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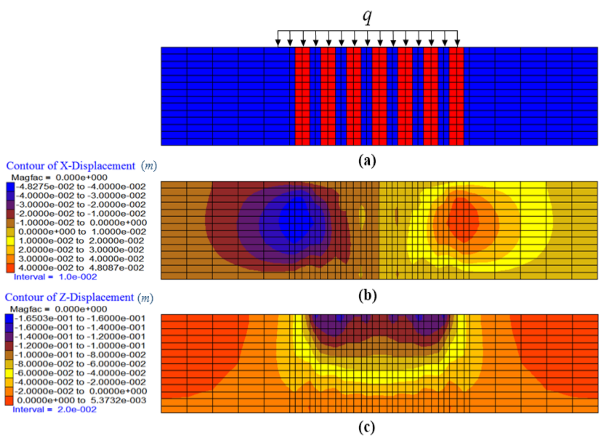
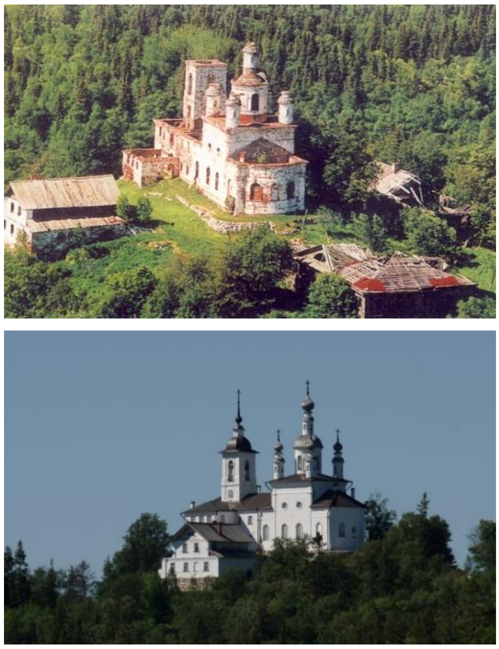
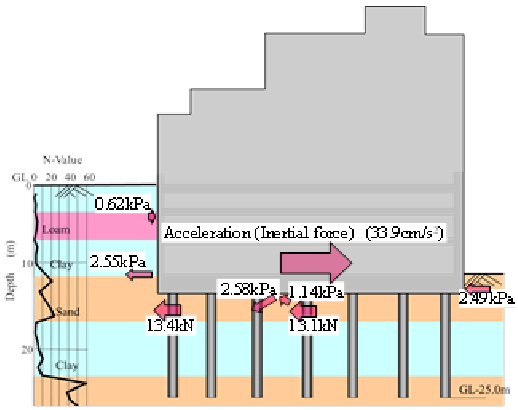


Behaviour of Foundation on End-bearing Stone Columns Group Reinforced Soil
(After Seifeddine Tabchouche et. al, 2019)



Long-term deformations of a historical church on the Anzer Island, White sea
(After Chernyshev Sergei N. , 2019)



Seismic Observations on Piled Raft Foundation subjected to Unsymmetrical Earth Pressure during Far Earthquake and Near Earthquake
(After J. Hamada and K. Yamashita, 2019)

Temperature-Stress Analysis of Rock-Shotcrete Structure under High Temperature Cooling Effect
(After Hui Su et. al, 2019)

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PREFACE

This Issue contains fifteen papers; the first paper is by Chernyshev Sergei N. on Long-term Deformations of a Historical Church on the Anzer Island, White Sea: Current study is aimed at determining the rate of the sand ground dislocations near the ultimately steep slope. The purpose of this work to determine the velocity of the sandy soils on flat ground on extremely steep to slope. In order to determine the rate, we conducted periodical measurements of the width of the tensile fractures in the load-bearing walls of the building constructed in 1830. Building of the object and its restoration in the current century have led to the imperfect structure of the building, lacking steel ties in the brick walls, which should have been installed at different levels, specifically under the floor and at the level of the vault abutment. The absence of ties has resulted in rupturing of examined building due to tensioning of the moving foundation. The errors of the constructors have transformed this building into an experimental object. The direction and the velocity of the ground movement have been determined. Our results suggest that tensioning of the foundation should be considered when designing the structure of the buildings constructed on the sandy layer near bents.

