2nd International Conference on

ACE Architectural, Civil, and Environmental Forensic Engineering

January 10-12, 2023

Webinar (Zoom)
Korea University, South Korea

Organized by f-PHI Hyper-converged Forensic Research Center for Infrastructure, Korean Geotechnical Society, KSSC Korean Society of Steel Construction, KOSHAM Korean Society of Hazard Mitigation

Sponsored by Ministry of Science and ICT, NRF National Research Foundation of Korea

2nd International Conference on

ACE Architectural, Civil, and Environmental
Forensic Engineering

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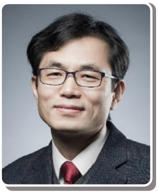
Welcome Message



On behalf of the organizing committee, I am sincerely pleased to invite you to the 2nd International Conference on Architectural, Civil, and Environmental (ACE) Forensic Engineering at Korea University in Seoul, Korea. The Hyper-converged Forensic Research Center committee for Infrastructures organized this 2nd international conference hosted by Korean Geotechnical Society (KGS), Korean Society of Steel Construction (KSSC) and Korean Sciety of Hazard Mitigation (KOSHAM).

This 2nd international conference takes place through an online Webinar (Zoom) during January 10-12, 2023. This conference aims to provide a current issue of Forensic Engineering relevant to failure, collapse, and other performance problems of construction facilities and built environments. The conference covers three major infrastructures (Underground, Structure, and Hydro-environment) and discusses well-withstand, reacting, and responding to large-scale complex disasters.

The core body of knowledge during the three-day long technical program will enhance our understanding of "Direction of Infrastructures against Complex Natural Disasters" and the fascinating conference theme "Hyper-converged Forensic Engineering" will lead to active Q&A sessions that enrich the conference. Indeed, this forensic research conference builds on curiosity-driven key research questions and contributes to bridging the gaps between academic achievement and industrial needs.

We would like to express the deepest gratitude to all the participants in this event, and special thanks to all distinguished speakers for their commitment and dedication. We hope you have an enjoyable and meaningful time during the event and we look forward to learning from your productive insights.

Jong-Sub Lee, Ph.D., P.E.

Professor, *School of Civil, Environmental & Architectural Engineering, Korea University*

Chair, *2nd International Conference on ACE (Architectural, Civil, and Environmental) Forensic Engineering*

PI, *Hyper-converged Forensic Research Center for Infrastructure (ERC sponsored by NRF), Korea University*

Day 1 Challenges in Geotechnical Engineering (Jan 10)

09:30-09:45	Registration
09:45-09:50	Welcome Address Jong-Sub Lee (PI, Hyper-converged Forensic Research Center for Infrastructure, South Korea)
09:50-10:00	Complimentary Address Moonkyung Chung (President in Korean Geotechnical Society, South Korea)
Session 1	**Underground Geosystems Stability Assessment** Chair : Prof. Jong-Sub Lee
10:00-10:30	On the Mechanical Behavior of Underground Pipeline Rehabilitated by Cured In Place Pipe Keh-Jian Shou (Vice President Asia in ISSMGE / Professor, National Chung Hsing University, Taiwan)
10:30-11:00	Characterization of Geotextile Tube Stability Yong-Hoon Byun (Professor, Kyungpook National University, South Korea)
11:00-11:30	Learning from Rehabilitation of Geotechnical Engineering Works Suttisak Soralump (President in South East Asia Geotechnical Society & Thai Geotechnical Society / Professor, Kasetsart University, Thailand)
11:30-12:00	Debris-Flow Hazard Assessment and Optimal Barrier Design Model for Mitigation Seung-Rae Lee (Professor, Korea Advanced Institute of Science and Technology, South Korea)
12:00-13:00	Lunch
Session 2	**Advanced Characterization Techniques for Geo-Infrastructures** Chair : Prof. Tae Sup Yun
13:00-13:30	Towards Community-Scale Landslide Resiliency: From 3D Mapping & Modeling of Past Natural Disasters to Preparing for Future Disasters Dimitrios Zekkos (Professor, University of California at Berkeley, USA)
13:30-14:00	Smart Sensing for Evaluation of Drilled Shaft Integrity Jong-Sub Lee (Professor, Korea University, South Korea), Jung-Doung Yu (Professor, Joongbu University, South Korea), Dongsoo Lee (Korea University, South Korea)
14:00-14:30	Current State of the Practice in the Philippines for Quality Assurance of Driven and Bored Piles Mark Albert Zarco (President in Philippine Society for Soil Mechanics and Geotechnical Engineering / Professor, University of the Philippines Diliman, Philippines)
14:30-15:00	Break
Session 3	**Forensic Failure Assessment** Chair : Prof. Yong-Hoon Byun
15:00-15:30	Geotechnical Marriage between Theory & Practice Marc Ballouz (President in ISSMGE / President in Int'l Institute for Geotechnics & Materials, Lebanon)
15:30-16:00	The Experience of Geotechnical Construction and Testing of Piling Foundations of Megastructures on Problematical Soil Ground of Kazakhstan Askar Zhussupbekov (Former Vice President Asia in ISSMGE / Professor, Eurasian National University, Kazakhstan)
16:00-16:30	Singapore Case Studies on Forensic Geotechnics Chun Fai Leung (Professor, National University of Singapore, Singapore)
16:30-17:00	Deep Learning for Image-Based Compressional Wave Velocity Prediction of Cement-Reinforced Soil Based on Core-Image Tae Sup Yun (Professor, Yonsei University, South Korea)
	Closing Comments

Day 2 Advanced Structural Engineering (Jan 11)

08:20-08:50	Registration
08:50-09:00	Introductory Comments & Welcome
Session 1	**Forensic Structural Engineering I** Chair : Prof. Thomas Kang
09:00-09:25	Beyond Machine Learning: Causality & Knowledge Discovery in Structural Engineering M.Z. Naser (Professor, Clemson University, USA)
09:25-09:50	Importance of Detailing on Response and Failure Mechanism of Bridges to Seismic Events Riyad S. Aboutaha (Professor, Syracuse University, USA)
09:50-10:15	Conditional Assessment of Fire Damaged Structures: From Reconnaissance to Advanced Analysis Venkatesh Kodur (Professor, Michigan State University, USA)
10:15-10:30	QnA
10:30-10:40	Break
Session 2	**Forensic Structural Engineering II** Chair : Prof. Seungjun Kim
10:40-11:05	Nonlinear Modeling of Beam-Column Joints in Forensic Analysis of Concrete Buildings Serhan Guner (Professor, University of Toledo, USA)
11:05-11:30	Assessment of Concrete Macrocrack Depth Using Infrared Thermography Young K. Ju (Professor, Korea University, South Korea)
11:30-11:55	Application of the Artificial Neural Networks on the Structural Health Monitoring for the Offshore Structures Seungjun Kim (Professor, Korea University, South Korea)
11:55-12:10	QnA
12:10-13:00	Lunch
Session 3	**Forensic Structural Engineering III** Chair : Prof. Seungjun Kim
13:00-13:25	Surrogate Model for Failure Back-Analysis Amichai Mitelman (Professor, Ariel University, Israel)
13:25-13:50	Utilising Artificial Neural Networks for Prediction Properties of High-Performance Concrete Harry Far (Professor, University of Technology Sydney, Australia)
13:50-14:15	Comparative Study on Dynamic Response of Fixed Offshore Wind Turbines with Different Substructures Using X-SEA Software Goangseup Zi (Professor, Korea University, South Korea)
14:15-14:30	QnA
14:30-14:40	Break
Session 4	**Forensic Structural Engineering IV** Chair : Prof. Seungjun Kim
14:40-15:05	Causes of Local Collapse of a Precast Industrial Roof after a Fire Bruno Dal Lago (Professor, University of Insubria, Italy)
15:05-15:30	Structural Health Monitoring of Railways Bridges Giorgio Monti (Professor, Sapienza University of Rome, Italy)
15:30-15:45	QnA
	Closing Comments

Day 3 Recent Approaches to React and Analyze Failures in Water & Environmental Systems in Climate Change (Jan 12)

09:20-09:50	Registration
09:50-10:00	Introductory Comments & Welcome
Session 1	**Water-Related Disaster Risk Reduction and Management** Chair : Prof. Donghwi Jung
10:00-10:20	Disaster Risk Management in Water Resources Engineering: Machine Learning Approaches Donghwi Jung (Professor, Korea University, South Korea)
10:20-10:40	Japan's New Policy on Water-Related Disaster Risk Reduction in Response to Climate Change Kenichi Tsukahara (Professor, Kyushu University, Japan)
10:40-11:00	Dynamic Evolution and Decoupling Analysis of Agricultural Nonpoint Source Pollution in Taihu Lake Basin during the Urbanization Process Dongying Sun (Professor, Jiangsu University, China)
11:00-11:20	Flood Risk Assessment to Economic Sectors in Vietnam Thi Thuy Ngo (Principal Researcher, Vietnam Institute of Meteorology Hydrology and Climate Change, Vietnam)
11:20-11:40	QnA
11:40-13:00	Lunch
Session 2	**Hydrology and Climate Change** Chair : Prof. Chulsang Yoo
13:00-13:20	No-Regret Climate Change Adaptation with Paradigm-Shifts against Water-Related Disaster in Japan Eiichi Nakakita (Professor, Kyoto University, Japan)
13:20-13:40	The Impact of Climate Change on Rainfall Patterns Seokhyeon Kim (Professor, Kyung Hee University, South Korea)
13:40-14:00	Application of Single Model Initial-condition Large Ensemble (SMILE) in Projecting Hydroclimatic Whiplash Wooyoung Na (Postdoctoral Associate, Western University, Canada)
14:00-14:20	Development of Regional Flood Forecasting System Based on Rainfall Radar Seokhwan Hwang (Research Fellow, Korea Institute of Civil Engineering and Building Technology, South Korea)
14:20-14:40	QnA
14:40-15:00	Break
Session 3	**Recent Advancement in Water Treatment Technologies in Response to Climate Change** Chair : Prof. Seungkwan Hong
15:00-15:20	Low Carbon and Circular Seawater Desalination Technology Seungkwan Hong (Professor, Korea University, South Korea), Jungbin Kim (Postdoctoral Researcher, Korea University, South Korea)
15:20-15:40	Electromagnetism for Enhancing the Performance of Emerging Water Desalination Processes Emad Alhseinat (Professor, Khalifa University, UAE)
15:40-16:00	Advances in Water Reuse Wontae Lee (Professor, Kumoh National Institute of Technology, South Korea)
16:00-16:20	Field Application of Positively Charged Bubble (PCB) Technology for Algae Removal and Further Utilization Mooyoung Han (Professor Emeritus, Seoul National University, South Korea)
16:20-16:40	QnA
	Closing Comments

