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摘要集

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目　录

Shaking table study on sand-EPS beads-mixtures using a laminar box

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Abstract: Mixture of sand-expanded polystyrene (EPS) beads is one of the new geo-materials with high compressibility that can be used as a seismic buffer and base isolation due to its great capability for energy dissipation. In this study, a series of 1-g shaking table tests is conducted to assess the dynamic properties of the sand-EPS beads mixtures with a particular focus on the stress-strain response and the variation of shear modulus and damping ratio at the range of medium to large levels of strain. The influence of various parameters, including the amplitude of input base acceleration and EPS content, on the response of sand-EPS beads mixtures is examined. The physical model of sand-EPS bead mixtures showed a lower induced peak acceleration compared to the clean sand model. Moreover, the addition of EPS beads to sand reduced the deformations caused by dynamic loading. The results also revealed that the damping ratio and shear modulus of the samples depend on the EPS bead content, such that its increase results in the damping ratio increasing to 100% or more. On the contrary, the shear modulus of all sand-EPS bead mixtures undergoes a significant reduction with the increase in EPS bead content.

Keywords: Geosynthetics, EPS beads, Chamkhaleh sand, shaking table, shear modulus, damping ratio

Interaction mechanisms in small-scale model MSE walls under the strip footing load

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Abstract: The effect of preloading on mechanically stabilised earth (MSE) has remained an aspect difficult to quantify in design, particularly when considering different reinforcement types, stiffness values, and facing rigidity. This study analyses several scaled model tests on MSE walls under a strip footing load with a single unloading-reloading cycle. Scaled models were constructed as part of this investigation to expand the evaluation of previously constructed full-scale tests. The strip footing load and wall deflections were measured and compared with analytical models. The failure mechanism of the soil, before and after the strip footing load, was included in the study via the particle image velocimetry (PIV) method. The results indicate that the bearing capacity of a strip footing is higher for a rigid facing than for a flexible facing. PIV analysis results for the first and second loading step formed two failure lines with the angle ($\pi/4+\varphi/2$). The deflection values in the second loading step, however, were smaller than those reached during the first loading in small-scale tests. Good agreement was observed between the proposed analytical method and experimental results for the second loading step, after taking into account the preloading effect.

Keywords: Geosynthetics, Scaled MSE model tests, Strip footing load, Preloading, Analytical analysis, Particle image velocimetry (PIV)

Monotonic, cyclic and post-cyclic shearing behavior of sand-EPS geofoam interface

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Abstract: Sand-EPS geofoam is commonly used as a seismic buffer in a variety of geotechnical applications to alleviate damages imposed by seismic vibrations. Evaluation of the properties of the sand-EPS geofoam interface is an essential part of the design and installation of EPS geofoam in direct contact with the parent sand. In this study, a series of laboratory tests are carried out using a large-scale direct shear apparatus to evaluate the monotonic, cyclic and post-cyclic behavior of the sand-EPS geofoam interface. Adopting the relative density of the parent sand, the density of EPS geofoam, the applied normal stress, the cyclic shear strain semi-amplitude and the number of cycles as the variable parameters, their influence on the response of the sand-EPS geofoam interface is investigated. According to the experimental results, with the increase in the number of cycles, sand relative density, EPS geofoam density and the applied normal stress, the equivalent or secant stiffness of the sand-EPS geofoam interface increases while its damping ratio declines. The results of the monotonic (MDS) and post-cyclic monotonic (CMDS) shearing experiments also show that with an increase in the EPS density and normal stress, which offers greater resistance against sliding, the mobilized shear stresses generally increase.

Keywords: Geosynthetics, Sand-EPS geofoam interface, Secant shear stiffness, Damping ratio, Monotonic, Cyclic, Post-cyclic, Large-scale direct shear tests

Use of geosynthetics to mitigate problems associated with expansive clay subgrades

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Abstract: Geosynthetics have recently been used for base course stabilization of roadways subjected to environmental loads associated with the presence of expansive clay subgrades. Repeated cycles of wet and dry seasons have often led to significant, non-uniform moisture changes within clay subgrades, resulting in differential settlements between the roadway edges and its centerline and, ultimately, in environmental longitudinal cracks. This paper quantifies the field performance of different sites in order to assess the effectiveness of using geosynthetics to stabilize the base course of roadways constructed on expansive clay subgrades. This includes evaluation of five full-scale field projects that had been subjected to actual traffic and environmental loads. The long-term performance of geosynthetic-stabilized and control sections was evaluated by quantifying the development and extent of longitudinal cracks and the degradation of the base course stiffness. Collectively, the performance evaluation of the multiple geosynthetic-stabilized and control sections in the five case studies demonstrates that geosynthetics can effectively mitigate roadway problems associated with expansive clay subgrades. In addition, field performance data also indicates that unconfined stiffness and tensile strength may not be sufficient for proper geosynthetic selection, pointing to the need for selecting them using properties that also quantify the soil-geosynthetic interaction.

