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4TH INTERNATIONAL CONFERENCE ON

ACE Architectural, Civil and Environmental FORENSIC ENGINEERING

January 14-17, 2025

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 · KOREA WATER RESOURCES ASSOCIATION

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

4TH 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 4th International Conference on Architectural, Civil, and Environmental (ACE) Forensic Engineering at Korea University in Seoul, Korea. This 4th international conference was organized by the Hyper-converged Forensic Research Center committee and hosted by the Korean Geotechnical Society (KGS), Korean Society of Steel Construction (KSSC), and Korean Water Resources Association (KWRA).

This 4th international conference takes place through an online Webinar (Zoom) during January 14-17, 2025 during 9:30 am to 6:00 pm in Korea Standard Time (KST). 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 (Geotech, Structure, and Hydro-environment) and discusses well-withstand, reacting and responding to large-scale complex disasters. A total of 40 distinguished speakers are invited to the 4th international conference on three major topics (Geotech, Structure, and Hydro-environment)

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, *4th International Conference on ACE (Architectural, Civil and Environmental) Forensic Engineering*
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DAY 1 | Innovation in Geotechnical Engineering | Jan 14, 2025

13:00-13:10	**Welcoming Address** **Jong-Sub Lee** *(PI, Hyper-converged Forensic Research Center for Infrastructure, South Korea)* **Complimentary Address** **Young Uk Kim** *(President, Korean Geotechnical Society, South Korea)*

Session 1 : Convergence of Geotechnical Engineering and Material Science — *Chair: Yong-Hoon Byun*

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14:00-14:25	**Sustainable Stabilization of Earthen Blocks using Bio-based Materials for Climate Resilient Building Construction** **Mohammad Shariful Islam** *(Professor, Bangladesh University of Engineering and Technology, Bangladesh)*
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Session 2 : Case Studies on Innovation and Practice — *Chair: Tae Sup Yun*

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15:15-15:40	**Geohazard Impacts in Nepal Himalayas: A Reconnaissance of Critical Events 2024** **Mandip Subedi** *(President, Nepal Geotechnical Society, Nepal)*
15:40-16:05	**Newly-established Certification System of Professional Engineers for Geotechnical Evaluation in Japan** **Junichi Koseki** *(Emeritus Professor, University of Tokyo, Japan)*
16:05-16:30	*Break*

Session 3 : Advances in Foundation Engineering — *Chair: Jong-Sub Lee*

16:30-16:55	**Piled Raft - A Modern Foundation Design Philosophy** **Phung Duc Long** *(President, Vietnam Society for Soil Mechanics and Geotechnical Engineering, Vietnam)*
16:55-17:20	**The Importance of Unimpeded Concrete Overflow in Bored Piles** **Mark Albert H. Zarco** *(President, Philippine Society for Soil Mechanics and Geotechnical Engineering, Philipines)*
17:20-17:45	**Implementation of the Discrete Area Method and its Impact on the Steel Reinforcement of Large Mat Foundations** **Grace Abou-Jaoude** *(Professor, Lebanese American University, Lebanon)*

DAY 2 — Challenges in Geotechnical Engineering — Jan 15, 2025

13:00-13:10	**Introductory Comments & Welcoming Address**

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14:00-14:25	**Geotechnical Forensic Engineering for Dam Rehabilitations** **Suttisak Soralump** *(President, Thai Geotechnical Society, Thailand)*
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Session 5 : Underground Stability Assessment — *Chair: Tae Sup Yun*

14:50-15:15	**Towards Establishment of Data-centric Approaches for Geotechnical Reliability Assessments** **Andy Yat Fai Leung** *(Professor, The Hong Kong Polytechnic University, Hong Kong)*
15:15-15:40	**Theory of Stability of Soil Masses and Soil Pressure on Retaining Structures based on the Satisfaction of the Limit Equilibrium Condition** **Askar Khasanov** *(President, Uzbekistan Geotechnical Society, Uzbekistan)*
15:40-16:05	**Green Hydrogen Production: Physical and Financial Impact of Geothermal Well Heat Losses on Overall System Performance** **Guillermo A. Narsilio** *(Professor, The University of Melbourne, Australia)*
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Session 6 : Applied Geotechnical Engineering — *Chair: Jong-Sub Lee*

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08:55-09:20	**Machine Learning is Reshaping Engineering Models: The Rise of Analysis Paralysis, Optimal yet Infeasible Solutions, and the Inevitable Rashomon Paradox** **M.Z. Naser** *(Professor, Clemson University, USA)*
09:20-09:45	**Steel Coupling Beams in Low-seismic and Wind Applications** **Bahram Shahrooz** *(Professor, University of Cincinnati, USA)*
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11:10-11:35	**An Efficient Shear-flexure Model for RC Walls and Further Developments** **Leonardo M. Massone** *(Professor, University of Chile, Chile)*
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13:25-13:50	**Load Reduction in Deeply Buried Structures: A Case Study with Expanded Polystyrene Blocks** **Amichai Mitelman** *(Professor, Ariel University, Israel)*
13:50-14:15	**Experimental Investigation on Failure Mechanisms of Transmission Towers** **Seungjun Kim** *(Professor, Korea University, South Korea)*
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Session 4 : Recent Advances in Forensic Structural Engineering Ⅳ *Chair: Goangseup Zi*

14:50-15:15	**Defect Detection Method of Welding using Thermography based on Machine Learning** **Young K. Ju** *(Professor, Korea University, South Korea)*
15:15-15:40	**Resistance of Headed Studs Welded within the Ribs of Steel Decking Transverse to the Supporting Beams** **Stephen J. Hicks** *(Professor, University of Warwick, UK)*
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10:00-10:30	**Pulsed Demand Modelling and its Impact on Design and Management of Water Distribution Networks** **Enrico Creaco** *(Professor, University of Pavia, Italy)*
10:30-11:00	**Explainable Artificial Intelligence for Reliable Water Demand Forecasting to Increase Trust in Predictions** **Robert Sitzenfrei** *(Professor, University of Innsbruck, Austria)*
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Session 2 : Advancements in AI and Modeling for Hydrological Systems — *Chair: Chulsang Yoo*

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13:30-14:00	**The Assessment of Potential Runoff Impacts from Artificial Cloud Seeding Operations in Idaho using the WRF-Hydro Model** **Jongkwan Kim** *(Doctor, NOAA-National Centers for Environmental Prediction, USA)*
14:00-14:30	**Advancing Snow Hydrology in a Changing Climate: The Role of Remote Sensing, Modeling, and Data Assimilation** **Eunsang Cho** *(Professor, Texas State University, USA)*
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16:00-16:30	**Climate-resilient Low-carbon Seawater Desalination: Integrating Renewable Energy and Recovering Energy from RO Brine** **Youngjin Kim** *(Professor, Korea University, South Korea)*
16:30-17:00	**Recent Advancement in Resources Recovery from Seawater Desalination** **Chanhee Boo** *(Professor, KAIST, South Korea)*
17:00-17:30	***QnA Session***

Enzyme-induced Mineralization of Struvite for Soil Improvement

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Both Microbially Induced Calcium Precipitation (MICP) and Enzyme-Induced Calcium Precipitation (EICP) techniques have been extensively studied for ground improvement, demonstrating effectiveness in enhancing soil properties. However, urea hydrolysis to produce calcium carbonate naturally generates ammonium ions as byproducts, which can cause environmental issues, including eutrophication in ecosystems and potential ammonia gas emissions. We propose a novel soil improvement technique by precipitating ammonium ions as struvite minerals ($MgHN_4PO_4 \cdot 6H_2O$) using an enzyme-based approach. A series of batch experiments were conducted at acidic initial pH, with varying Mg:N:P molar ratios (1:1:1 and 1:2:1, with N regulated by urea concentration) and urease concentrations (0, 0.5, 1, and 2 g/L). Under a 1:2:1 molar ratio, all urease concentrations reached the optimal pH for struvite formation within 2 days, whereas the 1:1:1 molar ratio did not reach the desired pH level. The solution pH was positively correlated with the urease concentration at a 1:2:1 molar ratio, while the consumption of N was negatively correlated, indicating that 0.5 g/L urease was the optimal concentration. XRD and SEM analysis confirmed the formation of struvite crystals with a coffin-like morphology at the optimal pH solution. Treated sand column with this solution exhibited the two times increase in shear stiffness due to struvite precipitation, along with a 50 % reduction in hydraulic conductivity.

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.

Bio-cementation Technique for Soil Liquefaction Mitigation

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With growing ecological awareness, environmentally friendly and sustainable construction methods are desired. Microbial induced carbonate precipitation (MICP) has gained substantial interest in geotechnical engineering. In this talk, the effect of different calcium sources on MICP is presented firstly. Three calcium sources, including calcium chloride, calcium nitrate, and calcium acetate, were selected based on their applicability and solubility. The results indicated that the uniformity of specimen was increased by controlling the pH value of MICP treatment solution at 8.50-8.70 before injecting the solution into the specimen. Calcium nitrate exhibits the highest calcite content in treated specimens. Also, we employed an MICP-enhanced fluid and simulated in-situ grouting to assess the effectiveness of soil improvement on a local soil. Procedures for lateral injection in the field with a 65 cm (L) × 50 cm (W) × 100 cm (H) test pit were established where the uniformity of treatment was evaluated. Lastly, we investigate methods for inducing sporulation. Various sporulation media were tested to identify the medium that maximizes spore formation. The spores were transformed into a powder form through freeze-drying and subsequently reactivated to observe the growth condition. The results indicate that Sporosarcina pasteurii exhibits varying morphologies when grown in different culture media, with the proportion of observed sporulated bacteria under microscopy also varying accordingly. After undergoing freeze-drying, the lyophilized state of spores can be effectively reactivated and cultivated in liquid culture media. The use of spores in a lyophilized state not only facilitates preservation but also enhances the convenience of material transport and treatment solution preparation during on-site applications.

Louis Ge is a professor in the department of civil engineering at National Taiwan University. He also serves as department chair. Dr. Ge received his BS from National Taiwan University, MS and Ph.D. from University of Colorado at Boulder in 1995, 2000 and 2003, respectively. Before joining National Taiwan University in 2011, he was a tenured associate professor at Missouri University of Science and Technology, USA. His research work focuses on granular mechanics, including soil liquefaction, ground improvement, and constitutive modeling. He has published more 60 journal papers. Dr. Ge is currently serving as an associate editor of Journal of Materials in Civil Engineering, an editorial board member of Journal of Testing and Evaluation, an editorial board member of Marine Georesources & Geotechnology, and an associate editor-in-chief of Geoenvironmental Disasters.

Sustainable Stabilization of Earthen Blocks using Bio-based Materials for Climate Resilient Building Construction

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The construction sector of Bangladesh faces increasing vulnerability due to soil erosion, flooding and environmental degradation as a result of the dynamic deltaic location of Bangladesh. In light of the significant environmental challenges, including topsoil depletion and high carbon emissions, recent research focuses on the alternative stabilization technique for earthen blocks incorporating bio-based materials as an alternative to fired clay bricks and concrete blocks. Earthen blocks have been produced using locally available alluvial soil, which offers a sustainable solution by minimizing environmental impact and utilizing underexploited resources. While being a traditional stabilizer, cement can also compromise cost-effectiveness and environmental viability when used more than 10%. Given that, Supplementary Cementitious Materials (SCMs) such as fly ash, rice husk ash, and sewage sludge ash have been explored to enhance the micromechanical properties of earthen blocks by forming Calcium-Silicate-Hydrate (C-S-H) gels that fill voids within the soil matrix, leading to improved strength and durability. This research also focuses on geopolymer stabilization as a viable alternative to cement. Geopolymers, synthesized using alkaline solutions like sodium hydroxide or aluminosilicate materials like metakaolin, produce a stable and dense matrix through polymerization offering mechanical properties comparable to or superior to cement-stabilized blocks with fewer greenhouse gas emissions and improved thermal properties making them a more sustainable choice for earthen blocks in tropical climates. Another focus of this research is the application of Microbially Induced Calcite Precipitation (MICP) in earthen blocks where calcium carbonate is precipitated within the soil matrix, improving load-bearing capacity and resilience to environmental factors, such as weathering, and flooding, by maintaining wet strength, wear resistance, and reducing water absorption.

