

# GEOTECHNICAL ENGINEERING

Journal of the



**SEAGS**  
Southeast Asian  
Geotechnical Society

**AGSSEA**  
ASSOCIATION OF GEOTECHNICAL  
SOCIETIES IN SOUTHEAST ASIA

Sponsored by



**AIT**  
Asian Institute of Technology

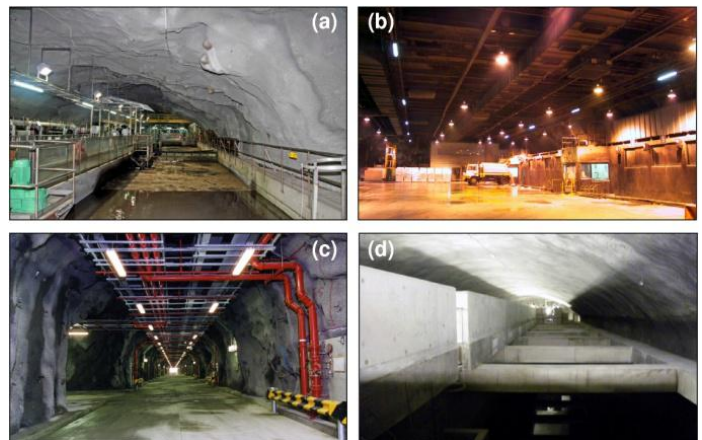


## EDITORS:

**Sing Lok Chiu** (*Part A: Hong Kong*), **Tiong Guan Ng** (*Part B: Singapore*) &  
**San Shyan Lin** (*Part C: Contributed Papers*)



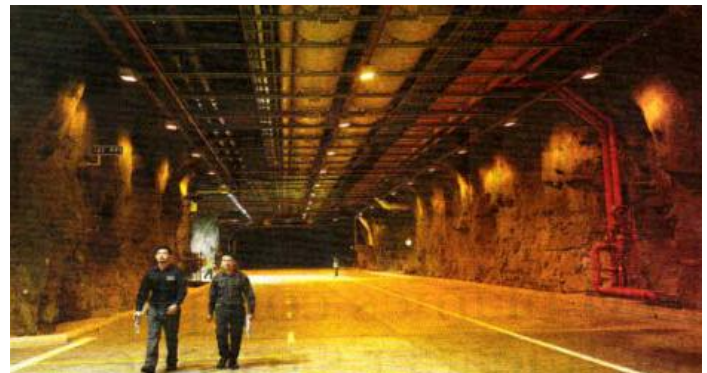
1972 Po Shan landslide in Hong Kong  
(After Ho and Cheung, 2016)



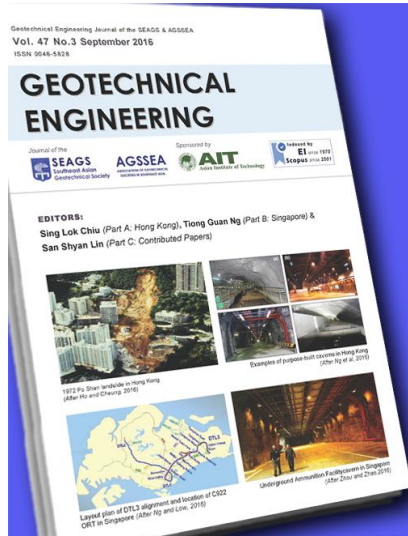
Examples of purpose-built caverns in Hong Kong  
(After Ng et al, 2016)



Layout plan of DTL3 alignment and location of C922  
ORT in Singapore (After Ng and Low, 2016)



Underground Ammunition Facility cavern in Singapore  
(After Zhou and Zhao, 2016)



# SEAGS-AGSSEA Journals

seags.ait.asia/journals

## ANNOUNCEMENT

**KINDLY READ THIS NEWS PLEASE** on more details of SEAGS-AGSSEA Journals from 1970 - June 2016 in SEAGS WEB and **Free Downloading of Articles** now from 1970 to 2011 Issues; this will be extended to 2012 by end of August and 2013 by end of 2016.

Web sites can be reached at:

1. <http://seags.ait.asia/journals/>
2. <http://seags.ait.asia/category/journals/1970-2011/>
3. <http://seags.ait.asia/info/journals-2012-43/>
4. <http://seags.ait.asia/info/journals-2013-44/>
5. <http://seags.ait.asia/info/journals-2014-45/>
6. <http://seags.ait.asia/info/journals-2015-46/>
7. <http://seags.ait.asia/info/journals-2016-47/>

All Journal Issues from 1970-2011 can be freely downloaded now. 2013 Issues can be freely downloaded by end of August 2016. 2014 Issues can also be downloaded by end of this year - that is 2016.

YOU ARE KINDLY REQUESTED TO CONTRIBUTE ARTICLES IN FUTURE ISSUES AND ALSO HELP IN REVIEWING AS WELL.

# GEOTECHNICAL ENGINEERING

Published by the:

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

---

## EDITOR-IN-CHIEF

Chairman: Dr. Teik Aun Ooi  
Prof. San Shyan Lin (Taiwan)-Leader  
Dr. Erwin Oh (co-Leader)  
Prof. Akira Murakami (Japan)  
Prof. Jian Hua Yin (Hong Kong)  
Prof. Suched Likitlersuang (Thailand)  
Dr. Eng Choon Leong (Singapore)  
Dr. Phung Duc Long (Vietnam)  
Prof. Madhav (India)  
Prof. S R Kim (Korea)  
Dr. Swee Huat Chan (Malaysia)  
Dr. Farrokh Nadim (Europe)  
Prof. Hadi Kabbaz (Australia)  
Prof. Robert Koerner (USA)  
Prof. Jay Meegoda (USA)  
Prof. Palmeira Ennio Marcus (South America)  
Prof. Abbas Soroush (Iran)  
Prof. Mounir Bouassida (Africa)  
Prof. A.S. Balasubramaniam (Convenor)

---

## EDITORIAL ADVISERS

A.S. BALASUBRAMANIAM, *Australia*  
E.W. BRAND, *U.K.*  
WEN HUI TING, *Malaysia*  
KWET YEW YONG, *Singapore*  
CHUNG TIEN CHIN, *Taiwan*  
DENNES T. BERGADO, *Philippines*

ZA-CHIEH MOH, *Taiwan*  
CHIN-DER OU, *Taiwan*  
JOHN CHIEN-CHUNG LI, *Taiwan*  
H.G. POULOS, *Australia*  
PEDRO SECO E PINTO, *Portugal*

## **SEAGS EXECUTIVE COMMITTEE MEMBERS (2016 – 2019)**

DR. NOPPADOL PHIENWEJ	President
DR. NOPPADOL PHIENWEJ	Hon. Secretary General
DR. ZA-CHIEH MOH	Founding President
DR. TEIK-AUN OOI	Immediate Past President
DR. CHUNG TIEN CHIN	Past President
PROF. KWET YEW YONG	Past President
DR. JOHN CHIEN-CHUNG LI	Past President
DR WEN HUI TING	Past President

## **SEAGS GENERAL COMMITTEE 2016 - 2019**

DR. NOPPADOL PHIENWEJ ( <i>President</i> )	
DR. NOPPADOL PHIENWEJ ( <i>Hon. Secretary General</i> )	
DR. ZA-CHIEH MOH ( <i>Founding President</i> )	
DR. TEIK AUN OOI ( <i>Immediate Past President</i> )	
DR. CHUNG TIEN CHIN ( <i>Past President</i> )	
PROF. KWET YEW YONG ( <i>Past President</i> )	
DR. JOHN CHIEN-CHUNG LI ( <i>Past President</i> )	
DR. WEN HUI TING ( <i>Past President</i> )	
PROF. A.S. BALASUBRAMANIAM( <i>Past President</i> )	
DR. CHIN DER OU ( <i>Past President</i> )	
IR. YEW WENG YEE	PROF. JIAN CHU
IR. KENNY K.S. YEE	PROF. T. LIANG
IR. THIEN SENG YEE	PROF. DER-WEN CHANG
PROF. HUNG-JIUN LIAO	DR. SOKTAY LIM
PROF. MEEI-LING LIN	PROF. DENNES T. BERGADO

*Geotechnical Engineering* is the official journal of the Southeast Asian Geotechnical Society and 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\$50 to individuals and US\$100 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: <http://www.seags.ait.ac.th>*

*Ir. Kenny Yee  
Hon. Secretary General  
Association of Geotechnical Societies in Southeast Asia  
E-mail: [kenny.yeeks@gmail.com](mailto:kenny.yeeks@gmail.com)  
Website: <http://www.agssea.org>*

## GEOTECHNICAL ENGINEERING

### AGSSEA COUNCIL SESSION 2016 - 2019

Chairman  
Hon. Secretary-General  
Hon. Treasurer  
Immediate Past Chairman  
  
Hon. Founder Chairman  
Founder Chairman  
Council Members

Southeast Asian Geotechnical Society (SEAGS)  
Vietnamese Society for Soil Mechanics and Geotechnical Engineering (VSSMGE)  
Hong Kong Geotechnical Engineering Society (HKGES)  
Geotechnical Society of Singapore (GeoSS)  
Thai Geotechnical Society (TGS)  
  
Chinese Taipei Geotechnical Society (CTGS)  
Indonesian Society for Geotechnical Engineering (HATTI)  
Malaysian Geotechnical Society (MGS)

