Geotechnical Engineering Journal of the SEAGS & AGSSEA

Vol. 48 No. 1 March 2017

ISSN 0046-5828

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

Indexed by EI since 1970 Scopus since 2001

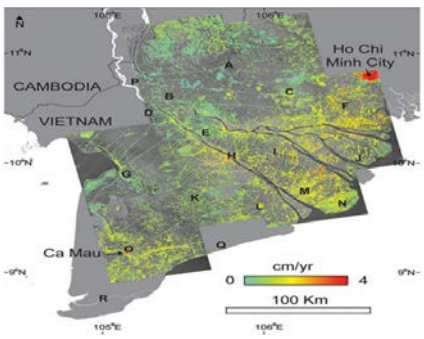
EDITORS:

Kazuya Yasuhara, Farrokh Nadim and **Dennes Bergado**

Geo-disasters in Japan in the Context of Climate Change
(After K. Yasuhara, S. Kawagoe and K. Araki, 2017)

Analysis and Simulations of Flood Control Dikes and Erosion Protection Schemes using PLAXIS FEM 2D and SLIDE Softwares
(After N. Chanmee, D.T. Bergado, T. Hino and L.G. Lam, 2017)

Climate change impacts in a large-scale erosion coast of Hai Hau district, Vietnam and the adaptation
(After Do Minh Duc, Nguyen Manh Hieu and Nguyen Chau Lan, 2017)



Subsidence and shoreline retreat in the Ca Mau Province – Vietnam: Causes, consequences and mitigation options *(After K. Karlsrud , B.V. Vangelsten and R. Frauenfelder, 2017)*

GEOTECHNICAL ENGINEERING

March 2017: Climate Change, Environmental Geotechnics and Geo-hazards

Edited by
Kazuya Yasuhara, Farrokh Nadim and **Dennes Bergado**

Kazuya Yasuhara

Kazuya Yasuhara is Professor Emeritus of Ibaraki University in Japan; His academic career started in Kyushu University where he was from 1968 to 1978, earning a Doctoral Degree as well. He was then a Professor at Ibaraki University from 1990 to 2007. Prof Yasuhara was the International Project Coordinator at the Institute of Global Change Adaptation Science from 2010 to 2015. He was also a Review Editor for IPCC AR 5 from 2010 to 2014. Since 2015, Prof. Yasuhara is a Specially appointed researcher at Ibaraki University.

Prof. Yasuhara was at University of Illinois Urbana- Champaign in Illinois, USA from 1979-1981 and was a Post Doctorate Research Fellow at the Norwegian Geotechnical Institute from 1986 to 1987. Prof. Yasuhara was the recipient of several prestigious awards: ASCE Best Paper Award in 1999; JGS Award for Meritorious Service in 1999; Groundwater Science and Technology Award (IAHR) in 2000; JGS Award for the Best Research Achievement in 2004; Best Paper Award from Japan Chapter of International Geosynthetics Society in 2006; and JGS Meritorious Research Award for Ground Environment in 2008. His current research interest is in Climate change-induced compound geo-disasters in Asia-Pacific regions and their adaptation countermeasures against earthquake-induced settlements of infrastructures. Prof. Yasuhara is the author of a very large number of publications in this field and others in Geotechnics.

Farrokh Nadim

Dr. Dr Farrokh Nadim is the director of the Centre of Excellence, the "International Centre for Geohazards" (ICG), at the Norwegian Geotechnical Institute (NGI). He has a BSc in structural engineering from Sharif University of Technology in Iran, and MSc and ScD degrees in civil engineering from Massachusetts Institute of Technology (MIT). Dr Nadim came to NGI in 1982 on a post-doctoral fellowship and joined NGI as a fulltime employee in 1984. His major fields of work are related to landslides and geohazards, risk and reliability analysis, geotechnical earthquake engineering, behaviour of geotechnical structures under cyclic and dynamic loading, and offshore foundation engineering. He is author or co-author of over 80 scientific publications, and Chair of Technical Committee 32 of ISSMGE: "Engineering practice of risk assessment and management". Since 2003 Dr Nadim has been an adjunct professor at both the Norwegian University of Science and Technology (NTNU) and University of Oslo (UiO).

Dennes Bergado

Prof. Bergado (Dennes) was in the Geotechnical Engineering batch that graduated from AIT in 1976. After working for a while in Philippines, Prof. Bergado studied at Utah State University in USA on a Full Bright Scholarship and worked with Prof. Loren Anderson. Prof. Bergado joined AIT as an Assistant Professor in 1982. At AIT in the early years Prof. Bergado was involved with many major Sponsored Research Projects including the USAID Funded Welded Wire Mechanical Stabilized Earth and Geosynthetics in Embankments on Soft Clays. Prof. Bergado was also deeply involved with the PVD Soft Ground Improvement Project at the Second Bangkok (Suvarnabhumi) Airport Site with the Airport Authority of Thailand. The Doctoral Students of Prof. Bergado were: Prof. Shivashankar, Prof. Chai, Dr. Long, Dr Panich, Dr Lorenzo, Dr Sompote, Dr Lai, Dr Abuel-Naga, Dr Chairat, Dr. Pittaya, Dr Jaturonk, and Dr Tawatchai to name a few. He successfully supervised a total of 17 doctor and 160 master graduates. Prof. Bergado wrote 2 books in soil/ground improvement, edited 22 conference proceedings with more than 140 journal and 280 conference papers. Prof. Bergado also edited the Volume on Geotechnical Engineering in SE Asia for the Golden Jubilee Conference at San Francisco in 1985. Prof. Bergado was associated with the Southeast Asian Geotechnical Society from the time he joined AIT, earlier as Editor of the Journal (1996-2000) and later became the Secretary General of SEAGS (2001-2012). He also initiated the Asian Center for Soil Improvement and Geosynthetics (ACSIG) and founded the International Geosynthetics Society (IGS)-Thailand Chapter. Currently, he is serving his second term as elected member of the IGS International Council. Prof. Bergado spent his Sabbatical at Saga University.

GEOTECHNICAL ENGINEERING

PREFACE

There are fourteen papers in this Issue edited by Yasuhara, Nadim & Bergado. The first paper is by Yasuhara et al on Geo-disasters in Japan in the Context of Climate Change. The authors say: Japan is an area affected strongly by land surface upheaval and by climate change instability. Background evidence of increasing and magnifying geo-disasters includes the following: (i) frequent and extremely severe torrential rainfall; (ii) high and increasing frequency of strong earthquakes (5+ and 6- as the Japan Meteorological Agency seismic intensity scale); and (iii) typhoons with magnified damage effects. Based on a review of that information stated above, an attempt has been made to overview the present situation and future trends of geo-disasters in the context of climate change and to present possible adaptive measures against disasters. Particularly, emphasis is assigned to the importance of the combined effects of plural events, which increases the probability of extreme events, sometimes triggering devastating consequences. Adaptive measures against climate change-associated geo-disasters are presented by classification into software and hardware. Special emphasis is devoted to the availability of information and communication technology (ICT) and information, communication and robot technology (ICRT) involving devices such as IC-sensors and un-crewed vehicles (UAV, drones), which are useful in early warning systems and in simple monitoring systems.

The second paper is by Do Minh Duc et al on climate change impacts in a large-scale erosion coast of Hai Hau district, Vietnam and the adaptation. It seems among the effects of global warming, sea level rise (SLR) and severe typhoons pose the greatest threat to the stability of human settlements along coastlines. Therefore, countermeasures must be developed to mitigate the influences of strong typhoons and persistent SLR for coastal protection. This study assesses climate change impacts on coastal erosion, especially in two projected SLR scenarios of RCP2.6 and RCP8.5. The results show that SLR and severe typhoons lead to the increase of coastal erosion, beach lowering and scour. Moreover, as in projected SLR scenarios, average waves in high tide can cause severe soil erosion at inner slopes and lead to dyke failure by 2060. The paper highlights the need for additional geotechnical engineering measures to protect the coast of Hai Hau district against SLR and severe typhoons. Among the alternatives available for countering these threats, applying soil stabilization and soil improvement combined with geosynthetics are promising strategies for coastal structures. Hybrid structures can be used with earth reinforcement and soil improvement. Additionally, the paper emphasizes the importance of multiple protective adaptations, including geosynthetics and ecological engineering measures against climate change-induced severe erosion on the coast of Hai Hau district.

Karsrud et al in the third paper described subsidence and shoreline retreat in the Ca Mau Province – Vietnam: Causes, consequences and mitigation options: The authors say in the past decades, the Ca Mau province located at the southern end of Vietnam, has experienced significant land-loss. Satellite data suggest that a loss of land, or a retreat of the shoreline, ranging from about 100 m to 1.4 km have occurred over the past 20 years or so. In addition to the retreating coastline, the Ca Mau coastline has experienced loss of mangrove forests and salt-water intrusion into canals and rivers in the region. A study undertaken in collaboration between Vietnamese and Norwegian institutions has tentatively concluded that the main cause of the land-loss is subsidence of the ground surface as a result of ongoing groundwater pumping. The experienced land-loss may be further enhanced by a climate change related sea-level rise. Large parts of the land area in Ca Mau lie less than 1.5 m above sea-level. The subsidence settlements may already have reached 40 to 80 cm in some places, and the present subsidence rates may correspond to 2-4 cm/year. Recent satellite based data using In SAR technology (Interferometry Synthetic Aperture Radar) confirm that significant subsidence is on-going in all provinces in Vietnam from Ho Chi Minh City and southwards. If no actions are taken soon, the implication will be that these provinces are lost to the sea within a time frame of a few decades.

The only realistic way to prevent such subsidence settlements is to greatly reduce groundwater pumping in the area, and replace it with water from other sources. Also in light predicted climate-change related sea-level rise, some physical barriers may also be required to protect the region against flooding. It is

recommended to immediately initiate an observational program and supplementary analyses to verify the present and future subsidence of the ground surface in Ca Mau. This is to ensure that remedial actions are planned for and implemented before it is too late.

In their paper (fourth one) Yahaya et al present rainfall erosivity variability for Penang Island in Malaysia. Rainfall erosivity considers the rainfall amount and its intensity. This is an important parameter for soil erosion risk assessment under future land use and climate change. Comparisons of all climatic parameters show that rainfall is directly involved in the loss of soil quality during torrential rain. The effect of rainfall erosivity in Northern part of Malaysia was considered for two stations, Bukit Berapit and Air Itam. Monthly as well as annual rainfall was obtained from the Department of Drainage and Irrigation, Malaysia for thirty years (1983-2012). Trends analysis of the rainfall data were obtained for 30 years that shows trends for mean annual rainfall. This was conducted using Mann-Kendall trend analysis and Sen's slope tests. Trend analysis shows that there is negative significant difference in mean annual rainfall for the studied period for Air Itam. The Fournier indexes were used to determine the effect of extreme rainfall events towards soil erosivity. Bukit Berapit recorded 3.33% cases of severe impact using Fournier index and 13.33% cases of high impact using modified Fournier index. The result shows that there is a relationship between rainfall trends and soil erosivity.

The fifth paper is on the influence of increased precipitation on the transient seepage through levees during flood events. This paper is by Scheurmann et al. The transient seepage through levees during a flood event depends on several factors, such as the initial water content condition within the levee as a result of former flood and precipitation events which is frequently neglected. Results of experimental and numerical investigations are presented which show the importance of the initial water content distribution on the resulting transient seepage. Analytical methods for calculating the transient seepage through levees are introduced. The modified method after Brauns (1999) allows for the determination of the seepage through levees under consideration of partly saturated conditions. The initial conditions for the transient seepage can be chosen based on simple considerations related to the field capacity or the effective infiltration of water due to precipitation.