The second paper is by J. Hamada and K. Yamashita on Seismic Observations on Piled Raft Foundation subjected to Unsymmetrical Earth Pressure during Far Earthquake and Near Earthquake: Seismic observations on piled raft foundation subjected to unsymmetrical earth pressure have been conducted just after the 2011 off the Pacific coast of Tohoku Earthquake. The seismically monitored building is a seven-story building with three basement floors, subjected to unsymmetrical earth pressure, located in Tokyo, Japan. Accelerations of the building, dynamic sectional forces of the piles and dynamic earth pressures on both sides of the embedded foundation and those beneath the raft were observed during over 550 seismic events including an earthquake with a magnitude of M8.1. The maximum acceleration of 0.358 m/s2 was observed on the building foundation. Based on the seismic records, it was confirmed that a lateral inertial force of the building was transferred to the subsoil through the raft. Comparing to different seismic type, the bending moments on piles due to far earthquake having relatively long period were larger than those due to near earthquake. It was also found that the ratio of the lateral load carried by the piles to the lateral inertia force of the building was estimated to be about 10 to 30 %.

The third paper by M. Manzur Rahman and Mohammed K. Islam on Determination of Virgin Compression Destructuring Line Parameters for Natural Clays: Based on the destructuring framework proposed by Liu et al. (2015) preceded by the work by Liu and Carter (1999, 2000), the virgin compression destructuring behavior of fifteen natural soil published in various literature over the last seven decades in several locations around the globe have been studied. Two methods (i.e., graphtwelve ical and two reference point approach) to determine the parameters used in the equation of compression destructuring line (CDL) are proposed and examined by simulating the experimental data. Also, a systematic approach to find the yield pressure is suggested. The study concluded that CDL parameters obtained from graphical approach successfully predicted the compression behaviors of structured soil for most of the soil samples. Nonconformity occurs in case of two reference point approach in some cases. The two reference point approach is very helpful for a quick approximation of the CDL parameters because of its simplicity. Theoretically, two reference point method should be independent of the selection of the two point sets and always yield the same parameters but due to the uncertainty of the precision of experimental data, it varied. The author used and suggested a universal by taking furthest two points on the destructuring compression data as references. Also, the analytical approach to locate the yield pressure point is found very helpful. These methods eliminate the rigorous process of trial and error to find CDL parameters and other conventional processes to locate the yield pressure.

In the paper (fourth one) by H. Soltani-Jigheh and S.N. Tahaei Yaghoubi on Effect of Liquid Polymer on Properties of Fine-Grained Soils: One of the most useful methods for improving engineering characteristics of soils is soil stabilization by chemical additives like cement, lime and polymer materials. Since polymeric additives are easier to handle, they have been used widely in geotechnical projects in recent years. The current practice is to evaluate the effect of CBR-Plus polymer on the physical and mechanical properties of fine-grained soils. For this purpose, CBR-Plus polymer was mixed with two high plasticity fine-grained soils and Atterberg limits, compaction and consolidated undrained (CU) triaxial tests were carried out on the compacted mixture in the laboratory. Interpretation of the results using scanning electron microscopy (SEM) images were carried out. Results show that CBR-Plus has insignificant effect on plasticity index and compaction characteristics of soils. Some amount of CBR-Plus additives lead to increase in shear strength of specimens. In fact, depending on the type of the soil, there is an optimum amount for this polymeric material in which the shear strength increases.

The fifth paper is on Geotechnical Aspects of Infrastructure Projects in Gypseous Soils by Safa Hussein Abd-Awn and Heba Qasim Hussein: This paper presents the behaviour of single tension pile in collapsible soil (Gypseous soil) by experimental work. The natural Gypseous soil with 66% gypsum used in the study was brought from Salah Al-Deen governorate in Iraq while that of the sand was brought from Karbalaa governorate, south of Baghdad, Iraq. The model pile used is smooth steel pipe pile with slenderness ratios (L/D) of 10, 15, 20 and 25. The effect of the gypsum content included in the soil as well as the effect of rest time and the effect of (L/D) on the pullout capacity of pile were studied in the laboratory scale model pile. The results showed that the pullout capacity of pile in Gypseous soil is more than its capacity in Sandy soil by about 64%. When the rest time was increased, the pullout capacity of tension pile embedded in Gypseous soil decreased. Increasing (L/D) ratio of pile in Gypseous soil from 15 to 20 increases pullout capacity of pile to about 65%, while increasing that ratio from 20 to 25 increases pullout capacity of pile to about 76%.