Keywords: Geosynthetics, Geogrid, Geotextile, Expansive Clay, Base Stabilization, Field Evaluation

In-plane elastic properties of geosynthetics from in-air biaxial tension tests

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Abstract: Geosynthetics experience load simultaneously in each principal material direction in applications such as retaining walls, constructed slopes, roadways, and reinforced granular load transfer platforms. Biaxial loading results in a stiffer load-strain response compared to that observed in uniaxial loading. Load-strain properties of geosynthetics determined from wide-width uniaxial tension tests are unable to account for this effect and are generally regarded as an index test. This paper presents the development of a biaxial testing procedure to provide load-strain response data necessary to determine in-plane linear elastic tensile properties of geosynthetics. These properties consist of two elastic moduli, two dependent in-plane Poisson's ratios and an in-plane shear modulus. The elastic moduli and Poisson's ratios are derived from non-bias biaxial tests where load is applied in the two principal directions of the material. The in-plane shear modulus is determined from biaxial tests on specimens where load is applied on a bias such that the principal material directions are oriented at a 45-degree angle to the test machine directions. The tests are performed on geosynthetics that have been load conditioned such that the subsequent load-strain response is considered to be a resilient response pertinent to repetitive load applications such as geosynthetic reinforced pavements.

Keywords: Geosynthetics, Geogrid, Geotextile, Biaxial loading, Resilient response, In-plane elastic properties, Elastic modulus, Shear modulus, Poisson's ratio, Bias test

Liquefaction behavior of fiber-reinforced sand based on cyclic triaxial tests

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Abstract: In this study, the liquefaction behavior and development laws of pore water pressure in fiber-reinforced sand were studied using cyclic triaxial tests, and the effects of cyclic stress ratio, fiber content, and fiber length were investigated. The test results showed that the cycle number leading to liquefaction and liquefaction resistance increased with fiber content and fiber length, whereas the cycle number leading to liquefaction decreased as the cyclic stress ratio increased. The pore water pressure accumulated more slowly in the fiber-reinforced sand than in the unreinforced sand, and the curves of pore water pressure at low cyclic stress ratio (0.195, 0.203, and 0.230) exhibit three stages, namely a rapidly increasing stage, a slowly increasing stage and a sharply increasing stage. The curves of pore water pressure at high cyclic stress ratio (0.258 and 0.282) exhibited a more varied pattern than those at a low cyclic stress ratio. Based on the test results, a three-parameter pore water pressure model was established considering the effect of cyclic stress ratio, fiber content, fiber length, and sand particle diameter. The predictions agreed relatively well with experimental results, demonstrating that the model can be used to predict pore water pressure in fiber-reinforced sands.

Keywords: Geosynthetics, liquefaction, pore water pressure, fiber-reinforced sand, cyclic stress ratio

Influence of pocket shape on numerical response of geocell reinforced foundation systems

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Abstract: Geocells are three-dimensional cellular expandable mats used to improve the load-carrying capacity of weak subgrades. The expanded geocell pockets take the shape of a honeycomb connected to their neighbouring pockets. This manuscript deals with the importance of considering the exact shape of the geocell pockets in three-dimensional numerical modelling. The data for the calibration of the numerical models was obtained through laboratory plate load tests. The numerical simulations were carried out using finite difference software, Fast Lagrangian Analysis of Continua in Three Dimensions (FLAC3D). The walls of the geocell were modelled using geogrid elements having only tensile load capacity. The interfaces between the geocell walls and the infill soils were modelled using Mohr-Coulomb yield criterion. Three shapes of geocell pockets, viz. an exact honeycomb shape and simplified shapes (square and diamond), were considered in the numerical simulations. The numerical models with an exact shape of pockets have shown better agreement with experimental data, while the models with approximated shape overestimated the actual load capacity. The paper describes the modelling approach and the reasons for more accurate numerical predictions with the exact shape of geocell pockets compared to simplified pocket shapes.

Keywords: Geosynthetics, Geocell, Geogrid, Foundation bed, Numerical analyses, Plate load tests, Numerical models, Finite difference analysis