Workshop on Frontiers of Multi-Hazard Mitigation Strategies in Urban Areas

– Highlighting geotechnical aspects –

2016 November 7th (Mon)

Room No.211, Lecture Hall 2, College of Economics

Yokohama National University

Workshop on Frontiers in Multi-Hazard Mitigation Strategies in Urban Areas

2016 November 7th（Mon）13:00 - 17:00
Room No.211, Lecture Hall 2, College of Economics
Yokohama National University

Program

◆Part 1, 13:00-15:30
Geo-hazards in urban areas and mitigation strategies

Sediment Disaster Risk Management in Japan
Dr. Hiroyuki Ono, Managing Director and Head, Sabo Technology Research Institute, Sabo Technical Center, Japan

Landslides, rockfalls, and debris flows researches at HK PolyU
Prof. Kam-Tim Chau, Professor, Department of Civil and Environmental Engineering, The Hong Kong Polytechnic University

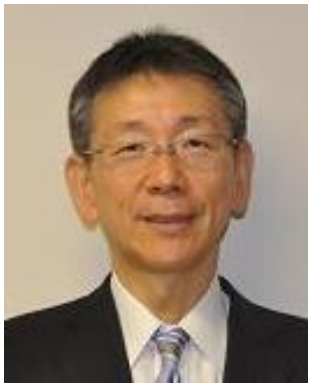
Geological Hazard Control of the Reconstruction and Recovery of Lushan Earthquake in China
Prof. Lin-Sheng Gu, Professor and Executive Director,
Institute for Disaster Management and Reconstruction,
Sichuan University - Hong Kong Polytechnic University

Strategies of Yokohama city for mitigating sediment disasters
Masato Tachibana, Chief Secretary for Crisis Management, Yokohama City

◆Part 2, 15:45-17:00
Multi-hazard mitigation strategies and urban risk management

Seismic retrofit of reinforced concrete structures using fiber-reinforced polymer composites
Dr. Jian-Guo Dai, Associate Professor, Faculty of Construction and Environment, The Hong Kong Polytechnic University

Long-period ground motion simulation and its impact on seismic response of high-rise buildings
Prof. You-Lin Xu, Chair Professor, Dean, Faculty of Construction and Environment, The Hong Kong Polytechnic University



Sediment Disaster Risk Management in Japan

by Hiroyuki Ono
Managing Director and Head,
Sabo Technology Research Institute,
Sabo Technical Center, Japan

Abstract
Mountainous and hilly terrains make up 70% of the total land in Japan. The Japanese islands are scattered with as many as 110 active volcanoes, accounting for about 10% of the earth's active volcanoes. Given highly weathered and rapidly changing geological and topographic setting, the Japanese islands are vulnerable to sediment disasters caused by heavy rains, earthquakes and volcano eruptions. In these conditions, sediment disasters occur in a variety of forms. In order to protect people and properties from sediment disasters, three types of preventive measures are taken: tangible measures building constructions; and two intangible measures by way of establishing a system of warning and evacuation, and restricting/ controlling development of new residential properties in sediment disaster prone areas.

Sediment Disaster Prevention Act (2000) requires relevant organizations in sediment disaster prone areas to establish warning and evacuation plans allowing smooth information sharing and thus quick actions to be taken by both governments and local people. Furthermore, in the designated sediment disaster prone areas, development activities are restricted and buildings are of debris-impact-proof type. It is also mandatory for prefecture governments and regional meteorological observatories to cooperatively issue Sediment Disaster Alert when there is an imminent risk of sediment disasters in a torrential rain. The Sediment Disaster Alert helps local municipalities judge to issue evacuation advisory/order.

The government of Japan is promoting comprehensive sediment disaster prevention measures including both tangible and intangible to cope with various types and dimensions of sediment disasters. It is necessary for us to develop rational risk assessment methods, designs of sabo facilities, methods to increase robustness of new and existing sabo dams, monitoring unstable slopes and detection of early signs of catastrophic landslides and breaching of natural dams.

Biography of Dr. Hiroyuki Ono
"Sabo" is now an English word of Japanese origin, meaning "sand erosion control." Dr. Hiroyuki Ono is one of key persons in the erosion and sediment control management in Japan. Most of his career, as shown below, has been involved with a number of projects of erosion and sediment control.