Hazarika in his paper sixth in the series discuss the use of low carbon and low cost (LC2) Materials in climate change adaptation measures. Material recycling of waste tires, which reduces the release of greenhouse gases, for protecting coastal structures from potential natural hazards is proposed here. A new technique using waste tires behind sea walls to protect them from the damage due to impact force of tsunami is described. Cultivation of suitable plants inside the tires was proposed and field tests on planting trees that can grow in saline soil conditions were performed to see whether tire structures can preserve the greenery of the area. A physical model for tsunami impact force simulation was also developed to evaluate the reduction effect of tsunami impact force by the tire structures. Results of this research, if implemented, is not only expected to contribute towards economic countermeasures against natural hazards, but also will go a long way towards providing a sustainable solution for infrastructure development in the future.

Lee et al are the authors of the seventh paper on performance monitoring of bridge foundations under multi-hazards
In an effort to proactively monitoring the safety of bridge foundations so as to probe the possible performance of bridge foundation during natural hazards such as floods, debris flows, rainstorms, and typhoons, an intelligent monitoring system was developed by the authors and had applied to several bridges. In this paper, theoretical background and development will be firstly described. Two case histories will then be presented to describe performance of bridge foundation during natural hazards. Such information will be also further discussed by integrating environment factors such as rainfall amount and flow velocity. Research progress presented in this paper is hoped to be helpful in understanding performance of bridge foundation during hazards so as to provide insights of pre-warning of bridge safety.

The eighth paper by Chanmee et al is titled analysis and simulations of flood control dikes and erosion protection schemes using PLAXIS FEM 2D and SLIDE computer softwares. In 2011, Thailand has suffered from devastating flooding due to climate change. During this time, 2 typhoons from the Pacific area went

straight across Vietnam to Northern Laos and Northern Thailand instead of the usual path to Taiwan and Japan. Subsequently, huge flooding damaged many infrastructures and overtopped flood protection dikes of many industrial estates and educational institutions in the Central Plain of Thailand such as at Hi-Tech Industrial Estate, Bang Pa-In Industrial Estate, Navanakorn Industrial Estate and Asian Institute of Technology. The same phenomenon also occurred in Laos PDR which caused unusually heavy rains and widespread river flooding in 2011.

Consequently, slope failures occurred along National Road 1B (NR 1B) in Pongsaly Province in Northern Laos due to undercutting erosions at the lower slopes by the adjacent flooded river. To evaluate the stability of these protection structures, finite element and limit equilibrium methods were utilized. PLAXIS 2D software was used to analyze the slope stability of improved flood protection dikes and erosion control schemes at low and high water levels incorporating the various supporting and reinforcing materials such as geosynthetics, concrete sheet pile and concrete slab. Moreover, the PLAXIS 2D software was also utilized to predict the vertical deformations (settlements) of improved flood protection dikes in cases of additional embankment height and at different cases of flood water levels. In addition, the SLIDE software was used to predict the value of the factor of safety by using limit equilibrium method for the improved flood protection dikes and erosion control schemes.

In the subsequent paper nine in the series Araki et al deal with arresting rainfall-induced red soil runoff in a farmland by inhibitory adaptation measures. Climate change-induced red soil erosion in Okinawa of Japan has become widely recognized due to the increased frequencies of heavy rainfall. Approximately 85% of runoff from farmland is accounted as a source of the red soil erosion. In this study, field experimental plots were conducted in Ginoza village in Okinawa to investigate the effectiveness of potential adaptation measures in arresting the red soil erosion. A physical model for estimating a sediment volume of soil erosion was derived based on grain size distribution. The maximum particle sizes were derived as a function of rainfall intensity, initial soil conditions and strength parameters of the surface soil. The measured maximum particle sizes of the discharged red soil were agreed well with the model results and could offer the basis for determining an appropriate method of adaptation based on geotechnical aspect.

Umino et al in the tenth paper deal with iron and steel slag properties and mechanisms for carbon dioxide fixation in a low-carbon society. The paper presents carbon dioxide (CO2) fixation properties of an iron and steel slag containing calcium, in order to contribute to a geotechnical application for the formation of a sound material-cycle society and a low-carbon society. To investigate the properties of CO2 fixation, CO2 fixation tests with constant flow were conducted. Results show that when the CO2 concentration 4500 μL-$_{CO2}$/L was flowed in a specimen by 0.05 L/min, for a non-aged steelmaking slag, the amount of CO2 fixed was the maximum: 0.04 g- CO2/g-slag. The amount of CO2 fixed in the steelmaking slag resulted from about 20% of soluble calcium in the chemical reaction. Therefore, it is possible that the quantity of CO2 fixation can be evaluated from the viewpoint of the mechanism of CO2 fixation using the quantity of water soluble calcium.

Kusakabe et al in the eleventh paper deal with the development of gross national safety index for natural disasters. After the Great East Japan Earthquake on March 11, 2011, it appeared that Japan was extremely vulnerable to natural disasters and lack of adequate social systems for mitigating natural disasters. The authors advocated a need for the development of safety index systems for natural disasters for policy makers and decision makers to prioritize mitigation measures to be implemented. The World Conference on Disaster Reduction in Kobe in 2005 adopted the Hyogo Framework for Action, which clearly states the urgent need for developing vulnerability index. An extensive literature survey was firstly conducted to find out the State of the Art regarding to the development of systems of indicators of disaster risk and vulnerability at national and sub-national scale. The survey indicates that the system of indicators such as World Risk Index (WRI) is widely accepted. By modifying the WRI index, a new index named GNS (Gross National Safety for natural disasters) was developed in this study. Risk in GNS is defined by Hazard x Exposure x Vulnerability. Five natural events are considered in 2015 version of GNS, including earthquake, tsunami, storm surge, sediment related disaster event, and volcanic activity. An initial calculation was carried out by using various big data available open to public. The results of disaster risk and vulnerability

are presented in the prefectural scale in Japan. Our intension is not to provide the ranking of GNS but to offer the policy and decision makers a piece of scientific information for selecting highest priority measures for mitigation in a rational manner. A few commentary remarks are added to include the impact of climate change on natural disasters in the safety index system.

The twelfth paper by Yuan et al. describes the flooding hazards and potential risks due to heavy rain and sea level change in Shanghai, China. Current sea level change is mainly induced by global warming which is believed to increase the sea level if sustained for a sufficiently long period of time. Many coastal cities around the world have suffered adverse effects as a consequence of sea level change. Shanghai is a coastal city which is located on the estuary of the Yangtze River with an elevation ranging from 3 to 4 m. Its geological and climatic conditions make the city sensitive to flooding risk caused by heavy rain and sea level change. This paper analyses the recent sea level change and heavy rainfall in Shanghai. Regional rates of sea level change can be divided into i) the rate of eustatic sea level change; ii) tectonic movement of the continent; and iii) land subsidence in Shanghai. A correlation analysis shows that the number of local torrential rains and short duration torrential rains correlates with sea level change. Incidents including pluvial flooding, sea water intrusion and potential damage to coastal structures will be more serious if the rate of sea level change continues to rise. To protect the environment and to control economic losses, more countermeasures should be established to prevent the potential hazards.

The thirteenth paper by Soralump and Chaithong is on the modeling impact of future climate on stability of slope based on general circulation model. Slope failures are one of geo-hazard which are one of the most dangerous and occur very often. Climate is an important role in stability of slope. In many cases rainfalls induce slope instability and lead to slope failure or landslide whereas evaporation might stabilize slope. Climate change due to greenhouse effect and global warming might affect precipitation and evaporation patterns in the future and influence future slope failure. Therefore, the paper proposes a method for assessment impact of climate change on slope failure occurrences based on general circulation model (GCM). Methodology combines between climate scenarios as a result of general circulation model and modified critical antecedent precipitation index model. GCM results are downscaled with dynamical-statistical technique to derive local climate. Analysis found that trends of susceptibility of soil instability vary and depend on climate in each year period.

The fourteenth paper by Ghosh and Pal describes the geotechnical measures for Uttarakhand Flash Flood in 2013 in India. In many “Run of the River” hydro-electric projects in the four main states of northern India have been frequented by “Cloud Burst” induced flash flood since 2003, which is primarily attributed to climate variability and land use pattern changes. Given the ageing population of vulnerable constructions along the hilly terrains, safety issues require more attention in the form of technical auditing cum inspections, routine monitoring, emergency drills, surveillance systems, and regularly updated emergency action plans. In addition to these accelerated events of “cloud burst” induced flash flood in the hilly region has opened up Dam safety issues, which are debated in the court of law for which geo-professional intervention have to be looked into. The climatic and other geo-morphological changes that might have caused Uttarakhand Flash Flood in 2013 are explained. Damages to the geotechnical structures in the form of excessive erosion, landslides, siltation of catchment area of several Dams in Uttarakhand state of India are described with some illustrations of landslide mitigation by indigenous bio-engineering solution as one the means of rehabilitation measures.

Editors:
Kazuya Yasuhara,
Farrokh Nadim
and Dennes Bergado

ACKNOWLEDGEMENT

Fourteen papers on Climate Change & Geotechnics are contained in this Issue. 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

GEOTECHNICAL ENGINEERING

March 2017: Climate Change, Environmental Geotechnics and Geo-hazards

Edited by
Kazuya Yasuhara, Farrokh Nadim and **Dennes Bergado**

TABLE OF CONTENTS

Cover Photographs:

1. Photo 1 Analysis and Simulations of Flood Control Dikes and Erosion Protection Schemes using PLAXIS FEM 2D and SLIDE Softwares *(After N. Chanmee, D.T. Bergado, T. Hino and L.G. Lam, 2017)*

2. Photo 2 Geo-disasters in Japan in the Context of Climate Change *(After K. Yasuhara, S. Kawagoe and K. Araki, 2017)*

3. Photo 3 Climate change impacts in a large-scale erosion coast of Hai Hau district, Vietnam and the adaptation *(After Do Minh Duc, Nguyen Manh Hieu and Nguyen Chau Lan, 2017)*

4. Photo 4 Subsidence and shoreline retreat in the Ca Mau Province – Vietnam: Causes, consequences and mitigation options *(After K. Karlsrud , B.V. Vangelsten and R. Frauenfelder,2017)*

Geotechnical Engineering Journal of the SEAGS & AGSSEA

Vol. 48 No. 2 June 2017

ISSN 0046-5828

GEOTECHNICAL ENGINEERING

Journal of the

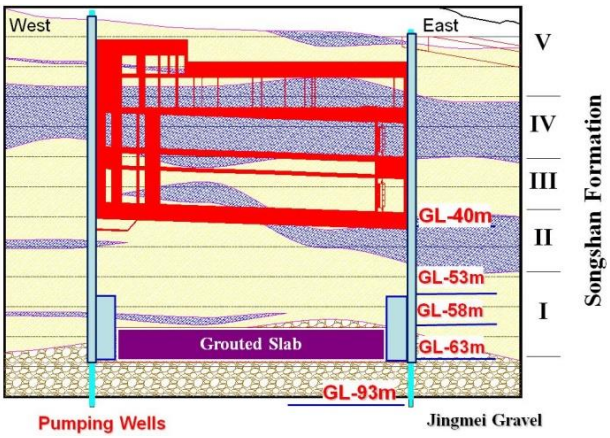
SEAGS Southeast Asian Geotechnical Society

