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TABLE OF CONTENTS

01	Foreword Organizing Committee members	03
02	Plenary Speakers Abdolreza Osouli, Endrit Tuzi, Esraa Daoud, Andrea Gonzalez, Sam X. Yao, Hamed Mousavi, Nefertari Carranza, Kai Qian, Hector Martin	04-16
	Keynote Speakers Providence Habumuremyi, Heath Kaufman, Manuel Manso Morato, Benedito Tadeu de Oliveira, Saeid Dalvand, Debashis Sanyal, Juan Cortés, Anastasios Mouratidis, David Campos Vásquez, Martin Manuhwa	17-29
	Invited Speakers Vinh-Long Tran, Rodrigo Andrés Fuentes, Anna Baranova, Lonny Simonian	30-36

Dear Colleagues,

It is our pleasure to extend a warm invitation to all scientists, academicians, young researchers, business delegates, and students from around the globe to participate in the International Conference on Infrastructure and Construction Engineering (ICICE-2026) scheduled to take place in Madrid, Spain on May 18, 2026.

ICICE-2026 will provide a platform to explore recent research and cutting-edge technologies, attracting a diverse and enthusiastic audience of young and talented researchers, business delegates, and student communities.

The primary objective of ICICE-2026 is to bring together, a multidisciplinary gathering of scientists and engineers from across the globe to share and exchange groundbreaking ideas in the fields of Infrastructure and Construction Engineering. The summit aims to foster high-quality research and international collaboration, facilitating discussions and presentations that are globally competitive and highlighting recent notable achievements in these fields.

We're looking forward to an excellent meeting with scientists from different countries around the world and sharing new and exciting results in Infrastructure and Construction Engineering.

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Machine Learning-Based Prediction of Critical Shear Stress of Lean Clay Soil at Two Bridge Sites in Illinois Using Experimental and Augmented Data

Abdolreza Osouli

Southern Illinois University Edwardsville, USA,

ABSTRACT:

Scour remains the leading cause of bridge failures, with hydraulic critical shear stress of soil playing a critical role in its development around bridge piers. This study aims to develop an effective prediction model for the critical shear stress of lean clay soil using machine learning (ML) techniques. Soil samples were collected using Shelby tubes at bridge sites in Iroquois and Franklin Counties, Illinois. The critical shear stress was determined based on data from a portable scour testing device, and soil index properties were obtained through laboratory testing. Extreme gradient boosting (XGBoost) was used to develop ML models for predicting the critical shear stress of lean clay soil. To address data imbalance and enhance model robustness, synthetic minority over-sampling technique with Gaussian noise (SMOEN) based data augmentation was employed. Model performance was evaluated under three approaches: (1) training and testing on a combined dataset of experimental and augmented data with a 70/30 split, (2) training and testing on balanced sets formed by separately sampling 70% of both experimental and augmented data for training, and the remaining 30% from each for testing, and (3) training solely on augmented data and testing on experimental data. The results demonstrated that the XGBoost model achieved strong predictive performance across all approaches, highlighting the potential of ML techniques in modeling the critical shear stress of cohesive soil.

Keywords: *Bridge Scour; Critical Shear Stress; Cohesive Soil; Machine Learning; Data Augmentation*

BIOGRAPHY:

Prof. Abdolreza Osouli is an Associate Professor of Civil Engineering at Southern Illinois University Edwardsville and a registered Professional Engineer in Missouri. He serves as Principal and CoPrincipal Investigator on multiple Illinois Department of Transportation (IDOT) research projects, focusing on aggregates, drilled shafts, and geotechnical performance. His expertise includes deep foundations, soil-structure interaction, seismic behavior, and erosion mechanisms. Dr. Osouli holds a Ph.D. in Geotechnical Engineering from the University of Illinois at Urbana-Champaign and has authored numerous journal and conference publications.

The Urban Past in the Present: Shkodra's Former Plan and its Role in Today's Development Strategies

Endrit Tuzi

Polytechnic University of Tirana, Albania

ABSTRACT:

This research explores the General Regulatory Plan for the city of Shkodra, developed as part of the Territorial Management and Administration Project initiated by the Government of Albania in collaboration with the World Bank. The project aims to enhance the efficiency of urban planning and sustainable territorial management across four major Albanian cities Shkodra, Durrës, Vlorë, and Kamza over a ten-year horizon (2010–2020).

Shkodra was strategically selected due to its exceptional geographic, cultural, environmental, and socio-economic characteristics. Positioned near European borders, Shkodra is endowed with diverse natural assets such as Lake Shkodra, multiple rivers, and the Balkan Alps, offering rich potential for eco-tourism, real estate development, and sustainable urban growth. As a historic center of culture, craftsmanship, and education with a university presence and skilled human capital the city is poised to integrate environmental stewardship with modern urban living.

Key strengths include clean air, abundant freshwater, established artisan industries, and existing waste and water infrastructure nearing European standards. The plan also responds to broader opportunities such as cross-border ecological cooperation with Montenegro, infrastructure upgrades that will integrate Shkodra into wider European transport networks, and the rising value of its ecological and touristic appeal.

The vision for Shkodra is to transform it into a model European city with a balanced urban ecosystem where built environments harmonize with natural landscapes, infrastructure is sustainable and inclusive, and residents enjoy a high quality of life. This research argues that realizing this vision requires not only urban design and environmental planning but also integrated policies that address existing infrastructure gaps and mitigate speculative development risks.

Biography:

Endrit Tuzi is a highly experienced architect and academic from Albania, specializing in architecture, urban planning, and heritage conservation. A graduate of the Polytechnic University of Tirana with advanced studies from La Sapienza University of Rome and Polytechnic University of Valencia, he has led and co-authored numerous public and private projects across Albania, including schools, government buildings, and urban development plans. He currently serves as a lecturer at the Faculty of Civil Engineering in Tirana and is pursuing doctoral studies in Architecture Technology.

The Use of AI in Predicting Disasters Such as Sudden Storms

Esraa Daoud

University Polytechnic of Valencia, Spain

ABSTRACT:

The prediction of sudden storms is a considerable challenge for meteorologists due to the consequences of such storms on public safety and infrastructure. Traditional methods of weather prediction, such as numerical weather prediction models and satellite imagery analysis, have gained immense advantages over the last few decades; however, they usually fail to give timely and accurate forecasts for rapidly developing storms. Sudden weather change such as flash floods, tornadoes, and thunderstorms often develop so rapidly that conventional techniques cannot respond in real time, hence giving minimal time for emergency responses or the evacuation of the public. In this context, Artificial Intelligence holds great promise for integration into storm prediction, offering vast improvements in the speed and accuracy of weather forecasting.

AI technologies, mainly machine learning and deep learning models, can process large volumes of meteorological data way more efficiently than conventional methods. Using various data inputs-satellite images, atmospheric pressure, wind patterns, and historical storm data-AI systems can identify minute patterns and anomalies that may not be as readily visible to human experts.

The main advantages of using AI in storm prediction include their real-time analysis capability. AI models analyze continuously incoming data to detect early signs of a storm in almost real time. Such quick detection allows warnings to be issued much faster compared to traditional meteorological methods and is a critical advantage in dealing with sudden storms, which can develop in minutes. In addition to this, these models are able to analyze the most complex data in real time and offer a more dynamic and adaptive approach to storm prediction, evolving as new information becomes available.

