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Bending and buckling analysis of functionally graded annular microplate integrated with piezoelectric layers based on layerwise theory using DQM

Mohammad Hadi Hajmohammad

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Abstract

In present paper, bending and buckling analysis of functionally graded material (FGM) annular microplate integrated with piezoelectric layers is investigated. The annular sandwich microplate is subjected to radial compressive and uniform transverse load. Considering the nonlocal elasticity theory for small scale effect is developed. In order to mathematical modeling of annular sandwich microplate, layerwise theory, is employed. Furthermore, the surrounding elastic medium is simulated by Pasternak foundation model, in which both compression and tension are assumed. The material properties of FGM annular microplate are supposed to vary through the thickness according to power law. Using energy method and principle of minimum potential energy, the size dependent governing motion equations are derived. In this study, the governing motion equations are solved numerically using differential quadrature (DQ) method. The present numerical solutions are validated through comparisons against those available in open literature for the reduced cases. Also, different boundary conditions at the edges of the annular sandwich microplate are considered. A parametric study is conducted to examine the effects such as elastic foundation, small scale effect, various boundary conditions, number of grid point, external voltages of piezoelectric layers, outer-inner radius ratio on the critical buckling load, are developed. The results clarify that external voltages are effective parameter on the critical buckling load and the bending behaviour of the system. In addition, the efects of elastic foundation is very remarkable on the buckling and deflection of the annular sandwich plate.

***Keywords*:** Buckling; Bending; Layerwise theory; Anuular sandwich microplate; FGM; Small scale effect; DQ method

*Corresponding author.