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Free Vibration of Axially Functionally Graded Simply Supported Beams Using Differential Transformation Method

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Abstract : Free vibration analysis of homogenous and axially functionally graded simply supported beams within the context of Euler-Bernoulli beam theory is presented in this paper. The material properties of the beams are assumed to obey the linear law distribution. The effective elastic modulus of the composite was predicted by using the rule of mixture. Here, the complexities which appear in solving differential equation of transverse vibration of composite beams which limit the analytical solution to some special cases are overcome using a relatively new approach called the Differential Transformation Method. This technique is applied for solving differential equation of transverse vibration of axially functionally graded beams. Natural frequencies and corresponding normalized mode shapes are calculated for different Young’s modulus ratios. MATLAB code is designed to solve the transformed differential equation of the beam. Comparison of the present results with the exact solutions proves the effectiveness, the accuracy, the simplicity, and computational stability of the differential transformation method. The effect of the Young’s modulus ratio on the normalized natural frequencies and mode shapes is found to be very important.

Keywords : differential transformation method, functionally graded material, mode shape, natural frequency
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