Apart from early detection, AI plays an important role in predicting intensity, track, and the potential impact of a storm. Based on historical data and present conditions of the storm, AI models predict not just the probability of the formation of a storm but also the strength and trajectory. This can especially be useful for planning evacuations, resource preparation, and issuing specific warnings to areas that might be at higher risk.

AI models with its concept of “machine learning,” and the algorithms evolve with new data and results, the more data is fed into the AI systems, the more refined the models become, capable of learning and factoring in the shifting patterns of global climate change and regional differences. This means that as time goes by, this process of continuous learning will refine risk assessments and predictions of extreme weather events, making AI even more powerful in long-term storm forecasting. Integration of AI into storm prediction brings with it several advantages over traditional methods: faster detection, more precise forecasts, and better management of resources. Enhancing the Early Warning System and

improving knowledge about storm behavior are other ways AI will revolutionize the way one gets ready for and responds to sudden storms.

BIOGRAPHY:

Esraa Daoud is a geotechnical engineering professional with over 19 years of experience in ground engineering, design management, and foundation design for major infrastructure projects. She currently serves as Regional Head of Geotechnical – Middle East at Atkins Réalis and is pursuing her PhD at the Polytechnic University of Valencia. Her expertise includes ground investigation, geotechnical analysis, and foundation solutions for high-rise buildings, transportation infrastructure, and large-scale developments across the Middle East and the UK.

Operationalizing Simulation-Based Decision Support for Investment Decision-Making in Smart Building Portfolios: Empirical Evidence for ESG- and Efficiency-Oriented Real Estate and Facility Management

Andrea Gonzalez

Zurich University of Applied Sciences, Switzerland

ABSTRACT:

Simulation-based decision support is increasingly relevant for smart building portfolios, yet its practical value depends on how simulations are operationalized in real estate and facility management decision-making. This paper focuses on the transition from simulation as a technical modelling activity to simulation as an actionable management instrument for investment, ESG, and efficiency-oriented decisions in smart building portfolios. [1, 2, 4]

Operationalizing simulations means embedding modelling, scenario analysis, empirical validation, and expert judgement into a structured decision process. In smart buildings, simulations can combine physical building behaviour, operational data, automation logic, and financial assumptions to assess whether a proposed measure is technically feasible, economically viable, and strategically aligned with portfolio goals. This is particularly important where investment decisions depend on uncertain future performance, such as energy savings, CO₂ reduction, operating cost effects, user comfort, peak-load management, or system integration requirements. [4, 5]

The paper frames Smart Building Management as a layered system in which sensors, IoT devices, building management systems, gateways, data parsers, interoperability standards, analytics, and digital twins create the technical foundation for simulation-based decision support. These components enable the collection, harmonization, and interpretation of operational data. However, data alone does not produce reliable decisions. It must be translated into simulation scenarios that test alternative technical and operational pathways, compare expected effects, and expose risks before investments are scaled across buildings or portfolios. [2, 3, 5]

Different simulation approaches support different decision needs. Continuous simulations, including system dynamics, finite-element methods, and computational fluid dynamics, can represent physical processes and building behaviour. Discrete and stochastic simulations, including Monte Carlo methods, queueing models, discrete-event simulations, and agent-based models, can represent uncertainty, operational events, user behaviour, and risk. When connected to real building data, these methods allow decision-makers to move from generic assumptions toward evidence-based scenarios. Operationalization is illustrated through three smart-building application contexts. First, smart heating retrofits in existing buildings show how simulation can estimate heating demand reduction, CO savings, payback periods, and retrofit attractiveness before implementation across a portfolio. Second, heat pump and photovoltaic integration demonstrates how simulations can connect load profiles, PV production, grid

electricity costs, self-consumption, total cost of ownership, and amortization to support investment decisions. Third, control validation in office buildings shows that simulation outputs must be checked against empirical operational data, since digital control strategies only create value when the physical building systems are actually controllable. [1, 4, 6, 7]

The contribution highlights that operationalizing simulations requires more than software tools. It requires clear target definitions, reliable input data, transparent assumptions, measurable performance indicators, and expert capability to challenge model outputs. This is especially relevant in the context of AI-supported analytics, where rapid outputs must be evaluated for consistency, plausibility, and consequences. Expert judgement remains essential for linking simulation results to technical feasibility, financial evaluation, ESG impact, and organizational implementation. [3, 4]

The paper concludes that simulation-based decision support becomes operationally valuable when it is integrated into a repeatable decision workflow: define objectives, collect and structure data, model scenarios, validate assumptions, compare investment options, assess risks, and monitor real performance after implementation. In this way, simulations become a practical bridge between smart-building technology, portfolio strategy, and measurable ESG and efficiency outcomes. [4, 5]

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BIOGRAPHY:

Prof. Dr. González is Professor and Head of the Smart Building Management Competence Group at the Zurich University of Applied Sciences (ZHAW), Switzerland. She also serves as an external lecturer at ETH Zurich, HSLU, HWZ, and other academic and professional institutions. Her research and professional work focus on smart buildings and cities, sustainable construction, digitalization, and human-centered strategies for the built environment. She earned her PhD in Madrid and Tokyo, conducted postdoctoral research at ETH Zurich and the University of Liechtenstein, and holds an MBA from the Polytechnic University of Madrid, along with executive education from INSEAD. Prof. Dr. González has led complex urban and real estate projects across Europe and Asia, published widely, and received several academic honors, including the Extraordinary UPM Research Prize.

The Interactive Effects of Loading Characteristics and Index Properties on the Resilient Response of Unbound Aggregates in Base and Subbase

Abdolreza Osouli

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ABSTRACT:

The resilient response of unbound aggregates (UA) is a critical component for designing of flexible pavements. In USA, there is not any standard for permanent deformation (PD) but there is a standard for resilient modulus (RM). However, in Europe there are standards related to PD. The loading characteristics to simulate the traffic load on the pavement structure is different among different standards/states. This study aims to evaluate the effect of loading characteristics such as loading shape (sinusoidal vs haversine) and loading frequency (1 Hz and 10 Hz) on the resilient response of UA. Engineered UA samples with varying gradation and plasticity indices are tested using repeated load triaxial (RLT) apparatus under large number of loading cycles. The engineered UA samples represent two different dust ratios, the percent passing #200 sieve to the percent passing #40 sieve, (0.4 and 0.6) and two different plasticity indices (5% and 9%). The experimental results are presented and discussed in terms of resilient modulus, permanent deformation, and shakedown theory limits.

Keywords: *Repeated Load Triaxial (RLT), Unbound Aggregates, Resilient Modulus, Permanent Deformation, Shakedown Theory Limit*

BIOGRAPHY:

Prof. Abdolreza Osouli is an Associate Professor of Civil Engineering at Southern Illinois University Edwardsville and a registered Professional Engineer in Missouri. He serves as Principal and CoPrincipal Investigator on multiple Illinois Department of Transportation (IDOT) research projects, focusing on aggregates, drilled shafts, and geotechnical performance. His expertise includes deep foundations, soil-structure interaction, seismic behavior, and erosion mechanisms. Dr. Osouli holds a Ph.D. in Geotechnical Engineering from the University of Illinois at Urbana-Champaign and has authored numerous journal and conference publications.

