《Geotextiles and Geomembranes》

（土工织物与土工膜）

<双月刊>

2020年第48卷第3期

摘要集

中国土工合成材料工程协会

国际土工合成材料学会中国委员会

目　录

1. 标题：Internal stability analysis of reinforced convex highway embankments considering seismic loading
作者：Shangchuan Yang, Yufeng Gao, Ben Leshchinsky, Kai Cui, Fei Zhang (China & USA) 1

2. 标题：Shear strength evaluation of composite pavement with geotextile as reinforcement at the interface
作者：Shyue Leong Lee, Mohammad Abdul Mannan, Wan Hashim Wan Ibrahim (Malaysia) 2

3. 标题：Reclamation of abandoned open mines with innovative meandrically arranged geotextiles
作者：Jan Broda, Petra Franitza, Ulrich Herrmann, Reinhard Helbig, Anna Große, Joanna Grzybowska-Pietras, Monika Rom (Poland & Germany) 3

4. 标题：Tension force analysis of geotextile tubes by half cross-section test
作者：H.J. Kim, P.R. Dinoy, H.S. Kim (Korea) 4

5. 标题：Geofoam blocks to protect buried pipelines subjected to strike-slip fault rupture
作者：Habib Rasouli, Behzad Fatahi (Australia) 5

6. 标题：Field assessment of railway ballast degradation and mitigation using geotextile
作者：Raghvendra Pratap Singh, Sanjay Nimbalkar, Saurabh Singh (India & Australia) 6

7. 标题：Stochastic evaluation of leakages through holes in wrinkle networks of composite liners
作者：Cheng Chen, Liang-tong Zhan, Yu Wang, Shuai Zhang, Yun-min Chen (China) ..7

8. 标题：Design method for quantifying embankment safety against lateral spreading and determining contribution of basal reinforcements
作者：Cihan Oser, S. Feyza Cinicioglu, Ozer Cinicioglu (Turkey) 8

9. 标题：Vertical compression of soft clay within PVD-improved zone under vacuum loading: Theoretical and practical study
作者：Yan-Bin Gao, Zhen Zhang (China) 9

10. 标题：Seismic performance of a whole Geosynthetic Reinforced Soil – Integrated Bridge System (GRS-IBS) in shaking table test
作者：Chao Xu, Minmin Luo, Panpan Shen, Jie Han, Feifan Ren (China & USA) 10

11. 标题：Numerical study of creep effects on settlements and load transfer mechanisms of soft soil improved by deep cement mixed soil columns under embankment load
作者：Pei-Chen Wu, Wei-Qiang Feng, Jian-Hua Yin (China) 11

12. 标题：Stability analysis of stone column-supported and geosynthetic-reinforced embankments on soft ground
作者：Gang Zheng, Xiaoxuan Yu, Haizuo Zhou, Shun Wang, Jiapeng Zhao, Xiaopei He, Xinyu Yang (China & Austria) 12

13. 标题：Performance of geosynthetic-reinforced soil foundations across a normal fault
作者：Kuo-Hsin Yang, Jung Chiang, Chao-Wei Lai, Jie Han, Ming-Lang Lin (China & USA) 13

14. 标题：Static structural behavior of geogrid reinforced soil retaining walls with a deformation buffer zone
作者：He Wang, Guangqing Yang, Zhijie Wang, Weichao Liu (China) ..….....….14

15. 标题：Fully coupled analysis of consolidation by prefabricated vertical drains with applications of constant strain rate tests: Case studies and an open-source Program
作者：Hung Tien Pham, Wolfram Rühaak, Dong Huy Ngo, Oanh Cong Nguyen, Ingo Sass (Germany & Thailand & Viet Nam) 15

16. 标题：Barrier properties of a geosynthetic clay liner using polymerized sodium bentonite
作者：Jin-Chun Chai, Nutthachai Prongmanee (Japan) ……....….....……16

17. 标题：Combining EPS geofoam with geocell to reduce buried pipe loads and trench surface rutting
作者：S.N. Moghaddas Tafreshi, N. Joz Darabi, A.R. Dawson (Iran & UK) ……..17

Internal stability analysis of reinforced convex highway embankments considering seismic loading

