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GEOTECHNICAL ENGINEERING

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EDITOR: Guofu Zhu, M. A. Hossain, Wan Huan Zhou

Prof Jian Hua Yin Honored with Special Issue March 2020 of SEAGS-AGSSEA Journal

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Professor Yin has a good track record in research and has played a leading role in development of advanced soil testing equipment, innovative fiber optical sensors, establishing a large-scale multi-purpose physical modeling facility for studying geo-hazards, organization of regional and international conferences. His research interests include (i) testing study of properties and behaviour of soils, (ii) elastic visco-plastic modeling, (iii) soft soil improvement, (iv) soil nails and slope analysis, (v) development and applications fiber optical sensors, (vi) soil-structure interface, and (vii) development of advanced/special lab testing apparatus. Professor Yin serves as a Vice-President of International Association for Computer Methods and Advances in Geomechanics (IACMAG), a Co-Editor of International Journal of Geomechanics (ASCE), and a Co-Editor of Geomechanics and Geoengineering (UK). He has received the honours of the prestigious "JOHN BOOKER Medal" in 2008, "Chandra S. Desai Excellence Award" in 2011, and "Outstanding Contributions Medal" in 2017 from all IACMAG. He delivered the high-status 2011 "Huang Wenxi Lecture" in Chinese Mainland.

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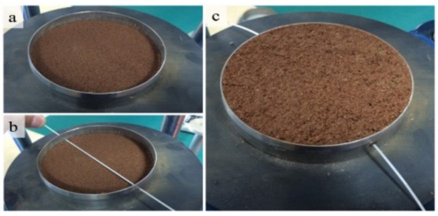
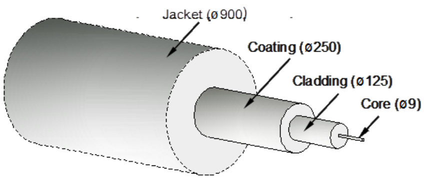
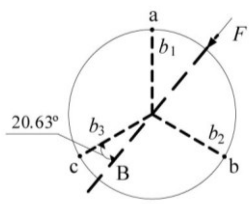
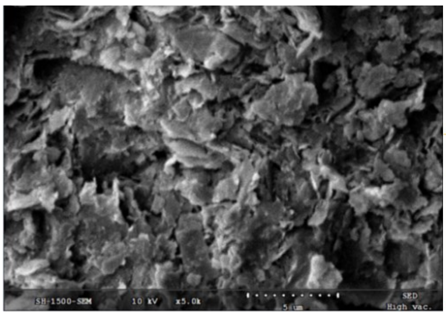


Influence of Soil Moisture on Interfacial Behavior of Soil-EmbeddedFiber Optic Sensor. Authored by H.H. Zhu, J.K. She and C.C. Zhang

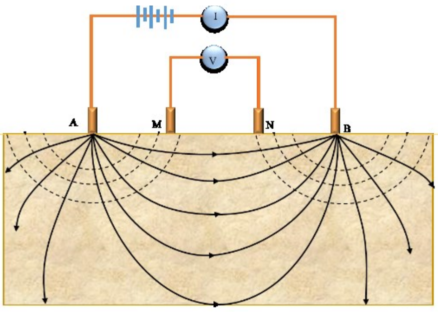


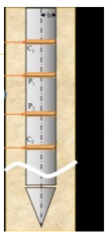


A Thin-Walled Hollow Tube with Embedded FBG Sensors for 3DDeflection Measurement Authored by W.H. Zhou and Z.L. Cheng

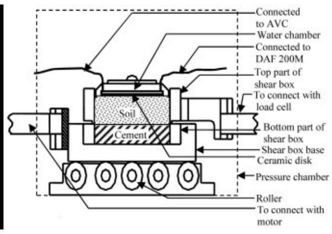


The Hydraulic Conductivity of a Marine Clay in the South ChinaSea under Different Isotropic Consolidation Pressures. Authoredby G.F. Zhu and H.T. Zhou





A Review on In-situ and Laboratory Measurement forMarineSediments. Authored by B. Zhu, H. Pei H.M. Yang, L.S. Liu,B. Xiao and Q. Yang



Laboratory Investigation of Unsaturated Soil-Cement Grout Interfaces. Authored by M. A. Hossain and J. H. Yin

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March 2020 Issue to Honour Prof Jian Hua Yin

For his Contributions in Geotechnics through Hong Kong Geotechnical Society, ISSMGE and Hong Kong Polytechnic University, Hong Kong, China

Professor Yin received a BEng degree in 1983 in Chinese Mainland, an MSc degree from Institute of Rock and Soil Mechanics of the Chinese Academy of Sciences in 1984, and a PhD from The University of Manitoba, Canada in 1990. Dr Yin has a mix of industrial and academic experiences. He joined Department of Civil and Environmental Engineering, The Hong Kong Polytechnic University in 1995 as an Assistant Professor. He was promoted to an Associate Professor position in 1999, to a Professor position in 2002, and to the position of Chair Professor of Soil Mechanics in 2014. Professor Yin has a good track record in research and has played a leading role in development of advanced soil testing equipment, innovative fiber optical sensors, establishing a large-scale multi-purpose physical modeling facility for studying geo-hazards, organization of regional and international conferences. His research interests include (i) testing study of properties and behaviour of soils, (ii) elastic visco-plastic modeling, (iii) soft soil improvement, (iv) soil nails and slope analysis, (v) development and applications fiber optical sensors, (vi) soil-structure interface, and (vii) development of advanced/special lab testing apparatus. Professor Yin serves as a Vice-President of International Association for Computer Methods and Advances in Geomechanics (IACMAG), a Co-Editor of International Journal of Geomechanics (ASCE), and a Co-Editor of Geomechanics and Geoengineering (UK). He has received the honours of the prestigious “JOHN BOOKER Medal” in 2008, “Chandra S. Desai Excellence Award” in 2011, and “Outstanding Contributions Medal” in 2017 from all IACMAG. He delivered the high-status 2011 “Huang WenxiLecture” in Chinese Mainland.

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Preface

This Issue containstwelve papers. They were acquired by Dr. Guofu Zhu, Dr. M. A. Hossain, and Dr. Wan Huan Zhou to honor Prof Jian Hua Yin.

The first paper is on Effect of Silt Content on Dynamic Characteristics of Saturated Sandy Silt by Y.M. Zhang, Z.L. Cheng and W.H. Zhou. In their paper, remoulded sandy silts with different silt contents (50%, 60%, 70%, and 80%) were prepared using three types of raw soils collected from the Yellow River Delta Area, Dongying city, China. The content of clay is controlled to be 8.5% in these samples and the dry density of these specimens is 1.643 g/cm3. The applied cyclic sinusoidal loading is 1 Hz. The effects of silt content on the hysteretic loop, backbone curve and Young's modulus of the reconstituted saturated sandy silts were studied. Besides, the effect of confining pressure on soil cyclic properties was considered. The hyperbolic model equation was used for fitting the relationship between cyclic deviatoric stress and cyclic axial strain (less than 0.3%). In the hyperbolic model equation, the parameters, a and b, have a decreasing trend with the increase of silt content and confining pressure. It indicates that the Young's modulus of remoulded saturated sandy silt increases with an increase in silt content and confining pressure.

The second one is about A Thin-Walled Hollow Tube with Embedded FBG Sensors for 3D Deflection Measurement authored by W.H. Zhou and Z.L. Cheng. FBG sensing technology has attracted considerable attention due to its intrinsic characteristics, for example, high sensitivity and precision, corrosion resistance, and electro-magnetic interference (EMI) immunity. In this study, one thin-walled hollow tube with embedded FBG sensors was designed and manufactured for three-dimensional deflection measurement. Three optic fibers were embedded equally on the circumference of the tube at an angle of 120 degrees in the cross section, and along the longitudinal direction of the tube. Ten FBG sensors with intervals of 10cm were connected in series in each optic fiber. Three types of tests were conducted for laboratory calibration. Two scenarios, simple support and cantilever support, were considered. Using the newly designed FBG sensed tube allows for the estimation of maximum deflection and the direction of the deflection. Under the simple support condition, the ratio of relative error over the measured data is less than 4%, while under the cantilever supported condition, this ratio varies between 3.37% and 8.78%. The results showed that the tube with three embedded series of FBG sensors proposed in this study can be used to monitor underground deformation with acceptable errors.

The third paper is by M.A. Hossain and J.H. Yin on Laboratory Investigation of Unsaturated Soil-Cement Grout Interfaces. The important parameters on which the shear strength of any interface depends are overburden stress and degree of saturation. Nowadays, grouting pressure is considered as an another important issue as it provides better interface strength than gravity grouting in case of cast-insitu soil-cement grout interface, like soil-nail and soil-pile interfaces. In the present study, a series of interface direct shear tests are performed between compacted completely decomposed granite (CDG) soil and

cement grout under different overburden stresses, matric suctions and grouting pressures. The interface shear strength envelopes are approximately linear, and the apparent interface friction angle and adhesion intercept increase with matric suction for particular grouting pressures. On the contrary, the apparent interface friction angle decreases with pressure grouting for different matric suctions except saturated condition, at which it remains constant. A mathematical model is proposed for predicting the shear strength of soil-cement interface considering the influence of matric suction, overburden stress and grouting pressure as independent parameters. It is obvious that the interface shear strength predicted from the proposed model agrees well with the experimental shear strength data for different overburden stresses, matric suctions and grouting pressures.