In the sixth paper is on Influence of Nano Copper Slag in Strength Behaviour of Lime Stabilized Soil by M. Kirithika and V.K.Stalin: Nanotechnology has been widely used in many applications such as medical, electronics, and robotics also in geotechnical engineering area through stabilization of bore holes, grouting etc. In this paper, an attempt is made to understand the influence of nano copper slag (1%, 2% & 3%) on the index, compaction and Unconfined Compressive Strength (UCS) properties of natural soil (CH type) with and without lime stabilization for immediate and 7 days curing period. Results indicated that upto 1% of nano copper slag, there is an increase in UCS of virgin soil and lime stabilised soil. Beyond 1% nano copper slag, there is a steep reduction in UCS and increase of plasticity both in lime stabilised soil and virgin soil. The effect of lime is found to show more influence on large surface area of nano copper slag in natural soil. In lime stabilised soil, for both immediate and curing effect, with 1% of nano copper slag the maximum UCS was 38% and 106% higher than that of the virgin soil strength.

The seventh paper by Md Shofiqul Islam and Atikur Rahman is on Slope Stability Problem and Bio-engineering Approach on Slope Protection: Sase Study of Cox's Bazar Area, Bangladesh: The slope stability problem of the six (06) locations in the Cox's Bazar district, Bangladesh were analyzed through laboratory measurement of the engineering properties of the soil samples, tensile strength of roots and numerical modeling using both limit equilibrium and finite element method. The modeling results show that the slopes are stable (FS value greater than 1) at the dry condition and the wet condition unless rocks are weathered. At the wet condition most of the slopes with loos soil are vulnerable for landslide and need supports to stabilize. We suggested the vegetal support (tap-rooted tree) to stabilize the vulnerable slopes of the study area. The experimental result shows that the roots of the local growing tap rooted trees (e.g., Chapalish, Korai, Gorjon, Telsur) grew linearly within a few years. The roots reached their length of 3-5 m within 4/5 years, yielding tensile strength of 70-80 MPa that enough to avoid the slope failure.

The subsequent paper eight in the series is by Nadia Mezni and Mounir Bouassida on Geotechnical Characterization and Behaviour of Tunis Soft Clay: Tunis soft clay being known as one of the most problematic soils has poor mechanical characteristics, high compressibility and exhibits fragile shear strength. This paper considers the geotechnical characterization of Tunis soft clay by compiling results from in situ and laboratory tests. Accordingly, some correlations are suggested. The assessment of observed behavior of Tunis soft clays in the zone of interchange ramps was investigated. The follow up of ramps behavior was performed for a period of three months. The evolution of settlement was monitored by rod settlement, hydraulic settlement and multi-points settlement. A plane strain model was built for numerical investigation conducted by Plaxis software to simulate the behavior of the ramp's embankment. Hardening Soft Soil Model (HSM) and Soft Soil Model (SSM) were adopted for the soft clay layer. The results showed an agreement between the predictions of the two models of the behavior of the soft clay. Using measured settlement the adopted behavior for Tunis soft clay is justified.

Mingyang Zhou and Kwong Soon Wong are the authors of the ninth paper on Strength of Peat Treated with Peat Ash: For construction on peaty ground, shallow peat layer is normally replaced by stiffer soil. The replaced peat may be burned into peat ash to reduce the volume. In this study, the potential of peat ash in improving the shear strength of peat was investigated using unconfined compression tests. It is found that peat ash has insignificant effect to the 7 days strength of peat. Peat ash increases the strength of peat by about 50% at Day 14. At Day 28 and 56, the effect of peat ash to strength of peat is comparable to the effect of cement, whereas the effect of cement is about 10% larger than that of peat ash. It is found that effect of peat ash in strengthening the peat become less significant with the present of cement.