Furthermore, fiber reinforcement, using natural and synthetic fibers such as jute, vetiver, polyester and banana fiber, has significantly improved the tensile strength, ductility, and crack resistance of earthen blocks, making them more durable and resistant to environmental wear. Additionally, the use of biopolymers like xanthan gum has been investigated to improve the durability of earthen blocks under cyclic wetting and drying conditions, crucial for flood-prone regions, due to their regenerative property. The inclusion of biochar has also been explored, with denser and more cohesive structures with improved mechanical properties and enhanced thermal performance of earthen blocks and environmental sustainability. These research endeavors highlight the potential of these alternatives in stabilizing earthen blocks to improve strength and durability properties while providing sustainable, cost-effective, and climate-resilient solutions, meeting the requirements of various earthen building standards for long-term structural integrity and performance. The innovative materials being explored offer promising applications for both rural and urban infrastructure, addressing critical construction challenges worldwide, especially in light of increasing risks from complex disasters driven by climate change and urban overpopulation.

Mohammad Shariful Islam is currently working as a professor at the Department of Civil Engineering, BUET. He is also an adjunct faculty member at Chandigarh University, India. His research specialization focuses on various state-of-the-art topics, including bioengineering, climate-resilient infrastructure, disaster-resilient rural housing, land reclamation, constitutive modeling of soil, etc. He has made significant contributions in the fields of Vetiver-based bioengineering, disaster-resilient infrastructure, and green bricks. These have been implemented in different projects in Bangladesh by government agencies and international agencies (ADB, EU, IFAD, IOM, SIDA, UNCDF, and UNDP) for road projects in Cambodia and Indonesia. Dr. Islam has published 184 research articles in reputed journals, conferences, and seminars and has given more than 25 keynote/invited lectures at home and abroad. He received 27 awards for research and academic excellence, which include Global Vetiver Champion Award 2023, Vetiver Network International Award 2023, FORUM86 Research Excellence Award 2020, King of Thailand Vetiver Awards 2015, Vetiver Network International Award 2015, the Best Paper Award from Springer Nature, ISSMGE, and JSCE, Dr. Rashid Gold Medal, Sharfuddin Gold Medal, Dean's Award, Monbusho Scholarship (Japan), and university merit scholarships. He is conducting and collaborating on different research projects with local and global partners. He has also been selected for the prestigious Dr. M Innas Ali Memorial Gold Medal 2023. Dr. Islam is dynamically contributing to national development by working as a member of a panel of experts or consultants on different important mega projects for airports, bridges, elevated expressways, highways, MRT, railways, seaports, submarine bases etc. in the country.

On the Protection and Rebuild of the Old Railway Stations – The Experience in Taiwan

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In this study, two cases of old railway stations in Taiwan were reviewed and discussed. The Taichung station, a major railway station of Taiwan Railway Administration (TRA), was built back in 1905. After more than 115 of service, a new elevated station was built nearby in 2020, and the old station was reserved as a historic site. On the other hand, due to the 1935 Shingchu-Taichung earthquake, there were serious damages to infrastructures, including the stations and bridges of the TRA. The stations like Shunshing and Taian stations were first restored and used until 1998, and were reserved as historic sites as well. The history and restoration of these old stations were reviewed and discussed from the geotechnical point of views.

Keh-Jian (Albert) Shou is now VP Asia of ISSMGE (2022-2026), Chairman of ISTT (2022-2025), 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), Associate Editor of the ASCE Journal of Pipeline Systems Engineering and Practice (SCI) and associate Editor of Underground Space (SCI). He obtained his Ph.D. degree (Civil Engineering) from University of Minnesota, U.S.A. in 1993. His major experience includes: 1. Visiting Professor, CNR-IRPI, Perugia, Italy (2013/8-2014/1). 2. Senior Principal Engineer, Shannon & Wilson, Seatlle, USA (2008/2-2008/9), 3. Visiting Professor, TTC, Louisiana Technical University, USA (2006/1-2006/2), 4. Visiting Professor, RCUSS, Kobe University, Japan (2003/10-2004/3), 5. Research Engineer, CSIR/Miningtek, South Africa (1998/2-1999/1), 6. Geotechnical Engineer, National Expressway Engineering Bureau, Taiwan (1993-1994).

Geohazard Impacts in Nepal Himalayas: A Reconnaissance of Critical Events 2024

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The Nepal Himalayas, known for their rugged terrain and active tectonic activity, are highly susceptible to numerous geohazards. Recent natural disasters have highlighted the escalating risks driven by geohazards and climate change. On November 3, 2023, a magnitude 5.7 MW (6.4 ML) earthquake struck Jajarkot in eastern Nepal, causing widespread destruction, triggering landslides, and destabilizing already vulnerable slopes. Similarly, a Glacial Lake Outburst Flood (GLOF) in Thame, located in the Everest region, on August 16, 2024, highlighted the growing threats associated with glacial retreat due to climate change, leaving downstream settlements devastated. Furthermore, unprecedented torrential rainfall from September 26 to 28, 2024, in central Nepal, including the Kathmandu Valley, resulted in over 250 fatalities and economic losses exceeding 1% of the national GDP. This rainfall event set new records at 25 meteorological stations, leading to catastrophic flooding and landslides. This study examines these extreme events through field-based reconnaissance to analyze their impacts and underlying mechanisms. The findings aim to deepen our understanding of the risks in the Hindu Kush Himalayan region and offer insights into disaster preparedness and sustainable development strategies, contributing to building safer communities and resilient infrastructure.

Mandip Subedi is an Associate Professor of civil engineering with geotech background at Universal Engineering and Science College of Nepal. He is also currently serving Nepal Geotechnical Society as its President. He has a Ph.D. in geotechnical engineering from Tribhuvan University of Nepal. In an honor of his nearly six years of cooperation with Ehime University activities in Nepal, Dr. Subedi has also been appointed as a Visiting Associate Professor of Ehime University at the Center for Disaster Management Informatics Research from April 2024. His main area of research interest is ground liquefaction and geohazards and he has published his research papers on renowned international journals. He is also the winner of the best research paper award of 2022 published in the Geoenvironmental Disasters.

Newly-established Certification System of Professional Engineers for Geotechnical Evaluation in Japan

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The 2011 Off the Pacific Coast of Tohoku Earthquake in Japan induced extensive liquefaction and severe embankment failure, which caused serious damage not only to public infrastructures but also to private residential areas. In order to promote policies and activities for preventing/reducing such geo-hazards, the Japanese Geotechnical Society (JGS) compiled a series of recommendations, in which an establishment of a new certification system of professional engineers for geotechnical evaluation, in particular on private properties, was proposed. In view of such social backgrounds, the Japanese Association for Geotechnical Evaluation (JAGE) was newly assembled and started its operation in 2013. As its current president, the lecturer introduces briefly the history, scopes and activities of JAGE that has been co-operated by four organizations including JGS, with a support of other six organizations. The total number of registered professional engineers who have passed official examinations increased gradually year by year and reached 1,283 as of August, 2024. They spread nationwide and are in charge of a variety of duties that are relevant to geotechnical evaluation in general, including forensic issues.

Junichi Koseki is a Professor Emeritus of the University of Tokyo (UTokyo) and currently serving as a technical officer at R&D center of Raito Kogyo, Co., Ltd., Japan. He obtained his Bachelor, Master and Doctoral degrees from UTokyo, Japan. During the period of 1987-1994, he worked as a researcher at Public Works Research Institute, Ministry of Construction, Japan. In 1994, he moved to UTokyo as an associate professor at Institute of Industrial Science (IIS). After promotion to a professor at IIS in 2003, he moved to Department of Civil Engineering, UTokyo in 2014 and served as a professor of Geotechnical Engineering Laboratory until March, 2023. His research interests include liquefaction and its countermeasures, deformation and strength properties of geomaterials, and seismic behavior of earth structures. He received the C.A. Hogentogler Award from Committee D-18 on Soil and Rock, ASTM in 2000 and 2004, the Best Paper Awards from the Japanese Geotechnical Society in 2007, 2009, 2010, 2012, 2016, 2020 and 2021 and the Best Paper Award from Japan Society of Civil Engineers in 2023. He was also the 2010-2011 Mercer Lecturer endorsed jointly by the International Society for Soil Mechanics and Geotechnical Engineering (ISSMGE) and the International Geosynthetics Society and the fifth Bishop Lecturer endorsed in 2019 by TC101 of ISSMGE on laboratory stress strain strength testing of geomaterials.

Piled Raft - A Mordern Foundation Design Philosophy

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Piled raft foundations have been more and more widely applied, especially for tall buildings. In piled raft foundations, piles are not designed to take the full load but only to reduce the settlement to an allowable level, or a pre-chosen settlement. Basing on the experimental results performed by the author, a simplified method, which can be easily used for the design practice, was suggested. In this paper the result from the Author's experimental study, which strongly supports the concept of settlement-reducers are reviewed. The experimental results are surprisingly in good agreement with case histories many years later. The method can be used in combination with FEM method for a conceptual design of a piled raft foundation, with a desired settlement. Using this approach, in this paper a foundation for a high-rise complex was studied. The foundation was designed as a conventional piled foundation. Piled raft foundation was studied as an alternative option. At a chosen settlement of 20 mm, a considerable number of piles could be saved. 3D FE analyses are performed to verify the settlement of the foundation system.

Phung Duc Long has over 45 years of international experience. He is currently the president of the Vietnam Society for Soil Mechanics & Geotechnical Engineering (VSSMGE). In 1974, he received his bachelor's degree from Hanoi University of Civil Engineering, Vietnam. From 1974 to 1988, he worked at the Institute for Building Science and Technology (IBST) in Hanoi. Between 1982 and 1988, he was a visiting researcher at the Swedish Geotechnical Institute (SGI). In 1993, he received his Doctor of Science degree (Ph.D.) from Chalmers University of Technology (CTH) in Gothenburg, Sweden. He worked for Skanska Sweden from 1994 to 2002 as a technical manager. He also served as a general director for WSP Asia and then WSP Vietnam from 2002 to 2012 in Hong Kong and later in Hanoi.

His areas of expertise include deep foundations and piled raft foundations for high-rise buildings, temporary and permanent support for deep excavations, soil improvement, underpinning, pile dynamics, cut-and-cover tunneling, and numerical analysis of soil-structure interaction problems. He has worked , as technical manager or chief engineer, on projects in many countries including Sweden, Norway, Denmark, the USA, England, Russia, Germany, India, Hong Kong, China, and Vietnam. Some of his key projects include the Uni-Storebrand Headquarters in Oslo with foundations on steel-core piles into rock; the SL-10 South Link in Stockholm with a sheet pile wall for a cut-and-cover tunnel in soft clay; Fredriksberg Metro Station in Copenhagen, the largest drilled-pile wall project in the world; soil stabilization for Highway I-15 in Salt Lake City, Utah, USA; the Öresund Link/Bridge between Sweden and Denmark; Årsta Bridge in Stockholm with pile foundations and a sheet pile wall in deep water and soft clay; and peer review of the foundation for the ICC Tower, a 118-floor, 490-meter high, the tallest tower in Hong Kong.

He has authored and co-authored more than 100 technical papers and books in Vietnamese, English, and Swedish for various national, regional, and international seminars, conferences, and technical journals. He has been a co-founder of the well-known GEOTEC HANOI conference series, and the chairman of the scientific committee and the chief editor of the five successive GH conferences.

The Importance of Unimpeded Concrete Overflow in Bored Piles

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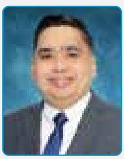
The use of column starter bars is a common practice in the Philippines in the construction of cast-in-place bored piles. Column starter bars are used to resist tension and shear forces across joints and provide continuity with the main vertical reinforcement bars and horizontal links of the column. By embedding column reinforcement bars during construction of the bored pile, the transition to construction of the column is expedited.

