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Homogenization of hexagonal and re-entrant hexagonal structures and wave propagation of the sandwich plates with symplectic analysis

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Abstract

The aim of this work is to provide closed-form expressions of the effective elastic constants of hexagonal and re-entrant hexagonal structures, which contain the variable dimensional parameters, such as the relative density, aspect ratio, length ratio and the cell wall angle. We also numerically investigate the dynamic properties of the sandwich plates with hexagonal cores. By taking into account the bending, axial and shearing deformations of the unit cell walls, the effective elastic constants are derived. In order to analyze the wave propagation of the sandwich plates, the original governing equations are converted into a set of the first-order governing differential equations in the Hamilton system, by introducing the dual variables and with the help of a variational principle. The precise integration method in conjunction with the extended Wittrick-Williams algorithm is utilized to numerically solve these equations to obtain the frequencies of structures. The effects of relative density, length ratio, cell wall angle and material distribution parameter on the dispersion relations of hexagonal and re-entrant hexagonal structures are investigated. It is found that the stiffness plays a more dominant role on the dispersion relations than that of the mass, and the effects of length ratio and material distribution parameter are more prominent than that of the cell wall angle.

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