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目　录

Monotonic and cyclic shear behaviour of geomembrane-sand interface

W. J. Cen[1], H. Wang[2], Y. J. Sun[3] and L. S. Wen[4]

1 Associate Professor, College of Water Conservancy and Hydropower Engineering, Hohai University, 1 Xikang road, Nanjing 210098, China, E-mail: hhucwj@163.com (corresponding author)

2 Postgraduate Student, College of Water Conservancy and Hydropower Engineering, Hohai University, 1 Xikang road, Nanjing 210098, China, E-mail: whhhuwh@163.com

3 Postgraduate Student, College of Water Conservancy and Hydropower Engineering, Hohai University, 1 Xikang road, Nanjing 210098, China, E-mail: 849145104@qq.com

4 Postgraduate Student, College of Water Conservancy and Hydropower Engineering, Hohai University, 1 Xikang road, Nanjing 210098, China, E-mail: wlshhu@163.com

Abstract: Geomembranes have been widely applied in hydraulic systems and mineral and environmental engineering. For geomembrane-lined soil structures, such as dikes, dams, and landfills, the geomembrane-soil interface could be a potentially unstable plane under static and dynamic loading. In this study, a large-scale shear apparatus was employed to investigate the monotonic and cyclic shear behaviour of a geomembrane-sand interface under varying normal stress and shear-displacement amplitude. A nonlinear mathematical piecewise model was developed to simulate pre-peak stress dependent stiffness and post-peak displacement-softening behaviour for the monotonic shear response of the geomembrane-sand interface. Furthermore, the study provided a modeling approach based on the Masing rule to represent the nonlinearity and hysteresis of the cyclic shear behaviour of the interface. The predictions made by the two proposed models were both in good agreement with the experimental monotonic and cyclic shear-test data.

Keywords: Geosynthetics, Geomembrane-sand interface, Monotonic shear test, Cyclic shear test, Nonlinear model

Influence of anchorage angles on pull-out resistance of geotextile wrap around anchorage

Y. Xu[1], D. J. Williams[2] and M. Serati[3]

1 PhD candidate, School of Civil Engineering, The University of Queensland, Brisbane, QLD 4072, Australia Director, UWE Global Pty Ltd, Shenzhen, 518000, China, E-mail: youwei.xu@uq.edu.au; ceo@uweglobal.com (corresponding author)

2 Professor, School of Civil Engineering, The University of Queensland, Brisbane, QLD 4072, Australia, E-mail: d.williams@uq.edu.au

3 Postdoctoral Research Fellow, School of Civil Engineering, The University of Queensland, Brisbane, QLD 4072, Australia, E-mail: m.serati@uq.edu.au

Abstract: Anchored geosynthetics are able to withstand higher tension and provide higher anchorage capacity. The simple run-out and wrap-around anchorages are two commonly used configurations in anchored geosynthetics. However, the influence of geometric parameters of different anchorage configurations on pull-out performance is still problematic. To study the influence of anchorage angles on pull-out resistance of the geotextile wrap around anchorage, two geometric control variables, namely, the top and bottom anchorage angles, were introduced and investigated experimentally and theoretically. A series of pull-out tests were carried out on the geotextile anchorages with varying configurations embedded in sand, including simple run-out and wrap around anchorages that were configured at varying top and bottom anchorage angles. Three stages were summarised to interpret the mobilisation of pull-out resistance of the geotextile wrap around anchorage during the pulling process. It was found that the smaller the bottom angle, the higher the initial pull-out resistance achieved at the early and middle stages, while the larger the top angle, the higher the final pull-out resistance achieved at the final stage. In addition, theoretical studies on pull-out resistance of the geotextile wrap around anchorage with varying anchorage angles were also carried out based on the static equilibrium analysis.

Keywords: Geosynthetics, Anchorage angles, Geotextile, Pull-out, Simple run-out, Wrap around

Enhanced bentonites for containment of inorganic waste leachates by GCLs

J. Scalia IV[1], G. L. Bohnhoff[2], C. D. Shackelford[3], C. H. Benson[4], K. M. Sample-Lord[5], M. A. Malusis[6] and W. J. Likos[7]

1 Assistant Professor, Civil & Environmental Engineering, Colorado State University, Fort Collins, CO, USA, E-mail: joseph.scalia@colostate.edu (corresponding author)

2 Assistant Professor, Civil & Environmental Engineering, University of Wisconsin-Platteville, Platteville, WI, USA, E-mail: bohnhoffg@uwplatt.edu

3 Professor & Head, Civil & Environmental Engineering, Colorado State University, Fort Collins, CO, USA, E-mail: shackel@engr.colostate.edu

4 Dean, School of Engineering, University of Virginia, Charlottesville, VA, USA, E-mail: chbenson@virginia.edu

5 Assistant Professor, Civil & Environmental Engineering, Villanova University, Villanova, PA, USA, E-mail: kristin.sample-lord@villanova.edu

