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摘要集

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Healing the world: a geosynthetics solution

N. Touze[1]
1 Deputy Director, Université Paris-Saclay, INRAE, SDAR, 78352, Jouy-en-Josas, France,
E-mail: nathalie.touze@inrae.fr

Abstract: There seems to be no consensus about whether the world is currently going through an unpreceded crisis. The conditions of life have greatly improved since the 17th century in terms of food quality and quantity, water quality, life expectancy, poverty, violence, environment, freedom, social equality, education, and so on. Some could argue that the good old days were terrible! However, a number of unacceptable conditions remain in our world and new ones have emerged, all requiring urgent improvements. The world is a complex organism, experiencing numerous troubles: economic and financial crises, environmental crises, agricultural crises, sanitary crises, psychological and identity-related crises, crises of values and sense, political crises, and so on. When faced with such a systemic crisis, the solution must be global. How can geosynthetics and the geosynthetics community contribute to resolving these crises and help to heal the world? The objective of this Giroud lecture is to analyse recent developments in geosynthetics in search of evidence of our contribution today to ensuring water quality for all, feeding the world, protecting the environment, mitigating natural disasters, facilitating economic solutions, and connecting people to help them to learn to live together according to universal human values.
Keywords: Geosynthetics, global, values, water, agriculture, environment, sustainability

A laboratory device to evaluate geosynthetic load–strain behaviour in MSE walls

F. H. M. Portelinha[1], M. C. Santos[2]and M. M. Futai[3]
1 F. H. M. Portelinha, Federal University of Sao Carlos, Civil
1 Engineering Department, Washington Luis Rd., km 235, Sao Carlos, Sao Paulo 13.565-905, Brazil.E-mail: fportelinha@ufscar.br (corresponding author)
2 Federal University of Sao Carlos, Civil Engineering Department, Sao Carlos, Sao Paulo, Brazil.E-mail: matheus.cardoso.santos@gmail.com
3 School of Engineering, University of Sao Paulo, Sao Paulo, SP, Brazil.E-mail: futai@usp.br

Abstract: Challenges for prediction of tension loads and deformations in geosynthetic mechanically stabilised earth (MSE) walls are proper characterisation of the in-soil material properties and stress transfer mechanisms. A laboratory device to better capture geosynthetic load–strain behaviour in geosynthetic MSE walls under working stress conditions is presented in this paper. Working stress conditions are understood to be the tensile load, strain and stresses in geosynthetic MSE walls under in service conditions when the soil strength is not fully mobilised as assumed in most design methods. In addition, the tensile load is transferred to the geosynthetic through the surrounding soil which is not captured using most tensile test methods found in the literature. The apparatus in this study simulates the primary load-transfer mechanism in geosynthetic MSE walls by accounting for soil confinement, strain compatibility between soil and geosynthetic, and soil-geosynthetic interaction. Tests using a woven geogrid, woven geotextile and needle-punched nonwoven geotextile in sand showed that ignoring interface slippage (though small) overestimates tensile loads in geosynthetic MSE design and analyses for working stress conditions. Geosynthetic stiffness and the magnitude of confining pressure are shown to be important parameters to compute tensile loads for geosynthetic MSE wall design and analyses.

Keywords: Geosynthetics, Tensile load, Reinforcement strain, Serviceability, Interaction

Practical seismic fragility estimation of unreinforced and reinforced embankments in Japan