Prof. San Shyan LIN  
Ir. Kenny YEE  
Ir. Kenny YEE  
Prof. Kwet-Yew YONG  
  
Dr. Za-Chieh MOH  
Dr. Teik Aun OOI  
Dr. Noppadol PHIENWEJ  
Prof. Dennes T. Bergado  
Dr. PHUNG Duc Long  
Dr. PHAM Van Long  
Prof. Charles Wang-Wai NG  
Ir Dr. Johnny CHEUK  
Dr. Kam Weng LEONG  
Prof. Chun-Fai LEUNG  
Prof. Suttisak SORALUMP  
Dr. Apiniti JOTISANKASA  
Prof. Chang-Yu OU  
Prof. Yung-Show FANG  
Prof. Masyhur IRSYAM  
Dr. Pinto Tua SIMATUPANG  
Dr. Sin-Fatt CHAN  
Ir. Shaw Shong Liew  
Prof. Jian CHU  
Prof. Hung-Jiun LIAO  
Dr. Swee Huat CHAN  
Dr. Wen-Hui TING  
Prof. A S BALASUBRAMANIAM  
Dr. John Chien-Chung LI  
Prof. Dennes T. BERGADO  
Ir. Raymond CHAN  
Dr. Chung-Tien CHIN  
Prof. TRINH Minh Thu

Nominated Co-opted  
Members

Advisors

*Ir. Kenny Yee*

*Hon. Secretary General*

*Association of Geotechnical Societies in Southeast Asia*

*E-mail: [kenny.yeeks@gmail.com](mailto:kenny.yeeks@gmail.com)*

*IEM Training Centre Sdn. Bhd.*

*No. 33-1A, Jalan SS 52/18*

*P.O. Box 224 (Jalan Sultan)*

*46200 Petaling Jaya, Selangor Darul Ehsan, MALAYSIA*

*Tel: (60) 03 7958 6851*

*Fax: (60) 03 79582851*

*E-mail: [iemtrainingcentre@gmail.com](mailto:iemtrainingcentre@gmail.com)*

# GEOTECHNICAL ENGINEERING

## EDITORIAL PANEL

Prof. D.T. Bergado  
Asian Institute of Technology  
Bangkok Thailand

Dr. R.P. Brenner  
Weinfelden  
Switzerland

Prof. D.W. Chang  
Tamkang University  
Tamsui Taiwan

Prof. Jian Chu  
Iowa State University  
Iowa U.S.A

Prof. Fuping Gao  
Institute of Mechanics  
Chinese Academy of Sciences  
Beijing China

Dr. Ivan Gratchev  
Griffith University Gold Coast Campus  
Gold Coast Queensland Australia

Dr. Wei-Dong Guo  
University of Wollongong  
Wollongong  
Australia

Dr. Abuel-Naga Hossam  
The University of Manchester  
Manchester U.K.

Prof. Dong-Sheng Jeng  
Griffith University Gold Coast Campus  
Gold Coast  
Queensland Australia

Prof. C. H. Juang  
Clemson University  
U.S.A.

Prof. A (Malek) Bouazza  
Monash University  
Melbourne Australia

Prof. Jin-Chun Chai  
Saga University  
Saga, Japan

Prof. Y.K. Chow  
National University of Singapore, NUS  
Singapore

Prof. Roger Frank  
Université Paris-Est  
École des Ponts ParisTech  
Laboratoire Navier-geotechnical team (CERMES)  
Marne-la-Vallée cedex 2 France

Prof. Christophe Gaudin  
University of Western Australia  
Perth Australia

Prof. Jürgen Grabe  
Karlsruhe University  
Germany

Prof. Jie Han  
The University of Kansas  
Lawrence, Kansas  
USA

Prof. B. Indraratna  
University of Wollongong  
Wollongong Australia

Dr. Apinit Jotisankasa  
Department of Civil Engineering  
Kasetsart University  
Bangkok Thailand

Prof. Poul V. Lade  
The Catholic University of America  
Washington, D.C., U.S.A.

Dr. Eng Choon Leong  
Nanyang Technological University  
Singapore

Prof. Robert Liang  
Akron University  
U.S.A.

Prof. San-Shyan Lin  
Taiwan Ocean University  
Keelung Taiwan

Prof. Tatsunori Matsumoto  
Kanazawa University  
Kakuma-machi, Kanazawa Japan

Prof. Fusao Oka  
Kyoto University, Kyoto Japan

Prof. Charles W. W. Ng  
The Hong Kong University of Science  
and Technology  
Kowloon Hong Kong

Dr. T.A. Ooi  
The Institution of Engineers, Malaysia  
Kuala Lumpur Malaysia

Prof. C.Y. Ou  
National Taiwan University of Science and  
Technology  
Taipei, Taiwan

Prof. Anand J. Puppala  
The University of Texas at Arlington  
Texas U.S.A

Professor Paulus P. Rahardjo  
Parahyangan Catholic University  
Indonesia

Prof. Helmut F. Schweiger  
Graz University of Technology  
Graz, Austria

Prof. Chun-Fai Leung  
National University of Singapore  
Singapore

Prof. Meei-Ling Lin  
Department of Civil Engineering  
National Taiwan University  
Taipei, Taiwan

Mr. Tom Lunne  
Norwegian Geotechnical Institute  
Oslo, Norway

Prof. Akira Murakami  
Kyoto University  
Kyoto Japan

Dr. Farrokh Nadim  
Technical Director  
Norwegian Geotechnical Institute (NGI)  
Oslo, Norway

Dr. Erwin Oh  
Griffith University Gold Coast Campus  
Gold Coast  
Queensland Australia

Prof. Zhen-Yu Yin  
Tongji University  
China

Dr. N. Phienwej  
Asian Institute of Technology  
Bangkok Thailand

Prof. Harianto Rahardjo  
Nanyang Technology University  
Singapore

Dr. Shinji Sassa  
Port and Airport Research Institute  
Nagase Yokosuka Japan

Prof. Shui-Long Shen  
Shanghai Jiao Tong University  
Shanghai China



Prof. D. N. Singh  
Indian Institute of Technology Bombay  
Powai, Mumbai, India

Prof. Ikuo Towhata  
University of Tokyo  
Tokyo Japan

Dr. Dariusz Wanatowski  
The University of Nottingham  
Ningbo, China

Dr. Albert T. Yeung  
University of Hong Kong (HKU)  
Hong Kong

Prof. Mitsutaka Sugimoto  
Nagaoka University of Technology  
Nagaoka Japan

Prof. B.V.S. Viswanadham  
Indian Institute of Technology Bombay  
Powai, Maharashtra, India

Prof. Li-zhong Wang  
Zhejiang University  
China

Prof. Jian-Hua Yin  
The Hong Kong Polytechnic University  
Hong Kong

# **GEOTECHNICAL ENGINEERING**

## **GUEST EDITORS**

**Prof. Jie Han (March 2011)**

**Prof. Tatsunori Matsumoto (June 2011)**

**Prof. Der-Wen Chang**

**Prof. Chang Yu Ou (September 2011 )**

**Dr. Dariusz Wanatowski (December 2011)**

**Prof. Charles W W Ng ( March 2012)**

**Dr. Apiniti Jotisankasa**

**Prof. Ikuo Towhata (June 2012)**

**Prof. Der-Wen Chang**

**Dr. Ivan Gratchev**

**Prof. Abdelmalek Bouazza (September 2012)**

**Tom Lunne (December 2012)**

**Prof. Don de Groot**

**Prof. Der-Wen Chang (March 2013)**

**Dariusz Wanatowski**

**Prof Akira Murakami (June 2013)**

**Dariusz Wanatowski**

**Prof. Fusao Oka (September, 2013)**

**Prof. Helmut F. Schweiger**

**Prof. Muhunthan Balasingham**

**Prof Jinchun Chai (December, 2013)**

**Prof Shuiling Shen**

**Prof Buddhima Indraratna (March, 2014)**

**A/Prof Cholachat Rujikiatkamjorn**

**Prof Tatsunori Matsumoto (June, 2014)**

**Prof Jurgen Grabe**

**Prof Der Wen Chang**

**B.V.S. Viswanadham (September, 2014)**

**Hanh Quang Le**

**Teik Aun Ooi**

**Shinji Sassa (December, 2014)**

**Poul V. Lade,**

**Li-zhong Wang,**

**Y.K. Chow,**

**Dong Sheng Jeng,**

**Christophe Gaudin,**

**Fuping Gao**

**Suched Likitlersuang (March 2015)**

**Suksun Horpibulsuk**

**Suttisak Soralump**

**Tirawat Boonyatee**

**Suchatvee Suwansawat**

**Thanakorn Chompoorat**

**San-Shyan Lin (June 2015)**

**Charng Hsein Juang**

**Robert Liang**

**Zhen-Yu Yin (September 2015)**

**Jian-Hua Yin**

**Prof. Jay Meegoda (December 2015)**

**Prof. Limin Hu**

**Dr. Phung Duc Long (March 2016)**

**Prof. San-Shyan Lin**

**Prof. Meei-Ling Lin (June 2016)**

**Sing Lok Chiu (Hong Kong Part) (September 2016)**

**Tiong Guan Ng (Singapore Part) and**

**San-Shyan Lin (Contributed Papers)**

**PAST EDITORS**

**Dr. E.W. Brand (1970 – 1973)**

**Dr. E.W. Brand, Prof. A.S. Balasubramaniam (1974 – 1976)**

**Dr. E.W. Brand, Dr. V.K. Campbell (1977 – 1978)**

**Dr. V.K. Campbell (1978 – 1980)**

**Mr. J.S. Younger (1980 – 1985)**

**Mr. D.R. Greenway (1986 – 1987)**

**Mr. P.G.D. Whiteside (1988 – 1989)**

**Mr. C.A.M. Franks (1990 – 1995)**

**Prof. D.T. Bergado (1996 – 2001)**

**Dr. N. Phienwej ( 2002 -2010)**

## **REVIEWERS LIST: March-June-September 2016**

Prof. A.S. Balasubramaniam

Australia

Email:

bala.b.balasubramaniam@griffith.edu.au

Prof. Dennes Bergado

Thailand

Email: dbergado@gmail.com

Prof. Leung C.F.