The fourth paper is authored by H.F. Pei and S.Q. Zhang onDisplacement algorithm based on FBG Sensor. Aiming to eliminate huge error in geotechnical monitoring, a novel sensor-fiber Bragg grating (FBG) inclinometer is well designed. Several correspondingly displacement algorithms that convert strain of grating into displacement of monitoring points are presented in details. And the performances of these algorithms are discussed in numerical simulation and experiments. The result shows central difference method(CDM) is more suitable for displacement calculation and its accuracy can be further improved by extrapolation. Finally, a slope indoor model test is conducted to search slip surface, which the results verify the feasibility of the novel sensor and correspondingly displacement algorithm.

The fifth paper is about A Review on In-situ and Laboratory Measurement for Marine Sediments presented by B. Zhu, H.F.Pei and Q. Yang. As well known, the resistivity and acoustic properties of marine sediments are the basic parameters for determining the sediment characteristics. In the past decades, diverse measuring methods and theoretical models have been developed to construct a reliable relationship between the measured electric or acoustic parameters and other physical characteristics of sediments. In this paper, recent research progress on in-situ and laboratory testing technologies of marine sediments has been comprehensively reviewed and summarized. The recent achievement of acoustic characteristics measurement for sediments during gas hydrate formation and decomposition is also reported in their study.

The sixth paper is by W.Q. Feng, X.J. Tian, X.N. Gong, P. C.Wu and J.H. Yin on Numerical Analysis on Consolidation Behaviour of Soft Ground Improved by Soil-Cement Column under Embankment Load. Soil-cement columns are widely used for soft ground improvement such as embankment, earth and rockfill dam, and other civil engineering structures. However, the existing consolidation analysis of the settlement of a foundation is mainly based on the assumption of a rigid foundation. The consolidation behaviour of a composite foundation with soil-cement columns under the embankment load is investigated in this study by using a finite element method in plane strain condition. The equivalent modulus and permeability of soil-cement columns are considered in the finite element simulations. The average degree of consolidation and stress concentration ratio of a soil-cement column and surrounding soil are used to evaluate the performance of consolidation behaviour of the soft ground improved by soil-cement columns. Parametric sensitivity analysis of a soil-cement column has been carried out. It is found that the consolidation behaviour of the composite foundation is largely influenced by the length and spacing of soil-cement columns. The consolidation rate increases with increasing soil-cement column length, Young's modulus of a soil-cement column, and soil-cement column permeability. But the consolidation rate decreases with increasing soil-cement column spacing.

The seventh paper is by X.S. Shi, J.H. Yin and L.J. Wang on Shear Strength and a Simple Stress-Strain Description of Rockfill Materials in Plain Strain State within Twin-shear Strength. Rockfill materials are widely used in geotechnical structures (e.g., rockfill dam and high fill subgrade) due to the high shear strength and high permeability. Most of the projects are related to plane strain state. It is well recognized that the shear strength of rockfill materials in plane strain state is significantly higher than that in the axisymmetric stress state for a given confining pressure, especially for large densities. In this case, the shear strength and stiffness of rockfill materials would be underestimated if conventional triaxial tests are adopted for evaluation. This difference can be attributed to the effect of intermediate principal stress, which cannot be described by the classical Mohr-Coulomb strength criterion. For this reason, the limit stress state in plain strain test is obtained based on twin shear theory, and the barotropy of rockfill materials is analyzed. Afterwards, the classical Duncan-Chang model is revised by incorporating the effect of intermediate stress. Comparison between the test data and the model simulation reveals that the proposed can well reproduce the pre-failure behavior of rockfill materials in plain strain state.

The eighth paper is on Consolidation Parameters of Macao Marine Deposit authored by T.M.H. Lok and X. Shi. A comprehensive review of marine deposit at Hong Kong and Macau was conducted and typical values of the consolidation parameters were summarized. A laboratory testing program was carried out on remolded and intact samples of Macau marine deposit. It was found that the Atterberg Limits of marine deposit in this study were similar to those of previous studies. Consolidation parameters, including compression index, recompression index, secondary compression index, and coefficient of consolidation from laboratory tests are presented.

The ninth paper is by H.H. Zhu, J.K. She and C.C. Zhang about Influence of Soil Moisture on Interfacial Behavior of Soil-Embedded Fiber Optic Sensor. Recently, fiber optic sensor-based distributed geotechnical monitoring has gained increased attention all around the world. These sensors have been directly embedded in slopes, embankments, tunnels and pipelines for measuring the distribution of strains and displacements of in-situ geo-materials and structures. The mechanical behavior of the interface between the distributed sensing fibers and the surrounding soil is a key factor governing the reliability of fiber-optic measurements. To evaluate the influence of soil moisture on the fiber-soil interfacial behavior, a series of pullout tests were performed under different overburden pressures. The test results show that the soil moisture has a significant effect on the pullout performance. The shear stress-pullout displacement relationship can be described by a tri-linear bond-slip model. The peak and residual shear strengths decrease linearly with the increase of soil moisture. While the overburden pressure plays a significant role in enhancing the fiber-soil bond strength. A reliable sensor fixing system should be provided for long-term geotechnical monitoring, especially for water-rich soil strata.

The tenth paper is on Two-dimensional numerical modelling of multi-tunnel interaction in clay by B.Q. Zhu, J.H. Yin and Z.Y. Yin. Constructing a new tunnel close to an existing one is a concerned engineering problem since the interaction between tunnels at a close range could lead to ground deformation and settlement of buildings. This paper presents the particular interest in ground settlement induced by tunnel excavations and the configurations of the twin-tunnel. The numerical model is established to investigate the multi-tunnel excavation induced deformation of the ground. An anisotropic constitutive model is implemented into a finite element code for use with presenting the stress integration

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March 2020: Guest Editors

Edited by:Dr. Guofu Zhu, Dr. Md. Akhtar Hossain, and Dr. Wan Huan Zhou

Guofu Zhu

Ir. Dr Zhu was appointed a Professor in the Department of Engineering Structures and Mechanics, Wuhan University of Technology in 2005. He received a BSc degree from Wuhan University in 1983 and a PhD from the Hong Kong Polytechnic University in 1999. Dr Zhu has participated in a lot of large geotechnical projects and has good experience in design of piled foundation, retaining wall, shoring for deep excavation, slope strengthening works. His research interests include numerical methods and program development in geotechnical engineering, consolidation settlement analysis of soils, piled foundations, testing study of soil properties, and numerical modeling for diaphragm construction, piled foundation, embankment construction, shield tunneling, pipe jacking, slope excavation, large cavern construction and deep excavation. He has produced more than 60 publications in referred journals and conference proceedings.

Md. Akhtar Hossain

Dr. Md. Akhtar Hossain has been serving as a Professor in the Department of Civil Engineering at Rajshahi University of Engineering & Technology, Bangladesh. He received his B.Sc. Engineering degree in 2001 from the Department of Civil Engineering, Rajshahi University of Engineering & Technology, Bangladesh. He obtained his Ph.D. degree from the Department of Civil and Environmental Engineering at The Hong Kong Polytechnic University, Hong Kong, China in 2010. His research areas include unsaturated soil mechanics, **s**oil-structure interactions, advanced laboratory and field testing in geotechnical engineering, subsoil exploration, ground improvement, and **s**hallow and deep foundations. Dr. Hossain has

published numerous peer reviewed international journal and conference papers. He is the reviewer of a number of international journals, including Canadian Geotechnical Journal**,** Geotechnical Testing Journal, Journal of Geotechnical and Geoenvironmental Engineering, International Journal of Geomechanics, Marine Georesources & Geotechnology, Geomechanics and Engineering: An International Journal, Acta Geotechnica, and European Journal of Environmental and Civil Engineering.

Hannah Wan Huan Zhou

Dr. Wan Huan Zhou is an Associate Professor at the University of Macau. She is currently appointed as the Associate Head of the Department of Civil and Environmental Engineering at the University of Macau. She obtained her Ph.D. degree from the Hong Kong Polytechnic University in 2008. Before joined the University of Macau in 2009, she worked as a lecture at the Hong Kong Polytechnic University. In 2015, she was promoted as to an Associate Professor. Her research areas include constitutive modeling of geo-material, numerical modeling in geotechnical engineering, ground improvement (soil nails, pile-supported embankment, geosynthetics, etc.), probabilistic analysis in geotechnical engineering, and advanced laboratory and field testing in geotechnical engineering. Dr. Zhou has published more than 60 peer reviewed international journal and conference papers. In 2011, she received the Award for Excellent Paper 2011, presented by International Association for Computer Methods and Advances in Geomechanics (IACMAG). Dr. Zhou is an independent reviewer of more than 10 international journals, including International Journal of Geotechnical and Geoenvironmental Engineering, International Journal of Geomechanics, Geotechnique, International Journal for Numerical and Analytical Methods in Geomechanics, Canadian Geotechnical Journal, Soils and Foundations.