M. Shinoda[1], S. Nakajima[2], K. Watanabe[3], S. Nakamura[4] and I. Yoshida[5]
1 Associate Professor, Department of Civil and Environmental Engineering, National Defense Academy,1-10-20 Hashirimizu, Yokosuka, Kanagawa 239-8686, Japan.
E-mail:shinoda@nda.ac.jp (corresponding author)
2 Senior Researcher, Structures Technology Division, Railway Technical Research Institute, 2-8-38, Hikari-cho, Kokubunji, Tokyo 185-8540, Japan. E-mail: nakajima.susumu.99@rtri.or.jp
3 Associate Professor, Department of Civil Engineering, University of Tokyo, 7-3-1 Hongo, Bunkyo, Tokyo 113-8656, Japan. E-mail: watanabe@civil.t.u-tokyo.ac.jp
4 Professor, Department of Civil and Environmental Engineering, Nihon University, Nakagawara 1,Tokusada, Tamura Koriyama, Fukushima 963-86420, Japan. E-mail: s-nak@civil.ce.nihon-u.ac.jp
5 Professor, Department of Urban and Civil Engineering, Disaster Mitigation, Tokyo City University, 1-28-1 Tamazutsumi, Setagaya, Tokyo 158-8557, Japan. E-mail: iyoshida@tcu.ac.jp

Abstract: The seismic fragility of an embankment can be calculated considering the permanent seismic displacement obtained through the Newmark's sliding block analysis implemented using a Monte Carlo simulation with various soil and tensile strengths of the reinforcement. The above method is exact and precise; however, it has high calculation cost and is inefficient in practical tasks. This paper proposes a practical and straightforward method to estimate the seismic fragility of unreinforced and reinforced embankments subjected to earthquakes for practical seismic risk assessment. First, a strong seismic motions database adjusted by the Arias Intensity was created to calculate the seismic fragility of embankments. Then, the analytical models were implemented as unreinforced and reinforced embankment models with different embankment heights defined according to the railway design standard in Japan. The sensitivity analysis of the seismic fragility estimation of unreinforced and reinforced embankments was conducted with various embankment heights, average values of friction angle of the backfill soil, and tensile strength of the primary reinforcement. A practical and straightforward fragility curve estimation equation, with design parameters commonly used to check the embankment stability, is proposed for practical use..
Keywords: Geosynthetics, Embankment, Reinforced soil, Seismic risk assessment, Fragility, Newmark method, Monte Carlo simulation

Linear visco-elastic 1D site response of sand-EPS geofoam layers under cyclic loading

T. Hakimi Basti[1], R. Jamshidi Chenari[2] and A. Firoozfar[3]
1 Graduate Student, Faculty of Civil Engineering, University of Zanjan, Zanjan, Iran, E-mail: tayebe.hakimi@gmail.com
2 Associate Professor, Department of Civil Engineering, Faculty of Engineering, University of Guilan, Rasht, Iran, E-mail: jamshidi_reza@guilan.ac.ir (corresponding author)
3 Assistant Professor, Department of Civil Engineering, Faculty of Engineering, University of Zanjan, Zanjan, Iran, E-mail: firoozfar@znu.ac.ir

Abstract: A two-part study was undertaken to evaluate the dynamic behavior of sand-EPS geofoam composite layers. The first part aimed at evaluating the dynamic properties of both sand and expanded polystyrene (EPS) geofoam, by performing a series of bender element and strain-controlled cyclic triaxial tests. EPS geofoam with density of 10 and 12 kg/m3 and Chamkhaleh sand with relative density of 55% were tested under confining pressures of 10 and 20 kPa. Normalized shear modulus and damping ratio curves were obtained and compared with the values reported in the literature. They show the dependence of the shear modulus and damping ratio on shear strain, confining pressure and density of the materials. The second part of the study involved linear visco-elastic 1D site response analysis of sand-EPS geofoam layers with different layer arrangements. Results showed that shear modulus attenuation occurs with increase in the volume fraction of the EPS geofoam and this diminution of the response amplitude becomes greater with lower EPS geofoam density. Finally, it was shown that replacing a lumped EPS geofoam inclusion with multiple very thin layers, while maintaining the overall EPS geofoam content, results in a diminished response effect.