On the Mechanical Behavior of Underground Pipeline Rehabilitated by Cured In Place Pipe

Keh-Jian Shou, National Chung-Hsing University

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Aged underground pipelines are commonly located below busy roads, and the traditional open-cut repairing methods involves possible social and economic impacts on traffic and businesses. Therefore, trenchless methods provide superior alternatives that avoid these concerns. As one of the trenchless rehabilitation methods, cured-in-place pipe (CIPP) possesses the advantage that it can preserve the original pipe alignment even under conditions such as joint separation or pipe bending. In this study, numerical analysis was applied to investigate the mechanical behavior of damaged underground pipeline rehabilitated by CIPP. The numerical model was calibrated by the laboratory test results, then applied to simulate the rehabilitated pipelines with various geometries and loading conditions. The influence of control factors (e.g., backfill, and interface) on CIPP rehabilitation performance was also analyzed in detail. The results of this study suggest that the CIPP could improve the damaged underground pipeline to certain extent, and the findings could be applied in design optimization and guideline development.

Keh-Jian (Albert) Shou is elected VP Asia of ISSMGE (2022~2026), now Chairman of ISTT, Honorary Chairman of CTSTT, and Distinguished Professor of Department of Civil Engineering, National Chung-Hsing University, Taiwan. His research interests include rock mechanics/engineering, engineering geology, and trenchless technologies. He has published more than 200 papers on these topics and is now the editor of Tunnelling and Underground Space Technology(SCI), and the associate editor of the ASCE Journal of Pipeline Systems Engineering and Practice(SCI) and Underground Space (SCI). He obtained his Ph.D. degree (Civil Engineering) from University of Minnesota, U.S.A. in 1993. His experience includes: 1. Senior Principal Engineer, Shannon & Wilson, Seatlle, USA (2008/2~ 2008/9), 2. Visiting Professor, TTC, Louisiana Technical University, USA (2006/1~ 2006/2), 3. Visiting Professor, RCUSS, Kobe University, Japan (2003/10~2004/3), 4. Research Engineer, CSIR/Miningtek, South Africa (1998/2~1999/1), 5. Geotechnical Engineer, National Expressway Engineering Bureau, Taiwan (1993-1994).

Characterization of Geotextile Tube Stability

Yong-Hoon Byun, Kyungpook National University

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Geotextile tubes are widely used in coastal protection, beach restoration and embankment reinforcement. Soils dredged on-site with a high water content are typically used to hydraulically fill the geotextile tubes, because the geotextile tubes can drain the water and retain the soil particles of the slurry. Generally, individual geotextile tube seems stable due to its high ratio of base width to height. However, the internal strength profile of geotextile tubes has not been sufficiently characterized yet, and furthermore, the structural stability of the stacked geotextile tubes can be affected by the internal shear strength of each tube. Therefore, the presentation contains the characterization of geotextile tube stability, which is divided into three themes: (1) internal strength characterization; (2) interface reinforcement between geotextiles; (3) behavior of stacked geotextile tubes. The first theme is to evaluate the internal shear strength of geotextile tubes using a miniature cone in a small-scale model test. Secondly, the characteristics of the interface friction between two geotextiles with respect to reinforcement will be demonstrated. Using three types of geotextiles and a cementitious binder, a series of direct shear tests for both unreinforced and reinforced geotextiles are performed along the curing period. Lastly, this presentation includes the horizontal and vertical displacements of four stacked geotextile tubes monitored using a dual camera system and digital image correlation technology. The interface layers between upper and lower geotextile tubes are either unreinforced or reinforced with a cementitious binder. As a result, this presentation shows the efficiency of interface reinforcement between geotextile tubes and the promising characterization techniques to evaluate the internal strength profile and displacement distribution of geotextile tubes.

Yong-Hoon Byun is currently working as an Associate Professor at the School of Agricultural Civil & Bio-Industrial Engineering at Kyungpook National University (KNU). He received his bachelor's degree (2009) and his Ph.D. (2014) in Civil and Environmental Engineering from Korea University. After working at Korea University for one year (2014~2015), he joined the Transportation Geotechnics research group at the University of Illinois as a Postdoctoral Research Associate in 2015. In 2017, he was hired as an Assistant Professor in Kyungpook National University. He specializes in characterization of various geo-materials using advanced in-situ testing methods and wave-based nondestructive testing methods. He is the Associate Editor of the International Journal of Geo-Engineering and the Editorial Board Member of Journal of Korean Society of Agricultural Engineers. He was honored with Young Researcher Awards by Korean Geotechnical Society (2018) and Korean Society of Agricultural Engineers (2021). He was selected as Young Geotechnical Engineers Symposium Delegate at 16th Asian Regional Conference on Soil Mechanics and Geotechnical Engineering nominated by Korean Geotechnical Society (2019). He is also a co-investigator of Hyper-converged Forensic Research Center for Infrastructure. His research interests are environmental-friendly binders and geosynthetics for embankment stabilization and advanced monitoring systems for transportation substructure and earth dam.

Learning from Rehabilitation of Geotechnical Engineering Works

Suttisak Soralump, Kasetsart University

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Most of infrastructure projects require good practice of Geotechnical engineering to achieve the desired goal. However, some basic Geotechnical knowledge might be overlooked and cause a serious outcome to the project. Learning from design and construction of the project is one thing but learning its performance during the operation is very essential. This lecture will give an example of projects that had serious Geotechnical issues that affected the operation and objective of the use of the structures. The detail research work of the project related to dams, slope and soft clay foundation will be discussed in this lecture to reveal what really happened along with their rehabilitation works. The use of probabilistic analysis to cope with uncertainty in input parameters will also be discussed. Therefore, it is essential for using engineering-wise design to prevent the unforeseen problems and not to repeat the same mistake again.

Suttisak Soralump is an Associate Professor in Civil Engineering Department , Kasetsart University. He is graduated with B.Eng. from Chulalaongorn University, M.Eng. (Soil Engineering) from Asian Institute of Technology, and PhD (Geotechnical Engineering) from Utah State University. He is the President of Thai Geotechnical Society and Southeast Asian Geotechnical Society and Chairman of Disaster Preparedness and Mitigation Working Group of AFEO. Dr. Suttisak specialize in Dam engineering, soft ground improvement, Slope stabilization, Geohazard mitigation, Landslide, Geotechnical Earthquake Engineering, Ground subsidence. Dr. Suttisak is an experienced Geotechnical Engineer. He was a team leader for more than 20 large dam rehabilitations, design and construction in Thailand and abroad. He is also involved in various ground improvement projects and has influenced in preparing several Engineering codes and Law related to Geo-hazard. He received many awards including Geotechnical Engineer of the year and Best National teacher of the year.

Debris-Flow Hazard Assessment and Optimal Barrier Design Model for Mitigation

Seung-Rae Lee, Korea Advanced Institute of Science and Technology

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Debris-flow hazards-prone regions pose a significant risk to people and infrastructures, which may cause casualties and inflict significant financial losses. Therefore, a comprehensive and efficient debris-flow risk assessment framework for assessing hazard risk and designing optimal barriers as mitigation measures are essential. The developed framework utilizes the following components to identify debris-flow risk and design optimal barriers: (a) UAV-spectral technology for quick site investigation to collect digital elevation model (DEM) and in-situ soil conditions, (b) statistical and physical model for identifying regional to large-scale landslide susceptibility, (c) SPEC-debris model for simulating debris-flow, (d) optimal closed and open-type barrier location selection model, and (e) SPEC-debris model for evaluating barrier performance. The SPEC-debris model is a depth-averaged numerical analysis model to simulate runout through the following governing equations: (a) smoothing particle hydrodynamic (SPH), (b) pathway algorithm adopted from shallow-water equations (SWE), (c) energy conservation model incorporating entrainment principle and Voellmy rheology, and (d) collision mechanism. The optimal barrier location selection model utilizes the debris-flow network data structure to model debris-flow propagation and the heuristic optimization model to find the most sustainable and cost-effective barrier locations that satisfy multiple engineering requirements. The SPEC-debris-barrier platform, which contains the SPEC-debris model, is an analysis software for simulating debris-flow, selecting optimal barrier locations, and evaluating barrier performance. The capability and applicability of the developed framework are demonstrated through the debris-flow disaster in 2011 at Mt. Umyeon, Seoul, South Korea.