Shangchuan Yang [a,*], Yufeng Gao [b], Ben Leshchinsky [c], Kai Cui [a], Fei Zhang [b]
a Key Laboratory of High-speed Railway Engineering of the Ministry of Education, Southwest Jiaotong University, Chengdu, 610031, China
b Key Laboratory of Ministry of Education for Geomechanics and Embankment Engineering, Hohai University, No. 1, Xikang Road, Nanjing, 210098, China
c Dept. of Forest Engineering, Resources and Management, Oregon State Univ, 319 Snell Hall, Corvallis, OR, 97331, USA

Abstract: The seismic internal stability of reinforced, convex embankments that are three-dimensional in nature is analyzed. A limit equilibrium based three- dimensional rotational failure mechanism is adopted to calculate the required reinforcement strength to maintain the stability of convex embankments. The results are presented in the form of stability charts and the effects of various parameters on the three-dimensional solution are investigated. The calculation of the required strength and length of reinforcement is demonstrated by two examples using an approach consistent with AASHTO (201 2). Comparing the strengths obtained under two and three-dimensional conditions, the results show that the two-dimensional results are more conservative with respect to the strength of reinforcement, but could be unconservative considering the required length of reinforcement, especially for reinforced convex embankments with gentle turning angles. The influence of seismicity causes greater three-dimensional effects when the reinforced convex embankment is vertical, but less so when the slope inclination is gentle.
Keywords: Geosynthetics; Reinforced soil; Convex embankment; Three dimensio; Limit equilibrium; Seismicity

Shear strength evaluation of composite pavement with geotextile as reinforcement at the interface

Shyue Leong Lee *, Mohammad Abdul Mannan, Wan Hashim Wan Ibrahim
Department of Civil Engineering, Faculty of Engineering, Universiti Malaysia Sarawak, 94300, Kota Samarahan, Sarawak, Malaysia

Abstract: This research was conducted to investigate the shear strength at the interface between polymer concrete and asphalt concrete with geotextile as reinforcement at the interface of these two types of concrete. The samples were tested for the parameters of different surface conditions [rough and smooth], curing types [room and thermal curing], temperature effect and the impact of geotextile as reinforcement. To investigate the correlation between these parameters, four different testing conditions were implemented. The results showed a significant improvement of shear strength for rough surface sample as compared to smooth surface sample. Moreover, samples cured in oven had lower shear strength as compared to samples cured in room condition. Besides that, high temperature has an adverse impact on the shear strength at the interface between polymer concrete and asphalt concrete due to the weakening of asphalt concrete at high temperature. As for samples reinforced with geotextile, the shear strength resistance was better as compared to unreinforced samples. Through visual observation, the types of failure under all testing conditions were mixed failure mode.

Keywords: Geosynthetics; Polymer concrete; Asphalt concrete; Surface condition; Curing types; Temperature

Reclamation of abandoned open mines with innovative meandrically arranged geotextiles

Jan Broda [a,*], Petra Franitza [b], Ulrich Herrmann [b], Reinhard Helbig [b], Anna Große [b], Joanna Grzybowska-Pietras [a], Monika Rom [a]

a Institute of Textile Engineering and Polymer Materials, University of Bielsko-Biala, Bielsko-Biala, Poland

b Saxon Textile Research Institute, Chemnitz, Germany

Abstract: For over fifty years, geosynthetics have been used for land reclamation of degraded areas. Several years ago for this purpose innovative geotextiles formed from meandrically arranged thick ropes were invented. The geotextiles were used for reclamation of abandoned lignite open-mine in Germany and disused gravel pit in Poland. The geotextiles were installed in abandoned mines. In next years positive influence of geotextiles on slopes behaviour and vegetation was observed. It was stated that the geotextiles provide stabilization of steep unstable slopes and significantly accelerate vegetation development. The innovative geotextiles perform functions unobtainable for other traditional products. The products are useful in an effective reclamation of open mines and constitute a valuable extension of the geosynthetic assortment applicable in land reclamation.

Keywords: Geosynthetics; Open mine reclamation; Kemafil technology; Vegetation restoration

Tension force analysis of geotextile tubes by half cross-section test

H.J. Kim [a], P.R. Dinoy [b,*], H.S. Kim [b]

a Head of Technology Research Institute, Department of Civil Engineering, Kunsan National University, Gunsan, 573-701, South Korea

b Department of Civil and Environmental Engineering, Kunsan National University, Gunsan, 573-701, South Korea

Abstract: A simplified equation, which allows for the calculation of the tension force using the actual tube height and pumping pressure with the flexibility to use a coefficient of lateral pressure (K), is proposed and validated theoretically by comparing the proposed method with two well-known methods in the literature, and experimentally, by conducting several half cross section tests. The half cross-section test proposed in this study is unique and configured in such a way that the top and bottom of the geotextile tube is supported by load cells to be able to quantitatively measure the maximum tension force, as well as the stress and strain of the geotextile tube. With the use of the simplified equation, the actual field conditions can be exceptionally represented, making it more advantageous over the previous methods.

