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Exact characteristic equations for some of classical boundary conditions of vibrating moderately thick rectangular plates

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Abstract

The dimensionless equations of motion are derived based on the Mindlin plate theory to study the transverse vibration of thick rectangular plates without further usage of any approximate method. The exact closed form characteristic equations are given within the validity of the Mindlin plate theory for plates having two opposite sides simply supported. The six distinct cases considered involve all possible combinations of classical boundary conditions at the other two sides of rectangular plates. Accurate eigenfrequency parameters are presented for a wide range of aspect ratio η and thickness ratio δ for each case. The three dimensional deformed mode shapes together with their associated contour plots obtained from the exact closed form eigenfunctions are also presented. Finally, the effect of boundary conditions, aspect ratios and thickness ratios on the eigenfrequency parameters and vibratory behavior of each distinct cases are studied in detail. It is believed that in the present work, the exact closed form characteristic equations and their associated eigenfunctions, except for the plates with four edges simply supported, for the rest of considered six cases are obtained for the first time.

Keywords: Mindlin plate; Vibration; Eigenfrequency; Eigenfunction; Rectangular; Mode shape; Closed form

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