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Winkler地基上有限长梁非线性自由振动

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NON-LINEAR FREE VIBRATION OF FINITE-LENGTH BEAMS ON THE WINKLER FOUNDATION

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摘要

基于经典Winkler地基模型及Euler-Bernoulli梁理论,考虑梁的几何非线性效应,运用Newton 第二定律建立了弹性地基上有限长梁的非线性运动方程.采用Galerkin 方法对运动方程进行一阶模态截断,进而利用多尺度法求得了该系统自由振动的一阶近似解.揭示了两端简支梁的非线性自由振动特性,分析了弹性模量、长细比及地基刚度系数等参数对系统固有频率的影响.并通过该系统的位移时程曲线,分析了阻尼对弹性地基上梁运动特性的影响.

关键词: Winkler模型 Euler-Bernoulli梁 几何非线性 多尺度方法 时程曲线

Abstract:

The non-linear free vibration of a finite-length beam on the elastic foundation is investigated. Based on the Winkler foundation model and Euler-Bernoulli beam theory, the nonlinear motion equation of the finite-length beam on an elastic foundation with geometric nonlinearity is deduced based on the Newton’s Second Law. The first-order mode truncation of the vibration function is obtained using the Galerkin method. The approximate solution of the free vibration of the finite-length beam is derived utilizing the multi-scale method to illustrate the behaviour of the non-linear free vibration. The effects of the slenderness ratio of beam, the modulus of elastic system and the stiffness of foundation on the natural frequency of the hinged-hinged beam on the Winkler foundation are analyzed. The influence of damping of the soil-beam system on the motion of the beam is also discussed.

Key words: Winkler model Euler-Bernoulli beam geometrical non-linearity multi-scale method time history records

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