Modeling Techniques for Three-Dimensional Discrete Element Analysis of A Conventional Ballasted Railway Track and Its Application

Akira AIKAWA Fumihiro URAKAWA

This paper describes newly developed techniques for the three-dimensional (3D) dynamic numerical model studies of a ballasted railway track induced by running train applying a discrete element method (DEM). Using the 3D digitizer, the author measured the three-dimensional shape of more than four thousand ballast stones as laid for existing railway tracks, and expresses them numerically as polyhedron models. Comparisons among measured data of the volume and principal moments of inertia for three axes by taking the number of measured points as parameters verified the reproducibility of the shape of the actual ballast using this system. A discontinuous model of the ballasted track was formed and the dynamic responses of track structure members in response to dynamic traffic loading of the train passing were simulated numerically using the 3D-DEM. The model comprises an assemblage of arbitrarily shaped 3D polyhedron crushed stones, rails, rail pads, sleepers, and a subgrade. Numerical results of analysis were also compared with experimental measurement results. The results verified that the newly developed techniques are beneficial for analyzing 3D ballast motion imparted by running trains.