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Experimental Investigation of the Effects of Subgrade Strength and Geogrid Location on the Cyclic Response of Geogrid-Reinforced Ballast

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Abstract

This study aims to investigate how the subgrade strength and the location of a geogrid within a ballast layer affect the geosynthetic's ability to stabilize railroad ballast. To do so, a total of thirteen large-scale cyclic load tests are performed on unreinforced tie–ballast assemblies and on tie–ballast assemblies reinforced with a geogrid placed at a depth of 150 mm, 200 mm, and 250 mm to compare the mechanical behavior of unreinforced ballast with that of geogrid-reinforced ballast. The results suggest that the compressibility of the subgrade supporting a geogrid-reinforced tie–ballast assembly plays a crucial role in determining the geogrid's reinforcing efficiency. In cases where a geogrid-reinforced ballast layer is supported by a competent subgrade, the geogrid's performance appears insensitive to its placement depth. However, the geogrid's location wields an increasingly significant influence over its ability to stabilize railroad ballast as the underlying subgrade becomes softer, with geogrids placed closer to the loaded area outperforming those located deeper in the ballast layer. The inclusion of geogrids in railroad ballast leads to reductions in the tie's permanent and resilient settlement which vary depending on the geogrid's location and subgrade compressibility. However, the tie–ballast assemblies' damping ratio appears to be insensitive to the presence of geogrids.

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