National University of Singapore

Singapore

Email: ceelcf@nus.edu.sg

Prof. Der Wen Chang

Tamkang University

Taiwan, R.O.C.

Email: dwchang@mail.tku.edu.tw

Prof. Wen-Cherng Chan

National Ilan University

R.O.C.

Email: wencherng@seed.net.tw

Dr. Muhsiung Chang

National Yunlin University of Science and  
Technology

R.O.C.

Email: changmh@yuntech.edu.tw

Prof. Tien-Chien Chen

National Pintung University of Science  
and Technology

Email: tcchen@mail.npust.edu.tw

Prof. Deepankar Choudhury

Indian Institute of Technology Bombay,  
India

E-mail: dc@civil.iitb.ac.in

A/Prof. Soon Hoe Chew

National University of Singapore  
Singapore

Email: ceecsh@nus.edu.sg

Prof. Jia-Jung Dong

National Taiwan Central University

Taiwan, R.O.C.

Email: jjdong@geo.ncu.edu.tw

Dr. John Endicott

AECOM Asia Ltd,

AECOM Technology Corporation

Hong Kong, China

Email: john.endicott@aecom.com

Prof. Yung-Show Fang

National Chiao Tung University

Taiwan, R.O.C.

Email: ysfang@mail.nctu.edu.tw

Prof. Louis Ge

National Taiwan University

R.O.C.

Email: louisge@ntu.edu.tw

Dr. Yi-Min Huang

Feng Chia University

R.O.C.

Email: niner@gis.tw

Dr. Wen-Chao Huang

National Central University

R.O.C.

Email: wenchao@ncu.edu.tw

Prof. Cheng-Yu Ku

National Taiwan Ocean University  
Taiwan

Email: chkst26@mail.ntou.edu.tw

Prof. Lin, Ming-Lang

National Taiwan University

R.O.C.

Email: mlin@ntu.edu.tw

Dr. Wei. F. Lee

National Taiwan University of Science and  
Technology

R.O.C.

Email: wflee0206@gmail.com

Prof. Chung-Jung Lee  
National Central University  
R.O.C.  
Email: cjleeciv@ncu.edu.tw

Prof. Meei-Ling Lin  
National Taiwan University  
R.O.C.  
Email: linml@ntu.edu.tw

Prof. San-Shyan Lin  
National Taiwan Ocean University  
R.O.C.  
Email: sslin46@gmail.com

Prof. Horn-Da Lin  
National Taiwan University of Science and  
Technology  
R.O.C.  
Email: hdlin@mail.ntust.edu.tw

Dr. Jen-Cheng Liao  
Taiwan Construction Research Institute  
R.O.C.  
Email: jcliao@tcrci.org.tw

Prof. John McCartney  
University of California, San Diego  
U.S.A  
Email: mccartney(at)ucsd.edu

Prof. Tatsunori Matsumoto  
Kanazawa University  
Japan  
Email: matsumoto@se.kanazawa-u.ac.jp

Dr. Tiong Guan Ng  
GeoEng Consultants (S) Pte Ltd  
Singapore  
E-mail: ngtg@geoeng.com.sg

Prof. Harry Poulos  
Coffey Geotechnics  
Australia  
Email: harry\_poulos@coffey.com.au

Prof. Yii-Wen Pan  
National Chiao Tung University  
Email: ywpan@mail.nctu.edu.tw

Dr. Tien Ho Seah  
ALFA GEOTECH CO., LTD., Thailand  
Email: seah@maageo.com

Er. Chua Tong Seng  
Kiso Jiban Singapore Pte Ltd  
Singapore  
Email: chuatongseng@hotmail.com

Prof. Keh-Jian Shou  
National Chiao Tung University, Taiwan,  
R.O.C.  
Email: kjshou@dragon.nchu.edu.tw

Prof. Harry Siew Ann Tan  
National University of Singapore  
Singapore  
Email: ceetansa@nus.edu.sg

Dr. Tai-Tien Wang  
National Taipei University of Technology  
R.O.C.  
Email: ttwang@ntut.edu.tw

Dr. Meng-Chia Weng  
National University of Kaohsiung  
R.O.C.  
Email: mcweng@nuk.edu.tw

Prof. Siu-Mun Woo  
National Taiwan University  
Taiwan, R.O.C.  
Email: smwoo@tfec.com.tw

Prof. Jian-Hong Wu  
National Cheng Kung University  
R.O.C.  
Email: jhwu@mail.ncku.edu.tw

Prof. Chien Chih Wang  
Cheng Hsiu University, Taiwan  
R.O.C.  
Email: ccw@csu.edu.tw

Prof. Zoe-Yee Yang  
Tamkang University  
R.O.C.  
Email: yang@mail.tku.edu.tw

Prof. K. Y. Yong  
National University of Singapore  
Singapore  
Email: uciyky@nus.edu.sg

## REVIEWERS LIST: 2011-2015

Prof. Hirokazu Akagi  
Waseda University  
Japan  
E-mail: akagi@waseda.jp

Prof. Herve di Benedetto  
ENTPE  
France  
Email: herve.dibenedetto@entpe.fr

Prof. Dennes Bergado  
Asian Institute of Technology  
Thailand  
Email: dbergado@gmail.com

Dr. Anil Bhandari  
Terracon Company  
U.S.A.

Dr. Daniela Boldini  
University of Bologna  
Italy  
E-mail: daniela.boldini@unibo.it

Dr. Tirawat Boonyatee  
Chulalongkorn University  
Thailand  
Email: tirawat.b@chula.ac.th

Prof. Malek Bouazza  
Monash University  
Australia  
Email: Malek.Bouazza@monash.edu,  
malek.bouazza@gmail.com

Prof. Fei Cai  
Gunma University  
Japan  
E-mail: cai@ce.gunma-u.ac.jp

Dr. Yan-Yan Cai  
National Huaqiao University  
China  
Email: bugyu0717@hqu.edu.cn

Prof. Wen-Jong Chang  
National Cheng Kung University, Tainan  
Taiwan  
Email: wjchang@mail.ncku.edu.tw

Prof. Sao-Jeng Chao  
National Ilan University, Ilan  
Taiwan  
Email: chao@niu.edu.tw

Dr. Nattaporn Charoentham  
Suranaree University of Technology  
Thailand  
E-mail: ch\_natta@sut.ac.th

Dr. Chia Han Chen  
National Center for Research on  
Earthquake Engineering  
Taiwan  
Email: chiaham@ncree.gov.tw

Prof. Jin-Wen Chen  
National Cheng Kung University  
Tainan, Taiwan  
Email: geochen@mail.ncku.edu.tw

Dr. Jin-Jian Chen  
Shanghai Jiao Tong University  
China  
E-mail: chenjj29@sjtu.edu.cn

Prof. Jie Ru Chen  
National Chinan University  
Taiwan  
Email: jrchen@ncnu.edu.tw

Dr. Qi-Ming Chen  
Louisiana Transportation Research Center  
U.S.A.  
Email: qchen1@lsu.edu

Prof. Ren-Peng Chen  
Zhejiang University  
China

Prof. John Carter  
The University of Newcastle  
Australia  
Email: John.Carter@newcastle.edu.au

Prof. Jinchun Chai  
Saga University  
Japan  
Email: chai@cc.saga-u.ac.jp

Prof. Der Wen Chang  
Tamkang University  
Taiwan  
Email: dwchang@mail.tku.edu.tw

Prof. Jianye Ching  
National Taiwan University  
Taiwan  
Email: jyching@ntu.edu.tw

Dr. Avirut Chinkulkijniwat  
Suranaree University of Technology  
Thailand  
Email: avirutgepg@gmail.com

Dr. Jiunn Shyang Chiou  
National Center for Research on Earthquake  
Engineering  
Taiwan  
E-mail: jschiou@narlabs.org.tw

Dr. Thanakorn Chompoorat  
University of Phayao  
Thailand  
Email: cthanakorn@gmail.com

Prof. Deepankar Choudhury  
Indian Institute of Technology Bombay  
India  
Email: dc@civil.iitb.ac.in

Prof. Y. K. Chow  
National University of Singapore  
Singapore  
Email: chowyk@nus.edu.sg

Dr. Tanan Chub-uppakarn  
Prince of Songkla University  
Thailand  
E-mail: tanan.c@psu.ac.th,  
tanan2284@yahoo.com

Prof. Tien-Chien Chen  
National Pintung University of Science  
and Technology  
Email: tcchen@mail.npust.edu.tw

Prof. Yit-Jin Chen  
Chung Yung Christian University  
Taiwan  
Email: yjc@cycu.edu.tw

Dr. Bastien Chevalier  
Polytech Clermont-Ferrand  
France  
Email:  
bastien.chevalier@univ-bpclermont.fr