6 Professor, Civil & Environmental Engineering, Bucknell University, Lewisburg, PA, USA, E-mail: mam028@bucknell.edu

7 Professor & Chair, Geological Engineering, University of Wisconsin-Madison, Madison, WI, USA, E-mail: likos@wisc.edu

Abstract: The sensitivity of sodium bentonite (Na-B) to adverse chemical interactions has spurred development of enhanced bentonites (EBs) for geosynthetic clay liners (GCLs) that provide superior properties for containment systems. EB-GCLs are engineered to control contaminant transport by maintaining low hydraulic conductivity (k) when exposed to solutions with high ionic strength, a preponderance of divalent cations, and/or extreme pH (<2 and >12). An overview of current EB-GCL technologies is provided. Engineering properties, including k, the effective diffusion coefficient (D*), and the membrane or chemico-osmotic efficiency coefficient (ω), are summarized for EBs and compared to properties of conventional Na-B. Applicability of indicator parameters currently used to assess GCLs containing Na-B (swell index, fluid loss, and liquid limit) is evaluated for EBs. Mechanisms proven or postulated to influence the behavior of EBs are presented and discussed. EBs generally have superior transport properties (lower k, lower D*, higher ω) in elevated concentration solutions, although some bentonites amended with proprietary additives (broadly termed contaminant resistant clays, or CRCs) have been found to be similar or inferior to Na-B. Compatibility tests conducted with containment liquids are necessary to assess the transport properties of EB-GCLs for site-specific applications.

Keywords: Geosynthetics, Bentonite, Enhanced bentonite, Geosynthetic clay liner

Closely spaced rectangular footings on sand over soft clay with geogrid at the interface

S. Saha Roy[1] and K. Deb[2]

1 Assistant Professor, Faculty of Technology, Uttar Banga Krishi Viswavidyalaya, Cooch Behar-736165 India; Research Scholar, Department of Civil Engineering, Indian Institute of Technology Kharagpur, Kharagpur – 721302 India, E-mail: sahasubinay@gmail.com

2 Associate Professor, Department of Civil Engineering, Indian Institute of Technology Kharagpur, Kharagpur – 721302 India, E-mail: kousik@civil.iitkgp.ac.in (corresponding author)

Abstract: In this study, laboratory-scale experiments are carried out to investigate the interference effect on bearing capacity and settlement behaviour of two closely spaced identical footings placed on the surface of a sand layer of limited thickness underlain by a soft clay layer with geogrid at the interface. Three pairs of model footings of different sizes are used in the study. The width (B) and length (L) of the footings are chosen in such a way that the L/B ratio (aspect ratio) of the footings is varied as 1.0 (square), 1.5 (rectangular) and 2.0 (rectangular). It has been observed that there is an optimum spacing where the bearing capacity of the interfering footing reaches the maximum value. The optimum spacing is found to be 2.0 times the width of the footing for all shapes of footings at H/B= 0.75, where H is the thickness of sand over soft clay. The maximum interference factor for bearing capacity (for a square footing) in homogeneous reinforced sand is 18% more than the sand-clay layered soil. The influence of footing interference increases with an increase in L/B ratio. The strain distribution along the reinforcement is also investigated and it is found that the strains in the reinforcement vary with the spacing ratio.

Keywords: Geosynthetics, Closely spaced footing, Interference factor, Sand-clay layered soil, Rectangular footing, Aspect ratio

Dynamic properties of sand-EPS bead mixtures

R. M. El-Sherbiny[1], S. H. Ramadan[2] and M. A. El-Khouly3
1 Associate Professor, Soil Mechanics and Foundations Research Lab., Faculty of Engineering, Cairo University, Giza, Egypt, E-mail: rsherbiny@eng.cu.edu.eg (corresponding author)
2 Research Assistant, Geotechnical Research Centre, University of Western Ontario, London, Ontario, Canada (Former Research Assistant, Cairo University), E-mail: sramada6@uwo.ca
3 Professor, Soil Mechanics and Foundations Research Lab., Faculty of Engineering, Cairo University, Giza, Egypt, E-mail: maelkhouly@eng.cu.edu.eg

