Soil Vibrations Due to Trains Moving over Rough Tracks by the 2.5D Finite/Infinite Element Approach

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The railway irregularity and dynamic properties of the moving train is newly incorporated in the 2.5D finite/infinite element simulation of the soil vibrations caused by subway trains. For soils that are uniform along the railway, only a 2D profile of the soil perpendicular to the railway needs to be considered, of which the near field is simulated by finite elements and the far field by infinite elements. Besides the in-plane degrees of freedom (DOFs) for plane elements, an extra DOF is needed to account for the out-of-plane vibration. The train is modeled by a series of mass-spring-dashpot units moving over rails with the irregular profile simulated as a stationary ergodic Gaussian random process. By summing up the load distribution function for each axle load moving over an infinite elastically supported beam, the wheel-rail interaction forces are obtained in the Fourier domain. The reliability of the proposed approach is verified by comparing the results obtained with the existing ones. Besides, the effect of floating slabs on the vibration isolation of railway tracks with respect to rail irregularity is also investigated. It is concluded that the velocity and acceleration responses of the soil are largely amplified due to the presence of rail irregularity, and that the high-frequency components induced by rail irregularity can be effectively reduced via installation of the floating slabs.

Keywords: rail irregularity; soil vibration; train; tunnel; 2.5D finite/infinite element; wave number

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