Keywords: Geosynthetics; Half cross-section test; Circumferential tension force; Soil pressure; Coefficient of lateral pressure

Geofoam blocks to protect buried pipelines subjected to strike-slip fault rupture

Habib Rasouli [a], Behzad Fatahi [b,*]

a School of Civil and Environmental Engineering, University of Technology Sydney, Sydney, Australia

b School of Civil and Environmental Engineering, University of Technology Sydney (UTS), Sydney, Australia

Abstract: This paper proposes using geofoam blocks to improve the safety of buried steel pipelines under permanent ground deformation due to strike-slip fault rupture. Since these geofoam blocks are deformable, they can compress during fault rupture and thus reduce the pressure imposed on the pipeline by the surrounding soil. This means that the pipe can sustain a higher level of tectonic deformations. For the pipeline system adopted in this study, the geofoam blocks consist of two 1 m thick blocks at each side and another on the top of the pipeline. The effectiveness of this configuration is then assessed in comparison to the conventional buried pipeline by three dimensional numerical simulations that consider the interaction between soil and structure and the impact of critical parameters such as the pipeline-fault trace crossing angle, geofoam blocks thickness and the internal pressure of the pipeline. The results indicated that the geofoam blocks reduced the axial tensile strain of nonpressurised pipeline from the unacceptable 4.16% to the safe level of 0.75% when the crossing angle was 135° . In addition, geofoam blocks successfully decreased the maximum ovalisation parameter and compressive strain of the non-pressurised pipeline from 0.237 and - 25.8% to 0.065 and - 0.47%, respectively when the crossing angle was 65° .

Keywords: Geosynthetics; Geofoam; Pipeline; Permanent ground deformation; Strike-slip fault

Field assessment of railway ballast degradation and mitigation using geotextile

Raghvendra Pratap Singh [a,b,c], Sanjay Nimbalkar [d], Saurabh Singh [e], Deepankar Choudhury [f,g,*],

a Department of Civil Engineering, Indian Institute of Technology Bombay, Powai, Mumbai 400076, India

b National High Speed Rail Corporation Limited, Mumbai, 400013, India

c Central Railway, Chalisgaon, 424101, India

d School of Civil & Environmental Engineering, University of Technology Sydney, NSW 2007 Australia

e North Central Railway, Firozabad, 283203, India

f Department of Civil Engineering, Indian Institute of Technology Bombay, Powai, Mumbai, 400076, India

g Academy of Scientific and Innovative Research (AcSIR), CSIR-HRDC Campus, India

Abstract: Rail tracks continue to deform due to degradation of ballast under the application of heavy train traffic. The resulting track deformations often lead to drainage impairment as well as loss of resiliency. For track replenishment, deep screening of ballast is usually adopted by Indian Railway (IR) either after 10 years or passage of 500 MGT traffic, whichever is earlier. To study the effectiveness of geotextile on track stability and assess possible reductions in maintenance costs, a layer of woven geotextile was installed at the ballast-subgrade interface in Bhusawal-Akola central railway section of IR which is the present study area. The results show that the. amount of degradation and fouling are different in UP and DN tracks due to inherent variation in traffic characteristics. This study also shows that the placement of geotextile in the track has led to prolonged maintenance cycle with favorable implications on cost and track shutdown periods. The findings of the present case study results will be useful for IR to reduce the ballast procurement and reuse of discarded material during deep screening in future.