AGSSEA ASSOCIATION OF GEOTECHNICAL SOCIETIES IN SOUTHEAST ASIA

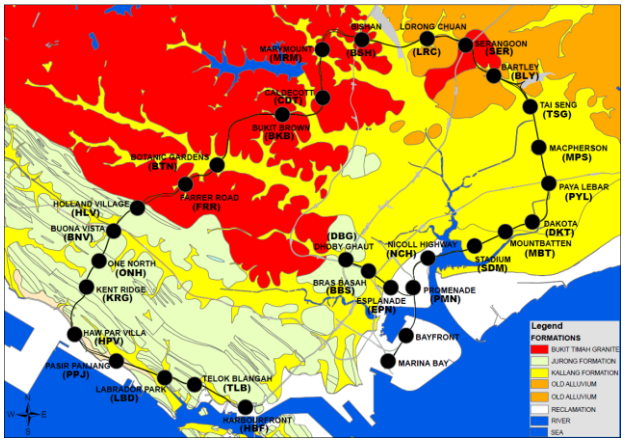
Sponsored by

AIT Asian Institute of Technology

Indexed by EI since 1970 Scopus since 2001

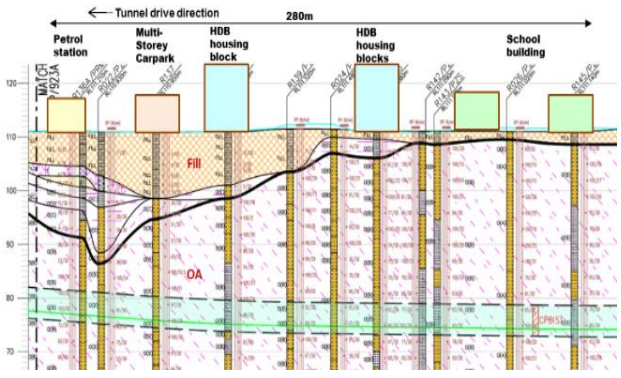


Excavation carried out at the Turnout Deep Excavations in Taipei Metro Construction
(After R. N. Hwang and Z. C. Moh, 2017)



Surface Geology of Singapore Geology and its Impact on the Construction of Singapore MRT Circle Line
(After Jeyatharan Kumarasamy, 2017)

KL Limestone karstic features Application of Gravity Survey in Urbanized City Environment
(After Charles Im, John Davies, Frank Collar and Seng Tiok Poh, 2017)



Geological profile of tunneling directly below the structures in library Bored tunnelling directly below buildings in Singapore Downtown Line
(After K.H. Goh, S. S. Ng and K.S. Ho, 2017)

GEOTECHNICAL ENGINEERING

June 2017: Papers on Mass Transit Projects & also contributed papers

Edited by
Kok Hun Goh, Jeyatharan Kumarasamy, Richard Hwang & San Shyan Lin

Kok Hun Goh

Dr Goh obtained his Bachelor of Engineering and Masters of Engineering from the National University of Singapore, and received his doctorate from the University of Cambridge. He has more than 15 years of geotechnical engineering experience, and has been involved in the design aspects of several road and rail infrastructure projects in Singapore. He is currently a deputy director who looks after the Geotechnical & Tunnels Division in the Land Transport Authority of Singapore. He is registered as a professional engineer in Singapore with specialisation in geotechnical engineering as well as a chartered professional engineer.

Jeyatharan Kumarasamy

Dr Jeyatharan Kumarasamy graduated from Cambridge University, UK (Ph.D. in Soil Mechanics) in 1992 and University of Peradeniva, Sri Lanka with B.Sc. (Eng.) First Class Honours in 1985.

He worked as senior geotechnical engineer for nearly five years with Parsons Brinckerhoff in Singapore Office. Since 2002, Jeyatharan is working with Land Transport Authority (LTA) on several major rail and road underground projects. He currently holds the Assistant Chief Specialist (Geotechnical) position in LTA.

Richard Hwang

Dr. Hwang received his bachelor degree from the National Taiwan University, master degree from North Dakota State University and doctor degree from the University of California at Berkeley. His doctoral research was on soil-structure interaction in earthquakes and he is one of the original authors of the finite element computer programmes FLUSH and QUAD4 for seismic studies. He was manager of Singapore Branch of Kiso-Jiban Consultants, and served as leader of a team of geotechnical engineers serving Singapore Mass Rapid Transit Corporation, which was later merged to Land Transport Authority, for the Phase 1 construction of the Singapore metro systems. At Moh and Associates, Inc. he led a team serving Department of Rapid Transit Systems providing geotechnical engineering consulting services on the construction of Taipei Metro.

Dr. Hwang is specialized in numerical analyses, foundation engineering, and underground constructions and has authored and co-authored 160 technical papers. He delivered the 7th Geotechnical Engineering Heritage Lecture at Taiwan Professional Engineers Association and received Geotechnical Engineering Heritage Award from Sino-Geotechnics Research and Development Foundation.

San Shyan Lin

Prof. San-Shyan Lin graduated from Chung Yuan University with a BSCE degree in 1981. He then obtained his master degree from Utah State University, Logan, Utah in 1985 and his PhD from Washington University in St. Louis, Missouri in 1992. Before his teaching career at university, Dr. Lin served as an engineer at Taiwan Area National Expressway Engineering Bureau between1992 to1994. Dr. Lin has been serving at Department of Harbor and River Engineering (DHRE) of National Taiwan Ocean University (NTOU) since 1994. He was promoted as a full professor in 2000. Thereafter, he took some university duties by serving as the secretary-general at office of the secretariat between 2001 and 2003; the chairman of DHRE between 2005 and 2006; the acting dean of college of engineering in 2007 and the vice president of NTOU between 2006 and 2012.

Prof. Lin served as a committee member of committee A2K03-Foundations of Bridges and Other Structures of TRB, USA between 1995 and 2004. Currently, he is still serving as a committee member of TC-212 and ATC-1 of ISSMGE and as an editorial board member of four international journals. In addition, Dr. Lin also served as the president of Taiwan Geotechnical Society (2011-2013); Chairman of International Geosynthetics Society- West Pacific Regional Chapter (2002-2004); CEO of Sino-Geotechnics Foundation (2011-2014) etc. Dr. Lin received the distinguished alumnus award from Chung Yuan University in 2009 and the distinguish Engineering Professor Award from Taiwan Pavement Engineering Society in 2011. Prof. Lin’s research and practical experiences have been dealt with deep foundations and geosynthetics.

GEOTECHNICAL ENGINEERING

PREFACE

There are seventeen papers in this Issue; the first twelve are papers edited by the Guest Editors: Kok Hun Goh, Jeyatharan Kumarasamy and Richard Hwang on Mass Transit Projects; additionally there are five contributed papers processed by our in-house editors.

The first paper is by R. N. Hwang and Z. C. Moh on Deep Excavations in Taipei Metro Construction: Discussed herein are the geological features of the Taipei Basin relevant to the construction of Taipei Metro and the deep excavations carried out with emphasis on back analyses of wall deflections. The excavation at the crossover next to G17 Station of the Green Line is adopted as an example to illustrate the applications of wall deflection paths and reference envelopes. The importance of calibrating inclinometer readings to account for the movements at the tips is confirmed by numerical analyses; and the assumption that movements at the joints between the struts at the first level and the diaphragm walls would be negligible in subsequent stages of excavation once these struts are preloaded is verified. Furthermore, it is proved that the concept of wall deflection path is very useful to quantify the influence of various factors, e.g., the depth and width of excavation, wall length, preloads of struts, and the thickness of soft deposits, on the performance of diaphragm walls.

The second paper is by Dazhi Wen on the Development of Reinforced Concrete Segmental Lining Design for MRT Bored Tunnels in Singapore: Reinforced concrete segments are commonly used as tunnel linings for bored tunnels constructed by tunnel boring machines (TBM). This paper describes the development and evolution of the segmental lining design from the Phases I/II of the Singapore Mass Rapid Transit (MRT) construction in the 1980s to the current design for the MRT lines under construction. The topics include the general arrangement of the segmental linings, structural design requirements, durability requirements, fire resistance and selection of waterproofing materials of the linings. The design and construction of bored tunnels in close proximity is presented with the experience gained in the past projects. Fire tests conducted by the Land Transport Authority are also presented. The rational, experience and challenges of adopting steel fibre reinforced concrete segments in recent MRT projects are discussed in the paper. The paper also presents in detail the experience gained in Singapore MRT projects in selecting the gaskets for waterproofing of the joints between segments to achieve the durability requirements for the bored tunnels.

In the third paper, Jeyatharan Kumarasamy described the influence of Geology and its Impact on the Construction of Singapore MRT Circle Line: The Circle Line (CCL) is a fully underground railway line in Singapore connecting the inner suburban areas of the city. It is 39.5 km long with 34 stations and built in six separate packages. Site investigations comprising boreholes, CPTs and geophysical surveys for the project were carried out in various phases to reveal ground conditions along the route in order to determine the most appropriate construction methods. Extensive field and laboratory testing were also carried out to establish geotechnical design parameters. This paper summarises geological conditions encountered along the CCL route and highlights the effect of geology on selected construction methods.

In their paper (fourth one) K.H. Goh and Y. Zhang discussed the issues related to Constructing the cut-and-cover tunnels and bored tunnels of the Singapore Downtown Line: The Downtown Line (DTL) is a major MRT line under construction after the completion of the Circle Line in Singapore. This paper discusses the ground conditions for the DTL and how it influenced the selection of the support systems adopted for the excavation for the stations which are constructed using cut-and-cover method, and also the selection of tunnel boring machines for the bored tunnels. The key features of the temporary support systems were presented together with their performance in terms of ground movements and ground water table drawdown. Issues encountered during the excavation, in particular for DTL Stage 2 in the soils and rocks of the Bukit Timah Granite Formation was also presented in the paper and the effectiveness of various measures implemented will be discussed based on the experience and observations during the construction. The key features and

parameters of all the earth pressure balanced and slurry TBMs used in different DTL contracts were also presented and compared.

The fifth paper is on Bored tunnelling directly below buildings in Singapore Downtown Line by K.H Goh et al: One of the specific challenges faced in undertaking underground infrastructure developments is the construction of bored tunnels directly below buildings. This paper reports the experiences of bored tunnelling directly below several buildings in the recently implemented Downtown Line project, including case studies with details such as the structural system and foundation details of the buildings, ground condition, geometry and clearance between the building foundation and the tunnelling works, as well as instrumentation monitoring results of ground and building settlement during tunnelling. It is hoped that these cases could be used as references in the design of future bored tunnelling works; to give greater confidence that tunnelling directly below buildings can be carried out without affecting the buildings so long as appropriate tunnelling controls are taken to mitigate ground deformation issues.

In the sixth paper, Charles Im et al presented the Application of Gravity Survey in Urbanized City Environment: Subsurface information and geotechnical data are required during the planning, development and design stages of all construction projects particularly where major components are supported on or in the earth and underlying rock. An understanding of the basic site geology is also necessary for the proper planning of the ground investigation works. Consequently, the geological features that will affect the design and construction of the project must be investigated and evaluated as much as possible within the allowable project timeframe to ensure successful implementation of the project. This paper presents an overview of the authors' experiences in using Gravity Survey, as a reconnaissance ground investigation method to identify areas of enhanced ground risks, in the complex variable and unpredictable Kuala Lumpur Karstic Limestone formation during the underground reference design stage of the Klang Valley Mass Rapid Transit Line 2 (SSP Line) in Kuala Lumpur, Malaysia. This paper also presents some lessons learnt of the past in the region, and what were the specific measures that had been strictly implemented on this occasion to ensure quality results can be derived from the Gravity Survey within the urbanized city environment and meet the objectives of the survey.

M. Kawasaki et al are the authors of the seventh paper on Water Sealing by Wire Brush with Grease for Pneumatic Caisson Method at Great Depth Underground: Pneumatic caisson method can be widely applied to various ground but suffers from a limitation on the applicable depth due to the work under high atmospheric pressure. To overcome the problem, the pneumatic caisson method employing an unmanned excavation method with helium mixed gas has been developed. However, the new technology of the pneumatic caisson method will be required to construct a vertical shaft for urban tunnels at great depth underground space. Therefore, applying water-sealing technique at shield tail to friction cut space around pneumatic caisson wall, a method to reduce atmospheric pressure in a working chamber at the ground with low permeability has been proposed. This research carried out the element tests to examine the water-sealing performance of the proposed method, and discussed the influence of some properties on water-sealing performance and its mechanism. As a result, it was confirmed that the proposed method can keep the grease pressure of 1 MPa for one hour.

