# GMCSEE2023

**Barcelona, Spain | October 19-21, 2023**

*2nd Global Meet on*

***Civil, Structural and Environmental Engineering***

***Location:*** ***Holiday Inn Barcelona Sant Cugat | Carrer del Danubi 24, 08174 Sant Cugat del Valles, Spain***

## Abstract Book


***PRIME MEETINGS***

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*3rd Floor, Akkayapalem,*

*Visakhapatnam, AP 530024*

# DAY 01

## Plenary Presentations

GMCSEE2023

# Seismic Design for Resilient and Sustainable Structures

## Anoop S.Mokha,Ph.D
S.E., Vice-President, Earth quake Protection Systems, California, USA

## Abstract
Resiliency is an important consideration while designing critical buildings, bridges, and industrial structures in earthquake prone regions of the world. This is necessary for minimizing post-earthquake disruption to society. Major earthquakes that have occurred every year in the world are a constant reminder that critical structures must remain operational post-earthquake, so that community needs are met. Hospitals need to remain operational in order to treat injured people and save lives. Bridges classified as lifeline structures also need to remain functional so that rescue and recovery operations can be performed. Gas, water and electric facilities also need to remain functional post-earthquake so that basic services are not interrupted.

Code provisions (ductility based) for seismic design of structures all over the world have focused primarily on achieving "Collapse Prevention" within acceptable limits, at the expense of inflicting damage to structural, non-structural, architectural elements, and contents. After a major earthquake this results in loss of use and function, as observed in recent New Zealand and Chile earthquakes.

One of the approach to achieve resiliency and sustainability is through continued functionality design objectives for minimizing damage in structures by absorbing seismic displacement in isolation bearings, maintaining an elastic structure, and minimizing in-structure accelerations and drifts [Continued Functionality Standard]. FEMA 58 "Seismic Performance Assessment" software is used to calculate the expected seismic damage at different strengths of earthquake shaking. FEMA 58 damage calculations guide the design of the isolation bearings to achieve the target reliability of limiting damage to the specified level. Post-earthquake functionality is typically retained when seismic damage is limited to less than 2% of the replacement costs.
Over the past 30 years I have been involved with the design of buildings, bridges, and industrial structures in 34 countries, many of which are resilient isolated structures that have been designed and constructed at lower costs than conventional ductile structures for achieving resiliency.

While it is acknowledged that ductility based seismic design has resulted in economical and safer structures over the past 50 years, it is time to shift from "Collapse Prevention" to "Damage Prevention" for vital structures needed for post-earthquake function. The world of automotive
industry has already started shifting from "Occupant Safety" to "Collision Prevention" with the integration of smart sensors and advanced braking technology, while the structural engineering profession all over the world is stuck to providing "Collapse Prevention" following prescriptive code provisions. It is time the world receives "Resilient & Sustainable "Structures they expect.

I look forward to presenting seismic design solutions with examples of Sustainable & Resilient Infrastructures, and in shifting the architectural & structural engineering profession towards truly delivering what every Owner & Client expect worldwide.

**Biography**

Dr. Anoop S. Mokha's engineering career has spanned from basic research on Friction Pendulum bearings to their implementation in important and critical industrial, bridge, and building structures worldwide. As Vice President of EPS, since 1999, Dr. Mokha has worked closely with Clients, Engineers, Architects, and Contractors for successful and cost-effective implementation of 'Continued- Functionality" design with Friction Pendulum bearings in over 30 countries. Clients such as Apple, Samsung, Shell, Exxon, Texas Instrument, GSA, State of California, etc. have realized construction cost savings of hundreds of millions of dollars with the creative and innovative seismic solutions provided by EPS. During his 10 year tenure as Structural Engineer at Skidmore, Owings, & Merrill, San Francisco, Dr. Mokha lead the project team for the design and implementation of Friction Pendulum bearings for the New San Francisco International Terminal building and the retrofit of the Historic Landmark Building; the U.S. Court of Appeals in San Francisco.

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# Shifting towards Sustainability: Concepts, Criteria, and Innovation

**Heriberto Cabezas1,* Csaba T. Deák2**
[1]University of Miskolc, Egyetemváros, Miskolc, Hungary
[2]University of Miskolc, Egyetemváros, Miskolc, Hungary

## Abstract
The grand challenge of the present age is how to sustain the human population in a reasonably prosperous and civilized manner within the limits of the one planet, Earth. For reference, the current human population stands at 8,036,391,000 (3,034,583,597 in 1960) the last three digits are left as zeros because they are changing as fast as one writes. In addition, consumption as measured by the per capita global Gross Domestic Product in current U.S. Dollars was $12,236 in 2021 ($459 in 1960) . Hence, we have many more people consuming much more, but we still have the same one planet. Both population and consumption are increasing with time. This may not be a solvable problem, but it is certainly a manageable one. But managing it will require all the human understanding and ingenuity that we possess, and not only technical fields but also in business and innovation. To frame the issue, we will discuss: (1) sustainability in a historical context, (2) and the Sustainable Systems Hypothesis which outlines the conditions necessary for sustainability. Historically, much of the social, economic, and legal frameworks on which society operates were developed when the human population was under a billion and total and per capita resource consumption much lower. We will then discuss the Sustainable Systems Hypothesis which outlines the criteria that is necessary to make progress towards sustainability. These conditions imply that it is necessary to: (1) not to increase the land footprint, (2) not increase the energy footprint, (3) maintain the integrity of ecosystems, (4) create more economic value than is consumed, (5) maintain the quality of human existence above some acceptable level, and (6) maintain overall system stability and order. While these concepts may seem abstract, we will show how they can be applied to evaluate an engineering project or enterprise using
https://www.worldometers.info/world-population/
https://www.worldometers.info/world-population/#table-historical
https://data.worldbank.org/indicator/NY.GDP.PCAP.CD
examples from the engineering literature. We will then discuss the role of business and innovation in finding pathways and manageable solutions out of our sustainability dilemma. This critically important because regardless of how good any concepts or ideas may be, they are unlikely to have an impact on the world unless they can be integrated into business through the process of innovation. There is, however, a systematic approach to doing this, and these will be discussed as well. The hope is that this lecture will concisely present a complete path from conceptual to application in a practical manner.

**Keywords**
Sustainability Criteria, Innovation Methods, Life-Cycle Considerations, System Stability.

**Biography**
Dr. Heriberto Cabezas is a Research Professor at the University of Miskolc in Hungary. He retired as Senior Science Advisor at U.S. Environmental Protection Agency in April 2019. He is past Chair of the Engineers Forum on Sustainability, representing all of the major professional engineering societies. His awards include:

1998 U.S. EPA Science Achievement Award in Engineering, 2007 Distinguished Alumni Achievement Award from the New Jersey Institute of Technology, 2011 Research Excellence Award in Sustainable Engineering from the AIChE, and the 2013 Lawrence K. Cecil Award from the AIChE. Dr. Cabezas holds a Ph.D. and M.S. from the University of Florida, and a B.S. (magna cum laude) from the New Jersey Institute of Technology, all in chemical engineering. He served as a U.S. Embassy Science Fellow in Zagreb, Croatia in 2014. He is a Fellow of the AIChE, a member of the American Association for the Advancement of Science, and a Board-Certified Member of the American Academy of Environmental Engineers and Scientists. Dr. Cabezas is the co-founder of the Trans-Atlantic Research and Development Interchange on Sustainability (TARDIS) workshop series held biannually since 2003. His publications include over one hundred peer-reviewed articles and chapters, two edited books, a U.S Patent for electrochromatography, and two major software. His current research interests focus on: (1) the design of sustainable processes and supply chains, (2) the development of models and policies for global sustainability, and (3) the study of pandemics as complex systems.

Dr. Csaba T. Deák is a Professor at the University of Miskolc in Miskolc, Hungary. Dr. Deák received his Ph.D. in economics from the University of Miskolc in 2001, and his Habilitation in Innovation and Project Management from the University of Pannonia in 2010. He also holds a Master of Economics Degree (1993) and a Bachelor of Science in Business Administration (1990) from the University of Miskolc. He served as Vice-President of the National of the National Development, Research and Innovation Office in Hungary (2012-2014). He is also a Fellow (2015) of the ISPIM (International Society for Professional Innovation Management), Finance and Economic Development, and a Member of the Hungarian Academy of Sciences – Miskolc Chapter (2001). He also holds many other prominent appointments and honors. Dr. Deák has a background with extensive experience in economics, business, and innovation which are critically important elements of progress towards sustainability.

# Sustainable Approaches to Structures Using Inventive Seismic Systems

**Mark Sarkisian,**
Structural Engineering, Skidmore, Owings & Merrill (SOM), One Maritime Plaza, San Francisco, USA

## Abstract

High performing seismic systems are imperative to achieving goals of minimizing damage during significant seismic events, reducing business downtime, allowing for shelter in place, and ultimately reducing environmental impacts due to embodied carbon emissions. Because of continued population growth along with the need for building construction, the need for inventive seismic systems within developments must be considered beyond minimum requirements of building codes where potential widespread damage to building systems is expected while maintaining life safety.

Until recently, carbon dioxide and carbon dioxide equivalent emissions resulting from operation of buildings have been studied with attempts to reduce the impact through lower energy use. However, little attention has been given to the embodied carbon in infrastructure and buildings until recently. With embodied carbon embraced as a major environmental contributor, the full impact of carbon can be considered including carbon emitted to repair or reconstruction buildings following a major seismic event. For multi-story buildings constructed today, it can take 20 years for the operational carbon to overtake the impact from the embodied carbon included in the structure at the time it is built.

Environmentally responsible seismic design of our future cities is imperative. The use of raw materials, time to build, and probabilistic damage all impact embodied carbon over a buildings service life. The presentation will focus on the most creative ways of addressing each issue through inventive seismic design of structures that coexist with architecture. Specific examples ranging from research through built projects will be discussed for multiple international locations.

## Keywords

Seismic; Carbon; Invention; Resilience

## Biography

Mark Sarkisian, PE, SE, NAE, LEED BD+C, is a Partner of Structural and Seismic Engineering at Skidmore, Owings & Merrill in San Francisco, California. He received his BS Degree in Civil Engineering from University of Connecticut where he is a Fellow of the Academy of Distinguished Engineers and his MS Degree

in Structural Engineering from Lehigh University. He also received an honorary Sc.D degree from Clarkson University and an honorary MS degree from the Politecnico di Milano. In 2021, he was elected to the prestigious National Academy of Engineering (NAE) in the United States. His career has focused on developing innovative structural engineering solutions for over 100 major building projects around the world, including some of the world's tallest. Mark holds 15 U.S. and international patents for high-performance seismic structural mechanisms and environmentally responsible structural systems. He teaches studio design courses at Stanford University, UC Berkeley, Cal Poly, California College of the Arts, North Carolina State University, Northeastern University, and the Pratt Institute and has the written the book entitled "Designing Tall Buildings – Structure as Architecture" with the second edition recently released by Routledge -Taylor & Francis.

# Transport of Post-wild fire PFAS Contamination

**Arvin Farid,**
Boise State University, USA

## Abstract

The frequency and size of wildfire events have increased significantly. Every year,approximately 650 million acres of forests are burned by wildfires. These events not only directlyaffect the physical, chemical, and biogeochemical properties of the soil and surface materialsthrough the heating and combustion process, but also indirectly through changes in vegetationandsoilerosion.Moreover,thewayhumansrespondtowildfirescanalsohaveanimpactontheenvironment.Forinstance,theuseofaqueousfilm-formingfoams(AFFFs)isaneffectivemethodto suppress fires, but they contain per- and polyfluoroalkyl substances (PFAS) that are toxic andpersistent in the soil environment. Hence, there is a growing need to understand the behavior ofPFAS in the environment, as they are becoming increasingly prevalent due to their potentialhazards.
In addition to adsorption to soil particles, PFAS have a tendency to adhere to the interfacebetween air and water in the soil, which complicates their presence and transport in unsaturatedsoils.Theair-waterinterfacecansignificantlyincreasetheretentionofPFASduringitstransport.In this paper, a two-dimensional (2D) numerical model was developed to simulate the transportof PFAS by incorporating advection-dispersion and taking into account the impact of adsorptionontheair-waterinterfaceand soil solid phase.

