Journal of Mechanical Science and Technology
Volume 23, Issue 11, January 2010, Pages 3013-3023

ISSN: 1738494X
DOI: 10.1007/s12206-009-0816-3
Document Type: Article
Source Type: Journal

Response of the beams on random Pasternak foundations subjected to harmonic moving loads

Younesian, D.[a], Kargarnovin, M.H.[b]
[a] School of Railway Engineering, Iran University of Science and Technology, Tehran 16846-13114, Iran
[b] Department of Mechanical Engineering, Sharif University of Technology, Tehran 11365-9567, Iran

Abstract

Dynamic response of infinite beams supported by random viscoelastic Pasternak foundation subjected to harmonic moving loads is studied. Vertical stiffness in the support is assumed to follow a stochastic homogeneous field consisting of a small random variation around a deterministic mean value. By employing the first order perturbation theory and calculating appropriate Green's functions, the variance of the deflection and bending moment are obtained analytically in integral forms. To simulate the induced uncertainty, two practical cases of cosine and exponential covariance are utilized. A frequency analysis is performed and influences of the correlation length of the stiffness variation on the beam responses are investigated. It is found that in each frequency response there is a peak value of frequency, which behaves as a decreasing function of the correlation length. Among two coefficient of variation of the beam deflection and the bending moment, the former is higher in the case of exponential covariance and it is independent of the magnification of the correlation length. © KSME & Springer 2009.

Language of original document

English

Author keywords

Moving load; Random vibration; Timoshenko beam; Viscoelastic foundation

Index Keywords

Beam deflection; Coefficient of variation; Correlation lengths; Decreasing functions; First order perturbation theory; Frequency Analysis; Harmonic moving load; Homogeneous field; Infinite beams; Integral form; Mean values; Moving load; Pasternak foundation; Peak values; Random variation; Random vibrations; Stiffness variations; Timoshenko beams; Vertical stiffness; Viscoelastic foundation
Engineering controlled terms: Bending (deformation); Bending moments; Frequency response; Green's function; Particle beams; Perturbation techniques; Soil structure interactions; Stiffness
Engineering main heading: Dynamic response

References (17) View in table layout

1 Chen, Y.-H., Huang, Y.-H.
Dynamic characteristics of infinite and finite railways to moving loads
(2003) *Journal of Engineering Mechanics*, 129 (9), pp. 987-995. Cited 11 times.
doi: 10.1061/(ASCE)0733-9399(2003)129:9(987)

View at publisher

2 Jaiswal, O.R., Iyengar, R.N.
Dynamic response of railway tracks to oscillatory moving masses
(1997) *Journal of Engineering Mechanics*, 123 (7), pp. 753-756. Cited 6 times.

View at publisher

3 Fryba, L.
(1999) *Vibration of Solids and Structures under Moving Loads*. Cited 238 times.
London: Thomas Telford

4 Frýba, L., Nakagiri, S., Yoshikawa, N.
Stochastic Finite Elements for a Beam on a Random Foundation with Uncertain Damping Under a Moving Force
(1993) *Journal of Sound and Vibration*, 163 (1), pp. 31-45. Cited 29 times.

doi: 10.1006/jsvi.1993.1146

View at publisher

5 Naprstk, J., Fryba, L.
Interaction of a long beam on stochastic foundation with a moving random load
(1993) *Proc. of the Conference: Structural Dynamics: Recent Advances*, pp. 714-723.
Southampton: Institute of Sound and Vibration Research

6 Naprstek, Jri, Fryba, Ladislav
Stochastic modelling of track and its substructure
(1995) *Vehicle System Dynamics*, 24 (Suppl), pp. 297-310. Cited 5 times.

View at publisher

7 Andersen, L., Nielsen, R.K.
Vehicle moving along a beam on a random modified Kelvin foundation
(2001) *Proc. of Eighth Int. Congress on Sound and Vibration ICSV8*
Hong Kong

8 Andersen, L., Nielsen, S.R.K.
Vibrations of a track caused by variation of the foundation stiffness
(2003) *Probabilistic Engineering Mechanics*, 18 (2), pp. 171-184. Cited 7 times.
doi: 10.1016/S0266-8920(03)00012-2

View at publisher

9 Kargarnovin, M.H., Younesian, D.
Dynamic response analysis of Timoshenko beam on viscoelastic foundation under an arbitrary distributed harmonic moving load
(2002) *Proc. of Fifth Int Conference on Structural Dynamics*. Cited 2 times.
Munich

10 Kargarnovin, M.H., Younesian, D.
Dynamics of Timoshenko beams on Pasternak foundation under moving load
(2004) *Mechanics Research Communications*, 31 (6), pp. 713-723. Cited 41 times.
doi: 10.1016/j.mechrescom.2004.05.002

View at publisher

11 Kargarnovin, M.H., Younesian, D., Thompson, D.J., Jones, C.J.C.
Response of beams on nonlinear viscoelastic foundations to harmonic moving loads
(2005) *Computers and Structures*, 83 (23-24), pp. 1865-1877. Cited 33 times.
doi: 10.1016/j.compstruc.2005.03.003

View at publisher

12 Younesian, D., Kargarnovin, M.H., Thompson, D.J., Jones, C.J.C.
Parametrically excited vibration of a timoshenko beam on random viscoelastic foundation jected to a harmonic moving load
(2006) *Nonlinear Dynamics*, 45 (1-2), pp. 75-93. Cited 9 times.
doi: 10.1007/s11071-006-1460-4

View at publisher

13 Oscarsson, J.
(2001) *Dynamic Train/Track Interaction-linear and Non-linear Track Models with Property Scatter*. Cited 15 times.
Goteborg: Department of Solid Mechanics, Chalmers University of Technology

14 Nayfeh, A.H., Mook, D.
(1995) *Nonlinear Oscillations*. Cited 2812 times.
New York: John Wiley & Sons

15 Solnes, J.
(1997) *Stochastic Processes and Random Vibration*. Cited 43 times.
New York: John Wiley & Sons

16 Zakeri, J.A., Xia, H.
Sensitivity analysis of track parameters on train-track dynamic interaction
(2008) *Journal of Mechanical Science and Technology*, 22 (7), pp. 1299-1304. Cited 5 times.
doi: 10.1007/s12206-008-0316-x

View at publisher

17 George, R.
(2003) *Railway Ballast Quality Monitoring*. Cited 2 times.
Southampton: Institute of Sound and Vibration Research ISVR

Younesian, D.; School of Railway Engineering, Iran University of Science and Technology, Tehran 16846-13114, Iran; email:Younesian@iust.ac.ir

Journal of Mechanical Science and Technology
Volume 23, Issue 11, January 2010, Pages 3013-3023