Seung-Rae Lee is a Professor of Civil and Environmental Engineering at the Korea Advanced Institute of Science and Technology (KAIST). Seung-Rae Lee received his bachelor's and master's degrees in civil engineering from Yonsei University in 1982 and 1984, respectively. Afterward, he received his master's degree and Ph.D. from Stanford University in 1985 and 1989, respectively. In 1989, he was hired as an Assistant Professor at the Korea Advanced Institute of Science and Technology (KAIST), where he is currently a Professor. He delivered many keynote lectures and seminars, including the 2021 Korean Geotechnical Society Fall Conference. His research interests include landslide hazard assessment and mitigation methods, in-situ data acquisition techniques, and thermo-hydro-mechanical properties of bentonite buffer in high-level radioactive waste storage.

Towards Community-Scale Landslide Resiliency: From 3D Mapping & Modeling of Past Natural Disasters to Preparing for Future Disasters

Dimitrios Zekkos, University of California at Berkeley

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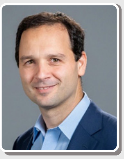
Landslides represent a distributed hazard that has significant consequences on infrastructure and communities. They occur due to a range of environmental "stressors" such as precipitation events, earthquakes, and human activities. Despite our capacity to reliably back-analyze landslides following their occurrence, our ability to predict the occurrence of landslides within a region remains limited, due to the lack of regional computational models with reliable, spatially-resolved input parameters. However, a predictive ability is key for our communities to become resilient against landslides. Advances in multi-scale monitoring approaches using satellites, Unmanned Aerial Vehicles and on-the-ground deployments can be leveraged to generate this input that can be used to calibrate predictive regional models. In this presentation, an application of such regional co-seismic landslide resiliency frameworks will be presented with a focus on the landslides that occurred during the November 17th 2015, M_w 6.5 earthquake in the island of Lefkada, Greece. The earthquake resulted in 700+ landslides. Using the satellite and UAV-based imagery, three-dimensional models of the co-seismic landslides at high resolution were created. The satellite and UAV imagery was also complemented with on-the-ground, in situ investigations. Regional slope stability analyses were conducted to match the mapped landslides following the earthquake and the insights were used for regional resiliency assessment against landslides as well as predictive modeling of subsequent events.



Dimitrios Zekkos, PhD, PE, is a Professor in the Civil and Environmental Engineering Department at the University of California at Berkeley and the CEO of ARGO-E an infrastructure analytics company. Dimitrios received his undergraduate degree from the University of Patras in Greece and his MSc and PhD from the University of California at Berkeley. Prior to joining Berkeley, Dimitrios worked at a consulting company in the Bay Area and was a faculty member at the University of Michigan. His research work is at the interface of natural hazards, geotechnical engineering, and informatics. He has deployed following disasters in many areas including the USA, Nepal, New Zealand, Japan, Dominica and Greece following natural disasters, such as earthquakes, hurricanes and monsoons. His research group devises and employs experimental and computational approaches to characterize the response of the geo-environment and infrastructure to natural hazards. His research has been recognized with several research Awards by organizations such as the American Society of Civil Engineers and the International Society for Soil Mechanics and Geotechnical Engineering. He can be reached at: https://dimitrioszekkos.org/

Smart Sensing for Evaluation of Drilled Shaft Integrity

Jong-Sub Lee, Korea University

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This study proposed and demonstrated a smart monitoring system that uses transmission lines embedded in a reinforced concrete structure to detect the presence of defects through the changes in the electromagnetic waves generated and measured by a time-domain reflectometer. Laboratory experiments were first conducted to identify the presence of voids in steel–concrete composite columns. The results indicated that a void in the concrete caused a positive signal reflection, and the amplitude of this signal decreased as the water content of the soil in the void increased. Multiple voids resulted in a decrease in the amplitude of the signal reflected at each void, effectively identifying their presences despite the amplitude reduction. Furthermore, the electromagnetic wave velocity increased when voids were present, decreased as the water content of the soil in the voids increased, and increased with the water–cement ratio and curing time. Field experiments were then conducted using bored piles with on-center (sound) and off-center (defective) steel reinforcement cage alignments. The results indicated that the signal amplitude in the defective pile section—where the off-center cage was poorly covered with concrete—was greater than that in pile sections where the cage was completely covered with concrete. The crosshole sonic logging results for the same defective bored pile failed to identify the off-center cage alignment defect. This study therefore demonstrated that electromagnetic waves may provide a useful tool for the health and integrity monitoring of reinforced concrete structures.

Jong-Sub Lee is a Professor at the School of Civil, Environmental, and Architectural Engineering at Korea University, and had served as an Associate Dean at the Graduate School, KU (2017-2019). Jong-Sub Lee received his bachelor's degree in in civil and environmental engineering from Korea University in 1991 and his master's degree in civil and environmental engineering from KAIST (Korea Advanced Institute of Science and Technology), Korea in 1993. After working for the Hyundai Engineering and Construction Company for seven years (1993~1999) as a research engineer, he entered the civil and environmental engineering graduate program at the Georgia Institute of Technology (Georgia Tech) in 2000. In 2003, he received his Ph.D. from Georgia Tech. In 2005, he was hired as an Assistant Professor in Korea University, where he is currently a Professor. He is a Principal Investigator (PI) of Hyper-converged Forensic Research Center for Infrastructure (ERC sponsored by National Research Foundation of Korea). He delivered many keynote lectures in international conferences including the 19th International Conference on Soil Mechanics and Geotechnical Engineering (ICSMGE). He is member of the National Academy of Engineering of Korea. He published more than 255 journal papers (140 international and 115 national) and 290 conference papers until 2022. His research interests are non-destructive testing and evaluation with advanced sensing, in-situ subsurface characterization, and foundations.

Current State of the Practice in the Philippines for Quality Assurance of Driven and Bored Piles

Mark Albert Zarco, University of the Philippines Diliman

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Given the often-challenging geotechnical conditions underlying most construction sites in the Philippines, pile foundations are a common scheme for founding structures. The majority of pile foundations in the Philippines consist of either pre-cast concrete piles or cast-in-place concrete bored piles. This paper presents an overview of the current state of practice regarding the quality assurance procedures used to identify installation and construction defects in driven and cast-in-place concrete piles. Quality assurance procedures generally involve tests aimed at determining the allowable capacity of the pile through either static or high-strain dynamic load tests, performed in combination with pile-integrity tests typically consisting of low-strain pile integrity tests (PIT) for driven piles or cross-hole sonic logging (CSL) for cast-in-place bored piles. The complementary nature of these tests in identifying installation or construction defects is highlighted in this paper and diagnosing the underlying causes in the construction protocol. The paper concludes by summarizing current challenges to implementing quality assurance protocols and provides recommended improvements to the current state of practice for addressing these challenges.

Mark Albert Zarco is a Professor and Head of the Geotechnical Engineering Group, Institute of Civil Engineering University of the Philippines Diliman. He is also the current chair of the Specialty Division for Geotechnical Engineering of the Philippine Institute of Civil Engineers (PICE), President of the Philippine Society for Soil Mechanics (PSSMGE) which is a member society to the ISSMGE, and serves as a Director in the International Press-in Pile Association (IPA). He is an honorary member of the Association of Structural Engineers of the Philippines (ASEP), and serves as the vice-chair of the ASEP Technical Committee on Soils and Foundations. His research interests lie in the area of computational geomechanics and its application to geotechnical engineering as well as the assessment and mitigation of risk association to geotechnical hazards. He holds a Doctor of Philosophy in Civil Engineering majoring in Geotechnical Engineering from the Virginia Polytechnic Institute and State University.

Geotechnical Marriage between Theory & Practice

Marc Ballouz, International Society of Soil Mechanics & Geotechnical Engineering

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This lecture is an effort to summarize years of practice in geotechnical and forensic engineering, lessons learned from combining design, contracting, academia and research. The lecture will introduce the concept of SOLGEH with the importance of collecting data prior to conducting any engineering analysis or giving any recommendations. The importance of a stable engineering solution lies in providing functionality with a cost effective solution without compromising safety. Every engineer should be very vigilant in checking the compatibility of units in every numerical data obtained or issued as most engineering problems in life come from the lack of matching units and incompetence of checking the logic of results. Skills are obtained from practice, and this is true in engineering. The best practice is in the every day life; thus engineering should be lived during the daily activities. Common example is in the observation of walking on sand that can tell us a lot about the theory we learn such as Terzaghi's equation. It is wrong to rely on intuition when solving engineering problems as it may lead to wrong conclusions. Theories were developed to be used. Key equations have changed humanity throughout history. Every engineering problem, simple or complicated, should be analyzed and theories applied before submitting results and taking decisions. The importance of marrying theory to practice is shown in many case histories. Lessons learned from some of those case histories are presented in this lecture in an effort to make an impact and leave the audience with some useful conclusions.

