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摘要集

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目　录

A hyperbolic model for mechanical behaviour of marginal soil-geosynthetic interface

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Abstract: Locally available marginal soils are of great interest to use as backfill material in geosynthetic reinforced soil structures due to their cost-effectiveness. The advanced stress–strain analysis of these structures necessitates the correct evaluation and the accurate description of marginal soil-geosynthetic interface behaviour. Therefore, the primary objectives of this study are numerical and analytical analysis of the soil-geosynthetic interface behaviour with application of a hyperbolic nonlinear elastic perfectly plastic constitutive model. In this investigation a series of large-scale direct shear tests was performed to evaluate the shear stress-displacement interface behaviour considering two types of marginal soils in contact with five types of geosynthetic materials in different soil moisture conditions. Accordingly, the hyperbolic model was used to simulate the soil-geosynthetic interface behaviour. Moreover, a three-dimensional finite element model of the direct shear test was developed using ABAQUS software and a user-defined subroutine was implemented to consider the hyperbolic interface model. The results indicated a very good agreement between the experimental data and the predicted finite element simulations of the direct shear tests and analytical solutions. Finally, a numerical simulation of a pullout test is presented in this paper with application of the hyperbolic interface model.

Keywords: Geosynthetics, Marginal soil, Reinforced soil structure, Soil-geosynthetic interface, Finite element modelling

Factors affecting multicomponent GCL-geomembrane interface transmissivity for landfills

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Abstract: A series of laboratory tests were conducted to investigate the interface transmissivity, θ, between a 1.5 mm thick high-density polyethylene geomembrane (GMB) and a multicomponent geosynthetic clay liner (GCL) when permeated with a simulated municipal solid waste landfill leachate under a range of applied stresses (10–150 kPa). The effect of three different prehydration fluids, a 4 mm diameter central coating defect, coating defect position, and the effect of coating orientation of the GCL were investigated. It was found that at an applied stress of less than 70 kPa, the effect of these factors on θ was largely masked by the variability in the initial interface contact condition between the GMB and GCL. At 100–150 kPa, the effects of initial variability were largely eliminated, but there was no notable effect of other factors for multicomponent GCLs on interface transmissivity.
Keywords: Geosynthetics, multicomponent GCL, interface transmissivity, composite liner, landfill

Vacuum-induced lateral deformation around a vertical drain in dredged slurry

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Abstract: The horizontal strain in the vacuum preloading/dewatering of dredged slurry is significant to the apparent clogging effect and estimation of surface settlement around a drain; however, it has seldom been investigated in previous studies. In this study, a vacuum consolidation model test assisted by particle image velocimetry (PIV) technology was conducted. The displacement vector field was obtained through PIV analysis and image processing; it was used to visually observe the deformation features around a drain. Based on the displacement field, the vertical/horizontal strains at varied radial distances were calculated to explain the 'soil pile' and apparent clogging effect. From the strain distribution with radial distances, a significant lateral compression zone near the drain and an extension zone at farther areas were confirmed. Furthermore, a simple explicit model was established to evaluate the horizontal strain within a prefabricated vertical drain unit cell considering a horizontal attenuated vacuum and compression/extension zone. Finally, this method was applied to predict the horizontal displacement in the model test. The results showed that the proposed method can estimate the lateral displacement of soft clay slurry fairly well.

Keywords: Geosynthetics, Laboratory tests, Strain

Influence of backfill type on the load-bearing performance of GRS bridge abutments

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Abstract: The influence of backfill type and material properties on the performance of field-scale geosynthetic reinforced soil (GRS) abutment models is investigated. Two alternative types of backfill as recommended in the Federal Highway Administration (FHWA) guidelines (called open-graded and well-graded) were used to build two field-scale model abutments and compare their load-bearing performance under a loading beam. Results are presented and discussed relative to the loading beam settlement, facing deformation and reinforcement strains. The well-graded backfill was found to result in smaller beam settlements and facing lateral deformations, especially at smaller loads that were comparable to service load levels. However, it was significantly faster and easier to compact the open-graded aggregate to the unit weight recommended in the guidelines. Nevertheless, performances of both abutment models were found to be satisfactory relative to the limiting requirements on the beam settlement and facing deformations at service load levels.