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List of PapersPage

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Honouring Prof Emeritus Osamu Kusakabe

Guest Editor: Masaki Kitazume

Masrur Abdull Hamid Ghani, Kenichi Ito, Minoru Kuriki and Shun Sugawara — **L. Ming, Y. Haiqing, H. Sakaeda and O. Ozgur**

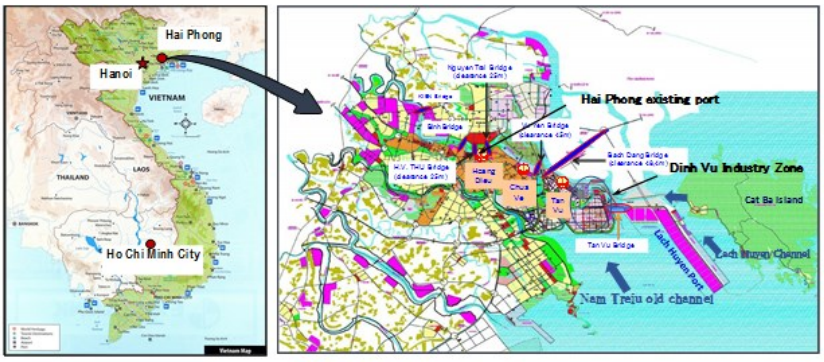

Figure 1 Location of Hai Phong City and Lach Huyen Port Construction Site

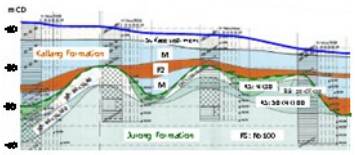

Figure4 Typical soil profileat the site

(1) Marine Clay (2) Residual soil

Photo 1 Soil samplesof the Marine Clay and Residual soils

Loh Chee Kit, Eugene Khoo, Seah Kim Huah, JamesLam Pei Wei, Thiam Soon Tan, Fumitaka Tsurumi and Takahiro Kumagai

J. Hamada, Y. Yamashita, T. Honda, M. Sugaya, M. Kamimura

Y. Ishihara, H. Yasuoka and S. Shintaku

Honouring Prof Osamu Kusakabe

KUSAKABE OSAMU currently with Ibaraki National College of Technology, obtained his Ph D & M Eng from the University of Cambridge. Prof Kusakabe had a distinguished academic & administrative career. Formerly, Professor, Director, Tokyo Institute of Technology Graduate School of Science and Engineering, Department of Civil Engineering, Graduate School of Science and Engineering Civil Engineering. He was also a Fellow of Churchill College Cambridge. He is a recipient of prestigious International Awards including Schofield Award (IJPMG); best paper awards of JGS; and award for distinguished service to the Japanese Geotechnical Society.

Prof Kusakabe's research interest include: Physical Modelling of Contaminant Transport in the Subsurface; historical of Development of Cone Penetration Tests with Reappraisal of Interpretation Methods and its Applicability to Clay Soils; Reappraisal of size effect on bearing capacity from plastic solution; Centrifuge Model Tests on Reducing Ground Vibration by Underground Wall; Propagation of Ground Vibration and its Countermeasures Methods- Centrifuge Modelling; Use of Mini-Drum Centrifuge for Studying Migration of Pollutant through a clay deposit; Attempts at centrifugal and numerical simulations of a large-scale in situ loading test on a granular material; Numerical and experimental modelling of wave barriers as a countermeasure against train-induced ground vibrations; An Application of Centrifuge Model in Environmental Geotechnics Assessment of Soft Geological Barrier Subjected to Pile Constructions in Waste Disposal Site. His research work on Centrifugal modelling in Geotechnics is worthy of praise

Guest Editor: Prof Masaki Kitazume

Prof Masaki Kitazume is currently a Professor at Tokyo Institute of Technology, Civil Engineering Department. He is an expert in soil stabilization methods and in centrifugal model testing. Prof Kitazume is the author of a comprehensive book on providing a state of the art on Deep Mixing Methods; covering: recent technologies, machinery, design, construction technology, quality control and assurance; The Deep Mixing Method (DMM), a deep in-situ soil stabilization technique using cement and/or lime as a stabilizing agent. His research work on deep chemical mixing has earned him worldwide reputation present the piled raft foundation with grid-form deep mixing walls supporting the largest scale base-isolated building in Japan

Preface

There are ten peer reviewed papers in this Issue of the journal honouring Prof Osamu Kusakabe.

The first paper is by Marsrur Abull Hamid,et al on Design and construction of Ho Chi Minh City Metro Line 1 Underground Section: Contract Package 1b (CP1b) is a part of Ho Chi Minh City Metro Line 1 (HCMC MRT Line 1) project which consists of underground construction of two stations, bored tunnels, cut-and-cover tunnel, and transition structure. Each structure has its own distinctive features due to its geographical location, underlying geotechnical layer and construction constrain. Opera House Station, whose construction method categorized as deep excavation (up to 30 m depth) is the first underground metro station in Vietnam which is situated in a cramped downtown and surrounded by old-sensitive shallow-founded buildings. It was built by top-down method as the method offers better control of retaining wall deformation to minimize settlement of adjacent buildings. The other station, Ba Son Station, located next to the riverside, was protected by double sheet pile structure during its construction. For cut-and-cover tunnel, the rigid steel pipe sheet pile (SPSP) was used to maintain stability for construction in the river and on the weak alluvium clay soil. The underlying alluvium clay also causes a negative skin friction issue in the design of pile for the transition structure in Ba Son area. As for tunneling beneath the city, the bored tunnel using Earth Pressure Balance (EPB) Tunnel Boring Machine (TBM) was selected. The TBM was launched from Ba Son Station toward Opera House Station twice: one for the east-bound track, and the other is for the west-bound track. In this project, several instruments were deployed to monitor and to ensure the safety of construction works and surrounding buildings. The data from the monitoring works were also useful for back analyzing and reconfiguration of the construction method. Those features brought challenges for both design and construction stages. The design and construction experience of the project are shared in this paper.

The second paper is by L. Ming, Y. Haiqing, H. Sakaeda and O. Ozgur on Big Challenges and Innovative Solutions at HZMB Link Project: Currently one of the world`s most challenging immersed tunnel projects, the Hong Kong – Zhuhai – Macau Bridge Link (HZMB) is being constructed in the Pearl River Estuary, connecting Hong Kong Special Administrative Region (SAR), mainland China (Zhuhai) and Macau SAR. It consists of 6km Immersed Tunnel with two artificial islands. Since the project is being built in the open sea, the design and construction of the tunnel and artificial islands faces a series of grand engineering challenges. For example, the long distance ventilation and safety design, prefabrication of elements weighing nearly 80,000 tons each, foundation, siltation, towing and installation under high water pressure as well as construction of the west and east artificial islands. This paper discusses the major challenges faced during the HZMB Link project design and construction, and gives examples of innovative solutions to overcome those challenges.

In the third paper, Thi Ha describe Lach Huyen Port Infrastructure Project and Soil Improvement Works: To cover cargo demand in northern part of Vietnam and to fit large size vessel in marine transportation sector, an international deep sea port for 100,000 DWT size vessel is being constructed in Lach Huyen area situated at south east part of Hai Phong City. In this project, reclamation work is being conducted at Port Terminal Area and Access Road Area. In the construction area, totally 20m to 30m of fine soil (clay, slit and sandy clay) layers are distributed. To accelerate the consolidation and to reduce the residual consolidation settlement during port operation, soil improvement works are being carried out by cement deep mixing method and prefabricated vertical drain method. In this paper, overall construction project will be introduced in briefly and then soil improvement works will be presented.

The fourth paper by J.N Shirlaw is on a comparison of EPB and slurry TBMs operating in mixed ground conditions resulting from tropical weathering of rock: Deep, but uneven, weathering of rock is common in tropical and sub-tropical areas. Infrastructure development in many Asian cities has required tunnelling through weathered rock profiles. The ground conditions for the tunnelling typically include saprolite, rock, and mixed faces of soil and rock. Where the rock is strong, and mixed ground is anticipated to be encountered over a significant proportion of the drive, slurry TBMs are typically specified in Singapore, based on local experience. Case studies of slurry and EPB tunnelling in mixed ground conditions, from Hong Kong, are presented, and compared, to illustrate the issues involved. For the EPB drive, there were very large increases in the Penetration Index and Specific Energy when working in pressurised EPB mode in ground conditions comprising >50% strong or stronger rock. In these ground conditions the rate of disc cutter replacement was significantly higher than when tunnelling in open mode in a full face of rock, on the same drive. Average progress rates fell to less than 3m per week in the most extreme conditions of 85% to 99% rock, with most of the time being spent on interventions, including a significant proportion of time required to cool the excavation chamber. It is postulated that these observations are related to the clogging of the cut chips of rock in the tool gap, ahead of the cutterhead, when the cut rock becomes the majority of the spoil. A slurry shield in comparable

conditions in Hong Kong did not experience the spikes in Penetration Index, Specific Energy, or cutter wear, in mixed ground conditions, that were experienced during the EPB drive.

