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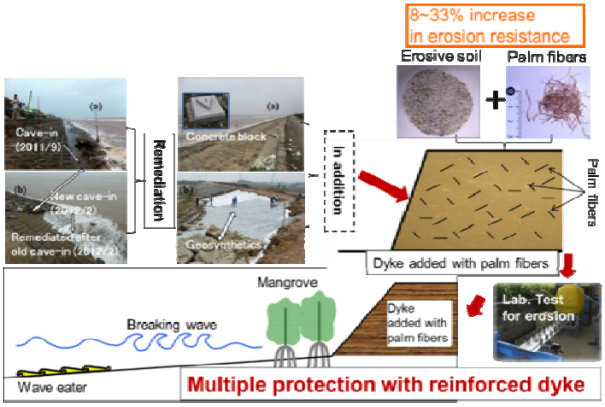
Editors: Dr. Phung Duc Long & Prof. San-Shyan Lin

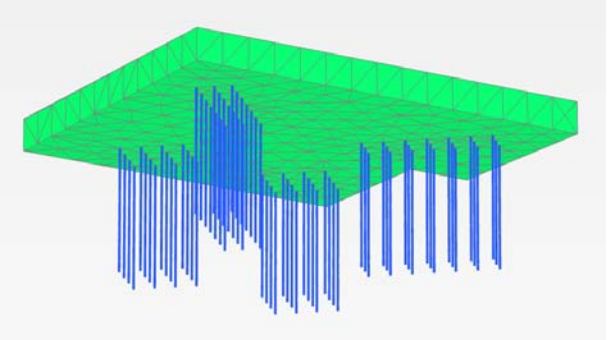


Multiple protective measures used in coastal areas

(After Yasuhara *et al.*, 2016)

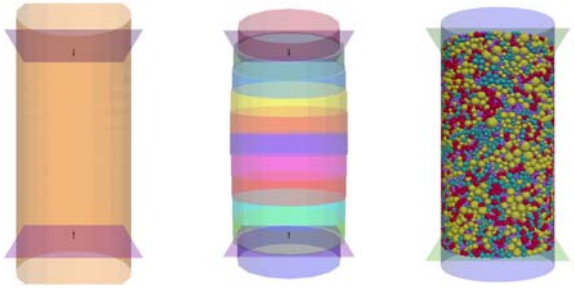
Example of erosional scene of river bank in the Mekong Delta

(After Yasuhara *et al.*, 2016)



Plaxis 3D piled raft foundation model

(After Phung Duc Long, 2016)



Geometry of DEM models

(After Nguyen Quang Tuan and H. Konietzky, 2016)

GEOTECHNICAL ENGINEERING

March-2016 Issue: Vietnam Special Issue
Edited by Dr. Phung Duc Long & Prof. San Shyan Lin

Dr. Phung Duc Long

Dr. Phung is President of the Vietnamese Society for Soil Mechanics and Geotechnical Engineering (VSSMGE). He received his Ph.D. degree at the Geotechnical Department, Chalmers University of Technology in Gothenburg, Sweden in 1993. He has worked at the Institute for Building Science & Technology (IBST) in Hanoi, Vietnam from 1975 to 1988; at the Swedish Geotechnical Institute (SGI) in Linköping, Sweden from 1988 to 1994; at Chalmers University of Technology from 1989 to 1993, at Skanska Sweden as Technical Manager from 1994 to 2002; at WSP Asia in Hong Kong as Associate Director from 2002-2003; at WSP Vietnam in Hanoi as General Director from 2003-2011; and at Long GeoDesign as Director since 2011.

Dr. Phung has 40 years of international experience. His expertise areas are: deep foundations and piled raft foundations for high-rise buildings, temporary and permanent support for deep excavations, tunneling, soil improvement, underpinning, pile dynamics, and numerical analysis of soil-structure interaction problems. He has worked with projects in many countries, as Sweden, Norway, Denmark, USA, England, Russia, Germany, India, Hong Kong, China and Vietnam, etc. Some of his highlight projects are: Uni-Storebrand Headquarter in Oslo with steel-core piles into rock; SL-10 South Link in Stockholm with sheet pile wall for deep cut & cover tunnel in soft clay; Fredriksberg Metro Station in Copenhagen, the world largest drilled-pile wall for deep excavation; soil stabilization with lime-cement columns for Highway I15, Salt Lake City, Utah, USA; Öresund Link between Sweden and Denmark; Årsta Bridge in Stockholm with pile foundations and sheet pile walls in deep water and soft clay; the peer-review of piled foundation for the ICC Tower, 118 floors, 490m high in Hong Kong, the No. 4 tallest high-rise in the world, and the Sailing Tower in Ho Chi Minh City, Vietnam. He is the author and co-author of more than 100 technical papers and books in English, Swedish and Vietnamese for different national, regional and international seminars, conferences, and technical journals. He is the chief editor of a number of publications, as the proceeding of the international conferences Geotec Hanoi 2011, and Geotec Hanoi 2013.

Prof. San-Shyan Lin

Dr. Lin is a Professor at Department of Harbor and River Engineering of National Taiwan Ocean University in Taiwan. He received his Ph.D. degree in Civil Engineering from Washington University in St. Louis, Missouri USA in 1992. Dr. Lin was an engineer at Taiwan Area National Expressway Engineering Bureau from 1992 to 1994. Prof. Lin also served as TRB A2K03 Committee member on Foundations of Bridges and Other Structures between 1995 and 2004. He is also serving as committee member of TC-212 and ATC-1 of ISSMGE and as editorial board member of four major international journals in geotechnical engineering.

Prof. Lin's research and practical experiences have been dealt with static and dynamic behaviour of deep foundations, ground improvement and effects of scouring on bridge foundations. In the past decades, he was involved in many research projects such as interpretation of pile load testing results due to axial, lateral, or combined loading; effect of soil liquefaction on performance of pile foundation in sand; seismic effect of pile foundations; performance of suction pile in sand or in clay; and effect of scouring on performance of pile and caisson foundations etc. Prof. Lin has published more than 110 peer-reviewed journal papers and conference papers. One of his published Journal papers dealing with cyclic lateral loading effect on permanent strain of deep foundation due to cyclic lateral loading has been cited more than 60 times in Google academic website by many international researchers working on wind turbine foundations.

GEOTECHNICAL ENGINEERING

PREFACE

This journal issue was edited and contributed from works in Vietnam by Vietnamese authors and other popular persons.Sixteen papers are contained in this issue. Dr. Phung Duc Long is the lead editor. His Vietnamese team included: Dr. Pham Van Long, Dr. Pham Huy Giao, Mr. Mai Trieu Quang, Dr. Nguyen Anh Minh, Dr. Vu Quang Hung, and Dr. Vu The Manh.

The construction field in Vietnam has been under a very fast development. More than ten years ago the first 30-storey tower appeared in Vietnam. Today, the height has reached to 70-80 floors. During the last decade many tall towers, long bridges, deep tunnels, large hydro-power dams, large airport and habours, etc have appeared in Vietnam. Thousands of kilometers of highway have been constructed. New metro projects have been started both in Hanoi anh Ho Chi Minh City. It is understandable why geotechnical engineering has recently developed very fast in Vietnam.