3. 1981 Graduated from Faculty of Agriculture, Kyoto University

4. 1981 Ministry of Construction
4. 1985 Chief of Planning Section, Sabo Division, Sabo Bureau, Ministry of Construction
1. 1993 Sabo Long Term Expert dispatched to the Republic of the Philippines by Japan International Cooperation Agency
4. 1998 Head of Yuzawa Sabo Construction Office, Hokuriku Construction Bureau, Ministry of Construction
4. 2007 Director General, Civil Engineering Bureau, Hiroshima Prefectural Government
4. 2010 Manager of Sabo Technology Research Institute of Sabo Technical Center
1. 2011 Director of Land Conservation Division, Sabo Department, River Bureau, Ministry of Construction
4. 2013 Director of Sabo Planning Division, Sabo Department, Water and Disaster Management Bureau, Ministry of Land, Infrastructure and Tourism
2. 2014 Director General, Sabo Department, Water and Disaster Management Bureau, Ministry of Land, Infrastructure and Tourism
11. 2015 Deputy Director General of Sabo Technical Center
4. 2016 Managing Director and Head of Sabo Technology Research Institute of Sabo Technical Center

Currently, Visiting Professor of Toyama Prefecture University

Doctor of Agriculture, Kyoto University
Professional Engineer of Civil Engineering
Professional Engineer of General Technology Project Management
Director of the Japan Society of Erosion Control Engineering

Landslides, rockfalls, and debris flows researches at HK PolyU

by K. T. Chau
Professor, Department of Civil and Environmental Engineering
The Hong Kong Polytechnic University

Abstract

Systematic investigations on landslides and debris flows have been conducted at PolyU. Bifurcation theory based model for creeping slope was proposed (Chau, 1995, 1999), and these papers opened up a new way of understanding landslides in terms of nonlinear mechanics. The model was further developed and cited by scientists from Stanford University (USA), University of Oregon (USA), Joseph Fourier University (France), University of Tokyo (Japan), University of Belgrade (Serbia), IIT Bombay (India), Helmholtz-Zentrum Potsdam (Germany), University of Edinburgh (UK), Columbia University (USA), University of Bristol (UK), Ecole Polytechnique (France), ETH Zurich (Switzerland), and UCLA (USA). In mainland China, Prof. S. Wang (member of Chinese Academy of Sciences) is the leading investigator extending this model to model real landslides. Numerical, theoretical and experimental analyses on debris flow, landslide and rockfall were conducted. The rockfall paper by Chau et al. (2002) on the "Coefficient of restitution and rotational motions of rockfall impacts" published in IJRMMS has been cited 198 times according to Google Scholar (citations are obtained from USA, France, Italy, mainland China, Switzerland, UK, Greece, Australia, Canada, Turkey, Spain, Germany, Austria, India, New Zealand, the Netherlands, Malaysia, Japan, Hong Kong, Korea, Egypt, Saudi Arabia, Taiwan, Iran, Poland, Portugal, and Norway). This work is particular widespread in mainland China because of its practical usefulness. In addition, GIS, fiber optics, GPS, and cloud computing have been employed. Pull-out strength and physical model tests of soil nails were conducted. A commercial software "Slope 2000" was developed and approved by the Buildings Department of the Hong Kong government. The first ever set of debris flows flume experiments were conducted at PolyU in 1999, and subsequently more experiments were conducted at Dongchuan debris flow observation and research station (operated by the China Academy of Sciences). Subsequently a 4-million Collaborative Research Fund was granted in 2014 by RGC to build a large scale debris flow flume in Hong Kong. This facility is useful in designing barrier to arrest debris flows from natural terrain. The first ever 3-D terrain based debris flow simulations were conducted using fluid flow models (Chau and Lo, 2004) and this can provide input conditions for our large scale flume tests.

