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摘要集

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目　录

A quantification of the short-term reliability of HDPE geomembrane seaming methods

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Abstract: This study provides a preliminary approximate quantification of the difference in seam reliability between fusion seams and extrusion seams of high-density polyethylene (HDPE) geomembranes based on leaks that exist at the end of installation. The two different seaming methods as well as seam testing methods are discussed. The reliability of the two seaming methods is compared using the number of leaks associated with extrusion seams versus fusion seams, which were found using electrical leak location surveys performed on a sampling of large geomembrane-lined facilities.

Keywords: Geosynthetics, Seaming reliability, Fusion seam, Extrusion seam, Dual-track fusion seam, HDPE, Geomembrane installation, Leak frequency, Electrical leak location

Novel application of machine learning for estimation of pullout coefficient of geogrid

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Abstract: Pullout behaviour of geogrids is critical to understand for the design of mechanically stabilized earth walls. The pullout coefficients are determined through laboratory testing on geogrids embedded in structural fill. Random forest (RF) is a data-driven ensemble learning method that uses decision trees for classification and regression tasks. In the present study, the use of the RF regression technique for estimation of pullout coefficient of geogrid embedded in different structural fills and at variable normal stress based on 198 test results has been investigated using five-fold cross-validation. 80% of the data has been trained on the model algorithm and the accuracy of the model is then tested on 20% of the remaining dataset. The performance of the model has been checked using statistical indices, namely R^2, mean square error, as well as external validation methods. The validity of the model has also been checked against laboratory tests conducted on geogrid embedded in four different fills. The results of the RF model have been compared to results obtained with three other regression models, namely, Multivariate Adaptive Regression Splines, Multilayer Perceptron, and Decision Tree Regressor. The results demonstrate the superiority of the RF-based regression model in predicting pullout coefficient values of geogrid.

Keywords: Geosynthetics, random forest, machine learning, pullout test

Influence of physical clogging on filtration performance of soil-geotextile interaction

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Abstract: During the past four decades the use of nonwoven geotextiles as filter materials in geotechnical works has experienced a marked increase. In this study, the water permeability coefficient of nonwoven geotextiles after 23 years of exploitation in drainage system was determined to evaluate the influence of physical clogging on filtration performance of geotextiles. The obtained results showed that the geotextiles were clogged by soil particles. What is more, the objective in this study was to establish a gradient ratio test method for estimating a clogging phenomenon of geotextile filter adequately. A series of gradient ratio tests on three kinds of needle-punched nonwoven geotextile filters whose number of constrictions differs was performed. A geotextile filter was put under a silty sand layer. Based on the test results, it was confirmed that the water permeability coefficient became small as the gradient ratio increased, depending on the number of constrictions of the geotextile. It was also found that the modified gradient ratio GR_4 is more sensitive than GR_8 and GR_{25}. Based on interpretation of the experimental results, the authors recommend the acceptance limit of GR_8 equal to 3.7 and of GR_4 equal to 4.8.

Keywords: Geosynthetics, nonwoven geotextiles, synthetic filters, physical clogging, constrictions, gradient ratio

Analytical model for the design of piled embankments considering cohesive soils

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Abstract: Geosynthetic-reinforced and pile-supported (GRPS) systems have already proven their good performance in supporting embankments constructed over soft soil. The load transfer mechanism in GRPS embankments depends on the complex interaction between the soil in place, the structural elements and the embankment's soil type (cohesive or cohesionless). However, the cohesion influence of the embankment soil has not been well investigated as it is often not considered in the design of such systems. The main aim of this study is to present an analytical model for GRPS embankments that combines several phenomena such as the concentric arches model in cohesive fill soils, the hyperbolic model for the isochrone geogrid curve, and subsoil's consolidation. Three-dimensional numerical analyses are also conducted to evaluate the embankment soil cohesion influence on the soil arching. Both the numerical and analytical results agree that the cohesive embankment fills strengthen the soil arching effect and increase the efficacy if compared with cohesionless embankment fills. A comparison of the analytical model with measured data and other design methods for full-scale field tests proved the proposed model efficiency. The proposed analytical model therefore can be applicable for GRPS embankments with cohesive and non-cohesive fill soils.