The issue's major topics relate to piled raft foundations; piled foundations for storage tanks; pile group settlements; coastal and riverine erosion in the context of climate change; soil characterization for land subsidence evaluation for MRT projects; discrete modelling of excavation in fractured rock; settlement management for urban tunnels; evaluation of performance of diaphragm walls; study on clayey soils using piezocone; DEM simulations of medium dense sand in triaxial apparatus; characteristic of unsaturated soil of earth fill dams; ground improvement using soil-cement columns/deep mixing method; and ground improvement with preloading, and PVD and vacuum pressure.

Phung Duc Long (paper No.1) has made a detailed study on pile raft foundation in which the piles are used for reducing settlement, not for taking the total load from superstructure as in the conventional pile foundations. The results from his field model test, which strongly supports the concept of settlement-reducers, are reviewed. Basing on the experiment, a simplified design method is proposed. In the paper, the method is used for the conceptual design of a large high-rise building complex. In combination with FEM, the simplified method gives a reliable tool for conceptual design of piled-raft foundations. PLAXIS 3D is used for modelling both the piled and un-piled foundations in the study.

Yasuhara *et al*, (paper No.2) describe climate change related disasters such as erosion along riverine and coastal areas of the Mekong Delta in the South Vietnam. Also, the red river delta in the north is expected to be exacerbated by land subsidence, sea-level rise (SLR), and magnified typhoons. Adaptation to severe erosion is expected to respond to regional circumstances and the demands of local residents. Based on the expectations outlined above, for soft adaptation, attempts were made to conduct perception surveys of local residents, in addition to field surveys of erosion at riverside and coastal areas using an un-crewed aerial vehicle (UAV). Furthermore, for hard adaptation, a proposal is made to conduct pilot field tests at the coast for reinforcing coastal dykes using the combined technique of locally available materials with cost-saving eco-geosynthetics in addition to application of ICT. This paper explains the possibility of

smart adaptation combining soft and hard adaptation to reduce severe coastal and riverine erosion in the Vietnamese deltas.

Nguyen, H. M., Fellenius, B.H., Puppala, A.J. Aravind, P., and Tran, Q.T. (paper No.3) introduce bidirectional static loading tests on two shaft-grouted barrette piles of the 40-storey Exim Bank Building in Ho Chi Minh City, Vietnam. Simulation of the measured load-movement response indicated that the shaft resistance response was hyperbolic. The test schedule was interrupted by unloading/reloading cycles, which disturbed the gage data and included uneven load-holding durations which exacerbated the analysis difficulty.

Pham Huy Giao and Ta Thi Thoang (paper No.4) have an excellent paper on soil characterization and land subsidence prediction for the first MRT line in HCM city to meet the transportation needs of a fast growing population and rapid urbanization. Being located in the Sai Gon-Dong Nai delta HCM city area has low elevations and is underlain by a sequence of clayey, silty and sandy soil layers. Land subsidence due to groundwater extraction had been suspected and observed in HCM city. In this study, geotechnical characterization of the subsoil along the first MRT line was carried out. Prediction of land subsidence along this MRT line was conducted using a FEM consolidation code.

Shiwakoti and Manai (paper No.5) examine the application of deep cement-mixing technique in improving engineering properties of soft grounds at nine different sites in southern Vietnam's typical soft soil deposits. The exercise consisted of running a series of laboratory tests on undisturbed soil samples and their mixes with cement and field trials, followed by field application of 500,000 m cement treated columns with 600mm diameter, using Dry Jet Mixing technique. After the field trials and applications, cores were extracted from the treated grounds to evaluate improvement in their engineering characteristics. Both the laboratory and the field results revealed a drastic enhancement in strength, stiffness, and permeability of the treated soft soils.

Over-consolidation ratio (OCR) is an important geotechnical parameter for predicting undrained shear strength, lateral pressure ratio and settlement of clayey ground. Piezocone studies were made by **Bui Truong Son, Le Hong Quang and Lam Ngoc Qui** (paper No.6). In Southern Vietnam, a thick layer of saturated soft clays distributes throughout all the area. It includes Mekong (in Ca Mau province) and Dong Nai (in HCMC and Vung Tau) alluvial deposits. Below the soft clayey layer, there is a layer of either stiff to very stiff clay or fine sand. Based on the reliable data of consolidation test results of samples taken by piston tube and piezocone, relationship between over-consolidation ratio and normalized penetration resistant is established and analysed.

Phan To Anh Vu (paper No.7) studied the ground improvement using soil-cement method: A case study with laboratory testing and in-situ verification for a Highway project in Southern Vietnam. This article presents the experimental unconfined compressive strength results of soil-cement columns to improve the soft soil gained by Tan Son Nhat-Binh Loi Outer Ring Road Project, located in Ho Chi Minh City, Vietnam. The laboratory test results revealed that the Stable Soil cement has a greater unconfined compressive strength than tower (60%) slag cement. In addition, cement-soil samples obtained from in-situ indicated that the target cement content of 240 kg/m3 was satisfied not only a required compressive

strength (>24 kgf/cm2) but also a low-cost. The obtained results are expected to provide an experience for further design and construction in Ho Chi Minh City and its vicinity.

Bengt Fellenius and Mauricio Ochoa (paper No.8) write on the use of piled foundations for wide storage tanks. The authors have analyzed five case records involving wide piled foundations and show that the foundation settlement can be modeled as a flexible raft placed at the pile toe level with the foundation load distributed according to Boussinesq stress distribution and that the capacity of an individual pile is not relevant to the foundation performance. Differential settlement between the perimeter and interior piles and the effect of drag force and downdrag are discussed. The limitation of drag force as affected by the pile spacing and the weight of the soil in between the interior piles is addressed.

Tran Thi Thu Hang and Frederic Dubois (paper No.9) deal with discrete modelling of excavation in fractured rock by NSCD method. The presence of the network of discontinuities on intact rock is a special feature of nature rock masses. Non Smooth Contact Dynamics method (NSCD) is a discrete numerical method that owns many strong advantages of the study on granular materials and has been used recently in rock engineering. LMGC90, open-sourced software built on NSCD, has demonstrated a robust capacity in the modelling and mechanical analysis of diverse environments, masonry and rock included. In this study, a numerical modelling of a multi-phase-excavation in fractured rock was realized. The simulation of the tunnelling with the consideration of the state of the excavation and its neighbouring rock blocks, during and after the excavation schedule, and at each excavation phase was conducted. The obtained mechanical behaviours of the model were analysed, and three failure mechanisms of the excavation vicinity during the tunnelling was aimed. The observed phenomena showed typical effects of two components of the rock mass (rock structure and rock material) to the stability of the excavation and the host rock mass.