Marc Ballouz, is the president of ISSMGE, the international society of soil mechanics & Geotechnical Engineering. ISSMGE was founded in 1936 by Karl Terzaghi, the father of modern geotechnics, and currently represents 90 country members with more than 30,000 geoengineers. This is the highest position a geotechnical engineer can reach worldwide. Dr. Ballouz is known for being the man of all trades: A solid theoretician as well as a hands-on practitioner. His engineering journey started early on when he was 15 on construction sites with his father civil engineer. After obtaining his PhD degree from Texas A&M University, He established his own company IGM that quickly became international, known for its Design/Built innovative solutions. He was simultaneously teaching at 3 universities from 1996 to 2008, and currently is a visiting professor teaching foundation engineering at Texas State University. He has more than 10 key papers in renowned geotechnical engineering journals, and more than 100 design/built reports for large and challenging projects worldwide, and many other publications including the famous YouTube video "what is geotechnical engineering" that got him the prestigious ISSMGE Public Relations award. He was active for 8 years at the ISSMGE board from 2009 to 2017. He was serving on the board of the GEOINSTITUTE of America (2021-2022) when he was elected President of ISSMGE on May 1st 2022.

The Experience of Geotechnical Construction and Testing of Piling Foundations of Megastructures on Problematical Soil Ground of Kazakhstan

Askar Zhussupbekov, L.N. Gumilyov Eurasian National University / Saint Petersburg State University of Architecture and Civil Engineering / Moscow State University of Civil Engineering

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This lecture presents the results of the geotechnical construction and testing of piling foundations of the Megastructures on problematical soil ground of (Abu-Dhabi Plaza, Expo-2017, LRT, BAKAD, International Hospitals in Petropavlovsk and Astana). A series of the static and dynamic piling tests, plate load tests, BDLT and PIT, Cross-hall investigations were carried out. The characteristics of difficulty soil mass associated with different layers were evaluated using numerical simulation as soil-structure interaction. The results show by graphically and also with analysis summarizing conclusions. This presentation will focus on the field applications of the megastructures on boring and drilling piles on problematical soil ground of Kazakhstan. This lecture provides programs and results of piling tests with static and

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different of the six construction sites under difficulty soil conditions. Forensic geotechnical engineering included comparison of test results which provided by different international standards (Kazakhstan codes, Eurocodes, American standards, etc.). These applications are important for understanding of interaction of piles with problematical soil ground of Megastructures of Kazakhstan.

Singapore Case Studies on Forensic Geotechnics

Chun Fai Leung, National University of Singapore

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Geotechnical failures occasionally take place in many parts of the world. Post-failure investigations would be initiated to establish the causes of failures such that lessons can be learned and mistakes not to be repeated as well as establish the guilty party involved for the purpose of court proceedings or compensation. However, such investigations are not straightforward as there are often missing or incomplete information and supporting documents resulting in missing links among the various stages of investigations. In this lecture, a number of cases studies are presented starting with the straightforward cases with the causes of failure readily identified after brief period of investigations. Less straightforward cases are then presented illustrating the necessary technique and expertise to dissect these cases. Finally, a couple of complex cases are then presented to highlight that for major geotechnical failure, it is often a combination of multiple factors that cause significant failures. The procedure to identify the order of importance of the factors is elaborated.

Chun Fai Leung is an Emeritus Professor at the Department of Civil and Environmental Engineering at the National University of Singapore (NUS), Prof Leung received his Bachelor and PhD degrees in civil engineering from the University of Liverpool, UK. His research interests include centrifuge modelling as well as offshore and marine geotechnics. He has published over one hundred papers in top tier international geotechnical and offshore engineering journals. Prof Leung delivered many keynote/invited lectures in international geotechnical and offshore engineering. He is a fellow of Academy of Engineers Singapore. Prof Leung received the Singapore Ministry of Transportation Innovation Awards in 2008 and 2021 and the Outstanding Geotechnical Engineer Award from the Geotechnical Society of Singapore in 2012. Prof Leung is also active in geotechnical practice as he has served as geotechnical consultant for over one hundred projects in Singapore and beyond. He has also served as expert witness for a number of geotechnical failures and issues.

Deep Learning for Image-Based Compressional Wave Velocity Prediction of Cement-Reinforced Soil Based on Core-Image

Tae Sup Yun, Yonsei University

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This study proposed a novel approach to predicting the compressional wave velocity (Vp) from surficial core images taken from a cylindrical core specimen of cement-reinforced soil using a convolutional neural network (CNN) regression model. It is based on the hypothesis that the internal structure of the specimen is partially exposed on the circumferential surface of the specimen by coring, so that the surficial core image is related to the compression wave velocity. Experimental measurement of Vp was conducted at hundreds of points along the horizontal direction in cylindrical cores, and the corresponding core images were cropped to include the measurement points. A dataset was prepared by pairing the pre-processed surficial core images with the measured Vp values, and a CNN regression model with a pre-trained backbone network by transfer learning as a feature extractor was constructed. Data augmentation and several regularization strategies were applied for stable learning while avoiding overfitting problems, and retraining of the network model by fine-tuning was performed under supervised learning. The predictive results of the trained network model achieved a convincing R-squared value of 0.78. Compressional wave velocity inherently describes the internal structure of the specimen, while the proposed model only used the surficial core images, resulting in slightly scattered predictions. The internal structure of the over- and under-estimated specimens was observed using 3D x-ray computed tomographic imaging, and it revealed that surficial core images insufficiently reflected their internal structure. Nevertheless, this study showed that consecutive Vp profiles could be obtained by estimating Vp at unmeasured points based on core images, and the proposed approach demonstrates the feasibility of image-based prediction of geotechnical properties.

Tae Sup Yun is a Professor at the Department of Civil and Environmental Engineering at Yonsei University, and now serves as an Associate Dean in College of Engineering (2020-2022). Tae Sup Yun received his bachelor's degree in Geology from Yonsei University in 1997. In 2001, he entered the civil and environmental engineering graduate program at the Georgia Institute of Technology (Georgia Tech) where he received his M.S. and Ph.D. in 2003 and 2005. Then, he was hired as a P.C. Rossin Assistant Professor at Lehigh University. In 2009, he joined Yonsei University. His research interests include deep learning based analysis of geotechnical visions and images, optimization of tunnelling by artificial intelligence, multi-phase fluid flow, and geophysical characterization of geomaterial.

Beyond Machine Learning: Causality & Knowledge Discovery in Structural Engineering

M.Z. Naser, Clemson University

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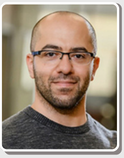
This talk aims to showcase the big ideas behind causality and machine learning (ML) from structural and fire engineering perspectives. A key focus is to showcase the fundamentals and outline the key differences between causality, ML and other traditional methods such as testing and numerical simulations. A second focus is to illustrate that without knowing how algorithms work and predict, we cannot truly rely on ML as we cannot interpret its logic, which brings scientific and ethical questions that warrant our attention as well as investigation. A primary goal is to educate researchers, practitioners, students and officials on the merit of augmenting ML with causality principles and explainability. Finally, we will share a philosophical view of ML as a knowledge discovery system that can help advance the domain of structural engineering.



M.Z. Naser is a tenure-track assistant professor at the School of Civil and Environmental Engineering and Earth Sciences & a member of the Artificial Intelligence Research Institute for Science and Engineering (AIRISE) at Clemson University. At the moment, his research group is creating Causal & eXplainable machine learning methodologies to discover new knowledge hidden within systems belonging to the domains of Structural engineering and Materials science to help us realize functional, sustainable, and resilient infrastructure. Much of his current projects cover the areas of structural & fire engineering, tailoring properties of construction materials, and retrofitting of aging structures. He is currently serving on a number of international editorial boards, as well as codal building committees (in ASCE, ACI, PCI, and FiB). He has published more than 100 SCI(E) indexed papers and three books on structural engineering and machine learning.

Importance of Detailing on Response and Failure Mechanism of Bridges to Seismic Events

Riyad S. Aboutaha, Syracuse University

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Well designed and detailed bridge maintains its integrity without collapse during seismic event. However, if a reinforced concrete bridge is poorly detailed due to lack of continuity of steel reinforcement, collapse of the bridge is inevitable. To maintain ductile response during seismic event, it is important to ensure the continuity of the load path through bridge joints connecting various bridge elements. This lecture presents lessons from failures of a reinforced concrete and steel bridges in the United States during past earthquake. The focus will be on the continuity of the load path, detailing and development of steel reinforcement in reinforced concrete bridge piers with joints and seating for secondary elements, in steel bridges. Recommendations for better detailing will also be presented.

Riyad S. Aboutaha, is an associate professor in the College of Engineering and Computer Science at Syracuse University. He received his bachelor´s degree in civil engineering from Beirut Arab University, Beirut, Lebanon, in 1981, the M.S. degree in structural engineering in 1990, and the Ph.D. degree in structural engineering from University of Texas at Austin in 2010. Dr. Aboutaha is a Fellow of the American Concrete Institute (ACI). Dr. Aboutaha has over 40 years of construction and research experience. In the last 34 years, he has been researching the use of new materials for renewal of civil infrastructure. Dr. Aboutaha has offered numerous seminars and workshops on evaluation and rehabilitation of concrete bridges with CFRP composites, including some for the U.S.A. Federal Highway Administration (FHWA), and the New York State Department of Transportation (NYSDOT). In addition, he completed major research projects on the GFRP bar ComBAR for Schöck Bauteile GmbH of Baden-Baden, Germany, on the durability of wearing surfaces for FRP bridge decks, for NYSDOT, and most recently bridge widening using CFRP composites for Shandong DOT, China. Prof. Aboutaha's current research interests are in the area of economy of preventive maintenance of concrete bridges, investigation of structural failures, and alteration of structural systems using CFRP

Conditional Assessment of Fire Damaged Structures: From Reconnaissance to Advanced Analysis

Venkatesh Kodur, Michigan State University

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Fire represents a severe hazard to civil infrastructure during their design life. To overcome the adverse effects of fire, structural members are to be provided with appropriate fire resistance ratings, as specified in building codes. However, historical survey data clearly suggests that while fires do cause some level of damage to structures, complete collapse of structural systems due to fire is a rare event. The probability of complete collapse in reinforced concrete or pre- stressed concrete (RC and PC) structures is even lower due to low thermal conductivity, high thermal capacity, and slower degradation of mechanical properties of concrete with temperature. Therefore, it is reasonable to assume that concrete structures, after most fire incidents, can be opened to re-occupancy with adequate repair and retrofitting. To ensure safe re-occupancy, as well as for developing optimum repair and retrofitting strategies, the residual capacity of the fire damaged structure is to be assessed following a fire event.