Keywords: Geosynthetics, Bender element, Cyclic triaxial, Chamkhaleh sand, EPS geofoam, Linear visco-elastic, Site response analysis

Role of Geotextiles Pore Size Distribution in Dewatering Tests

N.Fatema[1]and S. Bhatia[2]

1 PhD Candidate, Department of Civil and Environmental Engineering, Syracuse University, 151 Link Hall, Syracuse, NY 13244, USA, E-mail: nfatema@syr.edu (corresponding author)

2 Meredith Professor, Department of Civil and Environmental Engineering, Syracuse University, 151 Link Hall, Syracuse, NY 13244, USA, E-mail: skbhatia@syr.edu

Abstract: For geotextile tube dewatering applications, several researchers have used one-dimensional dewatering tests to estimate soil piping and sediment retention by correlating geotextile pore openings (AOS, O50–O98) and sediment particle size (D10–D90). These results are of limited use in predicting the dewatering rate required to meet a specific standard in a full-scale geotextile tube application since, in the field, flow rate is more important than sediment piping or retention. To overcome some of the limitations, this study focused on evaluating the role of geotextile pore size distribution on flow rate using the pressurized two-dimensional dewatering test (P2DT) with unconditioned and conditioned slurries. In this test, the radial and axial flow can be measured independently, therefore enabling accurate assessment of the performance of geotextile tubes under actual full-scale field conditions. In this study, glacial rock dust was used as sediment, and 1-woven, 2-composite, 2-nonwoven and 1-natural nonwoven geotextiles were used in the dewatering tests. Twelve P2DT and 40 capillary flow tests were performed to evaluate the dewatering characteristics of geotextiles. The test results showed that the pore size distribution of geotextiles played a role in effluent release with conditioned slurries.

Keywords: Geosynthetics; Geotextiles; Pore Size Distribution; Dewatering Test; Flow rate; Clogging

Numerical Investigation of Reinforced Soil Structures with GRS-IBS Design Features

F. Gebremariam[1] B. F. Tanyu[2] E. Güler[3] G. S. Urgessa[4] P. Shen[5]
1 Graduate Research Assistant, George Mason University, Department of Civil, Environmental, and Infrastructure Engineering, Fairfax, VA, USA, E-mail: fgebrema@gmu.edu
2 Associate Professor, George Mason University, Department of Civil, Environmental, and Infrastructure Engineering, Fairfax, VA, USA, E-mail: btanyu@gmu.edu (corresponding author)
3 Visiting Professor, George Mason University, Department of Civil, Environmental, and Infrastructure Engineering, Fairfax, VA, USA, E-mail: fguler@gmu.edu
4 Associate Professor, George Mason University, Department of Civil, Environmental, and Infrastructure Engineering, Fairfax, VA, USA, E-mail: gurgessa@gmu.edu
5 Post-Doctoral Researcher, Tongji University, Department of Geotechnical Engineering, Shanghai, China, E-mail: 18310183@tongji.edu.cn

Abstract: This paper focuses on investigation of the effects of the presence of a bearing bed and reinforced soil foundation (RSF), the vertical reinforcement spacing and reinforcement stiffness, and subgrade compressibility on design components, including the lateral displacement of facing, maximum tension in reinforcement (T_{max}), connection strength (T_o), and differential settlement in reinforced soil structures reinforced with woven geotextile. The investigation was conducted through numerical simulation of reinforced soil structures using the finite element program Plaxis 2D under plain strain condition. The results from the numerical analyses showed that the vertical reinforcement spacing has more effect on the design components than the reinforcement stiffness. The effect of slab load in widely spaced structures showed that the T_{max} decreased linearly with depth. However, for closely spaced structures with a bearing bed, the reduction in T_{max} with depth was bilinear. The existence of T_o in closely spaced structures was evident. The observed values of T_o were very close to values of T_{max}. Inclusions of the bearing bed and RSF were found to have beneficial effects and can be implemented in design and construction of widely spaced reinforced soil structures to improve the performance.

Keywords: Geosynthetics, Geosynthetic reinforced soil (GRS), Integrated bridge system (IBS), Vertical reinforcement spacing, Bearing bed, Reinforced soil foundation, Facing displacement, Reinforcement tension, Connection strength, Settlement