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Using the Nonlocal Theory of Free Vibrations Nanobeam

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Abstract : The dimensions of nanostructures are in the range of inter-atomic spacing of the structures which makes them impossible to be modeled as a continuum. Nanoscale size-effects on vibration analysis of nanobeams embedded in an elastic medium is investigated using different types of beam theory. To this end, Eringen's nonlocal elasticity is incorporated to various beam theories namely as Euler-Bernoulli beam theory (EBT), Timoshenko beam theory (TBT), Reddy beam theory (RBT), and Levinson beam theory (LBT). The surrounding elastic medium is simulated with both Winkler and Pasternak foundation models and the difference between them is studies. Explicit formulas are presented to obtain the natural frequencies of nanobeam corresponding to each nonlocal beam theory. Selected numerical results are given for different values of the non-local parameter, Winkler modulus parameter, Pasternak modulus parameter and aspect ratio of the beam that imply the effects of them, separately. It is observed that the values of natural frequency are strongly dependent on the stiffness of elastic medium and the value of the non-local parameter and these dependencies varies with the value of aspect ratio and mode number.

Keywords : nanobeams, free vibration, nonlocal elasticity, winkler foundation model, Pasternak foundation model, beam theories
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