Volume 41 Number 2 JUNE 2010 ISSN 0046-5828

GEOTECHNICAL

ENGINEERING

Journal of the

SOUTHEAST ASIAN GEOTECHNICAL SOCIETY

&

ASSOCIATION OF GEOTECHNICAL SOCIETIES IN SOUTHEAST ASIA

AGSSEA

Sponsored by

ASIAN INSTITUTE OF TECHNOLOGY

Volume 41 **Number 2** **JUNE 2010** **ISSN 0046-5828**

GEOTECHNICAL ENGINEERING

Published by the:

SOUTHEAST ASIAN GEOTECHNICAL SOCIETY &
ASSOCIATION OF GEOTECHNICAL SOCIETIES IN SOUTHEAST ASIA

The Secretariat, SEAGS
Room 211, AIT Library
Asian Institute of Technology
P.O. Box 4, Klong Luang
Pathumthani 12120, Thailand

Website: hiip://www.seags.ait.ac.th

Volume 41 Number 2 JUNE 2010 ISSN 0046-5828

GEOTECHNICAL ENGINEERING

AGSSEA COUNCIL SESSION 2010 - 2013

Ir. Kenny Yee
Hon. Secretary General
Association of Geotechnical Societies in Southeast Asia
c/o Menard Geosystems Sdn Bhd
No. 15-2 Jalan USJ 10/1E
47620 Subang Jaya, Selangor, MALAYSIA
Tel: (60) 03 5632 1581
Fax: (60) 03 5632 1582
E-mail: kenny@menard-asia.com

IEM Training Centre Sdn. Bhd.
No. 33-1A, Jalan SS 52/18
P.O. Box 224 (Jalan Sultan)
46200 Petaling Jaya, SelangorDarul Ehsan, MALAYSIA
Tel: (60) 03 7958 6851
Fax: (60) 03 79582851
E-mail: choy.iemtc@gmail.com

Volume 41 Number 2 JUNE 2010 ISSN 0046-5828

GEOTECHNICAL ENGINEERING

CONTENTS

Main Papers:

Cover Photograph: Landslide at Expressway, Keelung-Shihchi in Northern Taiwan on April 25, 2010. Four people were reported killed by the massive landslide. Photo Courtesy of Air Patrol, NPA, Taiwan

Volume 41 Number 2 JUNE 2010 ISSN 0046-5828

GEOTECHNICAL ENGINEERING

EDITORIAL PANEL

Volume 41 Number 2 JUNE 2010 ISSN 0046-5828

GEOTECHNICAL ENGINEERING

EDITORIAL TEAM

Volume 41 Number 2 JUNE 2010 ISSN 0046-5828

GEOTECHNICAL ENGINEERING

(a)Selected Contributions from 2010 Issues

(1) The March 2010 issue of the journal contains three important contributions. The first one is the paper by Jamiolkowski, Carrier, Chandler, Hoeg, Swierczynski and Wolski presented as the Za Chieh Moh Lecture recently in Taipei. This excellent paper is on the geotechnical problems and the investigation associated with the design and construction of the Europe's largest copper tailings disposal facility at Zelazny in South-west Poland. In this paper Jamiolkowski et al emphasized that a thorough study of the local geology is essential for the selection of an appropriate site in locating a large tailing disposal facility. Insufficient site investigation works can result in jeopardising the safety of the tailings disposal. Secondly, the paper illustrates the value of the good characterization engineering properties of the foundation soils and the tailing materials. Thus the selection of the most important laboratory and field testing methods is most vital in characterizing the stress-strain –strength behaviour of the geomaterials involved in this important project. Prof. Jamiolkowski concluded that given the extended period of time over which the tailings disposal work has been developed and will continue to function in the future, the use of an observational method is the best approach to follow with extensive instrumentation in ensuring the safety of the tailing dam. Tailing disposal has become the most important and rapidly growing geotechnical activity as every year, the mining industry processes hundreds of millions of tonnes of earth and rock to extract the industrial construction and energy minerals which are the foundation requirements of our modern technological civilization emphasized Prof. Jamiolkowski. Prof. Jamiolkowski is the Emeritus Professor at the Technical University of Torino and a past-President of ISSMGE. The co-author Carrier is one of the most active consultants in USA. The other co-author Prof. Chandler is a well known Professor at Imperial College London in Engineering Geology and Geotechnical Engineering. The paper is also co-authored by Prof. Kaare Hoeg, a former Director of NGI and a past_President of ICOLD. Prof. Wolski is an old hand in Geotechnics and a well known Professor in Poland. Mr. Swierczynski is with KGHM in Poland.

(2) Dr. Dennis Becker from Golder Associates is the Author of the second paper on Testing in Geotechnical Design. In his paper, Dennis emphasised that testing is an integral part of the geotechnical design and should not be viewed as a separate entity in isolation from analysis and design. He then described the Geotechnical Circle concept as a useful framework that provides a useful framework which provides the much needed linkage between the various components of geotechnical design and captures its iterative nature. Readers of the journal would also be familiar with the famous Geotechnical Triangle of Professor John Burland. Dennis also stressed that adequate planning and working within a consistent framework such as the CSSM concepts enhance the development of meaningful testing programs and the assessment and interrogation of the results. The design and implement of successful testing programs require a thorough understanding and knowledge of the factors that control or significantly affect the engineering properties write Dr. Dennis Becker; also knowledge of the limitations of each type of test. Dennis then goes on to discuss the values and limitations of the various empirical correlations available to practitioners. In his excellent paper Dennis writes, "Correlations used or developed should be based on suitable theoretical considerations and a physical appreciation and understanding of the expected behaviour and why the properties can be expected to be related". The use of formal statistical methods and reliability theory to analyse, interrogate and integrate test results is recommended by Dennis. Geotechnical testing is also valued as a key integral part of achieving design improvement, design efficiencies and verifying performance of geotechnical structures and geo-structural components. The role of physical modelling tests under 1g and multiple g conditions in the centrifuge is also greatly valued by Dennis in providing insightful and beneficial results to projects if their limitations are understood and the results used to compliment those obtained from analytical and numerical modelling. The knowledge from physical, analytical and numerical modelling when used in a combine manner, not only assist in refining the analysis and design but also helps to have an improved understanding of soil-structure interaction and failure mechanisms.

