

SC
SEMBENELLI CONSULTING srl

GEOTECHNICAL SPECIAL PUBLICATION NO. 206

DEEP AND UNDERGROUND EXCAVATIONS

PROCEEDINGS OF SESSIONS OF GEOSHANGHAI 2010

June 3–5, 2010
Shanghai, China

HOSTED BY
Tongji University
Shanghai Society of Civil Engineering, China
Chinese Institution of Soil Mechanics and Geotechnical Engineering, China

IN COOPERATION WITH
Alaska University Transportation Center, USA
ASCE Geo-Institute, USA
Deep Foundation Institute, USA
East China Architectural Design & Research Institute Company, China
Georgia Institute of Technology, USA
Nagoya Institute of Technology, Japan
Transportation Research Board (TRB), USA
The University of Newcastle, Australia
The University of Illinois at Urbana-Champaign, USA
The University of Kansas, USA
The University of Tennessee, USA
Vienna University of Natural Resources and Applied Life Sciences, Austria

EDITED BY
Fulvio Tonon
Xian Liu
Wei Wu

ASCE

Published by the American Society of Civil Engineers



Library of Congress Cataloging-in-Publication Data

GeoShanghai International Conference (2010)

Deep and underground excavations : proceedings of the GeoShanghai 2010 International Conference, June 3-5, 2010 Shanghai, China / edited by Fulvio Tonon, Xian Liu, Wei Wu. p. cm. -- (Geotechnical special publication ; no. 206)

Includes bibliographical references and index.

ISBN 978-0-7844-1107-0

I. Excavation--Congresses. II. Tonon, Fulvio. III. Liu, Xian, 1977- IV. Wu, Wei, 1961- V. American Society of Civil Engineers. V. Title.

TA730.G46 2010

624.1'9--dc22

2010012105

American Society of Civil Engineers

1801 Alexander Bell Drive

Reston, Virginia, 20191-4400

www.pubs.asce.org

Any statements expressed in these materials are those of the individual authors and do not necessarily represent the views of ASCE, which takes no responsibility for any statement made herein. No reference made in this publication to any specific method, product, process, or service constitutes or implies an endorsement, recommendation, or warranty thereof by ASCE. The materials are for general information only and do not represent a standard of ASCE, nor are they intended as a reference in purchase specifications, contracts, regulations, statutes, or any other legal document. ASCE makes no representation or warranty of any kind, whether express or implied, concerning the accuracy, completeness, suitability, or utility of any information, apparatus, product, or process discussed in this publication, and assumes no liability therefore. This information should not be used without first securing competent advice with respect to its suitability for any general or specific application. Anyone utilizing this information assumes all liability arising from such use, including but not limited to infringement of any patent or patents.

ASCE and American Society of Civil Engineers—Registered in U.S. Patent and Trademark Office.

Photocopies and reprints.

You can obtain instant permission to photocopy ASCE publications by using ASCE's online permission service (<http://pubs.asce.org/permissions/requests/>). Requests for 100 copies or more should be submitted to the Reprints Department, Publications Division, ASCE, (address above); email: permissions@asce.org. A reprint order form can be found at <http://pubs.asce.org/support/reprints/>.

Copyright © 2010 by the American Society of Civil Engineers.

All Rights Reserved.

ISBN 978-0-7844-1107-0

Manufactured in the United States of America.

Preface

At the current rate of population increase, only 650 years will elapse before each human being will have only 1 m^2 of land available. This is a paradoxical situation and something must happen before it is reached. On a geological scale, 650 years are a blink of an eye. Since the good of Society is at the top of Civil Engineers' ethics, Civil Engineers are urged to find solutions to cope with an ever increasing population. The pressure exerted by the population increase, the sensitivity toward the environment, and the ever increasing cost of the land all call for underground excavations as sustainable Civil Engineering infrastructures of this century to provide room for services, transportation of people and goods, water supply and disposal, sanitation, storage, etc.

Against this backdrop, the papers contained in this ASCE Geotechnical Special Publication testify to the research and practical implementations carried out around the world, and specially in China, to use the subsurface as a Civil Engineering dimension to solve today's Society's needs. Deep excavations and retaining structures, tunnels and underground excavations are covered in this volume together with new frontiers in urban geotechnology.

The hope of the Editors is that the volume be of interest to engineers that operate in the underground construction industry and to those that are approaching such a fascinating field. The Editors also wish that this set of papers contributes to increase the visibility of underground construction in the eyes of decision makers as a feasible and effective solution to the Society's needs.

The Editors:

Fulvio Tonon

University of Texas at Austin, USA

Xian Liu

Tongji University, China

Wei Wu

University of Natural Resources and Applied Life Sciences, Vienna, Austria

Acknowledgements

The Editors would like to express their sincere thanks to the reviewers that made it possible to provide feedback to the authors and eventually select the papers for publications. Their names are given here in alphabetical order.