Duong Diep Thuy, Pham Quang Hung, and Le Thiet Trung (paper No.10) studied the pile groups in Vietnam using a method for estimating the pile group settlement considering the distribution of pile shaft friction, called SDF. For illustrating the proposed method is used for a full scaled experimental model by Koizumi et al (1967), for a field model test by Phung (1993) and for two case histories in Vietnam, Ca Mau Fertilizer Plant, and Ecopark Tower 2. Comparison of the calculated settlements with the measurement results shows that the SDF method provided a good prediction for all the studied cases.

Nguyen Quang Tuan and H. Konietzky (paper No.11) deals with the mechanical behaviour of Hai Duong Medium dense sand in triaxial test and its simulation using DEM. Numerical simulations of the drained triaxial behaviour of medium sand, a typical constructional soil material and widely used in Northern Provinces of Vietnam, were performed using discrete element method (DEM). The sand was simulated based on spherical particles using PFC3D with a non-linear contact model including rolling resistance. The calibrated simulations show that the DEM model is able to capture the mechanical behaviour of sand. The effects of different microscopic parameters on the macroscopic behaviour of the sand were investigated.

Tran The Truyen, Nguyen Van Hung, and Tran N. Hoa (paper No.12) studied the influence of geometrical parameters of soil cement columns on the settlement of embankments on reinforced soft soil. Deep Mixing Method (DMM) is a widely used soft soil improvement method in the construction of road, port, and tunnel foundations, etc. Deep mixing of cement with soil and water, forming Soil Cement Columns (SCC) in situ, has been applied in many projects in Vietnam in recent years; it has proved many advantages compared with other applied methods in the site. At present, Vietnamese engineers are concerned with finding out recommendations for an optimal choice of SCC scheme. This paper analyzes the influence of main geometrical parameters of SCC including the length, the diameter, and the spacing on the behavior of reinforced soft soils in some construction projects in Vietnam. The results will be an important basis for recommendations on the choice of rational schemes of SCC for soft soil improvement in Vietnam.

Benson Hsiung, Dao Sy Dan and William Cheang (paper No.13) evaluated the performance of diaphragm walls by wall deflection paths for deep excavations in Central Hanoi. The objective of this paper is to evaluate the performance of diaphragm walls by wall deflection paths for deep excavations in Central Hanoi. PLAXIS 2D was used for 2D finite element analyses in this paper. A benchmark analysis was first conducted on the excavation to verify the validity of material models and their input parameters for predicting wall deflections. The reference envelopes of wall deflection paths were then delivered for various conditions of deep excavations in Central Hanoi. Considering the current prediction, up to 72 mm of the maximum lateral wall displacement was predicted for an excavation with a 21.9 m depth. Reference envelopes of excavations have been developed and discussed in various conditions of the excavation. It is found that the maximum lateral wall displacement at the first stage of excavation is roughly inversely proportional to the Young's moduli of soils. Changing the wall thickness leads to the limited difference in reference envelope at shallow excavation stages, but this may not be correct when the excavation goes deeper.

Hoang Hiep and Pham Huy Giao (paper No.14) studied the effect of vacuum pressure distribution on settlement analysis results for an improved thick soft clay deposit at Sai Gon-Hiep Phuoc terminal port, South of Vietnam. In this study an approach of settlement analysis using a FORTRAN code was proposed to successfully simulate the large consolidation settlement of a thick soft clay deposit, improved by combination of preloading, PVD and vacuum pressure for Sai Gon-Hiep Phuoc (SGHP) project. Geotechnical characterization of the subsoil profile underlying the project site was carefully done to provide input data for settlement analysis, in which a particular focus was given on studying the vacuum pressure distribution along the 35-m deep PVD. It was found that the coefficient of vacuum pressure distribution (kP) from 0.85 to 1.0 gave the best estimation of the time-dependent total primary settlement as embankment construction goes in addition to a smear effect RS= 3.0. The increasing trend of kP with time might be explained by the fact that for the later stages of loading the vacuum pressure could spread more to the depth.

Nguyen Thi Ngoc Huong and Trinh Minh Thu (paper No.15) studied the Characteristic of Unsaturated Soil of Earth Fill Dams in Vietnam. Earth dams in Vietnam, especially earth dams at the central part of Vietnam, are generally made using in-situ soils having low clay content. The knowledge, experience, calculation theory, apparatus etc, for unsaturated soils in Vietnam are still very limited, especially the

studies of the influences of the shear strength of unsaturated soils to the stability of earthen structures. Therefore, study on the soil-water characteristic curve, shear strength and coefficient of permeability versus different matric suction for Vietnamese soil is an urgent task. This study shows that when the matric suction in the soil changes, the effective cohesion c' would also change; however the internal friction angle is almost unchanged for some types of soil in Vietnam. The experimental results can be applied to study the effect of unsaturated soil to the factor of safety of the slope.

Finally paper by **Alain Guilloux and Hervé Le Bissonnais** (paper No.16) is on the management of settlements for urban tunnels. The TOULON highway tunnel is located in a very dense urban environment, and a much complex geology. The excavated section is about 120 m^2 and the depth is in the range 15-35 m. The aim of the paper is to show how a great attention was paid to the settlements control: at the design stage through soils investigations, survey of existing constructions in regards to their sensibility to tunnel induced settlement, definition of settlements thresholds, and choice of ground pre-reinforcement techniques; during the construction, by heavy monitoring of deformations and continuous adaptation of the supports to the actual settlements and buildings behaviour.

This issue contains sixteen papers which are related to the Vietnam soil conditions and contribute to the advancement of geotechnics, and are all written by the Vietnamese authors, about projects in Vietnam, or the topics that Vietnam are facing. It is hoped that the issue will demonstrate how the authors have made their studies geared in a manner useful to geotechnical engineers in Vietnam and elsewhere.

Phung Duc Long

ACKNOWLEDGEMENT

It is a genuine pleasure to note that this Issue contains sixteen excellent contributions as made by authors mostly from Vietnam in using modern developments in Geotechnics relevant and applicable to Vietnamese soil and rock conditions. They are mostly practical in nature and is an excellent example of how research be conducted useful to our geotechnical profession in practice. Dr. PHUNG Duc Long is the lead editor. His Vietnamese team included: Dr. Pham Van Long, Dr. Pham Huy Giao, Mr. Mai Trieu Quang, Dr. Nguyen Anh Minh, Dr. Vu Quang Hung, and Dr. Vu The Manh.

The Preface by Dr. Phung adequately covers the details of the contributions by the authors. Vietnam is an important arm of our AGSSEA and has developed enormously in the recent years with tall buildings, coastal structures, highways and expressways, airport developments etc. It is a paradise for geotechnical engineers. We are all most grateful to Dr. Phung and his team. This issue demonstrates the future of Geotechnics extend to all member countries of AGSSEA and beyond. The successful conferences and symposia organised by the Vietnamese Society for Soil Mechanics and Geotechnical Engineering (VSSMGE) is also worthy of praise.