(3) The third article in our March issue is by Prof. Ueng from National Taiwan University on Shaking Table Tests for Studies on Soil Liquefaction and Soil-Pile Interaction. Readers of our Journal must be familiar with the large earthquakes in Taiwan including the 1999 Taiwan Chi-Chi earthquake which caused extensive and very large scale soil liquefaction which resulted in severe damage of foundations, lifelines, and water front structures; excessive settlements, lateral soil spreading and landslides. Prof. Ueng describes a large laminar shear box which can take specimens of the size 1880mm x1880mm x 1520mm. With this equipment a series of uni and multi-directional shaking table tests were performed with clean sand and sand with silt fraction. Special sample preparation methods were developed by Prof. Ueng and his research team. Shaking table tests were also conducted on model piles, in the bi-axial laminar shear box with and without sand. The responses of the sand as well as the model piles were measured; these measurements included the displacements, accelerations, pore pressures and settlements in the sand and also corresponding measurements at various locations in the piles. Prof. Ueng presented results to indicate, that two dimensional shaking induced higher pore water pressures and deeper liquefaction depths than the one dimensional shaking for the same acceleration magnitude. Relationships were presented between the volumetric stain in the sand after liquefaction during earthquakes. The sand with silt fines exhibited a stronger liquefaction resistance but higher volumetric strain after liquefaction than the clean sand. The dynamic responses of the soil-pile system indicated that the behaviour of the model pile under shaking was dependent on the soil density, the dynamic characteristics of the pile and the surrounding soil and the mass of the superstructure. It is anticipated that the results of these studies and others as continued will provide bases for evaluation of the mitigation methods for liquefaction hazards and aseismic design of structures with pile foundations in a liquefiable ground.

(4) The fourth lecture of the March issue is on Rainfall Triggered Landslide: from research to mitigation practice in Thailand by Suttisak Soralump. Geotechnical Engineering Research and Development Centre (GERD), Kasetsart University has developed landslide data base of Thailand which contains almost 40 years of information on landslides events starting from 1970. From the data based it was found that there are two types of landslide which can be classified based on the extensive losses namely limited area landslide and large area landslide. It was found that more than 95 percent of limited area landslides are always caused by disturbance from human activities causing the change in landform or surface and underground water flow characteristics. On the other hand large area landslide is natural and mainly caused by unusual precipitation in the area. However there are also evidences that deforestation or agricultural processes is the main cause of the large area landslide. It is noticed that the landslides occurred mainly in the northern and central part of the country. It is also found that the frequency of the landslide is increasing sharply during the last decade starting from 1996. The assumptions for the increase in frequency of the landslides are: landslides naturally occur more often due to the climate change; mismanagement of land use due to the increase in population and the need to use the land for agricultural purposes; a combination of the two reasons as stated above. The paper is concluded with the comments: rainfall triggered landslide is manageable if warning criteria and hazard prone areas can be identified from field works. To get such data, comprehensive geotechnical investigation is needed. The landslide prone area must be grouped as based on geology, engineering properties of the sub-soils; also strength reduction models and infiltration models are important tools to calculate the amount of rainfall that may trigger landslides. The landslide hazard map is just a guideline to map the extent of hazards and to zone the terrain as based on risks prone to landslide. It seems within a scale of 1:4,000, it is possible to apply the detail geotechnical analysis to obtain the hazardous area and the level of rainfall that might induce landslides.

June, 2010 Issue

(1) The June issue of the journal has a paper by Prof. Jean Louis Briaud and Seung Jae Oh on Bridge Foundation Scour. According to Jean Louis and his co-author, the bridge scour is the aggradation or degradation of the riverbed around the bridge structure in contact with the soil and is generally divided into general scour, contraction scour and local scour. General scour happens without the existence of a bridge. One example of a general scour is the case of the artificial straightening of a channel in a river which increases the flow velocity in the river and leads to erosion. Contraction scour results from the acceleration of the flow due to the constriction of a channel by the approach embankments. Local scour happens due to the velocity increase and turbulence around bridge obstacles such as piers and abutments. Jean Louis and his co-author described the erosion process in soils under the flow of water as a result of three things. First a drag force and associated shear stresses develop at the interface between the soil particle and the flowing water above it. Second, the normal stress on top of the soil particle decreases because of the water flow; indeed as the velocity increases around the soil particle or the obstacle, the pressure drops to maintain conservation of energy according to Bernoulli's principle. This phenomenon is similar to the air flow on top of an airplane wing where the pressure is lower than than below the wing thereby developing the uplift force necessary for the plane to fly. Third, the normal and shear stresses applied at the boundaries are fluctuating with time because of the turbulence in the water. These fluctuations find their roots in the appearance and disappearance of eddies, vortices, ejections and sweeps in the flowing water; and they can contribute significantly to the erosion process especially at higher velocities. In some cases they are the main reason of erosion says Jean Louis and his co-author. Under testing for erodibility an Erosion Function Apparatus developed by Briaud et al 1999 was described. Jean Louis stress that while EPA, provides an accurate method for determining the erosion resistance of soils in laboratory setting, there is still a need for a simple method and device that can be used in field. Jean Louis then described the Pocket Erodometer Test (PET) as a simple test which can be performed in a few seconds with an inexpensive, compact, and very light instrument. Jean Louis then described the erosion categories as based on 15 years of studies. In these studies, the erosion rate is plotted with respect to the flow velocity; six zones are plotted where Very High Erodibility is observed in (Zone 1), and then High Erodibility, Medium Erodibility, Low Erodibility Very Low Erodibility and Non-Erosive as Zones increasing from, II, III, IV V and VI. Jean Louis then described bridge scour prediction, scour types, maximum pier scour, contraction scour, abutment scour, time dependent prediction, probability approach and SRICOS-EFA method. In these studies, extensive use of dimensional analyses is made. The SRICOS-EFA computer program is used to calculate three types of scour depth: pier, contraction and abutment.