The tenth paper is by Hui Su, Min Liang, Baowen Hu, ZhouXiang Xuan, Yue Xin, and Yi Zhu on Temperature-Stress Analysis of Rock-Shotcrete Structure under High Temperature Cooling Effect: Take the diversion tunnel located in geothermal area as engineering background, the coupled temperature-stress analysis of rock-shotcrete structure with high temperature was performed under immersion action of cold water. The Physical and simulation experiment show that temperature evolution of rock-shotcrete structure can be classified into three stages, which are initial rapid decay stage, deceleration decay stage and the equilibrium stage; The stress simulation shows that the sharp change of stress will occur in the shotcrete layer during the first stage, and maximum principal stress is mainly manifested as tensile stress, which will easily lead to tensile failure of the shotcrete layer; the displacement simulation shows that the rock-shotcrete structure takes on overall shrinkage deformation in each temperature stage, and it is most obvious for shotcrete layer. The deformation of rock plate will not stop until temperature reaches stable state. Such kind of deformation law will weaken constraint on the shotcrete material, and therefore lead to stress relief in the shotcrete layer.

A. Sridharan, Santhosh Kumar. T.G, Benny Mathews Abraham and Sobha Cyrus are the authors of the eleventh paper on Applicability of Hyperbolic Method for the Prediction of Shear Strength Parameters from Multistage Direct Shear Tests: Measurement of shear strength through a conventional direct box shear test involves the requirement of at least three identical soil specimens. The collection of samples and carrying out a number of tests is very expensive and time consuming. Multistage shear strength test provides a faster method for the determination of shear strength parameters of a soil through tests on a single sample. Earlier studies conclusively proved the effective use of multistage triaxial compression test to predict the shear strength of soils. In this paper an attempt is made to study the possibility of using multistage box shear tests on a single soil sample instead of the conventional box shear tests to predict the shear strength. Undrained direct shear tests conducted on three different soil types - medium sand, air dried Cochin marine clay and red earth showed very good agreement between the results of multistage and conventional box shear tests. It has been brought out that the stress- strain curve in the shear box test follows the hyperbolic form throughout the test. Hence, it is possible to predict the failure shear stress, knowing the stress-strain relationship for the initial portion only. Making use of this behavior, multistage tests were carried out on single sample changing the normal load after obtaining initial portion of stress- strain behaviour. It has been brought out that the conventional box shear test could be approximated to multistage box shear test using only one soil sample, avoiding the variability between three or four soil samples used in a conventional test. The test procedure has the distinct advantage of requiring only one sample coupled with large saving in time without much compromise on the accuracy.

Twelfth in the series is the paper on Behavior of Foundation on End-bearing Stone Columns Group Reinforced Soil by Seifeddine Tabchouche, Mounir bouassida and Mekki Mellas: The prediction of the settlement of foundations on soil reinforced by a group of end-bearing stone columns was investigated. 3D numerical models with constant improvement area ratio are considered into two configurations. The first configuration consists of stone columns group located in regular triangular pattern. Whilst, an equivalent reinforcement by concentric crowns is used by the second configuration. Geotechnical parameters of the reinforced soil modeled by the Mohr Coulomb constitutive law are adopted from Tunisian case history. Numerical predictions of the settlement by the finite difference code FLAC 3D and analytical ones by Columns and COLANY software are compared. It has been verified that the settlement prediction by the unit cell model is underestimated in regard to predictions obtained by the 3D reinforced soil models. Elsewhere settlement predictions by the equivalent concentric crowns are close to those obtained by the corresponding models of stone columns group reinforcement. When the equivalent concentric crowns reinforcement is adopted the increase in contact area with the soft soil does not affect the settlement prediction when total adhesion is assumed along those interfaces. Using the FLAC 3D code, it is more suitable to handle the input data by the equivalent concentric crowns to perform the computations.

