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摘要集

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目　录

Confined-reinforced earth with various geogrid lengths in reducing differential settlement

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Abstract: Reducing differential settlement between bridges and their embankments caused by an earthquake is necessary to maintain traffic, especially emergency vehicles accessing affected areas. The confined-reinforced earth (CRE) method has been proposed to strengthen the subgrade layer at the bottom of a road pavement and to ultimately reduce road surface unevenness. The method uses granular soil, geogrid layers and confining tie rods. This study presents model experiments designed to investigate the effects of embedded geogrid lengths on CRE behavior under differential settlement and cyclic (vehicle) loads. The CRE was constructed on a fixed plate to simulate a bridge abutment, and on a movable plate to simulate the settlement of an embankment. The results showed that the surface settlement distribution and the maximum surface slope of the CRE decreased with an increase in embedded geogrid length until the geogrids are sufficiently long. Beyond this length value, the deformation only changed slightly. The tensile strain in the geogrids also increased with increased embedded geogrid length under settlement, and the maximum tensile strain increased linearly with increasing settlement. The increment of tensile strain due to the cyclic load was larger for lower geogrid layers than for upper geogrid layers.

Keywords: Geosynthetics, Confined-reinforced earth, Geogrid length, Differential settlement, Cyclic load

Numerical modelling of geotextile tubes filled with gold mine tailings

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Abstract: Geotextile tubes are generally used in hydraulic and marine applications such as coastal protection and flood control. They are also used to dewater sludge from sewage treatment plants and dredged materials. Studies have been carried out to derive analytical solutions and develop empirical models as well as numerical simulations to represent the behaviour of geotextile tubes in such applications. However, there has been insufficient attention on dewatering of mining tailings. This article presents the numerical results of modelling a geotextile tube using Abaqus, a commercially available finite element software package. The mechanical behaviour of the tube was simulated while it was being filled with gold mining tailings. Back analyses of a large-scale field test as well as parametric analyses were performed to evaluate the influence of filling pressure, elastic modulus and finite element type on the stress–strain behaviour of the geotextile tube. In terms of validation, the numerical results agreed well with the analytical results and field test observations. A smaller elastic modulus causes greater strain. Comparing the results obtained using different types of finite elements, it was observed that the membrane element used to simulate the geotextile tube represented its mechanical behaviour well.

Keywords: Geosynthetics, Geotextile tube, Finite element model, Analytical methods, Mining tailings, Mechanical behaviour

Fatigue performance of geosynthetic-reinforced asphalt layers

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Abstract: This study aims at understanding the influence of different geosynthetic reinforcements on the fatigue performance of asphalt layers and the corresponding mechanisms involved. Three different types of geosynthetic reinforcement, namely a biaxial polypropylene geogrid (PP), a polyester geogrid coated with a polymer-modified binder (PET) and a glass geogrid composite (GGC), were employed to understand the fatigue behaviour of asphalt layers via an asphalt beam fatigue test (ABFT) along with the use of digital image correlation (DIC) techniques. The ABFT results suggest that incorporating geosynthetic reinforcement in the asphalt layers improved the fatigue performance by factors of 11, 27, and 38 for the PP, PET, and GGC specimens, respectively. With the aid of DIC, the mechanisms involved in enhancing the fatigue performance of asphalt layers were effectively evaluated. At failure, a maximum tensile strain of 11.2% was obtained using DIC in control specimens against maximum strain values ranging from 2.7 to 3.8% in geosynthetic-reinforced asphalt specimens. Reductions in layer thickness for the geosynthetic-reinforced asphalt layers on the order of 5.9% (PP), 17.6% (PET), and 23.5% (GGC) were established for the geosynthetics evaluated in this study, based on test results adopted in a design example.