K. Y. Yong

N . Phienwej

T. A. Ooi

A. S. Balasubramaniam

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GEOTECHNICAL ENGINEERING

March 2016: VIETNAM SPECIAL ISSUE

Editors: Dr. Phung Duc Long & San Shyan Lin

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Honouring Dr. Bengt Fellenius: Guest Editor: Dr. Phung Duc Long (Lead Editor), Prof. Der Wen Chang & Dr. T. Hosoi

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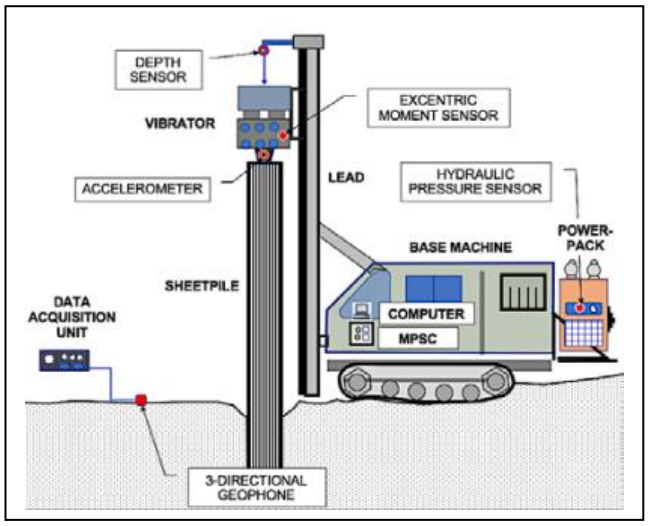

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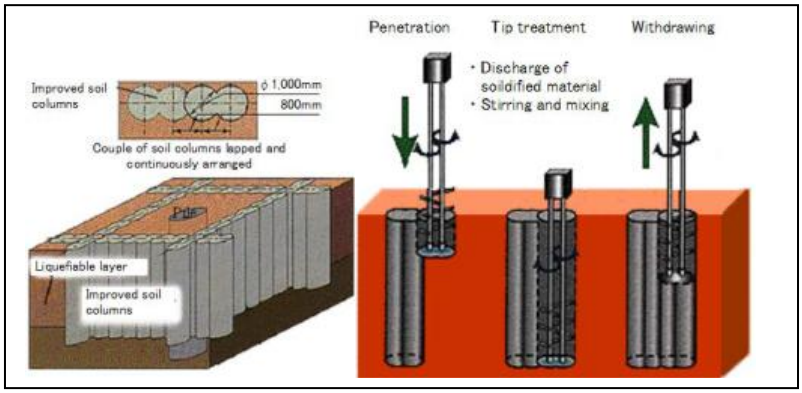

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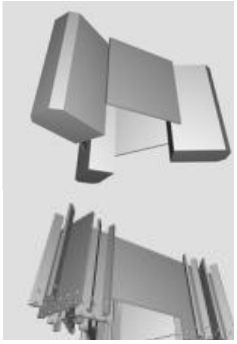

Left: Photo 1 Test nodular diaphragm wall having nodular parts and pile base enlargements
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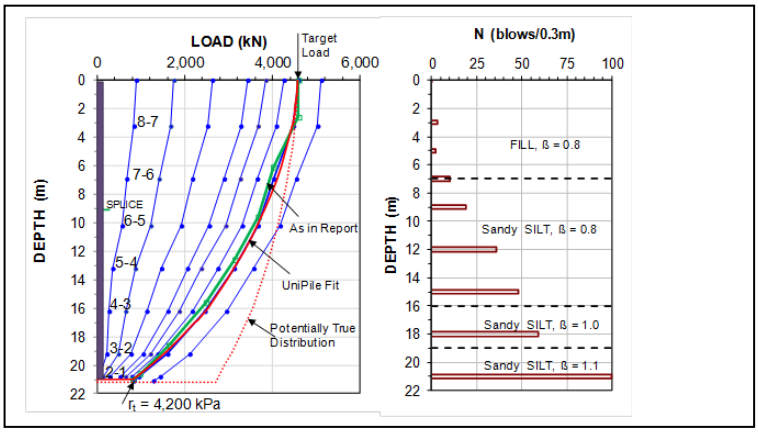
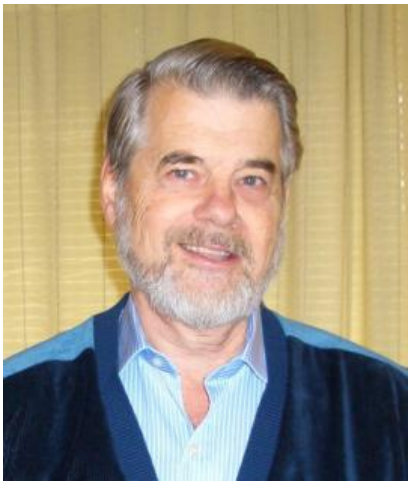
Load distribution deternied from strain vales



Honouring Dr Bengt Fellenius



Dr. Bengt H. Fellenius is a professional engineer specializing in foundation design and studies by participation in project teams, special investigations, instrumented field tests, etc. Services are also provided in regard to construction problems, claims, and litigation in collaboration with Consultants and Contractors, as well as Owners.

Dr. Fellenius, Professor of Civil Engineering at the University of Ottawa from 1979 through 1998, is an internationally recognized authority in the field of soil mechanics and foundation engineering, and, in particular, in deep foundations. He has gained a wealth of practical experience during more than 50 years of work at home and overseas through a variety of assignments that encompass foundation, embankment, and soil improvement design for water and sewage treatment plants, industrial plants, as well as bridges, highway, and airport projects, and marine structures and urban area development projects; some of which he has written up in 300+ technical journal and conference papers, articles, books, and book chapters. Copies of many of the papers are available for downloading from Dr. Fellenius' web site: [www.Fellenius.net]

Dr. Fellenius moved from his native Sweden to Canada in 1972 where he worked on foundation investigations and design and construction projects in North America and overseas. In 1973, he was one of the first to apply geotextile soil separation sheets to stabilize roadbeds and construction surfaces, investigating conventional carpet underlay (Celanese) for this purpose. He was active in promoting to the US market the splicing of prestressed concrete piles by means of mechanical full-strength splices, and he introduced to Canada and the USA ground improvement applications of lime column method for reducing soil compressibility and wick drains (the Geodrain and Alidrain) for accelerating consolidation and stabilizing landslides. He was one of the earliest (1977) to research and use dynamic testing and the Pile Driving Analyzer in actual project design and construction.

In 1984 he introduced the Janbu method of determining soil compressibility and analysis of settlement. He has also had a fundamental part of the development of commercial software for analysis of settlement from loads on natural soils and soils subjected to soil improvement methods, design of piled foundations, and other software. In 1984, he published the design and analysis method for foundation design known as the “Unified Method of Design for Capacity, Drag Force, Settlement, and Downdrag”.