Engineering Coastal Resilience Under Extreme Environmental Exposures

Sam X. Yao

Simpson Gumpertz & Heger, USA

ABSTRACT:

Numerous coastal sites face increasingly severe environmental risks such as sea level rise and aging waterfront infrastructures. Since building coastal resilience is often subjected to various financial and environmental constraints, innovative engineering solutions are required to re-establish resilient and robust coastal sites. In this presentation, the presenter will outline general engineering approaches to coastal resilience and also describe project examples where engineering design was tailored to mitigate environmental risks such as seismic instability of seawalls and shoreline, aging waterfront structures, unknown buried objects and hazard contamination in ground, and sea level rising. The examples will demonstrate how multiple design solutions were synergistically integrated to address several risks at specific sites. The presentation attempts to communicate in-depth understanding of various complex aspects of coastal resilience and to advance the state-of-the-art in coastal engineering practice.

BIOGRAPHY:

Dr. Sam Yao, Ph.D., P.E., is Senior Principal and Vice President at Simpson Gumpertz & Heger, where he has led the Marine Engineering Group for over a decade. With more than 36 years of experience, he specializes in the design and rehabilitation of marine and heavy civil structures, including bridges, ports, and coastal infrastructure. He holds a Ph.D. in Civil Engineering from the University of Illinois at Urbana-Champaign and is a licensed Professional Engineer in multiple U.S. states and Canada. Dr. Yao has published extensively and received notable awards, including the NCSEA Award for the SR-520 Floating Bridge and recognition for his contributions to the Panama Canal Expansion Program.

Enhancing Efficiency and Reducing Computational Time in Free Vibration Analysis of Plates Using a Hybrid Element Free Galerkin– Finite Strip Method

Hamed Mousavi

Kermanshah University of Technology, Iran

ABSTRACT:

In this study, an efficient and flexible hybrid method is presented for the free vibration analysis of thin plates, aiming to enhance accuracy in regions with complex geometries while significantly reducing the computational cost in other parts of the domain. In the proposed approach, the meshfree Galerkin method employing three types of shape functions—Moving Least Squares (MLS), Improved Moving Least Squares (IMLS), and Interpolating Moving Least Squares (InMLS) is seamlessly combined with the classical Finite Strip Method (FSM). In areas with irregular geometries, complex boundaries, or steep gradients, the meshfree method is utilized due to its strong capability in modeling challenging geometries and applying boundary conditions without the need for explicit meshing. Conversely, in regular and rectangular regions, the finite strip method is employed because of its simple computational structure and high efficiency. This integration enables a large portion of the domain to be modeled using only a limited number of strips, while the complex regions are analyzed with the meshfree method. As a result, compared to using the meshfree method alone, the overall computational time can be reduced by up to 50% without compromising accuracy. Furthermore, comparison of results obtained from the three shape functions shows that MLS and IMLS significantly reduce computation time in many cases; however, for plates with highly disproportionate aspect ratios, MLS may lead to ill-conditioning in the stiffness matrix. Therefore, the IMLS shape function, offering superior numerical stability, is recommended in such scenarios. Overall, the proposed hybrid method, by combining the accuracy of meshfree approaches with the computational speed of the finite strip method, provides a robust, efficient, and reliable framework for the free vibration analysis of plates, particularly those with complex geometries and demanding computational requirements.

Keywords: *Free Vibration Analysis; Improved Element-Free Galerkin (IEFG); Finite Strip Method (FSM); Computational Efficiency.*

BIOGRAPHY:

Dr. Hamed Mousavi has been an Assistant Professor of Structural Engineering at Kermanshah University of Technology since October 2024. He received his Ph.D. from Isfahan University of Technology in 2019, where he studied the combined use of the finite strip method and the element-free Galerkin method for plate analysis. He also holds an M.Sc. from K. N. Toosi University of Technology, focusing on the simulation of gas shock absorbers in steel frames, and a B.Sc. from Razi University, ranking third in his class. Dr. Mousavi previously served as Director of Structural Engineering at ASACAV Company. He has authored a book on ABAQUS and published several papers. His research interests include numerical methods, earthquake engineering, and structural rehabilitation.

Closing the Integration Gap: iPaaS as the Connective Fabric for Data Flow Across the Built Environment Lifecycle

Nefertari Carranza

Founder of NCON, Spain

ABSTRACT:

The Architecture, Engineering, and Construction (AEC) industry generates vast quantities of data across the project lifecycle, from conceptual design through construction, commissioning, and long-term operations. Yet this data remains often trapped in disconnected silos: BIM authoring platforms, project management tools, field applications, IoT sensor networks, enterprise asset management systems, and facilities operations software each operate within their own closed ecosystems. The result is a persistent integration gap that drives rework, inflates costs, degrades decision-making, and prevents the industry from realizing the promise of digital transformation. This presentation argues that Integration Platform as a Service (iPaaS) represents the missing architectural layer needed to close this gap. Unlike point-to-point integrations or proprietary middleware, iPaaS provides a scalable, cloud-native framework built on open APIs, open-source connectors, and standardized data protocols that enable bidirectional data flow between any system at any phase of the lifecycle. More critically, the adoption of iPaaS demands a fundamental shift in how the industry procures technology: we must begin requiring open APIs, published data schemas, and interoperability commitments from every technology vendor in our ecosystem. Drawing on active research conducted in collaboration with IBM, this presentation uses the BIMto-Operations Digital Twin pipeline as the primary case study, demonstrating how iPaaS enables the seamless flow of building information from design models into operational digital twins, creating a living, continuously updated representation of the built asset. Additional examples illustrate how iPaaS connects construction scheduling platforms to the Common Data Environment for 4D coordination, integrates cost systems through the CDE into the BIM model for 5D operational budgeting, and ensures clean, accurate file exchange between authoring tools and the CDE, turning BIM from a static deliverable into the dynamic information container ISO 19650 envisioned. Attendees will leave with a clear understanding of the integration gap's cost to BIM-driven workflows, a technical framework for evaluating and implementing iPaaS within their information management ecosystems, actionable criteria for holding technology vendors accountable to interoperability standards, and a vision for how connected data environments can make 4D and 5D BIM in operations a reality rather than an aspiration.

Keywords: *iPaaS, Integration Platform as a Service, BIM, Digital Twin, Open API, AEC Interoperability, Construction Technology, Data Flow, Operations & Maintenance, Built Environment Lifecycle*

Interpretable Probabilistic Resistance Model for RC Structures Against Progressive Collapse

Kai Qian

Guilin University of Technology, China

ABSTRACT:

Reinforce concrete (RC) beam-column substructures are critical bearing components in buildings, which face an increasing risk of progressive collapse induced by accidental loads during their service life. Existing resistance evaluation encounters huge challenges regarding computational efficiency and simplifying assumption. This paper proposes a novel progressive collapse resistance model for RC structures based on probabilistic machine learning (ML). Firstly, the 284 samples included compressive arch action (CAA) database is established using median absolute deviation method. Secondly, the sparse variational gaussian processes (SVGP) is employed to predict progressive collapse resistance by developing a novel anisotropic compound kernel function. Finally, the relative importance of features influencing the SVGP model's predictions is quantified using the Shapley Additive explanations (SHAP) algorithm. The results show that the proposed SVGP model achieves predictive accuracy of 97% on the CAA testing set. The proposed SVGP model exhibits excellent predictive performance endowed with a novel kernel, which is capable of characterizing global smoothness and capturing local abrupt features. This developed novel model significantly outperforms other kernels-based SVGP models, six ML models, and three mechanics-based semi-empirical models. The SHAP-based interpretable analysis identifies several critical structural attributes for estimating the progressive collapse resistance of RC beam-columns substructures.