Keywords: Geosynthetics; Ballast; Fouling; Degradation; Deep screening; Railway track

Stochastic evaluation of leakages through holes in wrinkle networks of composite liners

Cheng Chen [a,b], Liang-tong Zhan [b,*], Yu Wang [c], Shuai Zhang [b], Yun-min Chen [b]
a Zhejiang University of Science and Technology, 310023, Hangzhou, China
b MOE Key Laboratory of Soft Soils and Geoenvironmental Engineering, Zhejiang Univ, Hangzhou, 310058, China
c Department of Architecture and Civil Engineering, City University of Hong Kong, Tat Chee Avenue, Kowloon, Hong Kong, China

Abstract: This paper presents a study on stochastic evaluation of leakages through holes in wrinkle networks of composite liners. The statistical parameters of wrinkles are used as indexes to describe the spatial distributions of wrinkles in a wrinkle network and the wrinkle density is modeled as a random field in the proposed approach, which allows the construction of a database about how wrinkles may be distributed in different conditions and provides input parameters for leakage evaluation at the design stage when the site has not been constructed yet and the aerial image of the wrinkle network (AWN) is unavailable. Statistical analyses were performed on wrinkle geometric parameters and wrinkle density of wrinkles from three sites reported in the literature. The procedures of generating random wrinkle networks (RWNs) based on the statistical parameters of wrinkles are introduced. The proposed approach was applied to typical examples and showed sufficient accuracy when compared to the evaluated leakages based on the corresponding AWNs. Wrinkle density is recommended to be modeled as random field.

Keywords: Geosynthetics; Leakage; Geomembrane; Hole; Wrinkle geometry; Wrinkle density; Statistical analysis; Random field theory

Design method for quantifying embankment safety against lateral spreading and determining contribution of basal reinforcements

Cihan Oser [a], S. Feyza Cinicioglu [b], Ozer Cinicioglu [c,*]
a Istanbul University - Cerrahpasa, Civil Engineering Department, Turkey
b Ozyegin University, Civil Engineering Department, Turkey
c Bogazici University, Civil Engineering Department, Turkey

Abstract: This study proposes an analytical method for the calculation of the safety factor against lateral spreading in embankments, both for cases with and without basal reinforcement. Hence, a new limit equilibrium approach is presented based on the lower bound plasticity theorem, which allows the computation of the required distribution of stresses along presumed slip surfaces at the limit state. Comparing the required distribution of stresses with the available resistances, the safety factor in the absence of basal reinforcement is calculated. If the safety factor is unsatisfactory, basal reinforcement can be introduced and its contribution to stability quantified. The lower bound approach allows the computation of mobilized resistance along the reinforcement. Accordingly, the proposed method allows the calculation of the safety factor against lateral spreading for problems involving basal reinforcements. Finally, the proposed method is compared with well- established methods in literature. Results suggest that the proposed method is reliable, practical, and applicable to safe and economical designs.
Keywords: Basal reinforcement; Lateral spreading; Soft soils; Embankment; Lower bound plasticity theorem

Vertical compression of soft clay within PVD-improved zone under vacuum loading: Theoretical and practical study

Yan-Bin Gao, Zhen Zhang *
Key Laboratory of Geotechnical and Underground Engineering of Ministry of Education, Department of Geotechnical Engineering, Tongji University, Shanghai, 200092, China

Abstract: Reliably estimating soil vertical compression under vacuum loading is still challenging for geotechnical engineers. In this paper, the soil vertical compression within the prefabricated vertical drain (PVD)-improved zone under vacuum pressure was investigated based on the theoretical analysis, reported laboratory tests and the case histories. A theoretical equation was developed to evaluate the effect of lateral displacement on the soil vertical compression. The observed small overall lateral-to-vertical strain ratio at the perimeter of the PVD-improved zone soil showed that the vertical compression of PVD-improved zone was close to one-dimensional (1 -D) state, but 1-D compression method yielded smaller predictions than the measurements from the case histories. The back analyzed soil modulus of the natural soft clay in Shanghai Disneyland Resort project showed considerable degradation as compared to the corresponding constrained modulus from the laboratory test. Such degradation could be due to the soil disturbance caused by PVD installation. The 1-D compression method was modified by introducing two factors to consider the effect of soil lateral displacement and to correct the constrained modulus due to the soil disturbance caused by PVD installation, respectively. The recommendations were provided after applying the proposed method to a case history.