Ideally, interface between the embedded column rebar and the bored pile should be free of construction defects as this critical section located in the upper 4-5 meters of the bored pile is generally subjected to large stresses during a seismic event. Crosshole Sonic Logging (CSL) tests performed on bored piles constructed in the Philippines indicate occurrence of anomalies within the pile-column transition zone where column starter bars are placed. Concrete coring of these critical sections of the pile confirms the presence of extensive construction defects. It is hypothesized that the use of column starter bars impedes the overflow of contaminated concrete which subsequently increases the likelihood of construction defects occurring at the transition zone between the pile and column.

The findings of this case study highlight the importance of ensuring unimpeded concrete overflow as well as quality control and quality assurance procedures, particularly when column starter bars are used in the construction of cast-in-place bored piles.



Mark Albert Zarco is a professor and Head of the Geotechnical Engineering Group, Institute of Civil Engineering, University of the Philippines Diliman. He is a fellow of the Philippine Institute of Civil Engineers (PICE), and is the current chair of the PICE Specialty Division for Geotechnical Engineering. He is also the current president of the Philippine Society for Soil Mechanics and Geotechnical Engineering (PSSMGE) which is a member society to the ISSMGE. He serves as a Director for 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.

Implementation of the Discrete Area Method and its Impact on the Steel Reinforcement of Large Mat Foundations

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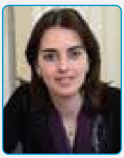
Mat foundation design often encounters significant soil-structure interaction challenges that are oversimplified. According to Winkler's hypothesis, the deformation of foundations under applied loads is confined to the loaded regions, but this is seldom accurate. In structural analysis, Winkler springs, defined by the coefficient of subgrade reaction (ks), are commonly used to represent the ground. To simplify modeling, designers often use a single ks value. In 1995, the iterative discrete area method (DAM) was introduced in ACI SP-152. The DAM accounts for variable ks values across the mat, but it is rarely used in practice. Other studies have also examined the distribution of Winkler spring stiffness to achieve more realistic results, primarily considering the soil as a continuum medium. However, these studies focused on the elastic behavior of soil or elastoplastic behavior under undrained conditions.

This study has two main objectives. First, it investigates the impact of the DAM on the steel reinforcement design of large mat foundations resting on elastic soils by comparing it with the reinforcement resulting from using a constant ks. Second, it aims to understand the effects of plastic strains and volume changes due to the consolidation of clayey soils. Three-dimensional parametric analyses of slabs on elastic and elastoplastic soil were performed using SAFE, Settle3, and ANSYS for various soil characteristics and loading configurations. Results indicate that the variable ks model in elastic soils generates an optimized steel reinforcement distribution, with a reduction in top steel reinforcement and an increase in bottom steel reinforcement. It also highlights the limitations of linear elastic models used to represent soft clays. In these cases, linear elastic soil models overpredict stiffness and bending moments. Incorporating the elastoplastic behavior of soil is crucial for accurate mat foundation design. The discrete area method was found to be most suitable for practical design, generating outcomes resembling those of an elastoplastic continuum finite element analysis. These findings have significant practical implications.

Using the DAM can lead to more efficient and cost-effective designs by optimizing steel reinforcement distribution. This not only enhances the structural performance and safety of mat foundations but also reduces material costs and construction time, making it a valuable approach for engineers and designers in the field.



Grace Abou-Jaoude is an Associate Professor of Civil Engineering at the Lebanese American University. Throughout her career, she has contributed to a variety of multispectral projects. As a woman in engineering, she has focused on the recruitment and retention of women in the field, particularly through a project aimed at engaging middle school students. While her primary research interest is in soil-structure interaction, she has successfully led two USAID-NSF PEER-funded grants to investigate landslide hazards and risks associated with rainfall and earthquakes in Lebanon, employing various analytical techniques. Additionally, she has organized non-technical educational workshops to enhance the understanding of landslide hazards and risks among public officials and policymakers in Lebanon. Her other research interests include ground improvement, underground construction, and geotechnical earthquake engineering.

Cavity (Sinkhole) Detection using Elastic and Electromagnetic Waves

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The objective of this study is to detect and estimate the size of a cavity beneath a concrete plate using ground penetrating radar (GPR) and microphone. A chamber is filled with dry sand and covered with a reinforced concrete plate. A cavity is placed between the concrete plate and sand. The GPR signals are measured at the surface of the concrete plate, and acoustic signals are acquired by impacting the concrete plate with an instrumented hammer and are measured by a microphone. Furthermore, experiments are performed with wet sand and the results are compared with those under dry sand conditions. The GPR survey results show that the accuracy of cavity location assessment using GPR may be deteriorated due to rebars. In addition, the wet condition of the soil can also reduce the accuracy of GPR signal polarity-based analyses for cavity detection. The microphone survey results show that the evaluated and actual locations match, and the estimated cavity size is slightly smaller than the actual size with dry and wet soil conditions. Thus, the microphone survey may be relatively accurate and less affected by the rebars and soil moisture in comparison to GPR survey. This study demonstrates that microphones may be used efficiently for cavity identification and size estimation under dry- or wet soil conditions.

Jong-Sub Lee is a Professor at the School of Civil, Environmental, and Architectural Engineering at Korea University (KU), and had served as an Associate Dean at the Graduate School, KU. 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 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 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 delivered many keynote lectures in international conferences including the 19th International Conference on Soil Mechanics and Geotechnical Engineering (ICSMGE) and the 17th Asian Regional Conference (ARC) on Soil Mechanics and Geotechnical Engineering. He is a fellow of the National Academy of Engineering of Korea. He published more than 300 journal papers (186 international and 114 national) and 343 conference papers. His research interests are non-destructive testing and evaluation with advanced sensing, in-situ subsurface characterization, and foundations.

Distributed Optical Fibre Strain Sensing for Instrumentation of Soil Nail Pull Out Test and Pile Maintained Load Test

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For the past few years, there has been rapid development in the area of smart sensor technologies, in particular by using structurally integrated optical fibre sensor to form the basis of smart structure technology. Recently, Brillouin Optical Time-Domain Analysis (BOTDA) has been implemented successfully in pile load tests. BOTDA is a distributed optical fibre sensor that allows measurement of strain along the full length (up to 100 km) of a suitably installed optical fibre. In this presentation, utilisation of BOTDA to replace vibrating wire strain gauges in soil nail pull out test and pile maintained load test in granite formation will be discussed. The load distribution along the soil nail and pile lengths during the testing will be presented as well. In addition, the empirical correlation between the mobilised soil shaft friction and Standard Penetration Test value, SPT'N along the soil nail and pile length will also be discussed.

Lee Peir Tien obtained his Bachelor of Engineering (Civil) from University of Technology, Malaysia in 2001. He has been involved in design and construction of various geotechnical specialist works for more than 20 years.

He involved in several major infrastructure projects in Malaysia such as Kajang Dispersal Link Road (SILK), Northern Double Track (Padang Renggas to Alor Setar), KVMRT Line 1, East Coast Rail Link (ECRL), KL – Singapore High Speed Rail (HSR) and Southern Double Track (Gemas to Kluang) etc. He also involved as the main designer in several reclamation projects such as Penang World City (60 acres), Melaka Gateway (500 acres), Penang South Reclamation (about 4000 acres), Butterworth reclamation (1000 acres). He also involved in Klang Valley MRT (KVMRT) Line 1 as internal geotechnical reviewer. He also familiar with advanced finite element modelling using PLAXIS 2D specifically on modelling of soil-structure interaction problem involving embankment, ground treatment, piled foundations and deep excavations

He has published more than a dozen technical papers on geotechnical engineering in international and local conferences. His research interests include soft ground engineering, slope stabilisation, foundation and deep excavation.

He was the Chairman for Geotechnical Engineering Technical Division (GETD) of IEM for Session 2017/2018 and 2018/2019. He also actively involved in Malaysian Geotechnical Society (MGS). He served as Committee Member from 2016 to 2020, was the Secretary General for Session 2020/2021. Subsequently, he was elected as the Deputy President and President for 2021/2022 and 2022/2023 & 2023/2024 respectively. Currently, he is the Immediate Past President of MGS for Session 2024/2025.

Geotechnical Forensic Engineering for Dam Rehabilitations

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Dam rehabilitations after failure or near failure require series of investigation techniques including instrumentation interpretations, details site characterization and appropriate computer modelling. Two case studies of dam rehabilitations will be presented in this lecture. The first case is the large RRC composited earth dam that damages caused by 6.3 magnitude of earthquake. Serious differential movement between the earth and RCC interface causing leakage of the dam that might lead to piping failure. After a series of investigations, the earth-reinforced soil wall combined with impermeable steel sheet pile was constructed to replace part of the dam crest to provide crest flexibility and leakage prevention during the strong earthquake. The second case is the rehabilitation of the downstream slope of the upper pond reservoir dike in which the slope material decomposes rapidly when subjected to increasing accumulation of moisture from prolong rainfall. The decompose of downstream slope material is causing the reduction in shear strength of soil hence affecting the stability of the dam. The detail investigation revealed that the ruzy grass that grow over the downstream slope surface tend to trap the surface runoff water and water slowing infiltrate into the slope causing the decompose of the compacted claystone used in the shell zone of the dam. Geosynthetic clay liner (GCL) was used to prevent the infiltration of rainfall and finally stop the decompose and serious slope movement.

Suttisak Soralump is a 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 Ph.D. (Geotechnical Engineering) from Utah State University. He is the President of Thai Geotechnical Society and immediate past president of Southeast Asian Geotechnical Society, chairman of Association of Geotechnical Society in Southeast Asia and Chairman of Disaster Preparedness and Mitigation Working Group of AFEO.

Prof. Suttisak specialize in Dam engineering, soft ground improvement, Slope stabilization, Geohazard mitigation, Landslide, Geotechnical Earthquake Engineering, Ground subsidence. Prof. Suttisak is an experienced Geotechnical Engineer. He was a team leader for more than 20 large dam rehabilitation, dam design and dam construction supervision projects 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.

Towards Establishment of Data-centric Approaches for Geotechnical Reliability Assessments

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This presentation covers various aspects relevant to the establishments of data-centric engineering, especially in the context of geotechnical reliability assessments. These include (i) compilation of databases of triaxial test results for several common soil types across different parts of Hong Kong; (ii) stress path analysis to reveal probabilistic distributions of critical state model parameters of such soils; and (iii) development of probabilistic analysis approaches and design charts to reveal the influence of geo-material variability to geotechnical system reliability. Example applications to slope engineering, deep excavations and foundation engineering will be presented to highlight the potential benefits and significance of data-informed approaches in civil and geotechnical engineering.

Andy Y.F. Leung is currently Associate Head (Partnership) and Associate Professor at the Department of Civil and Environmental Engineering, The Hong Kong Polytechnic University. He obtained Ph.D. degree at the University of Cambridge, UK, and had practiced in the industry in the USA and Hong Kong before joining PolyU. His research interests include soil-structure interaction, reliability of geotechnical and structural systems, probabilistic analysis approaches and novel geotechnical instrumentation technologies. He has received various awards on research, teaching excellence and knowledge transfer. He served as the President of Hong Kong Geotechnical Society between 2022-2024.

Theory of Stability of Soil Masses and Soil Pressure on Retaining Structures based on the Satisfaction of the Limit Equilibrium Condition

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Currently, geotechnical engineering widely uses tasks that consider issues of stability and the determination of soil pressure on retaining structures. This report will examine approaches to solving stability problems and soil pressure on retaining walls. When calculating these tasks, volumetric forces (pore pressure) and cohesion (c) should also be taken into account. These effects are proposed to be considered as variable coefficients that either reduce or increase normal stresses. The obtained results are compared with experiments. The report will cover the main postulates and methods for stability calculation based on classical strength theories, such as Coulomb's and Mohr-Coulomb theories, and the conditions for limit equilibrium of external and internal forces. The issues of determining the active weight W and excess shear forces ΔT, utilized by the authors to define active (passive) pressure and the calculated value of the angle of inclination of the failure surface θ, are discussed. The results of the calculations are compared with established analytical models.