References:

(1) Chau K.T. (1995) "Landslides modeled as bifurcations of creeping slopes with nonlinear friction law" *International Journal of Solids and Structures*, Vol. 32, No. 23, December, pp. 3451-3464 (SCI journal published by Elsevier).
(2) Chau K.T. (1999) "Onset of natural terrain landslides modeled by linear stability analysis of creeping slopes with a two state variable friction law" *International Journal of Numerical and Analytical Methods in Geomechanics* Vol. 23, No. 15, pp. 1835-1855 (SCI journal published by Wiley).

Biography of Professor K.T. Chau

Department of Civil and Environmental Engineering, The Hong Kong Polytechnic University

Prof. Chau is a Chair Professor of Geotechnical Engineering at the Hong Kong Polytechnic University. He obtained his Honors Diploma with distinction from Hong Kong Baptist College, Master of Engineering in Structural Engineering from the Asian Institute of Technology (Thailand) with the Tim Kendall Memorial Prize, PhD in Theoretical and Applied Mechanics from Northwestern University (USA), and an Executive Certificate from the Graduate School of Business of Stanford University (2005). He was a former Associate Head of CEE (2000-2006) and former Associate Dean of FCE (2006-2011). He is a Fellow of the Hong Kong Institution of Engineers (HKIE), and a recipient of the "Distinguished Young Scholar Award" of the National Natural Science Foundation, China (2003) and of the "Teaching Excellence Award" of the Department of Civil and Environmental Engineering (2013). He was the President of the Hong Kong Society of Theoretical and Applied Mechanics (2004-2006), Chairman of the Geomechanics Committee (2005-2010) of the Applied Mechanics Division (AMD) of American Society of Mechanical Engineering (ASME), the Vice President of the Hong Kong Institution of Science (2010-2011), and Chairman of the Elasticity Committee of the Engineering Mechanics Institute (EMI) at the American Society of Civil Engineers (ASCE) (2010-2012) as well as the Technical Committee TC103 of the International Society of Soil Mechanics and Geotechnical Engineering (2010-2013). He is a scientific advisor to the Hong Kong Observatory (2008-2018). He is a guest professor of the Taiyuan University of Technology and Beijing Institute of Technology, and a visiting professor to University of Calgary, Kyoto University, and Harvard University. His first book entitled "Analytic Methods in Geomechanics" was published by CRC Press (a member of Taylor & Francis Group) in 2013. His new book "Theory of Differential Equations in Engineering and Mechanics" is scheduled to publish in 2017 by CRC Press and is about 950 pages.

Geological Hazard Control of the Reconstruction and Recovery of Lushan Earthquake in China

by Lin-Sheng Gu
Professor and Executive Director,
Institute for Disaster Management and Reconstruction,
Sichuan University - Hong Kong Polytechnic University

Abstract

Compared with the reconstruction of Wenchuan earthquake, the reconstruction of Lushan earthquake pays more attention to geological disasters, and put forward a train of thought as “explore a new way of reconstruction and recovery with the guide of the Party Central Committee, the local government as the main body and the people in the disaster areas extensive participate in".The Sichuan provincial government organized to compile a series of special plans for the reconstruction and recovery of the Lushan Earthquake,such as "Special Plan of Eco-environment Restoration during the Reconstruction and Recovery of Lushan Earthquake ","Special Plan of Disaster Prevention and Mitigation during the Reconstruction and Recovery of Lushan Earthquake" and " Special Plan of Geological Hazard Prevention &Controlling during the Reconstruction and Recovery of Lushan Earthquake", according to the bearing capacity comprehensive evaluation of resources and environment, as well as a series of principles, such as "the Overall Plan of Reconstruction and Recovery after Lushan Earthquake", "Decision by the Sichuan Province Party Committee on Promoting the Scientific Reconstruction of Stricken Areas on Lushan earthquake and Speeding up the Construction of the Happy and Beautiful New Home" and "Strong Earthquake Disaster Assessment Report of Lushan Sichuan ‘4·20’". In the comprehensive management of geological hazards, the project measures were put forward on the area which faced a serious threat to public safety, the damage by major geological disasters in the project were repaired, and the dangers of moderate and slight geological disasters were eliminated. Measures of integrated management were applied on the mountains and small watershed that surround the major towns which risk high geological disasters. More attentions have paid to the geological hazard monitoring and warning, as well as the emergency capacity building. Professional monitoring was applied to the major geological disaster area, the monitoring and prevention system was improved, and the early warning and forecast consultation linkage mechanism was established. The construction of geological environmental monitoring station was strengthened, and the development of professional emergency team building was promoted. The concept of avoiding relocation put forward point to the scattered farms who live in a geological hazard threat area which the project management was not applied very well, and the phased approach was applied on the relocation. Poverty alleviation and development, ecological migration, construction

of new rural areas, urban reconstruction and resettlement of land were comprehensive considered on the process of relocation.

