Load Transmission Characteristics and Natural Modes of Ballast Layer subject to Traffic Loads

Akira AIKAWA

This paper details the field measurement and FE analysis carried out to clarify the transmission characteristics of dynamic loads within a ballast layer. Base on the spectral analysis of the measured data, the accelerance curve and compliance curve of the ballast layer indicate existence of two typical different natural modes of the ballast layer. One is the first-order elastic resonance mode of the ballast aggregate at around 650 Hz at which the whole ballast aggregate repeats the vertical expansion and shrinkage elastically as a continuous body. The other is the rigid body vibrational mode at around 40 Hz at which the mass of the track structure and the indirect additional mass given by a train vibrates simultaneously up and down due to the spring stiffness of the ballast layer. It is apparent that the ballast layer has hardly any capacity to reduce vibration components around these natural frequencies. A weak roadbed and overburdened mass theoretically cause the reduction of the frequency in the rigid body mode. It can be inferred that the occurrence of ballast resonance with the passing-axle frequency causes the shift and the flow of ballast.