Askar Khasanov is a professor at Samarkand State University and the Head of the Geotechnical Engineering Group at SamGASI. He is the President of the Uzbekistan Geotechnical Society under ISSMGE and serves as General Director of LLC "Geofundamentproekt". Khasanov is a member of the New York Academy of Sciences in Engineering Geology and an active member of the International Technical Committee on Geotechnics for Heritage Sites. He has received several prestigious awards, including the N.M. Gersevanov Medal from the Russian Society for Soil Mechanics and the T.Zh. Junisov Medal from the Kazakhstan Geotechnical Society. His research focuses on soil stability, stress-deformed states of loess soils, and foundation strengthening for cultural heritage sites. He led projects on reinforcing key monuments like the Tilla-Kori Madrasah in Samarkand. Dr. Khasanov holds a Doctor of Technical Sciences from SamGASI and has authored over 140 articles and several influential textbooks on geotechnical engineering.

Green Hydrogen Production: Physical and Financial Impact of Geothermal Well Heat Losses on Overall System Performance

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This lecture will discuss a thermo-economic assessment of geothermal-based hydrogen production systems over a 30-year period, focusing on the effects of heat loss in geothermal wells on system performance. A comprehensive 3D finite element (FE) model is employed to accurately simulate both underground and aboveground components, including impervious ground and aquifer layers. The modelling approach combines thermodynamic and thermo-economic analysis to compare the performance of advanced Organic Rankine Cycle (ORC) configurations with a simple ORC system. The findings highlight the significant impact of heat losses between the production well and surrounding ground, leading to a temperature difference between the bottom and top of the well. This temperature difference, especially in the initial five years of operation, results in a 19.3% reduction in hydrogen production rate and a 12% increase in production costs. Over time, this difference diminishes, reaching 1.4 °C by the final 10 years, with only 4% and 9% variations in production rate and cost, respectively. The study underscores the importance of considering the thermal interactions between wellbores, the surrounding impervious ground, and the aquifer in modelling geothermal-based hydrogen production systems, which has been neglected in previous studies. The results reveal that accurately simulating heat loss in geothermal wells is essential for assessing long-term system performance. Furthermore, the inclusion of advanced ORC-TEG (Thermoelectric generator) configurations demonstrates potential for optimising system efficiency and reducing costs, thus improving the economic feasibility of geothermal hydrogen production.

Guillermo A. Narsilio is Deputy Head of the Department of Infrastructure Engineering at the University of Melbourne (2020–today) and Chair of the ISSMGE Technical Committee 308 on Energy Geotechnics. He is a former member of the ARC College of Experts (2018–2021). Dr. Narsilio is also a past Chair of the Australian Geomechanics Society (Victoria Chapter, 2019–2020) and a former Australian Research Council (ARC) Future Fellow. Dr. Narsilio received his Ph.D. in Geotechnical Engineering (2006) and his Masters in Mathematics (2006) and in Geotechnical Engineering (2003) from Georgia Institute of Technology (US). He obtained his Civil Engineering degree from the National University of Cordoba (Argentina) in 2001. He undertook his postdoctoral experience at the University of Melbourne where he is now a Professor. His research interests include numerical modelling, multi-scale porous material characterisation and performance and the (sustainable) energy industry; with emphasis on basic and applied shallow and deep geothermal energy systems and the use of AI.

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Application of Multiple Driven Fibre Reinforced Columnar Intrusion (MFCI) for Ground Improvement - Case Studies

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Construction in soft soil is a great challenge in the field of geotechnical engineering. Soils with low shear strength and high compressibility causes ground engineering problems like bearing capacity failures, slope instability and differential settlements. Vertical drains using displacement methods are extensively used for ground improvement in soft clay deposits. A major limitation of this method is the need of preloading to initiate consolidation process and reduction of permeability in drain vicinity due to remolding of soft clay. Cochin is known for its deep deposits of soft marine clays and the soil encountered in this area is highly compressible and prone to settlement problems. Such complexities of the marine clays require construction of deep foundations, which are highly expensive and time consuming. Ground Improvement techniques such as sand drains, sand piles, PVDs, stone columns and lime columns are extensively used to overcome the problems arising due to soft clay deposits and to reduce the cost of foundation. The installation of vertical drains by means of a mandrel by displacement system of columnar intrusion causes significant remolding of the subsoil, especially in the immediate vicinity of the mandrel. Thus a zone of smear is developed around the columnar intrusion on withdrawal of mandrel leading to reduced permeability and increased compressibility and this has to be considered in the analysis and its effect has to be accounted in the coefficient of consolidation values. In order to find out the effect and extend of smear zone lot of research has been carried out on various types of soils across the globe. The extent of smear zone and permeability ratio for various types of clay by few investigators are: For Boston Blue clay (Onoue 1991), d_s/d_m = 1.6 and k_h/k_s = 3, for Bangkok Clay (Bergado et al. 1993) d_s/d_m = 2 and k_h/k_s = 10, for Sydney Alluvial clay (B. Indraratna and Redana 1998) d_s/d_m = 4~5, for Cochin Marine Clay (Anil Joseph et al. 2015) d_s/d_m = 2.63 and k_h/k_s = 1.315~1.44, etc. When sand drains are installed through very weak soil, the continuity of the drains gets broken due to necking of very soft clay and the collapse of the sand columns.

In order to improve the strength and efficiency of drains, fiber reinforced columnar intrusions are used. To overcome the reduction of permeability due the formation of smear zone, a novel concept of multiple driven columnar intrusion is adopted. During the second driving, drainage media installed initially gets penetrated into smeared zone formed during first drive which helps to improve permeability properties. The laboratory studies were conducted to compare consolidation behavior with time for single and double driven columnar inclusion using hybrid mix formed with sand, coarse aggregate and fiber. Laboratory results shows that double driven columnar inclusion shows much enhanced performance. The concept is applied in field for construction of Oil tank farm at Willingdon Island, Cochin. By adopting concept of double driving by fiber reinforced columnar inclusion and preloading using hydro testing the installation time of individual tank could be reduced to 55 days from 150 days and a saving of 32% in foundation cost was achieved. Case study two examines the use of MFCI for ground improvement in a bridge project in Kerala, where the road was supported on embankments. After ground improvement with Prefabricated Vertical Drains (PVD) at Gramenchira and Parechal, two new bridges with approach embankments were constructed. As the project neared completion, significant distress, including large settlements and embankment movements occurred. The presentation covers the causes of failure and the rehabilitation measures including the adoption of MFCI techniques to stabilize the foundations and ensure the embankments' stability by effectively improving the soft clay soils. Case study three explores the geotechnical challenges encountered during the deep excavation for a mall and 20 storied residential tower project and the mitigation strategies adopted. During the progress of excavation, the retaining system adopted for the work was at the brim of failure due to the bulk movement of the soft marine clay causing higher stress on supporting systems. To mitigate this, a combination of lime fly ash and fiber-reinforced columnar intrusions was adopted, effectively preventing further bulk soil movement and stabilizing the retaining system. This ground improvement technique optimized retaining wall design and ensured the structural stability of the project.

Anil Joseph is the Managing Director of Geostructurals (P) Ltd., a leading foundation & structural consultancy firm based at Cochin. He has provided foundation and structural consultancy for more than 3000 high-rise structures including many landmark multistoried and infrastructure projects in India and abroad in the last 30 years. His design of Nippon Toyota showroom at Kalamassery, Platynum Mall at Maradu, Lulu Grand Hyatt Hotel & Convention Centre, Bolgatty Island, Kochi, and Hyatt Regency, Trichur has won the ICI-UltraTech Award for Outstanding Concrete Structures of Kerala in the building category in the year 2012, 2017, 2018 and 2020 respectively. He is the Managing Director of CECONS (P) Ltd., a construction firm specialized in the execution of pile foundations and also the Director of Engineers Diagnostic Centre (P) Ltd., a firm specialized in geotechnical investigation and retrofitting works.

He is the President of Indian Geotechnical Society for the year 2023 to 2026, National Council Member of Institution of Engineers India in Civil Division for the term 2021 to 2025, Chairman of IEI Civil Division Board for 2024. He is a Governing Council member of Indian Association of Structural Engineers, the Chairman of Indian Concrete Institute, Kochi Centre, the Vice Chairman of Builders Association of India, Cochin Chapter, and the Hon. Secretary of Kerala Management Association. He is representing India in International Technical Committee TC-220 on "Field Monitoring in Geo Mechanics" and in Asian Technical Committee AsRTC-14 on Smart Observation Methods. He is the Immediate Past President of Association of Structural and Geotechnical Consultants, Kerala, Immediate Past State President of Graduate Association of Civil Engineers, the Past President of Association of Piling Specialists, Kerala, Member of Association of Contracting Engineers, Executive Committee Member of Deep Foundation Institute India, and an adjunct faculty of Albertian Institute of Science & Technology, Cochin, TocH Institute of Science and Technology, Cochin, Federal Institute of Science and Technology, Angamaly.

As per the direction of Supreme Court, it was decided to raze 5 high rises at Maradu, Cochin, and Dr. Anil Joseph was appointed as the Geotechnical and Structural expert in the technical committee by the Govt of Kerala in the year 2019. He also played a vital role in the demolition of Supertech Twin Tower Noida in August 2022. He was bestowed with the Honorary Membership of Nepal Geotechnical Society in 2024.

Dr. Anil Joseph is also involved in various social activities such as Vice President of the Regional Sports Centre, Kadavanthara, Cochin. He is an active Rotarian and was the Former Assistant Governor of Rotary District 3201 and past president of Rotary Club of Cochin Downtown. He was one among the top 10, Diamond Hall of Fame, New Age Icon Change Makers 2020. He is married to Rinna Anil, Director of Cecons Pvt Ltd and is blessed with two children: son Akhil Anil, who is doing his Ph.D. in Geotechnical Engineering from Texas A & M University, USA, and daughter Alina Anil, doing her M.S in Earthquake Engineering from University of California, Los Angeles.

Smart Foundations on Undermining and Seismic Regions in Kazakhstan

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The study considers conical foundations with their apex pointing downward to increase the cross-sectional area and, as a consequence, the bearing capacity during settlement and under the influence of horizontal tensile deformations in the undermined areas. To simulate the deformability of non-buried and seismically exposed foundations, a three-dimensional expandable box was fabricated and assembled. Models of a conical foundation with a cone opening angle of 90° and 80° were buried in the ground to 0.75 of its height in order to provide a safety margin under further loading by increasing the load-bearing area when the cone is immersed. deeper into the ground. Laboratory and field tests were carried out on the vertical loading of single cones before and after horizontal soil displacement. To compare the bearing capacity, isolated shallow foundations with a diameter equal to the cross-sectional area of the conical foundation at the intersection with the ground surface were tested. According to the results obtained, isolated shallow foundations lost their bearing capacity after 0.15 kN in laboratory tests and after 75 kN in field tests, while the ultimate bearing capacity of conical foundations of a commensurate cross-section on the ground surface was not achieved even after 0.2 kN in laboratory tests with horizontal soil movement and at a load of 100 kN in field tests. The main goal of this study is to develop stable foundations that can effectively respond to significant ground displacements, helping to prevent emergency situations and reduce construction costs. Comparative loading experiments were carried out on both conical and columnar foundation models of the same diameter. The objective was to evaluate the settlement and bearing capacity of soil under horizontal ground displacement induced by horizontal tensile deformations in areas affected by underground mining and seismic activity.