Loh Chee Kit et al in their 5th Paper deal with Reuse and Recycling of Clayey Soil in Pasir Panjang Terminal Phases 3 and 4 Project in Singapore: In order to increase the handling capacity of ports in Singapore, the Maritime and Port Authority of Singapore (MPA) has embarked on massive port development projects for the past decade. One of the major projects was the Reclamation for Pasir Panjang Terminal Phases 3 and 4, completed in April 2015. The project provided 200 hectares of port land equipped with 5.7 km of berthing facilities to accommodate ultra-large container ships. In this project, MPA embraced sustainable development by reusing dredged and excavated clayey soil as reclamation fill and as fill material to form a containment bund within the footprint of the project. Nearly half of the reclamation fill consisted of clayey soil, which was improved using prefabricated vertical drains with surcharge. The containment bund, which served as a temporary earth-retaining system during reclamation filling, was formed using geotextile tubes filled with clayey soil treated with cement. This paper describes the innovative design and construction in the project.
A. Lim and C. Y. Ou in the sixth paper describe the performance of cross and buttress walls to control wall deflection induced by deep excavation in dense urban area.
The authors, J. Hamada, Y. Yamashita, T. Honda, M. Sugaya, M. Kamimura in the seventh paper on piled raft foundation with grid-form deep mixing walls supporting the largest scale base-isolated building in Japan: This paper offers a case history of 300-m high supertall building in Japan. Since the building has a five-story basement, the top-down method was adopted to carry out the underground construction works safely as well as to save construction time by simultaneous construction of the upper and the basement floors. Furthermore, to ensure high performance against strong earthquakes, piled raft foundation consisting of bottom-enlarged cast-in-place concrete piles and steel H-piles built-in soil-cement wall (TSW) embedded in a very dense sand was employed as a cost-effective foundation. In order to confirm the validity of the foundation design, field monitoring on the settlements and the vertical load sharing between the piles and the raft was performed.

The subsequent paper eight in the series is by K. Yamashita, J. Hamada and K. Hirakawa on Piled raft foundation supporting a supertall building in Osaka constructed by top-down method: This paper offers a case history of 300-m high supertall building in Japan. Since the building has a five-story basement, the top-down method was adopted to carry out the underground construction works safely as well as to save construction time by simultaneous construction of the upper and the basement floors. Furthermore, to ensure high performance against strong earthquakes, piled raft foundation consisting of bottom-enlarged cast-in-place concrete piles and steel H-piles built-in soil-cement wall (TSW) embedded in a very dense sand was employed as a cost-effective foundation. In order to confirm the validity of the foundation design, field monitoring on the settlements and the vertical load sharing between the piles and the raft was performed.

Wang Guixuan, Yin Xunqiang and Zhao Jie in the nineth paper discuss Anti-Seismic Numerical Analysis of Water Intake Structure of Pakistan Karachi K-2/K-3 Nuclear Power Plant: Based on the actual conditions of Pakistan Karachi K2/K3 Nuclear Power Plant (NPP), the special topic of seismic numerical simulation calculation and anti-seismic numerical analysis of water intake structure are introduced. Firstly, the project profile of K2/K3 NPP is briefly presented, including the preliminary design, the soil conditions of site, and the purpose and contents of the proposed special topics. Then, the physical and mechanical qualities of the foundation are introduced. Next, the method for calculating the designed ground motion parameters of engineering site are proposed and parts of results are listed which meet the provisions of standard and can be used as an input data for the anti-seismic analysis. Finally, anti-seismic analysis of water intake gate shaft, water intake tunnel, and diversion dike and bank revetment of water intake channel is described, respectively. Through the numerical analysis, it can be concluded that the design scheme put forward in the design can adopt appropriate reinforcement measures and the marine structure is stable under SL2 earthquake loading.

The last paper tenth in the series is by Y. Ishihara, H. Yasuoka and S. Shintaku on Application of Press-in Method to Coastal Levees in Kochi Coast as Countermeasures against Liquefaction: There had been a concern that coastal levees in Kochi would lose their functions due to the settlement caused by liquefaction of the underlying ground as well as the wide-area ground subsidence of 2 meters in the coming huge Nankai Trough earthquake. Protected inlands were supposed to suffer from the long-term flood due to the succeeding tsunami. To cope with these problems, 13-kilometer-long levees in Kochi Coast have been appointed to be in direct control of Ministry of Land, Infrastructure, Transport and Tourism (MLIT), and have been under construction for seismic reinforcement.

Requirements for this construction project were as follows: (1) levees have to be tenacious and their deformations have to be restricted below the allowable values, (2) construction should have minimal impacts on the surrounding environment and human activities, and (3) construction should be carried out at high speed and at low cost, even though cobbles and obstacles are contained in the ground. Under these requirements, reinforcement using sheet piles or tubular piles, along with the Press-in Method as their installation method, was chosen as a solution. This paper explains in detail the background and the decision making process of selecting the construction method for reinforcing the coastal levees in Kochi Coast, as well as the results of piling work in Nino and Nii sections.

Masaki Kitazume

ACKNOWLEDGEMENTS

Ten papers are contained in this issue. The Guest Editor is Prof Masaki KItazume. No doubt the material contained herein would be most valuable to our profession. The editors have adequately described the contributions in the preface. They are to be congratulated for these contributions.

Dr. Teik Aun Ooi
Prof. San Shyan Lin
Prof. Kwet Yew Yong
Dr. Noppadol Phienwej
Prof. A. S. Balasubramaniam

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GEOTECHNICAL ENGINEERING

Journal of the
SEAGS Southeast Asian Geotechnical Society
AGSSEA ASSOCIATION OF GEOTECHNICAL SOCIETIES IN SOUTHEAST ASIA
Sponsored by
AIT Asian Institute of Technology
Griffith UNIVERSITY
Indexed by EI since 1970 Scopus since 2001 ESCI since 2017

Honouring Prof Harry G Poulos

Guest Editor: Emeritus Professor John Carter

Harry Poulos (left) with Rolf Katzenbach and Kenji Ishihara, Dubai, 2009

Harry Poulos 2009 Terzaghi Oration, Egypt

Dubai Creek Tower project

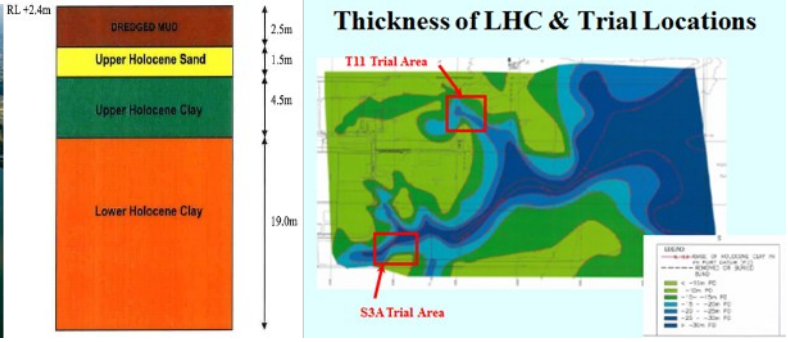
In Middle East

The Emirate Tower

3000 t Load Test with Reaction Anchors

Port of Brisbane Project

Ground Improvement Trials Port of Brisbane



Soil Profiling with CPT CPTu

Hong Kong Building Project

Smart Tunnel Project, kuala Lumpur 2003

Bangkok 1977

Taipei 1997

Popular Guest Lecturer in AGSSEA-SEAGS Member countries and Za Chieh Moh Lecturer in Kl in May 2016

Honouring Prof Harry G Poulos

Harry Poulos obtained a Civil Engineering degree from the University of Sydney in 1961, and then went on to do a PhD degree in Soil Mechanics, graduating in 1965. He worked with the consulting firm of McDonald Wagner and Priddle for a year before joining joined the Department of Civil Engineering at Sydney University in 1965. He was appointed a Professor in 1982, a position which he held until his retirement in 2001. In 1989, he joined the consulting firm of Coffey Partners International, and is currently a Senior Principal with Coffey Geotechnics. He is also an Emeritus Professor at the University of Sydney, and an Adjunct Professor at the Hong Kong University of Science and Technology.

He has published books and technical papers on foundation settlements, pile foundations, and offshore geotechnics. His main research interests continue to be in deep foundations and their application to high-rise buildings, and to problems relating to ground movements near foundations.

He has been involved in a large number of major projects in Australia and overseas including the Docklands Project in Melbourne, the Crown tower development in Sydney, Egnatia Odos highway project in Greece, high-rise foundation problems in Hong Kong, the Emirates twin Towers in Dubai. the Burj Khalifa tower in Dubai, the Incheon 151 Tower in Korea, and the Dubai tower in Doha, Qatar.

He was elected a Fellow of the Australian Academy of Science in 1988 and a Fellow of The Australian Academy of Technological Sciences and Engineering in 1996, and in 1999 was made an Honorary Fellow of the Institution of Engineers Australia. In 2010, he was elected a Distinguished Member of the American Society of Civil Engineers, the first Australian to receive this honour, and in 2014, he was elected as a Foreign Member of the US National Academy of Engineering.