The eighth paper by N. Som and is entitled Geotechnical Challenges of Kolkata Metro Construction: The paper gives an account of the Kolkata Metro construction which included the first underground railway for mass rapid transit system of an Indian city. Construction was started in 1975 and the first line of the metro covering a length of 17 km was opened in 1984. Thereafter construction had been taken up in phases. Currently Kolkata metro construction includes an ambitious package of 140 km of underground, at grade and viaduct stretches. Construction has to be done in very difficult condition through congested urban areas which includes a tunnel below the Ganga river. Resource crunch and construction through heavily built-up urban land extended the period of construction but modern design techniques and field instrumentation have helped to ensure high quality work in densely populated urban centre.

In the ninth paper, Gerardo Agustin Pittaro deals with the use of pressure relief wells to optimize ground improvement layer thickness in deep excavations: Deep excavations in soft ground often need stabilization with ground improvement (GI). One of the methods to improve the ground is to use Jet Grouting Piles (JGP)

or Deep Soil Mixing (DSM). JGP and DSM are achieved by mixing the soil with cement and water, generating a structure that performs well under compression forces but not under tension forces. These ground improvement blocks provide larger passive resistance thereby reducing wall displacements. Due to the above mentioned one of the necessary requirements for successful design is that no tension forces are allowed in any zone of the ground improvement block. This paper discussed how pressure relief wells inside the excavation are used in order to decrease the tension strains in the ground improvement block. In order to demonstrate this, 2D numerical analyses were performed.

C. Veeresh and K.H. Goh in the tenth paper discussed about Bukit Timah Granite Formation - Engineering Properties and Construction Challenges: The Bukit Timah Granite Formation is one of the oldest geological formations in Singapore and is found mostly in the central and northern parts of Singapore. A major section of Singapore's underground metro construction passes through the Bukit Timah formation soils, and extensive field and laboratory testing has been carried out on the rock samples. Uniaxial Compressive Strength (UCS) tests have been carried out on hundreds of samples, test results have shown wide variation in the strength and the maximum strength is found to be much higher compared to the previously published data. This paper presents a review of UCS strength of the Bukit Timah Formation, Point Load index tests and correlations which were developed for site specific locations. This paper also reviews the abrasivity of Bukit Timah Granite and factors affecting it. Influence of UCS and other factors on the drilling, coring and excavation rates in Bukit Timah Granite are also presented.

In the eleventh paper and the last one assembled by the guest editors, L.J. Endicott presents the experiences of 41 years of Mass Transit Underground Railways: In 1975 many cities in Southeast Asia were becoming congested and few had underground railways. Now several cities have underground railway systems comprising several lines and many stations, some extend above ground. Currently underground railways are being built or are being extended in many cities in Southeast Asia. Construction projects are often large including several sections of tunnels and stations in one contract. This paper reflects on the early days of pioneering and on some of the changes that have taken place in the planning, design, and construction of underground Mass Transit Systems during the last 41 years.

The twelfth paper as described by by T. N. Huynh, H.V. Pham, M. Sugimoto, Y. Tanaka, H. Ohta and K. Yasui on the Simulation of H&V shield behaviour at sharp curve by kinematic shield model. The paper discusses the restriction of underground space use and the horizontal and vertical variation shield method (H&V shield) was innovated, of which the cross section is changed from horizontal multi-circular shape to vertical one or vice versa. However, this method has never been applied in practice. Therefore, this study aims to examine the H&V shield control method, using the developed the kinematic shield model for H&V shield. As a result, the following were found: 1) the calculated shield behaviour has an overall good agreement with the planned one; 2) the ground displacement is a predominant factor affecting shield behaviour; and 3) the proposed model can simulate the H&V shield behaviour reasonably.

The thirteenth paper (also contributed direct to the in-house editors) by Badee Alshameri, Aziman Madun and Ismail Bakar is the first of the contributed papers edited by San Shyan Lin on Comparison of the Effect of Fine Content and Density towards the Shear Strength Parameters : The improvement of soil strength is very important in the engineering design for the civil and geotechnical projects. However, this improvement can be achieved by improving the shear strength parameters of soil (i.e. shear strength, friction angle and cohesion) by using different techniques (e.g. densify the soil and change the soil composition). This paper will compare between the effects of density and fine content towards the shear strength parameters. Numerous soil samples (i.e. 99 samples) from six soil mixtures of sand-kaolin mixtures were compacted and subjected to direct shear box test to evaluate the effect of density and fine content. The results showed some discordant effects between the density and fine content. While the cohesion increased by the increment of the fine content, it decreased by the increment of the density. However, both of shear strength and friction angle increased to the highest value with the increment of the fine content and density then by further increment in the fine content and density, the shear strength and friction decreased where this behaviour can be explained through the inter-granular void ratio issue. On the other side, even the results showed interface between the effect of density

and fine content, but the fine content has more significant effect in the shear strength parameters and also in the soil density value itself.

The fourteenth Paper (also contributed direct to the in-house editors) by Xiao-long Zhou et al is on Shaft Resistances of Jacked Open-ended PHC Pipe Piles: The shaft resistance of open-ended pipe piles during installation and static loading test plays an important role in the design of pile foundation. One open-ended Pre-stressed High-strength Concrete (PHC) pile instrumented with sensors was jacked to investigate the performance of shaft resistance during installation and loading test. Test results indicated that the shaft resistances gradually transferred along depth during installation, and the magnitude is closely related to soil properties. The shaft resistance at the same depth decrease with jacked cycles. After five jacked cycles, the shaft resistances in sand silt at 6 m depth decreased about 58.8%. The decrement of silty clay at 10 m depth was about 12.1% after three jacked cycles. In the loading test, the shaft resistance of test pile were gradually mobilized from up to down.

P.R. Stott and E. Theron in the fifteenth paper (also contributed direct to the in-house editors) is on the Estimation of Shrink/Swell Potential and Variability of Clays by Small-Scale Suction Tests: The relationship between suction and water content gives crucial information about a soil. Small projects like economic housing do not warrant the time and cost of determining the full soil water suction curve. A considerable range of soil suctions can easily be achieved within a reasonably short time by using small samples, simple suction control and a high precision balance. It appears that in this way it may be possible to estimate heave potential and variability of soil properties at reasonable cost in an acceptable time. Variability assessment appears to offer significant potential for improving the reliability of foundation design on shrink/swell soils.

The sixteenth paper (also contributed direct to the in-house editors) by M. R. Selamat et al is on Pullout Tests on Strips with Anchorage Elements under Low Stresses: The lack of pullout capacity of reinforcement strips often compromised the finishing quality of the mechanically stabilized earth (MSE) structure. In this research, three strips were each attached with 6 anchorage elements of 1cm, 2cm, and 3cm deep respectively in order to enhance the pullout capacities, while another strip was plain. Each strip was subjected to pullout tests under low normal stresses ranging from 1.61kPa to 13.20kPa to simulate shallow embedment in the field. Under the low normal stress of 1.61kPa, the pullout capacities of strips with anchorage elements were enhanced up to 366% of the plain strip capacity; under the higher normal stress of 13.2kPa however, the pullout capacity enhancements were only up to 163% of the plain strip capacity. The results indicate the merit of attaching anchorage elements to strips under shallow overburden in a MSE structure and the significant increase in pullout capacity achievable by such strips.

The last paper of this Issue is seventeenth (also contributed direct to the in-house editors) by Li Changhong, Zhou Xiaolong, Zhang Long,Wei Xiaoming and Li Wanling on Numerical Simulation Analysis and In-situ Monitoring of Long and Narrow Deep Foundation Pit. The authors studied the characteristics of long and narrow deep foundation pit. The displacement distribution of X-axis with different length-width ratios of 1:1, 2:1 and 3:1 were analyzed and then the displacement distribution of Y-axis at the slope bottom and the displacement distribution of Z-axis at the foundation bottom were studied. The different displacement distribution law of pile-anchor support and soil nailing wall support were analyzed in different excavation processes considering in-situ supporting schemes, and the different supporting effects of the two supporting structures were presented on the stability of foundation pit slope. By comparing the monitoring values at the 32 in-situ positions, the numerical simulation result was basically identical with the monitored data, on average 3mm higher than the measured value. By using MIDAS software, the excavation and supporting process of the foundation pit could be simulated, and it can provide guidance for the construction of long and narrow deep foundation pit and adjust the monitoring period appropriately.

Editors:
Kok Hun Goh
Jeyatharan Kumarasamy
Richard Hwang
San Shyan Lin

ACKNOWLEDGEMENT

Seventeen papers are contained in this issue. Twelve of them are assembled by the Guest Editors and another five contributed papers directly to the in-house 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

Geotechnical Engineering Journal of the SEAGS & AGSSEA Vol. **48 No. 2 June 2017 ISSN** 0046-5828

GEOTECHNICAL ENGINEERING

June 2017: Mass Transit Projects & Contributed papers

Edited by
Kok Hun Goh, Jeyatharan Kumarasamy, Richard Hwang & San Shyan Lin

TABLE OF CONTENTS

Cover Photographs

1. Photo 1 Excavation carried out at the Turnout Deep Excavations in Taipei Metro Construction
(After R. N. Hwang and Z. C. Moh, 2017)

2. Surface Geology of Singapore Geology and its Impact on the Construction of Singapore MRT Circle Line
(After Jeyatharan Kumarasamy, 2017)

3. KL Limestone karstic features Application of Gravity Survey in Urbanized City Environment
(After Charles Im, John Davies, Frank Collar and Seng Tiok Poh, 2017)

4. Geological profile of tunneling directly below the structures in library Bored tunnelling directly below buildings in Singapore Downtown Line
(After K.H. Goh, S. S. Ng and K.S. Ho, 2017)

Geotechnical Engineering Journal of the SEAGS & AGSSEA

Vol. 48 No. 3 September 2017

ISSN 0046-5828

GEOTECHNICAL ENGINEERING

Journal of the

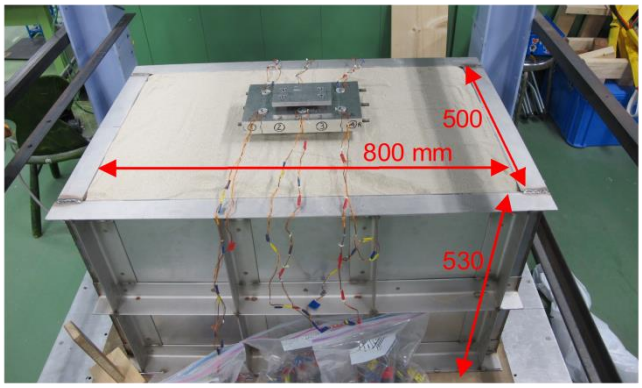
SEAGS Southeast Asian Geotechnical Society