Nonetheless, extent of fire-induced damage in concrete structures is highly variable. In case of exposure to a severe fire, concrete members might experience significant structural damage resulting from loss of concrete due to possible fire induced spalling, buckling of rebars and relatively larger permanent deformations. Alternatively, exposure to moderate fire scenario may not result in noticeable deformations or loss of concrete section due to spalling, and thus loss of structural capacity of the fire exposed concrete member may not be significant. Thus, there is always uncertainty regarding level of remaining structural capacity in fire exposed concrete members. Currently engineers assess residual capacity of fire-damaged concrete structures using thumb rules, combined with limited coupon tests. There are no well-established procedures or guidance in current codes and design standards for evaluating residual capacity of fire damaged structures.

To overcome the current knowledge gaps, a comprehensive five-step approach is developed for evaluating residual capacity assessment of fire-damaged concrete structures. The proposed approach, based on forensic engineering principle, utilizes a combination of visual assessment techniques and thumb rules, non-destructive testing, as well as simplified and advanced analysis methods, to assess the extent of fire-induced damage to a concrete structure under different scenarios. The advanced analysis procedure is implemented in a comprehensive numerical model developed in the finite element computer program ABAQUS for specifically evaluating residual capacity of fire damaged concrete members. Through a set of case studies, the application of advanced analysis for evaluating realistic residual capacity of fire damaged concrete members will be illustrated.

Venkatesh Kodur is a University Distinguished Professor and Director of the Centre on Structural Fire Engineering and Diagnostics at Michigan State University. He is an internationally recognized scholar for his contributions in structural, material and fire engineering fields. His research interests include fire resistance analysis and design of structural systems, material performance at elevated temperatures and Building collapse investigations. Dr. Kodur has published more than 500 peer-reviewed papers in journals and conferences, and has given numerous key-note presentations at major international conferences. As per Google Scholar, he has more than 17,500 citations with an "h" index of 72. Dr. Kodur's contributions to the Civil Engineering and Fire Protection Engineering professions have been recognized by peers through prestigious honors and awards. He has been elected as Fellow of six Institutes/Academies: Canadian Academy of Engineering, American Society of Civil Engineers, Indian National Academy of Engineering, Structural Engineering Institute, American Concrete Institute, and the Society of Fire Protection Engineers. He is a professional engineer, Associate Editor of Journal of Structural Engineering, and Journal of Structural Fire Engineering, editorial board member of five leading journals, Chairman of ASCE(SEI)-SFPE 29 (Fire) Standards Committee, and a member of UK-EPSRC College of Reviewers. He has won many awards and prestigious appointments, including Michigan State University "University Distinguished Professor" Award, American Institute of Steel Construction Faculty Fellowship Award, MSU Distinguished Faculty Award, NRCC (Government of Canada) Outstanding Achievement Award, Fulbright Scholar award; "INFOSYS Visiting Chair Professor" appointment at the Indian Institute of Science, Bangalore, India, and NATO Award for collaborative research. Most notably, Dr. Kodur was part of the Federal Emergency Management Agency and American Society of Civil Engineers/Society of Fire Protection Engineers high profile "Experts Team" that investigated the collapse of the World Trade Center buildings as a result of September 11 attacks.

Nonlinear Modeling of Beam-Column Joints in Forensic Analysis of Concrete Buildings

Nirmala Suwal, Prajwol Hada, Serhan Guner, University of Toledo

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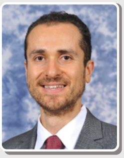
Beam-column joints are a critical component of reinforced concrete frame structures. They are responsible from transferring forces between adjoining beams and columns while limiting story drifts and maintaining structural integrity. During severe loading, beam-column joints deform significantly, affecting and sometimes governing, the overall response of frame structures. While most failure modes for beam and column elements are frequently considered in plastic-hinge-based frame analyses, the joint failure mode is frequently omitted. One reason for this is the dearth of published guidance on how to derive the joint hinge properties and where to place these hinges. Many joint models are available in literature but their adoption by practicing structural engineers has been rather limited due to their complex nature. The objective of this study is to provide a critical review of the available beam-column joint models and propose a beam-column joint modeling approach for the use of practicing engineers. The proposed approach uses rotational spring formulations to model both interior and exterior joints. The experimental validation studies undertaken demonstrate that the proposed approach provides accurate response simulations. Important modeling considerations are also presented to assist practitioners in properly modeling beam-column joints in forensic frame analyses.



Serhan Guner is an Associate Professor in the Department of Civil and Environmental Engineering at The University of Toledo, Ohio, USA. Prior to joining Toledo, he worked as a consulting engineer at Morrison Hershfield. During this time, he received the Carson Innovation Award for the finite element analysis and upgrade design of a concrete support structure for a reciprocating compressor. In 2018, he received the ASCE ExCellence in Civil Engineering EDucation (ExCEEd) Fellowship. He is currently serving in six national committees including ACI-ASCE Committee 447 (Finite Element Analysis), Committee 370 (Impact and Blast Load Effects), Committee 123 (Research and Current Developments), DFI Helical Piles and Tiebacks Committee, and DFI Electric Power Systems Foundations. Dr. Guner's core research focus is structural mechanics as applied to numerical modeling and experimental validation. His research projects investigated structural response to extreme loads (impact, blast, tsunami, and hurricane loads), shear behavior of concrete elements, analysis of disturbed regions and deep members, structural strengthening and upgrade, and development of computer code and machine learning algorithms. Dr. Guner has published more than 35 technical papers and advised more than 25 research students. He has taught 8 undergraduate and 6 graduate courses several times at Toronto, Ryerson, and Toledo, and nominated five times for Outstanding Teaching and Advising awards.

Assessment of Concrete Macrocrack Depth Using Infrared Thermography

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Cracks are common defects in concrete structures. Thus far, crack inspection has been manually performed using the contact inspection method. This manpower-dependent method inevitably increases the cost and work hours. Various non-contact studies have been conducted to overcome such difficulties. However, previous studies have focused on developing a methodology for non-contact inspection or local quantitative detection of crack width or length on concrete surfaces. However, crack depth can affect the safety of concrete structures. Although macrocrack depth is structurally fatal, it is difficult to find it with the existing method. Therefore, our research group performed an experimental investigation based on non-contact infrared thermography and multivariate machine learning in this study to estimate the hidden macrocrack depth. To consider practical applications for inspection, we experimented with the simulated piloting of an unmanned aerial vehicle equipped with infrared thermography equipment. We evaluated the crack depths using linear regression, gradient boosting and random forest (AI regression methods).

Young K. Ju, a professor at Korea University, received a bachelor´s degree in architectural civil engineering from Korea University, Seoul, South Korea, in 1991, the M.S. degree in structural engineering in 1993, and the Ph.D. degree in structural engineering from Korea University in 1999. In 1995, he joined Daewoo Institute of Construction Technology as a senior researcher. He worked as a postdoc research associate at the University of Texas at Austin from 2003 to 2005. In 2005, he joined RIST (Research Institute of Industrial Science and Technology) as a senior researcher. In 2007, he finally joined the school of civil, environmental and architectural engineering at Korea University as a professor. Dr. Young K. Ju is the director of the Building Forensic laboratory of Korea University. This lab researches building forensic technology that monitors the structural condition in early stages, performance-based design, and smart construction technologies such as 3DP and PCM. He has published more than 57 SCI(E) indexed papers for structural engineering.

Application of the Artificial Neural Networks on the Structural Health Monitoring for the Offshore Structures

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The structural condition should be frequently investigated to ensure the structural safety and performance of the infrastructures. For offshore structures, structural health monitoring (SHM) should be strictly conducted because the failure of the primary structural members induces unexpected disaster. But, due to the environmental and structural characteristics of the offshore structures, there is a limitation on effective structural health monitoring using the various sensors. Therefore, effective methodologies should be developed and applied. In this presentation, the application of artificial neural networks (ANNs) on the effective SHM for offshore structures is introduced with examples of the submerged floating tunnel, which is being widely studied as the future transportation infrastructure. The ANN-based damage detection methodology is presented with numerical validation cases. In addition, the structural pattern recognition strategy for long-term structural condition change evaluation is introduced.