This report introduces the planning and policy of reconstruction on geological disaster management after earthquake, which base on the engineering techniques for debris flow control in Lengmu Gou, Baoxing County. Lengmu Gou is located in the north of Baoxing County, which catchment area is 9.44km2 , length of about 5.63km and the average longitudinal gradient is 212 per thousand. With the national AAAA tourist attraction ,the Ancient City of Panda, which is under the construction, Baoxing County has strengthened the integrated management of debris flow on Lengmu Gou area to ensure safety after the "4·20" strong earthquake in Lushan. Baoxing County also focus on creating a geological relics protection and science popularization park in the Lengmu Gou, and try to create a thanksgiving education base and a patriotic education base. Besides, the Country is under take to construct a Urban Ecological Leisure Park theme of the city of the Ancient City of Panda. The project of debris flow comprehensive management of Lengmu Gou has completed the prevention and control of debris flow progress, the viewing platform, the leisure landscape and the outdoor display construction of debris flow popular. The project now has become an important part of the Ancient City of Panda. It achieved the goal of reconstruction that the disaster area of the debris flow transforms to the geological park and promoting the disaster prevention education.

Biography of Professor Dr. Lin-Sheng Gu

Professor and Executive Director, Institute for Disaster Management and Reconstruction, Sichuan University - Hong Kong Polytechnic University.

In 1997, he completed a Doctoral degree from the Graduate School for International Development, Nagoya University, Japan.1998-2002,worked as one UN Researcher at the United Nations Center for Regional Development (Nagoya Office).2002-2005, visiting professor of the faculty of public management, Tsinghua University. From 2005 to 2009, worked as Director of Center for Public Safety Planning and Research, Urban Planning and Design Institute, Tsinghua University.From June 2013 to now , worked as Executive Director of Institute for Disaster Management and Reconstruction(IDMR) ,Sichuan University - Hong Kong Polytechnic University .

His research field mainly include disaster reduction risk, post disaster reconstruction and planning, emergency management and disaster education.

Tangible and intangible measures that Yokohama has been taking for slope failure risks

by Masato Tachibana
Chief Secretary for Crisis Management, Yokohama City

Abstract
Wet places tend to get wetter, and dry places dryer in the warming world. Recent heavy rains in Japan have been responsible for the increasing rate of about 1000 slope failures per year. Yokohama is no exception in that 20 to 50 slope failures have been occurring every year over the past decade. Given this situation, Yokohama city has been developing both tangible and intangible measures to mitigate damage caused by slope failures.
The torrential rain in the October 8th, 2014 Typhoon triggered a slope failure north of Yokohama, which killed two people. Since this event, geologists, on consignment from Yokohama City, have been conducting through field surveys at 9800 steep slopes in total 2,429 designated landslide-prone areas to extract most dangerous slopes to watch. For each of these extracted slopes, the city has decided to issue unexceptionally an evacuation advisory in response to issuance of mudslide warning from the Prefectural government and the Japan Meteorological Agency, allowing each county to respond without hesitation at a moment's notice.

Simultaneously, the city financially supports owners of steep slopes to stabilize their slopes. For this, the city offers two subsidy systems, one for full-scale slope protections, and the other for tentative measures. The subsidy system for full-scale slope protections has started since 2006. These protection works are to be based upon the Building Standards Law of Japan. The subsidy system for tentative measures has started since April, 2015. It was set up out of necessity to cope with unstable slopes where full-scale protection works are physically difficult.

Yokohama city has been taking all possible measures to mitigate slope failure disasters to be sure, but the most effective way is to realize the best balance among self-help, mutual assistance, and public assistance. With tangible measures such as strengthening retaining walls and intangible measures based upon risk awareness of people, I believe we can develop a more rational system to cope with slope failure problems.

