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Ride comfort of high-speed trains travelling over railway bridges

 Kargarnovin, M.H.^{a b} , Younesian, D.^{a b}, Thompson, D.^{a b}, Jones, C.^{a b} 
^a Mechanical Engineering Department, Sharif University of Technology, Tehran, Iran

^b Institute of Sound and Vibration Research (ISVR), University of Southampton, Southampton, United Kingdom

Abstract

The ride comfort of high-speed trains passing over railway bridges is studied in this paper. A parametric study is carried out using a time domain model. The effects of some design parameters are investigated such as damping and stiffness of the suspension system and also ballast stiffness. The influence of the track irregularity and train speed on two comfort indicators, namely Sperling's comfort index and the maximum acceleration level are also studied. Two types of railway bridges, a simple girder and an elastically supported bridge are considered. Timoshenko beam theory is used for modelling the rail and bridge and two layers of parallel damped springs in conjunction with a layer of mass are used to model the rail-pads, sleepers and ballast. A randomly irregular vertical track profile is modelled, characterized by its power spectral density (PSD). The 'roughness' is generated for three classes of tracks. Nonlinear Hertz theory is used for modelling the wheel-rail contact. The influences of some nonlinear parameters in a carriage-track-bridge system, such as the load-stiffening characteristics of the rail-pad and the ballast and that of rubber elements in the primary and secondary suspension systems, on the comfort indicators are also studied. Based on Galerkin's method of solution, a new analytical approach is developed for the combination between the rigid and flexural mode shapes, which could be used not only for elastically supported bridges but also other beam-type structures. © 2005 Taylor & Francis Group Ltd.

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 Kargamovin, M.H.; Mechanical Engineering Department, Sharif University of Technology, Tehran, Iran
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Volume 43, Issue 3, March 2005, Pages 173-199

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