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A single variable refined theory for free vibrations of a plate using inertia related terms in displacements

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Abstract

In this paper, a simple to use and single variable refined theory for free vibrations of a plate is proposed by incorporating inertia related terms in displacements. To the best of the authors' knowledge, no such approach has been reported in the literature pertaining to plate theories. The theory has only one fourth-order governing differential equation involving a single variable. Moreover, the expressions for displacements, strains, stresses, moments and shear forces of the theory are also expressed in terms of a single variable. It is worthwhile to note that, the expressions for shear forces of the present theory obtained by using strain-displacement and constitutive equations also involve inertia related terms. Whereas, the other first-order and higher-order shear deformation plate theories would result in the inconsistency of the expressions for shear forces obtained by using strain-displacement and constitutive equations and those obtained by using equilibrium equations. Efficiency of the proposed theory is demonstrated through illustrative examples for free vibrations of simply supported isotropic rectangular plates. Results obtained by using present theory are compared with three-dimensional theory of elasticity results, and also with those obtained by other first-order and higher-order shear deformation plate theories. Results obtained are quite accurate.

Keywords: Free vibrations, Inertia related terms, Shear deformation plate theories

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