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目　录

Geosynthetic-reinforced cushioned piles with controlled rocking for seismic safeguarding

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Abstract: In this study, a cushioned pile foundation reinforced with geosynthetics is proposed to protect buildings and foundations from seismic energy. This composite foundation utilises piles to control foundation settlement while the geosynthetic-reinforced cushion modifies the dynamic structural characteristics and the load transfer mechanism. The seismic performance of this proposed foundation system is evaluated numerically using FLAC3D software. A fully coupled nonlinear dynamic analysis was conducted in the time domain. The variation of shear modulus corresponding to shear strains in the soil is used to simulate the dynamic behaviour of the soil, while the influence of the plasticity index is also captured. The soil-geosynthetic interface utilises the Mohr-Coulomb failure criterion to capture possible sliding and pull-out of the reinforcement layers. 3D numerical predictions of the tensile forces mobilised in the geosynthetic layers, the shear forces, the lateral deformations and maximum and residual inter-storey drifts in the building are presented and discussed in this paper, as well as how the shear forces and bending moments develop in the piles, and the lateral pile displacements. The results indicate that the proposed geosynthetic-reinforced cushioned pile foundation can provide design engineers with an alternative solution for safeguarding buildings constructed on soft soils in earthquake-prone regions.

Keywords: Geosynthetics, Geosynthetic-reinforced cushioned pile foundation, End-bearing pile foundation, Interposed layer, Geosynthetic reinforcement, Soil-foundation-structure interaction

Transverse shaking table test of a half-scale geosynthetic reinforced soil bridge abutment

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Abstract: This paper presents an experimental study on the response of a half-scale geosynthetic reinforced soil (GRS) bridge abutment subjected to shaking in the direction transverse to the bridge beam. The specimen geometry, reinforcement stiffness, soil modulus, applied surcharge stress and characteristics of the earthquake motions were scaled according to established similitude relationships for shaking table tests in a 1g gravitational field. The GRS bridge abutment was constructed using modular facing blocks, well-graded angular sand and uniaxial geogrid reinforcement, in both the longitudinal and transverse directions. Facing displacements, bridge seat settlements, accelerations, vertical and lateral soil stresses, reinforcement strains, and bridge seat and bridge beam interactions were measured during a series of input motions. The average incremental residual bridge seat settlement was 4.7 mm after the Northridge motion, which corresponds to a vertical strain of 0.22% for the lower GRS fill. After the series of motions, the maximum residual tensile strains occurred near the facing block connections for the lowermost reinforcement layer and under the bridge seat for higher reinforcement layers.

Keywords: Geosynthetics, Geosynthetic reinforced soil, Bridge abutment, Retaining wall, Shaking table test

Interaction of adjacent strip footings on reinforced soil using upper-bound limit analysis

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Abstract: This paper explores the ultimate bearing capacity of two closely spaced interfering strip footings resting on a reinforced cohesionless soil bed using upper-bound limit analysis. The soil is assumed to follow the Mohr-Coulomb failure criteria along with the associated flow rule. A kinematically admissible multi-block failure mechanism is adopted in the analysis. The effect of interaction is studied with respect to angle of internal friction of soil (ϕ), clear spacing between the footings (s) and the number of reinforcement layers (p). The interference effect in terms of efficiency and influence factor is found to increase with the increase in s and becomes maximum at a critical spacing (s_{cr}) followed by a reduction with further increase in s. However, the interference effect is seen to decrease with increase in the number of reinforcement layers. The present theoretical observations are generally found to be in good agreement with the results reported in literature for the same class of problem.

