

ANALYSIS OF SETTLEMENT MITIGATION ON THE BRIDGE APPROACH USING LIGHTWEIGHT GEOFOAM EMBANKMENT MATERIAL

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ABSTRACT

The construction of bridge embankments on soft soils frequently presents challenges during both the construction and operational phases. The inherent characteristics of soft soils, particularly their low shear strength and high compressibility, often result in issues related to bearing capacity and settlement. Excessive settlement of bridge embankments can cause substantial damage to the pavement structure. The use of geofoam as a lightweight fill material offers a promising alternative to mitigate the settlement and stability problems commonly encountered in bridge embankment construction. This study aims to evaluate the impact of geofoam application on the stability and settlement behaviour of embankments. A two-dimensional finite element analysis was conducted using the PLAXIS program. The study site is characterized by a soft soil profile predominantly composed of clay with consistency ranging from very soft to soft, extending to a depth of 10 meters. The back-analysis results demonstrated a close correspondence with the pre-remediation conditions. The effectiveness of geofoam treatment was analyzed across four thickness configurations: 1 m, 1.5 m, 2.5 m, and 2.91 m. The application of a 2.91 m-thick geofoam layer achieved a factor of safety exceeding 1.5 under static conditions and over 1.1 under seismic conditions. This configuration also satisfied the settlement criteria (maximum settlement of 10 cm over a 10-year period) and wall deflection criteria (maximum deflection of less than 1.0%H), thereby meeting design requirements. The analysis of the impact of geofoam application on stability revealed that increasing the thickness of the geofoam layer led to higher factors of safety. Furthermore, the influence on settlement was evident, as increasing the geofoam thickness resulted in a reduction in both total and residual settlement.

Keyword: Bridge's Approach, Finite Element Method, Geofoam, Stability, Settlement.