AGSSEA ASSOCIATION OF GEOTECHNICAL SOCIETIES IN SOUTHEAST ASIA

Sponsored by

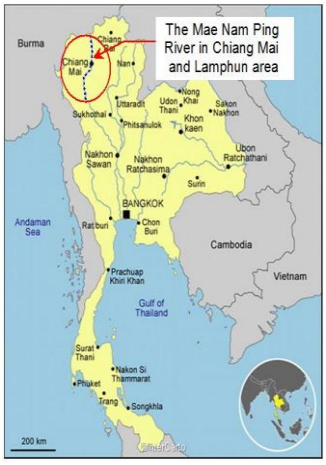
AIT Asian Institute of Technology

Indexed by EI since 1970 Scopus since 2001 ESCI since 2017

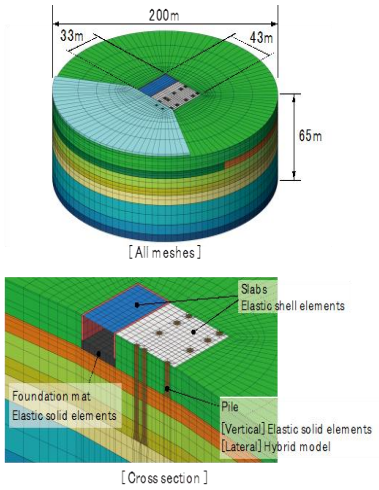


Experimental Study on Pile Foundations Having Batter Piles Subjected To Combination of Vertical and Horizontal Loading at 1-G Field
(After A.T. Vu, T. Matsumoto, S. Kobayashi and S. Shimono, 2017)

Consideration of Effects of Pile Group Interaction in Piled Raft System Based on Field Monitoring and Single Pile Load Tests
(After K. Yamashita, S. Wakai, J. Hamada and T. Tanikawa, 2017)



Fundamental Experiments on a Reinforcement Method Using Sheet Pile Wall for Bridge Pile Foundations Subjected To Pile Embedment Reduction and Numerical Validation
(After T. Tikanta, T. Matsumoto, A. T. Vu, S. Kobayashi, S. Shimono and C. Bamrungwong, 2017)



Design and Analysis of Composite Foundation for High-rise Buildings
(After K. Watanabe, N. Suzuki and M. Sahara, 2017)

GEOTECHNICAL ENGINEERING

September 2017: Deep Foundations

Edited by: Tatsunori Matsumoto, Der Wen Chang & San Shyan Lin

Tatsunori Matsumoto

Prof. Matsumoto is now with Kanazawa University in Japan for nearly 37 years. He was educated at the Kanazawa University and received his Doctoral Degree from Kyoto University for his work on steel pipe piles in 1989. He has extensive research and practical experience on piled foundations and piled raft foundations. Prof. Matsumoto has a Shake Table Facility for the study of dynamic and earthquake type of behaviour of piled foundations. He has also worked on the centrifuge with pile groups and piled raft foundations in collaboration with Taisei Corporation. Prof. Matsumoto also has wide experience in the seismic design of raft and piled raft foundations. Prof. Matsumoto is one of the authors of the computer software PRAB—Piled Raft Analysis with Batter Piles. With this software piled raft foundation can be analyzed with vertical and horizontal loads as well as moment.

Der Wen Chang

Prof. Der-Wen Chang has been the Geotechnical faculty member at The Department of Civil Engineering of Tamkang University (TKU), Taipei, Taiwan for over 25 years. He received Ph.D. in Civil Engineering at The University of Texas at Austin in 1991 and MS in Civil Engineering at Michigan State University in 1987. Prof. Chang has supervised the research work of over 70 Master Thesis and 3 Ph.D. Thesis at TKU, and published more than 200 articles as the Journal, Conf. papers and reports. Nearly all his research studies are related to numerical modeling and dynamic analyses for the geotechnical structures. His research experiences include NDT methods on pavements, seismic behaviors of the pile foundation, constitutive modeling of the soils, and recent study on the performance based design for the earth structures. Prof. Chang is also the visiting Professor at University of Washington at Seattle, US in 2008 and LN Gumilyov Eurasian National University at Astana, Kazakhstan for research studies in 2010 and 2011. Other than the research works, Prof. Chang devotes himself a great deal to serve the communities. He involves heavily and indeed shows his good performance in the public works related to education and constructions. Prof. Chang is currently the Executive Board member of Chinese Taipei Geotechnical Society, GC member at SEAGS and Editorial Panel for SEAGS/AGSSEA J. of Geotechnical Engineering, and TC212/TC305/ATC18 member at ISSMGE. He is also the Chairman of Conference Committee at 16ARC which is to be held in Taipei, Taiwan in October, 2019.

San Shyan Lin

Prof. San-Shyan Lin graduated from Chung Yuan University with a BSCE degree in 1981. He then obtained his master degree from Utah State University, Logan, Utah in 1985 and his PhD from Washington University in St. Louis, Missouri in 1992. Before his teaching career at university, Dr. Lin served as an engineer at Taiwan Area National Expressway Engineering Bureau between1992 to1994. Dr. Lin has been serving at Department of Harbor and River Engineering (DHRE) of National Taiwan Ocean University (NTOU) since 1994. He was promoted as a full professor in 2000. Thereafter, he took some university duties by serving as the secretary-general at office of the secretariat between 2001 and 2003; the chairman of DHRE between 2005 and 2006; the acting dean of college of engineering in 2007 and the vice president of NTOU between 2006 and 2012.

Prof. Lin served as a committee member of committee A2K03-Foundations of Bridges and Other Structures of TRB, USA between 1995 and 2004. Currently, he is still serving as a committee member of TC-212 and ATC-1 of ISSMGE and as an editorial board member of four international journals. In addition, Dr. Lin also served as the president of Taiwan Geotechnical Society (2011-2013); Chairman of International Geosynthetics Society- West Pacific Regional Chapter (2002-2004); CEO of Sino-Geotechnics Foundation (2011-2014) etc. Dr. Lin received the distinguished alumnus award from Chung Yuan University in 2009 and the distinguish Engineering Professor Award from Taiwan Pavement Engineering Society in 2011. Prof. Lin’s research and practical experiences have been dealt with deep foundations and geosynthetics.

GEOTECHNICAL ENGINEERING

PREFACE

There are 17 papers in this Issue; the first twelve are papers edited by the Guest Editors: Tatsunori Matsumoto, Der-Wen Chang and San-Shyan Lin; additionally there are five contributed papers are processed by our in-house editors.

The first paper is by K. Ng and T. Sullivan on challenges and recommendations for steel H-piles driven in soft rock: The capacity of a pile driven in soft rock depends on soil confinement along the pile and rock at its toe; these are rarely known during design. This design challenge often leads to a large discrepancy between estimated and measured resistances. Results of six bridge projects completed in Wyoming, USA, are presented to highlight the challenges pertaining to present design and construction practices of driven piles in rock. The results show that static analysis methods, dynamic analysis methods, and structural analyses yield inconsistent pile resistance estimations. A recommendation considering the structure-geomaterial interaction is proposed to improve the design and construction of steel H-piles driven in soft rock.

The second paper is by Anh-Tuan Vu, Tatsunori Matsumoto, Shun-ichi Kobayashi and Shinya Shimono on Experimental study on pile foundations having batter piles
subjected to combination of vertical and horizontal loading at 1-g field: in the paper, the behaviours and resistance mechanisms of pile foundations having batter piles were investigated through a series of vertical load tests and combination load tests on model foundations in dry sand ground at 1-g field. Pile foundation models consisting of 3 piles and 6 piles, with or without batter piles, were used in the experiments. The model pile was close-ended pipe with a length of 255 mm and an outer diameter of 20 mm. Dry silica sand having a relative density, Dr, of about 82% was used for the model ground. The results indicate that the piled raft having batter piles is the most effective to increase the resistances (in both vertical and horizontal directions) and reduce the inclination.

In the third paper, T. Tikanta, T. Matsumoto, A. T. Vu, S. Kobayashi, S. Shimono and C. Bamrungwong conduct experiments on a reinforcement method using sheet pile wall for bridge pile foundations subjected to pile embedment reduction and numerical validation. Due to the riverbed soil excavation for the utilization in construction works for many years, the level of riverbed of the Mae Nam Ping River has been considerably decreased, resulting in reduction of embedment lengths of piles for many bridge foundations. Erosion was not a cause of the lowering of the riverbed. Reductions of bearing capacity due to the lowering of riverbed soil is the main cause of bridge pile foundation settlements or collapses at present. In order to prevent the damages of existing bridge pile foundations caused by the riverbed soil excavation, a reinforcement method using sheet piles called “Sheet Pile Wall (SPW) reinforcement” is proposed. The experimental results show that the proposed SPW reinforcement method is very efficient and promising. Numerical simulation of an experiment using FEM was also carried out to get more insight into the mechanism of the SPW method and validate the proposed SPW method.

In their paper (fourth one) San-Shyan Lin, Yun-Chih Chiang, Xin-Hua Lin, Hsing-Yu Wang, and Sung-Shan Hsiao carry our numerical studies on performance of offshore wind turbine composite suction pile in sand subjected to combined loading. Numerical analysis on the performance of the proposed suction pile with enlarged lid size subjected to combined lateral and axial loading is presented in the paper. The numerical model is firstly validated by comparison with other numerical study results. The parametric analysis results prove a suction pile with enlarged lid size has better performance than a normal suction pile on both the overall bearing capacity and the stability of the foundation.

The fifth paper is on Consideration of Effects of Pile Group Interaction in Piled Raft System Based on Field Monitoring and Single Pile Load Tests by K. Yamashita, S. Wakai1, J. Hamada and T. Tanikawa. In the paper, the effects of pile group interaction were investigated based on the results of two monitoring cases of piled raft foundations and single pile load tests in soft ground. Based on the investigation, it was found that the modified load-settlement data of the monitored piles were generally consistent with the static load-settlement curve of a single pile. Therefore, no significant effects of pile group interaction on settlement were found. In such cases as pile groups with large spacing, single pile load test data can be more useful in the settlement prediction of piled rafts and pile groups. In addition, it was found that the pile head stiffness of the equivalent static load-settlement curve derived from the rapid load testing in clay soils using the UPM was considerably large compared to the stiffness of the static load test curve, as pointed out by previous studies.

In the sixth paper, In-situ Full Scale Load Tests and Reliability Evaluation of Bearing Capacity for Nodular Cast-in-place Concrete Pile is studied by K. Watanabe, A. Mitsumori, H. Nishioka and M. Koda. This paper firstly summarizes the in-situ full scale load tests, and then describes the results of standard bearing capacity based on the data from the in situ full-scale load tests, finally mentions the estimation of ground resistance coefficient for nodular cast-in-place concrete piles.

The seventh paper by K. Watanabe, T. Yamamoto and T. Sudo is titled Development of Steel Pipe Pile Combined with Ground Improvement in Narrow Spaces. Since pile construction in narrow spaces is constrained by the site and process, in this paper, a construction method combining steel pipe piles with ground improvement using a mechanical agitator (e-column construction method®) was developed. This paper briefly summarizes the construction method, presents the static load tests and rapid load tests, and discusses the results of load tests. The results of the loading tests suggest that the bearing capacity can be evaluated by using the undrained shear strength and SPT N-value. Also, a simplified rapid loading test can be applied to validating the bearing capacity at a construction site. For the joint of the steel pipe piles, the maximum tensile resistance obtained from the experiment was larger than that obtained from the calculation formula.

In the subsequent paper eight in the series K. Watanabe, N. Suzuki and M. Sahara deal with Design and Analysis of Composite Foundation for High-rise Buildings. This paper shows two design cases of composite foundations for high-rise buildings. These two foundations were designed by considering the effect of deformation on the results of a static FEM analysis. The slab settlement was measured upon completion of construction. It was con-firmed that composite foundations deform within a presupposed range.