Dr. Fellenius is and has been an active participant in many national and international professional societies and research associations and in Canadian and US Codes and Standards Development. For example, Member of the subcommittee for the American Society for Testing and Materials D-4945 Standard for High-Strain Dynamic Testing of Piles; Chairman of the Canadian Geotechnical Society, CGS, Technical Committee on Foundations writing the

1985 Canadian Foundation Engineering Manual; Member of the Ministry of Transportation Committee for the Development of the 1983 and 1992 Ontario Bridge Design Code; Author of three Public Works Canada publications: Marine Division Master Specifications for Piling, Pile Design Guidelines, and Hammer Selection Guide; Past Overseas Correspondent Member to the Geotechnical Engineering Advisory Panel of the Institution of Civil Engineers, ICE (London); and Past Member of Editorial Board for the ASCE Geotechnical Engineering Journal.
Dr. Fellenius has given lectures and courses to several universities and been invited lecturer at international conferences throughout Europe, the Americas, and South-east Asia.

Guest Editors: Dr. Phung Duc Long

Dr. Phung is President of the Vietnamese Society for Soil Mechanics and Geotechnical Engineering (VSSMGE). He received his Ph.D. degree at the Geotechnical Department, Chalmers University of Technology in Gothenburg, Sweden in 1993. He has worked at the Institute for Building Science & Technology (IBST) in Hanoi, Vietnam from 1975 to 1988; at the Swedish Geotechnical Institute (SGI) in Linköping, Sweden from 1988 to 1994; at Chalmers University of Technology from 1989 to 1993, at Skanska Sweden as Technical Manager from 1994 to 2002; at WSP Asia in Hong Kong as Associate Director from 2002-2003; at WSP Vietnam in Hanoi as General Director from 2003-2011; and at Long GeoDesign as Director since 2011.

Dr. Phung has 40 years of international experience. His expertise areas are: deep foundations and piled raft foundations for high-rise buildings, temporary and permanent support for deep excavations, tunneling, soil improvement, underpinning, pile dynamics, and numerical analysis of soil-structure interaction problems. He has worked with projects in many countries, as Sweden, Norway, Denmark, USA, England, Russia, Germany, India, Hong Kong, China and Vietnam, etc. Some of his highlight projects are: Uni-Storebrand Headquarter in Oslo with steel-core piles into rock; SL-10 South Link in Stockholm with sheet pile wall for deep cut & cover tunnel in soft clay; Fredriksberg Metro Station in Copenhagen, the world largest drilled-pile wall for deep excavation; soil stabilization with lime-cement columns for Highway I15, Salt Lake City, Utah, USA; Öresund Link between Sweden and Denmark; Årsta Bridge in Stockholm with pile foundations and sheet pile walls in deep water and soft clay; the peer-review of piled foundation for the ICC Tower, 118 floors, 490m high in Hong Kong, the No. 4 tallest high-rise in the world, and the Sailing Tower in Ho Chi Minh City, Vietnam. He is the author and co-author of more than 100 technical papers and books in English, Swedish and Vietnamese for different national, regional and international seminars, conferences, and technical journals. He is the chief editor of a number of publications, as the proceeding of the international conferences Geotec Hanoi 2011, and Geotec Hanoi 2013.

Prof. Der Wen Chang

Prof. Der-Wen Chang teaches at The Department of Civil Engineering of Tamkang University (TKU), Taipei, Taiwan for over 19 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 60 Master Thesis and 3 Ph.D. Thesis at TKU, and published more than 160 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. 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 now serving as the Secretary General of Chinese Taipei Geotechnical Society, GC member of SEAGS, Editorial Panel for SEAGS/AGSSEA J. of Geotechnical Engineering, Committee members for Public Construction and Hazard Prevention in Taipei City and Taipei County governments. He will continue to work in the academia and hoping that his studies can better improve the civil engr. technologies.

Preface

There are ifteenseventeen peer reviewed papers in this Issue of the journal honoring Dr Bengt Fellenius. The guest editors are Dr Phung Duc Long & Prof Der Wen Chang .

The first paper is K. R. Massasch and C. Wersäll Monitoring and Process Control of Vibratory Driving: Vibrators are used increasingly in the foundation industry, primarily for installation of piles and sheet piles, but also for deep vibratory compaction. Fundamentals of vibratory driving are described that make it possible to choose vibrator performance parameters based on field monitoring and performance control. Variable frequency and amplitude vibrators have become available that make it possible to adapt the driving process to project-specific requirements. The components of modern electronic measuring systems are detailed that can be used to monitor, control, and document different aspects of vibratory driving. Two examples are presented—vibratory driving of sheet piles and resonance compaction—which show how the performance of vibrators and sheet piles can be analysed and adapted to meet specific requirements. By using the advanced monitoring and process control systems, the efficiency of vibratory driving is enhanced. From the retrieved parameters, a better understanding of the vibratory driving process is gained, which can be used to develop a valuable database

The second paper is on Load-movement response by t-z and q-z functions by Mohammad Manzur Rahman and Bengt H. Fellenius: A static loading test provides more than a "capacity", its primary use is to show the load-movement response of the pile-and-soil system in order to assist in analysis of the transfer of a supported load to the soil. A pile is an axial unit composed of a series of short lengths (elements) that are affected by shaft shear or toe stress, expressed as a relation of stress (load) versus movement for the element. The analysis of the load-transfer must consider the development of shaft shear and toe resistances as a function of movement for a pile shaft or toe element, expressed in a load-transfer function commonly called t-z and q-z function. The conditions of the soil around a pile determines the response of the elements making up a pile. Inasmuch soil layering usually varies along a pile, the t-z function modeling the response of an element will differ along a pile. The response of a pile head, that is, the actual pile load-movement curve, is the sum of the response of the individual pile elements. Fitting the theoretical load-movement response to actual test results by trial-and-error applying a series of shaft (t-z) functions and a toe (q-z) function, enables a calibration of a pile and site that serves to establish the load-transfer conditions of a piled foundation at the site needed for determining what short and long-term settlement the foundation will experience. This, a crude "capacity" assessment will not do. Eight functions for modeling strain-hardening and strain-softening response are presented in the paper and their use in fitting theoretical to actual results is illustrated.

The third paper on Common mistakes in static loading test procedure and result analysis is by Bengt H. Fellenius and Ba N. Nguyen: Static loading tests on piles are arranged in many different ways ranging from quick tests to slow test, from constant-rate-of-penetration to maintained load, from straight loading to cyclic loading, to mention just a few basic differences. Frequently, the testing schedule includes variations of the size of the load increments and duration of load-holding, and occasional unloading-reloading events ("cycles"). The development and reduced costs of instrumentation over the past decades have enabled also routine tests to be enhanced with instrumentation for measuring load-induced axial strain in a test pile. The strains are converted to load by multiplication with the pile axial stiffness, EA. Both the modulus, E, and the pile area, A, are often uncertain values. In contrast to steel, E-modulus for a concrete pile is strain and stress dependent and, moreover, it can differ considerable from one pile to the next, especially so for cast-in-situ piles. In a bored pile (cast-in-situ pile), the actual pile size can differ from the nominal by 50 % or more, usually, the actual size is larger than the nominal. However, if the analysis is directed to determining and applying the pile stiffness directly, the uncertainty and inaccuracy can be offset, provided that proper test procedure is stringently adhered to. Unfortunately, instrumenting test piles and performing the test while still using unequal size of load increments, duration of load-holding, and adding unloading-reloading events will adversely affect the means for determine reliable results from the instrumentation records. A couple of case histories are presented to show difficulties arising from improper procedures involving unequal load increments, different load-holding durations, and unloading and reloading events—indeed, to demonstrate how not to do.

