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摘要集

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目　录

Influence of geosynthetic reinforcement on maximum settlements of semi-rigid pavements

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Abstract: The aim of this paper was to improve the understanding of the influence exerted by geosynthetic reinforcement on stress and strain states in typical semi-rigid pavement structures subjected to traffic loading. A comparison of traffic-load-induced settlements of pavements with and without reinforcement is presented. The pavement-subgrade structure was modeled as a two-dimensional three-layer system using the finite element method. The behaviour of such structures was analysed in terms of ground compaction. A model of soil compaction was used to predict pavement deformation under repeated traffic loading. A series of numerical simulations were conducted to investigate the settlements of pavements with and without reflective cracks. It was assumed that reflective cracks propagate from the base layer to the pavement surface. The main attention was focused on the positive effect of the inclusion of reinforcement in pavements on the behaviour of such structures under traffic loading. The influence of such factors as subgrade properties, the magnitude of traffic loading and the presence of cracks in the pavement structure on stress and strain states was investigated. It was confirmed that placing a geosynthetic reinforcement layer inside the bituminous layer leads to a significant reduction in pavement settlements.

Keywords: Geosynthetics, Reinforcement, Traffic load, Pavement settlements, Reflective cracks, Ground compaction.

Shaking table study of the influence of facing on reinforced soil wall connection loads

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Abstract: Reinforcement plays an important role in seismic stability and performance of reinforced soil retaining walls, and accurate assessment of reinforcement connection loads is an essential step in internal stability analysis of reinforced soil retaining walls using pseudo-static methods. However, the influence that the choice of wall facing could have on reinforcement connection loads is not adequately addressed in the current pseudo-static methods of analysis. In this study, two shaking table tests were carried out on full-height panel and modular block reinforced soil retaining wall models in order to examine the influence of facing type on the connection loads in the two models. The magnitudes and distributions of measured connection loads in the two models are compared with each other and against predictions from two pseudo-static methods. Results of this study shows that reinforcement connection loads are primarily influenced by the outward inertial force of the facing rather than dynamic earth pressure. Predicted connection loads from the Bathurst and the FHWA method showed better agreements with the measured results on the modular block and full-height panel wall models, respectively.

Keywords: Geosynthetics, Reinforcement,Reinforced soil retaining walls, Connection loads,Shaking table, Modular block, Full-height panel

Laboratory investigation of unsaturated clayey soil-geomembrane interface behavior

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Abstract: Suction-controlled interface direct shear tests were conducted on textured and smooth HDPE geomembrane counterfaces in contact with lean clay. Soil samples were compacted wet of optimum to simulate placement conditions in a composite liner. Tests on saturated samples and soil only were conducted for comparison. Additionally, limited testing was conducted to study the effect of shearing rate on the results. Results reveal that matric suction provided increased shearing resistance, compared to the saturated case, for the textured and smooth geomembrane interfaces, and the extended Mohr-Coulomb envelope provided a good model for geomembrane interface strength. However,strength increases were relatively small compared to soil only, particularly for the smooth interface.Total and water volume changes during shearing were significantly different for unsaturated and saturated conditions. Water volume changes during shearing in saturated soil and interfaces corresponded directly to volume change tendencies during shearing; however, for unsaturated soils this was not the case. Shearing displacement rate was observed to have a profound effect on the shearing resistance of textured geomembranes but had little apparent influence on the smooth geomembrane.Results of this study provide great insight into the unsaturated shearing behavior of clay-geomembrane interfaces and important data for development of constitutive models.

Keywords: Geosynthetics, Soil-geomembrane interface, Matric suction, Soil shearing behavior, Smooth HDPE, Textured HDPE

Numerical simulation of a geotextile soil wall considering soil-atmosphere interaction

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Abstract: This paper presents a numerical method for considering soil-atmosphere interaction applied to infiltration into an unsaturated geosynthetic reinforced soil wall and its effect on wall stability. A hypothetical nonwoven geotextile reinforced soil wall was subjected to simulated conditions of evaporation and precipitation over 2 years considering local climate variation in São Paulo city,Brazil. Net infiltration and actual evaporation were quantified inside and outside the reinforced zone,allowing for the assessment of changes in soil suction and factors of safety. The study discusses the implications of using in-plane draining reinforcements (e.g. nonwoven geotextiles) and soil-atmosphere effects. Results show that soil suction and factors of safety variation are more dependent on consecutive days of precipitation than on isolated heavy rainfalls. For the climate conditions considered in this study, results show that approximately 50% of the precipitation and potential evaporation transformed into net infiltration and actual evaporation, respectively. Additionally, the numerical results indicate that after the first wetting of the soil inside the reinforced soil zone, the evaporation to the atmosphere did not remove water from the inside of the geosynthetic reinforced wall because of the capillary break.