(2) The June 2010 issue also contains a paper by Balaubramaniam *et al* on settlement of embankments in soft soils. The major part of this paper is devoted to the evaluation of settlements in embankments constructed in marine, deltaic and estuarine soft soils. The estuarine deposits are more heterogeneous with the soft soil layer thicknesses relatively small and at times the thicknesses change rapidly within short distances. Over the years, there is a substantial reduction in boreholes and laboratory tests as carried out in site investigation works in soft soils. In situ tests and in particular CPT and CPTu tests now play a dominant role in all site investigation works. A simple voids ratio-logarithmic effective stress relationship is shown to be very helpful in understanding the degree of consolidation (DOC) and the OCR during removal of surcharge and in estimating residual settlement arising from secondary settlement. The classical expressions used in the evaluation of settlements with and without PVD are tabulated. The role of DOC in curtailing excessive residual settlement for preloading with and without PVD is shown with diagrammatic sketches using the pore pressure isochrones. The observational approach in designing embankments and reclamation works as based on fully instrumented test embankments is recommended. The Asaoka method of estimating ultimate settlement from measured surface settlement and then estimating DOC is recommended. The Hansbo method is found to be adequate in works related to preloading with PVD. The current geotechnical practice seem to need the classical work done on shear strength and compressibility of soft soils as there is a drastic reduction in traditional laboratory tests in estimating these parameters and also the doubt on the quality of samples. The use of CPT and CPTu tests is also emphasised. In analysing the slopes of embankments, wedge type of analysis is recommended when the thickness of the soft soil is relatively small and the soft soils are underlain by hard layers. Preliminary works on the geogrid reinforced pile supported (GRPS) embankments is presented. BS8006, Terzaghi and Hewllett and Randolph methods are found to make similar predictions in line with the numerical analyses using Plaxis software for the behaviour of GRPS embankments as used in approaches closed to structures.

(3) The third paper in the June issue is by Der Wen Chang, *et al* on Seismic Performance of Piles from PBEE and EQWEAP Analyses. The authors emphasised that Performance based Design (PBD) has received attentions from researchers in recent years. GeoCode -21, Eurocode 7 both are based on PBD. To estimate the seismic performance of the structures, the so called *Framing Equation* was suggested by US experts for Performance based Earthquake Engineering (PBEE) analysis. In such analysis, the probability in terms of the annual rate of exceedence for the intensity measure (IM) of the earthquake, the engineering demand parameter (EDP) and the damage measure (DM) of the structure , and the decision variable (DV) used for decision making can be analysed using step- by- step discreet procedures. One can estimate the probabilities of structural parameters and compare them to the limited values for design purpose. For piled foundations located at a site with known ground conditions, the seismic displacements and internal moments of the piles can be measured for many possible earthquake conditions. One can estimate the probabilities of these quantities following the PBEE procedures, and the rate can be estimated with all the possible influence factors. By proper control of the factors, the analysis is an applicable tool to evaluate the seismic performance of the earth structures. For analysis of structural behaviour, static and pseudo-static analyses as well as the dynamic analysis are all available to the engineers. In this paper, the wave equations of the pile segments subjected to the seismic ground motions are suggested for simplicity and time dependent capability.

(4) The fourth paper by Okimura *et al* is on the improvement of the prediction accuracy of the system of real –time type hazard map of slope failures caused by heavy rainfalls. Japan has been vulnerable to landslide disasters caused by heavy rainfalls. The most common trigger of landslide disasters in Japan is slope failure. In order to mitigate landslide disasters, it is important to evaluate the potential of slope failure events in space and time quantitatively and to develop the system that send the disaster information based on results of the evaluation. The Japanese experts have developed the system of real-time type hazard map of slope failure disasters caused by heavy rainfalls.

In recent years, the assessment of landslide disaster risk has become a topic of major interest in many parts of the world says Okimura et al. In Japan, the mountainous and hilly areas make up 70% of the total land area and weak geological materials are widely distributed. In mountainous areas, the local depopulation leads to inadequate forest management, thereby resulting in mountain devastation. With these natural and social conditions, Japan has been vulnerable to landslide disasters caused by heavy rainfalls and earthquakes frequently every year, and landslide disasters account for about a half of the dead and missing people by natural disasters. In order to prevent landslide disasters, structural measures such as the construction of sabo facilities are necessary. However, new land development has increase the threat of landslide disaster and an enormous amount of money and time will be required to make all these hazard areas safe by only structural measures. Therefore, it is necessary not only structural measures but also non-structural measures to protect human lives and properties from landslide disasters. The most common trigger of landslide disasters in Japan is slope failure (shallow landslide). These slope failures are often triggered during heavy rainfalls when pore-water pressures build up at the contact between the surface soil layer and the underlying bedrock. Rainfall-triggered slope failures are controlled by rainfall characteristics, namely intensity, duration and distribution, slope topographic attributes and soil properties such as thickness, density, shear strength and permeability. Therefore, in order to mitigate slope failure disasters, it is important to evaluate the potential of slope failure events in space and time by considering these parameters and to develop the system that send the disaster information based on result of the evaluation.