Asadollahi Pooyan
Aschaer Franz
Bao Yihai
Berhe Tensay
Cai Yongchang
Chen Ran
Grabe Juergen
Hawks Andre
Idinger Gregor
Jia Xin
Jiang Xiaomo
Jiang Xiaomo
Kim Seung Han
Kolymbas Dimitrios
Li Lin
Li Xiaojun
Murray Brad
Pimentel Erich
Qi Jilin

Schanz Tom
Seo Sang Yeon
Tang Yongjin
Tao Jin
Triantafyllidis Theodor
Vogt Norbert
Wang Xuetao
Wang Yuannian
Xie Xiongyao
Xu Qianwei
Yang Hong
ye Guang
You Xiaomin
Zeiml Matthias
Zhang Dongmei
Zhao Huiling
Zhao Xu
Zou Yazhou

Contents

Deep Excavations and Retaining Structures

Design and Construction of Reinforced Steel Chain Wall	1
Kepha Abongo, Makoto Kimura, and Akihiro Kitamura	
Deformation Regularity and Simplified Calculation Method for Foundation Pit with Confined Water during Excavation and Dewatering	9
Chunlin Ding and Xiaohong Meng	
Model Tests and Numerical Simulations on Pile-Soil Interaction of Passive Piles	17
Jian Zhou, Xiao-liang Chen, Qing-you Zeng, and Biao Wu	
Design and Research of Circular Diaphragm Wall for Deep Excavation of Shanghai Tower	24
Jian Jia, XiaoLin Xie, ChuanPing Liu, JieQun Zhai, and Yu Zhang	
Analysis of Case Histories on Deep Excavations in Marine Clay	37
S. Y. Lam, X. Ma, and M. D. Bolton	
Analytic Method of Load-Displacement Curve for Tension Anchors Based on Hyperbolic Load-Transfer Function	43
Wei Liu, Long-zhu Chen, and Xiao-zhou Xi	
Experimental Research of Jet-Grouting Parameters in Different Soil Conditions	49
Alexey Malinin, Ilya Gladkov, and Dmitry Malinin	
Mitigation of Sheet Pile Movements during DDC by Open Trenches	55
Yong Tan, Fangle Peng, and Shaoming Liao	
Deep Excavation Induced Pile Movement in Bangkok Subsoil—A Numerical Investigation	62
Pornkasem Jongpradist, Tanapong Rukdecchuai, Sompote Youwai, Warat Kongkitkul, Attasit Sawatpanich, and Jutha Sunitsakul	
A Case Study of Retaining Wall with Soil-Cement Mixing Reinforcement for Korean Urban Site	70
YoungSeok Kim and YongSang Cho	
A Preliminary Study on the Behavior of Axially Loaded Single Pile Subjected to Lateral Soil Movement behind a Retaining Wall	76
Feng Yu, Feng Chu, and Fa-Yun Liang	
A Combined Retaining Structure and Its Application in Deep Excavation	84
Yuwen Yang	
Interaction Effect of Retaining Wall and Existing Foundations in Braced Excavation	92
H. M. Shahin, T. Nakai, M. Kikumoto, Y. Uetanti, and F. Zhang	

Deformation Prediction of Deep Excavation Based on Unequal Interval Grey Model GM(1,1).....	100
E-chuan Yan, Ying Li, Yu-lei Li, and Ting-ting Zhang	
Three Dimensional Performance Observed in an Irregular Deep Excavation in Shanghai Soft Clay	107
Hua Yuan and Qinghe Zhang	
Evaluation of Stability of Tailings Dam Based on Evolutionary Artificial Neural Network.....	114
Zai-hong Li, Rui Chen, and Wei-dong Lei	
Identification of Landslide Susceptible Slopes and Risk Assessment Using a Coupled GIS-FEA-Module.....	120
Franz-Xaver Trauner, Conrad Boley, and Eva Nuhn	
Deformation of Anchor-Sheet Pile Wall Retaining System at Deep Excavations in Soft Soils Overlying Bedrock	126
Jianqin Ma, Bo S. Berggren, Håkan Stille, and Staffan Hintze	
Centrifuge Model Study of Impact on Existing Undercrossing Induced by Deep Excavation.....	132
X. Y. Xie, Z. W. Ning, X. R. Liu, and F. Z. Liu	
<i>Tunneling and Underground Construction</i>	
Effectiveness of Ground Improvement for a Cut-and-Cover Tunnel with a Backfill Slope Based on Finite Element Analysis.....	144
Hong Yang	
Reconstruction of the Temperature Distribution on the Vertical Direction of Tunnel in Fire Accidents.....	152
Yin-gang Fang, He-hua Zhu, and Zhi-guo Yan	
Determination of Stress Release Coefficient and Analysis of Influence Factors in Granular Soil Tunnel.....	158
Zhuang Li and Shun-hua Zhou	
Study on Rock Mass Stability Effect of High Water Pressure Tunnels by Hydraulic Fracturing Failure	164
Zongli Li, Xiaohui Liu, and Qingwen Ren	
Application of Single Pass Tunnel Lining with Steel Fibre Reinforced Shotcrete on the Ventilation Shaft of Mount Motian Tunnel	170
L. J. Su, X. K. Xing, Z. P. Song, H. J. Liao, and S. Y. Wang	
Numerical Analyses and Elasto-Plastic Behavior Study on Surrounding Rock Mass of the Underground Caverns in a Hydropower Station during Deep Excavations	176
Yong Li, Weishen Zhu, and Linfeng Sun	
Study on Mechanism of Simultaneous Backfilling Grouting for Shield Tunneling in Soft Soils	182
Zhiren Dai, Yun Bai, Fangle Peng, and Shaoming Liao	
Study on Shiziyang Tunnel Engineering Geology and Shield Tunneling	191
Xinan Yang, Yongqin Yao, Ying Zhang, and Peixu Ye	