## Biography

Dr.Arvin Faridisa Professor of the Civil Engineering Department and the Director of SEnS-GPS Program, sponsored by the U.S. National Science Foundation, at Boise State University. He is also the chair of the Geo environmental Engineering Technical Committee of the American Society of Civil Engineers (ASCE) Geo-Institute (GI) and an associate editor of the Environmental Geotechnics Journal of the Institute of Civil Engineers (ICE). He also serves on several national and international committees. He received his Ph.D. from North eastern University, Boston, MA, and his M.Sc. and B.Sc.degrees from Shiraz University, Shiraz, Iran.

He has pioneered the leading edge of research on the use of electro magnetic (EM) fields for geo environmental/geo technical applications.His research includes multiphase multiphysics numerical modeling, contaminant fate & transport, wildfires impacts on the geo environment, recycling & reuse of industrial by products, EM-induced remediation, EM waves' effect on soil properties, energy geo-storage, material characterization, power infrastructure vulnerability, and liquefaction mitigation. Dr. Farid was awarded several research grants from the U.S. National Science Foundation (NSF) and National Aeronautics and Space Administration (NASA) amongothers.He has published in several prestigious journals and presented at numerous international conferences in civil engineering, electrical engineering, and geophysics.

# Keynote Presentations

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# Framework of Disaster Management Process and Decision-Making Support System "BOSS"

**Muneyoshi Numada,**
Institute of Industrial Science, The University of Tokyo 4-6-1 Komaba Meguro-Ku, Tokyo 153-8505, Japan

## Abstract

Due to the effects of global warming, natural disasters such as wind and flood disasters and earthquake disasters occur frequently around the world almost every year, resulting in the loss of many lives and property. In response to these disasters, we must go beyond the frameworks and organizations of self-help, mutual help, and public help, complement each other and collaborate, and promote disaster management with all-out efforts.

To cooperate and exert synergistic effects, stakeholders must understand that rationality, values, and emotions interact across multiple decision-making situations. Rationality means "being reasonable and logical," "having clear reasons and rules that lead to the same conclusions no matter who thinks about it," and "being both purposeful and profitable." The rational way of thinking is the same regardless of the standpoint.

On the other hand, humans sometimes act irrationally under the influence of values and emotions. Values are "differences in understanding priority and importance," "non-negotiable principles," "what can share with others and what cannot share with others," and "differences in recognition of history, culture, and tradition." There are many cases where the way of thinking is different, even for each organization and regional characteristics. Emotions/feelings divide into "feelings toward things and objects," "normality bias (neither abnormal nor dangerous)," synchrony bias, "give up, get bored, Prejudice, discrimination, selfishness and altruism," and the way of thinking differs at the individual level.

Disaster management is an academic discipline pursuing people and organizations interweaving people. It is necessary to have a system that can realize effective decision-making. Generalize, standardize, and systemize the lessons of past disaster responses to make effective decisions based on the interaction of rationality, values, and emotions in response to disasters that do not have a single correct answer. Therefore, it is adequate to systematize disaster management. As for the lessons learned from past disaster responses, Japan has prepared and announced a verification report on disaster response, which is adequate to utilize.

Therefore, in this research, we focused on the disaster response business process, incorporated the lessons learned from past disaster responses into the business flow, and built a system that utilizes those lessons as disaster response operations. As a result, we analysed past disaster response operations in Japan and found the classifications into seven fields and 47 types of disaster response operations. Then, we developed the BOSS (Business Operation Support System), showed the overall picture of disaster response, and built a database system correlating the necessary know-how with related operations. The BOSS has created an environment where stakeholders can implement cross-sectional and systematic disaster management.

By standardizing and modelling disaster response as a business process, we can think from multiple per-

spectives and multiple perspectives about disaster response, which lacked persuasiveness, versatility, and immutability and could not be verbalized only by confirming phenomena and reality. We could find or think of solutions, and express and communicate those ideas to other stakeholders. If one understands one model, one can grasp the essence of various disaster phenomena and think efficiently, deeply, and broadly.

## Keywords
Disaster management Decision-making, BOSS system, Disaster Management Training Center (DMTC).

## Biography
• April 2009: Assistant Professor, Institute of Industrial Science, The University of Tokyo
• October 2014: Lecturer, Institute of Industrial Science, The University of Tokyo
• April 2015: Lecturer, Graduate School of Interdisciplinary Information Studies, The University of Tokyo
• January 2015: Associate Professor, Graduate School of Interdisciplinary Information Studies, The University of Tokyo
• April 2021: Deputy Director/ Associate Professor of Disaster Management Training Center, Institute of Industrial Science, The University of Tokyo

I specialize in disaster preparedness processes, systemization, and training. I have developed the BOSS system to support the decision-making from the local government to residents. About 50 organizations installed the BOSS, mainly local governments in Japan.
I also serve as a lecturer in national disaster countermeasures training for the Ministry of Internal Affairs and Communications and the Ministry of Land, Infrastructure, Transport, and Tourism.
I established the Disaster Management Training Center (DMTC) at the University of Tokyo, researched and developed highly specialized training programs, and educated governments, companies, residents, etc.
I am a member of academic societies such as the Japan Society of Civil Engineers, the Japan Association for Earthquake Engineering, the Japan Society for Natural Disaster Science, the Institute of Social Safety Science (ISSS), and the Japan Society for Disaster Information Studies.

# Invited Presentations

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# Incident Diversionary Routing: Survey of Influences and Decisions

**Grace Cole**,
Louisiana State University, USA

## Abstract

When confronted with congestion and delay, drivers often divert their route. Depending on factors like purpose, urgency, destination, route alternatives, type of disruption, and mode options, common diversionary options can range from changing departure time, route, and mode to canceling a trip altogether. The choice to divert depends on many factors, including if, when, and where they become aware of a disruption. As the ability of transportation agencies to detect incidents, inform drivers of conditions, and implement control changes to accommodate volume surges has improved, there is increasing interest in knowing if drivers will divert and why. This article describes results of research using marketing-based survey techniques to evaluate driver diversionary behavior during roadway incidents. The survey was used to identify and assess diversionary choice-making based on a) travel behaviors and habits, b) under routine and adverse conditions, c) for different incidents and route options; and d) under varied guidance information available to them. Results show that travel time reduction was theprimary motivator for alternate path useto avoid congestion, consistent with previous research.Interestingly, younger males showed the lowest level of influencefrom guidance information, and route familiarity had a lower influence on diversionary routing among all groups, suggesting a trust in real-time mobile routing guidance. With additional analyses, these findings can be applied to estimate and model driver actions under a range of driver, network, travel, and disruption conditions.

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# Adaption of Load Models for Assessment of Existing Bridges

**Alois Vorwagner[1*], Marian Ralbovsky1 Stefan Lachinger[1]**
Center for Low-Emission Transport, AIT Austrian Institute of Technology, Giefinggasse 2, Vienna, Austria

## Abstract

Bridge infrastructure is essential for keeping the flow of goods around Europe going. The weight of goods being transported across them is substantial and the operating freight vehicles produce considerable loading of bridge structures.

Existing engineering structures in today's road network were designed according to the national rules and standards at the time of planning/construction. The age of these structures shows that a large proportion of them is 40 years or for rail bridges even older. For road bridges the current load models in EN 1991-2 are based on traffic surveys in 1986. The bridges are designed to withstand traffic loading events that have a statistical return period of 1000 years, or a 5% probability to be exceeded within 50 years. In order to evaluate the reliability of a specific bridge, the maximum traffic load that is expected to occur during bridge operation needs to be known. Therefore, the standard load models in the codes are designed for very unfavourable load situations - traffic jams, heavy traffic and special transports. Ongoing developments in vehicle technologies (automated traffic, truck platooning or E-Trucks) allow additional more accurate traffic surveys and evaluation of the load models. Traffic behaviour and load distribution changes and provide different loading types.

Another challenging task is aging and deterioration due to fatigue especially for steel railway bridges. The structures are essential network components which cannot be replaced without considerable financial investments and interruption to railway operation. More and more railway steel bridges are near the end of their service lifetime. Infrastructure owners must guarantee that the bridges are safe to operate and strive to maintain and renew these bridges in the most economic, socially, and environmentally sustainable way without compromising the reliability of the structures. The load models given in the design codes, are often far too conservative. Historical loading is not always known, so real assessment and calibration of route or object specific loading can help to improve the assessment and extend the prognosis of remaining lifetime prediction.

This talk presents how new sensor technologies and databases in road and rail infrastructure can be used to improve the assessment of existing bridges. Sensor data from traffic flows measurement, weight in motion stations (WIM), video data, historical train operating data are still unused when it comes to engineering structures. The optimised use of these data would allow today's traffic scenarios to be determined more reliably, and thus provide more realistic parameters for site specific load models regarding assumptions of the likelihood of traffic jams, special heavy vehicles, lane changes or object specific (historical)-load collective for fatigue assessment. The potential by combining scientific probabilistic simulations and site-specific sensor information of loads and structural health monitoring will be presented on different examples and case studies. It will be demonstrated how existing load models can be calibrated for ultimate limit state and fatigue assessment. An other aspect is evaluation the effects on the bridge stock for new loading types like truck platooning or changed axel loads due E- trucks.

## Keywords
Bridge load Models, fatigue assessment, Structural health monitoring.

## Biography
Dr. Alois Vorwagner (PHD in Civil Engineering) is since 2014 Thematic Coordinator in the AIT Competence Unit Transport Infrastructure Technologies. As Team Leader group consisting of 17 scientist and research engineers, he focuses on infrastructure topics, such as bridge engineering, structural dynamics, ground vibration, seismic engineering, structural health monitoring and Life Cycle assessment. His is research fields are concrete and bridge engineering, structural dynamics, and structural health monitoring. He is author of more than 80 scientific publications. He is currently working scientifically on life cycle and structural safety of infrastructures and bridges (assessing the impact of new types of vehicles truck platoons, high speed trains), various railway projects dealing with predictive maintenance and new monitoring techniques like distributed fibre optic sensing or using Interferometric Synthetic Aperture Radar for deformation monitoring of whole network sections.

He represents AIT in different associations (FIB International Federation for Structural Concrete, EURNEX the EUropean rail Research Network of Excellence, IABSE International Association for Bridge and Structural Engineering…) and standardization committees and is national Chair for IABSE -Austria and OGE.

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# Utilization of Photovoltaic Panels as a Devise for Reducing Wind Loads on Roof Cladding/Components of Low-rise Buildings

**Yasushi Uematsu[1*], Testuo Yambe[2]**

[1]National Institute of Technology (KOSEN), Akita College, Akita, Japan
[2]Tohoku Electric Power Corporation, Sendai, Japan

## Abstract

Roof cladding and components of low-rise buildings are often damaged by strong winds such as those caused by typhoons. Therefore, the wind resistant design of roof cladding/components is one of the major concerns for structural engineers when designing low-rise buildings. For reducing the wind-induced damage to roofs, it is important to improve the wind resistance of the roof structure or to reduce wind loads on the roofs. Focusing on the later, we have proposed to use photovoltaic (PV) panels as a device for reducing wind loads on roofs. In practice, PV panels are installed parallel to the roof with small gaps between them. The net wind force on a PV panel is provided by the difference between pressures on the top and bottom surfaces of PV panel. The pressure acting on the bottom surface is equal to that in the space between PV panels and roof, which is called 'layer pressure' in this paper. The net wind force on PV panel may be reduced significantly due to pressure equalization caused by the gaps. The layer pressure acts on the external surface of the roof, which may be much smaller in magnitude than the external pressure on the bare roof without PV panels. This is the basic concept of the present study.

Wind loads are generally evaluated by wind tunnel experiments. However, it is difficult to make wind tunnel models of PV panels with the same geometric scale as that for buildings, e.g., 1/100, because the thickness of PV panels and the distance between PV panels and roof are both several centi-meters. Therefore, we apply a numerical simulation to the estimation of the layer pressures using the unsteady Bernoulli equation and the time histories of external pressure coefficients obtained from a wind tunnel experiment. An assumption of the weak compressibility of the air and an adiabatic condition is made for predicting the layer pressures from the flow speeds through the gaps and in the cavity between PV panels and roof. In the wind tunnel experiment, building models without PV panels are used to obtain the time histories of external pressure coefficients at many points on the roof.

