

Numerical Analysis of Geogrid Reinforcement on Sub-Ballast Embankment for Railway Tracks Over Soft Clay Soil

Dannita Sari Widodo¹, Bambang Setiawan², Niken Silmi Surjandari³

¹, Universitas Sebelas Maret Surakarta, Indonesia ;

², Universitas Sebelas Maret Surakarta, Indonesia ;

³, Universitas Sebelas Maret Surakarta, Indonesia ;

¹; ²; ³;

Abstract

Background - The construction of railway tracks on soft clay soil faces significant challenges, particularly related to stability and soil settlement. Soft clay soils possess characteristics such as low bearing capacity, high compressibility, and a high potential for deformation under loading.

Purpose - This study aims to evaluate the performance of railway track structures on soft clay soil with and without geogrid reinforcement.

Methodology - The research method involves experimental testing and numerical simulation to compare stability response and settlement under conditions with and without geogrid reinforcement. The subgrade consists of soft clay soil collected from Sragen, Central Java, Indonesia. Laboratory tests were conducted to determine water content, bulk density, plasticity index, liquid limit, and triaxial strength. This analysis uses biaxial geogrid as the reinforcement material for the subgrade.

Findings - The results show that the use of geogrid significantly enhances load distribution on the ballast layer and reduces settlement by up to 30% compared to unreinforced conditions. Additionally, geogrid improves the subgrade stiffness modulus and minimizes differential displacement along the railway track. These findings indicate that geogrid reinforcement can be an effective solution for improving railway performance on soft clay soils, particularly in areas with moist subgrade conditions. This research contributes to the design and planning of railway infrastructure in regions with problematic clay soil conditions.

Originality - The soil input data parameters for numerical analysis are derived from primary laboratory test data.

Keywords: geogrid reinforcement, railway track, soft clay soil, soil displacement, soil stability.