He has received a number of awards and prizes, including the Kevin Nash Gold Medal of the International Society of Soil Mechanics and Geotechnical Engineering in 2005. He was the Rankine Lecturer in 1989 and the Terzaghi Lecturer in 2004, and was selected as the Australian Civil Engineer of the Year for 2003 by the Institution of Engineers Australia. In 1993, he was made a Member of the Order of Australia for services to engineering

Lead Guest Editor: Emeritus Professor John Carter

John Carter has more than 30 years experience in teaching, research and consulting in civil, geotechnical and offshore engineering. His research interests include analytical and numerical modelling, soil-structure interaction, rock mechanics, the behaviour of cemented and uncemented carbonate soils, soft soil engineering, tunnelling and offshore foundations. He has attracted more than $5 million in competitive research funding and been associated with development projects attracting additional grants of more than $4 million. He is the author of several hundred refereed technical papers in geotechnical engineering and engineering mechanics, covering a diverse range of topics from theoretical mechanics to experimental applications. His research output includes a significant body of work on the engineering behaviour of seabed carbonate sediments. Because of the expertise acquired during his research career in geotechnics John Carter has been called upon to consult widely to industry on a range of geotechnical projects including soft clay foundations, offshore foundations, retaining walls and buried structures. He has also been retained as an expert consultant on numerous offshore foundation problems for a number of major oil and gas companies, including BHP, Esso, Woodside, Wapet, Bond Oil, Amoco and Exxon. He is currently a consultant director of Advanced Geomechanics, a geotechnical consultancy based in Perth, providing specialist advice to the offshore industry on foundation problems and on-shore and offshore site investigations. He has also been involved in commercialization of research and the marketing of its outcomes, including his own specialist geotechnical software. Between 1997 and 2000 he was a director, representing the interests of the University of Sydney, of Benthic GeoTech Pty Ltd, a $10 million joint venture company that conceived, designed, built and now operates PROD, the Portable Remotely Operated Drill, which is used to penetrate the ocean floor, conduct in situ tests and recover core samples. John Carter's experience with engineering projects has required him to work in Australia, Britain and the USA. He has authored more than 60 major consulting reports for a range of clients, including mining companies, oil companies, other engineering consultancies and lawyers. Examples of this experience are as follows: - Underground cavern analysis and design, Chatswood-Parramatta Rail Link, NSW. - Expert witness report on the design, construction and maintenance of an industrial car park, Sydney. - Geotechnical Reviewer, for the design of the Yelgun to Chinderah, Pacific Highway bypass, NSW. - Expert witness, Thredbo Landslide, NSW. - Expert witness, house foundation problems - Ellerton Park Estate,

NSW. - Retaining wall review, East Arm Port Development, Darwin. - Expert witness, Cooks River Cofferdam failure. - Preliminary foundation engineering and specialised laboratory testing, Gorgon Development. - Consultant to Amoco, Exxon Production Research, Woodside Offshore Petroleum Pty Ltd, Esso, Wapet, Bond Oil and BHP on pile foundations for offshore oil and gas production platforms. - Consultant to CSR-Humes, Rocla and the Concrete Pipe Association on problems of soil-structure interaction, including the behaviour of buried pipes and buried concrete arches. - Consultant to various mining companies on aspects of underground mine stability. - Consultant to various Geotechnical consultancies on foundation engineering problems. - Director (1997-2000), Benthic GeoTech Pty Ltd, a joint venture company that designed, built and now operates PROD, a Portable Remotely Operated Drill for use in penetrating and recovering core samples

Target Dates: Guest Editors:Topics & ContributingAuthors

1: Target Date for First Submission of Manuscripts:

March 2019

2: Review and corrections of manuscripts: March to September 2019

3: Target Date of Release: June 2020

4: Topics of contributing Authors:

Assessment of Geotechnical Design Parameters; Shallow & Deep Foundations, Theory & Practice; Seismic Response of Deep Foundations; Identification of Characteristics and Performance of Existing Foundations; Remediation Techniques for Deficient Foundations; Ground Improvement Techniques

5: Authors agreed to contribute:

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20 Dr Kiyoshi Yamashita

21: Prof Chu Jian

22: Prof Der Wen Chang-Abstract Received

23: Prof Harry Tan –Abstract received

PROFESSOR HARRY G. POULOS - LIST OF PUBLICATIONS: Towards end

Preface

There are 23 peer reviewed papers in this Issue of the journal honouring Prof Harry G Poulos. The guest editor is Prof John Carter.

The first paper is on Risk Content in Existing Geo-engineering Codes by Mabel CHEDID and Jean-Louis BRIAUD:
Title: Risk Content in Existing Geo-Engineering Codes;

Authors' affiliation: Zachry Dpt. of Civil Engineering, Texas A&M University, College Station, Texas 77843-3136, USA (briaud@tamu.edu)

Abstract: Geotechnical engineering design was at first based on a global factor of safety calculated using average and representative values of the soil parameter. While this deterministic approach is still being used, a probabilistic approach has emerged to account for the variability of the soil parameters and to ensure an acceptable probability of failure. Ultimately, geotechnical structures should be designed considering not only the failure probability but also the value of the failure consequence. Risk, defined as the probability of failure multiplied by the value of the failure consequence, should therefore play a pivotal role in geo-structures design. In fact, risk concepts have, to a little extent, been incorporated in various Geo-engineering design codes. This paper first defines the risk associated with any civil engineering structure. The historical development of design codes from working stress design to risk informed design is then presented. Risk concepts in existing major geotechnical engineering guidance documents are summarized. Finally, a future approach for civil engineering design based on a constant tolerable risk is proposed.

Table of Content:
Risk definition; Historical development of design codes (WSD, LRFD, RD, Performance design);Risk content in existing codes—AASHTO,Eurocode,Canadian highway bridge design code,Australian code,Japanese performance base code,Hong Kong slope code,USBR,USACE,IBC & ISO; Future approach-Small bridge big bridge argument, The bubble chart, Constant risk target and variable load and resistance factors & Geo-Institute Risk Design Standard; Conclusions

The second paper is by Roger Frank on Displacement calculation of piles with pressuremeter results - Some theoretical background

The third paper on Performance of Estuarine Soft Clay with Prefabricted vertical Drains (PVD) Under Surcharge and Vacuum Preloading: Australian Experience by:Buddhima Indraratna, Pankaj Baral, Cholachat Rujikiatkamjorn, A.S. Balasubramaniam & Richard Kelly:

ABSTRACT:
Most essential infrastructure is constructed along coastal belts composed of very weak soft soil with high compressibility and low permeability. Soft alluvial and marine clay deposits have very low bearing capacity and excessive settlement characteristics; properties which pose design and maintenance implications for tall structures and large commercial buildings, as well as port and transport infrastructure. These very soft deposits must be stabilised before commencing construction of infrastructure. Several ground improvement techniques have been applied to improve the ground in past by different researchers and among them Prefabricated vertical drains (PVDs) combined with vacuum pressure and surcharge preloading is an efficient and cost effective technique for accelerating consolidation by promoting rapid radial flow which

reduces excess pore pressure and increases the effective stress. This paper presents several case histories on marine clay from Australia (i.e. Port of Brisbane, Queensland; Pacific Highway, Ballina & Sunshine coast) and summarises the performance of embankment in terms of vertical settlements, excess pore water pressure dissipation and lateral deformation.

The fourth paper is by Wei Dong Guo on Pile(s) responses during embankment loading and excavation: A total of 10 typical pile tests are simulated using 2- and 3- layer model. The test-piles (single or in groups) are installed nearby excavation (behind stable or collapsed walls), embedded in moving embankment (due to 'consolidation'), and/or subjected to lateral spreading. The study is aimed at gaining input parameters for excavation and embankment loading, to facilitate the pile design.

The 5th paper by M. R. Madhav, Raksha Rani Sanadhya and Jitendra Kumar Sharma is on ANALYSIS OF STIFFENED GRANULAR PILED RAFT: For the design of foundations on deep deposits of soft or problematic soil, piled raft is usually provided to reduce the total and differential settlements of foundation and structures built on them. Granular piles may be used in place of conventional concrete or steel piles because of their several additional advantages. Stone columns/granular piles composed of compacted gravel, sand or mixture of both are used. It is required that the load carrying capacity of these granular piles (GP) should be increased for improved performance. Stiffening of granular piles implies that the material of the GP in its top portion of length, is replaced by relatively strong material partially having better strength and stiffness properties, i.e. higher deformation modulus in comparison to the material of granular pile in the lower portion. Geogrid encased columns, SDCM (stiffened deep cement mixing), fibre reinforced granular material, etc. are common forms of stiffening GP. Present study deals with the analysis of partially stiffened granular pile with rigid raft based on the continuum approach. The overall response of the top stiffened GP-raft foundation is evaluated in terms of the settlement influence factor, settlement reduction factor in comparison to unstiffened granular piled raft, normalized GP-soil interface shear stresses, percentage load shared by GP, normalised contact pressure distribution beneath the raft and percentage load transfer to the base of GP with relative stiffness factor and relative length of stiffening.
The sixth paper on Foundation investigation and analysis for Tall tower developments is by C Haberfield, J Finlayson and A Lochaden: Many tall buildings are supported on piled rafts and/or deep bored cast-insitu piles. Good engineering design requires foundation structure interaction analysis and a clear understanding of the factors controlling the performance of the footing system. These rely on a sound understanding of the ground characteristics and individual and group pile performance, including adequate collection of data and testing which can only be achieved through detailed and targeted ground investigation and in situ testing. This paper focuses on the ground investigation methods available and how the results are used to achieve a reliable estimate of footing system performance using foundation structure interaction analysis. It highlights the importance of accurate inputs into the analyses, especially in respect to the stiffness characteristics of the ground and the load displacement performance of individual piles. This is illustrated through a number of case studies of tall tower projects that the authors have been involved in.