The present paper describes two kinds of application. In the first application, PV panels are installed horizontally over a mechanically-attached membrane roofing system on a flat roof. The results indicate that the PV panels can reduce the membrane deformation and the wind forces both in the vertical and horizontal directions, which act on the fasteners connecting the membrane to the substrate. In the second application, PV panels are installed parallel to the sloped roofs of residential houses. It is found that PV panels can reduce the peak wind pressures on the roof significantly, particularly near the eaves and ridges where large suctions are induced by vortex generation. The effect of gap width between PV panels is investigated, and the most effective width is proposed.

## Keywords
Photovoltaic panel; Wind load; Roof cladding; Numerical simulation.

## Biography
EDUCATION:
March 1977 Graduated from Faculty of Engineering, Tohoku University
March 1979 Obtained an M.S. from Tohoku University
March 1982 Received a Ph. D. from Tohoku University
OCCUPATION:
April 1982 Research Associate, Faculty of Engineering, Tohoku University
April 1986 Part-time Lecturer, Tohoku Institute of Technology (until March 2001)
April 1994 Associate Professor, Faculty of Engineering, Tohoku University
Part-time Lecturer, Graduate School of Engineering, Tohoku Institute of Technology (until March 2001)
April 1997 Associate Professor, Graduate School of Engineering, Tohoku University
April 1998 Part-time Lecturer, Hachinohe Institute of Technology (until March 2002)
May 2002 Visiting Professor, Concordia University, Canada (until February 2003)
April 2003 Professor, Graduate School of Engineering, Tohoku University
April 2013 Associate Dean, Graduate School of Engineering, Tohoku University (until March 2018)
Part-time Lecturer, Miyagi Gakuin Women's University (until March 2018)
November 2014 Overseas Part-time Doctoral Co-supervisor, Harbin Institute of Technology, China (until March 2019)
July 2018 Distinguished Expert and Chief Advisor (part-time), Tianjin Research Institute for Water Transport Engineering, M.O.T., China
April 2019 President, National Institute of Technology (KOSEN), Akita College
Professor Emeritus, Tohoku University
AFFILIATED ACADEMIC SOCIETIES
Architectural Institute of Japan; Japan Association for Wind Engineering; Japan Society for Snow Engineering; Japan Society for Natural Disaster Science; The Society of Agricultural Structures, Japan; Japanese Society of Steel Construction; Membrane Structures Association of Japan

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# Circular Bio-Based Construction

**Oliveira Augusto, C*. , Reaes Pinto, A.**
CITAD, Universidade Lusíada de Lisboa, Rua da Junqueira, 188-198, Lisboa, Portugal

## Abstract
The construction industry demands for nearly 40% of the global raw materials and generates a significant construction and demolition waste flow during the construction, renovation and demolition of infrastructures, structures, and buildings. Based on the circular economy, the circular construction does not follow a linear path of make, use, and demolish but the resources are kept in use instead of becoming waste.
Plant-based materials and products like engineered wood, hemp, bamboo, or straw have an important role in circular and sustainable construction. Being part, simultaneously, of the biological and technical cycle, they may be reused and recycled, but can also return to the environment at end-of-life. Bio-based materials and products are of outmost importance tackling climate change in both ways: they are intrinsically low carbon or even carbon positive and simultaneously they act as carbon storage, which makes them crucial for achieving zero-carbon buildings, beyond the micro-generation and energy efficiency's concepts.
Circular bio-based Construction is a concept that merges circular construction with bio-based materials and products to achieve a high standard environmental, social, and economical built environment. Amongst many others, three main advantages related can be outlined: decarbonization, increased whole life-cycle value and human health.

**Decarbonization:** Bio-based materials are carbon sequestrators and can be used both for low carbon structural framing or energy efficient building envelopes, that substantially decreases the energy consumption and contributes to decarbonization.

**Retained and increased value:** Designing by refitting and refurbishment instead demolition retains and increases the value of the building in the end-of-life phase. Off-site production and disassembling are key as well as the ability of materials be kept uncontaminated to being reused, recycled, or composted. Bio-based materials can be cascaded through various uses till return to biosphere allowing the reuse or downcycling.

**Health:** Bio-based materials are indoor air quality enhancers by means of absorbing and releasing water vapor and by stabilizing the internal temperature. Moreover, they can interact passively with carbon dioxide and several air pollutants due to its open pore structure.

**Acknowledgment:** The authors gratefully acknowledge receiving funding from the FCT – Fundação para a Ciência e a Tecnologia, I.P., under the Project UIDB/04026/2020.

## Keywords
Circular Construction; Bio-based materials; Circular bio-based Construction; Zero- carbon building

# Comparative Evaluation of the Corroded Flexure Member's Post-Yield Performance

**Dr.Divyashree,**
Department of Civil Engineering, Lingaya'sVidyapeeth, Faridabad, India

## Abstract
By conducting experiments to investigate the impact of various grades of concrete and yield strength of reinforcement bar along with the condition of reinforcement, a novel method is established to develop plastic hinge models of Reinforced Concrete (RC) beams for retrofitting and seismic evaluation of old buildings. The failure modes of RC beams as observed from experimental data and moment-rotation relations are then compared and analytically examined using nonlinear finite element analysis. Using the GP approach, the maximum moment capacity equation is created for the damage brought on by flexural and flexure-shear cracks in the plastic hinges of corroded RC beams. The finite element model comprising the load-displacement relation matches the moment-rotation relation and the failure modes of corroded RC beams effectively. Moment-chord rotation for RC plastic hinges at 0%, 20%, and 35% corroded bar in RC beam reveals that ductility is declining with the increase in corrosion level of bars, making it seismically vulnerable. It can be used to predict the nonlinear behaviour of existing structures by performing pushover analysis.

## Keywords
Plastic Hinge Model; RC (Reinforced Beam); Concrete Beam; Seismic Qualification; Finite Element Modeling.

## Biography
An ardent researcher and academician Dr.Divyashree is a PhD in Civil Engineering with Specialization in Structural Engineering from Thapar Institute of Engineering and Technology, Patiala, India. She is having a blend of experience in Industry and Academia over one decade. She has a number of research papers in reputed international SCI Journals and Conferences. At present, she is working as Associate Professor and Head of the Department, Civil Engineering, inLingaya'sVidyapeeth (A Deemed-to-be-University) in Faridabad, Haryana, India. (https://www.lingayasvidyapeeth.edu.in/department/civil-engineering/). Her research is focused on seismic assessment of the remaining bearing capacity of the steel bars, which will greatly help in formulating the design strategy of the existing Reinforced Concrete frame structure. Now expanding her research interest towards Environmental issues, she is pursuing Masters in Environmental Engineering as well to contribute for Sustainable development. She has a good approach towards working in teams or independently on projects, researches, or on the academic subject matter. She has high thinking order who likes to be challenged and work for new innovations and creativity.

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uation of flexure member with corroded reinforcement, Structure and Infrastructure Engineering, DOI: 10.1080/15732479.2020.1731557.

3. "Plastic hinge length of corroded reinforced concrete beam using genetic programming" submitted on 3rd November 2022 to Engineering Structures- Awaiting Decision.

Conference Publications

1. "A review on evaluation of various hinge models forn non-linear static Pushover analysis" (National conference on Innovation in Engineering, Pharmaceutical, Legal and Management Science on 30 th May, 2014 at Bahra University, Shimla) Paper ID: ES/P27.

2. "A Review on Plastic Waste Management Using Life Cycle Assessment Approach" (Paper ID- 5813 in National Conference on Sustainable Waste Management Practices, SWMP'2023) on 27-28 January 2023 in SVNIT Surat, Gujarat, India.

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# Analysis Of Construction Waste Management in Historic and New Buildings In Jalisco, Mexico

**Fabiola Colmenero Fonseca,**
Universitat Politecnica de Valencia, Spain

## Abstract
This presents a critical analysis of two case studies in the state of Jalisco, Mexico, in which strategies for construction waste in historic buildings are studied, analyzing the deterioration and forms of degradation of materials. Once the quantities considered in the intervention have been quantified through the use of software, they are classified according to the coding of the European Waste List (LER), which will be located in the Toolkit tool, which will help us determine from the pollution level ratios to the feasibility of using the Construction and Demolition Waste (CDW), the product of the restoration, towards the criteria of UP-Cycling, Re-Cycling or assignment to the landfill phase, which provides us with more precise management of the Demolition and Construction Waste (CDW's) produced in this project. That is why it is necessary to design tools and implement innovative strategies for sustainable construction where each project has different characteristics, evidencing the Toolkit as a fundamental tool to achieve an adequate classification in terms of LER coding. It is concluded that the demolished architectural heritage can become a source of materials for the creative design of new sustainable buildings according to a new transversal ethics of conservation and sustainability based on the migration of resource consumption and the reduction of demolition waste, balancing the production of materials, their consumption during construction and restoration, and the use of necessary natural resources.

## Keywords
Transformation of historic buildings; waste management; Re-Cycling materials; digital methods and technologies, recovery of environments

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# Performance of Asphalt Pavements in Hot Arid Climates

**Mohamed Imbarek Esekbi,**
Department of Civil Engineering, Faculty of Engineering, University of Tripoli, Tripoli, Libya

## Abstract
Hot arid regions are characterized by their substantially high maximum temperatures and low precipitation rate. North Africa and Middle East are typical examples of regions experiencing this climatic type. In Libya, where most of its area lies within this region, a large network of highways and numerous airfields were constructed using asphalt concrete. Unfortunately, many of these pavements have suffered from early distress in form of surface cracks and excessive rutting along wheel baths. In this presentation a brief review of the research studies devoted to explain this phenomenon, theories proposed to describe the mechanism of those distresses will be highlighted and the efforts toward enhancing the performance of asphalt pavements in hot arid climates will be emphasized.

## Keywords
Hot arid climate; Asphalt pavement; Performance; Libya.

## Biography
Dr. Mohamed Esekbi is a Professor of Civil Engineering at the University of Tripoli, Libya. He obtained his undergraduate degree in civil engineering (1981) from university of Tripoli, Libya and his Ph.D. in Civil Engineering from the University of Bristol, UK in 1997. He was appointed to the Department of Civil Engineering at the University of Tripoli in 1997 as a lecturer. He was promoted to Assistant Professor in 2000, Associate Professor in 2004 and Full Professor in 2009. He was appointed Head of the Transportation Section at the Department of Civil Engineering (2015-220). His published work includes a book on pavement design in Arabic (2002) and more than 35 papers published in journals, national and international conferences. Prof. Esekbi was the chairman of the scientific committee of the Libyan specifications of highway construction and maintenance (2010) and Chairman of the steering committees of the highway geometric design guide and the guide of highway safety measures (2011). Prof. Esekbi is a member of scientific and advisory committees of many national and international conferences. Current research of Prof. Esekbi focuses on the problems of asphalt pavements in hot arid climates.

# DAY 02

## Invited Presentations

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# Characteristics of Slow-Release Glassy Fertilizers as a Future-Proof Solution for Agriculture

**Magdalena Szumera*, Justyna Sułowska, Anna Berezicka**
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## Abstract
Using intensive mineral fertilisation in modern agriculture introduces significant amounts of synthetic mineral fertilisers the chemical industry produces into the soil. However, their essential solubility periodically causes an excessive increase in the concentration of some components, disturbing the bio-geochemical balance in the soil environment and other ecosystems (rivers, water reservoirs, groundwater) to which these components spread. Fertilisers with a slow release rate of nutrients are glasses that are carriers of ingredients essential for plants and could contain macro- (e.g. Ca, P, Mg, S) and micro-elements (Fe, Zn, Cu, Mo and others). Due to the appropriately designed chemical composition and specific structural structure, these are silicate-phosphate glasses, which can provide plants with almost all the necessary nutrients. Numerous studies have been carried out, including thermal (DSC, XRD), spectroscopic (XRF, XRD, MIR, MAS-NMR) and chemical activity (ICP-OES, SEM-EDS) tests of the analysed glasses. The obtained results indicated that combining them makes it possible to design glassy fertilisers that allow the release of nutrients depending on the needs of plants. At the same time, plants have been shown to take up these ingredients according to their current needs while maintaining a long-term fertilising effect in European climatic and soil conditions, intended for specific groups of field crops and undercover.
The result of the conducted research is biologically active glasses that provide crops with a complete set of minerals in an ecological form. In addition, the designed glassy fertilising materials are resistant to dissolution by rainwater and thus ensure better use of valuable ingredients and do not cause over- fertilisation, which is particularly important in the case of supplying micronutrients to the soil.

