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Exact Vibration Analysis of a Rectangular Nano-Plate Using Nonlocal Modified Sinusoidal Shear Deformation Theory

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Abstract : In this paper, exact close form solution for out of plate free flexural vibration of moderately thick rectangular nanoplates are presented based on nonlocal modified trigonometric shear deformation theory, with assumptions of the Levy's type boundary conditions, for the first time. The aim of this study is to evaluate the effect of small-scale parameters on the frequency parameters of the moderately thick rectangular nano-plates. To describe the effects of small-scale parameters on vibrations of rectangular nanoplates, the Eringen theory is used. The Levy's type boundary conditions are combination of six different boundary conditions; specifically, two opposite edges are simply supported and any of the other two edges can be simply supported, clamped or free. Governing equations of motion and boundary conditions of the plate are derived by using the Hamilton’s principle. The present analytical solution can be obtained with any required accuracy and can be used as benchmark. Numerical results are presented to illustrate the effectiveness of the proposed method compared to other methods reported in the literature. Finally, the effect of boundary conditions, aspect ratios, small scale parameter and thickness ratios on nondimensional natural frequency parameters and frequency ratios are examined and discussed in detail.

Keywords : exact solution, nonlocal modified sinusoidal shear deformation theory, out of plane vibration, moderately thick rectangular plate
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