Biography of Masato Tachibana
Superintendent for Crisis Management, City of Yokohama

Mr. Masato Tachibana, through his 38 years career in City of Yokohama, has been devoting much of his energy on all fronts in municipal government administration.

March 1976 Bachelor of Economics, Meiji University

Feb. 1978	Employed by City of Yokohama
May 2002	Executive Director, Health and Welfare Center, Seya Ward Administration Office
April 2004	Executive Director, Ward Support Department, Civic Affairs Bureau
April 2006	Executive Director for Management and Planning, Management and Planning Promotion Department, Urban Management and Planning Bureau
Dec. 2006	Executive Director, Management and Planning Promotion Department, Urban Management and Planning Bureau
April 2007	Executive Director, Management and Planning Promotion Office, Urban Management and Planning Bureau
April 2009	Director General, Health and Social Welfare Bureau
April 2012 -present	Superintendent for Crisis Management, City of Yokohama

Seismic retrofit of reinforced concrete structures using fiber-reinforced polymer composites

by Jian-Guo Dai
Associate Professor, Faculty of Construction and Environment,
The Hong Kong Polytechnic University

Abstract
Many existing reinforced concrete (RC) buildings in Hong Kong are vulnerable to earthquake since they were designed prior to the introduction of modern standard design codes provisions. The concept of strength hierarchy (e.g., strong-column weak-beam combination) was not considered in the design to develop sufficient structural ductility and robustness. Therefore, seismic retrofit is a very important issue for existing RC buildings in Hong Kong. Among the many techniques that have been developed, the use of externally bonded fiber-reinforced polymer (FRP) composites has gained increasing acceptance in the past two decades due to the high strength-to-weight ratio and non-corrosive property of FRP composites. In this presentation, two recent research developments in the speaker's group on two types of FRP strengthening techniques are introduced. One is near surface-mounted (NSM) FRP strips for strengthening of empty RC beam-column joints and the other is large rupture strain (LRS) FRP composites for strengthening of RC columns. Compared to externally bonded FRPs, NSM FRPs exhibit much better bond performance with the substrate concrete. On the other hand, LRS FRPs are cheaper and more environmentally friendly compared to conventional FRPs (i.e., carbon, glass and aramid) because the former are often made from recycled plastics (i.e. PET bottles).

The contents of the presentation consist of both experimental study and analytical modeling. The experimental studies covered LRS FRP-confined plain and RC columns under monotonic and cyclic axial compressive loading, LRS FRP-confined RC columns subjected to combined axial loading and cyclic lateral force, RC beams shear-strengthened with LRS FRP composites and NSM FRP-strengthened seismically deficient RC beam-column joints subjected to cyclic loading. The analytical modeling work consisted of development of various constitutive laws for FRP-confined concrete, buckling reinforcing bars in FRP-confined concrete and bond behaviour of NSM FRP strips as well as simulation of the structural behaviour of FRP-strengthened RC members under different loading schemes. Both experimental and theoretical work demonstrated that the desired strength hierarchy in seismically deficient RC structures can be realized through an optimal use of LRS FRP composites and NSM FRP strips and ductile failure can be achieved through the FRP strengthening.

Biography of Dr. Jian-Guo Dai

Dr. Jian-Guo Dai obtained his PhDs in Structural Engineering from Dalian University of Technology in 2000 and in Socio-Environmental Engineering from Hokkaido University in 2003. Before joining The Hong Kong Polytechnic University in 2008, he had two years of experience as a post-doctoral fellow at Hokkaido University and then worked as a research scientist in the Life Cycle Management Research Centre, Port and Airport Research Institute, Japan for two and a half years. His major research areas include "Fiber-Reinforced Polymer (FRP) Composites for Construction", "Durability and Life-cycle Management of Concrete Structures in Marine Environments" and "Fiber-reinforced Cementitious Composites". Dr Dai is the recipient of several academic awards including the "Best Research Paper Award'' from ASCE, Journal of Composites for Construction in 2005 and "Distinguished Young Scholar Award" from the Association of FRP for Construction, Chinese Society of Civil Engineers in 2011. He is an active member of IIFC, ISO/TC71, JCI and ACF. He is also an Editor of the SCI journal "Advances in Structural Engineering" and serves more than 50 international journals as a referee. Dr Dai has co-edited 3 conference proceedings and 4 SCI journal special issues. He has published 2 book chapters and about 180 international journal and conference papers (including 54 SCI journal papers). He has been the Chair, Co-chair or a member of organizing/scientific committees of more than 50 international conferences. He has delivered more than 50 invited presentations worldwide. At present, he is an Editor of the SCI journal of "Advances in Structural Engineering" and an Editorial Board Member of several international journals and serves more than 50 international journals as a referee.