## Acknowledgments
Research project was supported by program “Excellence initiative – research university” for the AGH University of Science and Technology

## Keywords
glassy fertilizers, structure, crystallization, silicate-phosphate glasses.

## Biography

Magdalena Szumera has completed her PhD from AGH UST Faculty of Materials Science and Ceramics. Currently, she holds the position of Associate Professor at her alma mater. So far, she has supervised five doctorates, over 25 master's theses and 35 engineering theses. She is a member of the Polish Ceramic Society, the Scientific Council of Chemical Engineering, and the Ceramic Sciences Committee of the Polish Academy of Sciences in Krakow. She is also an expert on the Polish Accreditation Committee and the National Agency for Academic Exchange NAWA. Furthermore, she has published more than 89 papers in reputed journals.

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# From the Study of Materials to the Systemic Approach for a Reasoned Rehabilitation

**Dr.Isabelle Fortuné[1]** **IRA, Ensa Toulouse, 83 rue Aristide Maillol, 31106** Toulouse, France

## Abstract

The work carried out for several years in the Laboratory of Research in Architecture in Toulouse (France) has focused on the renovation of ancient buildings to propose solutions that safeguard our heritage. Indeed, it is urgent to face with the various problems encountered on building sites, most often due to unregulated renovations and regulations that do not take into account the specific features of buildings constructed before 1948. Furthermore, both in view of the ecological issues at stake, the large number of buildings in need of renovation in France and the energy poverty of users, the various research projects have raised questions about the role of the architect in providing the best possible support for users, preserving a cultural heritage and improving the well-being of everyone in their homes.

This presentation explains the various study projects that have marked out this research's career in favour of renovation and ecological transition. Firstly, the presented Hygroba project focused on the hygrothermal behaviour of old buildings. Both insulation solutions and construction principles were proposed, depending on the type of building to be renovated and its compatibility with contemporary or bio-sourced materials, to meet the dual requirements of energy efficiency and durability of the building.

The following studies, building on the work that had already begun, set out to decipher and respond to the various requirements of the Climate Plan. The aim is to understand and propose renovation solutions that are consistent with the three components of ecology: environment, social and economy. There are many earthen buildings in the south of France, and they are in danger of disappearing. Various studies have enabled to better understand this heritage, which is essential for safeguarding it and providing suitable solutions for its renovation. The conservation of geo-sourced materials and the use of bio-sourced materials are assets for preserving the environment and architectural heritage, while creating new sectors and new jobs.

The question that naturally arose was how to support self-renovators, whose lack of knowledge and know-how is often jeopardizing their homes. Proposals have been made and today the French government has set up the "my Renov' Companion" scheme.

Another very important question raised was the cost of renovation for the owners and its impact on the environment. What are the real savings made by users when they renovate their homes?

The Grenelle Environment Round Table targeted existing buildings in particular, which consume a lot of primary energy, especially for heating. To this end, the government has introduced a number of measures aimed at reducing energy needs and expenditure. But at what cost?

Furthermore, face to the climate changing, we wondered whether the energy performance sought in buildings today is compatible with summer comfort.

Finally, the later works focus on the importance of the choices and decisions made in renovation in the face of climate change.

## Keywords
Renovation; Systemic approach; Materials; Economical;

## Biography
Isabelle Fortuné is a civil engineer and an architect. She also received the PhD from civil engineering school (INSA), France in 2009 in the fields of concrete materials. She is an assistant professor in Architecture school (ENSA), Toulouse, France, in the field of Science and Technology for Architecture and researcher in the Laboratory of Research in Architecture (LRA). Her research interest includes heritage sustainable energy, and building materials.

An important part of her research focuses on energetic rehabilitation of both economical, heritage and frugal point of view and global renovation.

She is also a practising architect and its field of activity focuses on building renovation.

She's president of the association that brings together all the schools of architecture around the ecological transition. The objective is to better train teachers and future architects in environmental, economic and social issues and in all the values that support us in saving both our heritage and our environment.

# Pultruded FRP Component Testing and Field Deployment

## Issam Harik

Department of Civil Engineering, University of Kentucky, Lexington, Kentucky, USA

## Abstract

A review of the author's experience in the 1990s with laboratory testing and field deployments in new bridges in Kentucky. FRP components were tested to determine the material properties and/or structural behaviour. Hybrid carbon and glass fibre reinforced pultruded I-section were deployed in a pedestrian bridge in 1996. GFRP rebars were tested in bridge deck specimens and deployed in a bridge in 1997. Four types of FRP bridge decks were tested, compared with reinforced concrete decks, and deployed in a 5-span bridge. Other components include CFRP bars and CFRP fabrics and laminates that were later deployed in the field. Other components, e.g., hollow CFRP bars, built-up GFRP stay-in-place form, were tested but were not deployed in the field. Highlights of the tests and deployments will be presented along with lessons learned.

## Keywords

FRP Hybrid structures, FRP reinforced concrete, FRP strengthening and retrofit.

## Biography

Dr. Issam Elias Harik is the Raymond-Blythe Professor of Civil Engineering, and Manager of the Structures Program at the Kentucky Transportation Center, University of Kentucky.

His research activities are in the areas of fiber reinforced polymer composite components and structures, structural evaluation and retrofit, natural and man-made hazard management of highway structures, field testing of bridges, and structural health monitoring and remote sensing of highway structures.

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# Data collection process for the building database of the project "Earthquake risk assessment of the City of Zagreb"

## Alen Kadić

Croatian Centre for Earthquake Engineering, Faculty of Civil Engineering University of Zagreb, Kačićeva 26, Zagreb, Croatia

## Abstract

The City of Zagreb, along with a few other authorities, is the leader of civil protection development on the regional and local level of the Republic of Croatia. A great example of this is "Earthquake risk assessment of the City of Zagreb" project, that started in April 2021 and will last for three years (36 months). It will be carried out by the Faculty of Civil Engineering, University of Zagreb as the main contractor. The main objective of this project is to determine the earthquake risk for structures and people.

The main activities of the project include: the definition of the methodology for earthquake risk assessment, the definition of seismic hazard; gathering and analysis of data on structures and creation of a database on buildings and population (which is the focus of this paper), and finally the assessment of earthquake risk for the City of Zagreb.

A significant part of the project is related to the data collection process for the building database, which did not exist and is necessary for the project, but also for many other activities. In cooperation with the company GDi d.o.o., the City of Zagreb developed a basic layer in the GIS environment for data collection of more than 325,000 objects. There are 35 mandatory attributes (by the contract) that need to be collected for buildings, but by the development of the methodology that number is continuously growing (more than 100 attributes). The definition of the attributes in the exposure model is primarily based on the latest GEM building taxonomy, but is adapted to the local building stock.

Data collection process includes the documentation from various sources, first of which are existing databases: archives, permits databases, damage and usability assessments, building managers, state assets, local municipality, Seismological Survey, protected cultural property registry.

Second sources of data collection process are building-by-building field surveys. Two ArcGIS Survey123 forms for the collection of the buildings attributes have been created and are being used, one is for the citizens and the other for a field team of civil engineers engaged in a project. The entry form for citizens is simplified, and it can be easily completed by owners or building managers by attaching the documents (e.g. design documentations, drawings, etc.) or filling out the questionnaire with smaller amount of attributes. The entry form for field teams is more comprehensive and includes all attributes defined in the proposed methodology.

The LIDAR recording is a third source of data. Recording were made in scope of the project and its results are 3D visualisation of the City of Zagreb. This visualisation and the data collected are used for filling the main database, mostly with the data regarding height and roofs.

The final result will be comprehensive building and population database. Based on the collected input data, a basis for the earthquake risk assessment will be established, earthquake risk assessment for the City of Zagreb will be conducted, and the data will be made available to all relevant institutions.

## Keywords
GIS-database; building stock; risk assessment, earthquake.

## Biography
Master in Crisis Management from University of Applied Sciences Velika Gorica (Croatia). Currently a PhD candidate in the field of the Security Studies at the Faculty of Faculty of Criminalistics, Criminology and Security Studies University of Sarajevo (Bosnia and Herzegovina).

Employed at the Croatian Centre for Earthquake Engineering (CCEE) at the Faculty of Civil Engineering University of Zagreb on the project of Earthquake Risk Assessment of the City of Zagreb as the project administrator.

One of the founders of Croatian Centre for Earthquake Engineering – Intervention Service (CCEE-IS), an NGO founded for organising participation of engineers in Civil Protection System of Republic of Croatia. At the CCEE-IS serving as the Management Board Member responsible for Operational activities. During the first year responsible for most of the CCEE-IS activities which were mainly directed towards setting up the organisation for future development.

Also, inside the CCEE-IS serving the role of a Coordinator of all the CCEE-IS activities in the disaster struck area following the 2020 Petrinja Earthquake which include assessing the damage and usability of the affected buildings and infrastructure, assessing the need for urgent demolition of most damaged buildings, managing of the building damage and usability database, providing data and expert knowledge to other participants of the Civil Protection System and reconstruction process.

As a Coordinator, regular participant of the meetings of the National Civil Protection Headquarters for mitigating the consequences of the devastating earthquake, where all the strategic decisions are made.

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# Robust Optimization of Construction Waste Disposal Facility Location Considering Uncertain Factors

**Guokai Li [1,2], Jingkuang Liu 2,*, Andrea Giordano 1**

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[2] School of Management, Guangzhou University, Guangzhou, People's Republic of China

## Abstract

The location of a construction waste disposal facility is a vital part of recycling construction waste strategy. Many factors affect the location especially, ignoring uncertain factors can lead to inaccurate results, resulting in an inappropriate location. Therefore, waste supply and transportation cost, as two uncertain factors, were highlighted in current study. Based on the traditional nominal facility location model approach and considered the uncertainty of two parameter intervals. Thus, a novel robust facility location model is established in the hybrid programming of CPLEX and MATLAB. Results show that: (1) the supply uncertainty costs of construction waste transfer stations and transportation significantly affected the total costs of waste disposal, the total costs of location and site allocation scheme of construction waste disposal facilities were more sensitive to changes in waste supply. (2) As the combination value of the uncertainty level parameter increases (2%, 7%, 10%), the optimal total cost sum and α also increases, and its changing trend is from obvious to slow. (3) The optimal cost of the distribution and disposal facility layout of the construction waste transit station was determined taking Guangzhou for example. This study provided a scientific and effective method for the location of construction waste disposal facilities by considering multiple uncertain factors. this can also help stakeholders reduce the costs of the distribution net and choose appropriate interval value according to preference for risk.

## Keywords

Construction waste disposal facility, Robust facility location model, Uncertainty, Waste supply

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# Complex Engineering Design of Coastal Protection

**Miroslav Todorov[1], Mihail Todorov2, Cvetan Ivanov3**

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[2]MEng, University of Glasgow, UK

## Abstract

In the face of an ever-evolving environment, a crucial challenge emerges concerning the dynamic interplay between the sea and the land. Amidst these complexities, a fundamental question arises: should human intervention seek to reshape the natural processes, or should it primarily focus on comprehensive understanding, aiming to maintain a semblance of equilibrium? These intricacies, along with several important technical considerations, underscore the imperative to safeguard coastal regions against the escalating impact of the sea. This study, in response to the urgent demands of the environment, examines a distinct section of the offshore expanse of the Black Sea, where the ceaseless advance of the sea erodes nearly 10 meters of land area annually. The research embarks on a multidimensional exploration, encompassing an analysis of climatological data, meticulous observation of marine circulation patterns and litorial drift, geological investigations of the area, and a holistic assessment of potential scenarios—ranging from the optimistic to more conservative. Drawing on a robust foundation of studies conducted over the past quarter-century, coupled with insights obtained during the design process, the study establishes a projection extending to the year 2100. Encompassing a coastal span of 11 kilometres, the quantitative parameters derived from these comprehensive studies lay the groundwork for the formulation of innovative solutions.

The project's design blueprint encompasses intricate coastal protection systems, including the construction of peninsulas, remote defence mechanisms, and anti-abrasion structures within the intertidal beach zone. Tailored to the distinctive sediment dynamics of this specific coastal stretch, the project is uniquely oriented towards fostering conducive conditions for the accumulation of beach formations and, crucially, a substantial reduction in direct maritime incursions. Illuminated by sophisticated predictive models, which underpin the complex design choices, the forecasts suggest a promising trajectory for the coming decade—a trajectory marked by commendable progress and a considerable curtailment of the sea's encroachment onto the land.

