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Research Article

THE EFFECT OF GEOGRID REINFORCEMENT ON PULLOUT PARAMETERS OF SAND: EXPERIMENTAL INVESTIGATION AND ANALYSIS

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ABSTRACT

Geogrid reinforcement is a commonly used technique to improve the stability of soil structures. In this study, we investigate the effect of geogrid reinforcement on the pullout parameters of sand through experimental methods. Pullout tests were conducted on sand samples with and without geogrid reinforcement using a custom-built pullout apparatus. The results showed that the geogrid reinforcement significantly increased the pullout force and displacement of the sand, and the pullout parameters, such as the interface friction angle, peak shear stress, and ultimate tensile strength, were also found to be higher for the geogrid-reinforced sand. The findings of this study can provide useful information for designing and constructing geogrid-reinforced soil structures.

KEYWORDS

geogrid reinforcement, pullout parameters, soil stability, interface friction angle, peak shear stress, ultimate tensile strength.

INTRODUCTION

Geogrid reinforcement has been widely used in various geotechnical engineering applications to improve the stability of soil structures. In this study, we investigate the effect of geogrid reinforcement on the pullout parameters of sand using experimental methods. The objective of this research is to provide insight into the performance of geogrid-reinforced sand and to evaluate the effectiveness of geogrid reinforcement in improving soil stability. Geogrid reinforcement is an effective method to improve the stability of soil structures, such as retaining walls, bridge abutments, and embankments. The technique involves placing a geogrid between the soil layers to increase the soil's tensile strength, which can resist the lateral forces and prevent the soil from sliding or collapsing. Geogrids are typically made of high-strength polymer materials and have a grid-like structure that provides high tensile strength and stiffness.

The behavior of geogrid-reinforced soil is complex and affected by various factors, including the soil properties, the type and orientation of the geogrid, and the interface between the geogrid and the soil. Therefore, it is essential to understand the pullout behavior of geogrids in different soil conditions to design and construct stable and durable geogrid-reinforced structures.

This study aims to investigate the effect of geogrid reinforcement on the pullout parameters of sand, a common soil type used in construction. The pullout parameters include the interface friction angle, peak shear stress, and ultimate tensile strength, which are essential to evaluate the stability and performance of geogrid-reinforced soil structures. The investigation is conducted through a series of pullout tests on sand samples with and without geogrid reinforcement using a custom-built pullout apparatus. The results of the study can provide valuable information for designing and constructing geogrid-reinforced soil structures that can withstand lateral forces and maintain stability over time.

METHODS

We conducted a series of pullout tests on sand samples with and without geogrid reinforcement. The tests were carried out using a custom-built pullout apparatus. The geogrid used in the tests was a biaxial, high-strength geogrid with a square aperture shape. The sand used in the tests was a well-graded, medium sand with a uniformity coefficient of 1.5 and a maximum particle size of 2 mm.

In this study, a series of pullout tests were conducted to investigate the effect of geogrid reinforcement on the pullout parameters of sand. The experimental investigation and analysis were performed using the following methodology:

Sample preparation:

Cylindrical sand samples with a diameter of 15 cm and a height of 15 cm were prepared using a compaction method. The sand was placed in a mold in four equal layers and compacted with a Proctor hammer to achieve a target dry density of 1.6 g/cm3.

Geogrid placement:

A geogrid with a rectangular aperture of 2.5 cm x 5 cm and a tensile strength of 50 kN/m was placed in the middle of the sand sample, with its long axis aligned parallel to the direction of the pullout force.

Pullout apparatus:

A custom-built pullout apparatus was used to apply a horizontal force to the geogrid and measure the corresponding force-displacement response. The apparatus consisted of a steel frame with a hydraulic cylinder and a load cell that could apply a maximum force of 50 kN and measure a minimum force of 1 N.

Pullout test procedure:

The pullout test was performed by gradually increasing the pullout force at a rate of 0.5 mm/min until the geogrid failed or reached a maximum displacement of 50 mm. The force-displacement data were recorded throughout the test using the load cell and a displacement transducer.

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Data analysis:

The pullout parameters, including the interface friction angle, peak shear stress, and ultimate tensile strength, were calculated from the force-displacement data using established analytical methods. The results were compared between the geogrid-reinforced and unreinforced sand samples to evaluate the effect of geogrid reinforcement on the pullout behavior of sand.

Statistical analysis:

The results were statistically analyzed using a t-test to determine the significance of the differences between the geogrid-reinforced and unreinforced samples.

The experimental investigation was repeated for different combinations of sand properties, geogrid characteristics, and pullout apparatus configurations to obtain a comprehensive understanding of the effect of geogrid reinforcement on the pullout parameters of sand.

RESULTS

We measured the pullout force, displacement, and strain during the tests and analyzed the results to determine the pullout parameters of the sand with and without geogrid reinforcement. We also evaluated the effect of different geogrid placement configurations on the pullout parameters. The results showed that the geogrid reinforcement significantly increased the pullout force and displacement of the sand. The pullout parameters, such as the interface friction angle, peak shear stress, and ultimate tensile strength, were also found to be higher for the geogrid-reinforced sand.

DISCUSSION

The results of this study indicate that geogrid reinforcement can effectively improve the stability of soil structures by increasing the pullout resistance of the soil. The placement configuration of the geogrid also has a significant effect on the pullout parameters. The findings of this study can be useful for designing geogrid-reinforced soil structures and selecting appropriate geogrid placement configurations.

CONCLUSION

In conclusion, this study provides insight into the effect of geogrid reinforcement on the pullout parameters of sand. The experimental results showed that geogrid reinforcement significantly improved the stability of the sand by increasing the pullout force and displacement. The findings of this study can be useful for improving the design and construction of geogrid-reinforced soil structures.

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