Hung-Jiun Liao, Chin-Lung Chiu, Chung-Kuang Chien, Yi-En Tang and Heng-Chih Cheng in the ninth paper deal with Pervious Material Made from Landslide Debris for Road Base Construction. This paper introduces an on-site mixing method to prepare pervious-CLSM (controlled low strength material) from the landslide debris by mixing it with proper amount of cement and water. Through the mixing process, the fine soils in the debris will flocculate to a sizable particles and/or stick to the surface of aggregates. As a result, the fines content of the debris can be eliminated and a pervious-CLSM is made. Through the binding effect of cement, the pervious-CLSM can also have moderate strength to maintain the stability of filled embankment and to sustain the traffic load as well. Together with geo-grid, a wrap-faced reinforced embankment as the road base can be constructed quickly using the site prepared CLSM as well as a backhoe machine and hand tools.

The tenth paper is by E. Heins, K.-F. Seitz, A. Chmelnizkij, M. Milatz and J. Grabe on Advances in numerical modelling of different ground improvement techniques. A lot of successful scientific research is conducted on piles and piling using various numerical methods. Therefore, it is assumed that numerical models can be used to improve ground improvement methods. In this contribution, different ground improvement techniques and numerical models to simulate the influence of these techniques on the surrounding soil are presented. Furthermore, optimization methods and potentials of ground improvement techniques are shown.

Ashutosh Kumar and Deepankar Choudhury are the authors of the eleventh paper on Load sharing mechanism of Combined Pile-Raft Foundation (CPRF) under seismic loads. In the present work, the load sharing mechanism under seismic loads for fully hinged (H) and fully rigid (R) connected Combined Pile-Raft Foundation (CPRF) have been studied by using three-dimensional finite element based geotechnical software. Results of the present analyses show that connection rigidity had little influence on vertical settlement of CPRF but had pronounced response on the load sharing by foundation components. In the purview of seismic loading, lateral stiffness played a pivotal role in deciding the load-settlement, lateral displacement, bending moment in piles and inclination response of CPRF. The load sharing by foundation components is governed by mobilization of lateral displacement.

The 12th paper and the last one as assembled by the guest editors is Deflection Behaviour of GFRP Bar Reinforced Concrete Passive Bored Pile in Deep Excavation Construction by J. L. Zhou, E. Oh, X. Zhang, M. Bolton, H. Y. Qin and L. Zhang. This paper describes the investigation of a glass fibre reinforced polymer bar (GFRP bar) as a replacement for a traditional steel bar reinforcement in bored concrete piles with specific application to deep excavation construction. The deflection behaviours of GFRP piles during the installation of one concrete and two steel supports were provided. It is concluded that, based on the difference between the total accumulated deflection of each pile, the GFRP bar reinforced concrete piles can resist the lateral loading and can provide an alternative to traditionally reinforced concrete piles used in shield construction.

The 13th paper by describe by Byron Mawer, Denis Kalumba and Charles Warren-Codrington is the first of the contributed papers edited by San Shyan Lin on Loading and Dynamic Response Considerations for the Design of Wind Turbine Foundations on South African Soils. The discussion of this paper was centered on the sources of loading that wind turbines experience and the consequences of this on the geotechnical design of gravity footings. Rotational stiffness of the foundation was shown to have an important effect on the dynamic response of the wind turbine tower, and thus, on the assumptions surrounding the calculation of the natural frequency of the global system. Soil stiffness effects on natural frequency assumptions were found to be more critical than the minimum stiffness requirements applied by design guidelines and had a notable effect on dynamic amplification for an undamped system.

The 14th paper (also contributed direct to the in-house editors) by Mounir BOUASSIDA, Mnaouar KLAI, Seifeddine TABCHOUCHE and Mekki MELLAS on Comparison of Numerical Analyses of Behaviour of Column-Reinforced Foundations. This paper studies the prediction of behaviour of foundations resting on a soil reinforced by sand and stone columns. A Tunisian case history of oil tank is investigated. By adopting the Mohr-Coulomb failure criterion for columns material and the hardening soil model for soft clay, the evolution of long term settlement predicted by Plaxis code showed the acceleration of the consolidation of the compressible soft clay due to the enhanced drainage property of column material.

P. Pizette and N-E. Abriak in the 15th paper (also contributed direct to the in-house editors) is on Particle image velocimetry analysis on the sinking of shallow foundation in 2D. This paper focuses on the development of punching device dedicated to study the failure of 2D analogue soil. In order to follow the kinematic behaviors of soil, Particle Image Velocimetry (PIV) analysis has been developed and tested in the case of the shallow foundations. The results show that the field of the soil displacement under the foundation can be followed via the PIV method. In particular, the image analysis results are qualitatively in good agreement with the Prandlt scheme.

The 16th paper of this Issue (also contributed direct to the in-house editors) is by B. T. T. Nguyen1, T. Takeyama2 and M. Kitazume on Attempt of Simple Calculation on studying Failure mechanism of DM Columns. A simple calculation, based on limit equilibrium method, was performed to evaluate the failure pattern of deep mixing (DM) columns, used to reinforce an embankment slope. In this study, a trial of limit equilibrium method to access the failure mode of the columns is focused with an overall mechanism. As a result, while the calculation can simply predict the failure pattern of the DM columns, a parametric study was also performed to evaluate the effect of several improvement factors.

The last paper of this Issue, the 17th (also contributed direct to the in-house editors) is Microzonation of liquefaction hazard using liquefaction index in Babol City by A. Janalizadechoobbasti, M. Naghizadeh rokni, and R. Charaty. In this paper, the zoning map of Babol liquefaction risk is provided. In this regard, a study was conducted on the soils in Babol and after examining different areas of the city, laboratory results and field studies of more than 50 boreholes in different areas with a depth of 20 m were analyzed for finding liquefaction and non-liquefaction segments. In this study, different approaches were used including Seed, Iwasaki, Haeri and Yasrebi, Chin & Zhang and Sewmez & Gocojlou procedures and finally, a computer program was written for examining and providing microzoning map of Babol liquefaction risk.

Editors:
Tatsunori Matsumoto
Der Wen Chang
San Shyan Lin

ACKNOWLEDGEMENT

Seventeen papers are contained in this issue. Twelve of them are assembled by the Guest Editors and another four contributed papers by the in-house 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

Geotechnical Engineering Journal of the SEAGS & AGSSEA Vol. **48 No. 3 September 2017 ISSN** 0046-5828

GEOTECHNICAL ENGINEERING

September 2017: Deep Foundations

Edited by
Tatsunori Matsumoto, Der Wen Chang & San Shyan Lin

TABLE OF CONTENTS

Cover Photographs

1. Experimental Study on Pile Foundations Having Batter Piles Subjected To Combination of Vertical and Horizontal Loading at 1-G Field
   (After A.T. Vu, T. Matsumoto, S. Kobayashi and S. Shimono, 2017)

2. Consideration of Effects of Pile Group Interaction in Piled Raft System Based on Field Monitoring and Single Pile Load Tests
   (After K. Yamashita, S. Wakai, J. Hamada and T. Tanikawa, 2017)

3. Design and Analysis of Composite Foundation for High-rise Buildings
   (After K. Watanabe, N. Suzuki and M. Sahara, 2017)

4. Fundamental Experiments on a Reinforcement Method Using Sheet Pile Wall for Bridge Pile Foundations Subjected To Pile Embedment Reduction and Numerical Validation
   (After T. Tikanta, T. Matsumoto, A. T. Vu, S. Kobayashi, S. Shimono and C. Bamrungwong, 2017)

Geotechnical Engineering Journal of the SEAGS & AGSSEA

Vol. 48 No. 4 December 2017

ISSN 0046-5828

GEOTECHNICAL ENGINEERING

Journal of the

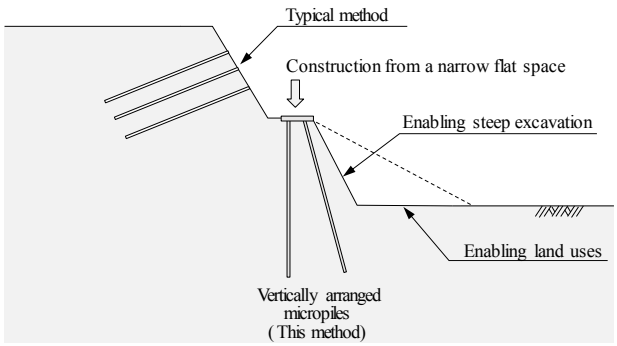
SEAGS Southeast Asian Geotechnical Society

AGSSEA ASSOCIATION OF GEOTECHNICAL SOCIETIES IN SOUTHEAST ASIA

Sponsored by

AIT Asian Institute of Technology

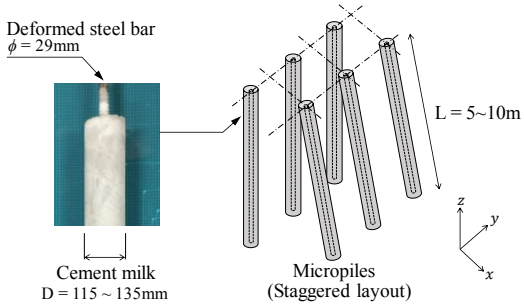
Indexed by EI since 1970 Scopus since 2001



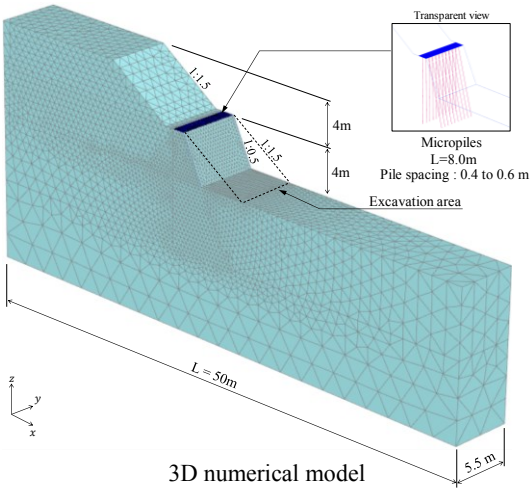
Overview of reinforced soil method by vertically arranged micropiles

Panoramic photographic view of the site

Soft Ground Improvement at the Rampal Coal Based Power Plant Connecting Road Project in Bangladesh
(After Sudipta Chakraborty, Ripon Hore, Fahim Ahmed and M. A. Ansary, 2017)



Overview of micropiles



3D numerical model

Numerical Study on the Design of Reinforced Soil by Vertical Micropiles
(After A. Kamura, J. Kim, T. Kawai, M.Kazama, N. Hikita and S. Konishi, 2017)

PREFACE

December 2017 Issue

This Issue is in two parts; Part 1 papers edited by Prof Akira Murakami as Guest Editor and Part 2 contributed papers directly edited by In-house Editors and Prof Mounir Bouassida

The first seven papers in the Issue are edited by Prof Akira Murakami as the Guest Editor and the subsequent papers are direct contributed ones; quite a few papers were acquired by Prof Mounir of papers from African continent.

The first paper is on Modelling the Effects of Static Shear on the Undrained Cyclic Torsional Simple Shear Behaviour of Liquefiable Sand by Gabriele Chiaro, L.I. Nalin De Silva and Junichi Koseki: Spanning from purely theoretical standpoint to practical applications, there is a particular interest to enhance understanding of the effects of static shear on the cyclic behavior of soil elements underneath sloped ground. To address this issue, two subsequent steps were undertaken in this study. First, a systematic laboratory investigation was carried out on Toyoura sand specimens subjected to various levels of combined static and cyclic shear stresses. Then, a new state-dependent cyclic model was developed. Since experimental findings have been exhaustively reported elsewhere, in this paper they are only briefly recalled for the benefit of comprehensiveness. Instead, the new model is presented in details and its performance is verified by simulating undrained cyclic torsional simple shear tests carried out on Toyoura sand specimens. Essentially, the model is built on an extended general stress-strain hyperbolic equation approach, in which the void ratio and stress level dependency upon non-linear stress-strain response of sand is incorporated. Besides, a novel empirical stress-dilatancy relationship is used to account for the effect of density on the stress ratio as well as to model the excess pore water pressure generation in undrained shear conditions as the mirror effect of volumetric change in drained shear conditions.