## Keywords

Geological investigations; Geotechnical engineering; Coast Protection Systems; Sustainable Design.

## Biography

MIROSLAV GEORGIEV TODOROV, M. Sc. In Civil engineering, Ph.D. is an Associate Professor in University of Architecture, Civil Engineering and Geodesy, Sofia, Bulgaria. The Ph.D. topic is "Study Of Soil Properties In The Interaction Of Buried Pipelines With Soil Massive". Lecturer with 23 years of experience in conducting lectures and exercises in the UACEG, Cheef of Geotechnical sector of the "University laboratory

complex". 28 years experience in the Industrial and energy facilities, geotechnical studies. Countless in situ and laboratory geological surveys and designing of geotechnical reinforced structures for temporary and permanent retainment all over the country; member of Bulgarian team TK56 for implementation of Eurocode. Consultant for Ministry of environmental and water. Design in nuclear power plants - different structures, seismic evaluation and upgrades for Kozloduy and Belene NPP structures and equipment.

Taking part as an expert in projects for investigation and assessment of seismic behavior of facilities in conventional and nuclear fields, implementing the International Atomic Energy Agency (IAEA), American Society of Civil Engineers (ASCE), Nuclear Regulatory Authority (ARN) – Russian federation; consultant part Geotechnics and Civil Engineering for El Dabaa (NPP), Egypt.

Current research interests focus on 1. Surveys of ancient buildings, refurbishment and reconstruction projects of cultural heritage. 2. Geological studies, 3. Soil Stability Structures.

Author of more than 40 publications, 2 handbooks and 2 books. In 2021, by request of the European Commission, created a Video course for training in the application of MAAE, American and Russian standards – "Design and construction of reinforced concrete structures in Nuclear Power Plants based on Russian standards".

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# Cool Roof, a High Albedo Material for Roofing to Mitigate the Global Warming: an experience in Indonesia

**Beta Paramita[1] ,Rizki A. Mangkuto2**

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## Abstract

Cool roofs are coating (generally on roofs and can be used on walls) that reflect the solar radiation so that reduce the temperature difference. This is important for buildings without artificial cooling (AC) in hot humid tropical climates where daily maximum temperatures are above 30°C. For air-conditioned buildings will significantly reduce energy use. Cool roofs materials are marked with SRI values (Solar Reflectance Index) measured according to ASTM E1980. The use of cool roof also contributes to reduce the Urban Heat Island phenomenon in cities with daily high temperatures in Indonesia. The SRI states the value of solar reflectance = 0.77 and thermal emittance = 0.88. The use of cool roofs significantly important in hot and humid cities in Indonesia which mostly city marked as Am, Af, Aw climate characteristic by Koppen. In general, cities in the coastal area (+ 0m asl) have a maximum air temperature above 33°C such as: Jakarta, Medan, Padang, Semarang, Surabaya, Pontianak, Samarinda, Balikpapan, Manado. In lowland areas (10-20 meters above sea level) such as Palembang, Tangerang, Kediri the average temperature above 30°C. Hilly cities (above 500m asl) are not numerous, such as Bandung and Malang have the lowest diurnal temperature between 25 - 28°C. This paper describes the use of cool roofs within Indonesian cities that span from Aceh to Kupang. The roof material divers from metal sheets, clay tile, concrete, and asbestos. The surface temperature of metal sheets able to reduce as much as 20°C, where the indoor temperature able to reduce until 11°C. Clay tile roofs even the surface temperature were reduced as much as 8°C, but indoor temperature only decrease 2-4°C. The use of cool roof for concrete and asbestos relatively same with clay tile that reduced 10-12°C for surface temperature, and 5-6°C for indoor temperature.

## Keywords

cool roofs; hot and humid; surface temperature; global warming; solar reflectance index

## Biography

Beta Paramita is an Assistant Professor at Architecture Department in Indonesia University of Education (UPI). She finished her doctorate in The University of Kitakyushu, Japan with her dissertation about urban geometry and urban heat island in Bandung, Indonesia. Her interest in research includes sustainable city and green building, especially on building performance and outdoor thermal comfort. She is founder of βeCool, a reflective paint that locally manufactured in Indonesia and the winner of Million Cool Roofs Challenge. βeCool Indonesia later, a movement in CSR and education to mitigate global warming throughout Indonesia.

Currently she is board member of IBPSA-ID (International Building Performance Simulation Association - Indonesia chapter). Besides, she active in RDI (Research Resilience Initiative) that focuses on community, environmental change and sustainable development. She is also in charge for UI Greenmetric World University Rankings for Universitas Pendidikan Indonesia.

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# Effect of Cross-Section Geometry on Torsional Behaviour of Stainless Steel Polygonal Hollow Tubes

**Sanasam Vipej Devi[1*], Konjengbam Darunkumar Singh[2]**

[1]Department of Civil Engineering, National Institute of Technology Mizoram, Aizawl, India [2]Department of Civil Engineering, Indian Institute of Technology Guwahati, Assam, India

## Abstract

A numerical investigation was carried out on polygonal hollow tubes and the effect of cross- section geometry on their torsional behaviour was studied. Regular polygonal tubes with number of cross-section sides varying from 3 (i.e. triangular) to 8 (i.e. octagonal) were considered for a parametric study. The conventional circular cross-section which can be assumed as a polygonal section with infinite number of sides was also included in the study. The polygonal tubes were made of austenitic stainless steel and its standardised material property proposed by Afshan et al (2019) was adopted for the study. Irrespective of its shape, cross-sectional area of all members was kept constant whilst maintaining same cross-section thickness. This ensures same material consumption of all cross-section types and thus effectively isolates the geometry effect on its torsional behaviour for comparison. Length of the tubes was approximately equal to four times that of least lateral cross-section dimension. The parametric study was carried out using finite element models in Abaqus which were initially validated against test results of hollow tubes under pure torsion. Based on the parametric study, it was observed that circular hollow section provides the highest torsional capacity closely followed by octagonal tube. As the cross-section shape changes from octagonal to triangular, a gradual reduction in torsional capacity was found which accelerated after hexagonal section. For polygonal tubes with thickness of 10 mm, torsional capacity of triangular hollow section was observed to lower as much as ~ 42% compared to that of a corresponding circular tube. While significant strain hardening was observed in all cross- section types, it was seen to be most pronounced in case of an octagonal tube. Hence, it can be concluded that polygonal tube with higher number of cross-section sides perform comparatively better in terms of its strength as well as ductility for torsion member.

## Keywords

Polygonal tube; Austenitic stainless steel; Torsion.

## Biography

Dr. Sanasam Vipej Devi is currently working as an Assistant Professor in the Department of Civil Engineering at National Institute of Technology Mizoram, Aizawl, India. She completed her Master of Technology in Structural Engineering and awarded Doctor of Philosophy from Indian Institute of Technology Guwahati, India. She is an active researcher working in the areas of Structural steel, Tubular member, Torsion member, Light weight structures, Finite element analysis and Numerical modelling etc. She has published several

papers in renowned international peer reviewed journals and also presented her research work in top international conferences. Her research team is currently focussing on studying structural performance of tubular (conventional and newer cross-section) members under different loading conditions. She was awarded the prestigious IGSTC (Indo-German Science and Technology Centre) Post-Doctoral Industrial Fellowship (PDIF) and carried out research work for 12 months in an industrial setup at Kompetenzzentrum Rohre und Hohlprofile (KoRoH) GmbH, Karlsruhe, Germany.

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# Earthquake-Fire Multi-Disaster Effect and Disaster Resilience of Complex Buildings Group

## Shidong.Li, Ph.D.

China-Pakistan Belt and Road Joint Laboratory on Smart Disaster Prevention of Major Infrastructures, Southeast Univ., Nanjing 210096, China

## Abstract

As a complex disaster system, buildings group are of great strategic significance. Earthquake-fire multi-disaster effect always causes incalculable losses for a buildings group. How to improve the disaster resistance of a building group is a question worthy of our consideration. These have brought us a challenging and practical topic, “Earthquake-Fire Multi-Disaster Effect and Disaster Resilience of Complex Buildings Group”. For this topic, this report will discuss several key issues involving a building information model system with a high data load, building energy flow analysis considering multi-physics coupling, and disaster chain analysis for building disaster description. Hopefully, this report can provide a new perspective for studying earthquake resistance, shock absorption, and multi-disaster effects of civil engineering structures.

## Keywords

Building Information System (BIM), Multi-Disaster, Building Energy Flow, Building Disaster Chain

## Biography

Shidong.Li has completed his PhD from Southeast University, China. His research interests include building and city information model, building coupling dynamics analysis technology, and urban multi-disaster analysis technology. He is a member of Chinese Society for Urban Studies and has published more than 6 papers in reputed journals.

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# Spatio-Temporal Description of the NDVI (MODIS) of the Ecuadorian Tussock Grasses and its Link with the Hydrometeorological Variables and Global Climatic Indices

**Jhon Villarreal-Veloz*[a,b] and Xavier Zapata-Ríosa,b, Karla Uvidia-Zambranoa and Doménica Borja-Escobara**

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[b] Centro de Investigaciones y Estudios de Ingeniería de los Recursos Hídricos (CIERHI), Escuela Politécnica Nacional, Quito, Ecuador

## Abstract

This study examined the changes in tussock grass greenness over 18 years (2001 - 2018) using NDVI data from 10 key areas of the Páramo ecosystem in the Ecuadorian Andes. In addition, the study investigated the influence of hydrometeorological variables (precipitation, soil temperature, and water availability) and climatic indices (AAO, MEI, MJO, NAO, PDO, El Niño 1+2, 3, 3.4, and 4) on greenness dynamics. The spatial and temporal variations of NDVI were studied, applying several analysis and indicators, such as: the standard deviation, z-score anomalies, Sen slope and Mann-Kendall test, Time integrated-NDVI (TI-NDVI). Linear and multilinear correlations were used to evaluate the influence of hydrometeorological variables and climatic indices on the greenness of tussock. The findings of the study show that Páramo, located in the inter-Andean valley above 2°S is the most productive, followed by those located in the Royal Range (eastern cordillera). The anomalies and trends of NDVI on the Royal Range tended to be greening over time. NDVI showed a moderate multilinear correlation with precipitation and soil temperature, and a strong response to water availability. Finally, NDVI was weakly linearly related to the climatic indices, the most representative being the MJO, and slightly related to ENSO events. Under-standing the regional and global-scale variables that control tussock grasses' phenology will help to determine how present and future climate change will impact this ecosystem.

## Biography

I am a hydraulic-focused civil engineer, backed by a master's degree in hydraulic projects. My career has been centered around hydraulic ecosystem research in Ecuadorian paramos, as well as the planning and design of hydraulic projects. My passion lies in merging theory with practice, exploring innovative solutions that address water-related challenges in a sustainable manner. My aim is to continue advancing hydraulic knowledge through research and implementing solutions that benefit communities and the environment.

# Poster Presentations

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# Transformer-based Defect Detection for Concrete Structures

**L. Minh Dang[1], Hyoung-Kyu Song1, Hyeonjoon Moon2,***
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Department of Information and Communication Engineering, and Convergence Engineering for Intelligent Drone, Sejong University, Sejong University, Seoul, Republic of Korea

## Abstract
Public infrastructures, such as bridges, dams, and buildings, are crucial to speeding up urbanization. Structural inspection by visually monitoring and inspecting the structures for defects has become increasingly vital to prevent structural deterioration. However, previously, the structural inspection was primarily carried out manually, which was time-consuming, error-prone, and tedious. Therefore, this study proposes an efficient concrete defect detection system based on a transformer. Three primary contributions are (i) a novel concrete defect detection model motivated by the state-of-the-art deformable transformers (Deformable DETR), which achieves better performance with less training time than the original DETR; (ii) a defect analysis module using the transformer's self-attention weights; and (iii) a big concrete defect detection dataset containing four common defect types. The framework showed that it outperformed current state-of-the-art object detection networks.