Keywords: Geosynthetics, piled embankment, soil arching, cohesive soil, numerical model, limit equilibrium methods

Effects of processing type on shear modulus and damping ratio of waste tire-sand mixtures

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Abstract: Processed waste tires can be used as additives for geotechnical applications in earthquake-prone areas. The increasing use of waste tires additives requires a better understanding of their dynamic behaviors. Processed waste tires as granular and fiber-shaped rubber particles under the same experimental conditions have not been studied before. The main purpose of this study is to carry out these experiments to determine the effects of two different processing techniques on the shear modulus and damping ratios of the mixtures. It is also the first time that the effects of fiber-shaped rubber particle inclusions are determined in detail. In addition, the results of similar tests using different processed waste tires were evaluated. The effects of the processed waste tires are given by evaluating the literature and this study together. It has been found that depending on the size, aspect ratio and content of the rubber material, the type of processing can significantly affect the dynamic properties of the mixture. The tested materials may be suitable as base isolation material. Of all the studies evaluated, the highest damping ratio was obtained with granulated rubber inclusions.

Keywords: Geosynthetics, Cyclic Triaxial Test, waste tire-sand mixtures, dynamic properties, geotechnical base isolation

Effect of reinforcement stiffness on response of back-to-back MSE wall upon infiltration

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Abstract: Back-to-back mechanically stabilized earth (MSE) walls are being widely utilized as bridge abutments and highway ramps, considering their cost effectiveness and ease of construction. Though high quality well-graded granular fill is the most appropriate backfill material, owing to its scarcity, locally available low-quality soils are often used as backfill. Nevertheless, numerous failure cases of such walls with low-quality soil are reported, especially subsequent to rainwater infiltration. The stiffness of reinforcement is a key parameter affecting the overall behaviour of MSE walls. The present study investigates the influence of reinforcement stiffness on the response of select fill, marginal fill, and hybrid-fill back-to-back MSE walls using a finite element (FE) based approach. Results show that stiffness of reinforcement has a significant effect on the overall performance of marginal fill wall upon rainfall infiltration. Specifically, with the increase of reinforcement stiffness, the infiltration-induced facing displacement decreases and reinforcement tension increases. However, the performance of select fill and hybrid-fill walls following rainfall infiltration was found to be satisfactory even with low stiffness reinforcements, and further improvement with increase of reinforcement stiffness was insignificant. The reduction of safety factors during infiltration was shown to be independent of reinforcement stiffness for all wall types.

Keywords: Geosynthetics, Back-to-back reinforced earth wall, Finite element modeling, Rainwater infiltration, Reinforcement stiffness

Vertical stability of geotextile-encased sand columns without and with surrounding soil

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Abstract: Use of geotextile encasement can enhance the axial capacity of individual sand columns by providing an additional confinement, hence reducing both the radial and axial deformations. In very weak soils, geotextile-encased sand columns (GESaCs) may buckle due to the lack of confinement offered by the surrounding soil. This paper focuses on the vertical stability of individual GESaCs of various diameters and lengths tested in air to demonstrate their performance in the extreme case where the surrounding soil offers no confinement, and in weak soil, which simulates the more likely case where such columns would be considered for use. Loose sand was selected to simulate the weak surrounding soil. Loading tests were conducted on individual GESaCs prepared in air and loose sand to investigate the load capacity, radial strain, and axial strain of columns. GESaCs of smaller diameters exhibited higher axial pressure capacities compared with those of larger diameters. GESaCs prepared in either air or loose sand delivered higher axial capacities at smaller length to diameter ratios. Columns in loose sand exhibited lower radial and axial strains as compared with those in air when the same pressure was applied on the top area of the column.

Keywords: Geosynthetics, sand column, geotextile encasement, vertical stability, buckling

Influence of cyclic load on pullout stiffness of geogrid embedded in well-graded gravel

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Abstract: Railway structures applied to high-speed railways must achieve high performance in terms of strength and deformation characteristics. This requirement has led to the widespread use of geosynthetic-reinforced soil (GRS) structures. For the design of GRS structures, it is important to evaluate not only the tensile strength of the geosynthetic but also the pullout stiffness (spring constant of geosynthetic). Hence, a series of cyclic pullout loading tests were conducted to evaluate the pullout characteristics of various types of reinforcement embedded in the soil. Moreover, these test results were compared with the results of in-isolation tensile tests with the same loading histories. The experiments revealed that the pullout stiffness increased with an increase in the confining pressure and in-isolation tensile stiffness, but decreased with an increase in the relative displacement between the soil and reinforcement. Although the pullout stiffness was found to be affected by factors such as experimental conditions and type of reinforcement, a similar trend was observed in the results of several other tests when examining the relationship between the normalized pullout stiffness and the average strain generated in the reinforcement. This interesting correlation can be taken into account during the design of GRS structures that support bridge girders.

Keywords: Geosynthetics, Design, Sustainable technology, Reinforced soil, Pullout test, In-isolation tensile test, Pullout stiffness