Askar Zhussupbekov is a Professor of Department of Civil Engineering of Eurasian National University (ENU, Kazakhstan) and also adjunct professors of Saint Petersburg State University of Architecture and Civil Engineering (SPBGASU), and Moscow State University of Civil Engineering (MGSU), Russia, and Director of Geotechnical Institute of ENU , Kazakhstan. Askar Zhussupbekov received his bachelor's degree and master's degree in civil engineering from Saint Petersburg State University of Architecture and Civil Engineering (SPBGASU), Russia, in 1977. After working for the Karaganda State Industrial University (1977-1982), Kazakhstan, as an assistant professor, he entered the geotechnical engineering graduate program at the Saint Petersburg State University of Architecture and Civil Engineering (SPBGASU), Russia in 1982. In 1985, he received his Ph.D. from SPBGASU. In 1986, he was hired as an Associate Professor in Karaganda State Industrial University (Kazakhstan), where he became to Professor and First Vice-Rector of Karaganda State Industrial University. He is now Presidents of Kazakhstan Geotechnical Society ,Kazakhstan Geosynthetic Society and as well as consulting work for civil and geotechnical projects at new capital Kazakhstan (Kazakhstan), West Kazakhstan (Caspian Sea area), Almaty (old capital of Kazakhstan), Saint-Petersburg, Moscow, Yuzhno-Sakhalinsk (Russia). He delivered several keynote lectures in international conferences including the 16th Asian Regional Conference of Geotechnical Engineering (ISSMGE). He is a chair of TC 305 «Geotechnical Infrastructure for Megacities and New Capitals» of ISSMGE. His research interests are geotechnical engineering (piling and deep foundations), geomonitoring, undermining soil ground, disaster prevention and reduction, in situ testing, preservation of historical sites. He has published more than 400 scientific papers, including 10 Geotechnical books.

Some Aspects of the Forensic Analysis of the Brumadinho Dam Failure

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The January 2019 catastrophic Brumadinho tailing dam failure caused 270 fatalities and had very significant worldwide repercussions for the engineering of tailings storage facilities. The failure was captured on camera and quickly identified as a flow liquefaction failure. The failure was sudden and unexpected, taking place in a sunny day, in a dam that had been closed for almost three years, that was being slowly drained and was closely monitored. The lecture describes some aspects of the numerical and experimental analyses that a team lead by the author carried out as part of a forensic investigation into the immediate cause of the dam failure. The different causal hypothesis that were proposed are examined and the one that was finally singled out as more likely -a borehole perforation to install piezometers- is described in some detail. Current ideas and activities related to identifying and evaluating flow failure risks in other similar structures are presented and discussed.

Marcos Arroyo is a Civil Engineer (MSc Politecnica Madrid, 1991). In 2001 he obtained a Ph.D. from Bristol University (UK). He worked as researcher at Politecnico di Milano, University College London and CIMNE. In 2007 he joined the Department of Geotechnical Engineering and Geosciences at UPC BarcelonaTech, where he is now Associate Professor and Head of Section. He is currently responsible for "Geotechnical design", "Foundations" and "Offshore foundations". He has directed to completion 12 Ph.D. and 25 MSc thesis. He has initiated a variety of research projects there that have attracted more than 5 M€ of public and private funding. His research is problem-driven and relies on different numerical (DEM, FEM, PFEM) and experimental (laboratory & in situ testing) techniques to address questions of geotechnical interest. The outcomes of this research are regularly published in peer-reviewed scientific conferences and journals. Marcos Arroyo worked for 8 years in geotechnical design offices and acts regularly as consultant in a variety of engineering projects. He is active in several normative committees, notably ISO TC182 Geotechnics and CEN TC250/SC7/ were he contributed to the initial drafts of the second generation Eurocode EC7.1 and EC7.2. Marcos Arroyo is the current Secretary of ISSMGE Technical Committee 102 "In Situ testing".

Forensic Investigation of Fire Damaged Steel Structures

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Fire represents a severe hazard to buildings and civil infrastructure during their design life. To overcome the adverse effects of fire, structural members, especially in buildings, are provided with appropriate fire resistance ratings, as specified in building codes. For these reasons, as well as due to effective fire-fighting measures, complete collapse of structural systems due to fire is a rare event. However, historical survey data clearly suggests that fires do cause some level of damage to structures. Therefore, it is reasonable to assume that steel, concrete, or composite structures, after most fire incidents, can be opened to re-occupancy with adequate inspection, 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 steel structures is highly variable. In case of exposure to a severe fire, steel members might experience significant structural damage resulting from a loss of fire insulation, local or global buckling, and the on-set of relatively larger permanent deformations. Alternatively, exposure to moderate fire scenario may not result in noticeable deformations or local or global buckling, and thus loss of structural capacity of the fire exposed steel member may not be significant. Thus, there is always uncertainty regarding level of remaining structural capacity in fire exposed steel structures. Currently engineers assess residual capacity of fire-damaged steel structures using thumb rules and visual observations, 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 rational engineering approach is proposed for assessing residual capacity of fire-damaged steel 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 steel structure. 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 steel members. Through a set of case studies, the application of advanced analysis for evaluating realistic residual capacity of fire damaged steel structures 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 civil and fire engineering fields and his research accomplishments have had major impacts. He has developed fundamental understanding on the behavior of materials and structural systems under extreme fire conditions. The techniques and methodologies resulting from his research is instrumental for minimizing the destructive impact of fire in the built infrastructure, which continues to cause thousands of deaths and billions of dollars of damage each year in the U.S. and around the world.

Dr. Kodur has published results from his research in 550+ peer-reviewed papers in journals and conferences, and has given 100+ plenary/key-note presentations at major international conferences and meetings. He is one of the highly cited authors in Civil Engineering and Fire Protection Engineering disciplines, and as per Google Scholar, he has more than 23,500 citations with an "h" index of 85.

Dr. Kodur has served in various leadership positions, including as Chairperson (Head) and Associate Chairperson of the Department of Civil and Environment Engineering at MSU, and as Chair of various technical committees and editorial boards of journals from leading professional societies. Most recently he has been elected to be the Chairperson of the steering committee of the international organization- "Structure in Fire".

In recognition of his contributions, he has been elected as Fellow of seven Institutes and Academies; including Academy of Sciences of the Royal Society of Canada, Canadian Academy of Engineering, American Society of Civil Engineers, and Indian National Academy of Engineering. Dr. Kodur is also the recipient of distinguished awards, such as 'NATO award for collaborative research', 'Govt. of Canada (NRCC) Outstanding Achievement Award', and 'Fulbright Scholar' award. Dr. Kodur also holds prestigious appointments including, "Distinguished Invited Visiting Professor" at EWHA Woman's University, South Korea; "INFOSYS Distinguished Visiting Chair Professor" at the Indian Institute of Science; Distinguished Visiting Professor at the Indian Institute of Technology-Bombay; Government of India "VAJRA Faculty (Award) for Collaborative Research" at the Indian Institute of Technology-Delhi and "Adjunct Professor" at the University of Waterloo, Canada. Most notably, Dr. Kodur was part of the Federal Emergency Management Agency and American Society of Civil Engineers high profile "Experts Team" that investigated the collapse of the World Trade Center buildings as a result of September 11 terrorist attacks.

Machine Learning is Reshaping Engineering Models: The Rise of Analysis Paralysis, Optimal yet Infeasible Solutions, and the Inevitable Rashomon Paradox

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This talk examines the philosophical tension between the acceptance of empirically derived codal provisions and skepticism facing machine learning (ML) models– despite their shared statistical foundations. To showcase this rarely explored front, this paper presents how ML can be successfully integrated into various structural engineering problems by means of formulation via deduction, induction, and abduction. Then, this talks identifies three principal paradoxes that could arise when adopting ML: analysis paralysis (increased prediction accuracy leading to a reduced understanding of physical mechanisms), infeasible solutions (optimization resulting in unconventional designs that challenge engineering intuition), and the Rashomon effect (where contradictions in explainability methods and physics arise). This talk argues for the need to rethink epistemological shifts in our domain to harmonize traditional principles with ML.

M.Z. Naser is a professional engineer and an assistant professor at the School of Civil and Environmental Engineering and Earth Sciences at Clemson University and a faculty member of the AI Research Institute for Science and Engineering (AIRISE). Dr. Naser serves as the current chair of the American Society of Civil Engineers (ASCE) Advances in Information Technology (AIT) committee and a voting member of various national and international engineering institutions. Dr. Naser's research creates causal and explainable machine learning methodologies to help us realize functional, sustainable, and resilient infrastructure.He has co-authored over 140 peer-reviewed publications, including a new textbook on machine learning and civil engineering, titled "Machine Learning for Civil and Environmental Engineers: A Practical Approach to Data-Driven Analysis, Explainability, and Causality" by Wiley. He is listed in the company with the world's most impactful researchers by Elsevier and Stanford University, ranking among the world's top 2% of scientists since 2022.

Steel Coupling Beams in Low-seismic and Wind Applications

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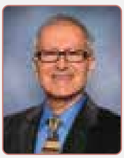
Based on the expected level of inelastic deformations, composite structural (shear) walls can be classified as Composite Ordinary Shear Wall (COSW) or Composite Special Shear Wall (CSSW). One common composite system involves linking reinforced concrete wall piers by steel (or steel-concrete composite) coupling beams that are embedded in the wall piers. Over the past several decades, extensive research has been conducted to develop data needed to codify design of steel (or steel-concrete composite) coupling beams in CSSW in which the wall piers are heavily reinforced and typically have boundary elements. The wall piers in COSW, on the hand, have substantially less reinforcement and do not require boundary elements. However, no experimental research had been conducted to understand the performance of steel coupling beams in COSW prior to the presented study. The test results from large-scale subassemblies and components in conjunction with detailed analytical studies were utilized to develop new design equations for calculating the required embedment length and determining connection stiffness of steel couplings in COSW. Compared to the values obtained from existing equations, which have been calibrated for CSSW, the new equation results in longer embedment lengths by as much as nearly 40% for cases that would likely be encountered in practice. This presentation will provide an overview of the experimental and analytical components of this research program.



Bahram Shahrooz is a professor of structural engineering at the University of Cincinnati. He is a registered professional engineer in Ohio and has served as a consultant on several projects. He is a Fellow of ACI, ASCE, and the Structural Engineering Institute (SEI) of ASCE. He is an active member of several ACI and ASCE technical committees. Dr. Shahrooz has received numerous research grants and contracts from federal and state funding agencies to (a) examine seismic performance of innovative hybrid structural systems; (b) revise bridge design codes to allow the use of high-strength materials and improve design of concrete bridges; (c) study load-carrying capacity and resistance mechanisms of existing, deteriorated bridges; and (d) investigate advanced composite materials in civil infrastructure. He has published more than 180 refereed journal papers, peer-reviewed conference proceeding papers, technical reports, and magazine articles. He is the recipient of the 2023 Precast/Prestressed Concrete Institute (PCI) Robert J. Award, the 2012 ASCE State of the Art of Civil Engineering Award, and the 2005 ASCE Moisseiff Award. Using his seminal research, he has spearheaded major changes in AASHTO LRFD Bridge Design Specifications and AISC Seismic Provisions for Structural Steel Buildings.

Investigation of the Structural Performance of UHPC Precast, Pretensioned Bridge Girders

Mary Beth Hueste, Amreen Fatima, Hyeonki Hong, John Mander, Stefan Hurlebaus, Anol Mukhopadhyay, Tevfik Terzioglu

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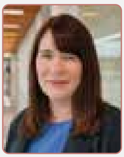
The advanced properties of ultra-high performance concrete (UHPC) include high strength, enhanced tension performance, and improved durability, making it attractive for application to precast, pretensioned bridge girders. An analytical feasibility study identified potential increases in span length that can be achieved using UHPC bridge girders when compared to conventional pretensioned concrete bridge girders. The superior mechanical properties can also be used to maintain span lengths comparable to conventional pretensioned concrete bridge girders with a reduced number of girder lines. Nonproprietary UHPC mixtures were designed to meet target strengths of 13-14 ksi (90-97 MPa) at release and 18-20 ksi (124-138 MPa) at service. The developed UHPC mixtures were tested to determine a range of fresh and hardened properties, and to assess durability. One of the developed nonproprietary UHPC mixtures was selected for production at a precast plant and achieved a compressive strength greater than 14 ksi (97 MPa) within 21 hours and 18 ksi (124 MPa) at 28 days without heat treatment. In addition, the evaluation for durability showed superior performance with a predicted service life greater than 150 years

Three full-scale UHPC precast, pretensioned bridge girders were fabricated at a precast plant and tested in the laboratory to evaluate flexure and shear performance. The girder specimens were topped with cast-in-place conventional concrete deck slabs to represent typical bridge girders in the field. The experimental program for each girder specimen included four-point bending tests in flexure, along with additional testing of the shear behavior at the girder ends. After load testing, the girder specimens were cored to investigate fiber distribution. It was found that the behavior of the specimens in flexure and shear were directly impacted by the fiber distribution and tensile strength of the UHPC used in the girder specimens.