Keywords: Geosynthetics; Vacuum preloading; Soil compression; Prefabricated vertical drain; Soil disturbance; Soft clay

Seismic performance of a whole Geosynthetic Reinforced Soil – Integrated Bridge System (GRS-IBS) in shaking table test

Chao Xu [a,b], Minmin Luo [b], Panpan Shen [b,*], Jie Han [c], Feifan Ren [b]

a Key Laboratory of Geotechnical and Underground Engineering of Ministry of Education, Tongji University, Shanghai, 200092, China

b Department of Geotechnical Engineering, College of Civil Engineering, Tongji University, Shanghai, 200092, China

c Department of Civil, Environmental, and Architectural Engineering, University of Kansas, Lawrence, KS, 66045, USA

Abstract: A scaled plane-strain shaking table test was conducted in this study to investigate the seismic performance of a Geosynthetic Reinforced Soil-Integrated Bridge System (GRS IBS) with a full-length bridge beam resting on two GRS abutments at opposite ends subjected to earthquake motions in the longitudinal direction. This study examined the effects of different combinations of reinforcement stiffness J and spacing Sv on the seismic performance of the GRS-IBS. Test results show that reducing the reinforcement spacing was more beneficial to minimize the seismic effect on the GRS abutment as compared to increasing the reinforcement stiffness. The seismic inertial forces acted on the top of two side GRS abutments interacted with each other through the bridge beam, which led to close peak acceleration amplitudes at the locations near the bridge beam. Overall, the GRS-IBS did not experience obvious structure failure and significant displacements during and after shaking. Shaking in the longitudinal direction of the bridge beam increased the vertical stress in the reinforced soil zone. The maximum tensile forces in the upper and lower geogrid layers due to shaking happened under the center of the beam seat and at the abutment facing respectively.

Keywords: Geosynthetics; Abutment; Bridge; Earthquake; Geosynthetic reinforced soil; Seismic; Shaking table

Numerical study of creep effects on settlements and load transfer mechanisms of soft soil improved by deep cement mixed soil columns under embankment load

Pei-Chen Wu, Wei-Qiang Feng *, Jian-Hua Yin
Department of Civil and Environmental Engineering, The Hong Kong Polytechnic University, Hong Kong, China

Abstract: Deep cement mixed (DCM) soil columns have been widely utilized to improve soft soil to support embankments or seawalls. However, the influence of the time-dependent behavior of the soft soil on the performance of DCM column-supported embankments is not well understood. In this study, the finite element (FE) model was established to investigate the creep effects on settlements and load transfer mechanisms of the soft soil improved by DCM columns under embankment load. Comparisons were conducted for the cases of the soft soil with or without creep. The parametric analysis demonstrated that the area replacement ratio and Young's modulus of the DCM column can largely influence the long- term behaviors of the DCM column-improved composite ground. The numerical results were also compared with the results calculated by German design method (EBGEO) and British design method (BS 8006). Regarding the vertical stress taken by the DCM column, EBGEO method provides a lower limit while BS 8006 method provides an upper limit.

Keywords: Geosynthetics; Column-supported embankment; Deep cement mixed soil column; Creep; Settlements; Load transfer

Stability analysis of stone column-supported and geosynthetic-reinforced embankments on soft ground

Gang Zheng [a,b,c], Xiaoxuan Yu [a,b], Haizuo Zhou [a,b,c*], Shun Wang [d], Jiapeng Zhao [a,b], Xiaopei He [a b], Xinyu Yang [a b]

a School of Civil Engineering, Tianjin University, Tianjin, 300072, China

b Key Laboratory of Coast Civil Structure Safety, Tianjin University, Ministry of Education, Tianjin, 300072, China

c State Key Laboratory of Hydraulic Engineering Simulation and Safety, Tianjin University, Tianjin, 300072, China

d Engineering, Department of Civil Engineering and Natural Hazards, University of Natural Resources and Life Sciences, Vienna, Feistmantelstraße 4, 1180, Wien, Austria

Abstract: This study focuses on the stability of stone column- supported and geosynthetic-reinforced embankments on soft soil. An upper- bound limit state plasticity failure discretization scheme (known as discontinuity layout optimization (DLO)), which determines the em bankment stability without pre-assuming a slip surface, is used. The relationships between the stability of stone column-supported and geosynthetic-reinforced embankments and various influencing parameters, including the soil strength, geometric configuration, reinforcement strength, and area replacement ratio, are analysed. It is found that geosynthetics provide a significant contribution to embankment stability. Two failure mechanisms of geosynthetics (i.e., rupture failure and bond failure) are revealed and the effect of geosynthetics on embankment stability is governed by the failure mode. The application of stone columns mitigates the risk of geosynthetic failure. To provide an analytical solution for primary design in engineering practice, an approach based on the limit equilibrium method is proposed. Validations are performed with the DLO solution to demonstrate the accuracy and reliability of the developed analytical approach.