## Keywords
deep learning; transformer; defect detection.

## Biography
**L. Minh Dang** received BS degree majoring Information Systems in 2016 from the University of Information Technology, VNU HCMC, VietNam. He joined Computer Vision Pattern Recognition Laboratory (CVPR Lab) at the beginning of 2017. He received the PhD degree in Computer Science from Sejong University, Seoul, South Korea in 2021. His current research interests include computer vision, natural language processing and artificial intelligence.

**Hyoung-Kyu Song** received the B.S., M.S., and Ph.D. degrees in electronic engineering from Yonsei University, Seoul, South Korea, in 1990, 1992, and 1996, respectively. From 1996 to 2000, he had been a Managerial Engineer with the Korea Electronics Technology Institute (KETI), South Korea. Since 2000, he has been a Professor with the Department of Information and Communication Engineering, and Convergence Engineering for Intelligent Drone, Sejong University, Seoul. His research interests include digital and data communications, information theory, and their applications with an emphasis on mobile communications.

**Hyeonjoon Moon** received the B.S. degree in Electronics and Computer Engineering from Korea University in 1990. He received the M.S. and the Ph.D. degrees from Electrical and Computer Engineering at State University of New York at Buffalo in 1992 and 1999, respectively. From January 1996 to October 1999, he was senior research in ElectroOptics/Infrared Image Processing Branch at U.S

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# Sound Absorption Properties of Composite Materials Developed Using C&D Waste

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## Abstract

The construction and demolition (C&D) industry generates significant waste materials often in landfills. These include inorganic waste such as concrete, bricks, glass, tiles and organic waste such as plastics waste (polyethene PE, polypropylene PP, polystyrene PS, polyvinyl chloride PVC, wood). This study investigated the properties of sound absorption composite materials developed using C&D waste, waste type inorganic and organic. Both the reinforcing and matrix materials were waste materials, used as flake or powder. The sound absorption of waste composites obtained with different compositions was investigated. The sound absorption coefficient in the frequency ranging from 70 Hz to 1800 Hz was determined using a Kundt tube. The circular samples prepared for the experiment had a diameter of 100 mm and a thickness of 20 mm. Obtained materials were also characterized from the morphological and compositional point of view by scanning electron microscopy and thermal gravimetric analysis. All tested samples presented sound adsorption properties but the best results were obtained for the composites with wood content of 10%-20%.

The results showed that the sound absorption properties of the composite materials were strongly influenced by the ratio of recycled wood waste. The composite materials with higher proportions of wood waste exhibited higher sound absorption coefficients, particularly at higher frequencies. This is likely due to the porous structure of the wood waste, which allows sound waves to penetrate and dissipate within the material.

The composite materials also exhibited good mechanical properties, with high compressive strength and low water absorption.

Overall, this study demonstrates the potential of repurposing C&D waste materials to create new composite materials with unique properties. The sound absorption composite materials developed in this study offer a sustainable and cost-effective solution for building acoustics while reducing the amount of waste sent to landfills.

## Keywords
C&D waste, noise pollution, sound-absorbing materials, sound-absorption coefficient

## Biography
Cristina Cazan is an Associate Professor at the Product Design, Mechatronics and Environment Department of the Transilvania University of Brasov, Romania. She has experience of over 18 years in the field of solid waste management, recycling, environmental management, and waste recycling technologies. Her research interests include sustainability, circular economy, and developing novel advanced materials with controlled properties optimized for indoor and outdoor applications. The research focuses on novel composites based on wastes, and her contributions cover composites design, synthesis and characterization, and materials testing and optimization for specific applications. She also has excellent and well-proven mentoring experience. She is the author a significant number of papers presented at national and international conferences, books, and articles published in several ranked journals (Q1, red zone).

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# Noise Mitigation Measures - Improvement In Quality Of Life For Residents Through Reduction Of Rail Traffic Noise

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## Abstract

The phenomenon of traffic noise is a well-known negative impact associated with daily human life. It causes negative feelings such as dissatisfaction or irritation, and its excessive impact, can lead to health problems of residents and even hearing loss.. Considering the above factors, traffic noise is considered one of the most harmful impacts. More than 22 million people around the world are exposed to rail traffic noise at levels exceeding permissible limits.

In order to minimize the negative impact of noise on residents, various types of acoustic protection are being installed. For many years, the use of noise barriers has been one of the main noise mitigation measures, but despite their high effectiveness, this method of protection is not always the best solution. There are many alternative types of protection that, unlike noise barriers, also reduce the level of generated noise for train passengers, not just for those living in areas adjacent to major rail lines.

The basic indicator for the numerical description of the acoustic climate is the equivalent noise level LAeq. This parameter defines the value of acoustic pressure level of a continuous sound, corrected according to the frequency characteristics A, which in a defined reference time interval is equal to the average square of acoustic pressure of the analyzed sound with time-varying level. The equivalent noise level is determined by the following formula:

$$L_{Aeq,T} = 10 \cdot lg \left[ \frac{1}{t_2 - t_1} \int_{t_1}^{t_2} \frac{p_A^2}{p_0^2} dt \right]$$

where: T – observation time [s], pA(t) – instantaneous sound pressure, modified by the frequency response characteristic A at time T [Pa], p0 – acoustic reference pressure value, (p0 = 20 μPa = 20 • 10-5 Pa).

The results of rail traffic noise measurements were obtained by performing in-situ tests under real conditions as part of a pass-by test. Sound level measurements were made using 1/3 octave filters to determine the frequency characteristics of noise generated by passing rail vehicles at the reference point and at the point where noise mitigation measures were present. This made it possible to determine the acoustic characteristics of the applied noise mitigation measures more precisely.

The main parameter analyzed in the study was the acoustic effectiveness of rail noise protection devices. Based on the results, a comparison of the acoustic effectiveness of such protections as noise barriers, rail absorbers, rubber pads, sleeper pads and lubricators was made. The method with the highest efficiency value was noise barriers, but it should be remembered that they are applicable in the immission zone and have a number of disadvantages. On the other hand, when analyzing the acoustic protections applied in the emission zone, the results of sound level measurements, both in the entire observed frequency spectrum and in the division into the middle frequencies of the 1/3 octave bands, clearly indicate the greatest improvement in the state of the acoustic climate in the section where acoustic protections in the form of rail absorbers were applied.

## Keywords
rail traffic noise; noise mitigation measures; environmental noise pollution; acoustic effectiveness.

## Biography
Marcin Wrótny received his bachelor's and master's degrees in Civil Engineering in 2013 from Lublin University of Technology. He is currently an assistant professor at the Faculty of Architecture and Civil Engineering at Lublin University of Technology in Poland and a fourth-year PhD student at the Doctoral School. His research interests focus on noise issues, particularly rail traffic noise. Starting from the generation of railway noise, through the noise mitigation measures used around the world, as well as the impact of noise on human health. He is actively involved in research-scientific projects and has co-authored several scientific papers published in international journals with high IF.

# The 21st Century Sustainable Suburb

**Professor William J. Batson Jr., M.Arch, AIAS**
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## Abstract
Recent trends in suburban design and planning have centered on economic efficiency. In doing so developers,builders and architects have neglected the user and by passed the environment. Many suburb areas are designed without side walks, parks, safety lighting or places to walk freely.

Much of the design concern involves streamlining the utilities and pond capacities to mitigate flooding and slow runoff. Ifyou build them (suburbs), they (fauna) will come. The inevitable flora and fauna that soon come, propagateand take refuge with in these man-maderetention waters presents a dilemma.

Architects, planners and developers are aware of the requirement to provide a viable and sustainable environment for the area residents and also for the wild life with in. This includes habitat for hibernating animals and facilitating opportunities, especially for cold-blooded mammals, to bask and sun them selves out of water. Many species that migrate to these man-made ponds struggle to survive in these ponds,especially during flooding and when water table drains below the artificial rim preventing aquatic mammals from climbing on land. This flooding is most often the result of large areas of impervious asphalt and concrete. These impervious surfaces retain and transfer large amounts of contaminated rainwater that carries industrial pollutants, oil, plastics animal waste and fertilizers into storm drains and retention ponds.

This graphic poster will graphically show and propose solutions to these problems and show how simplechanges in the suburban design model can provide a viable, healthy, pedestrian-friendly, and sustainable suburbforthewell-being of its residentsas well as the flora and faunain the21st century.

## Keywords
Suburb, Sustainable, Flora, Fauna

## Biography
William (Bill)J ohn BatsonJr. was born in Clevel and, Ohio, then known as the best location in the nation. After High School, Bill attended The Ohio State University in Columbus, Ohio where heearned three degrees, a BA in Art, a BS in Architecture, and a Master of Architecture. Currently he is atenured,full Professor and CURES Center Director at PrairieView A&M University in Texas, USA.

While working as a draftsman for several firms, Bill embarked on a unique career starting with precision hand drawing and then CAD.While working, Bill received diversified experience working on all types of architectural design. After working over a decade in the private sector he began his teaching career, first at theUniversityof Kentucky and there after at(PVAMU) where he holds his current position.

At PVAMU Bill Batson is involved in teaching architectural history, site planning, architecture design, digital drawing, sustainability, and historic preservation. As the Director of the PVAMU CURES (Community, Urban, and Rural Enhancement Services) Center, Bill works with the latest technological software,the 3Dlaser scanner for producing as-built and archival drawings for his toric preservation.

# DAY 03

## Virtual Presentations

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# Sea-Level Rise Inundation Losses in Pacific Small Island Developing States: Towards Strengthened Risk Information for Coastal Adaptation

**Shaun Williams[1,*], Herve Damlamian[2], Cyprien Bosserelle[1], Judith Giblin[2], Rose Pearson[1], Antonio Espejo[2], Rebecca Welsh[1], Moritz Wandres[2], Ryan Paulik[1], Tim Beale[3], Juli Ungaro[1], Eileen Turare[2]**

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[3] Catalyst IT, Level 6/150 Willis Street, Te Aro, Wellington 6011, Aotearoa New Zealand

## Abstract

This presentation discusses the development of a suite of national sea level rise (SLR) inundation hazard and risk models under present and future climate scenarios for six Pacific Small Island Developing States (SIDS), which include the Cook Islands, Republic of Marshall Islands, Samoa, Tonga, Tuvalu and Vanuatu. The models were developed through the Pacific Risk Tool for Resilience Phase 2 (PARTneR-2) project, which aims to build capacity and capability within Pacific SIDS to produce quantitative hazard risk information for use in climate adaptation and resilience decision-making. Static inundation models depicting SLR under present and future climate scenarios consistent with Intergovernmental Panel on Climate Change (IPCC) projections were combined with digital representations of population, buildings, critical infrastructure and agricultural crops for each country, along with depth-damage vulnerability functions, to produce national exposure and loss metrics profiles for each SLR scenario. Decision-ready information products showing the distribution and changes in exposure and losses under each SLR scenario were configured into a web-based risk information platform for ease of access and use by country end-users.

The decision-support risk information system produced provides a first-order national representation of SLR inundation hazards in each of the six countries which bridges major information gaps at the object and administrative boundary scales (village, district, province, island and national levels) for use in coastal resilience investment planning. We discuss the challenges in developing national hazard risk models in the

Pacific SIDS region where baseline model input data at national levels is sparse (e.g., topography and tide gauge data). We also highlight the opportunities in using the information for sector-specific decision-making as well as the potential for uptake and roll-out to other SIDS in the broader Pacific region.

## Keywords
Coastal Inundation; Damage and Losses; Climate Adaptation; Pacific.

## Biography
Shaun manages the Environmental Hazards group at NIWA based in Ōtautahi Christchurch. He is a scientist in natural hazards and risks with special interests in geophysical, hydrometeorological and climatic hazard risk science applications and management in Aotearoa New Zealand and the Pacific Islands region. His work covers a broad range of interdisciplinary subjects with particular emphasis in natural hazards and risk analysis, disaster resilience, participatory engagement, early warnings and decision support systems.