Friction in Complex Projects: A General Theory of Delay Propagation in Socio-Technical Systems

Hector Martin

Queen's University Belfast, UK

ABSTRACT:

Project delays in large-scale, complex systems are often treated as isolated anomalies or additive outcomes of discrete causes. This paper advances a general theory of organizational friction—the emergent, multi-domain resistances across physical, organizational, cognitive, and informational dimensions that interact nonlinearly to amplify minor disruptions into systemic breakdowns. Drawing on Clausewitz's concept of friction, complexity theory, and socio-technical systems thinking, we propose a four-phase process model of delay propagation: latent friction, interaction onset, frictional resonance, and systemic disruption. The theory reframes delay as a path-dependent, threshold-driven phenomenon, challenging linear planning paradigms and extending coordination, dynamic capabilities, and resilience theory.

Keywords: *Delays, organization friction, nonlinear disruption, project resilience, complex adaptive systems*

Ground Response to the Combined Use of Pipe-Jacking and Horizontal Directional Drilling

Providence Habumuremyi

Fuzhou University, China

ABSTRACT:

The increasing demand for underground infrastructure in densely populated urban environments has accelerated the adoption of advanced trenchless construction technologies. Among these, pipe-jacking and horizontal directional drilling (HDD) are frequently employed due to their ability to minimize surface disruption and environmental impact. In practice, these two methods are often used in combination to address complex subsurface conditions and spatial constraints. This study investigates the ground response induced by the integrated application of pipe-jacking and HDD, with particular emphasis on deformation mechanisms arising from their interaction during staged construction processes. A representative case study involving multiple shallow tunnels constructed beneath a major transportation corridor is analyzed through a combination of comprehensive field monitoring data and three-dimensional numerical simulations. Both surface and subsurface settlement profiles are systematically evaluated to assess the influence of construction sequence, tunnel geometry, relative positioning, and spacing on overall ground behavior. The findings reveal that while individual trenchless methods tend to produce predictable and relatively symmetrical settlement patterns, their combined application introduces significant interaction effects. These interactions can alter both the magnitude and spatial distribution of maximum ground deformation. Specifically, previously constructed tunnels modify the in-situ stress field, leading to stress redistribution that manifests as asymmetric settlement troughs and localized variations in ground response. The extent of these interaction effects is found to decrease with increasing tunnel separation distance and diameter, allowing later-stage excavations to exert a more dominant influence on the deformation profile. Furthermore, the study highlights the critical role of construction staging in mitigating cumulative settlement and controlling ground movements. Key parameters governing ground response are identified, including overburden depth, tunnel spacing, excavation sequence, and method integration strategy. Overall, the results demonstrate that careful planning and coordination of pipe-jacking and HDD operations can effectively manage ground deformation while maintaining construction efficiency. This research provides valuable insights for the design, prediction, and execution of multi-method trenchless construction projects in complex urban environments.

BIOGRAPHY:

Providence Habumuremyi is a postdoctoral fellow at Fuzhou University, specializing in tunnel face stability and geotechnical engineering. He earned his Ph.D. and Master's degrees in Civil Engineering from Beijing Jiaotong University and a B.Sc. from the University of Rwanda. With experience spanning both academia and industry, Providence has worked as a civil engineer and field inspector on various infrastructure projects in China and abroad. His research interests include tunnel stability, structural dynamics, and finite element analysis. He is also an active reviewer for peer-reviewed journals.

Effects of Damaged SFRM Insulation on Fire Performance and Residual Capacity of Steel Special Moment Frame Connections

Heath Kaufman

The Citadel - The Military College of South Carolina, USA

ABSTRACT:

This study investigates the structural performance of steel beam connections with damaged spray-fired resistive material (SFRM) insulation under combined fire and loading conditions. This research addresses a critical gap in understanding how SFRM damage, which can be damaged during seismic events, affects the fire resistance and residual capacity of structural steel I-shape beam members in special moment frame systems.

Four damaged insulation scenarios were modeled using ABAQUS finite element analysis: (1) missing bottom flange insulation, (2) single-side web insulation damage, (3) both-sides web insulation damage, and (4) combined bottom flange and web insulation damage. Each model was subjected to ASTM E119 standard fire conditions for one hour, followed by loading to failure while maintaining elevated temperatures.

Results from the fire phase revealed significant temperature increases in protected areas due to heat conduction from exposed regions. The bottom flanges experienced temperature increases up to 316°F even when protected, with the influence of damaged areas extending approximately 12 inches from the exposure zone. Beyond this distance, temperature effects became negligible.

The loading-to-failure phase demonstrated substantial capacity reductions despite limited exposure areas. The bottom flange missing condition retained 84% of the undamaged capacity, while the most severe condition (both webs and bottom flange missing) retained only 65% of original capacity. Notably, with only 10% of the beam length directly exposed to fire temperatures, overall beam capacity decreased by 35%.

These findings highlight the critical importance of maintaining SFRM integrity in seismic design and reveal that localized insulation damage can significantly compromise structural fire performance. The study provides essential data for developing more accurate fire resistance assessments of seismically damaged structures and suggests the need for enhanced SFRM attachment details in seismic zones.

BIOGRAPHY:

Dr. Heath Kaufman is an Assistant Professor of Civil, Environmental and Construction Engineering at The Citadel – The Military College of South Carolina. He brings both academic and industry experience, having previously worked as a Structural Engineer at Schaefer Inc., managing a wide range of complex projects across multiple structural systems. His research focuses on structural fire engineering, seismic design, and structural behavior under extreme loading conditions. Dr. Kaufman is a licensed Professional Engineer and an active contributor to engineering education and research.

Delay Analysis in Construction: The Contractual Dimension

Manuel Manso Morato

University of Burgos, Spain

ABSTRACT:

In construction disputes, delay analysis is often presented as a technical exercise driven by programmes, progress records, and critical path methodology. In practice, however, its real value depends on something more fundamental: the contract. Experience shows the central role that technical contractual interpretation plays in the assessment of delay and explains why no delay analysis can be truly persuasive unless it is firmly grounded in the contractual framework governing the project, specially taking into account the different approach required depending on the type of Contract implemented. Meanwhile some Contracts require a pro-active approach and demand prospective analyses, others require a wait-and-see approach which leads to retrospective analyses to be carried out.

Provisions relating to extensions of time, notice, causation, concurrent delay, float, mitigation, and claims procedures shape the identification of responsibility and entitlement. These clauses influence not only the legal position of the parties, but also the selection, structure, and evidential weight of the delay methodology itself. Particular attention is given to the practical significance of this issue in both judicial proceedings and arbitration, where the credibility of a delay analysis frequently turns on the expert's ability to connect technical findings with the parties' contractual rights and obligations. For counsel, experts, and project professionals alike, the contract is not simply background context; it is the instrument that defines the relevance of the facts and the strength of the claim.

A practice-oriented perspective on the intersection of contract interpretation and delay analysis reveals a clear message: in construction disputes, the most compelling delay opinions are those that combine technical rigor with contractual precision.

BIOGRAPHY:

Manuel Manso is a Civil and Building Engineer with extensive international experience across Europe, the Americas, the Middle East, and Asia. He specializes in risk and contract management, particularly in forensic delay analysis and dispute resolution for complex construction projects. He has been recognized in the Lexology Index – Construction and received the 2025 Young Engineer Award from CICCIP. Manuel also serves as a visiting lecturer at the University of Burgos, focusing on construction procedures and project productivity.