Keywords: Geosynthetics, Bearing capacity, Interference effect, Limit analysis, Plasticity, Reinforced soil, Strip footing

Assessing the ultimate uplift capacity of plate anchors in geocell-reinforced sand

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Abstract: Use of geosynthetic reinforcement may improve the performance of many geotechnical systems, including anchors. In this study, the uplift capacity of geocell-reinforced sand is studied based on a series of near large-scale experiments and calibrated three-dimensional Finite Element (FE) models. Using the verified FE models, a comprehensive parametric study of over 270 models was performed to assess the influence of friction angle, geocell stiffness, embedment depth, anchor size, and geocell-anchor width ratios on uplift capacity. Uplift capacity increases with embedment depth and friction angle, but the relative increase is more pronounced for loose sand. The observed shape effects are amplified in reinforced installation. The increase in uplift capacity observed decays for geocell-anchor width ratios greater than 3, but an increase in geocell stiffness demonstrates increased uplift capacity through the increased mobilization of geocell resisting uplift. Finally, based on the verified numerical models, a semi-empirical equation is proposed to enable estimation of uplift capacity in geocell-reinforced sand, demonstrating good agreement with results from numerical simulations.

Keywords: Geosynthetics, Plate anchor, Geocell layer, Uplift load, Numerical analysis, Analytical analysis

Sidewalls and PVDs below embankments on soft soils – three-dimensional analysis by FEM

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Abstract: The sidewall technique (steel sheet pile or reinforced concrete walls, typically) – combined or not with prefabricated vertical drains (PVDs) – is a technique that minimizes the lateral deformation and upward displacement in the surrounding ground of embankments on soft soils, as well as increasing the overall stability of the structures. Although there is a large number of studies in the literature involving PVDs, there is a lack of studies regarding the sidewall solution, especially involving three-dimensional analysis. In order to overcome this deficiency, a computer code based on the finite element method (FEM) is used to analyse the three-dimensional behaviour of an embankment on soft soil incorporating sidewalls and PVDs. The same embankment, but without the vertical drains, is also modelled and compared with the case of PVDs. In addition, a parametric study is performed to evaluate the influence of the bending stiffness of the wall on the behaviour of the embankment. The computer code incorporates fully mechanical-hydraulic coupled analysis with the soil constitutive relations simulated by the p–q–θ critical state model.

Keywords: Geosynthetics, Embankment, Soft soil, Sidewalls, Vertical drains, Fully coupled analysis, Three-dimensional modelling

Large-strain tensile behaviour of geomembranes with defects using 3D digital image correlation

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Abstract: A series of uniaxial tensile tests was conducted to investigate the large-strain tensile behaviour of high-density polyethylene (HDPE) geomembranes with defects. The experimental optical technique of 3D digital image correlation (DIC) was used to measure the full-field displacements and strains of the geomembranes during the tensile process. The differences between the average axial elongations and the local strains of intact geomembranes were discussed based on the strain measurement results for different tensile phases. For geomembranes with defects, large local strains near the defects sharply increased with increasing average axial elongations and the influence ranges of different types of defects in the geomembranes exhibited small differences after large tensile deformations. Compared with an intact geomembrane, defects significantly changed the local tensile behaviour of a geomembrane.

Keywords: Geosynthetics, 3D DIC, True strain, Geomembranes, Defects, Uniaxial tensile test

Evaluation of tensile load model accuracy for PET strap MSE walls

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Abstract: There are conflicting opinions regarding whether or not mechanically stabilized earth (MSE) walls constructed with polyester (PET) straps should be classified as relatively inextensible type, and thus fall into the same category as steel reinforced soil walls, or whether they should be viewed as relatively extensible and grouped with MSE walls that are designed with geosynthetic sheet reinforcement such as geogrids and geotextiles. The differences in predicted loads using models associated with each category can be significant. The writers collected 71 measurements from eight different instrumented PET strap wall projects. The data showed that these PET strap walls behaved more like extensible geosynthetic walls constructed with geogrids and geotextiles (or at least at the stiffer end of these walls) rather than MSE walls with relatively inextensible (steel) reinforcement. The accuracy of the Coherent Gravity Method, the Simplified Method and the Simplified Stiffness Method was assessed statistically using analysis of bias values, where bias is the ratio of measured to predicted load. The Coherent Gravity Method and the Simplified Method resulted in conservative (safe) estimates of reinforcement loads under operational conditions on average. However, the Simplified Stiffness Method was the most accurate and did not result in an excessive level of conservativeness.

Keywords: Geosynthetics, Polyester (PET), Strap reinforcement, Mechanically stabilized earth (MSE) walls, Coherent Gravity Method, Simplified Method, Simplified Stiffness Method