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Wave propagation in periodic beam networks – mechanism of local resonance

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ABSTRACT

We study the wave propagation in infinite two-dimensional periodic beam networks using finite element simulations and experimental techniques. Although the characteristic pass and stop bands (i.e., bandgaps) of these systems have been heavily investigated in earlier research efforts, more careful scrutiny on the problem leads us to the conclusion that the bandgaps in the triangular beam lattice are because of the localized resonance, similar to the mechanism in acoustic metamaterials with artificial resonators made of multiple constituent materials. In this study, we show, for the first time, that flat phonon modes and locally resonant bandgaps can be generated in a system comprised only one material phase. In addition, we conduct a parametric study on the effects of network global topology, local geometry as well as defect density on the locally resonant bandgaps.