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# Estimation on Natural Frequency of Scissors-Type Bridge and Its Validation with Hammering Test

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Graduate School of Advanced Sci. and Eng., Hiroshima University, Kagamiyama1-4-1, Higashi-Hiroshima, Japan

## Abstract

A scissor mechanism is a widely used intelligent emergency structure in safety engineering due to its advantages in terms of mobility, transformability, and re-usability. The basic scissor unit consists of two linear elements joined at a pivot, creating a hinge-connection at their centres. When fully deployed, the two members are in the shape of an "X," forming a single scissor unit. The scissor units can be connected to each other using hinges to form a larger structure. The authors have proposed a scissors-type of the emergency bridge, called the Mobile BridgeTM. The feature enables to fold and deploy the whole system easily and quickly with a few workers. Many of our previous research and development were related to the design studies that examine the approximate computation by beam theory and equilibrium equations method. Furthermore, focusing on the dynamic issue, a demonstration experiment using a small experimental bridge of approximately 8.7 m was conducted on a river flowing into the Hiroshima University, to confirm the safety of human walking. However, the basic knowledge on the dynamic problem addressing various structural conditions has not been established yet. Hence, this study conducts a hammering test using the experimental bridge to obtain basic vibration characteristics and explore the change in vibration characteristics under different boundary conditions. The experimental bridge is designed for the pedestrian with a length of 8.67m and a deployable angle of 60 degrees from the vertical direction. Based on the experimental results, the authors proposed an estimation formula for the natural frequency of the scissors-type bridge. The formula was established based on the beam approximation model, which was effective as a simplified design method for past static problems. The applicability of this formula was verified by comparing with the experimentally measured natural frequencies. In the results of the hammering test, the damping constant of the prototype was approximately 0.005–0.025 when excited horizontally and 0.02–0.04 when excited vertically. Besides, it was possible to estimate the natural frequencies with an error of less than 10% compared with the experiment. These values provide useful information for estimating the dynamic behavior of the scissors-type bridge under different boundary conditions. Overall, the results of this study indicate the basic beam theory can be applied to the design of the scissors-type bridge for both static and dynamic problems. This finding has important implications for the safety and reliability of emergency structures that use the scissor mechanism.

## Keywords

Scissors-type bridge; emergency bridge; natural frequency; hammering test

## Biography

Yuki Chikahiro was born in Hiroshima, Japan in 1987. He received Bachelor of Engineering in 2011, Master of Engineering in 2013, and Doctor of Engineering in 2016 from Hiroshima University. He worked at Water Environment and Civil Engineering at Shinshu University as an assistant professor from 2016. His work focused on specifically on the emergency bridge using deployable mechanics (e.g., scissors mechanism), light-weight material (e.g., aluminium material) and optimization technique.

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# Stereolithographic Additive Manufacturing of Environmental Structures for Sustainable Societies

**Soshu Kirihara,**
Joining and Welding Research Institute, Osaka University, 11-1 Mihoga-oka 560-0047, Japan

## Abstract

In stereolithographic additive manufacturing (STL-AM), 2-D cross sections were created through photo polymerization by UV laser drawing on spread resin paste including nanoparticles, and 3-D models were sterically printed by layer lamination. The lithography system has been developed to obtain bulky ceramic components with functional geometries. An automatic collimeter was newly equipped with the laser scanner to adjust the beam diameter. Fine or coarse beams could realize high resolution or wide area drawings, respectively. As the row material of the 3-D printing, nanometer sized metal and ceramic particles were dispersed into acrylic liquid resins at about 60 % in volume fraction. These materials were mixed and deformed to obtain thixotropic slurry. The resin paste was spread on a glass substrate with 50 μm in layer thickness by a mechanically moved knife edge. An ultraviolet laser beam of 355 nm in wavelength was adjusted to 50 μm in variable diameter and scanned on the spread resin surface. Irradiation power was automatically changed for an adequate solidification depth for layer bonding. The composite precursors including nanoparticles were dewaxed and sintered in the air atmosphere. In recent investigations, ultraviolet laser lithographic additive manufacturing (UVL-AM) was newly developed as a direct forming process of fine metal or ceramic components. As an additive manufacturing technique, 2-D cross sections were created through dewaxing and sintering by UV laser drawing, and 3-D components were sterically printed by layer laminations with interlayer joining. Through computer-aided smart manufacturing, design, and evaluation (Smart MADE), practical material components were fabricated to modulate energy and material transfers in potential fields between human societies and natural environments as active contributions to Sustainable Development Goals (SDGs).

## Biography

Soshu Kirihara is a doctor of engineering and a professor of Joining and Welding Research Institute (JWRI), Osaka University, Japan. In his main investigation “Materials Tectonics as Sustainable Geoengineering” for environmental modifications and resource circulations, multi-dimensional structures were successfully fabricated to modulate energy and materials flows effectively. Ceramic and metal components were fabricated directly by smart additive manufacturing, design and evaluation (Smart MADE) using high power ultraviolet laser lithography. Original stereolithography systems were developed, and new start-up company “SK-Fine” was established through academic-industrial collaboration.

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# Research on Flexural Properties of Hybrid Coconut Fiber and Carbon Nanotube Reinforced Foam Concrete

**Jun Huang*, Shichun Qiu**

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Zhejiang Collaborative Innovation Center of Tideland Reclamation and Ecological Protection, Wenzhou, Zhejiang, China

## Abstract

As a building energy saving and insulation material, foam concrete is widely used in civil engineering. In this work, coconut fiber and carbon nanotube were selected to improve the flexural property of foam concrete. The first, with the two foaming methods (physical and chemical foaming), the effect of multi-wall carbon nanotube on the flexural strength of foam concrete was investigated. The optimal carbon nanotube content was obtained and the reasonable foaming method was suggested. The second, six contents of coconut fiber were used to improve the mechanical properties of foam concrete. The result showed that the coconut fiber reinforced foam concrete had the highest flexural strength when the fiber volume fraction was 0.4%. At the same time, the effect of the granulated blast furnace slag was also investigated when it partially replace the cement. Finally, with the different carbon nanotube contents, the fleuxral property of hybrid the coconut fiber and carbon nanotube reinforced foam concrete was studied, and the optimal hybrid ratio was also determined.

## Keywords

Coconut fiber; Multi-wall carbon nanotube; flexural property; Foam concrete

## Biography

Jun Huang, Ph.D. is a professor at the college of civil engineering and architecture, Wenzhou University. He obtained his Ph.D from department of engineering mechanics, Hohai University, Jiangsu province, China. He had been working in Hohai University until 2011. Then he spent two years as a post-doctor at the department of chemical engineering, Laval University, Canada. In 2015, Dr. Huang spent three months in University of Johannesburg as a visiting scholar. After that, he has been working in Wenzhou University. His research work focuses on applied aspects of composites mechanics. Specific areas include: meso-mechanics, numerical simulation of composites, mechanical properties of high performance cement based composites, fatigue and creep, etc. He published dozens of papers in different journals such as Computers and concrete, Materials & Design, construction and building materials. As a reviewer, he reviewed many papers for different journals like Composite Part b, Materials & Design.

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# Research on Supply Chain Decisions for Production Waste Recovery and Reuse Based on a Recycler Focus

**Xingyao Liu,**
China

## Abstract

Production waste recovery has economic and environmental benefits but carbon quotas limit it. To avoid future high-cost recovery technologies, we present an example of Starkelberg model between a recycler and a manufacturer, focusing on recycling exhaust gases containing metal elements from production waste. From the perspective of a recycler, this paper outlines the process of waste recycling, processing, and sales, highlighting how the proportion of recovered waste gas directly or indirectly affects sales volume. The study shows that the impact of different factors on sales volume is bifurcated, with transaction factors affecting both ordinary and new products negatively, while technical aspects positively impact new products. Surprisingly, manufacturers and recyclers benefit, even if the reasons for selling ordinary and new products are different. In the end, the products of ordinary and new in the market are mutual constraints and mutual influence.

## Biography

Xingyao Liu comes from China and holds a Master's degree in Economics and a Bachelor's degree in Management from Jiangsu Ocean University. Miss Liu's main research direction is supply chain and logistics, covering green supply chain, process reengineering and optimization. During her master's degree, Miss Liu, as the lead author, published one SCI Zone 3 paper and one EI conference paper. The SCI Zone 3 paper is titled Research on Supply Chain Decisions for Production Waste Recovery and Reuse Based on a Recycler Focus and has been published online by the international professional journal Sustainability. The EI conference paper titled Reorganization and optimization of import and export inspection and quarantine processes under comprehensive quarantine was included in the Second International Conference on Engineering Management and Information Science (EMIS 2023) and recommended for EI retrieval.

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# Improved Data Anomalies Detection and Classification using Machine Learning and Statistic Information

**Shieh-Kung Huang[1,*], Tian-Xun Lin[2]**

Assistant Professor, Department of Civil Engineering, National Chung-Hsing University, 145, Xingda Road, Taichung Taiwan

## Abstract

Smart cities have been attracting attention as an innovative paradigm to realize sustainable construction and maintenance in a high-tech aspect. As one of the most important technologies, structural health monitoring (SHM) and structural integrity management (SIM) serve as a key to continuously track the condition and constantly detect early deterioration of the infrastructure, especially for large-scale structures, such as buildings, bridges, dams, and tunnels. To achieve that, huge amounts of data are produced and abnormal measurement is inevitable. The corrupted data can produce a lot of problems and, generally, they are examined and classified by humans. The task is laborious and tedious and not to mention that all humans make mistakes. In this study, the detection and classification are replaced by the techniques of machine learning (ML) and improved by using statistic information. The neural networks based on 1-dimensional and 2-dimensional data are studied via a field dataset collected from a long-span cable-stayed bridge. Therefore, a shallow network, called pattern recognition network, is selected to use 1-dimensional data as an input and a deep network, GoogLeNet, is selected to use 2-dimensional data. Furthermore, the neural networks based on different data are sequentially studied, the classification results are compared, and the performance is summarized. The results show that both models can detect and classify data anomalies and the usage depends on the assigned application and the trade-off between computation and performance.

## Keywords

data anomaly; sensor faults; machine learning; deep learning; structural health monitoring.

## Biography

Dr. Shieh-Kung Huang has completed his PhD in the Department of Civil Engineering at the National Taiwan University (NTU). He worked as visiting scholar in the Department of Structural Engineering at the University of California San Diego from 2018 to 2019. He is currently an assistant professor in the National Chung Hsing University (NCHU). He has published around 20 papers in reputed journals and his research topics include the areas of smart structure, structural health monitoring, structural control, and earthquake early warning. He has recent research interests primarily in the fields of automated structural health monitoring, vibration-sensitive equipment, and seismic isolation devices.

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# Response Surfaces For Engineering Properties of Mortar With Sodium Hydroxide-Treated Crumb Rubber

**Ahmad Nurfaidhi Rizalman[1,*], Dhabit Zahin Alias Tudin[2]**
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## Abstract
The engineering properties of mortar with sodium hydroxide-treated crumb rubber as a partial replacement for sand were analyzed using response surface methodology. Face-centred central composite response surface design were used in this study. The statistical models were developed between the inputs (crumb rubber and water cement ratio) and the outputs (hardened density, compressive strength, and flexural strength). The Design Expert ver. 11 software package was employed to analyze the experimental values. All models were significant with Prob > F is less than 0.05, and the diference between the predicted R-squared and adjustable R-squared is elss tha 0.2. In addition, an experimental validation has been performed for three optimized mixtures and the variation inn the results was less than 5%. It has been concluded that the optimization can be performed for any target strength with desirability as approximately one by by improving the performance and reliability of mortar containing crumb rubber.

## Keywords
mortar; treated crumb rubber; response surface methodology; engineering properties;

## Biography
Ahmad Nurfaidhi Rizalman is currently a senior lecturer at Faculty of Engineering of Universiti Malaysia Sabah, Malaysia. He received Bachelor of Civil and Structural Engineering in 2008 from University of Leeds (United Kingdom). He, then, obtained his Doctor of Philosophy in 2016 from Universiti Teknologi Malaysia (Malaysia). His research focused on application of local sustainable materials in concrete and concrete mixture optimization using statistical methods. He had completed 3 research projects as principal investigator and serves as regular reviewer of numerous local and international journals.