Abstract: Soils modified with Expanded Polystyrene (EPS) beads are typically used as lightweight mixtures to solve many geotechnical challenges. In seismically active areas, understanding the relationship between dynamic properties and strain levels of such mixtures is important for geotechnical applications. The aim of the study is to evaluate the shear modulus and material damping of sand-EPS bead mixtures over a wide range of strains to provide a basis for evaluation of using such mixtures as seismic buffers behind earth retaining structures and for base isolation in seismic areas. Dynamic properties of sand-EPS bead mixtures are evaluated from resonant column and cyclic triaxial tests at small and large strains, respectively. Sand-EPS bead mixtures with varying EPS bead content, up to 2.5% by weight, have been tested at confining pressures of 50, 100 and 200 kPa. Results were analyzed to calculate the small-strain shear modulus, minimum damping ratio, shear modulus degradation curves, and damping curves. Results indicate a decrease in shear stiffness with increasing bead content at all strain levels. Material damping is relatively unaffected at small shear strains; however, it increases at larger strains. The dynamic testing performed yielded properties that can be reflected on applicability of the mixture in geotechnical applications.
Keywords: Geosynthetics, EPS beads, Sand-EPS bead mixture, Resonant column, Cyclic triaxial, Shear modulus, Damping

Numerical evaluation of the effect of differential settlement on the performance of GRS-IBS

A. Ardah[1], M. Y. Abu-Farsakh[2] and G. Z. Voyiadjis[3]

1 PhD Candidate, Department of Civil and Environmental Engineering, Louisiana State University, Baton Rouge, LA 70803 USA, E-mail: aardah2@lsu.edu

2 Research Professor, Louisiana Transportation Research Center, Louisiana State University, Baton Rouge, LA 70808 USA, E-mail: cefars@lsu.edu (corresponding author)

3 Boyd Professor, Department of Civil and Environmental Engineering, Louisiana State University, Baton Rouge, LA 70803 USA, E-mail: voyiadjis@eng.lsu.edu

Abstract: This paper presents the numerical results of the performance of the Geosynthetic Reinforced Soil Integrated Bridge System (GRS-IBS) due to differential settlement underneath the reinforced soil foundation (RSF), underneath the reinforced zone including the RSF, and underneath the retained soil. The performance was evaluated in terms of reinforcement strain, lateral facing deformation, bump at the approach roadway – bridge slab intersection, and lateral facing pressure. Four different differential settlement values of 50, 100, 150, and 200 mm were selected for this study under three different service loading conditions corresponding to bridge spans of 24.4, 30.5, and 36.6 m. Simulations were conducted using the two-dimensional (2D) PLAXIS 2016 finite element (FE) program. The hardening soil model was used to simulate the backfill material behavior. The interface between the backfill material and the reinforcement was simulated using the Mohr-Coulomb model. The reinforcement and facing block were simulated using the linear elastic model. The results of FE analyses indicate that the differential settlement under the RSF has a high impact on both the strain distribution along the reinforcement and the lateral facing displacement.

Keywords: Geosynthetics, Differential settlement, Reinforced soil, Geosynthetic reinforced soil (GRS), Integrated bridge system (IBS), Finite element analysis, Bridge abutment

Effect of fiber reinforcement on shear strength and void ratio of soft clay

M. Mirzababaei[1], A. Arulrajah[2], A. Haque[3], S. Nimbalkar[4] and A. Mohajerani[5]

1 Lecturer, School of Engineering and Technology, Central Queensland University, 120 Spencer Street, Melbourne, Victoria 3000, Australia, E-mail: m.mirzababaei@cqu.edu.au (corresponding author)

2 Professor, Department of Civil and Construction Engineering, Swinburne University of Technology, Hawthorn, Victoria 3122, Australia, E-mail: aarulrajah@swin.edu.au

3 Senior Lecturer, Department of Civil Engineering, Monash University, Victoria 3800, Australia, E-mail: Asadul.Haque@monash.edu

4 Lecturer, School of Civil and Environmental Engineering, University of Technology Sydney, NSW 2007, Australia, E-mail: Sanjay.Nimbalkar@uts.edu.au

5 Senior Lecturer, School of Engineering, RMIT, Victoria 3001, Australia, E-mail: abbas.mohajerani@rmit.edu.au

Abstract: In this study, a series of multi-stage drained reverse direct shear tests were carried out on soft clay samples reinforced with 0.25% and 0.50% polypropylene fibers of 6 mm, 10 mm and 19 mm in length. Tests were carried out at different normal effective stresses and cumulative horizontal shear displacement of 1.17 times of the sample width. Results showed an increase of the shear strength with the increase of fiber content and length. However, the rate of improvement was capped with the normal effective stress applied during the shearing stage. At a high normal effective stress, the shear strength of the fiber-reinforced soft clay approached that of the unreinforced clay regardless of the amount of fiber inclusion. The rate of shear strength improvement decayed with the number of shear cycles. Fiber reinforcement also resulted in a reduction of the compressibility of the soft clay at consecutive consolidation and shear stages. Although the effective internal friction angle of the soft clay was not altered significantly with the fiber reinforcement, the effective cohesion of the soft clay improved significantly as much as 6.4 and 8.5 times with the inclusion of 0.25% and 0.50% of 10 mm long fibers, respectively.

Keywords: Geosynthetics, Fiber reinforcement, Fiber length, Drained shear strength, Reverse direct shear test, Multi-stage test, Soft clay