The fourth paper on stiffening effect on end bering granular pilesis by M. R. Madhav ,A. Vaibhaw Garg, B. Jitendra Kumar Sharma: Among the various economic options available for ground improvement the use of granular piles (GP),

composed of compacted gravel, sand or mixture of both, is the most preferred choice. The performance of these GP is limited by low strength and stiffness of the soil near the ground surface. If GPs are partially strengthened and stiffened near the ground surface their overall performance gets enhanced several fold. Stiffening of GP can be achieved by replacing partially the upper portion of GPs with material having higher strength and deformation modulus, e.g. by geosynthetic encased columns, SDCM (stiffened deep cement mixing), etc. Analyses of a single and group of two partially stiffened end bearing GPs is presented in this paper. Results in terms of top settlement influence factor, settlement interaction factor for two-pile group, settlement reduction factor, percentage load transferred to the base, variation of normalized shear stress distribution along the length of the pile are presented. Settlement influence factor decreases while the percentage load transferred to the base of increases with increase in the relative stiffness factor and the relative length of stiffening from top of the partially stiffened GP, both for single as well as for two pile group.

The fifth paper is Long-term behavior of piled raft with grid-form deep mixing walls on reclaimed ground by K. Yamashita ,A. Uchida and T. Tanikawa: This paper offers a case history of a friction piled raft, supporting a four-story parking garage on reclaimed land. The subsoil consists of filled sand and alluvial loose sand which have the potential for liquefaction. Hence, grid-form cement deep mixing walls were employed as a countermeasure of liquefaction with the piled raft. Below the sand layers, there are very-soft to medium alluvial clay layers, which are normally consolidated or under-consolidated, and the depth of the dense sand layer changes markedly near the center of the site. To reduce the differential settlement due to consolidation of the clay, 152 friction piles of different length were employed. To confirm the validity of the foundation design, field monitoring on the foundation settlement and the load sharing between the piles and the raft was performed. The measured settlements and the maximum angular rotation of the raft about 12 years after the end of the construction were less than an acceptable value. Furthermore, at the time of the 2011 off the Pacific coast of Tohoku Earthquake, no significant change in effective contact pressure between the raft and the unimproved sand was observed after the event, which confirms that the effectiveness of the grid-form DMWs as a countermeasure of liquefaction.

The sixth paper is by Koji WATANABE and Toshimi. SUDO on In-situ Full Scale Load Tests and Estimation Method of Pile Resistance for Nodular Diaphragm Wall Supporting High-rise Tower: In recent years, the height and weight of buildings have increased. This trend is noticeable especially in the urban central areas of Japan. Both tension force and compression force occur in foundation such as pile foundations or wall foundations because of the overturning moments from earthquake and wind loads. Because of these situations, it is necessary to develop new types of foundations for high-rise superstructures. The nodular diaphragm wall is a new type of foundation with a nodular part at the middle section of the wall foundation. The purpose of this study was to evaluate the application of the nodular diaphragm wall for the high-rise tower. This paper firstly reviews foundations similar to the nodular diaphragm wall, secondly describes the outline of the high-rise tower, then presents the tension and compression load tests, and finally discusses the design formula for the nodular diaphragm wall.

The seventh paper is on Three-dimensional Finite Element Analyses of Barrette Piles under
Compression and Uplift Loads with Field Data Assessments by D.W. Chang, C. Lin, T. Wang, Y.K. Lin, F.C. Lu and C.J. Kuo: This paper presents the three-dimensional finite element modeling of barrette piles in clayey and sandy soils in which the piles are subjected to statically compressive and uplift loads. Load displacement curves and load transfers were monitored and compared to the solutions from one-dimensional finite difference analysis. Capacities of the barrette piles were examined by interpretation methods and bearing capacity equations. Pile load test data of the barrette piles located in Xingyi District at Taipei Basin was simulated. It was found that the conventional bearing capacity equations are applicable to barrette pile. The interface elements between pile and soils were found significantly affecting the results. Finite element analysis can provide more complete solutions rather than finite difference analysis. It is also found that the soil frictions of uplift pile in soft clays at Taipei Basin were underestimated with the commonly reduced strength ratios.

The eighth paper is on CPT-CPTU and Pile loading test record by: Abolfazl Eslami, Sara Moshfeghi: Measurements are a primary source of acquiring information in geotechnical engineering. In recent decades, cone and piezocone penetration tests (CPT and CPTu) are more favoured due to rapid performance, accuracy and providing continuous records with depth. The cone penetrometer can be considered as a model pile. This is chiefly more pronounced where soft to medium deposits are encountered. Due to uncertainties in geomaterial properties and modelling, a detailed and precise data source can significantly improve reliability indices. Accordingly, to facilitate quantifying the uncertainties, there are currently several databases in the realm of piling and CPT. AUT (Amirkabir University of Technology):

Geo-CPT&Pile Database was initially developed in 2015 by 466 case records including pile and CPT records. At present, it is updated to the total number of 600 case records which are partly accessible online.

Aiming at pile performance-based design, risk analyses and evaluation of optimum safety factor have been examined based on value engineering by Wasted Capacity Index (WCI). Subsequently, the performance of direct CPT methods for pile bearing capacity estimation have been assessed focusing on reliability-based approaches. In addition, a methodology was employed to predict the load-displacement and bearing capacity of driven piles interactively. Finally, an algorithm is implemented for pile geotechnical performance-based design through a selected database considering probabilistic, reliability and risk assessments.

The nineth paper is on Bidirectional Loading Tests on Grouted and Not-Grouted Bored Piles in Vietnam By Hai M. Nguyen, Anand J. Puppala, Long D. Phung and Trung T. Nguyen: In recent years, the post shaft-grouting technique has been used prevailingly for improving the drilled shaft bearing capacity of the high-rise building foundation projects in Mekong River basin of Vietnam. However, the effectiveness of the post shaft-grouting works for the drilled shafts is rarely obtained as expected. This paper will present the bidirectional load test results on the non-grouted and grouted shafts of the Lancaster Lincoln high-rise building project in Ho Chi Minh City, Vietnam. The test shafts had diameter of 1.5 m and were constructed to a depth of 85.0 m below ground surface. The shaft grouting was performed for about 49 m above the drilled shaft toe level. The bidirectional load test results and the analysis shows that the unit shaft resistances of the sand and clay layers were increased about 150 and 300 percent after grouting, respectively.

