Insertion of Geogrid to Ballast Layer to Improve Rail Track Performance

S. Venuja*, S.K. Navaratnarajah, C.S. Bandara and J.A.S.C. Jayasinghe

Department of Civil Engineering, Faculty of Engineering, University of Peradeniya, Peradeniya 20400, Sri Lanka
**venujas@eng.pdn.ac.lk*

Rail transport provides assured services to commuters and freights more economically. In conventional rail tracks, rails are rested on sleepers on top of the layered substructure. The ballast layer is the prominent load-bearing layer in the substructure. It facilitates quick drainage through its interconnected larger voids. Ballast is a highly angular coarse granular material that is obtained from blasting rocks and has high shear strength. Ballast particle breakage with time is the main crisis that affects the functionality and service life of tracks. It blocks the drainage as the broken particles clog the voids in the ballast layer. It also increases the frequency of monitoring and the maintenance cost. This ballast degradation depends on load cycles, aggregate gradation, the angularity of particles, and track confining pressure. One of the popular methods to decrease ballast deformation and degradation is the adaption of geogrid into the substructure. Polymeric geogrids with different shaped apertures are used in rail track applications. Geogrid has high tensile strength and high adaptability. Geogrids provide reinforcement and confinement to the ballast aggregates through the excellent mechanical interlocking of granular aggregates into the apertures. This study analyzed the effect of geogrid insertion into the ballast layer to understand the shear behavior of ballast by conducting large-scale direct shear tests on ballast with and without geogrid. There was a significant improvement in the shear resistance of ballast with the geogrid insertion due to the particle interlocking into the geogrid apertures. Moreover, numerical modeling was carried out using the discrete element method which confirmed the experimental findings. It is concluded that geogrids provide beneficial performance improvement to the ballasted tracks as it reduces the frequency of maintenance, provides lateral confinement to the ballast layer and improves load transmission.

Keywords: Ballast, Breakage, Gradation, Geogrid, Confinement

This research is supported by the Accelerating Higher Education Expansion and Development (AHEAD) Operation of the Ministry of Higher Education funded by the World Bank (AHEAD/RA3/DOR/STEM/No. 63).