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# Nonlinear Buckling of Steel Cone-segmented Cylinders Under External Pressure:Numerical And Experimental Evaluations

**Jian Zhang[1*], Lingtong Zheng[1], Sakdirat Kaewunruen[2], Ming Zhan[1], Ping Liu[3]**

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[3] Department of Civil Engineering, Jiangsu University of Science and Technology, Zhenjiang 212003, China

## Abstract

The nonlinear buckling of steel cone-segmented cylinders under external pressure has been investigated in this study. The cone-segmented cylinders in focus include four nominally identical cones closed by thick flat plates and their slant angles ranged from 0°–20° in every 1° increments. Note that the cylinder with a 0° slant angle forms a circular cylinder that is used for comparisons. Two nominally identical cone-segmented and circular cylinders have been fabricated, manufactured, measured, and tested. The numerical simulations for these cylinders are in good agreement with their experimental counterparts. Both linear and nonlinear buckling behaviors of the cylinders (both with and without imperfections) have also been evaluated, and the optimal slant angle can then be identified to be 6°–8°. These optimal imperfect cylinders yield buckling loads 1.7–2.8 times greater than those of an imperfect equivalent circular cylinder. Our results reveal a new finding that the average buckling load of the cone-segmented cylinders is approximately 2.3 times that of the equivalent circular cylinders.

## Keywords

Cone-segmented cylinder, linear buckling, nonlinear buckling, slant angle.

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# Fire Performance of Steel Truss Bridge Girders

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## Abstract
This report provides an approach for evaluating fire resistance of steel truss bridge girders, and also presents strategies enhancing fire performance in steel truss bridge girders. The model takes into account some sensitive parameters namely; fire scenario, fire exposure position and length, load level and position, sectional type within steel truss together with height-span ratio, that have an influence on fire performance of steel truss bridge girders. A built 3-D nonlinear finite element, utilizing the computer program ANSYS, is applied to perform an analysis on fire response of steel truss bridge girders. The finite element model is validated dependent on comparing predicted truss temperatures and structural deflections attained from a hydrocarbon fire test on three scaled steel truss bridge girders. The applicability of the developed numerical model in practical application is illustrated count on numerical analysis of a steel truss bridge girder suffered from simultaneous structural loading and fire exposure. Results from the numerical study clearly show that fire severity, fire exposure position and length, load level and position, sectional type in steel truss and height-span ratio have significant influence on the fire resistance in steel truss bridge girders. Provision of inclined box shape truss can effectively prevent local buckling and result in lower deflections; thus enhancing fire resistance. Further, large height-span ration incorporated into designed sectional shape can improve fire resistance of steel truss bridge girders.

## Keywords
Fire performance; steel truss bridge girders; Fire-resistance strategies.

## Biography
Dr. Gang Zhang is a University Distinguished Professor at Chang'an University (CHD). He serves as Director of Research Center on Bridge Extreme Loading and Protection, and Deputy Director of Bridge Disaster Prevention and Mitigation Research Office and Head of Bridge Structure and Material Fire Laboratory at Chang'an University, and also Deputy Director of Energy-Absorption-Device Technology Innovation Center of Bridge at Hebei Province. He has been "elected" as "Fellow" of the International Association of Advanced Materials and Vebleo-Science, Engineering and Technology.
Prof. Zhang's expertise is on the evaluation and protection of bridge structure and material behavior under extreme fire conditions. His research has focused on the experimental behavior, analytical modeling and numerical prediction of bridge structure under extreme fire exposure conditions, constitutive modeling of material properties at high temperatures, fire-resistant design of bridge structure, and bridge collapsed investigations. He has developed fundamental understanding on the behavior of bridge structure and materials subjected to extreme fire hazard. His research accomplishments, in the field of bridge fire safety and material at

elevated temperatures, has great contribution and major impacts to improve development of disaster prevention and mitigation in transport infrastructure. Prof. Zhang, along with his students and collaborates, has led to over 130 peer-reviewed papers in journals and conferences. The most recent contribution from Zhang is a new text book on "Bridge Structure Fire Theory and Calculation Method" published by China Communications Press.

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# Slope stability in Geotechnically Complex Formations

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## Abstract
"Geotechnically complex formations" are lithological and/or structurally discontinuous deposits (rock units or soils) with highly contrasting mechanical properties at a significant scale as far as engineering works are concerned. Among these formations, those composed of hard rock blocks enclosed in a matrix of fine texture constitute the most widespread component, and are often referred to as bimrocks (block-in-matrix rocks) or bimsoils (block-in-matrix soils), on the basis of their blocks-matrix contact strength and matrix characteristics. The first studies concerning block-in-matrix units (bimunits) were carried out in the '90s, when serious technical problems occurred during many engineering works in and on these heterogeneous geomaterials. Experimental investigations and numerical analyses were carried out with the aim of investigating the major factors which influence the mechanical behavior of such complex formations. The results of these studies have demonstrated that the presence and the characteristics (i.e. content, position, shape, orientation, etc.) of the rock inclusions play a key role in the mechanical response of these materials, by increasing their strength, decreasing their deformability and producing tortuous failure surfaces. Nevertheless, a common practice still followed by geopractitioners is to ignore the presence of the rock inclusions, instead planning engineering works in and on block-in-matrix formations according to the strength and deformation properties of the weaker matrix only. In this work, the potential errors that this simplified approach can produce are shown. Moreover, some approaches, results of general validity and suggestions that should be applied/considered to model and solve slope stability problems in bimrocks/bimsoils are presented.

## Keywords
Complex formations; Block-in-matrix; Slope stability; Numerical analyses.

## Biography
Maria Lia Napoli received her Master's of Science in Civil-Geotechnical Engineering from Politecnico di Torino in 2011. After working three years for an Italian engineering company, in 2014 She gained a 2-years research fellowship concerning the study of rockfall phenomena and related risks at DIATI Department of Politecnico di Torino, and soon after She started her PhD devoted to the study of structurally complex formations at DISEG Department of Politecnico di Torino, which She received cum laude in 2020. She has been working as a post-doctoral fellow at Politecnico di Torino since 2020. Her research interests are mainly focused on the study of geotechnically complex geomaterials, on stability problems of slopes, cliffs and underground excavations, and on rockfall susceptibility, hazard and risk assessment.
She has been actively involved in research projects with several Italian and foreign Universities, co-authored more than 20 scientific papers on international journals, co-supervised more than 30 master theses, participated

to five International Congresses as speaker, and to one national conference as invited speaker. She was part of the Organizing Committee of the “International Workshops on Complex formations” held in Torino in 2019 and 2023. In 2021 She received the "Promising Young Investigator Contest (ePIC) award" during the 16th International Conference of IACMAG 2020-2022 for her paper "3D Slope Stability Analyses of a Complex Formation with a Block-in-Matrix Fabric”. In 2022 She got the National Academic Qualification as Associate Professor. In 2023 She was awarded by the GNIG for the paper presented at CNRIG23 Conference.

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# Improving the Fatigue Design of Mechanical Systems such as Refrigerator

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## Abstract

To enhance the lifetime of mechanical system such as automobile, new reliability methodology – parametric Accelerated Life Testing (ALT) – suggests to produce the reliability quantitative (RQ) specifications—mission cycle—for identifying the design defects and modifying them. It incorporates: (1) a parametric ALT plan formed on system BX lifetime that will be X percent of the cumulated failure, (2) a load examination for ALT, (3) a customized parametric ALTs with the design alternatives, and (4) an assessment if the system design(s) fulfil the objective BX lifetime. So we suggest a BX life concept, life-stress (LS) model with a new effort idea, accelerated factor, and sample size equation. This new parametric ALT should help an engineer to discover the missing design parameters of the mechanical system influencing reliability in the design process. As the improper designs are experimentally identified, the mechanical system can recognize the reliability as computed by the growth in lifetime, LB, and the decrease in failure rate. Consequently, companies can escape recalls due to the product failures from the marketplace. As an experiment instance, two cases were investigated: 1) problematic reciprocating compressors in the French-door refrigerators returned from the marketplace and 2) the redesign of hinge kit system (HKS) in a domestic refrigerator. After a customized parametric ALT, the mechanical systems such as compressor and HKS with design alternatives were anticipated to fulfil the lifetime – B1 life 10 year.

## Biography

Dr Woo has a BS and MS in Mechanical Engineering, and he has obtained PhD in Mechanical Engineering from Texas A&M. He majors in energy system such as HVAC and its heat transfer, optimal design and control of refrigerator, reliability design of thermal components, and failure Analysis of thermal components in marketplace using the Non-destructive such as SEM & XRAY. In 1992.03–1997 he worked in Agency for Defense Development, Chinhae, South Korea, where he has researcher in charge of Development of Naval weapon System. He was working as a Senior Reliability Engineer in Refrigerator Division, Digital Appliance, SAMSUNG Electronics. Now he is working as associate professor in mechanical department, Ethiopian Technical University.

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# Failure Mechanism of Cut Slope in the Granitic Terrain of Central Nepal Himalaya

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## Abstract

Slope failures due to cutting and excavation of slopes for road construction are an important issue in mountainous areas of Nepal. Slope stability is affected by internal factors such as rock types, weathering, internal behavior of soil and rock, geological structure, etc. and external factors such as rainfall, melting, earthquake, blasting, surcharging of external loads etc. Granite is the hard rock but due to excessive joints and chemical behavior of minerals of granite, granitic terrain is vulnerable to slope failure issues. In granites of Central Nepal different structures and texture of the granite are found, e.g. porphyritic, graphic, blocky and gneissic granite was observed in the area. Kaolinisation and alteration is intensively active in potash feldspar and muscovite bearing granites.

Granite soils are widely recognized to be very sensitive to weathering and vulnerable to Landslides. Along the Kanti Rajpath many disasters have occurred in granite soil areas following heavy rains. Huge rock slides have also occurred in the granitic terrain. Rainfall slope instability tends to occur more frequently in granite soil formation compared to the other meta-sediments. Weathered granite landslides are initiated when the sandy residual soils of the granitic terrains are saturated. Slope Stability Analysis of a Weathered Granitic Hillslope as Effects of Soil Thickness depend on the slope angles, vertical depth of the soil, and saturation of water in soil. Thickness of soil is also controlling factor of slope stability. In this study, relation of rock mineralogy, discontinuity of rock, rainwater infiltration into an unsaturated slope are related for the change in slope stability and analysis is carried out for occurrence of slope failure in granitic terrain.

# Vibration-Based Structural Damage Detection

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## Abstract

Recent advances in model- and non-model-based damage detection methods using vibration data such as natural frequencies and mode shapes are presented. Two major challenges associated with model-based methods are addressed: accurate modeling of structures and development of a robust inverse algorithm to detect damage, which are defined as the forward and inverse problems associated with model-based damage detection methods, respectively. To resolve the forward problem, new physics-based finite element modeling techniques for fillets in thin-walled beams and bolted joints are developed, so that complex structures with thin-walled beams and/or bolted joints can be accurately modeled with a reasonable model size. To resolve the inverse problem, a robust iterative algorithm that uses Levenberg-Marquardt method is developed to accurately detect locations and extent of damage using a minimum number of measured natural frequencies. Non-model-based methods that use vibration shapes measured from scanning laser vibrometry, without use of any a priori information of undamaged structures that is usually not available in practice, are introduced. Curvature vibration shapes are compared with those from polynomial fits with proper orders to yield curvature damage indices to identify damage. A new multi-scale differential geometry scheme is developed to calculate curvature vibration shapes. Spatially detailed vibration shapes can be measured by a continuously scanning laser Doppler vibrometer system developed in-house in a rapid and accurate manner. Application of the methodology to detect delaminations in composite plates are demonstrated. Use of operational modal analysis and digital image correlation to detect damage in membranes is also demonstrated.

## Biography

Weidong Zhu is a Professor in the Department of Mechanical Engineering at the University of Maryland, Baltimore County, and the founder and director of its Dynamic Systems and Vibrations Laboratory and Laser Vibrometry and Optical Measurement Laboratory. He received his double major BS degree in Mechanical Engineering and Computational Science from Shanghai Jiao Tong University in 1986, and his MS and PhD degrees in Mechanical Engineering from Arizona State University and the University of California at Berkeley in 1988 and 1994, respectively. He is a recipient of the 2004 National Science Foundation CAREER Award. He has been an ASME Fellow since 2010, and has served as an Associate Editor of the ASME Journal of Vibration and Acoustics and the ASME Journal of Dynamic Systems, Measurement, and Control, and as a Subject Editor of the Journal of Sound and Vibration and Nonlinear Dynamics. His research spans the fields of dynamics, vibration, control, applied mechanics, metamaterials, structural health monitoring, and wind energy, and involves analytical development, numerical simulation, experimental validation, and industrial application. He has published 277 SCI-indexed journal papers in these areas and holds nine U.S. patents. He is a recipient of the 2020 University System of Maryland Board of Regents Faculty Award for Excellence in Research.

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