Seungjun Kim, an associate professor at Korea University, received the bachelor´s degree in civil engineering from Korea University, Seoul, South Korea, in 2004, the M.S. degree in structural engineering in 2006, and the Ph.D. degree in structural engineering from Korea University in 2010. He worked as a postdoc research associate at Texas Transportation Institute and Texas A&M ocean engineering division from 2012 to 2014. In 2014, he joined Samsung Heavy Industries as a senior researcher. In the company, he has conducted many projects to develop the effective design and analysis method for very large offshore oil&gas platforms. He worked at the department of construction safety and disaster prevention engineering at Daejeon university from 2016 to 2019. Then, he finally joined the school of civil, environmental and architectural engineering at Korea University as an assistant professor. Dr. Seungjun Kim is the director of the structural system laboratory of Korea University. The main research interests are innovative numerical simulation, development of advanced offshore floating systems, and AI-based smart structural monitoring technologies, and effective construction safety technologies. He has published more than 60 SCI(E) indexed papers for structural engineering.

Surrogate Model for Failure Back-Analysis

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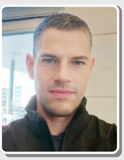
Recently, 9m high concrete cantilever wall segments collapsed due to earth loading. Granular soil was deposited into the space between the wall and a nearby rock slope. The wall segments were not designed to carry lateral earth loading and collapsed due to excessive bending. Such failure events provide important opportunities for back-analysis and calibration of numerical models. As many geotechnical programs rely on the Mohr-Coulomb (MC) criterion for elastoplastic analysis, it is useful to apply this failure criterion to the concrete material. Accordingly, a back-analysis was carried out in order to search for the suitable MC parameters of the concrete. In order to accelerate the back-analysis task, machine-learning (ML) tools are used to analyze the FE models. Compared to traditional back-analysis studies where good agreement between model and reality are deemed successful based on a limited number of models, the current ML analysis demonstrate that a range of possible combinations of parameters can yield similar results. In this presentation, I will focus on the application of ML for similar back-analysis tasks.



Amichai Mitelman is a lecturer and researcher at Ariel University, Israel, where he received his bachelor´s degree in civil engineering in 2005. Dr. Mitelman is a licensed professional engineer, and has gained experience as a structural and tunneling engineering, contributing to the design of various civil engineering project. He completed a Masters in 2015 and PhD in 2020, in the mining department in the University of British Columbia, Canada, focusing on tunnel engineering and rock mechanics. Currently, Dr. Mitelman's research interest include numerical modeling and machine-learning applications in ground-support interaction problems.

Utilising Artificial Neural Networks for Prediction Properties of High-Performance Concrete

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The most popular building material, concrete, is intrinsically linked to the advancement of humanity. Due to the ever-increasing complexity of cementitious systems, concrete formulation for desired qualities remains a difficult undertaking despite conceptual and methodological advancement in the field of concrete science. Recognising the significant pollution caused by the traditional cement industry, construction of civil engineering structures has been carried out successfully using Geopolymer Concrete (GPC), also known as High Performance Concrete (HPC). These are concretes formed by the reaction of inorganic materials with a high content of Silicon and Aluminium (Pozzolans) with alkalis to achieve cementitious properties. These supplementary cementitious materials include Blast Furnace Slag, a waste material generated in the steel manufacturing industry; Fly Ash, which is a fine waste product produced by coal-fired power stations and Silica Fume, a by-product of producing silicon metal or ferrosilicon alloys. This result demonstrated that GPC/HPC can be utilised as a substitute for traditional Portland cement-based concrete, resulting in improvements in concrete properties in addition to environmental and economic benefits. This presentation explores utilising experimental data to train artificial neural networks, which are then used to determine the effect of supplementary cementitious material replacement, namely fly ash, granulated blast furnace slag and silica fume, on the compressive strength, tensile strength and modulus of elasticity of concrete and to predict these values accordingly.

Harry Far is a Chartered Professional Engineer (CPEng) with over 14 years of professional experience practicing as structural design engineer and design manager. He is currently a Senior Lecturer in the School of Civil and Environmental Engineering teaching in different areas of structural engineering including structural analysis, design and construction. Dr. Far has published several high ranked journal articles and refereed conference papers in the field of structural engineering and his main research interests lie in Steel structures, composite cold-formed steel flooring systems, composite structural members, seismic design and earthquake engineering and dynamic soil-structure interaction. For his research excellence, he has received Earthquake Engineering Award from Australian Earthquake Engineering Society (AEES) and Australian Postgraduate Award from the University of Technology Sydney.

Comparative Study on Dynamic Response of Fixed Offshore Wind Turbines with Different Substructures Using X-SEA Software

Chuan Ma[1], Sorrasak Vachirapanyakun[2], Pasin Plodpradit[2], Kidoo Kim[2], Goangseup Zi[1], [1]Korea University, [2]Konkuk University

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In recent years, with the rapid development of offshore wind energy, fixed offshore wind turbines (OWT) represented by Monopile, Tripod, and Jacket substructures have been widely used around the world. Based on the NREL 5MW reference OWT model, the RNA simplified finite element models (FEM) of these three different substructures were established by using the self-developed aero-hydro-servo-elastic coupling program X-SEA in this study. In addition, we further conducted a comparative study of the dynamic responses of these three substructures under normal and extreme conditions, mainly including the structural mode (natural frequencies and mode shapes), tower top displacement, shear force and bending moment at the mudline, member maximum stress, etc. Finally, we obtained the optimal OWT substructure model suitable for the water depth of 50m in the southwestern sea area of Korea and put forward substantive suggestions for its structural design.

Goangseup Zi, a professor at Korea University, received the bachelor´s degree and M.S. degree in civil engineering from Hanyang University, Seoul, South Korea, in 1994 and 1996, respectively. and the Ph.D. form Northwestern University, Evanston, IL, USA. in 2002. From 2012 to the present, he has been a professor at Korea University. He holds positions on the boards of directors for the Korea Concrete Institute, Korea Society of Civil Engineers, Korea Arbitrators Association, and Korea Structure Diagnosis Maintenance Engineering Society (Vice President, Director). In addtion, He is a member of the following advisory committees: Yeosu Gwangyang Port Authority, Korea Rail Network Authority, Seoul Metropolitan Rapid Transit Corporation, Korea Electric Power Corporation, Ministry of Land, Infrastructure, and Transport. Additionally, he serves on the Expert Committees of the Korea Concrete Institute's Creep-Long-Term Behavior Committee and the Offshore Wind Power Offshore Planning Committee of the Korean Society of Civil Engineers. Dr. Goangseup Zi is the director of the Structural Engineering & Mechanics Laboratory of Korea University. The major research fields are mechanistic-chemical complex deterioration analysis and material design of concrete structures, offshore wind power support structure development and analysis techniques, and development of digital construction standards framework. He has published more than 144 SCI(E) papers for the structural engineering and has been indexed more than 8500 times. Moreover, he was recognized as a Highly Cited Researcher by Clarivate Analytics in 2018 and, according to Mendeley Data, is currently in the top 2% of researchers in 2022.

Causes of Local Collapse of a Precast Industrial Roof after a Fire

Bruno Dal Lago, University of Insubria

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Precast roofing systems employing prestressed elements are often employed as smart structural solutions for the construction of industrial buildings. The precast concrete elements usually employed are highly engineered, and often consist in thin-walled members, characterised by a complex behaviour in fire. The lecture describes an investigation carried out after a fire event which damaged a precast industrial building made with prestressed beam and roof elements, and non-prestressed curved barrel vault elements interposed in between the spaced roof elements. As a consequence of the exposure to the fire, the main elements were found standing, although some locally damaged and distorted, and the local collapse of few curved barrel vault elements was observed in one edge row only. In order to understand and interpret the observed structural performance of the roof system under fire, a full fire safety engineering process was carried out according to the following steps: (a) realistic temperature-time curves acting on the structural elements were simulated through computational fluid dynamics; (b) temperature distribution within the concrete elements was obtained with non-linear thermal analysis in variable regime; (c) strength and deformation of the concrete elements were checked with non-linear thermal-mechanical analysis. The analysis of the results allowed to identify the causes of the local collapses occurred, attributable to the distortion caused by temperature to the elements causing loss of support in early fire stage rather than to the material strength reduction due to the progressive exposure of the elements to fire. Finally, practical hints are provided to avoid such a phenomenon to occur when designing similar structures.

Bruno Dal Lago, associate professor at Università degli Studi dell'Insubria in Varese (Italy) and adjunct professor at Politecnico di Milano in Milan (Italy), received the bachelor, master, specialisation and PhD degree from Politecnico di Milano in the area of Structural Engineering. He worked as a postdoc research associate at Politecnico di Milano from 2015 to 2019 and was appointed as assistant professor in Università degli Studi dell'Insubria from 2019 to 2022. He is co-founder of the consultant office DLC Consulting in Milan. He participated to relevant research projects related to precast concrete structures, including Safecast, Safecladding, Eirocrete, and ReLUIS. His main research interests are innovation in precast concrete technology, behaviour and design of precast structures under extreme loads such as earthquake and fire, testing and simulation of mechanical connections for precast concrete, prestressing techniques. He has published more than 120 scientific papers, more than 30 of which in ISI journals.

Disaster Risk Management in Water Resources Engineering: Machine Learning Approaches

Donghwi Jung, Korea University

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The primary goals of disaster risk management are (1) to identify any potential hazards and failures, (2) to assess their severity and (3) to determine proper countermeasures for recovery. Better disaster risk management can be achieved by thorough forensic engineering analysis of historical disaster given sufficient data and information collected during the event. Traditionally, for disaster risk management, methods such as field measurements, expert opinion, laboratory experiments, and numerical simulations have been used. As a huge amount of data is continuously collected with the rapid development of big data techniques, machine learning models have been widely applied as promising tools for risk assessment and management. This lecture first presents the state-of-the-art review of machine learning models applied in the domain of disaster risk management (e.g., drought outlook, flood prediction) with the focus on water resources engineering. Then, potential future research topics are discussed.