The Japanese experts have developed the system of real-time type hazard map of slope failure disasters caused by heavy rainfalls. This hazard map is a digital map that expressed slope stability evaluation results by Okimura and Ichikawa model and slope failure dangerous area that changes hour by hour can be displayed by inputting the short-term rainfall prediction information. The validity of the prediction accuracy of the system was verified by using a past disaster case. As a result, the system can be considered moderately accurate as the system of real-time type hazard map. However, a lot of potential failure cell appeared, where slope failure did not occur actually. Therefore, it was necessary to improve the accuracy of the input parameter in order to attempt further accuracy improvement of the evaluation result. The authors focus on the depth of surface soil layer which is one of the input parameters and aim at a further improvement of prediction accuracy of this system.

The authors concluded that the modified prediction model of the depth of surface soil layer improved the prediction accuracy of the system of real-time type hazard map of slope failure disasters caused by heavy rainfalls. As a result, the number of potential failure cell decreased greatly, where slope failure did not occur actually, by using new model and a lot of potential failure cells, which appear like the row, almost disappeared, that was the problem of former models. Thus the prediction accuracy improved as compared with using former prediction model. As future tasks, it is necessary to verify the applicability of this model to another region and geology. In addition, it is necessary to examine the prediction technique of the degree of slope failure potential and to make use of the knowledge in practice to transmit the warning of disaster and emergency information to the public prior to such landslides.

(5) The fifth paper by Bae *et al* is on a Case Study of Settlement Behaviour of a Dynamic Compacted High Rock Embankment. The foundation for the transformer substation in Korea was to be constructed on a high embankment of 63m width with rock and reinforced with bored piles. Such a foundation system may have serious limitations in terms of cost as the embankment is going to be built by means of roller compaction. On consideration of long term displacement due to creep, the first design was modified to dynamic compaction with nine sub-embankments (7m thickness each) and on a piled raft. In this paper the results of a study involving a series of in-situ experiments and measurements conducted to verify the stiffness of the embankment and to evaluate the quality of the dynamic compaction and long term displacement. Plate load tests were carried out for the verification of the stiffness that affects the bearing capacity and creep movements of the embankment. Settlement measurements were also made during the entire period of construction to estimate long term movements. Numerical analyses were also carried out to characterise the ground movement during construction.

So far the 7th step of the 9 steps in embankment construction is completed. Comparisons are made of the observed and predicted settlements. These studies indicate that the construction control measures are adequate.

September 2010 Issue

(1) The recent advances in pile testing and diaphragm wall construction in Japan are described by Prof. Kenji Ishihara. The first part of this paper consists of brief introduction of the in-situ pile loading tests that have been conducted in Japan over the last two decades in connection with the design and construction of high-rise buildings in areas of soft soil deposits. In addition to the conventional types of tests in which the load is applied at the top and at the toe of the pile (O-cell test), what may be called “pile toe bearing test” and “skin friction test” is introduced. The results of these tests are described and compared with those from the conventional type of the pile loading tests. In-situ prototype tests are also introduced in which bearing power of Barrette type pile is compared with that of the circular type pile. A special case of in-situ pile loading tests conducted in Singapore is also introduced in which the friction between the circular ring-shaped concrete segment and the surrounding soil deposit was measured directly during excavation of the shaft by applying loads up and down by jacks installed between two adjacent segments in vertical direction. The second part of this paper is a brief description on constructions of large-diameter circular diaphragm walls that was carried out about 10 years ago for the LNG storage tank in the coastal site in Tokyo Bay. The construction of the large-scale Kawasaki Island in the middle of Tokyo Bay in Japan will also be introduced. The whole scheme and process of construction is for these two undertakings is introduced with some comments on observed behaviour of the walls and on special precaution taken during construction.

In the design and practice of foundations supporting heavy-weight structures such as high-rise buildings or large-scale facilities, of utmost importance is to know the load-carrying characteristics of soil or rock deposits at depths as deep as 30m-50m. Estimates of the load-bearing capacity for piles embedded into such deep-seated deposits have been made generally by carrying out what is known as the O-cell test or pile toe loading test. In some cases, direct loading tests are performed by large concrete blocks or segments on the intact surface of the deep deposits which are exposed during excavation of pits or shafts for foundation construction. The outcome of these in-situ tests has not unfortunately been publicized and compiled to the extent that these data can be effectively utilized for the design practice in the future. In view of this, some data from the in-situ pile loading tests performed in Japan were collected and presented in this paper.

(2) Ground Improvement – A Green Technology towards a Sustainable Housing, Infrastructure and Utilities Developments in Malaysia is described in the paper by Kenny Yee and Dr. Ooi Teik Aun. This paper consists of two main parts. The first part is on the development, advancement and achievement of ground improvement technology in Malaysia. The second part is on sustainable construction towards a low carbon economy of recycling and the use of low-carbon construction processes. This paper will be of invaluable use to practicing engineers and stakeholders.

Yee & Ooi describe the development and advancement of applied ground improvement in Malaysia covering a period of more than 30 years. Beginning with the Port Klang Power Station in 1978 where more than 3 million meters of vertical drains were installed, it is still considered as one of the most economical solutions to treat soft ground. However, with the rapid development called by the Malaysian government to achieve a fully developed nation by 2020 (Vision 2020) very often the solution of vertical drains proved to be inadequate where time is a constraint and that the ground is extremely soft. Under such circumstances, vacuum consolidation was used as an alternative. Its first application was in the North-South Expressway in 1992 and subsequent applications include the New Kuching Deepwater Port. Due to its isotropic consolidation state, it provided the necessary consolidation in a shorter time and the necessary stability required during the works. Otherwise, construction works would have been difficult, if not impossible to carry out within the time constraint with problems of instability to the river bank.