The thirteenth paper is by A.S. Balasubramaniam, J.M.N.S. Jayasiri, E. Oh, G. Chao, H. Kim and R. N. Hwang on Instrumented Piles Tested in 1969 in Fine Loose Sand at Holmen, Drammen: Revisited 2019: The work presented here relates to the instrumented piles tested in 1969, by the Norwegian Geotechnical Institute (NGI) in loose sand at Holmen, Drammen. The material contained in the first publication, which is an Internal Report F.273.0 of NGI (Balasubramaniam et al., 1969), was mainly on the load tests only and contained the analyses of the vibrating wire gauges as based on the zero of the gauges after the pile driving, to make sure the best set of zero values were used. The publication of Gregersen et al. in 1969, includes pull out tests and also the effect of the residual stresses developed in the piles during pile driving. Further, the work of Gregersen et al. contains a detail section on the performance of the vibrating wire gauges and in particular the drifting of the zero of the gauges. The entire pile testing work and reporting in NGI internal report F.273.0 (Balasubramaniam et al., 1969) included a description of the instrumentation used and the results obtained from load and pull out tests on precast reinforced concrete piles. The piles, of circular cross section and available in standard lengths, can be joined together in the field by means of threaded connectors.

The primary purpose of the instrumentation was to determine the distribution of axial load along the length of the pile and the point load and also to measure the distribution of lateral earth pressure acting on the periphery of the pile. To accomplish these goals, the piles were equipped at a number of levels with strain gauges embedded in the concrete, on the reinforcing steel, and earth pressure cells on the sides of the piles, together with hydraulic piezometers for measuring pore water pressure in the sand. The instrumentation system was based on the operating principle of the vibrating-wire strain gauge (Bjerrum et al., 1965). Altogether four instrumented piles were used in the test program, three cylindrical and the fourth conical in shape, and had a uniform taper, typical for a Norwegian timber pile. The piles were constructed in such a manner that the 8m long cylindrical and conical piles can be tested first and later, after completion of these tests each one of them can be lengthened by connecting additional 8m segment of instrumented cylindrical pile to make up two 16 m long test piles. The test program also included additional tests on a single pile, which was made up of 4 m long precast concrete pile sections driven one section at a time and tested for embedded lengths of 3.5, 7.5, 11.5, 15.5, 19.5 and 23.5 m; the latter pile only had load cell at the top to measure the applied load and was not instrumented.

A. Puttiwongrak and N. N. Htwe are the authors for the fourteenth paper on Application of Electrical Resistivity Imaging and Slope Modelling to the Investigation of Landslide Sliding Geometry in Phuket: Over the last decade, landslides triggered by rainfall in Phuket have been a major problem affecting development and tourism. An investigation of areas susceptible to landslides is necessary in order to institute policies to reduce the impact of landslide and to ensure the safety of tourists. In this study, two dimensional electrical resistivity imaging (2D-ERI) was applied and slope stability modelling was conducted to investigate the sliding surface and the thickness of the sliding mass in a study area which is prone to landslide during intense and prolonged rainfall. The result of the 2D-ERI was used to validate the result of a simulation of the slope stability to determine the landslide sliding surface and the thickness of the sliding mass based on rising piezometric head due to rainfall. Further, the model geometry of the slope stability was reconstructed using the 2D-ERI data, and the simulation was repeated. The result for the factor of safety (FS) when the piezometric head was rising was found to have been overestimated in the original simulation Therefore, the reconstruction of the model geometry is essential to avoid the over-estimation of the FS in slope stability modelling in conditions of rising piezometric head.

S. Moriyasu1, S.P. Chiew, K. Otsushi, N. Matsui, S. Taenaka, K. Teshima, M. Tatsuta and H. Tanaka are the authors for the fifteenth paper on Comparison of Flexural stiffness between Hat-type and U-type steel sheet pile retaining walls in a Field Test in Singapore: The use of the Hat-type steel sheet pile can potentially improve the performance of earth retaining walls because of two of its features: its wide width and location of interlocks. It can reduce the piling time and number of piles required for walls because of its 900-mm width, which is the widest among the hot-rolled monopiles in the world. Furthermore, Hat-type piles can achieve full-shear force transmission at the interlocks because their connections are located at the outer edge of the wall. This study focuses on the second feature, i.e., the interlock shear force transmission. The lateral load and excavation tests were performed to compare and verify the difference in the interlock behavior between U-type and Hat-type sheet piles. As the result, in contract to the reduction of shear force transmission of the U-pile wall, the Hat-pile wall exhibited high flexural stiffness because the interlocks achieved the full-shear transmission mode.