Donghwi Jung is an Assistant Professor in School of Civil, Environmental and Architectural Engineering, Korea University. Donghwi Jung received his Bachelor and Master's degree in Civil, Environmental and Architectural Engineering from Korea University in 2009 and 2011, respectively. In 2013, he received Ph.D. in Civil Engineering and Engineering Mechanics from University of Arizona. His research interests lie in the interdisciplinary area of water system optimization, with particular emphasis on system resilience and sustainability. The ultimate contribution of his work in this area is toward allowing water systems (water distribution system, urban drainage system, etc.) to maintain their performance and to sustain the availability of water during and after natural (i.e., unanticipated) and human-made disturbances (i.e., pipe bursts, earthquakes, population increases, and climate changes).

Japan's New Policy on Water-Related Disaster Risk Reduction in Response to Climate Change

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In 2020, after experiencing tragic water disasters in recent years, Japan's Ministry of Land, Infrastructure, Transport and Tourism greatly shifted its flood management policy to the new policy, River Basin Disaster Resilience and Sustainability by All. Japan's new policy considers river basins as spaces that include the watershed and flood plain areas, and this policy takes comprehensive and multilayered actions in three phases: 1) flood prevention by river management facilities, 2) exposure reduction by land use management and 3) early warning and evacuation to save lives. The policy calls for all stakeholders in river basins, including the national government, prefectures, municipalities, private enterprises, residents and water users, to take actions for disaster resilience and sustainability. This presentation introduces the details of the new policy and related policies implemented by the Government of Japan.

Kenichi Tsukahara is a Professor of Department of Civil Engineering, Kyushu University. He is also a member of the Science Council of Japan, and an Executive Board Member of the World Federation of Engineering Organizations. After graduating Department of Civil Engineering, Kyushu University, he joined the Ministry of Construction of the Government of Japan (GOJ) in 1985, He has served in a number of important positions both in GOJ and International Organizations such as the Policy and Planning Officer of the Asian Development Bank. In 1993, he received Ph.D. in Regional Science from University of Pennsylvania. His main research interest is land use management for water related disasters.

Dynamic Evolution and Decoupling Analysis of Agricultural Nonpoint Source Pollution in Taihu Lake Basin during the Urbanization Process

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Agricultural nonpoint source pollution (ANPSP) has become an important focus of water governance in recent years. In this study, taking the Taihu Lake Basin as an example, the dynamic interrelation between urbanization and ANPSP is macroscopically displayed by the VAR model, and the coevolution characteristics of the two are quantitatively measured by the decoupling index. Then, the LMDI method is used to explore the influence of urbanization's accompanying effects, including pollution intensity, economic structure, output level and population factors. The results showed that (1) since 2006, TN has continued to decline, while TP initially increased then decreased. The main pollution sources were livestock and poultry breeding and planting, while the contributions of rural life and aquaculture to pollution gradually increased. (2) Urbanization has a positive effect on ANPSP after reaching a certain stage, but there is a possibility of pollution rebound; urbanization mitigates ANPSP, but still contributes to environmental pollution. (3) The decoupling between urbanization and ANPSP is achieved across the basin. Meanwhile, the spatiotemporal heterogeneity of the TP decoupling index is more evident than that of the TN index. (4) The intensity effect and structure effect promote the strong decoupling between urbanization and ANPSP, while the output effect and population effect make the decoupling relationship evolve to adverse states such as expansive negative decoupling and expansive coupling.

Dongying Sun is an Associate Professor in School of Management, Jiangsu University. Dongying Sun received his Bachelor degree in Management Science and Engineering from Xidian University in 2009. In 2016, he received Ph.D. in Management Science and Engineering from Hohai University. His research interests focus on the interdisciplinary integration of water, with particular attention to demand management under changing environments. The key contributions of his work in this area are to achieve equitable and efficient allocation of scarce water resources, multiagent collaborative pollution governance mechanisms, and to achieve water-related sustainable development goals. His research is founded by The National Natural Science Foundation of China and MOE (Ministry of Education in China) Project of Humanities and Social Sciences.

Flood Risk Assessment to Economic Sectors in Vietnam

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Flooding is one of the most threatening disasters in Vietnam, occurs every year and has been becoming more severe under climate change and urbanization. To prevent flood and mitigate flood damage, flood risk assessment is considered as one of the most important steps in flood risk control. This lecture assesses flooding risk as a combination of hazard, exposure and vulnerability according to concept of IPCC AR5 (2013). The hazard indicates flood magnitude in terms intensity, probability and extent. The exposure to flood includes all element at flood risk such as people, infrastructure and environment. The vulnerability to flood is the characteristics of the elements, e.g., people and infrastructure, that might increase the impacts of flooding. The assessment is then pilot applied to agriculture and oil and gas sector in several areas of Vietnam.

Thi Thuy Ngo got Bachelor degree in 2008 from Hanoi Water Resources University (Thuyloi University). In 2009, Thi Thuy Ngo achieved a master scholarship from DAAD for TERMA-VN program in Hanoi, Vietnam and got Master degree in Water Resources Management. In 2017, she received Ph.D. in Civil, Environmental and Architectural Engineering from Korea University with the topic in Urban drainage system and Optimization. Currently, Thi Thuy Ngo is a Principal Researcher in Vietnam Institute of Meteorology Hydrology and Climate Change, Hanoi, Vietnam. Her research interests are in flood forecasting, hydrological and hydraulic modeling and flood risk assessment. Thuy contributes to propose a method to assess flood risk in provinces of Vietnam and for different economic sectors.

The Impact of Climate Change on Rainfall Patterns

Seokhyeon Kim, Kyung Hee University

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Climate change is changing rainfall patterns and this is having a significant impact on our lives. According to recent research, the size of extreme rainfall events has increased globally over the past century and is predicted to become more severe. Research indicates that as temperatures rise, rainfall becomes more concentrated in space and time. These changes in rainfall will affect estimates of rainfall intensity, frequency, duration, and probable maximum precipitation (PMP). As we see flooding occurring in various parts of the world, it raises questions about whether infrastructure designed based on past rainfall data is still effective. In light of this reality, it is necessary for us to understand the changes in the amount and spatial and temporal distribution of rainfall caused by climate change and to strive to reasonably reflect these in various policies and design criteria in order to protect our lives and property and maintain sustainability. This talk presents projected changes in the spatial and temporal distribution of future extreme rainfall events.

Seokhyeon Kim has been working as an assistant professor at the Department of Civil Engineering at Kyung Hee University since March 2022. Dr. Kim received his Bachelor of Science in Civil and Environmental Engineering from Korea University in 2001 and his Master of Science in Water Resources Engineering from Korea University in 2008, and he received his Ph.D. in Remote Sensing and Water Resources Engineering from UNSW Sydney in 2017. Before coming to Kyung Hee University, he worked as a water resources engineer at Hyundai Engineering and Construction from 2008 to 2013, and from 2017 to 2022 he worked as a postdoctoral researcher at the Water Research Centre of UNSW Sydney after completing his Ph.D. His main research areas are the validation, improvement, and utilization of remote sensing data in the fields of climate change and water resources. He has collected and analyzed vast amounts of data such as rainfall, soil moisture, evapotranspiration, and vegetation. Dr. Kim was awarded the Early Career Research Excellence Award by the Modelling and Simulation Society of Australia and New Zealand (MSSANZ) in 2021. He has published a total of 32 papers in journals such as Remote Sensing of Environment and Water Resources Research and is currently a topic editor for MDPI Remote Sensing and an associate editor for Frontiers in Water.

Application of Single Model Initial-condition Large Ensemble (SMILE) in Projecting Hydroclimatic Whiplash

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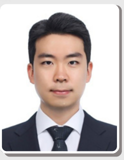
Global increases in hydroclimatic whiplash, also referring to the rapid transition from an extreme at one end to the other, for example, from drought (flood) to flood (drought), are raising concerns. This type of compound hazard can aggravate water resources management or crop production. Growing evidence suggests that global warming has contributed to the higher frequency and magnitude of climate extremes, which raises the question of whether more frequent hydroclimatic whiplash with higher intensity is expected in the future as well. Therefore, an overall perspective on the changing risks of the transitions between hydroclimate extremes needs to be understood to build a climate-resilient forensic framework. Recent development of Single Model Initial-condition Large Ensembles (SMILEs) enables presenting an expected range of future climate change outcomes. It can also project the characteristics of dry-wet transitions more robustly based on the statistical modeling with large samples. This lecture first introduces the background of SMILEs and the advantages it has in hydroclimatic studies. Then, an application of continental-scale SMILE to investigate the hydroclimatic whiplash across North America in the future is presented.



Wooyoung Na is a Postdoctoral Associate in Department of Civil and Environmental Engineering, Western University. He received his Bachelor degree in Civil, Environmental and Architectural Engineering from Korea University in 2016. In 2021, he received Ph.D. in Water and Environment Major of Civil, Environmental and Architectural Engineering from Korea University under the Integrated Master-Ph.D. Program. His research interests include climate change, water resources management and remote sensing to better understand hydrological processes in different spatiotemporal scales. His recent work mainly contributes to assessing the anthropogenic climate change impact and internal climate variability on water-related compound hazards with multivariate statistical approaches. He is also interested in securing water resources in water-stressed regions and improving the performance of flood forecasting.