Apart from treating soft ground, loose sand deposit in disturbed ground caused by tin-mining operations as well as land reclamation from the sea needs to be improved. Mechanical methods of improvement using dynamic compaction and vibro compaction are described. As early as 1978, dynamic compaction has been used for housing developments. Dynamic compaction was used to compact clayey sand overlying loose sand over very hard sandstone rock for the raft foundation of a 22-storey tower block. In 1995, heavy compaction using a 750 ton.m compaction rig was used to compact loose sand down to 10 – 15m depth in the Shah Alam Expressway. While dynamic compaction proves to be cost effective, surface vibration is a concern to neighbouring structures. With safe distance less than 20 – 30m, alternative vibro compaction is carried out. A unique combination of dynamic compaction and vibro compaction was carried out at the Double Tracking project from Ipoh to Rawang where dynamic compaction was carried out to a safe distance of 10m from the live railway track and vibro compaction was used inside the safe zone. This match-and-mix solution provided the best return for production and economy.

Another category of ground improvement covered in this paper is ground reinforcement. Dynamic replacement, vibro replacement and the more recent development of controlled modulus columns are described. Dynamic replacement and vibro replacement found their applications in the late 1980s for infrastructure developments especially with the North South Expressway along the west coast and the East Coast Expressway on the east. These expressways forming part of the national road network connecting towns and cities have given fresh impetus to rapid developments into urban areas. With environmental constraints in urban areas, dynamic replacement has to deal with surface vibrations while vibro replacement has to deal with finding water source and sludge disposal for the wet method. This calls for an environmental friendly solution as an alternative. The unique installation process of controlled modulus columns offers minimum vibration and virtually no spoil disposal was first used in the raising of an embankment for an existing dam in 2002. This technology which was developed in Europe in the late 1990s was used in this project to avoid progressive fissuring due to overstressing of the in-situ clay core material while reinforcement works was carried out during the full operation of the dam.

Yee & Ooi highlighted in this paper that even though ground improvement has over 30 years of local experience, it has also increased awareness of its limitations as each technique has its own merits, limitations and economies. Descriptions on suitable types of soil for each treatment type, design issues, performance evaluation and choice of methods and selection criteria are included for each category of ground improvement methods namely, consolidation, compaction and reinforcement.

The global concern for climatic changes was not to be left out. Sustainable development was covered in the second part of this paper. Defined as "… development that meets the needs of the present without compromising the needs of the future…" this paper has included case studies on the CO_2 emission audit for a warehouse construction with an option of deep piled foundation or shallow foundation on improved ground by dynamic compaction; a storage terminal with an option of ground improvement using vertical drains with fill surcharge or vacuum consolidation and a highway embankment on dynamic replacement in combination with vertical drains instead of removal and replacement of unsuitable material. This paper concludes with a call for using low-carbon technology and to introduce carbon footprint accounting practice.

(3) The paper by Ryuji Manai is on the enhancement of pile capacity by shaft grouting technique in the Ruspa Bridge Project in Bangladesh. It primarily covers the Base Grouting and Shaft Grouting techniques which were introduced for the first time in Bangladesh in order to enhance the cast-in-situ pile capacity for the Main Bridge. Among 10 km long by-pass construction (Satkhira-Mongla), the pivot of the project was to construct the Main Bridge over the river Rupsa of 640m in length (5 nos. 100m middle span and 70m end spans) and approach bridge of 720m, total length of 1.36km.

The main pier foundation consists of 6 nos. 2500mm dia. cast-in-situ piles (length 75m) at each pier location. Each pile has a permanent steel casing from EL0 to -35m. Pile construction was carried out by reverse circulation drilling method using slurry replacement technique to stabilize the pile bore and tremie method for concreting. The piles were designed to a working load of 2250 ton of which major component of pile capacity is shared by skin friction and the remaining by end bearing.

The Adoption of such extensive shaft grouting technique in this project is the first of its kind in Bangladesh and the authors consider that the experience in this project will be a predecessor for many challenging future projects in Bangladesh and elsewhere in not only resolving problematic piles but also for achieving more economical pile design by using this technique. The mix proportions for both base and shaft grouting are carefully designed to have good flowability, long term durability and adequate strength to make the shaft grouted pile act homogeneously. Following to the other reported case, the author concluded to use the grout mix of following proportions aiming to gain 28 days strength of 20MPa: the water cement ratio 0.74; Bentonite, % of Cement: admixture, 1.20cc/1kg of Cement; Portland . The result of pile load tests demonstrated that the effect of enhancement of pile capacity with shaft and base grouting techniques could be achieved as high as 5 to 7 times that of plain piles which is far more than the previously reported 1.5 to 3 times in the other projects.

(**4) Dr. Phung Duc Long paper is on Piled Raft - A Cost-Effective Foundation Method for High-Rises.** The use of piles in piled raft foundations can reduce settlements and differential settlements and lead to considerable saving in foundation costs. Only a limited number of piles, called settlement-reducers, may improve the ultimate load capacity, the settlement performance, as well as the required thickness of the raft. In this article the results from the experimental studies, which strongly supports the concept of piles as settlement-reducers in piled raft foundations in non-cohesive soils, are reviewed. The applications of FEM in the design of piled-raft foundations for high-rise buildings are also discussed. A foundation system must be designed to ensure sufficient external stability of the entire system and maintain the internal load-bearing capacity of the building components through appropriate design of the components.

Ten case histories were presented to illustrate the load sharing by the piles and the raft respectively. These case histories are on : Messe-Torhaus, Frankfurt 130m high , 30-storey ; Messeturn, Frankfurt 256m, 60-storey ; Westend 1, Frankfurt 208m; PETRONAS, Kuala Lumpur 450m, 88-storey; QV1, Perth, West Australia, 42-storey; Treptower, Berlin 121m ; Sony Centre, Berlin; ICC, Hong Kong 490m, 118-storey ; Commerzbank, Frankfurt PF, 300m ;; Skyper, Frankfurt 153m.

