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Effective dynamic properties of a row of elastic inclusions: the case of scalar shear waves. (English) Zbl 1374.74106

J. Elasticity 128, No. 2, 265-289 (2017).

Summary: We present the homogenization of a periodic array of elastic inclusions embedded in an elastic matrix. We consider shear elastic waves with a typical wavelength $1/k$ much larger than the array spacing h and thickness e. Owing to the small parameter $\eta = kh$, with $e/h = O(1)$, a matched asymptotic expansion technique is applied to the wave equation in the time domain. The homogenized problem involves an equivalent interface associated to jump conditions of the Ventcels type. Up to the accuracy of the model in $O(\eta^2)$, different jump conditions are possible, which correspond to enlarged versions of the interface; these jump conditions are parametrized by the thickness a of the homogenized interface. We inspect the influence of a (i) on the equation of energy conservation in the homogenized problem and (ii) on the error of the model for a simple scattering problem. We show that restoring the thickness of the real array, $a = e$, is the optimal configuration regarding both aspects.

MSC:

74Q10 Homogenization and oscillations in dynamical problems of solid mechanics
74Q15 Effective constitutive equations in solid mechanics
74Q20 Bounds on effective properties in solid mechanics

Keywords:

shear waves; interface homogenization; matched asymptotic expansion

Full Text: DOI

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