Restoration of the Moorish Pavilion and Architectural Complex of Manguinhos, in Rio de Janeiro, Brazil

Benedito Tadeu de Oliveira

Oswaldo Cruz Foundation, Brazil

ABSTRACT:

The article deals with interventions in the Moorish Pavilion or Moorish Castle in Manguinhos, in Rio de Janeiro, main monument of the architectural complex of the Oswaldo Cruz Foundation – Fiocruz, one of the most significant and symbolic architectural ensembles in Brazil. It is the headquarters Fiocruz, under the supervision of the Brazilian Ministry of Health, the most prominent institution of science and technology on health in Latin America. It was protected by the National Historic and Artistic Heritage Institute (IPHAN) in 1980. The construction of the complex started in 1904 and the construction of the Moorish Pavilion started in 1905. It was on the initiative of the renowned Brazilian scientist Oswaldo Cruz and was designed by the Portuguese architect Luiz Moraes Júnior. The Moorish Pavilion, adopted the eclectic language and received the most varied influences of monuments, styles and decor: Montsouris Observatory, English railway stations, Elizabethan architecture and Moorish architecture.

An architectural reading of the Moorish Pavilion will be made, examining the architectural language adopted; the material and building systems used in its construction; its meaning for the city and the heritage designation process, the surrounding environment in various periods, and the physical, functional and visual relationship with the city. Regarding the restoration works method, the following will be examined: causes of deterioration, diagnosis and state of conservation, interventions performed over the years, the project and methodology of the latest intervention. In the conclusion, the article will analyze the interventions undertaken in the light of the modern principles of cultural heritage preservation, the importance of the restoration works of the Moorish Pavilion Manguinhos, and its use as a public cultural and scientific space for the city. The Manguinhos Architectural Complex, gathers historical, cultural, and scientific values to apply as a candidate as UNESCO World Cultural Heritage.

BIOGRAPHY:

Dr. Benedito Tadeu de Oliveira is a distinguished Brazilian architect and specialist in the restoration of monuments, holding a Ph.D. from Sapienza University of Rome. He serves as a Senior Researcher at Oswaldo Cruz Foundation (Fiocruz), where he has led major cultural heritage conservation initiatives, including restoration of the historic Manguinhos architectural complex and significant projects in Ouro Preto. He is an active member of International Council on Monuments and Sites and has published extensively on cultural heritage preservation. With international academic contributions across Europe, Asia, and the Americas, Dr. Oliveira is widely recognized for his expertise in architectural conservation, heritage management, and restoration of historic monuments.

Exploration of Devulcanized Rubber and Lignin-Enhanced Composites for Future Infrastructure Applications: A Material Design Approach

Ján Kruželák

Slovak University of Technology in Bratislava, Slovakia

ABSTRACT:

The rapid expansion of global infrastructure demands innovative, high-performance materials that align with circular economy principles. This study explores a novel material design approach by integrating thermomechanically devulcanized ground tire rubber (GTR) and lignin-based biopolymers into advanced composite systems for civil engineering applications.

Central to this research is the thermomechanical devulcanization process, which utilizes high shear forces and controlled thermal energy to selectively break sulfur cross-links within the rubber matrix. This process partially restores the plasticity of the vulcanized waste, allowing for enhanced interfacial adhesion and co-vulcanization within new composite formulations. To further optimize the mechanical and environmental stability of these recycled systems, lignin - a renewable byproduct of the pulp and paper industry - is introduced as a multifunctional biopolymer. Lignin serves not only as a sustainable reinforcing filler but also acts as a natural antioxidant and UV stabilizer, potentially increasing the service life of materials exposed to harsh outdoor conditions.

This presentation outlines the theoretical framework for utilizing these hybrid composites in specific infrastructure sectors, such as vibration damping layers for railway systems, elastomeric bridge bearings, and noise-insulating structural panels. By analyzing the synergetic effects between the thermomechanically reactivated rubber phase and the lignin-reinforced matrix, this research proposes a path toward decarbonizing the construction industry. The proposed “Material Design Approach” emphasizes the scalability of these bio-based composites as a viable, high-performance alternative to purely synthetic elastomers in future engineering projects.

Keywords: *Devulcanized Rubber, Lignin, Sustainable Composites, Infrastructure Materials, Circular Economy.*

BIOGRAPHY:

Prof. Ján Kruželák is a distinguished researcher and academic at the Slovak University of Technology in Bratislava (STU), specifically within the Faculty of Chemical and Food Technology. His long-standing research expertise lies at the intersection of rubber technology, polymer science, and sustainable material engineering. His work primarily focuses on the thermomechanical devulcanization of rubber waste and the innovative application of biopolymers, such as lignin, into rubber compounds. Prof. Kruželák's research aims to bridge the gap between traditional polymer processing and the principles of the circular economy, developing high-performance, eco-friendly composites for industrial and en-

gineering applications. He has authored numerous scientific publications in high-impact journals and is a recognized expert in the field of rubber materials, contributing significantly to the development of sustainable solutions for rubber waste management and advanced material design.

Advanced Evaluation of Green Roof Systems Within Low Impact Development Frameworks: Enhancing Urban Hydrological Performance and Environmental Resilience

Saeid Dalvand

Project Contracts Manager at SCICO, Iran

ABSTRACT:

Urbanization has intensified environmental challenges, including disrupted hydrological cycles, urban heat island effects, and diminished ecological resilience, necessitating innovative solutions like green roofs within Low-Impact Development (LID) frameworks. This study evaluates the performance of green roof systems in enhancing urban hydrological and environmental outcomes. Through advanced hydrodynamic modeling, high-resolution field instrumentation, life-cycle assessments, and policy analysis, the research examines green roofs in semi-arid and temperate urban settings, including regions like Iran with diverse semi-arid climates. Results demonstrate that optimized green roof configurations reduce peak stormwater runoff by 35–85%, extend hydrograph lag times by up to 60 minutes, decrease rooftop temperatures by 25–40°C, and improve water quality by reducing total suspended solids and nutrient loads by 40–70%. Green roofs also promote biodiversity, carbon sequestration, and socio-ecological connectivity in urban areas. Policy analysis highlights the role of regulatory frameworks, financial incentives, and stakeholder collaboration in overcoming adoption barriers, while addressing challenges such as high costs, structural constraints, and maintenance needs. This research establishes green roofs as critical ecological infrastructure for fostering sustainable, resilient, and climate-adaptive urban systems, providing actionable insights for urban planners and policymakers.

Keywords: *Green roofs, Low-Impact Development, stormwater management, urban resilience, environmental sustainability, urban policy*

BIOGRAPHY:

Saeid Dalvand is a Senior Civil Engineer and Senior Researcher in the Master's Program in Project Management at Amirkabir University of Technology and Tehran Metro University. Currently serving as Project Contracts Manager at SCICO Holding, Iran. He is also an active member of the Urban Planning and Environment Committee of the Iran-UK Chamber of Commerce and the Iran-France Chamber of Commerce.

Need of Modular Prefabricated Industrialized Housing in Indian Building construction sector

Debashis Sanyal

National Institute of Technology, India

ABSTRACT:

The Indian construction industry is at a critical turning point. There is a significant shift from traditional building practices to modular, prefabricated, and industrialized construction. This change is driven by India's urgent need to meet ambitious housing and infrastructure targets due to rapid urbanization and a growing population. This research looks at the direction, benefits, and main challenges of adopting these methods in India.