The seventh paper is on Numerical simulations of the pressuremeter test: Problems and lessons learnt by Q.J. Ong & S.A. Tan - National University of Singapore, Singapore: The pressuremeter test being able to account for all environmental factors, in-situ stresses, soil stress history and drainage conditions is a key in-situ test for geotechnical projects. Numerical simulations of the pressuremeter test gives confidence in both the field test results and the constitutive model parameters to be adopted for design. In this paper, the various types of pressuremeters are briefly discussed, and modelling techniques for practical pressuremeter simulations are proposed. Case histories of pressuremeter testing in different soil types are reviewed, and simulations of the pressuremeter test are compared against test data as well as other in-situ and laboratory tests for validation. This paper will also touch on the importance of modelling the correct boundary conditions and the difference in simulations between stress and strain controlled tests.

The eighth paper is on Settlements of piled raft foundations from finite-difference analyses on piles and raft affected by finite boundaries by Der-Wen Chang and Hsin-Wei Lien, Department of Civil Engineering, Tamkang University, Tamsui, New Taipei city, Taiwan: In this study, the settlements of a piled raft foundation under vertical loads were computed using Finite Difference (FD) analyses. Computer program WEAPR-S was established incorporating the FD formulas for a surface piled raft foundation resting on soft soils. Boundary effects of the finite raft were taken into account in such analysis (Chang et al., 2017). The WEAPR-S analysis was verified with the 3D Midas-GTS analysis on a numerical piled raft foundation where the length and width of the raft were assumed at 26 m, and the thickness was

kept as 1 meter. The diameter (d) of the piles was assumed at 1 meter. The pile spacing and diameter ratio (S/d) of 4, 6, and 8 were considered for the foundation where the spacing distance (S) between adjacent piles was kept at 4, 6 and 8 meters for case studies. Shear wave velocity of soils was assumed at 120, 150 and 180 m/sec while the Poisson's ratio of the soil was assumed 0.4. Elastic half-space was assumed for the ground soils. Foundation settlements were examined by applying a uniform load of 100 kPa on the raft. Pile and soil resistances were considered as the reactions underneath the raft. For FEM analysis, Analytical zone was examined to ensure a stable solution of comparisons.
For the single raft foundation analysis conducted by a module WERAFT-S developed in this study, it was found that the simplified soil spring model (EsAs/ls) works rationally well with the use of the appropriate thickness of the springs (ls). The zone of the soil spring model was found slightly larger than the area of the foundation. However if the Lysmer Analog spring model was adopted with the application of averaged soil spring constant, it was found that the Analog model would yield much smaller foundation settlements especially when the ground soils became much softer. In such case, unevenly distributed soil stiffness underneath the raft should be considered. The foundation stiffness at the center can be much less than those appeared at the end of the foundation.
For piles underneath the raft, the equivalent stiffness of the piles was computed assuming linearly elastic soil springs attached to the piles. Simplified soil springs (e.g., GsAs/ls and EsAs/ls) were assumed for soils at the pile shaft and the pile tip. The equivalent pile stiffness was examined with a couple of other soil models. They were found very similar in the analysis. For the soil stiffness underneath the raft, the Lysmer Analog model was simply adopted. Comparing the solutions from WEAPR-S and Midas-GTS, the calculated foundation settlements at the center and the edges were found similar when S/d is equal to 8. However the ones at the corners from WEAPR-S were found nearly half of those calculated from the Midas analysis. The differences appeared at the settlements of the corner were also found when the ground stiffness was changed. In addition, it was learnt that the pile-to-pile interactions are significant when S/d is less than 8. Without considering the pile-to-pile interactions, the foundation settlements estimated by WEAPR-S would be much smaller than those from the Midas analysis.

The nineth paper by Renato P Cunha is on Evaluation of analytical and numerical techniques to simulate curtain pile walls in a tropical soil of the Federal District of Brazil:

Tenth paper is by Alessandra Mandolini on an investigation on the performance of simple design tools for piled rafts: The work tries to shed light on the performance of design and analysis methods for piled rafts. Different approaches are employed: the Poulos-Davis-Randolph (PDR) method, in its original form and two modified formulations taking into account soil non-linearity, as well as more complicated numerical approaches involving BEM and/or FEM concepts. The results of the investigation are compared with experimental data coming from physical models and field tests. The role exerted by crucial parameters like raft and pile stiffness and type of non-linearity attributed to the soil on the settlement under working load and load sharing between piles and raft is discussed. Some considerations about the suitability of the different methods as a function of the adopted design philosophy is discussed, also in light of available design regulations.

The eleventh paper is by Raffaele Di Laora on Pile design in seismic areas: small or large diameter?: This work furnishes a contribution towards the identification of the role of diameter in the design of piles in seismic areas. Such a long-standing issue has been discussed over the years mainly with regards to their capability of resisting two kind of forces. More specifically, along with the ones imposed at pile top by the structure oscillations (inertial type), additional bending arises from the deformations of the surrounding soil (kinematic type). However, the latter forces are the outcome of a complex interaction phenomenon which on the other hand makes piles displace less and therefore transmit a smoothened seismic load to the structure. It will be shown in the paper that the optimum pile size to resist earthquake forces strongly depends on the soil stiffness profile. However, the more piles attract internal forces on themselves, the more they are able to unload the structure.

Others to follow:

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20: Dr Kiyoshi Yamashita

21: Chu Jian

ACKNOWLEDGEMENTS

Twenty two papers are contained in this issue honouring Prof Harry G Poulos. The Lead Guest Editor is Prof John Carter. No doubt the material contained herein would be most valuable to our profession. The editors have adequately described the contributions in the preface. They are to be congratulated for these contributions.

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Griffith UNIVERSITY

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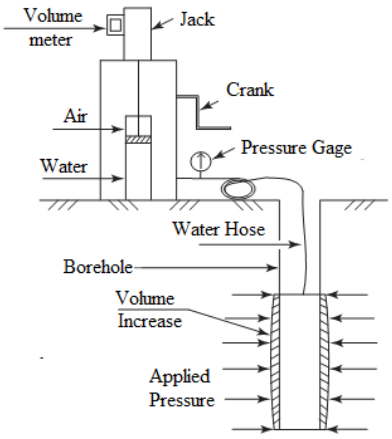
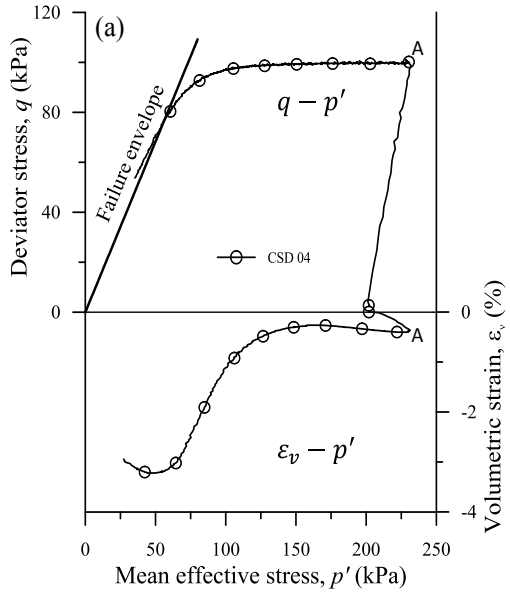
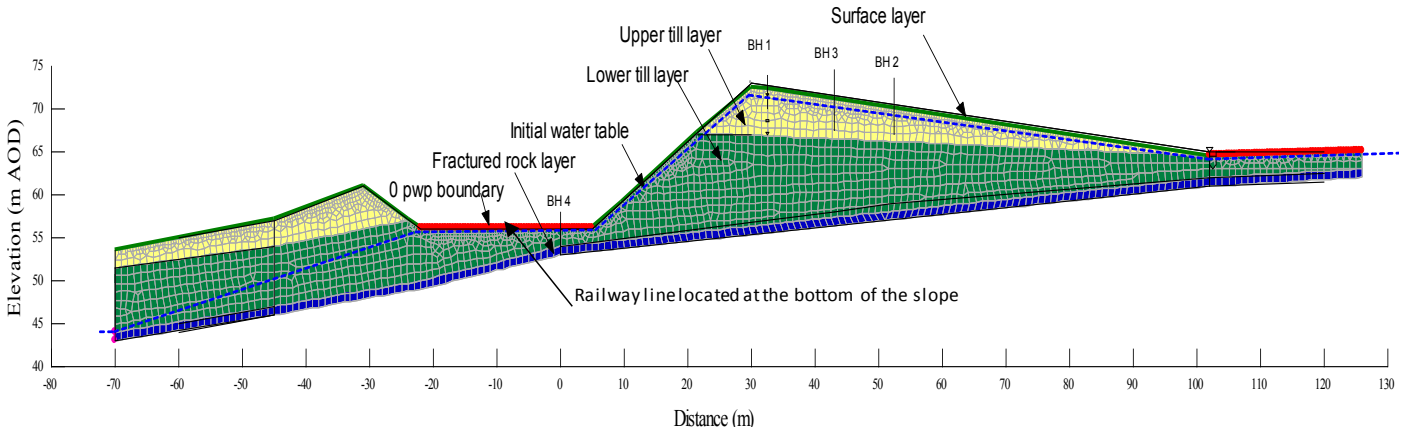
EDITORS: MD MIZANUR RAHMAN AND HOSSAM ABO EL-NAGA







