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

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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, employing the discrete element method (DEM). 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 plain strain slice of a standard ballasted cross section, bound by periodic boundaries along the longitudinal direction of the rail line. The mechanical characterisation of the material is derived via calibration to available drained triaxial tests on ballast specimens. The DEM results are compared with the load distribution assumed in the British Standards and the level of conservativeness of the latter is now assessed in a quantified manner.

Keywords: Railway Ballast, Load Distribution, Discrete Element Method, Polyhedral Particles, Realistic Particle Shapes.