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Free Vibration Analysis of Timoshenko Beams at Higher Modes with Central Concentrated Mass Using Coupled Displacement Field Method

Authors : K. Meera Saheb, K. Krishna Bhaskar

Abstract : Complex structures used in many fields of engineering are made up of simple structural elements like beams, plates etc. These structural elements, sometimes carry concentrated masses at discrete points, and when subjected to severe dynamic environment tend to vibrate with large amplitudes. The frequency amplitude relationship is very much essential in determining the response of these structural elements subjected to the dynamic loads. For Timoshenko beams, the effects of shear deformation and rotary inertia are to be considered to evaluate the fundamental linear and nonlinear frequencies. A commonly used method for solving vibration problem is energy method, or a finite element analogue of the same. In the present Coupled Displacement Field method the number of undetermined coefficients is reduced to half when compared to the famous Rayleigh Ritz method, which significantly simplifies the procedure to solve the vibration problem. This is accomplished by using a coupling equation derived from the static equilibrium of the shear flexible structural element. The prime objective of the present paper here is to study, in detail, the effect of a central concentrated mass on the large amplitude free vibrations of uniform shear flexible beams. Accurate closed form expressions for linear frequency parameter for uniform shear flexible beams with a central concentrated mass was developed and the results are presented in digital form.

Keywords : coupled displacement field, coupling equation, large amplitude vibrations, moderately thick plates
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