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A trigonometric plate theory with 5-unknowns and stretching effect for advanced composite plates

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Abstract. A simple but accurate trigonometric plate theory (TPT) for the bending analysis of functionally graded single-layer and sandwich plates is presented. The significant feature of this formulation is that, in addition to including the thickness stretching effect, it deals with only 5 unknowns as the first order shear deformation theory (FSDT), instead of 6 as in the well-known TPT. The TPT possesses in-plane and transverse shear strain shape functions (sin(z/m) and cos(z/n)) containing the parameters "*m*" and "*n*" that should be properly selected. The governing equations and boundary conditions are derived by employing the principle of virtual work. A Navier-type closed-form solution is obtained for functionally graded single-layer and sandwich plates subjected to bi-sinusoidal load for simply supported boundary conditions. Numerical results of the present TPT are compared with the FSDT, other quasi-3D higher order shear deformation theories (HSDTs), and 3D solutions. The important conclusions that emerge from the present numerical results suggest that: (a) for powerly graded plates the present TPT produces as good results as refined quasi-3D HSDTs, however (b) for exponentially graded plates the present TPT yields improved results; (c) it is possible to gain accuracy keeping the unknowns' number constant but by selecting properly the parameter "*m*" and "*n*".

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