For piled footings in non-cohesive soil, a systematic experimental study of the behaviour of the piled footings with the cap being in contact with the soil surface, has been carried out by the Author, in 1993.The study shows that the influences of the footing (cap) in contact with the soil on the bearing capacity of piles and on the load-settlement behaviour of a piled footing are considerable. The mechanism of load transfer in a piled footing involves a highly complex overall interaction between piles, pile cap and surrounding soil, which is considerably changed due to pile installation and to the contact pressure at the cap-soil interface. In order to clarify the overall cap-soil-pile interaction and the load-settlement behaviour of a piled footing in non-cohesive soil, three extensive series of large scale field model tests were performed by the Author in 1993. Through the study, the Author has tried to create a better understanding of the load-transfer mechanism and of the load-settlement behaviour of a piled footing in non-cohesive soil, as well as the overall interaction between the piles, the cap and soil, especially the settlement-reducing effect of the piles. All the pile groups were square, and consisted of five piles: one central and four corner piles. In these tests, the following measurements were made: individual pile loads, total applied load, lateral earth pressure against the pile shaft and displacement of the footing. Axial pile loads were measured by means of load cells at the base and the top of each pile. A load cell was placed in the middle of a corner pile, to study the load distribution along the pile length. The lateral earth pressure against pile shaft was measured for the central pile, by twelve Glötzl total stress cells, installed symmetrically on all the four sides of the pile. Displacements were measured by electric resistance transducers. All the instruments were monitored by a data logger.

From the test results, very important remarks are drawn: when the load is applied on the piled footing, the piles at first take a major portion of the load; not until pile failure a considerable portion of load is transferred to the cap; the load-settlement curve of the cap in a piled footing is very similar to that of a cap alone; the load carried by the piles in a piled footings is much larger than that the load carried by a *corresponding* free-standing pile group.

December 2010 Issue

(1) The December 2010 issue contains a paper on the Geotechnical aspects of Incheon Bridge project by Dr. Sung-Min Cho. The geotechnical aspects of the foundation works and related items were presented in this paper. The mission of Incheon Bridge project was to make a 21.4 km long national expressway between Incheon International Airport (IIA) and New Songdo City crossing the Yellow Sea. The expressway has 6 lanes for two way traffics and 86 % of the total length, as same as 18,348 m (approximately 18.4 km) is a continuously connected bridge.

The Incheon Bridge is the integrated set of several special featured bridges including a magnificent cable-stayed bridge which has a main span of 800 m width to cross the navigation channel in and out of the Port of Incheon on the Yellow Sea. Incheon Bridge is making an epoch of long-span bridge designs thanks to the fully application of the AASHTO LRFD (load & resistance factor design) to both the superstructures and the substructures. A state-of-the-art geotechnologies which were applied to the Incheon Bridge construction project is introduced. The bearing capacity and deformational characteristics of the rock penetrated drilled-shaft foundations were verified static pile load test; 8 full-scale pilot piles were tested in both offshore site and onshore area prior to the commencement of constructions. Compressible load beyond 30,000 tonf pressed a single 3 m diameter foundation pile by means of bidirectional loading method including the Osterberg cell techniques. Detailed site investigation to characterize the subsurface properties had been carried out. Geotextile tubes, tied sheet pile walls, and trestles were utilized to overcome the very large tidal difference between ebb and flow at the foreshore site. 44 circular-cell type dolphins surround the piers near the navigation channel to protect the bridge against the collision with aberrant vessels. Each dolphin structure consists of the flat sheet piled wall and in-filled aggregates to absorb the collision impact. Geo-centrifugal tests were performed to evaluate the behaviour of the dolphin in the seabed and to verify the numerical model for the design. Rip-rap embankments on the seabed are expected to prevent the scouring of the foundation. Prefabricated vertical drains, sand compaction piles, deep cement mixings, horizontal natural-fibre drains, and other subsidiary methods were used to improve the soft ground for the site of abutments, toll plazas, and access roads. Light-weight backfill using EPS blocks helps to reduce the earth pressure behind the abutment on the soft ground. Some kinds of reinforced earth like as MSE using geosynthetics were utilized for the ring wall of the abutment. Soil steel bridges made of corrugated steel plates and engineered backfills were constructed for the open-cut tunnel and the culvert. Diverse experiences of advanced designs and constructions from the Incheon Bridge project have been propagated by relevant engineers and it is strongly expected that significant achievements in geotechnical engineering through this project will contribute to the national development of the long-span bridge technologies remarkably.

(2) The paper by How, Wang and Dong Sheng in the December 2010 issue, is on three dimensional behaviour of an over-sized excavation in Shangai clay. In this paper, a case study regarding the excavation of the largest excavation in Shanghai soft clays (Zhongsheng Shopping Mall) is investigated through field studies and numerical modelling. To reduce the excavation induced deformation and construction time, a combination of excavation support schemes, the central part by bottom-up method and the peripheral part by top-down method, is used in this construction project. Extensive field performance data, including wall deflections and ground surface settlements, were collected. Construction sequences are summarized and correlated with the measured data. Three-dimensional effective stress elasto-plastic finite element analysis is conducted to examine the wall deflections and ground surface movements. A comprehensive comparison with the field observations has demonstrated the capacity of numerical models for the predictions of wall deflections and ground surface settlements. Numerical studies indicate that both the wall deflection and ground surface settlement are affected by the excavation corner as well as the length and the shape of the wall. Parametric studies of two construction sequences reveal that the deformations of the wall and soil are larger due to the circumstance that some supports are not installed in time during excavation. Zoned excavation exerts a slight effect on the wall deflection for the wall panels near the centres of the excavated zones, but causes less wall deflection for the wall panels near the corners of the excavated zones.