Laboratory and field testing of geomaterials for engineering application
By Md Mizanur Rahman and Hossam Abo El-Naga

GEOTECHNICAL ENGINEERING

December 2020: Part 1 papers of SEAGS 50th Anniversary

Edited by: Md Mizanur Rahman and Hossam Abo El-Naga

Md Mizanur Rahman

A/Prof Rahman obtained his PhD in Civil Engineering from the University of New South Wales, Canberra and then worked as research associate and post-doctoral fellow at the UNSW, Canberra and the University of Canterbury, New Zealand respectively before joining the University of South Australia in 2010. He has 15 years of research experience in different disciplines involving international collaborators from USA, UK, New Zealand, Germany, India, China, Bangladesh etc. His current research interest includes soil-water interaction, seepage (permeability), reuse of waste (construction & demolition, tyre) materials, microbial induced calcite precipitation (MICP) for strengthening soils/concrete, constitutive modelling of material behaviour, finite element modelling (FEM), discrete element modelling (DEM), artificial neural network (ANN), evolutionary polynomial algorithm (EPA), data acquisition and developing new testing technique etc. His research funding was over 2.3M AUD in last five years. These funding includes the prestigious fellowship (Australian Academy of Science Early Career Fellowship), ARC, state government and industry partners. He is very keen to facilitate research collaborations within/across the strands to create opportunities for other collaborations across the university and industry.

Hossam Abo El-Naga

Hossam Abuel-Naga is the leader of Civil Engineering discipline at La Trobe University, Australia and Adjunct Professor at Chongqing University, China. Previously, he was Senior Lecturer and Leader of Geo-Engineering at The University of Manchester, UK; Senior lecturer at The University of Auckland, New Zealand; and Research fellow at Monash University, Australia. He has over 25-year experience in

geotechnical engineering, specialising in soil behaviour under multi-physical coupled processes. Applications of this research area include nuclear waste disposal technology, methane hydrate mining technique, energy foundations, ground improvement, landfill lining system, and more. He served as a Reviewer/Panellist for several Research Funding Agencies including; National Science Foundation-USA, Australian Research Council, Swiss National Science Foundation, Portuguese Foundation for Science and Technology, Qatar National Research Fund, and HiCi, King Abdulaziz University, Kingdom of Saudi Arabia.

GEOTECHNICAL ENGINEERING

PREFACE

December 2020 Issue

This volume contains **13 invited papers** from SEAGS-AGSSEA member countries, Australia, Bangladesh, India, Germany and UK.

Title 1: Estimating hydraulic conductivity assisted with numerical analysis for unsaturated soil – A case study
Authors: Md Rajibul Karim, David Hughes and Md Mizanur Rahman
Status: Accepted

Abstract: Meteorologically induced pore water pressure changes and associated changes in effective stress often affect the behaviour of geotechnical structures such as slopes. Seasonal fluctuations in pore water pressure can lead to stiffness degradation which is also known to have caused a number of failures across the world. These effects are likely to become more severe in the future as dryer summers and wetter winters are expected to become more frequent climate scenario in many parts of the world. To analyse the behaviour of a slope subjected to atmospheric boundary interactions, a number of parameter may be used including the soil water characteristics curve, saturated and/or unsaturated hydraulic conductivity of soil, and strength parameters. Some of them (e.g., hydraulic conductivity) are very difficult to deduce with high degree of certainty because of natural variability of soils and limitations in testing procedure. This paper outlines how numerical techniques combined with conventional field or laboratory investigation can serve as a useful technique to overcome some of these limitations specially in deducing hydraulic conductivity. The effectiveness of these techniques will be tested using a well-documented case study form the United Kingdom.

Title 2: Shear strength derivation of Jakarta stiff clay by use of pressuremeter test data
Authors: Tjie-Liong Gouw and Paulus P. Rahardjo
Status: Accepted

Abstract: Due to its rather brittle nature, retrieving undisturbed samples of Jakarta cemented greyish stiff clay, often found at a depth of 30 to 120m, is very difficult. Good and reliable shear strength parameters, i.e., c and ϕ values, obtained from triaxial test are hardly available. In practice, many engineers are often forced to estimate these parameters through SPT test data which are of course greatly varied from one engineer to another. It will be good if these parameters can be derived by an in-situ testing device. Since Pressuremeter is an in-situ soil testing device able to yield stress strain relationship of soil, a research is carried out to derive c and ϕ values from Pressuremeter test data curves through cavity expansion theory. Results prove that c and ϕ values of Jakarta stiff clay can be derived by matching Pressuremeter test data curve with values calculated through modified cavity expansion theory. The derived c and ϕ values are comparable with CIU triaxial test strength parameters obtained from relatively good 'undisturbed' samples

Title 3: Laboratory study on natural fibre amended fly ash as an expansive soil stabilizer
Authors: B. Soundara, S. Selvakumar and S. Bhuvaneshwari
Status: Accepted

Abstract: Expansive soil sub grade pose major problems for the pavements due to their volume change characteristics. In the present investigation, the suitability of fibre reinforced fly ash on the stabilisation of expansive soil is studied. Coconut fibre is chosen as natural reinforcing fibre with a cut length of 10 mm and used in different percentages such as 0.25, 0.5 and 1% along with fly ash content 20% of dry weight of soil. Laboratory tests includes standard Proctor tests, swelling pressure tests and California Bearing Ratio (CBR) tests were conducted to determine the maximum dry density (MDD), optimum moisture content (OMC), swelling pressure and strength of the soil with and without fibre reinforced fly ash matrix. With the addition of admixtures, the OMC is decreased and MDD is increased, the swelling pressure is decreased drastically and CBR values increased with the addition of admixtures showing an optimum improvement for soil with 0.5% fibre and 20% fly ash content. Thus the test results favoured the utilisation of waste materials such as fly ash and natural coconut fibre to enhance the suitability of stabilized expansive soil as sub grade for pavements.

Title 4: Conceptual approach for in-situ geotechnical-hydraulic monitoring applied to opencast mining dumps prone to liquefaction

Authors: Wiebke Baille, Negar Rahemi and Diethard König

Status: In progress

Abstract: An increased number of liquefaction events have occurred during the recent years in the former opencast mines in the Lusatian region (Germany). The liquefaction events are in general related to both the very loose state of the sandy deposits (average thicknesses 50 m) in-situ and the increase in ground water level up to close to ground surface after the end of active mining. Lusatian region is not at risk for earthquakes. However, both phenomena flow liquefaction and cyclic mobility induced by either monotonic or cyclic loading conditions are relevant (Castro 1975, Ishihara 1993). It was shown in literature that the onset of liquefaction due to both monotonic and cyclic loading is characterized by the instability line (Rahman & Lo 2012). Sources of monotonic or cyclic loading triggering liquefaction were found to be, amongst others, earth construction or dynamic compaction works, or even specific weather conditions like winter storm combined with frost. Remediation of the former open pit mining sites for public use requires adequate risk mitigation against liquefaction hazard.

The study presents a conceptual approach for evaluating the liquefaction susceptibility of loosely deposited sandy soils of open-pit mining dumps combining critical state soil mechanics and instability concept with the soil state in field.

Undrained triaxial tests on samples taken from the site were performed. Based on the laboratory tests, the critical state line (CSL) in void ratio e versus effective mean stress p' plane [CSL(e-p')] and in e versus deviator stress q plane [CSL(e-q)] were determined. Further, the instability stress ratio $\eta_{IS} = q_{max}/p'$ as a function of state parameter y was deduced (Been & Jefferies 1985, Lade 1992). The in-situ void ratios depending on depth were determined from CPT tests using correlations (Friedrich 2005). The ground water level and the related pore water pressures are also known from the CPT data, thus, the in-situ stress state for a given depth was calculated using assumptions for Coefficient of earth pressure at rest, K_0. For any given point in field at a certain depth, the corresponding state parameter $\psi_{in\text{-}situ}$ can be calculated by subtracting the critical state void ratio e_{crit} from the in-situ void ratio $e_{in\text{-}situ}$ values ($\psi_{in\text{-}situ} = e_{in\text{-}situ} - e_{crit}$) for the respective mean effective stress p' corresponding to the depth of the considered point.

Using this approach, any in-situ state can be evaluated with respect to the relevant lines [CSL(e-p'), CSL(e-q), instability line]. Firstly, initial states with potential risk for flow liquefaction ($\psi_{in\text{-}situ}$ is positive) can be separated from states with risk for cyclic mobility ($\psi_{in\text{-}situ}$ is negative). Further, based on the CSL(e-p') and the CSL(e-q), a need for compaction can be quantified. Secondly, the location of any in-situ stress state expressed as ratio $h_{in\text{-}situ}$ with respect to the instability line h_{IS} can be used to quantify a possible pore water pressure reserve Δu.

The above described procedure was applied to two sets of field data. The first field case contains CPT data at the same location in year 2005 and 2011. During this time period, the ground water level increased about 5 m. For both data, the determined criteria for flow liquefaction based on instability line h_{IS} is compared to fixed empirical criteria for allowable pore water coefficient $R_u = \Delta u/s_v = 0.1$ to 0.4. It was shown that a criteria based on a fixed R_u may not be at the save side. In the second field case, CPT data as well as in-situ

pore water pressure measurements were used to evaluate the state in a given profile of the sandy deposit before, during and after blast densification.

