17th Symposium on Earthquake Engineering
November 14-17, 2022
IIT Roorkee, India
Paper No. 362

Seismic Analysis of Railway Track

Adesh Ghogre[1], Harshad Phadke[2], O R Jaiswal[3]

[1]Post Graduate Student, Dept. of Applied Mechanics, VNIT Nagpur 440010
[2]Assistant Professor, Dept. of Civil Engineering, Bajaj Institute of Technology, Wardha 442001
[3]Professor, Dept. of Applied Mechanics, VNIT Nagpur 440010

Abstract

In the past earthquakes, there are quite a few instances wherein, railway tracks got damaged. There are also instances when train (coach) got derailed either in stationary or running conditions like in the Tangshan Earthquake of July 1976, when 9 trains were overturned and derailed (Esmaeili and Noghabi 2013). There are many studies on dynamic response of railway tracks to moving loads, however, there are very few studies on seismic response of railway tracks. Particularly, the lateral seismic response of ballasted track is not properly understood (Sogabe et al. 2013). In the present study, seismic response in lateral direction (perpendicular to the track length) is studied. First, a simple beam on an elastic foundation with lateral springs is analysed. Then, rails and sleepers are explicitly modelled, and the ballast and subgrade are represented using vertical and lateral springs. Seismic response is obtained using a Finite Element (FE) model. In the FE model, track stiffness is suitably quantified in vertical and horizontal directions. Three models in increasing order of refinement in representation of the sleepers, sub-ballast, subgrade, etc. are modelled. First, an earthquake in lateral direction is applied over the entire length of the FE model. Then, the earthquake is applied over a selected length in the central portion of the FE model. Seismic responses (displacement) from all three models are compared and they are found to be in good agreement. Further, it is noted that if base excitation is applied over a limited length in the central region, the maximum displacement at the central node remains unaltered. However, along the track length, the seismic response decreases rapidly beyond the region of the earthquake. This study can help in suggesting means to control seismic response of railway tracks.

Keywords: Railway track, Seismic response, Track damage, Train derailment