Dr. Bengt H. Fellenius  
Consulting Engineer  
Canada  
Email: bengt@fellenius.ne

Dr. Jean-Francois Ferrellec  
University of Nottingham  
U.K.  
Email:  
jean-francois.ferrelec@nottingham.ac.uk

Prof. R. Finno  
Northwestern University  
U.S.A.  
Email: r-finno@northwestern.edu

Dr. K. Fujisawa  
Kyoto University  
Kyoto, Japan  
E-mail: fujik@kais.kyoto-u.ac.jp

Dr. Fumihiko Fukuda  
Hokkaido University  
Japan  
E-mail: fukuda@eng.hokudai.ac.jp

Dr. Edwin García Quintero  
Universidad de Antioquia UdeA  
Medellin, Columbia

Dr. W. Gates  
Monash University  
Australia  
Email: Will.Gates@monash.edu

Prof. Chung Sung Gyo  
Dong-A University  
Korea  
Email: sgchung@dau.ac.kr

Dr. An Deng  
The University of Adelaide  
Australia  
Email: an.deng@adelaide.edu.au

Prof. Jia-Jyun Dong  
National Central University  
Taiwan  
Email: jjdong@geo.ncu.edu.tw

Dr. Yan-Jun Du  
Southeast University  
China  
Email: duyanjun@seu.edu.cn

Dr. Ed Ellis  
University of Plymouth  
U.K.  
Email: edward.ellis@plymouth.ac.uk

Prof. Wei Dong Guo  
Griffith University  
Australia  
Email: wdguo@uow.edu.au

Dr. Junji Hamada  
Takenaka Corporation  
Japan  
Email: hamada.junji@takenaka.co.jp

Prof. Bipul C. Hawlader  
Memorial University, St. John's  
Canada  
Email: bipul@mun.ca

Dr. Yosuke Higo  
Kyoto University  
Japan

Dr. Ken-ichi Hirokoshi  
Taisei Corporation  
Japan  
E-mail: kenichi.horikoshi@acecc-world.org

Prof. Yu-Ning Ge  
National Taiwan University  
Taiwan  
Email: louisge@ntu.edu.tw

Dr. V.N. Georgiannou  
National Technical University of Athens  
Greece  
Email: vngeor@civil.ntua.gr

Dr. J. Grabe  
Karlsruhe University  
Germany  
Email: grabe@tuhh.de

Dr. Ivan Gratchev  
Griffith University, Gold Coast  
Australia  
Email: i.gratchev@griffith.edu.au

Prof. Don De Groot  
University of Amherst  
U.S.A.  
Email: degroot@ecs.umass.edu

Prof. M.W. Gui  
National Taipei University of Technology  
Taiwan  
Email: wmgui@ntut.edu.tw

Dr. Wei Guo  
Nanyang Technological University  
Singapore  
Email: GuoWei@ntu.edu.sg

Prof. An-Bin Hwang  
National Chiao Tung University  
Taiwan  
Email: abhuang@mail.nctu.edu.tw

Prof. Jin Hung Hwang  
National Central University  
Taiwan  
E-mail: hwangjin@cc.ncu.edu.tw

Dr. Richard Hwang  
Moh and Associates  
Taiwan  
Email:  
richard.hwang@maaconsultants.com



Dr. Dolrerdee Hormdee  
Khon Kaen University  
Thailand  
E-mail : Dolhor@kku.ac.th

Prof. Jie Han  
University of Kansas  
U.S.A.  
Email: jiehan@ku.edu

Prof. Suksun Horpibulsuk  
Suranaree University of Technology  
Thailand  
Email: suksun.sut.ac.th

Prof. Lee Fook Hou  
National University of Singapore  
Singapore  
Email: ceeleefh@nus.edu.sg

Dr. Pio-Go Hsieh  
Hwa Hsia Institute of Technology  
Taiwan  
Email: spg@cc.hwh.edu.tw

Dr. Hsii-Sheng Hsieh  
Trinity Foundation Engineering Consultants  
Taiwan  
Email: trinity@ms4.hinet.net

Dr. B. Hsiung  
National Kaohsiung University of Applied  
Science  
Taiwan  
Email: benson@cc.kuas.edu.tw

Dr. Jie Huang  
University of Texas at San Antonio  
U.S.A.  
Email: jie.huang@utsa.edu

Prof. Charng Hsein Juang  
Clemson University  
U.S.A.  
Email: hsein@clemson.edu

Dr. Phongthorn Julphunthon  
Naresuan University  
Thailand  
Email: pop\_civil@hotmail.com

Assoc Prof. Hossam Abuel-Naga  
La Trobe University  
Australia  
Email: d.jeng@griffith.edu.au

Prof. Buddhima Indraratna  
University of Wollongong  
Australia  
Email: Indra@uow.edu.au

Dr. Koichi Isobe  
Nagaoka University of Technology  
Japan  
E-mail: kisobe@vos.nagaokaut.ac.jp

Prof. Ching-Jiang Jeng  
Huaan University  
Taiwan  
Email: jcjh@cc.hfu.edu.tw

Prof. Dong.-Sheng Jeng  
Griffith University Gold Coast Campus  
Australia  
Email: d.jeng@griffith.edu.au

Prof. Sang Seom Jeong  
Yonsei University  
Korea  
Email: soj9081@yonsei.ac.kr

Dr. Peerapong Jitsangiam  
Curtin University  
Australia  
Email: P.Jitsangiam@curtin.edu.au

Dr. Pornkasem Jongpradist  
King Mongkut's University of Technology  
Thonburi, Thailand  
Email: pornkasem.jon@kmutt.ac.th

Dr. Apiniti Jotisankasa  
Kasetsart University  
Thailand  
Email: fengatj@ku.ac.th

Prof. Hideo Komine  
Ibaraki University  
Japan

Dr. Apichit Kampala  
Rajamangala University of Technology  
Thailand  
Email: apc\_kum@hotmail.com

Dr. Warat Kongkitkul  
King Mongkut's University of Technology  
Thonburi  
Thailand  
Email: warat.kon@kmutt.ac.th

Dr. Kiyonobu Kasama  
Associate Professor  
Kyushu University  
Japan  
Email: kasama@civil.kyushu-u.ac.jp

Prof. Jun-Ichi Koseki  
Tokyo University  
Japan  
E-mail: koseki@civil.t.u-tokyo.ac.jp

Prof. T. Katsumi  
Kyoto University  
Japan  
E-mail: katsumi.takeshi.6v@kyoto-u.ac.jp

Prof. Cheng-Yu Ku  
National Taiwan Ocean University  
Taiwan  
Email: chkst26@mail.ntou.edu.tw

Dr. Yoshiaki Kikuchi  
Port & Airport Research Institute  
Japan

Dr. Lyesse Laloui  
École Polytechnique Fédérale de Lausanne  
(EPFL)  
France  
Email: lyesse.laloui@epfl.ch

Dr. Sayuri Kimoto  
Kyoto University  
Japan  
E-mail: kimoto.sayuri.6u@kyoto-u.ac.jp

Prof. Chung-Jung Lee  
National Central University  
Taiwan  
Email: cjleeciv@cc.ncu.edu.tw

Prof. Makoto Kimura  
Kyoto University  
Japan  
E-mail: kimura.makoto.8r@kyoto-u.ac.jp

Dr. Joon Kyu Lee  
University of Western Ontario  
Canada  
Email: jkleegeo@gmail.com

Prof. Masaki Kitazume  
Tokyo Institute of Technology  
Japan  
Email: kitazume.m.aa@m.titech.ac.jp

Prof. E.C. Leong  
Nanyang Technological University  
Singapore  
Email: CECLEONG@ntu.edu.sg

Dr. Claudia Klotz  
University of Stuttgart  
Germany

Dr. Anthony Leung  
The University of Dundee  
U.K.  
Email: a.leung@dundee.ac.uk

Prof. Shun-ichi Kobayashi  
Kanazawa University  
Japan  
Email: koba@se.kanazawa-u.ac.jp

Prof. C.F. Leung  
National University of Singapore  
Singapore  
Email: ceelcf@nus.edu.sg

Dr. Eiji Kohama  
Port and Airport Research Institute  
Japan  
Email: kohama-e83ab@pa.ktr.mlit.go.jp

Prof. Dov Leshchinsky  
University of Delaware  
U.S.A.  
Email: dov@udel.edu,  
adama@GeoPrograms.com

Dr. Meng- Jia Li  
Technical Director  
GSE Lining Technology Inc.,  
U.S.A.

Dr. Jian Li  
Ecole Centrale de Nantes  
France  
E-mail: lij@whrsm.ac.cn

Dr. Meng- Jia Li  
Technical Director  
GSE Lining Technology Inc.,  
U.S.A.