Long-period ground motion simulation and its impact on seismic response of high-rise buildings

by You-Lin Xu
Chair Professor, Dean, Faculty of Construction and Environment, The Hong Kong Polytechnic University

Abstract
Long-period ground motion induced by earthquakes has recently gained increasing concern with the rapid development of high-rise buildings, long-span bridges, large spatial structure, and large offshore structures. This is particularly true for most of the modern mega cities, like Hong Kong, Shanghai, New York, Singapore and Dubai among others, with a dense cluster of high-rise buildings and located in the intra-plate regions with low or moderate seismicity. This is because on one hand, long-period seismic waves from distant large-magnitude earthquakes attenuate more slowly compared with high-frequency components and soft soils will amplify the long-period waves to a large extent. On the other hand, the natural periods of high-rise buildings are usually so long (>5s) that large resonant response will be induced by long-period ground motions, which will cause damage to structural or non-structural components of high-rise buildings.
In this study, the stochastic simulation procedure with a seismological model is reviewed and the variability of parameters in the seismological model is discussed. It is believed that the Q-f relationship accounting for the whole path anelastic attenuation follows different patterns in different frequency ranges and thus a 3-segment curve model (in log-log space) is proposed to model the Q-f relationship to overcome the potential biased estimation in the low-frequency components from the commonly-used coda wave method. The optimal curve-fitting process is performed to determine the Q-f relationship for Hong Kong region based on the digital ground motion recordings. The calibrated attenuation factor is incorporated with the stochastic simulation procedure to generate representative synthetic times series. The simulated results are validated through time domain and frequency domain comparison with measured seismic records. The impact of long-period ground motions on high-rise buildings is also manifested through a numerical study.

Biography of Professor You-Lin Xu
Professor You-Lin Xu received his PhD degree from University of Sydney, Australia. He is Chair Professor of Structural Engineering (2003-present), The Founding Director of Research Centre for Urban Hazards Mitigation (2002-present), former Head of Department of Civil and Environmental Engineering (2007-2013), and Dean of Faculty of Construction and Environment (2014-present) of The Hong Kong Polytechnic University. He has conducted research and consulting in structural engineering over three decades with special interests in wind engineering, structural health monitoring, structural vibration control and

smart structures. He has been engaged in many high-level projects, including the structural health monitoring projects on the Tsing Ma Bridge and the Stonecutters Bridge in Hong Kong. He has published over 230 SCI journal papers, delivered over 70 keynote/invited lectures at international conferences, and served in various capacities in several international associations and international journals. He has received several prestigious awards, including the 2006 Croucher Senior Research Fellowship, the 2010 Qian Ling Xi Computational Mechanics Award, and the ASCE 2012 Robert H. Scanlan Award in recognition of his outstanding research achievements. He wrote two books "Structural Health Monitoring of Long-Span Suspension Bridges" and "Wind Effects on Cable-Supported Bridges" published by Taylor & Francis and John Wiley & Sons respectively. He is Fellow of The Hong Kong Institution of Engineers, Fellow of American Society of Civil Engineers, Fellow of Engineering Mechanics Institute of USA, and Fellow of Institution of Structural Engineers of UK.

Organized by

International Strategy Organization, Yokohama National University
Faculty of Urban Innovation, Yokohama National University
Faculty of Construction and Environment, The Hong Kong Polytechnic University
Institute of Disaster Management and Reconstruction,
Sichuan University – Hong Kong Polytechnic University

Co-sponsored by

SAKURA Exchange Program in Science of the Japan Science and Technology Agency