Development of Regional Flood Forecasting System Based on Rainfall Radar

Seokhwan Hwang, Korea Institute of Civil Engineering and Building Technology

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Flash floods occurring in watersheds with short lag time, such as urban and small mountain watersheds, cannot be predicted with rain gauges alone. In this study, a flash flood prediction system was constructed using the very short time extrapolated prediction using rainfall radar as input data. This system can provide 3-hour advance forecast for small town as 3-level risk information. To successfully operate a flash flood warning system (FFWS), it is necessary to ensure the quality of the rainfall forecasts and minimize the time spent on forecasting and issuing warnings. The rainfall forecasts which are used as input in existing FFWS suffer from low quality and problems with their bias correction techniques, and the accuracy of their warnings cannot be guaranteed. If a sufficient flash flood forecast lead time cannot be ensured, the accuracy of the system's forecast/warning is reduced. The goal of this study is to develop technology for small area flood advance warnings and dynamic flash flood forecasting. To achieve the goal of this study, it is necessary to first develop a technique for improving rainfall forecast quality, a technique for ensuring flash flood forecast lead time, a technique for real-time flash flood monitoring and transition analysis, and a radar-based flash flood detection/forecast system. Next, this study will develop a FFWS, operate an on-site flash flood model in the trial region for on-site operations, develop and operate an on-site Korean flash flood model, and develop technology for joint operation of the Korean radar/flash flood model. Afterward, this study will develop technology for analysing rain gauge growth/dissipation trends, technology for analysing patterns which allow flash flood growth, and technology for forecasting cumulative rainfall amounts on a very short time scale. Finally, this study will determine the rainfall events which lead to flooding by considering characteristics such as cities' impermeable regions, spatial distribution, observation network characteristics, basin slope, etc. in order to establish a methodology for calculating flood forecast/warning standards which reflect cities' hydrometeorological characteristics.

Seokhwan Hwang is a research fellow in Korea Institute of Civil Engineering and Building Technology (KICT). Seokhwan Hwang received his Bachelor, Master's degree in Civil and Environmental Engineering from Korea University in 1997 and 1999, respectively. In 2009, he received Ph.D. in Civil and Environmental Engineering from Korea University. His research interests lie in the hydrological measurements, climate change analysis based on historical data, and analysis and applicability in flood forecasting systems based on radar observation. The ultimate contribution of his work in this area is an evaluation of rainfall radar's hydrological applicability and system establishment and an automation of flood early warning system using radar for disaster mitigation.

Low Carbon and Circular Seawater Desalination Technology

Seungkwan Hong, Jungbin Kim, Korea University

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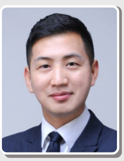
The Middle East and North Africa (MENA) region is the largest seawater desalination market due to limited surface water sources. Thermal-based desalination was dominant over seawater reverse osmosis (SWRO) in the region in that the desalination plants are often coupled with power plants to reuse hot seawater. Besides, SWRO is operated with high pressure due to high salinity and high-temperature seawater. However, SWRO technologies are developing rapidly, and SWRO desalination plants can consume less energy compared to thermal desalination plants. To enter the high-competitive desalination markets in the MENA region, a Korean research consortium (i.e., KORAE Research Group) was launched in 2016 to develop low-carbon SWRO desalination technologies optimized for the Arabian Gulf region. A 1000 m^3/d SWRO pilot plant was installed and operated by the KORAE Research Group by applying newly developed desalination technologies: high-performance SWRO membranes, algae-response pretreatment system, and future electrochemical desalination system. The developed technologies exhibited low energy consumption compared to existing technologies, and thus overall plant SEC was significantly reduced to less than 3.3 kWh/m^3. This study examines the feasibility of low-carbon SWRO desalination technologies with both theoretical analysis and practical experiences.



Jungbin Kim is a postdoctoral researcher at Korea University. He graduated with both a B.S. degree and a Ph.D. degree from Korea University in 2016 and 2021 respectively. His research focuses on the development of energy-efficient seawater reverse osmosis desalination processes. He has published 11 journal articles in the field of chemical engineering and 2 books/book chapters regarding the reverse osmosis membrane processes. Based on his active research, he has received 10 awards relating to desalination and membrane processes. Moreover, he holds 16 applied patents and 9 granted patents. One of the patents was transferred to a company (amount: 52,000 USD). Furthermore, from 2019 to 2022, he was a committee member of the International Desalination Association (IDA) Young Leaders Program (YLP) in the Asia-Pacific region. From 2023, he will be a chair of the International Water Association (IWA) Young Water Professionals (YWP) Korea Chapter.

Electromagnetism for Enhancing the Performance of Emerging Water Desalination Processes

Emad Alhseinat, Khalifa University

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Energy security, Water scarcity, and environmental challenges i.e. global warming are the most pressing global challenges facing mankind in the 21st century. In UAE, water desalination provides about 80% of water consumed in the country. However, the currently used desalination processes have high power consumption and overall cost. Thus, this talk aims to present electromagnetism as an innovative technique to enhance the efficiency of emerging desalination technologies such as Capacitive Deionization (CDI) and Membrane Distillation. This presentation will shed light on the effects of alternated electromagnetic fields on solvent structures and their interactions with solutes and how it can be utilized to enhance the efficiency of separation processes and other important applications.

Emad Alhseinat acquired his Ph.D. in Chemical Engineering in 2013 from the University of Edinburgh-UK. Dr. Alhseinat is currently an associate professor in the Chemical Engineering Department at Khalifa University in Abu Dhabi. Since his appointment as an assistant professor at KU in 2016, he has managed to attract internal and external research grants that total to more than AED 6.7 Million as principal investigator (PI) and more than AED 13.7 Million in total (PI+ Co-PI). Currently, Dr. Alhseinat has established his lab in novel separation processes for water treatment and desalination. Dr. Alhseinat is a co-founding member of the Center for Membrane and Advanced Water Technology at Khalifa University. Dr. Alhseinat has filed five patents and 48 scientific journal papers in high-impact Journals. He is currently an active member of the Center for Membranes and Advanced Water Technology (CMAT) and the Center for Catalysis and Separations (CeCaS) at KU. His research efforts are focused on contributing to solving the problem of freshwater shortage in the arid region by improving the efficiency of water desalination and treatment processes and creating innovative and sustainable solutions.

Advances in Water Reuse

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Water shortage is challenging issues in many regions and/or countries in the world. Recent heat wave and drought possibly by climate change are emphasizing the importance of water reclamation and reuse. The technologies have improved to treat and reclaim wastewater to a suitable quality for a wide range of water reuse applications. In some cases, potable water reuse is considered to be an innovative and sustainable water supply solution. However, the technologies have disadvantages and risks to overcome. This presentation intends to provide the latest developments and future prospects on advanced technologies and case studies for water reuse. It also provides a broad snapshot for trends, issues and challenges in the water reuse industry.

Wontae Lee, Ph.D., P.E., is a Professor of the Department of Environmental Engineering at Kumoh National Institute of Technology (KIT), South Korea. He is also the Director of the Gyeongsangbuk-do Carbon Neutrality Center supported by Korean Ministry of Environment and Gyeongsangbuk-do. He received his B.S. degree from Kyungpook National University, M.S. degree from Korea Advanced Institute of Science and Technology (KAIST), South Korea, and Ph.D. degree in Civil and Environmental Engineering from Arizona State University. Dr. Lee has published over 100 peer-reviewed papers in journals and has given numerous presentations at major technical conferences. Dr. Lee's contributions to the Environmental Engineering professions have been recognized by peers through prestigious honors and awards, such as Prime Minister's Commendation and Best Paper award by the Korean Federation of Science and Technology Societies. His current research interests include best practices for water reclamation and reuse, application of information and communication technologies to water and wastewater treatment facilities, and carbon neutrality technologies in Environmental Engineering.

Field Application of Positively Charged Bubble (PCB) Technology for Algae Removal and Further Utilization

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Algal bloom is becoming a big challenge at many lakes in the world due to its toxicity to animals and human as well as loss of social and economic opportunity because of its aesthetic problem. And it is expected to be intensified due to the global warming. An innovative idea using positively charged bubble (PCB) can make a breakthrough in removing or utilizing algae in natural system. Patented Highrate Onsite Movable Boat for Algae Removal (HOMBAR) system is applied at a river in Korea and is planned for further field application at the lakes in US and Vietnam. Further utilization of harvested algae for bio-fuel can be possible because of low chemical concentration of collected sludge.

Mooyoung Han is a professor Emeritus at Seoul National University, since 2021 after retiring his 31-year academic career at SNU and Kyung Hee U. He obtained his BS and MS from Seoul National University, and PhD at the Univ. of Texas. Prof. Han is now a fellow member of IWA, the chairman of IWA-RWHM (Rainwater Harvesting and Management) specialist group, and a member of Presidential Water Management Committee. His major interest is in the particle separation processes such as flocculation, sedimentation and flotation. However, his work also covers rainwater harvesting and management. Recently, he declared the "Rain City Initiative" to change the cities to collect rainwater instead of draining it, and is also working toward forming the "International Youth Rainwater Network" to make a platform to exchange indigenous wisdom from each country. His most recent interest extends to RFD (Rainwater For Drinking) system to overcome technical, economic and social barriers using multiple barrier concept and Nature Based Solution. He is promoting his innovative RFD system to developing and developed countries to achieve SDG6.

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