In addition, the depth of the girders, the number of prestressing strands, and presence of harped prestressing tendons influenced the performance of the full-scale girder specimens under flexure and shear loading. This presentation describes the overall research program and provides specific findings with respect to the development and application of nonproprietary UHPC mixtures to precast, pretensioned bridge girders along with the full-scale flexure and shear tests of the fabricated UHPC girder specimens.



Mary Beth Hueste is the Truman R. Jones, Jr. '43 Professor in the Zachry Department of Civil and Environmental Engineering at Texas A&M University. She joined Texas A&M in 1998 where she is a member of the structural engineering faculty. She is also Division Head for the Construction, Geotechnical and Structures Division of the Texas A&M Transportation Institute. Dr. Hueste conducts research promoting sustainable and resilient infrastructure, including the development of new design approaches and application of innovative materials to enhance the service-life, structural performance, and safety of the built environment. Much of her recent research has concentrated on furthering the use of new materials and designs for bridge structures, with a focus on prestressed concrete bridge systems. She is active in the American Concrete Institute (ACI) and was named Fellow of the Institute in 2011. She is a member of ACI Committee 318 (Building Code) and the ACI Technical Activities Committee. She was recognized in 2021 with the ACI Joe W. Kelly Award for her outstanding contributions to educating the next generation of engineers and her leadership in advancing the concrete industry through research and committee activities. Dr. Hueste is a member of the Editorial Boards of the ACI Structural Journal and Engineering Structures. She holds a BS degree from North Dakota State University, a MS degree from the University of Kansas, and a PhD degree from the University of Michigan, all in Civil Engineering.

Seismic/Fire Performance Enhancement of Concrete Structures using Self-prestressed Iron-based Shape Memory Alloy

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Shape memory alloys (SMAs) are a class of smart materials that have unique thermomechanical characteristics. Shape memory effect (SME) of SMAs enables self-prestressing of concrete structures simply by heating of SMAs without requiring heavy jacking equipment. Therefore, the use of SMAs in civil infrastructure has gained a keen attention in structural/seismic applications. This research presents an experimental study on the application of iron-based SMA (Fe SMA) as an efficient alternative for active confinement retrofitting of concrete columns with non-seismic details. Furthermore, this research introduces a new potential application of SMAs to improve structural performance of concrete slab at elevated temperature such as fire. The SME activated in a fire situation is expected to delay significant fire damage and help the slab exhibit satisfactory flexural response.

Donghyuk Jung is an associate professor in the school of civil, environmental and architectural engineering at Korea University since 2022. His primary research interests lie in enhancing the resilience and sustainability of infrastructure systems through the use of advanced structural materials. In particular, he plans to build on his background in the structural/seismic design of reinforced concrete structures and smart materials/systems to develop durable, high performance mitigation techniques for multi hazard scenarios and extreme climate related deterioration. Dr. Jung obtained his Ph.D. in 2018 and M.S. in 2012 in civil engineering from the University of Illinois at Urbana Champaign. He completed his B.S. in architectural engineering at Korea University in 2010. Before coming to Korea University, he served as an assistant professor in the department of architectural engineering at Pusan National University from 2019 to 2022. Dr. Jung received the 2023 Martin P. Korn Award from the Precast/Prestressed Concrete Institute (PCI).

An Efficient Shear-flexure Model for RC Walls and Further Developments

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A research was conducted to develop a macroscopic modeling approach that integrates axial, flexure, and shear interaction under cyclic loading conditions to obtain reliable predictions of the nonlinear response of reinforced concrete (RC) structural walls. The model, named as Efficient-Shear-Flexure-Interaction (E-SFI), is intended to provide accurate results for squat, medium-rise, and slender planar walls, with a computationally efficient formulation that can be used under generalized conditions. The E-SFI model, which is based on the Shear-Flexure Interaction Multiple-Vertical-Line-Element-Model (SFI-MVLEM), incorporates a two-dimensional RC panel behavior described with a fixed-crack-angle approach. The novel formulation removes the internal degree of freedom per RC panel element of the SFI-MVLEM by incorporating a calibrated expression to compute the horizontal normal strain (εx), and therefore removing the assumption of zero resultant horizontal stress ($\sigma x = 0$) to increase the range of applicability of the model. The model is validated against a large set of test specimens from the literature. Analytical model results reveal the ability of the model to accurately reproduce the hysteretic response for all considered cases, with an important reduction in the runtime and an improved current tangent convergence rate compared with the SFI-MVLEM. Further extensions of the model to columns that require 3D concrete material formulation and walls with general cross-sections that require generalized degrees of freedom at the corner nodes are also discussed, showing good results and highlighting the capabilities of the model.

Leonardo M. Massone is a Professor at the University of Chile and Technical Manager at IDIEM from the same University. He received his BS degree from the University of Chile, and his MS and Ph.D. degrees from the University of California, Los Angeles. He teaches concrete design, advanced concrete design, and nonlinear analysis of structures classes. His research interests include analytical and experimental studies of reinforced concrete systems, with emphasis on seismic response. He has written more than 60 articles indexed in WoS (Web of Science). He has received both national recognition, such as from the Chilean Institute of Engineers (2014), and international recognition, such as the “Young Professor Best Paper Award” for the 36th Conference on Deep Foundations (USA, 2011), “Best Paper Award” for the 10th International Congress on Advances in Civil Engineering, (Turkey, 2012) and for the Structural Design of Tall and Special Buildings journal (USA, 2017). He has been recognized from the 2021 to 2024 rankings, within the world's top 2% citation index in the area according to Stanford University and Elsevier. He was Director of the Civil Engineering Department between 2014 and 2018 and since 2023 has been the technical manager at IDIEM. He was a voting member of an ACI 318 sub-group for the 2019 version and is currently the coordinator for the update of the Chilean design code for reinforced concrete structures, NCh430.

Numerical Modeling for Cement Composites with Steel Slag

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Steel slag has limitations as a cementitious composite material due to the expansion risk associated with free CaO. This presentation aims to elucidate the expansion mechanism of steel slag and develop a numerical model to enhance its applicability. Through microstructural analysis, the expansion mechanism was identified, and fracture mechanics was employed to mathematically describe the expansion-induced failure. The volumetric strain of reaction products was calculated based on volumetric compatibility, and the results were compared with empirical expansion rates. The numerical model demonstrated strong agreement with the experiments, confirming its reliability for predicting expansion behavior.

Goangseup Zi is conducting research on "structural systems" with the application of solid mechanics. Depending on the length scale of interest, the "structural system" may include structures, members, and materials. Specifically, his research focuses on the failure mechanisms of structural systems made of quasi-brittle materials, such as concrete, rocks, and synthetic composite materials.

Prof. Zi's work has spanned multiple engineering disciplines, where he has made significant advances in computational fracture mechanics, fracture and damage mechanics, the deterioration of concrete structures, and multi-physics modeling. His expertise also extends to on- and offshore wind energy substructures, where he is developing and analyzing support structures under extreme environmental conditions, including fatigue assessment, optimization design, and advanced finite element modeling through tools like X-SEA, a program specifically tailored for offshore wind turbine support structures.

Prof. Zi's groundbreaking contributions have been recognized with numerous prestigious awards. Notably, in 2018, he was honored as a Highly Cited Researcher by Clarivate Analytics, an accolade awarded to the top one percent of authors worldwide with the most cited publications across all scientific and engineering fields. Furthermore, from 2020 to 2023, he was recognized as a Top 2% Researcher by Elsevier Data Repository, reflecting his sustained impact and contributions to the global research community. His prolific academic career includes the authorship or coauthorship of two books and more than 100 research articles published in internationally refereed journals.

Load Reduction in Deeply Buried Structures: A Case Study with Expanded Polystyrene Blocks

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Accurate load estimation for deeply buried structures is a persistent challenge in engineering, as applying the full dead load is often overly conservative and inefficient. This study examines the effectiveness of expanded polystyrene (EPS) blocks in reducing loads on the top slab of a deeply buried concrete culvert. The research combines field monitoring using strain gauges, simplified load reduction calculations, and finite element (FE) modeling. Different soil constitutive models—Mohr-Coulomb, Hardening Soil Model (HSM), and elastic—were evaluated in the FE analysis. Results revealed that while the choice of soil constitutive model had limited impact on soil-structure interaction, the Young's modulus of the filling material played a critical role in the structural response. EPS blocks were shown to significantly decrease loads, reducing the maximum bending moment from 0.07 MNm to 0.04 MNm. The FE models closely mirrored trends observed in field measurements, particularly in the relationship between cover height and structural strain, though model predictions were lower than actual measurements. The simplified load reduction method demonstrated reasonable accuracy being slightly over-conservative. This case study highlights the potential of EPS to enhance the cost-efficiency and performance of deeply buried structures, providing practical insights for their design and construction.

Amichai Mitelman is a senior lecturer in the Department of Civil Engineering at Ariel University, Ariel, Israel. He received the B.Sc. degree in civil engineering in 2005, the M.A. degree in law in 2013, and the M.Sc. and Ph.D. degrees in mining engineering in 2015 and 2020, respectively, from The University of British Columbia, Vancouver, BC, Canada. Dr. Mitelman is a licensed structural engineer with extensive experience in design and consulting. His research interests encompass geotechnical engineering, tunneling, civil engineering, and machine learning applications in engineering. He has published more than 30 technical papers on these topics.

Experimental Investigation on Failure Mechanisms of Transmission Towers

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In this presentation, the experimental investigation into the failure modes of large-scale transmission towers is discussed. Recently, we designed and fabricated four different types of transmission towers based on a newly suggested LRFD-based design code. First, we evaluated the ultimate load-carrying capacities of the towers and compared them to results from nonlinear analysis. By applying design load combinations, we measured structural stresses in the main posts and bracing, as well as displacements. The experimental results indicate that towers with main posts made of angle members exhibit inelastic buckling, whereas those with main posts made of hollow section pipes exhibit yielding at the sections. Detailed findings will be discussed in this conference session.

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 90 SCI(E) indexed papers for structural engineering.

Defect Detection Method of Welding using Thermography based on Machine Learning

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Recent advancements in fourth-industrial technologies have provided innovative solutions for structural safety inspections. This research proposes a cost-effective and time-efficient technology that employs thermal cameras and drones to investigate the exterior of structures. A novel approach utilizing thermography and machine learning algorithms was developed to identify defects in butt welding. The machine learning models were trained on a dataset comprising over 2,000 thermal images of welding defects, along with corresponding external parameter data influencing the thermal images. The developed algorithm achieved an impressive accuracy of over 80% in detecting butt welding defects. Two verification experiments were conducted to validate the practicality of this technology. The first involved evaluating the technology in a factory setting where real-time butt welding was being manufactured. The second experiment assessed the technology's performance when integrated with a thermal camera mounted on a drone. These evaluations demonstrated the feasibility and potential of the proposed method for improving structural safety inspections.

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 research building forensic technology that monitors the structural condition in early stages, performance-based design, and smart construction technologies such as Modular or Composite structural member. He has published more than 60 SCI(E) indexed papers for structural engineering.

Resistance of Headed Studs Welded within the Ribs of Steel Decking Transverse to the Supporting Beams

Stephen J. Hicks, Vitaliy V. Degtyarev
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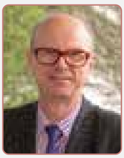
When stud connectors are welded within the ribs of steel decking, their resistance is reduced compared to studs in solid concrete slabs. To account for this reduction, many international standards provide reduction factor equations, which have been derived empirically from push tests. This paper presents a new empirical design model for calculating the stud resistance, based on machine learning methods and structural reliability. The new design model provides significantly higher resistances for certain combinations of variables than those evaluated from existing code-defined equations. The results show that a large range of variables need to be included to accurately describe the resistance.



Stephen Hicks is Head of Civil and Environmental Engineering at the University of Warwick and possesses over 20 years of international research and development experience in steel and steel-concrete composite structures gained from roles both in Europe and the Asia-Pacific region. He has previously held senior management positions at the Heavy Engineering Research Association in New Zealand (2008 to 2019) and the Steel Construction Institute in the UK (1997 to 2008).