Dr. Sergio Lourenco  
University of Cardiff  
U.K.  
Email: LourencoSD@cardiff.ac.uk

Dr. Xia Li  
University of Nottingham  
U.K.  
Email: xia.li@nottingham.ac.uk

Prof. Chi Wei Lu  
National Kaohsiung First University of  
Science and Technology  
Taiwan  
Email: cwlu@ccms.nkfust.edu.tw

Dr. Jen-Cheng Liao  
Taiwan Construction Research Institute  
Taiwan  
E-mail: jcliao@tcric.org.tw

Dr. Martin D. Lui  
University of Wollongong  
Australia  
Email: martindl@uow.edu.au

Prof. Suched Likitlersuang  
Chulalongkorn University  
Thailand  
Email: fceslk@eng.chula.ac.th

Mr. Tom Lunne  
Norwegian Geotechnical Institute, Oslo  
Norway  
Email: Tom.Lunne@ngi.no

Prof. Der-Guey Lin  
National Chung Hsing University, Taichung  
Taiwan  
Email: dglin@dragon.nchu.edu.tw

Prof. M.R.Madhav  
Professor Emeritus, JNT University;  
Visiting Professor, IIT, Hyderabad  
India

Prof. Jaw-Guei Lin  
National Taiwan Ocean University  
Taiwan  
E-mail: jglin@mail.ntou.edu.tw

Dr. Bappaditya Manna  
Department of Civil Engineering  
Indian Institute of Technology  
India  
Email: bmanna@civil.iitd.ac.in;  
bd\_manna@yahoo.com

Prof. Horn-Da Lin  
National Taiwan University of  
Science and Technology, Taiwan  
Email: hmlin@mail.ntust.edu.tw

Dr. Ammanulah Marri  
NED University of Engineering and  
Technology  
Pakistan  
Email: amanmuri@neduet.edu.pk,  
amanmarri@yahoo.com

Prof. Meei-Ling Lin  
National Taiwan University, Taipei  
Taiwan  
Email: linml@ntu.edu.tw

Prof. San-Shyan Lin  
National Taiwan Ocean University  
Taiwan  
Email: sslin46@gmail.com

Dr. Huabei Liu  
City College of New York  
U.S.A.  
Email: hliu@ccny.cuny.edu

Dr. Jainkun Liu  
Beijing Jiaotong University  
China  
Email: jkliu@bjtu.edu.cn

Dr. Xianfeng Liu  
The University of Newcastle  
Australia  
Email: xianfeng.liu@newcastle.edu.au

Dr. Yoshiyuki Morikawa  
Port & Airport Research Institute  
Japan  
E-mail: morikawa@pari.go.jp

Dr. Robb Eric S. Moss  
California Polytechnic State University at San  
Luis Obispo  
U.S.A.  
E-mail: rmoss@calpoly.edu

Professor Akira Murakami  
Kyoto University, Kyoto  
Japan  
Email: akira\_m@cc.okayama-u.ac.jp

Dr. Abdoullah Namdar  
Senior Lecturer  
University of Malaysia at Pahang, Malaysia  
Email: ab\_namdar@yahoo.com

Prof. Sheng-Huo Ni  
National Cheng Kung University, Tainan  
Taiwan  
Email: tonymi@mail.ncku.edu.tw

Dr. Alec Marshall  
University of Nottingham  
U.K.  
Email: alec.marshall@nottingham.ac.uk

Dr. Rainer Massarsch  
Geo Risk & Vibration Scandinavia AB  
Sweden  
Email: rainer.massarsch@georisk.se

Prof. Tatsunori Matsumoto  
Kanazawa University  
Japan  
Email: matsumoto@se.kanazawa-u.ac.jp

Dr. R. McWatters  
AAD  
Australia  
E-mail: rebecca.mcwatters@aad.gov.au

Prof. Y. Miyata  
The National Defense Academy  
Japan  
E-mail: miyamiya@nda.ac.jp

Dr. Thirapong Pipatpongsa  
Kyoto University  
Japan

Prof. Harry G. Poulos  
Coffey Geotechnics Pty Ltd, Sydney  
Australia  
Email: harry\_poulos@coffey.com.au

Prof. Anand Puppala  
University of Texas  
U.S.A.  
Email: anand@uta.edu

Dr. Jilin Qi  
Beijing University of Architecture and  
Civil Engineering, China  
E-mail: qijilin@lzb.ac.cn

Dr. Jiangu Qian  
Tongji University  
China  
E-mail: qianjiangu@tongji.edu.cn

Dr. Satoshi Nishimura  
Hokkaido University  
Japan  
E-mail: nishimura@eng.hokudai.ac.jp

Prof. Harianto Rahardjo  
Nanyang Technological University  
Singapore  
Email: CHRAHARDJO@ntu.edu.sg

Prof. Charles Ng  
Hong Kong University of Science & Technology  
Hong Kong  
Email: Charles.ng@ust.hk, cecwwng@ust.hk

Dr. Mizanur Rahman  
University of South Australia  
Australia  
Email: Mizanur.Rahman@unisa.edu.au

Prof. Erwin Oh  
Griffith University  
Australia  
Email: Y.Oh@griffith.edu.au

Dr. Wanwarang Ratananikom  
Burapha University  
Thailand  
Email: wanwarangr@buu.ac.th

Prof. C.S.P. Ojha  
Indian Institute of Technology Roorkee  
India  
Email: cojhafce[at]iitr.ac.in

Prof. Krishna R. Reddy  
University of Illinois at Chicago  
U.S.A.  
E-mail: kreddy@uic.edu

Professor Emeritus Fusao Oka  
Kyoto University, Kyoto  
Japan

Prof. Kerry Rowe  
Queen's University  
Canada  
Email: <kerry.rowe@queensu.ca>

Prof. Chang-Yu Ou  
National Taiwan University of Science and Technology  
Taiwan  
E-mail: ou@mail.ntust.edu.tw

Dr. Shinji Sassa  
Port and Airport Research Institute  
Japan  
Email: sassa@ipc.pari.go.jp

Prof. K. K. Phoon  
National University of Singapore  
Singapore  
Email: kkphoon@nus.edu.sg

Gökhan Saygılı  
Norwegian Geotechnical Institute, Oslo  
Norway

Dr. Julian Seidel  
Monash University  
Australia  
Email: Julian.Seidel@monash.edu

Prof. Helmut Schweiger  
Graz University of Technology  
Austria

Dr. Nader Shariatmadari  
Iran University of Science and Technology  
Iran  
Email: Shariatmadari@iust.ac.ir

Dr. Suriyah Thongmune  
Chiangmai University  
Thailand  
Email: suriyah@eng.cmu.ac.th

Prof. S.L. Shen  
Shanghai Jiao Tong University  
Shanghai, China  
Email: slshen@sjtu.edu.cn

Dr. N. Touze-Foltz  
CEMAGREF  
France

Dr. Yang Shen  
Hohai University  
China  
E-mail: shenyang1998@163.com

Dr. Jim Shiau  
Senior Lecturer  
University of Southern Queensland  
Australia  
E-mail: jim.shiau@usq.edu.au

Professor Satoru Shibuya  
Kobe University, Kobe  
Japan  
Email: shibuya@kobe-u.ac.jp

Prof. R. Shivashankar  
National Institute of Technology Karnataka  
India  
Email: shivashankar.surathkal@gmail.com

Dr. Suttisak Soralump  
Kasetsart University  
Thailand  
Email: soralump\_s@yahoo.com

Dr. Chanaton Surarak  
Royal Thai Army  
Thailand  
Email: chanatons@gmail.com

Prof. Jiro Takemura  
Department of Civil Engineering  
Tokyo Institute of Technology  
Japan  
Email: jtakemur@cv.titech.ac.jp

Dr. Chaosheng Tang  
Nanjing University  
China  
Email: tangchaosheng@nju.edu.cn,  
tangchaosheng@163.com

Dr. Pornpot Tanseng  
Suranaree University of Technology  
Thailand  
E-mail: pornpot@sut.ac.th

Prof. Ikuo Towhata  
The University of Tokyo  
Tokyo, Japan  
Email: towhata.ikuo.ikuo@gmail.com

Dr. Hirofumu Toyota  
Nagaoka University of Technology  
Japan  
E-mail : toyota@vos.nagaokaut.ac.jp

Dr. Taro Uchimura  
Associate Professor  
The University of Tokyo  
Japan  
E-mail: uchimura@geot.t.u-tokyo.ac.jp

Prof. Tzou-Shin Ueng  
National Taiwan University, Taipei  
Taiwan  
Email: ueng@ntu.edu.tw

Dr. Boonchai Ukritchon  
Chulalongkorn University  
Thailand  
Email: fcebuk@eng.chula.ac.th

Professor Ryosuke Uzuoka  
Tokushima University, Tokushima  
Japan  
Email: uzuoka@tokushima-u.ac.jp

Maarten Vanneste  
Norwegian Geotechnical Institute, Oslo  
Norway  
Email: maarten.vanneste@ngi.no

Dr. Dariusz Wanatowski  
Faculty of Science and Engineering  
University of Nottingham Ningbo  
China  
Email:  
Dariusz.Wanatowski@nottingham.ac.uk

Dr. Kuo-Lung Wang  
National Chi Nan University, Nantou  
Taiwan  
Email: kuolung@gmail.com;  
klwang@ncnu.edu.tw

Prof. Fumio Tatsuoka  
Tokyo Science University  
Japan  
E-mail: tatsuoka@rs.noda.tus.ac.jp

Dr. Y. Watabe  
Port and Airport Research Institute  
Japan  
E-mail: watabe@ipc.pari.go.jp

Dr. Ming Xiao  
California State University at Fresno  
U.S.A.  
Email: mxiao@engr.psu.edu

Prof. Kai Sin Wong  
Nanyang Technological University  
Singapore

Dr. Jie Xu  
Hohai University  
China

Dr. Zhen-Yu Yin  
Ecole Centrale de Nantes  
France  
Email: zhenyu.yin@sjtu.edu.cn

Dr. Ye Shuang Xu  
Shanghai Jiaotong University  
China  
E-mail: xuyeshuang@sjtu.edu.cn