(3) Living with Landslide Risk is the title of the paper by Lacasse, Nadim and Kalsnes from the International Centre for Geohazards (ICG) / Norwegian Geotechnical Institute (NGI), Oslo, Norway. Landslides represent a major threat to human life, property and constructed facilities, infrastructure and the environment in most mountainous and hilly regions of the world. Statistics from the Centre for Research on the Epidemiology of Disasters (CRED) show that landslides are responsible for at least 17% of all fatalities from natural hazards worldwide. The socio-economic impact of landslides is underestimated because landslides are usually not separated from other natural hazard triggers, such as extreme precipitation, earthquakes or floods. Many lives could have been saved if more had been known about the risks and risk mitigation measures had been implemented. The paper summarizes key aspects in the assessment of geological hazard and risk and exemplifies these with the risk associated with landslides.

The role of such assessments in a risk management context is discussed by Lacasse *et al* and recommendations for the identification and implementation of appropriate risk mitigation strategies are provided. The frequency of landslide disasters is increasing due to more extreme weather than before, increased population and increased

Vulnerability. The situation calls for intensified focus on and action to provide mitigation measures, both with respect to hazard and risk. The management of the risk associated with landslides and other geohazards involves decisions at local, regional, national and even trans-national levels. Lack of information about the risk appears to be a major constraint to providing improved mitigation in many areas. The selection of appropriate mitigation strategies should be based on a future-oriented quantitative risk assessment, coupled with useful knowledge on the technical feasibility, as well as costs and benefits, of risk reduction measures.

Technical experts acting alone cannot choose the "appropriate" set of mitigation and prevention measures in many risk contexts emphasised Lacasse *et al*. The complexities and technical details of managing geohazards risk can easily conceal that any strategy is embedded in a social/political system and entails value judgments about who bears the risks and benefits, and who makes the decisions on these matters. Policy-makers and affected parties engaged in solving environmental risk problems are thus increasingly recognizing that traditional expert based decision-making processes are insufficient, especially in controversial risk contexts.

Risk communication and stakeholder involvement have been widely acknowledged for supporting decisions on uncertain and controversial environmental risks, with the added bonus that participation enables the addition of local and anecdotal knowledge of the people most familiar with the problem. Precisely which citizens, authorities, NGOs, industry groups, etc., should be involved in which way, however, has been the subject of a tremendous amount of experimentation. The decision is ultimately made by political representatives, but stakeholder involvement, combined with good risk communication strategies, can often bring new options to light and delineate the terrain for agreement. The human impact of geohazards is far greater in developing countries than in developed countries. Capacity building initiatives focusing on organizations and institutions that deal with disaster risks and disaster situations could greatly reduce the vulnerability of the population exposed to natural disasters. Many of these initiatives can be implemented within a few years and are affordable even in countries with very limited resources.

(4) The paper by Edil is on Erosion, Slope Stability, Prediction of Future Recession in Actively Eroding Slopes. Evolving slopes are those slopes subject to active erosion processes such that their morphology, thus their stability, is changing rapidly i.e., in human-time scale rather than geological-time scale. There may be several erosion processes but the most influential ones are related to the interactions with an external body of water such as wave action on coastal cliffs and bluffs (defined as steep slopes due to active erosion) such as along the shorelines of oceans, lakes, and reservoirs. The cost-effective solutions often are a combination of both stabilization and management approaches to minimize the impact. These concepts are presented based on the author's 35 years of experience observing and dealing with the bluffs along the shorelines of the Great Lakes (specifically Lakes Michigan and Superior). These lakes are subject to large lake level fluctuations and high waves, thus significant wave erosion takes place reshaping the bluffs and often leading to landslides. The state of knowledge with respect to shore erosion and associated bluff stability issues is presented including the available methods of predicting rate of erosion and determining bluff stability along with the controlling factors. The approaches to mitigating coastal recession are described. Finally, the environmental and ecological impact of coastal structures, which is gaining significant attention recently, is highlighted.

The geology of the Great Lakes shoreline is shaped largely by the movement of glaciers. The Great Lakes formed behind retreating ice sheet when large quantities of ice melted. Re-advances of various ice lobes formed the glacial tills and lake sediments that form the shoreline of the Great Lakes today. The records of water levels in the Great Lakes over the last century indicate that water levels fluctuate up to about 2 m with a period of 15-20 years in addition to daily and seasonal fluctuations. These fluctuations, coupled with other factors such as storm activity and shoreline configuration, give rise to varying rates of shore erosion and instability of coastal bluffs, which culminate in coastal recession and economic loss. The shore erosion problem requires different strategies in different parts of the lakes depending on local circumstances (both physical and socio-political). In some areas prediction of future shoreline recession and providing setbacks for development to minimize economic loss may be appropriate and in some other areas coastal protection and bluff stabilization approaches may be required.

Wave erosion and associated bluff instability present a continuous problem in the coastal slopes. There are semi-empirical approaches that delineate the effect of the fundamental operating factors on shore erosion and bluff instability. These approaches, which are site or region-specific by their very nature, are summarized and can be adopted in other locations by careful considerations based on local conditions. It is anticipated that historical recession rates may change with global climate change as the water levels are likely to deviate from the modern patterns. Therefore, such impacts need to be considered in planning and management of coastal development. Coastal structures are still a viable approach; however, their design and justification require greater care since there is a higher level of perception of their deleterious effects on neighbouring properties and their environmental and ecological impacts in the near shore.

(b) March 2011: Special Issue on Geosynthetics-- Prof. Jie Han at the University of Kansas in USA is the guest editor of this special issue, which is intended to be released in March 2011

This special issue will focus on the design of geosynthetics for different applications ranging from walls, slopes, embankments, roads, landfills, and earth structures for coastal protection and land reclamation. Seven technical papers will be contributed by a combination of internationally well-known experts and young, energetic researchers and/or engineers in this area from China, Japan, Malaysia, Singapore, and the United States.