After being elected by the 34 countries that are CEN members, Stephen is currently serving as Chair of the Eurocode 4 committee (CEN/TC 250/SC 4) responsible for the European design standard for steel and concrete structures. He has been a UK delegate on CEN/TC 250/SC 4 since 2005 and participated on three Project Teams responsible for developing the second generation of Eurocode 4 between 2015 and 2022.

He was previously both Chair and Drafting Leader of the committee responsible for the first harmonized Australian and New Zealand bridge design standard for steel and composite bridges AS/NZS 5100.6. He also served on the committee responsible for the first Australasian composite building design standard AS/NZS 2327. As well as participating on several other committees responsible for design, execution and product standards, he has served in a number of governance roles, including Director of the Australasian steel certification body ACRS and EPD Australasia.

In addition to national and international standards, he has expertise in the development of new construction products for manufacturers in both Europe and the Asia-Pacific region, such as cold-formed steel sheeting profiles for composite slabs in both normal and fire conditions. Stephen has regularly delivered CPD courses to designers within Europe, Australasia and Singapore, and has also delivered several Eurocode training courses on steel and composite structures in China.

Behaviour of Precast Sandwich Cladding/Compartment Panels in Fire

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The current technology of lightened and thermal-break sandwich panels made of precast concrete, typically employed in Europe and many other areas of the world mainly for the cladding or the internal compartmentation of industrial buildings, will be presented. These panels are typically connected to the structure by means of a statically determined scheme with mechanical straps and brackets. Such panels, when subjected to fire, tend to bend towards the fire, which can cause physical interference with the structural elements, potentially leading to levering and subsequent failure of the connection devices. However, the deformation of the panels is typically neglected in both simplified and advanced prescriptive design methods, typically focused on the cross-sectional strength only. A systematic numerical evaluation of the issue is presented, together with the results of a subsequent series of analysis typical of the performance-based fire design approach: advanced simulation of fire with CFD method, non-linear transfer heat analysis, and advanced non-linear thermo-mechanical analysis. An advanced methodology for the assessment of the thermo-mechanical performance of those panels is presented. Moreover, the best practice expedients to avoid potential levering effects are presented and discussed.

Bruno Dal Lago, an associate professor in Structural Analysis and Design at University of Insubria, received the bachelor´s and M.S. degrees in building engineering from Politecnico di Milano, Italy, where he also obtained his Ph.D. degree in structural engineering in 2015. He worked as a postdoc research associate at both Politecnico di Milano and University of Insubria up to 2022. Since 2024, he was elected Dean of the engineering courses at University of Insubria.

The main research topics of Dr. Bruno Dal Lago are related to precast concrete structures, mainly in the fields of technology/innovation, behaviour under exceptional loads such as earthquake and fire, and environmental sustainability.

Dr. Bruno Dal Lago is currently coordinator of the task 6 “Fire” within WP3 “Models of Structural Vulnerability for Natural Hazards and Industrial Cascade Effects” and unit coordinator of the task 5 “Dowel connections” within WP11 “Cast-in-situ and precast reinforced concrete constructions” of the ReLUIS research programme.

He has published more than 140 scientific papers, 40 of which in ISI journals in different fields of structural engineering.

Digital Solutions Self-healing Water Distribution Systems

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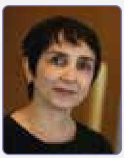
The water industry is facing a number of challenges such as the supply-demand deficit, leakage, bursts, etc. These are exacerbated by climate and demographic changes and aging assets. Predictive asset management is emerging as a vital tool in addressing some of these challenges. The self-healing systems are being introduced as potential intervention options for addressing deterioration issues in piped networks. This talk will look into what that means for water distribution networks. It will also explain some innovative approaches that are being developed to contribute to the delivery of self-healing systems and transition to more smart water systems.



Raziyeh Farmani is a Professor of Water Engineering at Centre for Water Systems, University of Exeter, UK. She is the chair of IWA's intermittent water supply specialist group. She was an Industrial Fellow of Royal Academy of Engineering (2019-2022). She specialises in urban water systems modelling, asset management, many-objective optimisation, uncertainty and risk assessment, and decision aid. Her research interests include Artificial Intelligence, data mining and their application for real-time control for smart water systems, integrated asset management of water supply and distribution systems including leakage management, energy management, sustainability and resilience issues, asset failure and deterioration modelling.

https://engineering.exeter.ac.uk/people/profile/index.php?username=rfarmani

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Pulsed Demand Modelling and its Impact on Design and Management of Water Distribution Networks

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This keynote lecture will present recent developments in the modelling of water distribution networks (WDNs) at fine spatial and temporal scale, in which nodal demands have pulsed nature. It will start by describing the two modelling approaches available in the scientific literature for the reconstruction of pulsed demands, namely i) the models using stochastic processes to evaluate the overall demand in the household and ii) the models capable of reconstructing the overall demand starting from its micro-components, associated with household fixtures. It will continue by showing the different performance and applications of the two modelling approaches. The results shown are obtained by using unsteady flow models of WDNs represented at various level of complexities and by using the pulsed demand as input. The keynote will then try to outline which insights can be obtained by means of the pulsed demand into the real system operation and how the results of WDN modelling in the presence of pulsed demand compares to those obtained under simplified conditions of smooth demand, in the context of design, analysis, management and control of WDNs. After summarizing the main findings in the scientific literature, the keynote literature will end by presenting unresolved issues and future perspectives.

Enrico Creaco obtained his Ph.D. in Hydraulic Engineering in 2006 and has researched topics pertinent to water and environmental systems for almost twenty years. His career began at the Universities of Catania and then Ferrara, Italy. From May 2014 to June 2015 he took up a Research Fellow post at the University of Exeter, UK, and then moved to the University of Pavia, Italy, to be first Assistant (2015-2018), then Associate (2018-2023) and finally Full (from 2023 onwards) Professor. He was Honorary Senior Research Fellow at the University of Exeter from 2016 to 2018. Since 2016, he has been Adjunct Senior Lecturer at the University of Adelaide.

He has been lecturer on hydraulic infrastructures at both undergraduate and postgraduate level and have published more than 130 papers in a variety of Scopus and ISI indexed international journals. He is Associate Editor of the Journal of Water Resources Planning and Management-ASCE and participated in/coordinated various national and international research projects. He is member of an European Action Group of EIP (European Innovation Partnership) on Water, titled CTRL+SWAN (Cloud Technologies & ReaL time monitoring + Smart Water Network) and of the academic spinoff MedHydro srl. He has given various keynote lecturers at both national and international level. Research interests: design and management of water distribution, sewer and irrigation systems; numerical modelling of shallow waters and sediment transport; demand analysis; protection of water distribution systems from contamination; hydrology and water resources management.

Explainable Artificial Intelligence for Reliable Water Demand Forecasting to Increase Trust in Predictions

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Artificial Intelligence (AI) applications in water supply systems can be classified as high-risk AI if a failure of the AI application results in a significant impact on the physical infrastructure or the reliability of supply. For example, the use case of water demand forecasting with AI for automatic tank operation is classified as high-risk AI and must meet specific requirements for model transparency (traceability, explainability) and technical robustness (accuracy, reliability). To this end, six widely used machine learning models, including both transparent and opaque models, are applied to different datasets for daily water demand forecasting and the requirements for model accuracy, transparency and technical robustness are systematically evaluated for this use case. Opaque models generally achieve higher forecast accuracy than transparent models due to their ability to capture the complex relationship between parameters such as weather data and water demand. However, this also makes them vulnerable to deviations and irregularities in weather forecasts and historical water demand. In contrast, the transparent models in this case study rely mainly on historical water demand data and are less influenced by weather data, making them more robust to various data irregularities. In summary, both transparent and opaque models can meet the accountability requirements, but differ in their level of transparency and robustness to input errors. The choice of model also depends on the preferences of the operator and the context of the application.

Robert Sitzenfrei received his Ph.D. in Environmental Engineering from the University of Innsbruck in 2010. As a researcher at the Department of Infrastructure Engineering in Innsbruck, he has led and co-led both basic and applied research projects in all areas of urban water management. His academic output includes over 280 publications in peer-reviewed journals, books, and conference proceedings. Prof. Sitzenfrei is an active member of scientific committees for various prestigious international conferences and frequently contributes as an editor and guest editor for special issues in leading journals. In 2015 he was hired as an Assistant Professor at the Unit of Environmental Engineering at the Faculty of Technical Sciences in Innsbruck, and was promoted to Associate Professor in the same year. In 2018, he was appointed as a full professor for Urban Water Management at the University of Innsbruck. Since 2024 he is Head of the Unit of Environmental Engineering and Deputy Head of the Department of Infrastructure Engineering. His research focuses on integrated and interdisciplinary approaches to resilience, urban water networks, and complex network analysis. He also explores cutting-edge topics like artificial intelligence, transition modeling, smart water cities, the interplay of water and energy systems, and sustainable urban development.

Flood Modeling and Mapping using AI Approaches

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Accurate hourly streamflow forecasting is vital for effective flood mitigation in gauged watersheds but remains challenging due to the complex nature of hydrological processes. This study introduces a groundbreaking methodology for short-term (1–6 h lead time) streamflow forecasting. The proposed framework combines multilayer perceptron (MLP) and gradient boosting (GB) with artificial rabbit optimization (ARO) and the honey badger algorithm (HBA), offering a robust alternative to complex physical models. Through systematic experiments, the impact of input data quality and quantity on forecasting performance is examined by applying two types of model configurations: base models (M1 and M2), which use a simpler set of input variables, and upgraded models (M3, M4, and M5), which incorporate more complex input features. The analyses elucidate how enhancements in model inputs can lead to significant improvements in streamflow prediction accuracy. The framework is applied to the flood-prone Chehalis Basin in the U.S. using 2011–2023 hydrometeorological data, including precipitation, temperature, humidity, wind speed, and streamflow. The optimized HBA-MLP hybrid approach demonstrates significant performance improvements over other methods during training and testing across 75 regional flood events. In the testing phase, based on a 2019–2023 subset excluded from the training data, the HBA-MLP model with the M5 input configuration provides 1–6 hour streamflow forecasts with a root mean square error (RMSE) of 1.87–7.58 (m^3/s) and an excellent R^2 of 0.99–1.0. On average, using this M5 configuration, the MLP models achieve a 58% lower RMSE and 22.6% lower mean absolute error compared with the GB models. Furthermore, the HBA-MLP M5 model excelled in predicting extreme flow events, addressing a key challenge in hydrological forecasting. The proposed model outperformed the National Water Model (NWM), especially during high-flow events, making the HBA-MLP M5 a more robust tool for real-time flood forecasting.

The proposed model outperformed the National Water Model (NWM), especially during high-flow events, making the HBA-MLP M5 a more robust tool for real-time flood forecasting. These results highlight how machine learning coupled with optimization strategies can overcome the limitations of standalone models. Overall, the proposed models yield highly accurate short-term predictions, facilitating effective flood mitigation. Using diverse input data sources and hybrid models, the proposed approach significantly enhances predictive performance, representing a major advancement in the field.

Sayed M. Bateni (Scholar h-index 35) received his Ph.D. from the Massachusetts Institute of Technology (MIT) Cambridge in 2011. He was a Postdoctoral Associate and Lecturer in the Department of Civil and Environmental Engineering at the University of California, Los Angeles (UCLA) from 2011-2013. He is currently a Professor of Hydrology, Water Resources, Remote Sensing, and Natural Hazards in the Department of Civil and Environmental Engineering at the University of Hawaii at Manoa. He is also the Senior Research Associate to the UNESCO-UNISA Africa Chair.