Dr. Chuang Yu  
Wenzhou University  
China  
E-mail: geoyuchuang@hotmail.com

Dr. Qiang Xue  
Chinese Academy of Sciences  
China  
Email: xueqiang@cugb.edu.cn

Dr. Fan Yu  
Chinese Academy of Sciences  
China

Dr. H.S. Yang  
National Center for Research on  
Earthquake Engineering  
Taiwan  
Email: hhyang@narlabs.org.tw

Dr. Dongmei Zhang  
Tongji University  
China  
Email: dm\_zhangcn@yahoo.com

Dr. Kuo-Hsin Yang  
National Taiwan University of Science  
and Technology, Taiwan  
E-mail: khy@mail.ntust.edu.tw

Prof. Feng Zhang  
Department of Civil Engineering  
Nagoya Institute of Technology  
Japan  
E-mail: cho.ho@nitech.ac.jp

Dr. Xiaoming Yang  
Oklahoma State University  
U.S.A.  
Email: xmyang@okstate.edu

Professor Ga Zhang  
Tsinghua University, Beijing  
China  
Email: zhangga@tsinghua.edu.cn

Dr. Yunming Yang  
Institute of Rock and Soil Mechanics  
Chinese Academy of Sciences, Wuhan  
China  
Email: ymyang@whrsm.ac.cn

Prof. M. X. Zhang  
Shanghai University  
China

Prof. Weimin Ye  
Tongji University  
China  
Email: ye\_tju@tongji.edu.cn

Dr. Siam Yimsiri  
Burapha University  
Thailand  
Email: ysiam@bua.ac.th

Prof. Jianhua Yin  
Hong Kong Polytechnic University  
China  
Email: jian-hua.yin@polyu.edu.hk

Dr. Yan Zhuang  
Hohai University  
China  
Email: zhuangyan4444@hotmail.com

Dr. Ji-Dong Zhao  
Hong Kong University of Science  
and Technology  
Hong Kong  
Email: jzhao@ust.hk

Dr. Ling-Ling Zeng  
Fuzhou University  
China

Prof. G. Zheng  
Department of Civil Engineering  
Tianjin University, China  
Email: kenneth\_zheng@vip.163.com

Dr. Annan Zhou  
Royal Melbourne Institute of Technology  
Australia  
Email: annan.zhou@rmit.edu.au

Dr. Qi-Yin Zhu  
China University of Mining and  
Technology  
China  
Email: qiyin.zhu@gmail.com



# **GEOTECHNICAL ENGINEERING**

## **PREFACE**

This is a combined Issue of paper contributions from Hong Kong and Singapore; it contains eighteen excellent papers including four papers directly submitted to the SEAGS Secretariat.

The first paper by Ho & Cheung is on challenges in improving slope safety through the landslip prevention and mitigation program. In 1977, the Hong Kong Government embarked on a systematic retrofitting programme, known as the Landslip Preventive Measures (LPM) Programme, to systematically upgrade existing substandard man-made slopes to meet modern safety standards. By 2010, some 4,500 high-risk government man-made slopes have been upgraded through engineering works, and the overall landslide risk arising from man-made slopes has been reduced to less than 25% of the 1977 level. Over the years, the programme has evolved progressively in response to Government's continuous improvement initiatives and rising public expectations in respect of slope safety and slope appearance. In 2010, the Government launched the Landslip Prevention and Mitigation (LPMit) Programme to dovetail with the LPM Programme, with the focus being on retrofitting the remaining moderate-risk substandard man-made slopes and systematically mitigating natural terrain landslide risk. This paper presents the challenges, technical advances and achievements of the LPM and LPMit Programmes.

The second paper is by Ng et al on Rock caverns- Hong Kong's hidden land. The hilly terrain and underlying geology of Hong Kong offer an excellent opportunity for placing urban facilities underground. About two-thirds of Hong Kong's land is found to be suitable for rock cavern development. Given the potential for multi-layer cavern development, a substantial usable area could be created. In September 2012, the Civil Engineering and Development Department of the Government of the Hong Kong Special Administrative Region commenced a study on "Long-term Strategy for Cavern Development", to develop a holistic approach in planning and implementing cavern development and render it a sustainable means for expanding land resources. The study also places emphasis on private sector participation as facilities, such as storage, warehousing and data centres, can benefit from rock caverns' stable and secure setting. Implementation of a long-term strategy for cavern development could provide a sustainable approach in easing the pressure of land shortage. Developing a systematic relocation programme for suitable Government facilities could release surface sites for other uses including housing, and placing nuisance or potentially hazardous facilities in caverns could remove incompatible land uses. Reserving rock cavern space to accommodate future public and private sector facilities underground could further reduce the land take. The Hong Kong Government has also commenced an initiative to explore the potential of underground space development in the urban areas. Facilitating rock cavern development at the urban fringes and underground space development in the urban areas could enhance Hong Kong's utilisation of land resources in pursuit of sustainable development.

The third paper is on the first subsea TBM road tunnel in Hong Kong by Liu et al. Subsea tunnels for transportation are traditionally constructed in the form of Immersed Tunnel (IMT). With the technical advancement of mechanized Tunnel Boring Machine (TBM) construction, subsea TBM bored tunnels were successfully constructed in different parts of the World over the last decade. Using a TBM has benefits over the IMT when excavating beneath the sea, since it does not require dredging and marine access. This makes it particularly favourable when coping with environmental concerns and constraints within existing shipping passages. Since the first subsea tunnel across the Victoria Harbour in Hong Kong was constructed in 1972 by immersed tunnel method, four other additional subsea immersed tunnels were constructed across the same Victoria Harbour between 1979 and 1997. The subsea tunnel of Tuen Mun – Chek Lap Kok Link (TM-CLKL) was also originally proposed using immersed tunnel method in the feasibility study stage. However, the tunnel scheme was changed to TBM bored tunnel in the Investigation and Preliminary Design Stage. The TBM bored tunnel scheme was further developed in the Detailed Design Stage and the project is now under construction. This would be the first subsea TBM road tunnel in Hong Kong and this paper discusses the key considerations and rationales in changing the original IMT scheme to the TBM bored tunnel scheme for the subsea tunnel section of TM-CLKL.

The fourth paper is by Tam and Chang on achievements and challenges to the Hong Kong landslide risk management. Landslide is one of the common natural hazards in Hong Kong. With the Government and public's concerted efforts, landslide risk in Hong Kong has been drastically reduced since the establishment of a comprehensive slope safety system in 1977. However, given Hong Kong's climatic and geographical conditions and the current state of technology, occurrence of serious landslides that could potentially cause multiple fatalities remains a distinct possibility, particularly during extreme rainfall events.

The fifth paper by Tsang et al is on sub sea horizontal directions coring (HDC). The Tuen Mun – Chek Lap Kok Link comprises a 9 km long dual 2-lane carriageway between Tuen Mun and North Lantau, with approximately 5 km long sub-sea tunnel between Hong Kong Boundary Crossing Facilities and Tuen Mun. This is a major highway infrastructure constructed to alleviate the increase in cross boundary traffic due to projected developments in the Northwest New Territories and North Lantau in Hong Kong, including the Airport developments and the Hong Kong-Zhuhai-Macao Bridge. The proposed subsea tunnel is to be constructed by large diameter Tunnel Boring Machines (TBM) which will bore underneath two sets of existing submarine power cables providing power supply to the Hong Kong International Airport. Ground investigation using conventional vertical marine drill holes is not allowed within the cable protection zone with the considerations of the potential risk of damaging the power cables. To provide sufficient ground information for the design of the proposed TBM tunnel, Horizontal Directional Coring (HDC) with a total length of 660m was proposed at the invert level along the tunnel alignment. It was anticipated that the HDC would go through rock, soil or soil/rock interface and terminate at interface of soft / mixed ground. The HDC works has been completed in mid-2013. This paper describes the design considerations and the trajectory planning of the HDC work, with construction of a marine platform (of size 15m x 20m to facilitate the installation of the HDC). The difficulties and problems encountered during the subsea horizontal drilling is also discussed.

The sixth paper from Hong Kong contribution is the seventh Lumb lecture by Endicott. The Lumb Lecture is held in Hong Kong biennially to celebrate the work and the legacy of a great Geotechnical Engineer, Professor Peter Lumb. This paper reviews changes in geotechnical practice, in and around Hong Kong, since his retirement and shows remarkable developments and some folly. What would he think of his legacy? Would he be disillusioned by folly or would he have taken satisfaction to see that, in many instances, his legacy lives on. There are a number of valid successors following in Peter's footsteps. This paper has drawn extensively upon the work of many good geotechnical engineers and is dedicated as a tribute to all of the geotechnical engineers, engineering geologists, geologists and other people who have made the name of Hong Kong synonymous with ground engineering. There are too many to single out individually.