Keywords: Geosynthetics, Numerical modeling, Climatic changes, Reinforced soil wall, Capillary barrier, Nonwoven geotextiles

Evaluation of vertical stress distribution in field monitored GRS-IBS structure

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Abstract: This paper presents a case study of a geosynthetic-reinforced soil (GRS) integrated bridge system (IBS) in which the vertical stresses during and after construction were monitored via instrumentation. The purpose of the study was to evaluate the effects of reinforcement spacing, width of the beam seat, and seasonal variations on the vertical stresses measured in the field. The stress distribution observed in the field was also compared to the theoretically estimated stress distribution. The results showed that the bearing bed where the reinforcements are doubled is effective in reducing the applied stresses by about 1.8 to 5.4 times. The width of the beam seat controlled the magnitude of the applied stresses on the GRS abutment and the applied stress was vertically transferred all the way to the foundation level even in wider beam seats. A comparison between field recorded and theoretical stress values showed that the Boussinesq method provides a better estimate of the field vertical stress distribution than the approximate 2 : 1 method, although the 2 : 1 method provides more conservative stresses to be considered for design. Results from long-term monitoring indicated that vertical stress distribution in the GRS abutments was not significantly influenced by seasonal variations.

Keywords: Geosynthetics, Vertical stress, Stress distribution, Geosynthetic reinforced soil (GRS),
Integrated bridge system (IBS), Earth pressure cells, Vertical reinforcement spacing, Beam seat width, Seasonal variations

The arching effect in rubber–sand mixtures

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Abstract: Arching effect in geomaterial refers to the stress redistribution as a result of induced displacements. It is most likely to occur in different situations such as retaining walls, piled foundations, tunnelling, and so on. The arching effects that occur in rubber–sand layers are examined in this paper. The digital image correlation technique and a series of pressure sensors were employed to capture the deformation characteristics and stress evolution developed in the sand and rubber–sand layers, which were subjected to active arching with and without a central surcharge in a trapdoor apparatus. A range of deformation measures, including horizontal and vertical displacements and strains, shear strains, and volume change variables were obtained and compared for different backfill materials. Ground response curves for sand and rubber–sand mixtures were developed using the stress measurement data. From the deformation data, an arch of equal displacement was introduced. It was observed that the use of rubber particles reduced the surface settlement of the sand layer and the arch heights, and higher stress reduction was obtained in the rubberised backfills.

Keywords: Geosynthetics, Rubber–sand, Arching effect, Digital image correlation, Strain analysis,
Trapdoor apparatus

Corrosion and puncture resistance of aluminium foil gas membranes beneath concrete slabs

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Abstract: Aluminium foil (AF) membranes are commonly installed below or above concrete floor slabs to reduce the migration of ground gases into buildings. The membranes typically comprise laminates of low-density polyethylene (LDPE), reinforcement and an aluminium foil layer. The key component providing gas resistance is the aluminium layer. This is typically 0.012 mm thick and is often encapsulated by very thin layers of LDPE. The foil is therefore vulnerable to damage from puncture by narrow sharp objects in the field. Aluminium corrodes in aggressive and moist environments and could therefore be affected by the fresh cement slabs and/or ground moisture. This paper summarises testing completed to assess the puncture and penetration vulnerability of AF membranes in real life scenarios and the observations from an experiment where AF membranes were exposed to various conditions, including alkaline, acidic and direct contact with cement environments. Based on the results, design considerations are provided for AF membrane applications.

Keywords: Geosynthetics, Geomembranes, Aluminium foil, Reinforcing scrim, Puncture, Corrosion, Ground gas, Vapour protection design