San Shyan Lin, Erwin Oh & Ooi Teik Aun

ACKNOWLEDGEMENT

Fifteen papers 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
Assoc Prof Erwin Oh
Dr. Noppadol Phienwej
Prof. A. S. Balasubramaniam

GEOTECHNICAL ENGINEERING

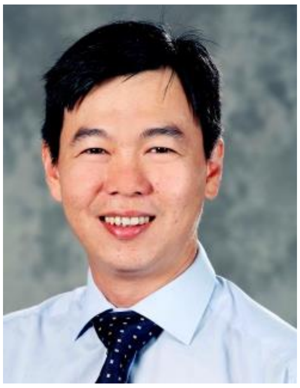
December 2019: Contributed Papers

Edited by: San Shyan Lin, Erwin Oh & Ooi Teik Aun

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.



Erwin Oh

Dr. Oh is the Associate Dean (International) for Griffith School of Engineering and a Senior Lecturer in Geotechnical Engineering at Griffith University. He received his Bachelor and Master degrees from National Taiwan Ocean University, and his PhD from Griffith University. Dr. Oh specialises in geotechnical and pavement engineering. He has co-authored over 100 refereed articles. His research interests include geotechnical issues for road infrastructure, soft clay behaviour, ground improvement techniques, and numerical modelling. Dr. Oh had previously served as Chairman (2011 to 2013) and Committee member (2004 to 2015) for Engineers Australia Gold Coast regional group, Chairman (2012) and Committee member (2006 to 2012) for Australian Geomechanics Society Queensland Chapter.

Teik Aun Ooi

Ir. Dr. Teik Aun Ooi obtained his Bachelor of Civil Engineering and Master of Engineering from Auckland Universiity in 1966 and 1968 respectively. He obtained his PhD from University of Sheffield in 1980. He was the Co - Organizing Chairman of the recently concluded SEAGC2016. He is the immediate Past President of the Southeast Asian Geotechnical Society (SEAGS), Founder Chairman of the Association of Geotechnical Societies in Southeast Asia (AGSSEA). He is a Past President of the Malaysian Institute of Arbitrators (MIArb). He is the Immediate Past ICE Country Representative for Malaysia (2000 - 2015), Founder Chairman of IEM Tunnelling and Underground Space Technical Division (TUSTD), Founder Chairman of IEM Consulting Engineering Special Interest Group (CESIG), He is an Honorary Fellow of The Institution of Engineers, Malaysia (Hon. FIEM), Fellow of the Institution of Civil Engineers (CEng FICE), Fellow of the MIArb (FMIArb), Fellow of Malaysian Society of Adjudicators (FMSA) and Fellow of Asean Academy of Engineering and Technology (FAAET). Dr. Ooi has fifty years of experience in the Construction Industry. He spent his initial fourteen years with the Public Works Department Malaysia before leaving to work in the private sector where he spent seventeen years working in the construction sector. He play major role in the Johore Baru Causeway widening and the design and construction of Senai Airport in 1970s. He was the Project manager for the Wisma Saberkas Building Project in Kuching in 1980s. He was Project Director for the Design and Construction supervision of the New Kuching Deep Water Port at Kampung Senari in 1990s. He started his consultancy practice in 2000 specialising in Civil and Geotechnical Engineering works. Dr. Ooi is a practicing Consulting Engineer, An Expert Witness in Court and in Arbitration, An Accredited Checker, An Arbitrator and An Adjudicator. He is a member of the Accredited Checker Committee of the Board of Engineers, Malaysia. Dr. Ooi devoted much of his time in honorable public service in continuing education of engineers and development of Malaysia Annexes for Eurocode 7 and 8. He is an independent executive director of IEM Training Centre Sdn Bhd since 1992. In 2013 he was appointed executive director of the IEM Academy Sdn Bhd. He has been Organizing Secretary and Chairman of numerous IEM Workshops, Seminars, and Conferences since 1970s. He was responsible for forming five active ICE Student Chapters in Universities in Kuala Lumpur. Dr. Ooi conducted touring lectures in geotechnical engineering to Malaysia, Vietnam, Thailand, Cambodia, Laos, Myanmar and Philippines. In Malaysia he was invited to deliver the prestigous 19th Professor Chin Fung Kee Memorable Lecture in 2009. He frequently delivered lectures to the final year University engineering students.