The second part of this Issue is contributions from Singapore. The papers are numbered continuously. Thus the seventh paper is by Ng and Low on Singapore case histories for the circle line and down town line projects. The case history of Overrun Tunnel (ORT) of C922 is basically an underground facility building functions as both Railway Facility (Operation Control Centre) and Electrical Substation (ESS) which is to be built next the Expo Station. ORT is located in old alluvium (OA). The proposed underground overrun tunnel is a box structure with dimensions of approximately 23m wide, 25m deep and approximately 440m long. The proposed diaphragm wall function as the earth retaining system (ERSS), it designed for both temporary loading conditions during excavation and permanent load conditions in accordance with LTA Civil Design Criteria. Bottom-up construction sequence is adopted where lateral supports using four (S3 to S6) or six (S1 to S6) layers of steel strutting were installed as excavation progresses downward. The most challenging part is the omission of the last layer of strut S6 for the whole ORT by using observational approach. The case history of C824 Nicoll Highway Station demonstrates that Jet Mechanical Mixing (JMM), if properly installed, has major benefits in controlling the stability and movements induced by deep excavations in soft ground. The reasons can be attributed to the fact that the inner soil column is comprehensively mixed, combined with the attributes of the outer jet grouted column with sufficient overlapping. The whole process undergoes tight quality control and rigorous testing to ensure a continuous and comprehensive slab. In addition to the JMM slab, there is the major benefit of the discrete soil mixing columns formed above the JMM slab during the withdrawal of the auger.

The eighth paper is on an update of the vacuum preloading methods by Chu et al. It has been more than 60 years since the concept of vacuum preloading was proposed. The vacuum preloading method has been evolving. There have been considerable improvements in the techniques as well as new applications. In this paper, several vacuum preloading methods including some new variations are introduced. The advantages and disadvantages of each method are compared. Technical issues such as improvement depth, vacuum pressure distribution in soil, and evaluation of degree of consolidation for soil under vacuum consolidation are discussed. A case history using a combined vacuum and fill surcharge preloading method for soft soil improvement is also used to illustrate the changes in the pore pressure versus depth profiles and the application of the method to calculate degree of consolidation using pore water pressure distributions.

In the ninth paper a new lithostratigraphical framework is proposed for Singapore by Lat et al. A study was initiated in mid-2013 by Building & Construction Authority of Singapore (BCA) to review the existing stratigraphy framework of Singapore. The new lithostratigraphical framework follows the recommendations of International Commission of Stratigraphy (ICS) and it was developed based on geological fieldworks observations and rock cores examination obtained from new deep boreholes. This paper will only cover on the Jurong Formation, Fort Canning Boulder Bed and Old Alluvium. The Jurong Formation has been upgraded to Jurong group according to ICS stratigraphy guidelines and the Jurong group is sub-divided into three (3) formations, known as Tuas formation, Bukit Resam formation and Pasir Panjang formation. The Fort Canning Boulder Bed and Old Alluvium have been re-classified as Fort Canning formation and Bedok formation respectively.

The following paper tenth in the series is by Tan on economical design of non-negative skin friction piles in soft clays. Code based design of piles with NSF consider the NSF force as a dragload to be imposed on the pile as an unfavourable design action. These codes like Singapore CP4, UK BS 8004 and the recent EC7 would indirectly factor up the value of the dragload while at the same time factor down the positive shaft friction below the neutral plane. Thus the pile design in very deep soft clays typical of Singapore and Asean coastal plains will lead to very conservative pile lengths to meet the code requirements. The Unified pile design method of Fellenius recognized this deficiency and it allows for better pile design with NSF taking into account the need for both force and settlement equilibrium between pile and soil. Fortunately, EC7 also allows for interactive pile/soil analysis using modern FEM tools that can optimise pile design for NSF, particularly when the remaining consolidation settlements around the piles are relatively small. This paper will compare these methods and provide insights into the proper understanding of NSF effects on pile behaviour, and recommend the way forward for rational and economical pile design in settling soils.

The eleventh paper is by Liu et al on design framework for spatial variability in cement treatment for underground construction. The most common form of ground treatment used to facilitate underground construction in Singapore is cement treatment. However, there is currently no indication on how safe and how conservative this adopted strength is since the prescribed strength bears no relationship to the probability of failure or factor of safety. This paper examined several sources leading to non-uniformity and spatial variation in cement-treated soils, including curing time effect, influence of operating parameters on slurry concentration, in-situ water content and column positioning errors. A framework for design and monitoring of ground treatment by cement was proposed.

The twelfth paper by Zhou and Zhao is on advances and challenges in underground space utility in Singapore. Despite its promise and many benefits for sustainable urban development, the use of underground space has tended to be the last resort, due to high development cost and the complexities in the planning and development of underground space. In 2010, the Economic Strategies Committee of the Singapore government made developing underground space part of the government's long-term economic strategy with specific recommendations on master planning, geological investigations, investment in research and development, and various policy issues. With this, the use of underground space has been

elevated to a strategic level and has become an economic imperative in land-scarce Singapore. The ESC report also recommended that the government should take the lead in catalysing the use of underground space. Based on these recommendations, the Singapore government has taken various initiatives and studies, and initiated various research projects in support of these initiatives. This top-down strategy has also made it possible to plan and coordinate the development of underground space in a holistic manner, and helps overcome of the key challenges at the systems. This paper gives a review of advances in underground space development, highlights some key challenges, and discusses the various recent studies and planning issues, and examines possible strategies for future use of underground space in Singapore. Furthermore, another four papers are included as contributed directly to the Editorial Team in this issue.

The thirteenth paper by Shaia and Abuel-Naga investigated the ageing induced changes in Fiber-Reinforced Polymer (FRP)/Granular interface shear behaviour under different aging environments. The test results indicated that FRP-granular interface shear behaviour was improved after subjected to the adopted aging environments. This improvement in the FRP interface shear behaviour could be mainly attributed to the observed increase in surface roughness under aging process.

The fourteenth paper authored by Dassanayake, Phien-wej and Giao dealt with modeling the groundwater pressure effect and slope stability analysis of C1 pit on deep pit mining of Mae Moh open pit lignite mine, Thailand. Stability of the west wall of the C1 pit for 2017 pit slope was evaluated in terms of the safety factor by the limit equilibrium method. Results obtained in this study indicated that the west wall is susceptible to failure due to water pressure associated with it. To maintain a safe slope, potentiometric head within west wall of C1 pit should be maintained below 170m, MSL.

In the fifteenth paper, Chen, Lin, Lee and Chen developed a seepage flow direct shear test device to investigate the effects of internal erosion to non-plastic silty sand prior to shearing. Tested results revealed that fines contents had noticeable influence on soil behaviours, regardless of whether an internal erosion process was applied to the samples.

In the sixteenth paper the Influencing factors including the Poisson's ratio and the rock specimen thickness on Brazilian test results are investigated by Yang and Wang using PFC3D program based on a complex-shaped grain model which can capture all the characteristics of brittle rock in three-dimensional environment. Through investigating the stress-strain curves and crack developing processes of the Brazilian test specimens, it was concluded that the Brazilian tensile strength will increase with the specimen thickness due to the great loading increment.

In the seventeenth paper an attempt was made by Cheng, Chern, Wu, and Lin to investigate the shear behaviour of soft rock joints under Constant Normal Load conditions, with special reference to the influences of infill thickness and moisture content on shear behavior of planar and rough joints. The results of this study showed that infilled water content could influence shear strength of planar and rough rock joints, more significant than infill thickness.

The last paper, by T.G.Santhoshkumar, Benny Mathews Abraham, A, Sridharan, and Babu T Jose, investigated the effectiveness of bentonite in improving the lateral flow of cement grouts in a coarse sand. It was found in the paper that addition of small percentages of bentonite and detergent increases the lateral flow of cement grout in coarse sand. The results indicated that addition of even a small amount of bentonite to the cement grout increases the grouting efficiency in coarse sand.

This combined Issue of the papers from Hong Kong, Singapore and other submissions makes further contributions in the development of Geotechnical Engineering in SE Asia. The editors are very pleased to have the opportunity in compiling the material presented herein.

**Sing Lok Chiu (Hong Kong Part),  
Tiong Guan Ng (Singapore Part)  
San Shyan Lin (Contributed Papers)**

## **ACKNOWLEDGEMENT**

Eighteen paper contributions contained in this issue are from Hong Kong, Singapore and papers contributed directly to the Editorial Team. No doubt the material contained therein would be most valuable to our engineering 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. Noppodol Phienwej**

**Prof. A. S. Balasubramaniam**

## GEOTECHNICAL ENGINEERING

**September 2016: HONG KONG AND SINGAPORE SPECIAL ISSUE**

**Edited by**

**Sing Lok Chiu** (*Part A: Hong Kong*), **Tiong Guan Ng** (*Part B: Singapore*) and  
**Prof. San-Shyan Lin** (*Part C: Contributed Papers*)



**Dr. Sing Lok Chiu**  
(*Hong Kong Part*)

**Dr. SL Chiu**, a registered geotechnical engineer to the Buildings Department of the government of the Hong Kong SAR, a geotechnical specialist. He graduated from Civil engineering department of National Taiwan University, MSc and DIC in “Soil Mechanics” at Imperial College of London University, UK, and PhD in “soil behaviours Mechanics” at Imperial College of London University, UK, and PhD in “soil behaviours at elevated temperature” at University of Sydney, Australia. He is a technical director (geotechnical) with AECOM Asia Company Limited, has been practising in geotechnical engineering field for more than 30 years. He has been DPM, PM, and special task team leader of various Landslip preventive Measures (LPM) Agreements with Geotechnical Engineering Office (GEO) of HKSAR Government as well as natural terrain hazard study agreements with Hong Kong Housing Authority (HKHA) over the past 15 years.

Besides, he has been actively involved in design and construction supervision of numerous prestigious site formation, foundation and deep basement construction works in urban areas, reclamations and ground improvement works in Hong Kong as well as throughout SE Asia and China. He recently led a team of foundation and bridge engineers undertaking design of the 2<sup>nd</sup> Penang Bridge – a cable-stayed bridge of total length of 26 km in Malaysia. At present, he is leading a team of geotechnical engineers undertaking tender design of KVMRT Line 2.