Keywords: Geosynthetics; Stone columns; Failure; Stability; Embankment

Performance of geosynthetic-reinforced soil foundations across a normal fault

Kuo-Hsin Yang [a,*], Jung Chiang [a], Chao-Wei Lai [b], Jie Han [c], Ming-Lang Lin [a]

a Department of Civil Engineering, National Taiwan University (NTU), 1, Sec. 4, Roosevelt Rd., Taipei, 106, Taiwan, China

b Department of Civil and Construction Engineering, National Taiwan University of Science and Technology (Taiwan Tech), 43, Sec. 4, Keelung Rd., Taipei, 106, Taiwan, China

c Department of Civil, Environmental and Architectural Engineering, The University of Kansas, 2150 Learned Hall, 1530 W. 15th St., Lawrence, KS, 66045, USA

Abstract: This paper presents a series of model tests on geosynthetic-reinforced soil (GRS) foundations across a normal fault. The aim was to evaluate the performance of reinforced foundations as a mitigation measure for surface faulting hazards. Experimental tests modeled a 3-m thick foundation in prototype subjected to a fault displacement up to 90 cm. Test varia bles included the number of reinforcement layers, reinforcement stiffness and location, and foundation height. Digital image analysis techniques were applied to determine the ground settlement profile, angular distortion, shear rupture propagation, and mobilized reinforcement tensile strain at various magnitudes of fault offset. Test results revealed that compared with the unreinforced foundation, reinforcement inclusion could effectively prevent the shear rupture propagating from the bedrock fault to the ground surface. It also spread the differential settlement to a wider influential zone, resulting in an average reduction of 60% in the fault-induced angular distortion at the ground surface. The maximum angular distortion decreased as the foundation height, number of reinforcement layers, and reinforcement stiffness increased. Relationships between the maximum angular distortion and maximum mobilized reinforcement tensile strain with fault displacement were therefore established. Based on the findings from this study, design suggestions and implications are discussed.

Keywords: Geosynthetics; Geosynthetic-reinforced soil foundation; Normal fault; Differential settlement; Angular distortion

Static structural behavior of geogrid reinforced soil retaining walls with a deformation buffer zone

He Wang, Guangqing Yang *, Zhijie Wang, Weichao Liu
School of Civil Engineering, Shijiazhuang Tiedao University, Shijiazhuang, Hebei, 050043, China

Abstract: To understand the structural behavior of geogrid reinforced soil retaining walls (GRSW) with a deformation buffer zone (DBZ) under static loads, the model tests and the numerical simulations were conducted to obtain the wall face horizontal displacement, vertical and horizontal soil pressures, and geogrid strains. Results showed that compared with the common GRSW, the horizontal displacement of GRSW with DBZ decreased, and the horizontal soil pressure acting on the face panel of GRSW with DBZ increased. The vertical and horizontal soil pressures showed a nonlinear distribution along the reinforcement length, and the value was smaller near the face panel. The horizontal soil pressure acting on the face panel of GRSW with DBZ was greater than that of the common GRSW in the middle portion. The cumulative strain of the geogrid had a single-peak distribution along its length; the maximum strain of the geogrid was 0. 45%, the maximum tension was approximately 29.12% of ultimate tensile strength.
Keywords: Geosynthetics; Geogrid reinforced soil retaining wall; Deformation buffer zone; Structural behavior; Model tests

Fully coupled analysis of consolidation by prefabricated vertical drains with applications of constant strain rate tests: Case studies and an open-source Program

Hung Tien Pham [a,*], Wolfram Rühaak [b], Dong Huy Ngo [c], Oanh Cong Nguyen [d], Ingo Sass [a]

a Geothermal Science and Technology, Institute of Applied Geosciences, Technische Universität Darmstadt, Germany

b Bundesgesellschaft für Endlagerung mbH (BGE), Germany

c School of Civil Engineering, Institute of Engineering, Suranaree University of Technology, Thailand

d Division of Soil Mechanics and Foundation Engineering, Southern Institute of Water Resource Research, Ho Chi Minh City, Viet Nam

