

Response Spectra for Surface Vibrations Caused by Passing Underground 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. These effects are more pronounced when evaluating buildings like hospitals, laboratories, museums, etc., and their assessments is an important design need. To respond to this requirement, in this project assessment spectra for passing trains moving with different velocities are calculated. Using these spectra, without resorting to the time consuming and costly analysis of a tunnel-soil system under moving loads, the maximum structural responses can be calculated rapidly. To make this end, the soil-tunnel interaction is modeled using a 3D finite difference scheme under the standard moving train loads. The dynamic analysis of such a system results in the ground surface vibration time histories at different distances from the tunnel axis. Then the maximum values of acceleration, velocity, and displacement responses are calculated for an SDF dynamical system. The above calculations are accomplished for different standard trains, train velocities, tunnel depth, distance from tunnel, and soil type, and are presented as assessment acceleration, velocity, and displacement spectra.

Keywords: Underground tunnel, soil-tunnel interaction, surface vibrations, assessment spectra.