Transition Behavior in Large Deflection of Un-symmetrically Layered Piezoelectric Plate under Initial Tension

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Abstract

Transition behavior in large deflection of un-symmetrically layered piezoelectric plate under pretension due to lateral load is studied. von Karman plate theory for large deflection is utilized and extended to the case of an un-symmetrically layered plate including a piezoelectric layer. The derived governing equations are simplified by neglecting the arising nonlinear terms for a linear consideration, yielding a Bessel or modified Bessel equation for the lateral slope. Analytical solutions for geometrical responses expressible in terms of Bessel and modified Bessel functions were developed, respectively, depending on the relative magnitude of piezoelectric effect. For a nearly monolithic plate under a very low applied voltage, the solutions correlate well with those for a single-layered case due to uniform lateral load available in literature and thus the present approach is checked. For a two-layered un-symmetric plate made of typical silicon-based materials, the transition behaviour is seen to be apparently influenced by the piezoelectric effect only in a low pretension condition.

Keyword：Transition Behavior, Large Deflection, Piezoelectric Effect, Initial Tension