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Stochastic hygro-thermo-mechanically induced nonlinear static analysis of piezoelectric elastically support sandwich plate using secant function based shear deformation theory (SFSDT)

Achchhe Lal, Nikhil M. Kulkarni and Vijayakumari H. Siddaramaiah
Department of Mechanical Engineering, SVNIT Ichchhanath, Surat 395007, Gujrat, India
Department of Mechanical Engineering, SVNIT Ichchhanath, Surat 395007, Gujrat, India
Department of Aerospace Engineering and Management, Jain University, Bangalore, India

Abstract:
The second order statistics of transverse nonlinear central deflection of elastically supported piezoelectric laminated composite sandwich plate (ESPLCSP) subjected to hygro-thermo-mechanical loading using micromechanical approach is evaluated in this paper. System randomness as micro-level material properties of fiber and matrix, material properties of piezoelectric, laminate thickness, lamination angle, foundation parameters, and load intensity are taken as independent random variables. The mechanical loading is taken as uniformly distributed and sinusoidal loadings. The secant function based shear deformation theory (SFSDT) with von-Karman nonlinearity is used for basic formulation. The elastic and hygrothermal properties of the composite material are considered to be dependent on temperature and moisture concentration have been evaluated utilized micromechanical modeling. A Newton–Raphson method based on C0 nonlinear finite element method combined with mean centered second order perturbation technique (SOPT) proposed by present authors for the composite plate is extended for sandwich composite plate. The effect of random system properties with changing the plate geometry, stacking sequences, support conditions, foundation parameters, piezoelectric layers, fiber volume fraction and temperature, and moisture distribution on ESPLCSP is presented. The performance of proposed approach is validated through comparison with those available in the literature and independent Monte Carlo simulation (MCS).

Keywords:
Laminated composite sandwich platenonlinear transverse central deflectionsecant function based shear deformation theoryrandom system propertieselastic foundation, SOPT

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