dynamic behavior of auxetic materials are interpreted in the light of Cosserat elasticity which admits degrees of freedom not present in classical elasticity: the rotation of points in the material, and a couple per unit area or the couple stress [1], [2]. The prediction of the Young'modulus and the effective Poisson's ratio are developed for a laminated periodic material made up of alternating aluminum and an auxetic material, by using the Bécus homogenization technique. Consider a laminated 2D composite plate made up of alternating the N aluminum and auxetic material layers, normal to the direction x of wave propagation (fig.1).

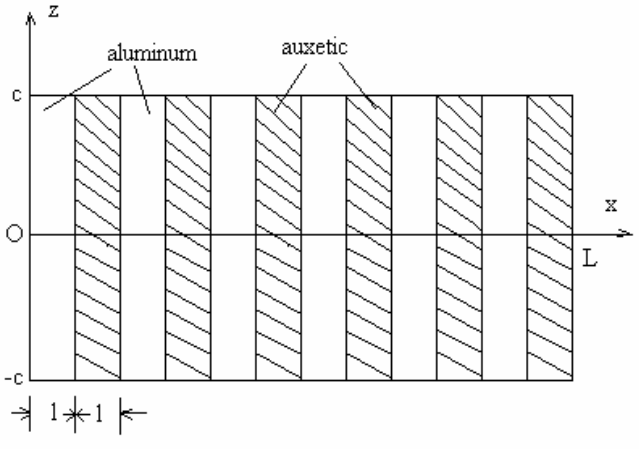

Fig. 1. The composite plate.

Fig. 2 represents the variation of the homogenized Young's modulus with respect to the volume fraction θ of aluminum and the Poisson's ratio ν of the auxetic material. In the simulation, the Young's moduli of aluminum and respectively, of the auxetic material are 109 GPa, and respectively, 1.55 GPa. It is observed that the Young's modulus is

increasing with respect to θ from 2 GPa, to about 140 GPa, having a maximum value for $\theta = 0.75$. For θ above this value, the Young's modulus is decreasing with respect to θ from 135 GPa, to about 90 GPa.

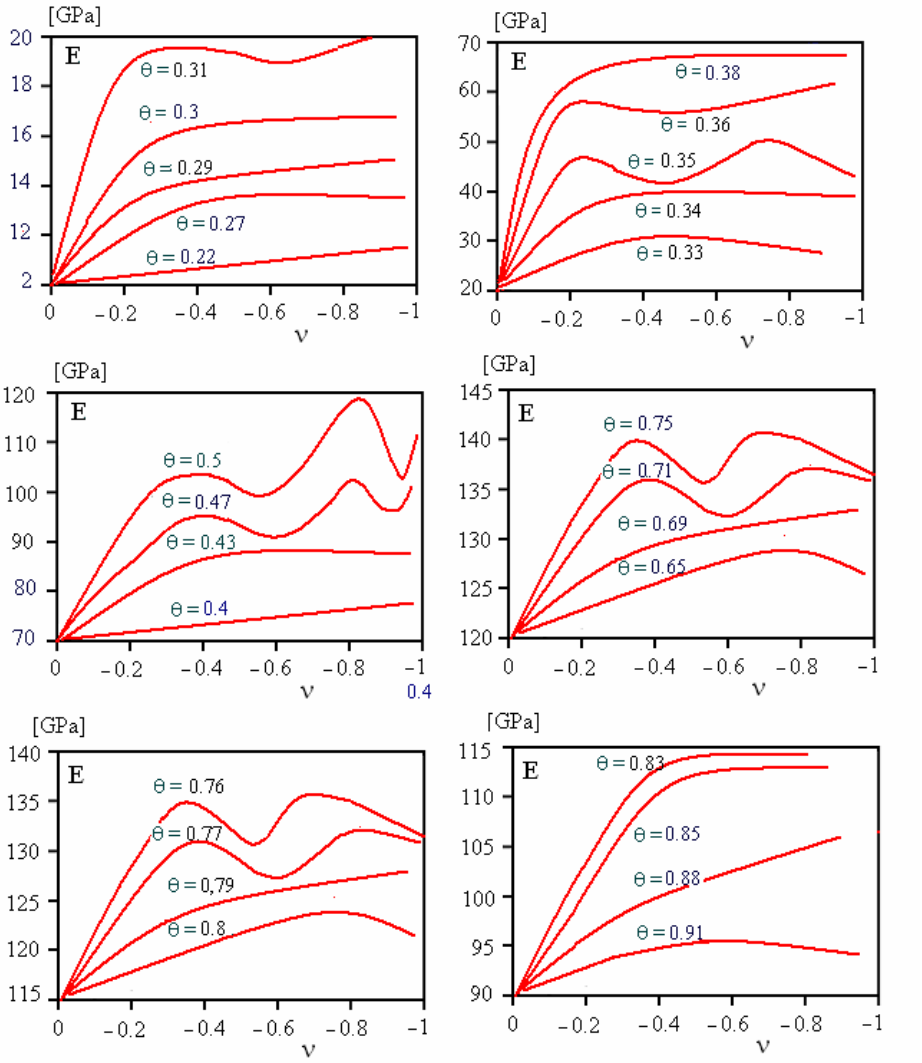

Fig. 2. The homogenized Young's modulus variation with respect to Poisson's ratio of the auxetic material.

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