**Dr. Tiong Guan Ng**  
*(Singapore Part)*

**Dr. TG Ng** is the immediate Past President of Geotechnical Society of Singapore (2014-2015). He graduated from the University Technology Malaysia (UTM) with first class honours degree in Bachelor of Civil Engineering in 1992. He obtained his PhD degree in the research of Spud Can Foundation on Sand in 1999 from the National University of Singapore (NUS). He left NUS to join a specialist ground engineering company as design engineer in 2000. In Feb 2002, he co-founded GeoEng Consultants, a consultancy firm specializing in civil and geotechnical works, which grows to become one of the largest geotechnical consultancy firms in Singapore in a few years. In Nov 2011 GeoEng Consultants was acquired and became part of Golder Associates, a global consultancy company specialists in ground engineering and environmental services.

At present, Dr. Ng is the Principal and Executive Director of Golder Associates in Singapore leading the local Geotechnical Business Unit. He specialises in analysis and design of earth retaining system, and has special interest in back-analysis and interpretation of instrumentation. He had involved in the design and supervision of earth retaining structures for several major projects in Singapore which include the world 1<sup>st</sup> underground MRT Depot (LTA Circle Line Contract 821), Geylang River Cross for Kallang Paya Lebar Expressway (LTA Contract 421), the deepest excavation within Marina Bay Sands Integrated Resort for MRT tunnels below Bayfront Avenue and Construction of Downtown Line 1 Promenade Station (LTA Contract 902). He also involved in the assessment and review of several geotechnical failure cases in Singapore which include excavation failure at Lengkong Empat, foundation failure at Church Street, the collapse of excavation at Nichol Highway Station and water leakage at Jalan Besar Station. He is currently leading the team for design and supervision of Changi Land Preparation Project.



**Prof. San-Shyan Lin**  
*(Contributed Papers)*

**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 66 times in Google academic website by many international researchers working on wind turbine foundations.

# GEOTECHNICAL ENGINEERING

## September 2016: HONG KONG AND SINGAPORE SPECIAL ISSUE

Edited by

**Sing Lok Chiu** (*Part A: Hong Kong*), **Tiong Guan Ng** (*Part B: Singapore*) and  
**Prof. San-Shyan Lin** (*Part C: Contributed Papers*)

### TABLE OF CONTENTS

<u>List of Papers</u>	<u>Page</u>
<b>PART A - HONG KONG</b>	
1: Challenges in Improving Slope Safety in Hong Kong through the Landslip Prevention and Mitigation Programme By Ken K.S. Ho and Raymond W.M. Cheung <a href="#">***Please click here to download paper</a>	01- 10
2: Rock Caverns – Hong Kong’s Hidden Land By K.C. Ng, K.J. Roberts and Y.K. Ho <a href="#">***Please click here to download paper</a>	11-18
3: The First Subsea TBM Road Tunnel in Hong Kong By Albert Liu, Stephen Chan, Conrad Ng, Joseph Lo, C. K. Tsang and Dunson Shut <a href="#">***Please click here to download paper</a>	19-24
4: Achievements of and Challenges to the Hong Kong Landslide Risk Management By Rick CK Tam and Michael MK Chang <a href="#">***Please click here to download paper</a>	25-30
5: Subsea Horizontal Directional Coring (HDC) By C. K. Tsang, S. F. Chau and Jimmy Chan <a href="#">***Please click here to download paper</a>	31-36
6: 7 <sup>th</sup> Lumb lecture 10th October 2012 “Peter Lumb’s legacy, Soil Mechanics = Simple concepts + mathematical processes + lateral thinking” By John Endicott <a href="#">***Please click here to download paper</a>	37-50
<b>PART B - SINGAPORE</b>	
7: Singapore Case Histories on Omission of Strut by Observation Approach For Circle Line and Down Town Line Projects By David Ng C. C. and Simon Low Y. H. <a href="#">***Please click here to download paper</a>	51-61

- 8: Vacuum preloading methods: an update 62-69  
 By Jian Chu, Shuwang Yan and Wei Guo  
[\\*\\*\\*Please click here to download paper](#)
- 9: A New Lithostratigraphical Framework Proposed for Singapore 70-73  
 By K.K Lat, K.H Goay, S.G Lau, S.L Chiam and K.C Chew  
[\\*\\*\\*Please click here to download paper](#)
- 10: Economical Design for NSF Piles in Soft Clays using Soil-Structure Interaction 74-78  
 By Siew Ann Tan  
[\\*\\*\\*Please click here to download paper](#)
- 11: Towards a Design Framework for Spatial Variability in Cement Treatment for Underground Construction 79-84  
 By Y. Liu, Y. Jiang and F. H. Lee  
[\\*\\*\\*Please click here to download paper](#)
- 12: Advances and Challenges in Underground Space Use in Singapore 85-95  
 By Y. Zhou and J. Zhao  
[\\*\\*\\*Please click here to download paper](#)

## **PART C - Contributed Papers**

- 13: Effect of Ageing Environment on Fiber-Reinforced Polymer/Granular Interface Shear Behaviour 96 -100  
 By H.A. Shaia and H.M. Abuel-Naga  
[\\*\\*\\*Please click here to download paper](#)
- 14: Groundwater Flow Modeling and Slope Stability Analysis for Deepening of Mae Moh Open Pit Lignite Mine 101-115  
 By A.B.N. Dassanayake, N. Phien-wej and P. H. Giao  
[\\*\\*\\*Please click here to download paper](#)
- 15: A Study on Internal Erosion of Low-Plasticity Silty Sand 116-122  
 By Jing-Wen Chen, Bo-Rung Lin, Wei F. Lee and Yie-Ruey Chen  
[\\*\\*\\*Please click here to download paper](#)
- 16: Analysis of Influencing Factors on Brazilian Test Results Based on A Complex-shaped Grain Model 123-129  
 for Brittle Rock  
 By Guangcheng Yang and Xinghua Wang  
[\\*\\*\\*Please click here to download paper](#)
- 17: Effect of Infill Moisture Content and Thickness on Shear Behavior of Planar and Rough Rock Joints 130-135  
 By Tsu-Chiang Cheng, Shuh-Gi Chern, Shin-Ru Wu and Yu-The Lin  
[\\*\\*\\*Please click here to download paper](#)
- 18: Role of Bentonite in Improving the Efficiency of Cement Grouting in Coarse Sand 136-143  
 By T.G.Santhoshkumar, Benny Mathews Abraham, A, Sridharan, and Babu T Jose  
[\\*\\*\\*Please click here to download paper](#)

## **Cover Photographs:**

1. 1972 Po Shan landslide in HK (After Ho and Cheung 2016)
2. Examples of purpose-built caverns in HK (After Ng et al, 2016)
3. Layout plan of DTL3 alignment and location of C922 ORT in Singapore (After Ng and Low 2016)
4. Underground Ammunition Facility cavern in Singapore (After Zhou and Zhao, 2016)

# **GEOTECHNICAL ENGINEERING**

## **Paper Contribution, Technical notes and Discussions**

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

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

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

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

10. Authors need not be Society members. Each author's full name, Society membership grade (if applicable), present title and affiliation and complete mailing address must appear as a footnote at the bottom of the first page of the paper.
11. Journal papers submitted are subject to peer review before acceptance for publication.
12. Each author must use SI (International System) units and units acceptable in SI. Other units may be given in parentheses or in an appendix.
13. Maximum of five keywords should be given.
14. REFERENCES  
American Petroleum Institute (API) (1993). Recommended Practice for Planning, Designing and Constructing Fixed Offshore Platforms – Working Stress Design, API Recommended Practice 2AWS (RP 2A-WSD), 20th edition, 1993, p191  
Earth, J.B., and Geo, W.P. (2011). "Asian Geotechnical amongst Authors of Conference Publications", Proceedings of Int. Conference on Asian Geotechnical, publisher, city, pp 133-137.  
Finn WDL and Fujita N. (2002). "Piles in liquefiable soils: seismic analysis and design issues," Soil Dynamics and Earthquake Engineering, 22, Issues 9-12, pp731-742
15. Discussions on a published paper shall be made in the same format and submitted within six months of its appearance and closing discussion will be published within twelve months.

For additional information, please write to:

**The Secretariat, SEAGS**

*Room 211, AIT Library*

*Asian Institute of Technology*

*P.O. Box 4, Klong Luang*

*Pathumthani 12120, THAILAND*

*Email: [seags@ait.ac.th](mailto:seags@ait.ac.th)*

*Website: <http://www.seags.ait.ac.th>*

**Ir. Kenny Yee**

*Hon. Secretary General*

*Association of Geotechnical Societies in Southeast Asia*

*E-mail: [kenny.yeeks@gmail.com](mailto:kenny.yeeks@gmail.com)*

*Website: <http://www.agssea.org>*

**IEM Training Centre Sdn. Bhd.**

*No. 33-1A, Jalan SS 52/18*

*P.O. Box 224 (Jalan Sultan)*

*46200 Petaling Jaya, Selangor Darul Ehsan, MALAYSIA*

*Tel: (60) 03 7958 6851*

*Fax: (60) 03 79582851*

*E-mail: [iemtrainingcentre@gmail.com](mailto:iemtrainingcentre@gmail.com)*

*Website: <http://www.iemtc.com>*