



Department of Civil Engineering and Engineering Mechanics
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Enhancing Ballasted Railroad Performance using Geocell Confinement



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(Host: Prof Hoe Ling)

In past years, railroad transportation has been of growing interest due to its efficiency and advancement in railway technologies. However, many issues arise due to the variability in subsurface conditions along the sizeable lengths of track that exist. One very important issue is the need for significant upkeep and maintenance for railways passing over areas of poor soil conditions due to continuous deformation and a lack of stiffness from the ballasted foundation. One general solution for lack of substructure integrity has been confinement, applied through a variety of reinforcement types, including geocell. To investigate the effectiveness of geocell confinement on ballasted substructure integrity, a series of embankment model tests with different configurations of geocell placement (one layer and two layers of geocell) were constructed and loaded monotonically and cyclically for comparison to unreinforced, control tests. Upon the completion of these tests, the model embankments and various parametric studies were simulated numerically using finite element procedures.

The tests and numerical simulations demonstrate that geocell confinement effectively increased stiffness and strength of a ballast embankment, while reducing vertical settlement and lateral spreading. Additionally, the parametric study shows that the use of geocell provides a composite, “mattressing” effect that distributes subgrade stress more uniformly than without reinforcement, increasing bearing capacity and reducing settlement, especially on soft foundations or when using weaker ballast. The results suggested that in some site conditions, use of geocell might be an economical alternative to frequent maintenance and/or lower train speeds. Additionally, it implies that geocell might be cost-effective when used in combination with degraded, weaker ballasts, i.e. inferior local or recycled materials. The use of geocell in ballast stabilization could prove to be a sustainable solution for a common and expensive problem.

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