The application of the suggested approach for the two field cases has demonstrated the potential of the approach for evaluation of liquefaction susceptibility as well as for the design of monitoring concepts or the design of engineering countermeasures to mitigate the risk of possible liquefaction events. However, further research is needed regarding (1) the uncertainties stemming from the intrinsic heterogeneity of the dumps in terms of state parameters (density, stress state, K_0 value) and material properties (grain size distribution, particle shape, fines content), and (2) the use of correlations for void ratio calculation based on CPT.

Title 5: Development of a stress-strain path controlled triaxial apparatus to understand the behaviour of silty sand

Authors: A. T. M. Z. Rabbi, M. M. Rahman, K. Mills and D. A. Cameron

Status: Accepted

Abstract: Triaxial tests are widely used to determine the shear strength, material properties and instability behaviour of soil. The conventional isotropically consolidated drained and undrained triaxial compression tests under constant confining stresses, fail to simulate many field stress conditions such as K0-consolidation for zero redial strain or the reduction of lateral confinement at constant shear stress and associated instability behaviour of slopes. Such strain or stress path-controlled tests need special arrangements and control systems. In this paper, a newly developed triaxial apparatus, capable of stress-strain path-controlled test, is described. The main feature of this apparatus is the precise measurement and control system, which permits individual control of the cell pressure, pore water pressure, vertical stress and axial strain. The apparatus was used to study the stress-strain behaviour of a South Australian silty sand under different stress-path testing such as isotropic and K0-consolidated undrained and drained shear, constant shear drained (CSD) and constant mean stress (CMS) tests. Critical state conditions were achieved with uniform soil deformation at large axial strains, except in the case of the constant shear drained (CSD) tests where a gradual reduction of lateral confinement accelerated sample failure.

Title 6: Laboratory Investigations on the Shear Behaviour of Sand -Tyre Derived Aggregate Mixtures

Authors: J.S.Vinod, M. Neaz Sheikh, Soledad Mashiri and Dean Mastello

Status: In progress

Abstract: A significant amount research has been carried out in the recent years to investigate possible options for the reuse of scrap tyres in civil engineering applications. One of the sustainable options is to utilise scrap tyre as tyre shreds/ tyre chips (generally called as Tyre Derived Aggregate, TDA) and sand mixture as a lightweight fill material in the construction of infrastructure. Utilising TDA in infrastructure projects has multiple benefits including environmentally sustainable recycling and reuse of the scrap tyre thereby easing the consumption of natural fills, reduced material costs and enhanced geotechnical properties of the soil. Understanding the shear and volume change behaviours of TDA and sand mixture is critical before recommending the mixture as a suitable lightweight-reinforcing structural fill. In this study, the effect of the addition of TDA on the shear behaviour of sand was investigated using large scale direct shear and triaxial apparatus. It has been observed that TDA has significant influence on the shear and volume change behaviours of sand. Also, overall improvements in the soil characteristics, such as enhanced shear strength, can be achieved by the addition of TDA in sand.

Title 7: Triaxial Testing Techniques for Liquefaction Study

Authors: M. A. L. Baki, M. M. Rahman and S. R. Lo

Status: In progress

Abstract: Triaxial apparatus is a widely acceptable and commonly chosen testing device for understanding mechanical behaviours of soils from laboratory tests. The uniform distribution of stress-strain inside the

specimen till large strain close to steady state is a challenge. Nearly three decades of research on instability and liquefaction behaviours of granular soils at the University of New South Wales (UNSW), Canberra, Australia provided significant improvements in triaxial testing techniques. In this article, different standardised and developed triaxial testing techniques will be discussed. These include the ability of triaxial testing device to measure and record instability behaviour, specimen preparation techniques, enlarge platen with free ends and its effects, accuracy and errors involved in the different measurements/calculations. Representative monotonic and cyclic test results of Sydney sand with fines and coal ash prepared under different specimen methods has been included to evaluate effectiveness and reliability of abovementioned techniques.

Title 8: Stress-Strain and Deformation Characteristics of an Unsaturated Soil-Cement Interface under Different Overburden Stresses and Grouting Pressures
Authors: M. A. Hossain and J. H. Yin
Status: In progress

Abstract: The most important parameters, by which the shear strength of any interface may be affected, are overburden stress and degree of saturation. Nowadays, grouting pressure is considered as another important parameter, which affects the interface behavior. In addition to gravity grouting, pressure grouting has been widely used to grout insitu soil-cement grout interfaces, like interfaces of soil-nail, soil-pile, and soil-anchor. In the present study, a series of interface direct shear tests were performed between a compacted completely decomposed granite (CDG) soil and cement grout under different overburden stresses, matric suctions, and grouting pressures. The stress-strain and deformation characteristics of the pressure grouted interface are similar to that of the CDG soil. However, the dilation values of soil-cement interface under different grouting pressures are smaller compared to CDG soil. The interface shear strength envelopes are approximately linear, and the apparent interface friction angle and adhesion intercept increase with matric suction for particular grouting pressures. On the contrary, the apparent interface friction angle decreases with pressure grouting for different matric suctions except saturated condition at which it remains constant.

Title 9: Causes of Damage of Rural Road in Coastal Areas of Bangladesh
Authors: Jahangir Alom, Emdadul Karim and Md. S. Hoque
Status: In progress

Abstract: The most important parameters, by which the shear strength of any interface may be affected, are overburden stress and degree of saturation. Nowadays, grouting pressure is considered as another important parameter, which affects the interface behavior. In addition to gravity grouting, pressure grouting has been widely used to grout insitu soil-cement grout interfaces, like interfaces of soil-nail, soil-pile, and soil-anchor. In the present study, a series of interface direct shear tests were performed between a compacted completely decomposed granite (CDG) soil and cement grout under different overburden stresses, matric suctions, and grouting pressures. The stress-strain and deformation characteristics of the pressure grouted interface are similar to that of the CDG soil. However, the dilation values of soil-cement interface under different grouting pressures are smaller compared to CDG soil. The interface shear strength envelopes are approximately linear, and the apparent interface friction angle and adhesion intercept increase with matric suction for particular grouting pressures. On the contrary, the apparent interface friction angle decreases with pressure grouting for different matric suctions except saturated condition at which it remains constant.

Title 10: Fracture energy and crack intiation from CCNBD Fracture Toughness test using Image Analysis
Authors: G. Sivakumar and V.B. Maji
Status: In progress

Abstract: Structures in rock mass consist of several inherent flaws and weaknesses like micro cracks, fractures, faults, bedding planes etc. Determination of fracture toughness plays pivotal role in deciding these crack formation/initiation, propagation and ultimately macro scale failure. In the present study, A Cracked Chevron Notched Brazilian Disc (CCNBD) fracture toughness test for both mode I and mode II fracture are conducted based on ISRM suggested method, to know the energy that is required to initiate the crack. Crack propagates from damaged zone to undamaged zone based on the crack initiation stress and the crack displacement parameters derived from the test. The crack displacement can be monitored using LVDT, but because of the brittleness in the rock material and very short duration of test, it is too difficult to be measured with LVDT. In this paper, an image analysis technique is described where the displacement is monitored by capturing video of the fracture toughness test conducted on artificially prepared rock specimens. Based on the various frames extracted from the video, the crack initiation and displacement can be precisely calculated and the results of the test can be found much more effectively.

Title 11: Advanced Laboratory Characterization of the Composition of Fine-Grained Soils – Specific Surfcae Area and Carbonate Content
Authors: Alan J. Lutenegger
Status: In progress

Abstract: Fine-grained soils are complex and often exhibit behaviour that is not fuly explained by traditional simple geotechnical characteristics. Compositional characteristics may influence behaviour but are often not evaluated in routine laboratory testing. Two compositional characteristics of fine-grained soils that are resonably easy to determine are Specific Surface Area and Carbonate Content. Both of these parameters may help explain diffrences in behaviour of seemingly similar fine-grained soils. Methods of measuring Specific Surface Area and Carbonate Content are described and typical values for a range of natural fine-grained deposits are presented. The influence of Specific Surface Area and Carbonate Content on the behaviour of fine-grained soils such as Atterberg limits, swell, compressibility and Activity is illustrated by presenting several examples. The results show that these two measurements can be a part of routine laboratory characterization of fone-grained soils.

Title 12: Influence of the sample preparation on the mechanical characteristics of Hostun sand
Authors: Meisam Goudarzy and Diethard König
Status: In progress

Abstract

Title 13: Simple method to determine vapour equilibrium time of soils
Authors: Hossam Abo El-Naga
Status: In progress

Abstract:

ACKNOWLEDGEMENT

Thirteen papers are contained in this issue. All of them are assembled by the Guest Editors. No doubt the material contained herein would be most valuable to our profession. The editors have adequately described the contributions in the preface. They are to be congratulated for these contributions.

Dr. Teik Aun Ooi
Prof. San Shyan Lin
Prof. Kwet Yew Yong
Dr. Noppadol Phienwej
Prof. A. S. Balasubramaniam

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