Keywords: Geosynthetics, Digital image correlation, Fatigue cracking, Asphalt concrete, Fatigue life

Behavior of discrete fiber-reinforced sandy soil in large-scale simple shear tests

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Abstract: This study presents results from a series of large-scale simple shear tests performed on sandy soil reinforced with randomly distributed fibers. The soil was mixed with polypropylene, glass and basalt fiber, respectively, with fiber content varying from 0% to 2% and sheared under a normal stress ranging from 100 kPa to 300 kPa. The effects of fiber type, content and normal stress on shear strength and the dilatancy behavior were examined. The friction state theory was employed to interpret the influence of fiber reinforcement on the dilatancy behavior. The results indicate that the additions of polypropylene and basalt fibers are beneficial to enhancing ultimate shear strength, whereas the glass fiber makes little contribution. It is shown that the fiber inclusion hinders the close packing and interlocking of soil particles and hence produces relatively looser soil fabric in the as-compacted state, leading to increased volume contraction accompanied by a negligible improvement or even reduction in shearing stiffness over a small to moderate strain range. The most obvious increase in shear strength generally occurs at a shear strain exceeding 10%, where the fibers and particles are in tight contact with each other, allowing full interface interaction and the mobilization of fiber tensile strength.

Keywords: Geosynthetics, Fiber reinforcement, Sandy soil, Simple shear test, Shear strength, Dilatancy

Working behaviour feedback of composite geomembranes based on seepage monitoring data

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Abstract: To assess the durability of the impermeability of composite geomembranes in hydraulic engineering projects, using nearly 20 years (2000–2018) of seepage monitoring data from the Wangfuzhou Hydraulic Engineering Project, this study conducts feedback analysis on the anti-seepage performance of the composite geomembranes of this project. Firstly, based on the seepage monitoring data, a qualitative analysis of the overall seepage behaviour of the embankment dams was carried out. Then, a typical section of the embankment dams was selected for quantitative analysis by establishing a statistical model of the water levels in piezometric pipes. Subsequently, orthogonal design, a neural network and a numerical calculation method were combined to invert the permeability coefficient of the composite geomembranes. Lastly, the working behaviour of the composite geomembranes was comprehensively analysed. The results show that the measured water level and separated time-dependent components of three piezometric pipes in the typical section GY5 decreased gradually during the study period. The permeability coefficient of the composite geomembranes inverted using the measured water level was $1.11 \times 10–12$ m/s. It is concluded that, after nearly 20 years of service, the composite geomembranes of the Wangfuzhou Hydraulic Engineering Project have experienced no apparent deterioration trend over time.

Keywords: Geosynthetics, Composite geomembrane, Seepage behaviour, Piezometric water level, Statistical model, Parameter inversion

Field assessment of improvement in composite modulus of geosynthetic-reinforced pavements

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Abstract: A field study was carried out by constructing 15 test sections on Sahol-Kim state highway (city: Surat, India) using different geosynthetic materials and three control sections. The benefits of geosynthetic reinforcement were evaluated in terms of composite modulus obtained by Light Weight Deflectometer and field California Bearing Ratio tests of the granular layer. The effect of geosynthetic type, its properties, the location of the geosynthetic, infill material, and so on was investigated. The increase in the tensile strength of the geogrid had less effect on composite modulus improvement factor (CMIF) compared to the aperture size of the geogrid. The placement depth of the geogrid also had a strong influence on CMIF. Pavements with geocell-reinforced bases exhibited higher modulus improvement compared to geogrid-reinforced pavements. Geocell sections with wet mix macadam as an infill material exhibited better performance compared to those with fly ash as an infill material.

Keywords: Geosynthetics, Pavements, Composite modulus improvement factor, Field California Bearing Ratio tests, Field tests

Experimental study of the shear behaviour of a multilayer geosynthetic liner system

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Abstract: Landfill stability is closely related to the shear strength of liner systems. Traditional interface shear tests at a single geosynthetic/geosynthetic or soil/geosynthetic interface cannot fully reflect the interactions between multiple geosynthetics within liner systems. To date, shear test data on composite liners that contain more than two geosynthetics are limited. This paper presents an experimental study of the interface shear behaviour of a multilayer geosynthetic liner consisting of a drainage geocomposite (GC), a textured geomembrane (GMB), and a needle-punched geosynthetic clay liner (GCL). It is revealed that the failure surface was transferred from the GCL interior to the GMB/GCL interface during the hardening stage. Higher displacement rates led to higher peak strengths, but a displacement rate of 0.1 mm/min yielded significantly higher residual strengths as this provided nearly drained conditions. Furthermore, three single interfaces contained in the composite liner were also tested, and the comparative analyses indicate that the macro shear strengths of multilayer liners can be roughly estimated with the test results of a single-failure interface.
Keywords: Geosynthetics, multilayer liner, geomembrane, geocomposite, direct shear test