Numerical Analysis of the Thermo-Hydromechanical Behaviour of Underground Storages in Hard Rock	198
Y. Jia, H. B. Bian, G. Duveau, and J. F. Shao	
Study on the Influence of Mix Proportioning on Cemented Mortar Engineering Properties for Tail Void Grouting of Shield Tunnel	206
Yucwang Han, Wei Zhu, Quanwei Liu, and Xiaochun Zhong	
Experimental Test on Communication Cable Tunnel Constructed by Shield Tunneling Method for Maintenance	218
Linxing Guan, Hiroshi Irie, Toru Shimada, and Atsushi Koizumi	
The Determination of Geometric Characteristics of Irregular Underground Bodies	224
Mehdi Zamani	
Stability Analysis of the Front Slope of Small-Distance Highway Tunnel with Very Large Section Based on 3D Monitoring.....	232
Dongwu Xie and Wenqi Ding	
Research on 3D Numerical Model of Segment Lining for Large-Section River-Crossing Shield Tunnel	243
An-long Jiang and Zhao Yang	
Upper Bound Solutions for the Face Stability of Shallow Circular Tunnels Subjected to Nonlinear Failure Criterion	251
Fu Huang and Xiao-Li Yang	
Analytical to the Issue of Spherical Cavities Expansion with the Non-Linear Mohr-Coulomb Failure Rule.....	257
Jinfeng Zou, Jian-Guo Peng, Jin-hua Zhang, Heng Lou, and Ai-jun An	
Study on Maintenance Technology of Shield Tunnel in Soft Ground.....	265
Yi Rui, Hehua Zhu, Mei Yin, and Xiaojun Li	
Seismic Response of Large Span Shallow Tunnels in Dilative Rocks.....	274
Xiao-Li Yang and Bo Huang	
Experimental Study on Anchoring Effect of Rock Bolts to Fractured Rock Mass.....	280
Wei-min Yang, Nuan-dong Wen, Shu-cai Li, and Xiao-jing Li	
Study on Evaluation Method of Fire Safety of Tunnel Lining Structure	288
Zhiguo Yan and Hehua Zhu	
Investigation into Artificial Ground Freezing Technique for a Cross Passage in Metro	294
Dayong Li and Hui Wang	
The Studies on Intelligent Construction Pre-Control of a Foundation Pit in Shanghai	300
Ming Wang, Youliang Chen, and Junhua Wu	
Analytical Study on the Control of Ground Subsidence Arising from the Phenomenon of Accompanied Settlement Using Foot Reinforcement Side Pile.....	307
Ying Cui, Kiyoshi Kishida, and Makoto Kimura	

3D Numerical Simulation on the Failure Mechanism of Tunnel Working Face by Particle Flow Code	313
Chengbing Wang, Hehua Zhu, and Wensheng Gao	
The Application of F&EI Method in Risk Assessment of Tunnel Gas Explosion	320
Jifei Wang, Hongwei Huang, and Xiongyao Xie	
Analysis on Ground Deformation Caused by Tunnelling of Large-Diameter Tunnel Boring Machine	327
Zhiyong Yang, Hongwei Huang, and Dongmei Zhang	
The Technological Issues of Health Monitoring in Wuhan Yangtze River Tunnel Operations	335
Haitao Dou, Hongwei Huang, Yadong Xue, and Qunfang Hu	
Safety Influenced by Combined Action of Sulphate and Chloride to Shallow Highway Tunnel	343
Rong-rong Yi and He-hua Zhu	
Numerical Simulation of EPB Tunnel Face Instability in Dry Sand by Discrete Element Method	355
Lvjun Tang, Renpeng Chen, Yunmin Chen, and Daosheng Ling	
An Improved Pseudo-Static Seismic Analysis for Underground Frame Structures	363
Huiling Zhao and Yong Yuan	

Indexes

Author Index	371
Subject Index	373