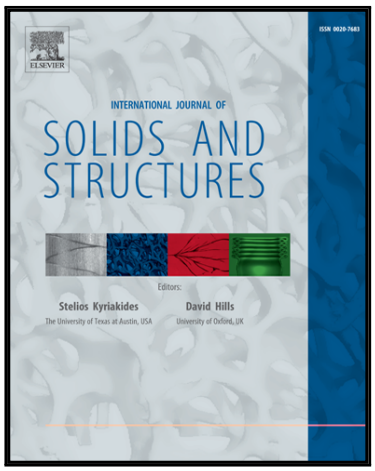

Dynamics of periodic ribbed plates with inner resonance Analytical homogenized model and dispersion features

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Dynamics of periodic ribbed plates with inner resonance Analytical homogenized model and dispersion features[☆]

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Abstract

The dynamic behavior of a periodic ribbed plate with local resonance is investigated. The behavior of the cell made of a beam clamped along a plate edge analyzed through multi-scale asymptotic method enables to derive the governing equations of the effective mechanical behavior. This approach allows obtaining a full homogenized analytical model that provides a relevant representation of the flexural and torsional mechanisms at both global and local scales. The complex dynamic behavior is shown to encompass several mechanisms associated with enriched kinematics. Two types of flexural and torsional waves are evidenced governed by two distinct differential equations that describes (i) waves where both beam and plate moves, and (ii) guided waves where the plate only is set in motion. The inner resonance of the plate induces unconventional dispersion features, with singularities associated either with the symmetric eigenmodes for the bending waves or the antisymmetric modes for the torsional waves. The guided waves are alternatively related to the symmetric and antisymmetric modes of the bended plate and are propagative above the corresponding eigenfrequencies. The predictions of the homogenized model are successfully compared to numerical calculations conducted using Wave Finite Element based methods, for two realistic examples of ribbed plates. The study provides design rules to tailor ribbed plate panels having specific atypical features in a given frequency range.

Keywords: asymptotic homogenization, ribbed plate, periodic structure, inner resonance

[☆] Fully documented templates are available in the elsarticle package on CTAN.

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