Analytical Determination of Electromechanical Coupling Effects on Interlaminar Stresses of Generally Laminated Piezoelectric Plates

Authors : Atieh Andakhshideh, S. Maleki, Sayed Sadegh Marashi

Abstract : In this paper, the interlaminar stresses of generally laminated piezoelectric plates are presented. The electromechanical coupling effect of the piezoelectric plate is considered and the governing equations and boundary conditions are derived using the principle of minimum total potential energy. The solution procedure is a three-dimensional multi-term extended Kantorovich method (3DMTEKM). The objective of this paper is to accurately study coupling influence on the edge effects of piezolaminated plates with finite dimensions, arbitrary lamination lay-ups and under uniform axial strain. These results can provide a benchmark for checking the accuracy of the other numerical method or two-dimensional laminate theories. To verify the accuracy of the 3DMTEKM, first examples are simplified to special cases such as cross-ply or symmetric laminations and are compared with other analytical solutions available in the literature. Excellent agreement is achieved in validation test and other numerical results are presented for general cases. Numerical examples indicate the singular behavior of interlaminar normal/shear stresses and electric field strength components near the edges of the piezolaminated plates. The coupling influence on the free edge effect with respect to lamination lay-ups of piezoelectric plate is studied in several examples.

Keywords : electromechanical coupling, generally laminated piezoelectric plates, Kantorovich method, edge effect, interlaminar stresses

Conference Title : ICCMMS 2018 : International Conference on Composite Materials, Mechanics and Structures

Conference Location : Vancouver, Canada

Conference Dates : August 09-10, 2018