LOAD DISTRIBUTION WITHIN RAILWAY BALLAST: A DEM STUDY CONSIDERING REALISTIC PARTICLE SHAPES

Vasileios Angelidakis*, Stefano Utili, Vasilis Sarhosis

School of Engineering
Newcastle University
NE1 7RU, Newcastle Upon Tyne, UK
{v.angelidakis2, stefano.utili, vasilis.sarhosis}@ncl.ac.uk

ABSTRACT

Railroad constitutes a significant part of the linear transportation infrastructure worldwide, with the majority of regular train tracks lying on ballast layers. To date, ballast is the least understood element of a rail track and its contribution is considered by the engineering practice in a qualitative and conservative manner. In this study, new insights are sought concerning the load distribution within a ballast layer, through numerical analyses. The Discrete Element Method (DEM) is employed, in which every grain can be modelled separately, so that the kinematic conditions present inside a granular assembly are captured adequately through particle to particle interactions. In the simulations performed, a sleeper is placed on a ballast layer. Ballast is modelled using polyhedral particles, with shapes based on real grains, so that particle to particle interactions are approximated in a realistic manner. The model is constructed as a 3D slice of a standard ballasted cross section, bound by periodic boundaries to the longitudinal direction of the rail line, so that plain-strain conditions are achieved, while the full kinematic aspects of the three-dimensional response are not suppressed. The mechanical characterisation of the material is derived through calibration to available drained triaxial tests on ballast specimens. The DEM results are compared with the load distribution regime considered in the British Standards and the level of conservativeness of the latter is now assessed in a quantified manner.