Abstract: The paper proposes a new approach to use measured data of the constant strain rate test (CRST) for analysis of consolidation by prefabricated vertical drains (PVDs). Each PVD has an influence zone that idealised as a unit cell. Consolidation behaviour of a unit cell is studied with an axisymmetric finite element (FE) model based on Biot's theory. From a CRST data, ASTM-D4186 or the back -analysis method is used to obtain stress-dependent parameters for the model. An open-source FE software named CONAXIS was developed for these purposes. Data from two projects in Mekong Delta Vietnam were used in this study. In the first project, nine CRSTs with various depths from a borehole were conducted. Two tests were chosen to be simulated using the proposed approach implemented in CONAXIS and the soft soil model in PLAXIS for validation and comparison purposes. Comparing to the laboratory data, CONAXIS gave more accurate results than PLAXIS. Then CONAXIS was used to calculate the settlement of the ground surface during the construction process with different scenarios. For the second project, six CRSTs from three boreholes were used to set up the model in CONAXIS. Modelled results of both projects showed good agreements with field monitoring data.

Keywords: Finite element method; Constant rate of strain test; Prefabricated vertical drains; CONAXIS; Nonlinear poroelasticity theory

Barrier properties of a geosynthetic clay liner using polymerized sodium bentonite

Jin-Chun Chai *, Nutthachai Prongmanee
Department of Civil Engineering and Architecture, Saga University, 1 Honjo-machi, Saga, 840-8502, Japan

Abstract: The hydraulic and swelling properties of a polymerized bentonite (PB), and the self-healing capacity of a geosynthetic clay liner (GCL) using the PB as the core material (PB-GCL) were investigated experimentally. Fivedifferent test liquids included of deionized water, NaCl solutions (0.1 M and 0.6 M) and CaCl2 solutions (0.1 M and 0.6 M) were used in this study. The PB exhibited a higher free swelling index (FSD) than that of the untreated bentonite (UB) for all test liquids. For permeability test, under a given void ratio (e), the value ofk of the PB is much lower than that of the UB in NaCl and CaCl2 solutions. The PB-GCL specimens demonstrated a higher selfhealing capacity than that of the corresponding GCL specimens using the UB (UB-GCL). Specifically, when using a 0.6 M CaCl2 solution for a 20-mm-diameter damage hole, the UB-GCL specimen provided a zero healing ratio (healed damage area/total damage area), but the PB-GCL specimen demonstrated an approximately 76% healing ratio. The results from this study indicate that the PB-GCL provided better barrier performance against cationic liquids with higher cation valence and concentrations compared to that of the UB-GCL.

Keywords: Geosynthetics; Geosynthetic clay liner (GCL); Self-healing capacity; Polymerized bentonite (PB); Free swelling index (FSI); Permeability

Combining EPS geofoam with geocell to reduce buried pipe loads and trench surface rutting

S.N. Moghaddas Tafreshi [a,*], N. Joz Darabi [a], A.R. Dawson [b]

a Department of Civil Engineering, K.N. Toosi University of Technology, Valiasr St., Mirdamad Cr., Tehran, Iran

b Nottingham Transportation Engineering Centre, University of Nottingham, Nottingham, UK

Abstract: This paper reports full scale experiments, under simulated heavy traffic, of geocell and EPS (expanded polystyrene) geofoam block inclusions to mitigate the pressure on, and deformation of, shallow buried, high density polyethylene (HDPE) flexible pipes while limiting surface settlement of the backfilled trench. Geocell of two pocket sizes and EPS of different widths and thickness are used. Soil surface settlement, pipe deformation and transferred pressure onto the pipe are evaluated under repeated loading. The results show that using EPS may sometimes lead to larger surface settlements but can alleviate pressure onto the pipe and, consequentially, result in lower pipe deformations. This benefit is enhanced by the use of geocell reinforcement, which not only significantly opposes any EPS-induced increase in soil surface settlement, but further reduces the pressure on the pipe and its deformation to within allowable limits. For example, by using EPS geofoam with width 0.3 times, and thickness 1.5 times, pipe diameter simultaneously with geocell reinforcement with a pocket size 110 X 110 mm2 soil surface settlement, pipe deformation and transferred pressure around a shallow pipe were respectively, 0.60, 0.52 and 0.46 times those obtained in the fully unreinforced buried pipe system. This would represent a desirable and allowable arrangement.

Keywords: Geosynthetics; Buried pipe; EPS block; Geocell layer; Pipe diameter change; Pressure; Soil surface settlement