Dr. Bateni has received numerous awards, fellowships and recognitions, including the followings: 1) Cooperative Institute for Research in the Atmosphere – National Oceanic and Atmospheric, 2) Administration (CIRA-NOAA) Scholarship in 2016, 3) Water for Food Daugherty Global Institute Fellowship in 2017, 4) College of Engineering Award for Excellence in Research in 2017 and 2021, 5) Joint Center for Satellite Data Assimilation (JCSDA) Scholarship in 2018, 6) University Corporation for Atmospheric Research (UCAR) Scholarship in 2019, 7) South Korea Visiting Scientist Fellowship in 2020, 8) U.S. Scholar Fulbright Scholarship in 2021, 9) HydroLearn Summer School Fellowship in 2021, 10) Water for Food Daugherty Global Institute Fellowship in 2022, 11) National Center for Atmospheric Research – Joint Numerical Testbed (NCAR-JNT) Fellowship in 2022, 12) Yonsei Frontier Fellowship in 2023, 13) National Science Foundation (NSF) Faculty Fellowship in 2024, 14) National Aeronautics and Space Administration (NASA) Faculty Fellowship in 2024, 15) Cooperative Institute for Research to Operations in Hydrology (CIROH) Fellowship in 2024, and 16) The University of Hong Kong Faculty Fellowship in 2025.

He has authored more than 130 publications in the high-impact factor journals, with an h-index of 35, and has over 65 conference abstracts, and 5 book chapters. He has secured more than $11 million USD in research grants from the NSF, NASA, Federal Emergency Management Agency (FEMA), United States Department of Agriculture (USDA), National Oceanic and Atmospheric Administration (NOAA), and Hawaii State Legislature. Additionally, he has been invited to give seminars at various universities and research centers.

The Assessment of Potential Runoff Impacts from Artificial Cloud Seeding Operations in Idaho using the WRF-Hydro model

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This study was designed to create a quantitative assessment framework for Idaho Power Company (IPC) and the Idaho Department of Water Resources (IDWR) to estimate what the potential impacts of cloud-seeding operations are with respect to the amount, location, and timing of snowmelt-driven runoff. WRF-Hydro–a high-fidelity, physics-based, spatially-distributed hydrologic modeling system–was employed in order to quantify the complex spatial and temporal patterns of snowpack accumulation, sublimation, snowmelt, natural (unregulated) runoff, and water supply. In this project, a 4-km model meteorological dataset (Rasmussen et al. 2023) with added temperature and precipitation bias adjustment that had been generated by the U.S. National Science Foundation (NSF) National Center for Atmospheric Research (NCAR) was utilized for calibration of WRF-Hydro for the Upper Snake (USB) and the Wood-Boise-Payette (WBP) basins. The study domains included nine calibration basins in the USB and nine in the WBP. This calibrated model was then used for the assessment of potential cloud-seeding impacts based upon IPC-provided scenarios.

Jongkwan Kim is a Project Scientist at the NOAA-National Centers for Environmental Protection (NCEP). Before joining the NOAA-NCEP, Dr. Kim was working at the National Center for Atmospheric Research (NCAR) and NOAA-National Water Center (NWC) to launch and apply the National Water Model and WRF-Hydro model. Dr. Kim received his bachelor’s degree in in civil and environmental engineering from Jeonju University in 2001 and his master’s degree in civil and environmental engineering from Korea University in 2003. He received his Ph.D. from Utah State University in 2012. His research mainly focuses on the development and application of hydrologic models and has contributed to the development of floodplain maps for the United States using the National Water Model and WRF-Hydro model.

Advancing Snow Hydrology in a Changing Climate: The Role of Remote Sensing, Modeling, and Data Assimilation

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Under a warmer climate, seasonal snow is one of the fastest-changing hydrologic components, and society in snow-dominant regions faces increased uncertainty regarding water resources management and risks from extreme hazard events (e.g., snowmelt floods and spring droughts). Research and operational efforts have been geared toward improving physics-based hydrologic models and developing new snow observing techniques. However, many operational hydrologic models still have limitations in model physics and input data, and existing observing techniques are limited due to inherent uncertainties and insufficient spatial and temporal coverage. The combined use of multiple remote sensing techniques, data assimilation, and physics-based models has the potential to fill existing snow simulation and observation gaps and advance our understanding of complex hydrologic processes. This lecture will describe how an integrated approach to monitoring and simulating snowpack helps us improve water supply and hydrological applications. I will also discuss current needs and opportunities between the snow science and civil engineering communities to implement sustainable infrastructure in a warmer world.

Eunsang Cho is an Assistant Professor of Civil Engineering at Texas State University (TXST) in San Marcos, Texas, USA. Dr. Cho's research focuses on hydrology, remote sensing, and snow processes, with an emphasis on quantifying the impacts of climate change and human activities on water resources, extreme events (e.g., floods and droughts), and water-related infrastructure in natural and human systems. His work integrates field observations, remote sensing techniques (from UAVs, aircraft, and satellite platforms), land surface and climate modeling, big-data analytics, and machine learning.

Dr. Cho earned his B.S. (2010) and M.S. (2014) degrees from Hanyang University in Seoul, South Korea, and his Ph.D. (2020) from the University of New Hampshire, USA. Before joining TXST, he served as a Postdoctoral Associate and Assistant Research Scientist in the Hydrological Sciences Laboratory at NASA Goddard Space Flight Center (GSFC). He was also affiliated with the Earth System Science Interdisciplinary Center (ESSIC) at the University of Maryland, College Park, from 2020 to 2023.

Dr. Cho has published over 28 peer-reviewed articles in leading journals, including Water Resources Research, Remote Sensing of Environment, and Geophysical Research Letters. His recent work has been highlighted in AGU EOS Science Magazine, ScienceDaily, and other notable outlets. He delivered an invited talk at the 2019 American Geophysical Union (AGU) meeting and received the 2020 AGU Water Resources Research Editor's Choice Award and the U.S. Consortium of Universities for the Advancement of Hydrologic Science Fellowship.

As a Principal Investigator (PI) and Co-PI, Dr. Cho has secured over $6.5 million in U.S. federal grants from agencies such as NASA, the Department of Energy (DOE), the Department of the Interior (DOI), and the Department of Transportation (DOT). He also serves on the executive committees of the American Meteorological Society (AMS) Hydrology Section and the Eastern Snow Conference (ESC).

Integrating Water-energy Systems Interdependencies for Climate-adaptive Infrastructure Planning

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Extreme weather events such as heatwaves, floods, and droughts significantly impact water and energy infrastructures, leading to water quality degradation, water shortages, power supply disruptions, and blackouts. These challenges critically influence the resilience of climate adaptation systems. In densely populated urban areas, the stable operation and management of water-energy infrastructures are essential for urban sustainability, given the intricate interdependencies between social, ecological and technological systems (SETS). Water is indispensable across all stages of energy production, including hydropower, thermal, and nuclear energy generation, while energy is essential for water treatment and supply processes. The operational interdependence of these systems extends beyond physical infrastructure to encompass socio-economic and ecological dimensions, making cascading impacts from disruptions a frequent concern. Existing studies often emphasize direct vulnerabilities arising from physical or structural connectivity, overlooking the systemic vulnerabilities stemming from indirect interdependencies. As the global significance of enhancing urban resilience against climate change grows, there is a pressing need for research and development in infrastructure planning that integrates social, ecological, and technological perspectives.

This study aims to address urban infrastructure vulnerabilities to flooding through the lens of water-energy systems interdependencies and urban complexity. By integrating these perspectives, the research provides a foundation for developing effective policies and strengthening urban resilience. The study offers a comprehensive understanding of the multifaceted causes and impacts of urban flooding through the integrated analysis of water-energy infrastructures, reviews domestic and international research trends, and identifies future research directions. The findings contribute to disaster response in the short term and enhance the climate resilience of urban water-energy systems in the long term.

Yeowon Kim is an Assistant Professor in the Graduate School of Energy and Environment and the Department of Integrative Energy Engineering at Korea University. Her research focuses on understanding the growing complexity of urban systems from the perspective of social, ecological, and technological systems (SETS) interactions, and envisioning resilient cities that can persist, grow, and even transform while maintaining their essential identities in the face of external forces like climate change. She integrates hydrologic models, vulnerability analysis, system dynamics models, decision support tools, and participatory workshops to improve infrastructure design and development strategies for systems-level urban water and energy resource management. Her recent research interests include investigating the roles of nature-based solutions in cities for urban flood resilience and carbon neutrality.

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Climate-resilient Low-carbon Seawater Desalination: Integrating Renewable Energy and Recovering Energy from RO Brine

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Seawater desalination has emerged as a crucial technology to address the global water crisis, especially in arid and semi-arid regions facing acute freshwater shortages. However, conventional desalination processes, particularly reverse osmosis (RO), are energy-intensive and contribute significantly to carbon emissions, posing challenges to global climate mitigation efforts. This study focuses on developing a climate-resilient and low-carbon seawater desalination framework by integrating renewable energy sources and implementing advanced energy recovery strategies for RO brine. The proposed approach incorporates solar and wind energy to power desalination plants, reducing reliance on fossil fuels and enhancing sustainability. By employing renewable energy, the system not only minimizes greenhouse gas emissions but also ensures operational resilience in regions with intermittent power supplies. Additionally, advanced energy recovery technologies, such as pressure exchanger devices, osmotic energy recovery systems and low-temperature thermal recovery systems, are utilized to harness energy from the high-pressure RO brine, significantly improving overall energy efficiency. These recovery processes also reduce waste discharge, mitigating the environmental impact on marine ecosystems. This research provides a comprehensive roadmap for transitioning towards sustainable desalination practices by aligning water production with renewable energy utilization and resource recovery.

Youngjin Kim is an Associate Professor in the Department of Environmental Engineering at Korea University (KU). He earned his bachelor's degree in Civil and Environmental Engineering from Korea University in 2010 and his master's degree in Environmental Engineering from Korea University in 2012. In 2017, he completed a dual Ph.D. program at Korea University and University of Technology Sydney. In 2019, he joined the Department of Environmental Engineering at Korea University as an Assistant Professor. He has published 46 SCI(E) papers and contributed to 2 book chapters. His research focuses on membrane technologies for desalination, water treatment and wastewater reuse.

Recent Advancement in Resource Recovery in Seawater Desalination

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Seawater desalination has emerged as a critical solution to address global water scarcity, yet its intensive energy demands and environmental impacts pose significant challenges. Recent advancements in resource recovery technologies are transforming desalination processes, enabling not only freshwater production but also the extraction of valuable by-products such as high-value minerals and precious metals. This dual approach optimizes resource utilization and mitigates waste, paving the way for more sustainable and cost-effective desalination practices. This lecture discusses three membrane-based cutting-edge developments with the potential to enable sustainable resource recovery from seawater desalination brines.

1) A liquid extraction membrane (LEM) is a selective separation technology that uses a liquid phase immobilized within a membrane's porous structure to extract and transfer specific solutes between two phases based on their chemical affinities.

2) Contact-electro-catalysis (CEC) is a process utilizing electron exchange during contact-separation cycles between a dielectric insulator and an aqueous solution to catalyze reduction of precious metals.

3) Temperature solvent extraction is a separation technique where temperature changes are used to alter the solubility of components in a solvent, enabling selective extraction of target substances.

Chanhee Boo is an Assistant Professor of Civil and Environ. Eng. Department at KAIST. Prof. Boo obtained his Ph.D. from Yale University in Chemical and Environmental Engineering. He also holds an M.S. in Civil, Environmental, and Architectural Engineering, and a B.S. in the same field, both obtained from Korea University. Prior to joining KAIST, he conducted postdoctoral research at Columbia University and also worked as a senior researcher at Korea Institute of Science and Technology (KIST).

Prof. Boo's research centers on the development of novel materials and innovative separation processes which can provide a key solution for a wide range of environmental challenges. He combines technological approaches from material and environmental science to address the most pressing separation challenges arising from the emerging water and industry sectors. His research also endeavors to improve fundamental understanding on interfacial phenomena, intermolecular interactions, and transport mechanisms.

The “Advanced Environmental Materials Lab (AEML)" led by Prof. Boo at KAIST is set to pioneer transformative advancements in water treatment and resource recovery technologies through innovative utilization of nano-scale organic and inorganic materials. His lab envisions pursuing three core research themes: (i) the efficient production of ultra-high-purity water, (ii) successful implementation of zero-liquid-discharge (ZLD) in seawater desalination and industrial wastewater treatment, and (iii) effective recovery of valuable resources from wastewaters.

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