The second paper by A. Kamura, J. Kim, T. Kawai, M. Kazama, N. Hikita and S. Konishi is on Numerical Study on the Design of Reinforced Soil by Vertical Micropiles. The mechanical behaviour of the reinforced soil by vertical micropiles was considered using the three-dimensional finite element analysis. To make effective use of space around the slope, soil needs to be reinforced using micropiles placed in a small area. The main objective of this investigation was to evaluate the mechanical influence of various micropile arrangements and to determine the effects of pile spacing for design purposes. Numerical simulations of three cases using different pile angles indicated the amount of slope displacement and the values of the sectional force of the micropiles differed significantly. Among the three cases, the maximum slope displacement was 1.7 times the minimum value. Finally, numerical simulations of three cases using different pile spacing was carried out to clarify the effects of pile spacing on the amount of slope displacement and the sectional force of the micropiles.

In the third paper Soil-water Coupled Analysis of Pore Water Pressure Dissipation in Performance Design—Examinations of Effectiveness in Reclaimed Ground is studied by Toshihiro Nonaka, Shotaro Yamada, and Toshihiro Noda: Japan has a large number of reclaimed regions unimproved against liquefaction and countermeasures in such regions are necessary to prepare for a great earthquake. A new macro-element method has been proposed that involves applying the soil-water-coupled finite deformation analysis code ***GEOASIA*** with an inertial term, and a numerical-analysis technique has been designed that quantitatively evaluates the improvement effect of the pore water pressure dissipation method (PWPDM). In this study, PWPDM effectiveness was examined for a reclaimed ground using the proposed method. Detailed examinations were conducted with the intention of developing a more advanced performance design, without being limited to the concept of the current design code. The main findings are as follows: 1) the proposed analysis code enables quantitative evaluation of the improved effectiveness of PWPDM in a reclaimed ground; 2) more advanced PWPDM designs are possible by not only suppressing the maximum

excess pore water pressure to the permissible range of the current design code, but also evaluating the ground deformation adequately; and 3) the new macro-element method, capable of reproducing the phenomenon of well resistance, can evaluate the reduction in the improvement effect because of the degradation of drainage capability, thus making it useful for maintenance purposes such as drain clogging.

In their paper (fourth one), Y. Fukumoto and S. Ohtsuka made Comparison of Sheared Granular soils: Same Void Ratio but Considerably Different Fabric: This paper reports a comparison of two types of sheared granular soil specimens, with almost the same void ratios but considerably different fabric, using the discrete element method in two dimensions. The specimens are prepared by applying two different methods of particle generation; one specimen is generated by placing the particles geometrically, while the other specimen is generated by placing the particles randomly. Then, computational direct shear tests are conducted in order to compare the yielding behaviours of the two specimens. The obtained bulk shear responses show different trends, even though the values for the void ratio at the initial state are almost the same. Toward the critical state, however, the initial differences in the stress state and the granular fabric gradually disappear and eventually reach almost the same state. The results reveal that not only macroscopic quantities, but also the contact force distribution and the angular variation in contact forces, have a unique critical state. In particular, the angular distribution of contact angles inside the shear band is also found to have a unique critical state.

The fifth paper is on Coupled Analysis of Navier-Stokes and Darcy Flows by the Brinkman Equations by S. Arimoto, K**.** Fujisawa and A. Murakami: Simultaneous analysis of seepage flows in porous media and regular flows in fluid domains has a variety of applications to practical problems. The objective of this paper is to present a numerical method to simulate these two different flows simultaneously and continuously, and to investigate the influence of the Darcy flows in porous media on the Navier-Stokes flows in the fluid domain. To this end, the authors have employed the Darcy-Brinkman equations, which include the Navier-Stokes equations and can approximately describe Darcy flows by changing the values of porosity and hydraulic conductivity. The solutions of the Darcy-Brinkman equations are affected by two dimensionless quantity, i.e., the Reynolds number, Re and the Darcy number, Da. After the procedures to provide stable solutions of the governing equations are explained, this paper considers the two types of problems involving Navier-Stokes/Darcy coupled flows and the influence of the two dimensionless parameters on the solutions are investigated. One is the backward-facing step flow with a porous step, and the other is the preferential flows in porous media. The numerical results have shown that the permeability of the porous step slightly affects the reattachment of the flow in the former problem, and that the shape of the void or cavity in porous media changes the structure of the flow in it and the Darcy number changes the flux into the fluid domain in the latter problem.

In the sixth paper, Y. Kurimoto, Y. L. Xiong, S. Kageyama and F. Zhang presented Numerical Investigation on Mechanical Behaviour of Natural Barrier in Geological Repository of High-Level Radioactive Waste. It is commonly known that geological repository is regarded as the most practical way of permanent disposal of high-level radioactive waste (HLW). Yet, there are some engineering problems needed to be solved before its practical application. In geological repository, one of the most important factors is the thermo-hydraulic-mechanical (THM) behaviour of natural barrier. The aim of this paper is to investigate the influence of temperature on the deformation and the strength of host rocks, such as the soft sedimentary rock, with some element tests and the numerical simulations with a program of FEM named as ***SOFT*** based on a thermo-elasto-viscoplastic constitutive model.

Trihanyndio Rendy Satrya, Ria Asih Aryani Soemitro, Toshifumi Mukunoki and Indarto are the authors of the seventh paper and the last one assembled by the guest editor on Change of Soil Properties in the Bengawan Solo River Embankment due to Drying–Wetting Cycles. This paper studies the behaviour of Bengawan Solo River embankment soil properties for both in-situ and laboratory conditions. In the laboratory, series of cyclic drying and wetting tests were carried out to clarify the changes of in-situ soil properties over time since the soil had been initially compacted. Maximum dry density from Standard Proctor test was applied as initial compacted condition. Three cycles of drying and wetting were used to represent three cycles of dry and rainy seasons. The in-situ soil investigation was carried out during seasons. The results show that the investigated in-situ soil properties were in good agreement with the laboratory test

results at the 2nd and 3rd cycles. It denotes that these numbers of cycles are required to achieve the similar condition as in-situ soil. In addition, by observing the rate of change in soil properties, it was possible to trace back the construction time of the river embankment.

The eighth paper and the rest are from direct contribution. The eighth paper is on Soft Ground Improvement at the Rampal Coal Based Power Plant Connecting Road Project in Bangladesh by Sudipta Chakraborty, Ripon Hore, Fahim Ahmed and M. A. Ansary. Preloading with vertical sand drain (VSD) is presented as a soil improvement method in this paper. The work is based on a real life road (4 lane and 2 slow moving lanes) construction project carried out in Rampal sub-district of Bagerhat, Khulna, Bangladesh. The construction sequences and the basic design example of VSD for embankment works on very soft clay soil are discussed in this paper. This paper presents soft ground improvement using VSD including VSD installation, preloading techniques, settlement and stability, design calculation, observational method and analysis of monitoring data. No extra load has been used; preloading has been carried out with the self-weight of road in combination with fill embankment. Soil treated with VSD, has resulted in improvement of soil settlement.

The ninth paper by Badee Alshameri , Aziman Madun and Ismail Bakar is entitled Assessment on the Effect of Fine Content and Moisture Content Towards Shear Strength**.** The shear strength τ, shear modulus G, friction angle $\emptyset$, and cohesion c are remarkable design parameters in the geotechnical and civil projects. These design parameters were affected by several factors. In this paper, the fine content and moisture content factors will be evaluated. Numerous compacted sand-kaolin samples were test through the direct shear box test (by using shear rate equals to 1 mm/min, the samples dimension equals to 100 × 100 mm) to assess the effect of these factors. The results show interface between both effects of fine content and moisture content towards the shear strength parameters. According to the results; (1) there is no significant effect on shear strength parameters at low portions of fine content FC and moisture content w, (2) at higher portion of FC and w, bot FC and w show different relationships with shear strength parameters, (3) both relative high shear rate and low applied stress lead to present high value of friction angle (4) compact the soil mixtures with same compaction effort and different fine and moisture content lead to change the soil structure and void ratio thus produce regressive relationship between the friction angle toward density.

Dipendra Gautam, Hemchandra Chaulagain, Hugo Rodrigues and Hem Raj Shahi in the tenth paper worked on Ground Response Based Preliminary Microzonation of Kathmandu Valley. This paper analyzes spatially selected 286 deep borehole logs reaching up to the bedrock are and the results are presented in terms of amplification factor, ground acceleration and predominant period. The peak ground acceleration (PGA) is estimated to be 0.10 and 0.50 g indicating strong influence of nonlinearity in particular areas of Kathmandu valley wherein de-amplification is observed. The peak spectral acceleration is found to be varying between 0.30 to 1.75 g for the study area and soil predominant period is estimated in the range of 0.7 to 5 sec. Preliminary microzonation maps for PGA and soil predominant period are prepared and presented in this paper. Comparisons and interpretations on the basis of 1934 and 2015 earthquakes are presented in terms of damage scenario.

In the eleventh paper, V. Oderah and D. Kalumba investigated on the Use of Sugarcane Bagasse for Soil Reinforcement in Geotechnical Applications. The global initiative of minimizing the generation of waste materials, and the reduction of the environmental footprint of industrial processes has impelled the innovation into their use in geotechnical applications. Use of these materials in this manner, especially as soil reinforcements, could help solve the drudgery and secondary snags of disposing of the materials. This study therefore aimed at investigating the effects of sugarcane bagasse reinforcement on selected South African soils as well as the drawbacks of environmental conditions on the composite formed. Different types of sugarcane bagasse were utilised in evaluating their effect on the shear strength characteristics of the composite. The results indicated a higher improvement in the angle of internal friction in finely grained soil compared to coarsely grained soil. Saturation of the composite in water insignificantly reduced the strength characteristics beyond 2 days. In addition, an increase in shear characteristics depended on fineness of the soil, bagasse type and content, and on the vertical load.

The twelfth paper as described by S. Daoud, I. Said, S. Ennour and M. Bouassida on Quasi-Static Numerical Modelling of an Ore Carrier Hold: The problems associated with ore carriers' incidents, have preoccupied international organizations and many research laboratories which have been mobilised to identify the causes and seek for the solutions. The cargo liquefaction is considered to be the major cause of ore carriers' capsizing. The final aim of this research is to establish a new test procedure for evaluating the shear strength of loaded ore in view of its liquefaction prevention. First, a brief review is presented about the possible origins of cargo instability and examines the stress distribution by means of a quasi-static numerical modelling. Second, an assessment of the shear ratio variation, in terms of the hold inclination is established. According to this analysis, at a 15° hold inclination, the maximum shear ratio is less than 0.2 in all pile areas except under the residual slopes and at the surface that are assumed to be the most vulnerable parts.

The thirteenth paper is on Shear Strength of an Expansive Overconsolidated Clay Treated with Hydraulic Binders by A. Mahamedi and M. Khemissa: This paper presents and analyzes the results of a series of identification, compaction and direct shear tests performed in accordance with the Algerian standards on an expansive overconsolidated clay treated with locally manufactured hydraulic binders (composed Portland cement and extinct lime). This clay comes from the urban site of Sidi-Hadjrès city (wilaya of M'sila, Algeria), where significant damages frequently appear in the road infrastructures, roadway systems and various networks and in civil and industrial light structures. Tests results show that the geotechnical parameters values deduced from these tests are concordant and confirm the shear strength improvement of this natural clay treated with cement or lime and compacted under the optimum Proctor conditions. However, contrary to its mineralogical characteristics which do not seem to be affected by the treatment, this expansive natural clay is characterized by as well drained as undrained shear strength sensitive to stabilizer content; the best performances are obtained for a treatment corresponding to 8% cement or lime content.

