Vibration of a Beam on an Elastic Foundation Using the Variational Iteration Method

Authors : Desmond Adair, Kairat Ismailov, Martin Jaeger

Abstract : Modelling of Timoshenko beams on elastic foundations has been widely used in the analysis of buildings, geotechnical problems, and, railway and aerospace structures. For the elastic foundation, the most widely used models are one-parameter mechanical models or two-parameter models to include continuity and cohesion of typical foundations, with the two-parameter usually considered the better of the two. Knowledge of free vibration characteristics of beams on an elastic foundation is considered necessary for optimal design solutions in many engineering applications, and in this work, the efficient and accurate variational iteration method is developed and used to calculate natural frequencies of a Timoshenko beam on a two-parameter foundation. The variational iteration method is a technique capable of dealing with some linear and non-linear problems in an easy and efficient way. The calculations are compared with those using a finite-element method and other analytical solutions, and it is shown that the results are accurate and are obtained efficiently. It is found that the effect of the presence of the two-parameter foundation is to increase the beam's natural frequencies and this is thought to be because of the shear-layer stiffness, which has an effect on the elastic stiffness. By setting the two-parameter model's stiffness parameter to zero, it is possible to obtain a one-parameter foundation model, and so, comparison between the two foundation models is also made.

Keywords : Timoshenko beam, variational iteration method, two-parameter elastic foundation model

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