

Spectral Analysis of Structure under Vibration due to Underground Passing Trains

Abstract

The passage of underground trains induces vibrations transmitted to the ground surface and the nearby structures. Ordinarily, these vibrations do not result in structural damage but can harm nonstructural elements and disturb the occupants. To respond to this requirement, in this research vertical acceleration response spectra for passing trains on the SDF system calculated. Using these spectra, without resorting to the time consuming and costly analysis of a tunnel-soil system under moving loads, the maximum structural response can be calculated rapidly. To make this end, the universal subway line trains with their details such as suspension, wheel, bogie, considered and three different standard train modeled, then the dynamic load from train wheel to the rail calculated. The soil-tunnel interaction is modeled using 3D finite element under dynamic moving train loads and the dynamic analysis of such a system results in the ground surface vibration time histories at the central point of the track. Finally, the maximum values of vertical acceleration responses are calculated for an SDF dynamical system. The above calculations are accomplished for three different tunnel depth, three different type of soil, three different standard trains, three different train velocities and are presented as response acceleration spectra. The results show that the vertical acceleration response spectra, is a function of train speed and train type to the depth of tunnel and the shear wave velocity in soil. Also from 81 analysed model 51 exceed the undesirable threshold of human feeling (0.55 g).

Keywords: Underground Trains, Soil-Tunnel Interaction, Surface Vibrations, Surface Structures, Response Acceleration Spectra