The fourteenth paper is on Numerical Modelling of Retaining Wall Resting on Expansive Soil by Bushra Suhale Al-Busoda , Safa Hussain Abid Awn, & Hassan Obaid Abbase : To model the behavior of expansive soil, it seems necessary to move towards elastoplastic models that have been used for different types of clays. Hardening soil model is chosen in this study. Retaining walls rested on expansive soils are subjected to uplift and lateral forces due to soil swelling. More importantly, the swelling in expansive soil tends to cause additional lateral pressure on wall that caused deformations and bending. Various pattern types of helical piles are used to reduce the vertical and lateral movement of retaining wall constructed on expansive soil. The backfill soil beyond retaining wall is affected by swelling of expansive soil that caused additional lateral earth pressure on the wall of retaining wall. This study showed that the use of inclined helical piles beside vertical helical piles under the base of retaining wall decreased vertical movement 94% and lateral movement 70% for ratio of length of helical pile to depth of expansive soil (L/H) equal to 3.2. In general, the presence of helical piles below retaining wall resisted and controlled the vertical movement but do not control lateral movement except the case of using inclined helical piles.

N. M. Alsanabani, T. O. AL-Refeai, and A. O. Alshenawy in the fifteenth paper is on Simplified Method for Designing Piled Raft Foundation in Sandy Soils: The main purpose of this study is to develop a simplified method for computing the load carried by piles, and settlement of piled raft based on the characteristics of an unpiled raft, pile group, and soil. These are important criteria for preliminary piled raft design. Based on the results obtained from finite element analysis, simplified formulas and curves are generated for different conditions of sand and different pile spacing. These formulas and curves contain the stiffness ratio and efficiency factor of the unpiled raft and pile groups. The results of the proposed method were validated using the Poulos–Davis–Randolph method.

The sixteenth paper by Ramkrishnan R., Karthik V., Mukund S. Unnithan, Kiran Balaji R., Athul Vinu M., Anju Venugopalan is on Stabilization of Seepage Induced Soil Mass Movements using Sand Drains: Rising groundwater levels increases the pore water pressure in the soil slopes, acting as a triggering factor for landslides. By installing sand drains (horizontal or vertical) along the slope, the groundwater level can be lowered below the critical level, reducing the pore water pressure and also the probability of slope failure significantly. In this study, laboratory-scale soil slopes of varying geometry were modelled in a tank and

constant inflow was provided to simulate groundwater flow. With and without loading, the critical phreatic levels for the various slopes were determined. Vertical sand drains were then installed along the slope and the tests were repeated for a fixed duration. It was found that the slopes did not fail and remained stable for a longer time period, even with increase of groundwater flow. Hence it was concluded that sand drains are a feasible slope stabilization technique even on slopes subjected to static loading.

The seventeenth paper is on Experimental Study on the Durability of Soil-Cement Columns in Coastal Areas by Pham Van Ngoc, Brett Turner, Jinsong Huang and Richard Kelly: Deep soil mixing is one of the most commonly used ground improvement techniques. With high sulphate content in soil and seawater, stabilized soil in coastal areas can deteriorate in strength due to sulphate attack. In this research, the degradation in strength of cement treated soil exposed to synthetic seawater is measured by uniaxial compression and needle penetration testing. Three exposure conditions, namely 100% seawater, 200% seawater and in sealed condition (control samples), were used to measure the deterioration level due to the effect of sulphate. In addition, the extent of the portlandite consumption was also measured by Thermo-gravimetric Analysis which reflects the calcium distribution in the soil-cement columns. The test results show that the strength deterioration occurs deeper and faster in higher seawater environments. Furthermore, when in contact with increasing sulphate concentration, the strength deterioration shows a close relation with calcium distribution.

The eighteenth paper is by Wei Xiaoming ,Li Changhong ,Zhou Xiaolong ,Hu Baowen & Li Wanling on The Change Laws of Strength and Selection of Cement-sand Ratio of Cemented Backfill: Lilou Iron Mine is the largest domestic underground backfill mining and uses advanced whole tailings cemented filling process system. For the backfill, both the change law of strength development and the cement-sand ratio are important considerations for design. A differentiation analysis was performed of the strength of laboratory test blocks at the age of 28d and in situ cemented backfill samples. When the filling slurry concentration was 72% and cement-sand ratio was 1:4, the in situ coring strength was 2.98 MPa higher than that of laboratory-cured specimens; when the slurry concentration was 68% and cement-sand ratios were 1:4, 1:6 and 1:8, the in situ coring strength was 1.68MPa, 2.33 MPa and 1.44 MPa higher than that of laboratory-cured specimens. With an increase of filling height, the change laws has been explored of downward parabola in conditions that the strength difference is consistent with the bulk density difference of the cemented backfill. The stress of cemented backfill with different ratios were calculated and analyzed on the basis of ANSYS numerical simulation and similar filling mines. According to the position of stress concentration and change law of strength difference, this paper proposes an design scheme for high-stage cemented backfill with ratio parameters at different heights.

The last paper of this issue is nineteenth by T.C. Ekneligoda, L.-T. Yang, D. Wanatowski, A.M. Marshall1, and L.R. Stace on Numerical modelling of Ground Subsidence at an Underground Coal Gasification Site. A detailed numerical modelling study was carried out by the authors to represent geotechnical aspects of the Wieczorek underground coal gasification (UCG) site in Poland. A coupled thermos-mechanical numerical model was created to represent a single coal burning panel. The coal burning process was simulated by modifying the energy balance equation with an additional term related to the calorific value of coal as a source. Temperature dependent material properties were assigned to the coupled thermal-mechanical model according to published data. In the model, the burning zone spread about 7.5m laterally after 20 days of burning. Results from the coupled model were used to gauge a worst-case scenario in terms of the potential size of a formed cavity. This data was used within a less computationally expensive mechanical-only numerical model in order to evaluate the ground subsidence caused by the worst-case scenario for single and multiple UCG burning panels. The single panel burning resulted in 23mm of ground subsidence at the top of the model after long term coal burning. The ground subsidence measured at the top of the model, at the centre point of the gasification arrangement, was approximately 72mm when five panels were burnt with an edge to edge panel distance of 5m; this was increased to 85mm for seven panels.

ACKNOWLEDGEMENT

Nineteen papers are contained in this issue. Twelve of them are assembled by the Guest Editors and another seven contributed papers directly to the in-house 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

GEOTECHNICAL ENGINEERING

December 2017: Papers by Guest Editor Akira Murakami & Contributed Papers

Edited by:
Akira Murakami, San Shyan Lin & Mounir Bouassida

Akira Murakami

Prof. Akira Murakami received his BS (1978) at the Agricultural Engineering Department; MS (1980) at the Civil Engineering Department and Dr. Agr. (1991) from Kyoto University (KU), respectively. In 1982, he became an assistant professor at the Agricultural Engineering Department of KU, and was promoted to an associate professor of KU in 1994. He moved to the Graduate School of Environmental Science of Okayama University with a promotion to full professor in 1999. After joining Okayama University for just 10 years, he moved back to a full professor of KU in 2009. He has served as the Vice President of the Japanese Geotechnical Society (JGS), the Board Member of the Japanese Society of Irrigation, Drainage and Rural Engineering (JSIDRE), and the International Association for Computer Methods and Advances in Geomechanics (IACMAG), and also serves as a core member of TC103 of ISSMGE and a member of the Multidisciplinary International Society on Inverse Problems in Science and Engineering. He had acted as the Secretary of TC34 of ISSMGE for two terms and delivered a general report of 'Numerical Methods' at 16ICSMGE held in Osaka. He is the recipient of the Japanese Society of Civil Engineering (JSCE) Paper Award (1996), the JSIDRE Sawada Prize (2007), the JGS Best Accomplishment Award (2008), the JSIDRE Best Paper Award (2010), the JGS Paper Award (2011, 2013) and is a Fellow of JSCE. His research interests include the data assimilation, inverse problem, finite element methods, mesh free methods, and DEM in geomechanics.

San-Shyan Lin

Prof. San-Shyan Lin graduated from Chung Yuan University with a BSCE degree in 1981. He then obtained his master degree from Utah State University, Logan, Utah in 1985 and his PhD from Washington University in St. Louis, Missouri in 1992. Before his teaching career at university, Dr. Lin served as an engineer at Taiwan Area National Expressway Engineering Bureau between1992 to1994. Dr. Lin has been serving at Department of Harbor and River Engineering (DHRE) of National Taiwan Ocean University (NTOU) since 1994. He was promoted as a full professor in 2000. Thereafter, he took some university duties by serving as the secretary-general at office of the secretariat between 2001 and 2003; the chairman of DHRE between 2005 and 2006; the acting dean of college of engineering in 2007 and the vice president of NTOU between 2006 and 2012.

Prof. Lin served as a committee member of committee A2K03-Foundations of Bridges and Other Structures of TRB, USA between 1995 and 2004. Currently, he is still serving as a committee member of TC-212 and ATC-1 of ISSMGE and as an editorial board member of four international journals. In addition, Dr. Lin also served as the president of Taiwan Geotechnical Society (2011-2013); Chairman of International Geosynthetics Society- West Pacific Regional Chapter (2002-2004); CEO of Sino-Geotechnics Foundation (2011-2014) etc. Dr. Lin received the distinguished alumnus award from Chung Yuan University in 2009 and the distinguish Engineering Professor Award from Taiwan Pavement Engineering Society in 2011. Prof. Lin's research and practical experiences have been dealt with deep foundations and geosynthetics.

Mounir Bouassida

Mounir Bouassida is a professor of civil engineering at the National Engineering School of Tunis (ENIT) of the University of Tunis El Manar where he earned his B.S., M.S., Ph.D., and doctorate of sciences diplomas, all in civil engineering. He is the director of the Research Laboratory in Geotechnical Engineering and has supervised 16 Ph.D. and 29 Master of science graduates. His research focuses on soil improvement techniques and behavior of soft clays. Dr. Bouassida is the (co)author of 87 papers in refereed international journals; 130 papers, including 20 keynote lectures; and three books. He is a member of the editorial committees of journals Ground Improvement (ICE), Geotechnical Geological Engineering, Infrastructure Innovative Solutions, and International Journal of Geomechanics (ASCE). He is also an active reviewer in several international journals. As a 2006 Fulbright scholar, Bouassida elaborated a novel methodology for the design of foundations on reinforced soil by columns. He was awarded the 2006 S. Prakash Prize for Excellence in the practice of geotechnical engineering. In 2008, Bouassida launched a Tunisian consulting office in geotechnical engineering, SIMPRO. He is a co-developer of the software Columns 1.01 used for designing column-reinforced foundations. Prof. Bouassida held the office of the vice president of ISSMGE for Africa (2005–2009). He benefited from several grants as a visiting professor in the USA, France, Belgium, Australia, Vietnam, Hong Kong, and Norway.

Geotechnical Engineering Journal of the SEAGS & AGSSEA Vol. **48 No. 4 December 2017** ISSN 0046-5828

GEOTECHNICAL ENGINEERING

December 2017: Papers by Guest Editor Akira Murakami & Contributed Papers

Edited by:
Akira Murakami, San Shyan Lin & Mounir Bouassida

TABLE OF CONTENTS

List of Papers **Page**

Cover Photographs

1. Numerical Study on the Design of Reinforced Soil by Vertical Micropiles: A. Kamura, J. Kim,
(After T. Kawai, M. Kazama, N. Hikita and S. Konishi, 2017)

2. Soft ground improvement at the Rampal Coal Based Power Plant Connecting Road Project in Bangladesh
(After Sudipta Chakraborty, Ripon Hore, Fahim Ahmed and M. A. Ansary, 2017)