Off-site construction provides strong advantages by cutting project timelines by 30% to 50%, thanks to simultaneous on-site and factory work. Manufacturing in a controlled environment ensures better quality, predictability, and safety. Reports show there are up to 80% fewer on-site accidents. Additionally, these building methods support sustainability by reducing material waste and energy use, fitting in with India's green building goals.

However, the industry faces complex challenges. High initial costs for setting up prefabrication facilities and the logistics of transporting large modules are major financial obstacles. A shortage of skilled workers and a traditional mindset that prefers conventional construction are significant socio-cultural barriers. The regulatory environment, with inconsistent state-level codes, further complicates nationwide implementation.

Ultimately, successfully scaling these methods involves more than just a technological upgrade. It is a strategic necessity. The combination of government programs and private sector investment, along with technologies like Building Information Modeling (BIM), is building a strong ecosystem. This strategic approach is set to transform India's construction landscape, making it more efficient, sustainable, and capable of achieving its national development goals.

Circular Economy as a Framework for Implementing Nature-Based Solutions in Spanish Cities

Juan Cortés

IE University, Spain

ABSTRACT:

Spanish cities are increasingly exposed to environmental pressures such as climate-related risks, biodiversity loss, and the depletion of natural resources. This work proposes a circular-economy-based framework to strengthen the implementation of Nature-Based Solutions (NBS) as a response to these complex challenges. Circular-economy principles — regenerating natural capital, keeping resources in use, and designing out waste — offer a systemic foundation for integrating NBS into urban planning and infrastructure development. By aligning closed-loop resource flows with green-blue infrastructures, cities can address heat-island effects, stormwater overload, ecosystem degradation, and urban vulnerability while improving long-term resilience.

The proposed framework synthesizes current research on circularity and NBS to demonstrate how regenerative design, adaptive governance, and resource-loop optimization can maximize the ecological and socio-economic benefits of nature-based interventions. The methodology incorporates policy analysis, review of emerging municipal practices in Spain, and insights from European circular-city approaches to identify leverage points for scaling NBS in dense urban environments. Embedding circular-economy logic in urban projects reduces lifecycle impacts, supports environmental performance goals, and reinforces European ambitions for climate-neutral, equitable and resilient cities.

Overall, this framework provides practitioners and policymakers with actionable guidance to expand NBS adoption through regenerative, resource-efficient, and community-centred strategies aligned with long-term urban sustainability objectives.

BIOGRAPHY:

Juan Cortés is Associate Director & Climate Change and Sustainability Leader at Arup Europe, as well as Adjunct Faculty at IE University. He is an urban sustainability specialist with expertise in climate adaptation, circular-economy strategies, and nature-based urban interventions. His professional work focuses on supporting cities in their transition toward climate-neutral and resilient development models through integrated planning, environmental policy, and regenerative design. He has contributed to multidisciplinary projects involving ecosystem-based solutions, urban resilience, and strategic sustainability frameworks, collaborating with public institutions and international partners. His interests include circular urban metabolism, sustainable infrastructure, and the integration of environmental and social priorities in city-scale planning.

Engineering assessment of cut slope condition and risk of slides along road corridors under construction

Anastasios Mouratidis

Aristotle University of Thessaloniki, Greece

ABSTRACT:

Cut slope slides are a persistent engineering challenge in every road construction project. Depending on the quality and the accuracy of the Geotechnical Design, but also on the complexity of the ground and underground conditions, cut slope slides may be frequent and, sometimes, disastrous. Undoubtedly, they are probably the utmost engineering threat in the frame of earthwork operations in most road construction projects.

Starting from the Fellenius Method for slope stability assessment and considering more sophisticated methods, such as, these of Bishop and Janbu, it seems that slope stability analysis of engineered cuttings is well established nowadays. The Janbu Method, especially, providing solutions for potential circular and non-circular slope slides, seems realistic and effective in most cases. However, Geotechnical Designers, using respective software to suitably design cuttings, often fail to predict a potential slope slide likely to occur at the stage of earthwork operations. This may reasonably attributed to a concise but not in-depth soil reconnaissance process but this is hardly the only reason of failure.

In many road construction projects, cut slope failures are recorded to have taken place in fully heterogeneous underground material, where rocks and boulders are encompassed by earth-like mass. In fact, this type of substratum is weaker than intact or faulted rocks but also than most types of earth-like materials (clay, silt, gravel). Difficult to simulate through mathematical models, this type of heterogeneous substratum exhibits low shear strength along rock-earth interfaces. Cohesion tends, practically, to zero, while friction along the interface is very low.

The hereby paper presents the geotechnical aspect of this frequent problem along road axes under construction, several site experiences on the topic and a comprehensive approach to face potential failures of heterogeneous cut slopes in the field.

Key Words: *slope, cut, stability, heterogeneity, earth, rock, analysis.*

An Analysis of the Smart Cities Mission: A Paradigm for Urban Infrastructure Planning in India

Debashis Sanyal

National Institute of Technology, India

ABSTRACT:

India's ambitious Smart Cities Mission is a broad plan to tackle the challenges of rapid urban growth. Launched to promote sustainable and inclusive development, the program aims to change city environments by combining strong infrastructure with smart, data-driven solutions. This approach focuses not just on technology but also on providing essential services like reliable water supply, consistent electricity, and effective transportation.

The mission uses a two-pronged strategy: focused Area-Based Development projects and technology-based Pan-City solutions. A key achievement has been the widespread setup of Integrated Command and Control Centres (ICCCs). These act as a central hub for managing urban issues by using AI and IoT to improve traffic flow, enhance public safety, and oversee civic services. During the pandemic, these centers even showed their flexibility by becoming "COVID war rooms."

However, the mission has encountered significant challenges. The top-down governance model, which created corporate-style Special Purpose Vehicles to work around local governments, has faced criticism for lacking accountability and public involvement. Financial issues have arisen; as some cities did not see, the expected Public-Private Partnerships materialize. This led to unused funds and delayed projects. There are also worries about a "smartness gap," since concentrating resources in specific areas may strengthen, instead of reduce, existing urban inequalities.

The Smart Cities Mission serves as a large-scale policy experiment. While it has achieved a high completion rate for projects, it has taught important lessons about how technology, governance, and social equity interact in urban development. Its legacy is not just the infrastructure built but also the insight it provides on the need for a more democratic, inclusive, and locally driven approach to urban planning.

Carbon Footprint (Scope 2) and Energy Intensity per Activity in Intermediate Complexity Hospitals in the Community of Madrid: Panel Analysis (2016–2024)

David Campos Vásquez

Polytechnic University of Madrid, Spain

ABSTRACT:

Hospital buildings account for 60–80% of healthcare sector electricity consumption, yet robust causal evidence on the relationship between building energy efficiency and Scope 2 emissions per unit of clinical activity remains scarce in the Spanish context. This paper presents the main findings of a study recently published in *Buildings* (MDPI, 2026, Vol. 16, 1381; DOI: 10.3390/buildings16071381).

The study applies within-group fixed effects estimation to an unbalanced panel of 12 intermediate-complexity hospitals in the Community of Madrid (2016–2024; $N = 107$ hospital-year observations), controlling for activity volume and exogenous shocks. Cluster-robust standard errors and Wild Cluster Bootstrap inference address the limited number of cross-sectional units ($G = 12$). A methodological correction is proposed for the artificial 74.6% discontinuity in Spain's electricity emission factor (2020–2021), introduced by CNMC Circular 2/2021.

