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Numerical Evaluation of Geogrid-Reinforced Slopes under Various Soil and Geometric Configurations

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Abstract

This study examines the stability of geogrid-reinforced slopes under different soil and geometric conditions using SLOPE/W. The Morgenstern-Price method was used to analyze three homogeneous soil parameter sets: silty clay, clayey sand, and clayey silt. Four slope inclinations (25 degrees, 30 degrees, 45 degrees, and 60 degrees) were considered, along with total slope heights of 18, 24, 30, and 36 m. The reinforced slopes were modeled using UX1100 uniaxial geogrid at vertical spacings of 0.5, 1.0, and 1.5 m. Each reinforced model was compared with its corresponding unreinforced model under the same dry, drained, and static conditions, with pore-water pressure set to zero. The results show that FOS decreased as the slope inclination and total height increased. The calculated FOS also varied with the soil parameters. Silty clay generally produced the highest FOS, while clayey sand produced the lowest despite having a higher friction angle, due to the combined effects of cohesion, friction angle, and unit weight. As expected, the 0.5 m spacing produced the highest FOS among the three spacings because it provided more reinforcement layers within the same slope height. However, closer spacing did not provide adequate stability in every case. For the 36 m slope at 60 degrees, the reinforced FOS values were 1.49, 1.06, and 1.17 for silty clay, clayey sand, and clayey silt, respectively, which were below the adopted requirement of 1.5. The findings show that geogrid spacing should be assessed alongside soil conditions and slope geometry. The results provide comparative trends for the idealized dry slope conditions considered and are not intended as site-specific design recommendations. FOS bertetulang ialah 1.49, 1.06 dan 1.17 masing-masing untuk lempung berkelodak, pasir berlempung dan kelodak berlempung. Semua nilai tersebut berada di bawah keperluan FOS 1.5 yang digunakan dalam kajian. Dapatan menunjukkan bahawa jarak geogrid perlu dinilai bersama keadaan tanah dan geometri cerun. Keputusan ini memberikan trend perbandingan bagi keadaan cerun kering yang diidealkan dan tidak dimaksudkan sebagai cadangan reka bentuk khusus tapak.

Keywords

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