Keywords: Geosynthetics, Geosynthetic reinforced soil-integrated bridge system (GRS-IBS), Bridge abutments, Field-scale model tests, Load-deformation performance, Backfill aggregate

Mechanical behavior of a fiber reinforced reclaimed asphalt pavement sand-cement blend

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Abstract: Reuse of reclaimed asphalt pavement, RAP, provides an option to face the obstacles of both an economic and environmental nature, reintegrating the material into the soil as an alternative way either to dispose of it, or to reduce other aggregates' usage. However, total or partial substitution must be associated with an improvement technique to abide by norms and regulations requirements, such as cement stabilization and fiber reinforcement. The research presented in this paper aims to evaluate the effects of including 24-mm polypropylene randomly distributed fibers on a mixture of a cemented sandy soil with a substitution of 30% reclaimed asphalt pavement (RAP) in lieu of soil. The experimental program was developed to examine the mechanical behavior of the mixture, including unconfined compressive strength, flexural tensile strength, splitting tensile strength, pulse-velocity, durability, and monotonic and cyclic simple shear tests, over different mixture dosages containing 3%, 5%, 7% and 9% Portland cement, 0.5% fiber, over a compaction effort to achieve dry weights of 16.4 kN/m^3, 17.2 kN/m^3 and 18.0 kN/m^3. The fiber reinforced mixtures were compared to literature results, utilizing the same materials. Results indicate improvement of strength and durability overall, and also a possible drawback concerning the material's Q3 shear modulus.

Keywords: Geosynthetics, fiber-reinforcement, ground improvement, reclaimed asphalt pavement, simple shear tests

2D and 3D simulations of static response of a geosynthetic reinforced soil bridge abutment

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Abstract: This paper presents two-dimensional (2D) and three-dimensional (3D) numerical simulations of a half-scale geosynthetic reinforced soil (GRS) bridge abutment during construction and bridge load application. The backfill soil was characterized using a nonlinear elastoplastic model that incorporates a hyperbolic stress–strain relationship and the Mohr–Coulomb failure criterion. Geogrid reinforcements were characterized using linearly elastic elements with orthotropic behavior. Various interfaces were included to simulate the interaction between the abutment components. Results from the 2D and 3D simulations were compared with physical model test measurements from the longitudinal and transverse sections of a GRS bridge abutment. Facing displacements and bridge seat settlements for the 2D and 3D simulations agree well with measured values, with the 2D-simulated values larger than the 3D-simulated values due to boundary condition effects. Results from the 3D simulation are in reasonable agreement with measurements from the longitudinal and transverse sections. The 2D simulation can also reasonably capture the static response of GRS bridge abutments and is generally more conservative than the 3D simulation.

Keywords: Geosynthetics, Geosynthetic reinforced soil, Bridge abutment, Numerical simulation, Three-dimensional, Two-dimensional

Experimental evaluation of salinity geosynthetics capillary barriers

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Abstract: This paper explores the transient upward flow of saline water in one-dimensional soil and soil–geosynthetics columns to evaluate preventive measures to mitigate salinity rise. Unsaturated soil concepts are utilised to elucidate the salinity movement through geotextile and geocomposite drain interfaces. The presence of a geotextile layer slowed down the capillary rise of the saline water. However, it did not prevent the breakthrough of the saline water due to the hydrophilicity of the geotextile and the suction at the geotextile base being close to the geotextile's water entry suction value. In contrast, using a geocomposite drain mitigated the upward saline wetting front. It acted as a salinity capillary barrier due to the initial hydrophobicity of its geotextile component and the air gap present in the geonet core.

Keywords: Geosynthetics, Salinity, Capillary break

Seismic response of geogrid-reinforced fiber-cement soil walls using shaking table tests

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Abstract: Improving the characteristics of local low-strength soils at the construction site is one of the appropriate approaches to employ the soils as a backfill of geogrid-reinforced soil (GRS) walls. In this study, the fiber-cement-treated sand–silt mixture was used as the backfill of walls. The post-earthquake performance of the walls was evaluated by applying the sinusoidal waves on 1 m high reduced-scale physical models and conducting a series of 1*g* shaking table tests. A comparison of the wall models constructed with treated and untreated backfill indicated the advantages of geogrid-reinforced fiber-cement-treated soil walls subjected to strong ground motion. The results revealed the better behavior of the wall models backfilled with treated soil mixtures under dynamic loading. Such improved performance was more evident in (*i*) deformation responses, including the lateral displacement of wall facing, deformation mode, failure surfaces, and settlement of backfill surface and (*ii*) acceleration response in different locations, including facing, reinforced, and retained zones of walls.

Keywords: geosynthetics, geogrid reinforced soil (GRS) wall, fiber-cement-treated sand–silt mixture, post-earthquake performance, reduced-scale physical models, 1*g* shaking table test