The within-hospital building energy use intensity (EUI_e) coefficient is $\beta = 0.646$ ($p < 0.001$), remarkably stable across six robustness specifications (range: 0.599–0.648; 8.2% variation). Wild Cluster Bootstrap confirms statistical significance despite standard errors 75% larger than the conventional cluster-robust estimate. A 20 kWh/m²•year EUI_e reduction achievable through HVAC retrofit in 1980s-era buildings translates into 13 kWh/stay savings, equivalent to 216 tCO₂/year for median-sized facilities (8.2% reduction). Within R^2 exceeds 0.97 across all specifications.

The findings identify building envelope and HVAC retrofit as the dominant structural lever for hospital Scope 2 emissions reduction, with facilities presenting EUI_e > 150 kWh/m²•year constituting priority targets for NextGenerationEU-funded interventions.

A Just, Equitable and Sustainable Energy Transition for Africa: The Case of Zimbabwe.

Martin Manuhwa

World Federation of Engineering Organizations, Zimbabwe

ABSTRACT:

Africa faces a critical challenge in achieving sustainable energy and infrastructure development amid rapid urbanization, climate change, and economic growth imperatives. Zimbabwe, in particular, struggles with an aging power grid, energy deficits, and limited adoption of renewable technologies, necessitating innovative engineering solutions. This study explores sustainable engineering solutions for Africa's energy and infrastructure development, with a focus on Zimbabwe as a case study. It integrates critical realism methodology, mixed-methods research, and systems thinking to evaluate key projects, policies, and institutional frameworks shaping the country's energy landscape.

The study was conceptualised on the premises that “The integration of sustainable engineering solutions, coupled with strategic policy interventions and public-private partnerships, can significantly enhance Zimbabwe's energy resilience and infrastructure sustainability.” This proposition was tested using quantitative and qualitative research methods, including surveys, interviews, the Delphi method, and triangulation, to analyze data from industry experts, policymakers, and engineers. Statistical and qualitative analyses were carried out to ensure a rigorous evaluation of the findings.

Key findings support the hypothesis by demonstrating that:

1. **Grid Modernization and Renewable Energy Integration** – Zimbabwe's energy sector can achieve greater stability and efficiency through investments in smart grids, AI-driven energy management, and increased adoption of solar, wind, and hydro power.
2. **Policy-Driven Incentives** – Strengthening regulatory frameworks and aligning them with international sustainability standards (e.g., SDGs, SADC Industrialization Strategy, African Union Agenda 2063) promotes investment in sustainable energy solutions.
3. **Public-Private Partnerships (PPPs) as Catalysts for Change** – Collaboration between government, private investors, and development agencies plays a crucial role in financing and implementing large-scale energy projects.
4. **Challenges in Implementation** – While sustainability policies exist, gaps in enforcement, funding constraints, and outdated infrastructure remain significant barriers to progress.

Through the application of critical realism, the study develops a conceptual model that bridges the gap between policy design and real-world implementation. The findings validate the hypothesis, demonstrating that sustainable engineering solutions—when supported by effective policies, investment, and technological innovation—can drive a just energy transition in Zimbabwe and across Africa.

The research concludes with practical recommendations for strengthening Zimbabwe's energy resilience, advocating for smart grids, circular economy principles, sustainable building practices, and institutional capacity-building. By aligning engineering innovations with regulatory reforms and financial strategies, this study provides a comprehensive roadmap for achieving long-term sustainability in Africa's energy and infrastructure sector.

Keywords: Sustainable Engineering, Energy Infrastructure, Renewable Energy, Critical Realism, Zimbabwe, Just Energy Transition, Public-Private Partnerships, Smart Grids, Sustainable Development Goals.

Using a Master Calendar for all Appointments in a Construction Project

Vinh-Long Tran

Independent Researcher, Germany

ABSTRACT:

Construction projects are becoming increasingly complex due to ongoing technological advancements, stricter regulatory requirements, and a growing number of project stakeholders. As a result, general contractors are faced with significant challenges in scheduling and coordination. Existing planning processes are often characterized by a lack of transparency, fragmented data structures, and inefficient coordination mechanisms, which can lead to increased administrative effort and a higher risk of schedule deviations. Against this backdrop, the objective of this study is to develop a cross-platform digital scheduling management system that integrates various planning tools into a centralized master calendar. In line with the concept of a “Single Source of Truth” (SSOT), this calendar serves as a consistent, unambiguous, and up-to-date reference for all project-related scheduling information. By consolidating heterogeneous data sources, the system establishes a non-redundant and reliable information base, thereby enhancing both traceability and planning accuracy.

A key design feature of the system is its multi-color visualization, which enables intuitive differentiation between various types of appointments and project participants. In addition, filter-based functionality allows users to selectively display or hide specific calendars, facilitating a task-oriented focus on relevant information and reducing cognitive load.

The results of the study demonstrate that the centralized aggregation and structured representation of scheduling data significantly improve transparency. At the same time, coordination efforts are reduced and planning reliability is increased. General contractors, in particular, benefit from more efficient management of complex construction projects, as decision-making processes are accelerated and coordination errors are minimized. Overall, the proposed approach represents a practical and scalable solution for optimizing digital scheduling management in the construction industry and contributes to the broader digital transformation and process improvement within the sector.

BIOGRAPHY:

Vinh-Long Tran currently work for a general contractor and have a strong interest in digital ways of working within the construction industry. I am highly motivated to continuously improve myself and to develop more efficient and modern working methods. Within my company, I have regularly contributed suggestions for improvement, focusing on optimizing processes, enhancing collaboration, and increasing overall project efficiency. I enjoy actively thinking about how workflows can be improved and how digital tools can support better outcomes in construction projects. Now, I would like to take this a step further by sharing my ideas with a broader audience. My goal is to present practical and forward-thinking concepts that contribute to the ongoing digital transformation of the construction industry and to engage in a wider professional exchange of ideas.

Innovative Technologies and Methodologies in Complex Bridge Structures

Kekoa Anderson

Koa Consulting, USA

ABSTRACT:

Built in 1954, the Shoemaker Bridge has long served as a key connection between Interstate 710 (I-710), surrounding neighborhoods, and Downtown Long Beach. However, its aging structure and outdated design, including sharp curves on the on- and off-ramps and other nonstandard features, have led to safety concerns, a high rate of accidents, and structural deficiencies. To address these issues, the City of Long Beach is planning to construct a new, state-of-the-art, iconic bridge that meets current Highway Capacity Manual design standards, enhances safety, and strengthens neighborhood connectivity. The new bridge will be located just south of the existing bridge and will feature an elevated roundabout at its eastern end, providing direct connections to 7th Street and Shoreline Drive.¹ The Shoemaker Bridge and realigned Shoreline Drive will feature dedicated bike and pedestrian paths, enhancing mobility and improving connections between the east and west sides of the I-710 corridor. These projects are part of the Elevate '28 Infrastructure Investment Plan, a historic initiative dedicated to enhancing Long Beach parks, community facilities, mobility access and streets. As the City set out to obtain environmental approvals for the proposed iconic Shoemaker Bridge, compliance with the Federal Migratory Bird Treaty Act (MBTA) was identified as an important issue to be addressed. As engineering professionals know, infrastructure projects situated within sensitive ecological areas can face complex and costly environmental approval hurdles. This white paper presents innovative solutions and a transferable process developed for the iconic Shoemaker Bridge that can be utilized for similar bridge projects facing challenges of both theoretical and actual avian interactions. In the case of the City of Long Beach's Shoemaker Bridge Replacement Project, the vision was clear: solve a complex engineering task with multiple constraints, optimize construction funding, and create an iconic structural landmark. However, the Project faced significant regulatory hurdles regarding perceived impacts to migratory birds and potential avian collisions because of the cable stay bridge design. Rather than viewing these environmental regulations as a barrier, the City¹ City of Long Beach, <https://www.longbeach.gov/> established a specialized TASC Force (Technology & Avian Safety Coalition) to launch a first of its kind comprehensive international study regarding cable-stay bridges. The Shoemaker Migratory Bird Treaty Act Compliance Study reports on the literature search conducted to analyze existing data on impacts related to cable stay bridges to identify best practices that could be used to balance infrastructure and nature, identifies processes to study migratory birds within the project area, analyzes U.S. Fish & Wildlife Service (USFWS) Best Management Practices (BMPs) and proposes a major multiple year study in conjunction with the local state university to create a comprehensive study of migratory bird habits in and around cable stay bridges. In order to create a truly effective international study, the City analyzed avian flight patterns, altitudes, seasonal activity, and bird species presence by integrating radar technology with on-site biologists. The methodology and resulting evidence-based data coupled with best practices for