(1) Prof. Dov Leshchinsky at the University of Delaware in USA, an internationally well-known expert in geosynthetics, will offer his broad and in-depth views on the issues in design of mechanically-stabilized earth (MSE) walls and slopes. He will discuss about the issues including but not limited to: division between slopes and walls, peak vs. residual strength, misinterpretation of field data, implication on long-term strength, and conflicts existing with implementing Load Resistance Factor Design (LRFD) codes.

(2) Dr. Teik Aun Ooi and Mr. C.H. Tee have many years' practical experience in design and construction of MSE walls and geosynthetic-reinforced steep slopes in Malaysia. They will share their rich experience and knowledge accumulated through years in terms of design and construction of geosynthetic-reinforced earth structures in Malaysia. Several interesting case histories will be presented and discussed.

(3) Prof. Jian Chu at Nanyang Technological University in Singapore is well-known for his research in ground improvement and land reclamation. He will contribute a technical paper on recent advances in the research and practice using geosynthetics for coastal applications including coastal protection and land reclamation. Several interesting case studies will be presented and discussed.

(4) Prof. Jinchun Chai at Saga University in Japan has developed a number of design methods for ground improvement, which are commonly adopted in practice. In this paper, Prof. Chai will propose a method for predicting undrained shear strength (Su) of saturated clayey backfill in embankments reinforced by dual function (reinforcement and drainage) geocomposites. The proposed method considers the effects of discharge capacity of the geocomposite, spacing between geocomposite layers, construction speed, and the coefficient of consolidation of the backfill. With the predicted Su values of the backfill material and the tensile strength of the geocomposite, the factor of safety of an embankment can be calculated by Bishop's slip circle method.

(5) Prof. Yumin Chen at Zhejiang University is a leading geotechnical researcher in China. He has been involved in the research and consulting of several major landfills in China. His technical paper will describe the development of landfills, the current practice, and the use of geosynthetics for separation, filtration, drainage, containment, and reinforcement in the landfill system in China.

(6) Dr. Jie Huang, an assistant professor at the University of Texas at San Antonia, Dr. Anil Bhandari, a project manager at Terracon (a major geotechnical firm in the USA), and Dr. Xiaoming Yang, a research associate at Louisiana Transportation Research Centre, are three active young researchers and/or engineers in geotechnical engineering. They will jointly contribute a technical paper to review and discuss different numerical methods (FEM, FDM, and DEM) used to model and analyse geosynthetic-reinforced earth structures including MSE walls, reinforced slopes and embankments, and reinforced unpaved and paved roads.

(7) Prof. Jie Han at the University of Kansas in USA is the guest editor of this special issue. He will also contribute a technical paper on the recent advances in geosynthetic-reinforced column-supported embankments. His paper will discuss different column technologies, address design issues, and shed light on recent research and developments related to the geosynthetic-reinforced column-supported embankments over soft soils including load transfer mechanisms, settlement, consolidation, and stability. A couple of case studies will also be presented in this paper.

Tentative titles of the technical papers to be included in this special issue are:

1. Issues in design of MSE Walls and slopes, Dov Leshchinsky
2. Case studies of geosynthetic-reinforced earth structures in Malaysia, T.A. Ooi and C.H. Tee
3. Geosynthetics for coastal applications, Jian Chu
4. Embankment construction with saturated clayey fill material using geocomposite, Jinchun Chai
5. Geosynthetics for landfill applications in China, Yunmin Chen
6. Numerical modelling of geosynthetic-reinforced earth structures, Jie Huang, Anil Bhandari, and Xiaoming Yang
7. Recent advances in geosynthetic-reinforced column-support embankments, Jie Han

(c) Other Special Issues (June & September 2011)

A special issue on Deep Foundations is also planned and to be edited by Prof. Tatsunori Matsumoto and Dr. Der Wen Chang and this is expected in June 2011. Professor Harry G. Poulos, Prof. Bengt Fellenius and several others are expected to contribute in this issue together with Prof. Tatsunori Matsuoka.

Also, Prof Chang Yu Ou is working on a special volume on deep excavations and tunnelling expected in September 2011.

Paper Contributions

SEAGS encourages the submission of scholarly and practice-oriented articles to is journal. Starting from 2008, the journal will be published quarterly. Before you submit an article, please review the guidelines stated herein for the manuscript preparation and submission procedures.

Geotechnical Engineering Journal accepts submissions via electronic or postal mail (by sending a CD). The manuscript file (text, tables and figures) in pdf format together with the submission letter should be submitted to the Editor, 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: noppadol@ait.ac.th or seags@ait.ac.th. Papers under review, accepted for publication or published elsewhere are not accepted. The review and publication procedures are available on seags website.

For additional information, please write to:

Dr. Noppadol Phienwej
Editor, Geotechnical Engineering Journal
School of Civil Engineering, Asian Institute of Technology
P.O. Box 4, Klong Luang, Pathumthani 12120 THAILAND
Email: noppadol@ait.ac.th
Fax no: (66-2) 524 5509 or (66-2) 524 5507

Geotechnical Engineering is the official journal of the Southeast Asian Geotechnical Society amd the Association of Geotechnical Societies in Southeast Asia. It is published four times a year in March, June, September and December and is free to members of the Society. The annual subscription rate for non-members is US$30 to individuals and US$50 to libraries and companies. Back issues are available. Cheques or money orders should be made payable to the Asian Institute of Technology. Membership application forms and other details can be obtained from:

The Secretariat, SEAGS
Room 211, AIT Library
Asian Institute of Technology
P.O. Box 4, Klong Luang
Pathumthani 12120, Thailand
Website: hiip://www.seags.ait.ac.th

IEM Training Centre Sdn. Bhd.
No. 33-1A, Jalan SS 52/18
P.O. Box 224 (Jalan Sultan)
46200 Petaling Jaya, SelangorDarul Ehsan, MALAYSIA
Tel: (60) 03 7958 6851
Fax: (60) 03 79582851
E-mail: choy.iemtc@gmail.com