Elasticity solution of thick laminated cylindrical panel with piezoelectric layer under dynamic loading

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Abstract

As a result of two characteristics, i.e. the direct piezoelectric effect and the inverse piezoelectric effect, piezoelectric materials are widely used in hydro-and electro-acoustics, communications and measurement technology. In recent years the novel usages of them as distributed sensors and actuators in active structure control as noise attenuation, shape control and vibration suppression have attracted serious attention. On the other hand, composite laminates are well known for their high stiffness and strength . Therefore, the integration of piezoelectric materials and structural composites has become the subject of focus in the area of smart materials and structures and numerous papers on this subject have been published.

The theories of plates and shells coupled with piezoelectricity theory were applied to piezoelectric sensor and actuator design [1]. System equations for piezoelectric shell vibrations were derived, using Hamilton's principle and linear piezoelectricity [2,3]. The piezoelastic solutions to long cylindrical panel and shell structures were also presented [4,5,6] . Elasticity solution of anisotropic thick laminated cylindrical panels subjected to dynamic loading was obtained by author [7].

In this paper, the elasticity solution of axisymmetric cross-ply laminated panel with piezoelectric layer is presented. The shell panel is simply supported at four sides and is subjected to asymmetric loading. The highly coupled partial differential equations (p.d.e.) are reduced to ordinary differential equations (o.d.e.) with variable coefficients by means of trigonometric

function expansion in circumferential and axial directions. The resulting ordinary differential equation are solved by Galerkin finite element method. Finally two and three layered panels with piezoelectric layer are solved and the results are compared with latest published results.

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