GEOTECHNICAL ENGINEERING

December 2019: Contributed Papers

Edited by:
San Shyan Lin, Erwin Oh & Ooi Teik Aun

TABLE OF CONTENTS

Cover Photograph

GEOTECHNICAL ENGINEERING

Paper Contribution, Technical notes and Discussions

SEAGS & AGSSEA encourage the submission of scholarly and practice-oriented articles to its journal. The journal is published quarterly. Both sponsors of the journal, the Southeast Asian Geotechnical Society and the Association of Geotechnical Societies in Southeast Asia, promote the ideals and goals of the International Society of Soil Mechanics and Geotechhnical Engineering in fostering communications, developing insights and enabling the advancement of the geotechnical engineering discipline. Thus the publishing ethics followed is similar to other leading geotechnical journals.Standard ethical behaviour of the authors, the editor and his editorial panel, the reviewers and the publishers is followed.

Before you submit an article, please review the guidelines stated herein for the manuscript preparation and submission procedures. Paper template is available upon request.

Geotechnical Engineering Journal accepts submissions via electronic. The manuscript file (text, tables and figures) in both words and pdf format together with the submission letter should be submitted to the Secretariat and copied to the Editor-in-Chief, Geotechnical Engineering Journal, c/o School of Engineering and Technology, Asian Institute of Technology, Room no. 211, AIT Library, Asian Institute of Technology, P.O. Box 4, Klong Luang, Pathumthani 12120, Thailand. Email: seags@ait.ac.th. Papers under review, accepted for publication or published elsewhere are not accepted. The guidelines for author are as follows:-

1. The manuscript including abstract of not more than 150 words and references must be typed in Times New Roman 9 on one side of A4 paper with a margin of 25 mm on each side. The abstract should be written clearly stating the purpose, scope of work and procedure adopted together with the major findings including a summary of the conclusions.
2. The paper title must not exceed 70 characters including spaces.
3. The maximum length of papers in the print format of the Journal is 12 two-column pages in single-spaced in Times New Roman 9 including figures and tables. A Journal page contains approximately 1,040 words. Authors can approximate manuscript length by counting the number of words on a typical manuscript page and multiplying that by the number of total pages (except for tables and figures). Add word-equivalents for figures and tables by estimating the portion of the journal page each will occupy when reduced to fit on a 160 mm x 240 mm journal page. A figure reduced to one-quarter of a page would be 260 word-equivalents. When reduced, the figure must be legible and its type size no smaller than 6 point font (after reduction).
4. Figures: Line art should be submitted in black ink or laser printed; halftones and color should be original glossy art. Figures should be submitted at final width i.e. 90 mm for one column and 185 mm for two columns. The font of the legends should be in Times New Roman and should use capital letters for the first letter of the first word only and use lower case for the rest of the words. Background screening and grids are not acceptable.
5. Each table must be typed on one side of a single sheet of paper.
6. All mathematics must be typewritten and special symbols identified. Letter symbols should be defined when they first appear.
7. The paper must have an introduction and end with a set of conclusions.
8. Practical applications should be included, if appropriate.
9. If experimental data and/or relations fitted to measurements are presented, the uncertainty of the results must be stated. The uncertainty must include both systematic (bias) errors and imprecisions.
10. Authors need not be Society members. Each author's full name, Society membership grade (if applicable), present title and affiliation and complete mailing address must appear as a footnote at the bottom of the first page of the paper.
11. Journal papers submitted are subject to peer review before acceptance for publication.
12. Each author must use SI (International System) units and units acceptable in SI. Other units may be given in parentheses or in an appendix.
13. Maximum of five keywords should be given.

14. REFERENCES

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15. Discussions on a published paper shall be made in the same format and submitted within six months of its appearance and closing discussion will be published within twelve months.

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