10: The tenth paper is on Design of axially-loaded piles: experimental evidence from 400 field tests : by Alessandro Mandolini & Raffaele Di Laora: This work is aimed at furnishing an experimental support to the design of axially-loaded piles, taking advantage of an extensive database of pile load tests carried out in different sites nearby Napoli, in South Italy. Experimental data consist of nearly 400 full-scale pile load tests, some of them reaching large values of settlement. Different technologies, including Non-Displacement, CFA and Displacement piles, have been used. The main results of the work consist in furnishing experimentally-derived rules and indications for pile design. With regards to failure loads, mobilization curves relating properly normalized values of load and settlement are proposed as function of the installation technology; indications on the bearing capacity of piles as function of geometry and technology are also provided. Initial stiffness of piles is investigated, identifying a rule of thumb for a rapid assessment, function solely of pile diameter and valid regardless of length and specific properties of pile and soil material.

The eleventh paper is on The use of equivalent circular piles to model the behaviour of rectangular barrette foundations By H.G. Poulos, H.S.W. Chow and J.C. Small: Analysis of barrettes having rectangular cross-sections can be performed using finite element analysis, but this requires a three-dimensional non-linear computation which can be time consuming. Therefore, in this paper, the use of simple means of analysis based on conventional piles of circular cross-section is examined. Equivalent dimensions are chosen for the circular piles to represent the barrette, and the behaviour of the piles is compared to finite element results for the barrettes. It is shown that for single barrettes and groups of barrettes under either vertical or lateral load, it is possible to model barrette behaviour using equivalent circular piles under most circumstances.

The twelfth paper is on Analysis of thermo-mechanical behaviour of energy piles byG. Russo, R.M.S. Maioranoand G. Marone: The use of pile foundations as heat exchangers in combination with heat pump conditioning systems are becoming increasingly popular. Quite a large number of small scale laboratory tests and field scale experiments are available and allow to gain an insight in the mechanisms governing pile-soil interaction under thermo-mechanical loading. In the paper numerical FEM simulations are carried out on published experimental small scale laboratory tests. The paper focus is on the load-settlement relationship and on the load-transfer curves with depth. The tests show that under purely cyclic thermal loading reversible strains are predominant, while the preliminary application of an axial load causes the development of irreversible deformations during the thermal loading. Numerical FEM simulations carried out with two different constitutive soil models confirm such a finding. A simple procedure to calibrate the model's parameters is proposed and validated.

The thirteenth paper is on A Method to Estimate Shaft and Base Responses of a Pile from Pile Load Test Results by Madhav Madhiraand Kota Vijay Kiran: Using hyperbolic relationships for the non-linear responses of shaft and base resistances, a method is proposed for estimating initial shaft and base stiffnesses and ultimate shaft and base resistances of a pile from pile load test results. An iterative procedure is used to arrive at the values of the above

parameters. The method is applied to some load - displacement data available from pile load test results to illustrate its efficacy.

The fourteenth paper is on Technical Issues on Static Load Tests for Bored Pile and Diaphragm Foundation By K. Watanabe , T. Hosoi, S. Matsushita, Richard Hwang and A. S. Balasubramaniam: Recent challenges in diaphragm wall and bored pile technologies are highlighted and a review of the technical level is reviewed is conducted whether they meet the technical requirement and demand. The following technologies are discussed : 1) Slurry effect on bearing capacity such as alternative slurry fluids-polymer slurry, friction resistance from laboratory test, mechanism of forming cake, influence of mixed soil in the slurry on the formation of cake against sand layer, thickness of cake by API test and Importance of slurry management, 2) Shape effect of test pile on bearing capacity such as circular pipe and rectangular pile, non-uniform shaft pile (Nodular pile) and enlarge base pile, 3) Elastic modulus such as and elastic modulus of cast-in place concrete pile and elastic modulus on tension load test.

The fifteenth paper is on piled raft on sandy soil-an extensive study by
V. Balakumar, Min Huang, Erwin Oh ,A. S. Balasubramaniam and Richard Hwang : The selection of foundation system for heavily loaded structures like storage tanks and tall buildings hitherto had been getting guided by two main factors namely the risk of bearing capacity failure of the foundation systems or the probability of settlement under the applied load exceeding the permissible value. The traditional design in such cases had always been deep piles without any discrimination between the above two conditions. Such an approach does not recognise the presence of raft covering them or its capacity to transfer the load to the supporting soil even under a favourable condition with a reasonable bearing capacity. Under such conditions the number of piles is governed by the geometry of the foundation rather than the loading requirement. This results in an uneconomical design leading to a very high factor of safety which cannot be justified from a common engineering point of view when settlement alone has to be restricted. The combined piled raft foundation system distinguishes itself from the tradition based pile group design in recognising the presence of raft and its capability to transfer part of the load to the ground.

Extensive research by authors like Yamashita et al (2010), Katzenbach (2000), Clancy and Randolph (1993), Poulos (2008) has helped the concept of piled raft cross many milestones. However work considering strata which is predominantly sandy appears to be scarce, as many of the works done consider the bed as over consolidated clay. Hence the study on the behaviour of piled raft with raft placed on predominantly sandy strata gains considerable importance. Keeping this in mind, extensive analytical work has been done by the above research group considering the soil profiles from various sites in the Gold Coast and Surfers paradise area (Balasubramaniam etal., 2008).This paper presents and discusses the results obtained from such a comprehensive study including a method to obtain a probable limiting capacity of the piled raft and a design method along with a comparative study on the analyses using 2D and 3D analyses. The effect of any intermediary compressible layer like peat on the pile group behaviour is also discussed in brief. Further the behaviour pattern and the dependence of load sharing by the pile group with reference to the settlement reduction level required which form the input data for the pile group design are also outlined based on a detailed small scale 1g model tests on model piled raft, an observational study conducted on a real time piled raft and their numerical analyses.

The sixteenth paper is by Phung Duc Long and B. William Cheang on Finite element modelling of a bidirectional pile test in Vietnam: Static loading test on single piles for verification is commonly required, yet very expensive and difficult to perform, especially for the large-diameter bored piles. The bidirectional test, also-called Osterberg cell test, is nowadays very common in Vietnam. The Finite Element Method (FEM), which is a reliable tool for simulating loading tests, can also be used to model a bi-directional pile test. In this paper, FEM is used for modelling a bidirectional test on a 2.5m-diameter, 80m long bored pile at the Cao Lanh cable-stayed bridge in the Mekong Delta, Vietnam. The FEM results are compared with the monitored data obtained from the bi-directional test. The comparison showed that FEM can be an effective and reliable tool in this case. The FEM is performed using PLAXIS 2D.

The seventeenth paper titled a FEM assessment on the use of t-z and q-z functions for deep foundations is by

Q. J. Ong and S. A. Tan: Load-movement t-z and q-z functions have been established and widely accepted as a tool to characterise pile shaft and toe resistances. The functions are best used to represent a short element along the pile. But the question remains whether these functions are dependent on pile diameter and pile depth. This paper discusses the soil-structure interaction and load transfer mechanisms of a single pile and reviews why the t-z and q-z functions have strong theoretical basis. Linear elastic and Mohr-Coulomb soils are used for this study to investigate normalized stress-strain curves for pile behaviour.

