

## Two-mode low-frequency approximations for anti-plane shear of a high-contrast asymmetric laminate

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*Abstract:* The anti-plane shear of a three-layered laminate of an asymmetric structure is considered. The chosen geometry of the laminate couples its symmetric and anti-symmetric motions. A high contrast in mechanical properties of the inner and outer layers is assumed. The types of contrast for which the lowest cut-off frequency of the first harmonic is close to zero are revealed. In case of a laminate with traction-free faces two-mode approximations of the exact dispersion relations incorporating both the fundamental mode and the first harmonic are derived. The accuracy of the asymptotic approximations is tested versus the solutions of the original dispersion relation. The associated 2D differential equations of motion are developed. In addition, the boundary conditions based on the Saint-Venant principle are proposed.

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