migratory birds cited by the regulatory agencies, led to informed design concepts and demonstrated high confidence of compliance with the MBTA. This paper serves as a comprehensive framework, detailing the project vision, technical approach, regulatory engagement, costs incurred, and design implications, offering a proven and proactive process for other complex projects facing similar challenges.

The New Paradigm of Emerging Structural Determinism in Building Planning

Rodrigo Andrés Fuentes

Construcciones Ruesma S.A., Spain

ABSTRACT:

This academic article presents a first-rate epistemological argument for its thesis: the chronic failure of the construction industry to meet its deadlines and cost commitments “is not a management problem, nor is it a problem of the quantity or quality of the data.” It is the mathematically inevitable consequence of an underlying dimensional incompatibility: the imposition of a one-dimensional deterministic structure (the directed CPM/Gantt graph, $d=1$) on an inherently multidimensional, nonlinear process whose natural topology is spherical and tensor-like in nature ($d=2$).

Supported by four theoretical scientific pillars—Shannon’s Information Theory (1948), Lorenz’s Chaos Theory (1963), Mandelbrot’s Fractal Geometry (1982), and the Santa Fe Institute’s Complex Systems Theory (1984)—and also firmly anchored in Humberto Maturana’s (1984) concept of structural determinism—which states that the behavior of any system is determined by its own internal structure, not by external disturbances—the proposed methodology, called LEAN-BIM Planner (LBP), is formalized as the first construction planning system that “produces genuine emergent structural determinism.”

Instead of prescribing the schedule from the outside and forcing reality to obey it, LBP constructs a geometric-tensor architecture—the LBP Tensor Matrix—in which the Gantt chart is not a plan but a result: the geometric trace of the tensor displacement of the state vectors.

The LBP Tensor Matrix is constructed using a canonical sequence of coordinate transformations that couple the building’s physical geometry with time and data into a single, coherent tensor of variable rank (the LBP Tensor Matrix). Each block of construction data becomes a state vector V in $R_n(E,T,B,P,Z,D,N)$, whose state vector answers seven key fractal questions about any construction block: at what stage of construction (E), in which train/sequence (T), in which block/car (B), on which floor/level (P), in which zone (Z), on which day (D), and carrying what data or information (N). The matrix evolves from rank 0 (scalar floors) to rank n by adding data dimensions, absorbing all the project information into a single, coherent, and verifiable object, in direct contrast to the exponential fragmentation of the linear model. Thus, the Gantt chart is not a plan: it is a resultant of the system, the geometric trace of the tensor displacement of the state vectors in the LBP Tensor Matrix

The 75/25 operational design ratio emerges from the convergence of the Yerkes-Dodson law, the Fibonacci sequence, and the golden ratio $\phi=1.618$, placing the dominant eigenvalue of the evolution operator at $\phi=0.75$ with a stable convergence regime.

As a direct consequence of this tensor structure, the project’s entropy decreases monotonically throughout its execution, converging toward the planned state rather than moving away from it. This convergence produces an outcome that the linear model can never guarantee: a unique, unambiguous, and verifiable project state at every stage of the project, which constitutes the oracle that smart contracts require to operate, thus enabling blockchain tokenization and the Web3 ecosystem in building projects.

Time-Adaptive Automation of Creation, Updates and Data-Control for Lineal Infrastructure in BIM

Anna Baranova

Intecsa, Spain

ABSTRACT:

Infrastructure projects often face the combined challenges of incomplete data, changing requirements, and strict deadlines. In such conditions, traditional BIM modeling approaches become inefficient and error-prone, especially when dealing with complex, linear structures like viaducts.

This presentation showcases a time-adaptive automation strategy developed for the Metrorey viaducts in Mexico. The system was designed to handle thousands of structural elements—piles, columns, dices, and capitels—each with unique coordinates and elevations. The key challenge was the lack of reliable Revit-native tools to manage such data granularity, particularly with millimetric accuracy and constant data updates.

Our solution involved pre-coding a modular system using adaptive Revit families and a custom plugin, structured to anticipate missing data and allow late-stage integration. This predictive methodology enabled the creation, verification, and instant update of model elements without rework—maintaining millimetric accuracy across evolving datasets.

Results showed a 99.7% reduction in modeling time: processes that would normally take 70 hours were completed in just 6 minutes. The model remained aligned with engineering data at every stage, with integrated error detection preventing rework and delays.

This workflow goes beyond automation of repetitive tasks—it introduces a predictive, modular framework where automation becomes a management tool. The approach not only ensured zero missed deadlines and no rework but demonstrated how planning with uncertainty can become a competitive advantage in infrastructure BIM.

Keywords: BIM Automation, Infrastructure Modeling, Revit, Viaducts, Data-Driven Design, Predictive Modeling, Civil Engineering

Cross-Cultural Construction Management Training: A COINS Simulation Case Study between Cal Poly and Czech Technical University

Lonny Simonian

California Polytechnic State University, USA

ABSTRACT:

This case study examines the use of the Construction Industry Simulation (COINS) game as a competitive learning platform between two universities: California Polytechnic State University, San Luis Obispo (Cal Poly) and the Czech Technical University in Prague (ČVUT). COINS is a web-based simulation designed to replicate the complexity of managing a construction firm, where participants must make decisions that balance time, cost, quality, resources, and project outcomes. Unlike traditional classroom methods, COINS places students in dynamic scenarios where their choices directly impact simulated project performance, providing immediate feedback on the consequences of managerial decisions.

In this case, teams from Cal Poly and ČVUT were tasked with running competing construction companies in a shared market environment. Each team faced challenges such as bidding for projects, managing resources, scheduling, cost control, and responding to unforeseen events. The competition required not only technical knowledge but also strategic planning, communication, and collaboration under pressure.

Initial findings from the simulation demonstrated distinct approaches influenced by cultural and educational contexts: Cal Poly students emphasized rapid decision-making and risk-taking, while the ČVUT team adopted a more methodical, resource-conservative strategy. Both approaches achieved success in different areas, highlighting the versatility of the COINS platform in cultivating diverse problem-solving skills.

The case illustrates how international competition in a simulation-based environment can broaden students' perspectives, sharpen their managerial and technical competencies, and prepare them for the globalized nature of today's construction industry.

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