Phung Duc Long, Der Wen Chang & T Hosoi

ACKNOWLEDGEMENTS

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

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

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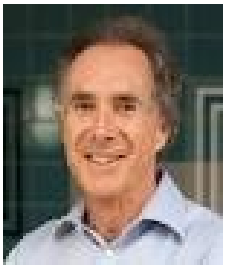
Geotech Hanoi 2019

Dr Long & Late Sven Hansbo



Harry G Poulos, Mark Randolph, Masaki Kitazume, Fredlund et al Guest Lecturers in Geotec Hanoi 2019(Others as well)

Honorary Guest Editor: Long et al

The series of International Conference on Geotechnics for Sustainable Infrastructure Development (GEOTEC HANOI) was organized successfully in 2011, 2013 and 2016 in Hanoi and it has become a well-known event not only in Vietnam but also internationally for its excellent quality and organizational scale.

Following the success of the three previous events, the 4th International conference, GEOTEC HANOI 2019 (GH2019) will be organized by FECON Corporation, the Vietnamese Society for Soil Mechanics and Geotechnical Engineering (VSSMGE), the Thuyloi University (TLU), and Kokusai Kogyo Co., Ltd (KKC) on November 28-29, 2019 at the National Convention Center, Hanoi, Vietnam. GEOTEC HANOI 2019 will be honorably patronized by the International Society for Soil Mechanics and Geotechnical Engineering (ISSMGE) and Japan International Cooperation Agency (JICA).

1: Contributing Authors: Partial List

Harry G. Poulos

Professor of Geotechnical Engineering and Soil Mechanics at University of Sydney, Australia.

As an expert on soil behaviour and pile foundations, Prof. Harry G. Poulos has had enormous academic research contributions to the behaviour of piles. He has been involved worldwide in various basic construction projects, such as pile foundations for skyscrapers in Dubai (Burj Al Arab, Emirates Towers, the Burj Dubai, the tallest skyscraper in the world, where he performed the geotechnical testing), the Docklands Project in Melbourne, or 700 km Egnatia Odos motorway straight through Greece (2001 to 2005), where in particular the earthquakes played a role. Other projects included consultations with various offshore structures such as oil rigs.

Adam Bezuijen

Professor of soil mechanics and geotechnics at Ghent University, Belgium and part-time senior specialist at Deltares, Delft, the Netherlands.

Pro. Adam Bezuijen was involved in research on revetments, dredging, tunnelling, geotextiles and model testing and was the scientific coordinator of the geotechnical centrifuge of Deltares. As a professor in Ghent, he guides PhD and Post-doc research on tunnelling, piled embankments, geotextile reinforcement, polymer treated bentonite and backward erosion piping. He is chair of the ISSMGE technical committee TC204 "Underground Construction in Soft Ground" and member of TC104 "Physical Model Testing."

Masaki Kitazume

Professor of Department of Civil and Environmental Engineering at Tokyo Institute of Technology, Japan.

Prof. Masaki Kitazume has over 40 years of experience on soil stabilization, ground improvement and foundation engineering. He was involved in many land reclamation and ground improvement projects in Japan and also invited as a technical committee member of several overseas construction projects. He has published many papers, mainly on the geotechnical aspects of soil stabilization, ground improvement and centrifuge model test-ing. He also published three books from Balkema Publishers and Taylor & Francis, on Deep Mixing Method, Sand Compaction Pile Method and Pneumatic Flow Mixing Method.

Delwyn G. Fredlund

Prefessor and Head of the Golder Unsaturated Soils Group, Canada

Professor Delwyn G. Fredlund has spent more than 40 years conducting research into the behavior of unsaturated and expansive soils. Prof. Delwyn G. Fredlund has undertaken international programs of collaboration with countries such as China, Africa, and Vietnam. He is the author of several books related to soil mechanics such as Soil Mechanics for Unsaturated Soils (1993), Unsaturated Soil Mechanics in Engineering Practice (2012)… He is also a recipient of the Order of Canada and is a member of the Canadian Academy of Engineering.

Lidija Zdravkovic

Professor of Computational Gemechanics and Head of the Geotechnics Division at Imperial College London, UK

Pro. Lidija Zdravkovic has led and managed several research projects in collaboration with industry and other academic groups, focusing on the development and application of numerical methods in geotechnical design and providing solutions to a wide range of geotechnical problems, including renewable energy, nuclear waste disposal and infrastructure resilience. She has authored and co-authored over 150 technical publications and received prizes from the Institution of Civil Engineers and the British Geotechnical Association, UK. Pro. Lidija Zdravkovic is active in the profession, advising on recent projects involving Heathrow Terminal 5 development, Crossrail excavations, offshore foundations and embankments and cut slopes on the High Speed Rail route in the UK.

Mark Randolph

Professor of Civil Engineering in the Centre for Offshore Foundation Systems, the University of Western, Australia.

The research of Prof. Mark Randolph interests range broadly across foundation engineering, with particular focus on pile foundations, and offshore geotechnics. He has co-authored two books, including "Piling Engineering" and the more recent "Offshore Geotechnical Engineering", and over 250 journal articles. He interacts closely with industry, both in research and through his role as Technical Advisor within Fugro AG. He is a Fellow of several learned academies including the Royal Society in the UK, was elected Western Australian Scientist of the Year in 2013 and was granted an honorary doctorate from ETH, Zurich in 2015.

2: Overlapping Timelines (Tentative-subject to change depending on progress)

The organizing committee of GEOTEC HANOI 2019 would like to thank very much for your interesting abstracts submitted to the conference. 270 abstracta are now received from around the world and are now in the process of receiving full papers. Each full paper will carefully be reviewed by 02 peer reviewers and the accepted full papers will be published as an E-proceedings in a series of **Lecture Notes in Civil Engineering** of Springer, which is **indexed in Scopus**.

The organizing committee would very much like you to note the following deadlines for full paper submission.

- **August 1, 2019**: Deadline for submitting full papers of accepted abstracts
- **September 1, 2019**: Deadline for submitting final version of accepted full papers.

For your full paper preparation, please use the full paper template, which can be downloaded at:
https://geotechn.vn/paper-submission/#paper-submission-fullpaper
Thank you very much for your valuable contribution to the conference.
We look forward to receiving your full papers soon.
Best regards
The organizing committee

In line with the above deadlines

3: Review of Papers: Jan –July 2020

2: Tentative Release of Issue : End of 2021- Mid 2022

GEOTECHNICAL ENGINEERING

PREFACE

Will be assembled once the papers are received

ACKNOWLEDGEMENT

Fourteen 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
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Prof. Kwet Yew Yong
Dr. Noppadol Phienwej
Prof. A. S. Balasubramaniam

GEOTECHNICAL ENGINEERING

March 1922 SEAGS – Geotec Hanoi 2019

Editors: Dr Long