BOOK OF ABSTRACTS

The 8th International Conference Series on Geotechnics, Civil Engineering and Structures

CIGOS 2026

INNOVATION IN PLANNING, DESIGN AND CIVIL INFRASTRUCTURE FOR RESILIENT AND SUSTAINABLE TRANSFORMATION

Ho Chi Minh City, April 16-17, 2026

Book of Abstracts

The 8th International Conference Series on
Geotechnics, Civil Engineering and Structures

CIGOS 2026

INNOVATION IN PLANNING, DESIGN AND CIVIL INFRASTRUCTURE FOR RESILIENT AND SUSTAINABLE TRANSFORMATION

The 8th International Conference Series on Geotechnics, Civil Engineering and Structures
INNOVATION IN PLANNING, DESIGN AND CIVIL INFRASTRUCTURE FOR RESILIENT AND SUSTAINABLE TRANSFORMATION

Published by AVSE Global, University of Architecture Ho Chi Minh City (UAH), and University of Sydney Vietnam Institute (SVI).

Editors: Cuong Ha-Minh · Cao Hung Pham · Hanh T.H. Vu · Dat Vu Khoa Huynh
Layout: Anh Vu Viet
Cover design: Anh Vu Viet

ORGANIZING COMMITTEE

Chairmen

Trong Thuat Pham, *Rector of University of Architecture Ho Chi Minh City, Vietnam*
Cao Hung Pham, *University of Sydney Vietnam Institute, University of Sydney, Australia*
Cuong Ha Minh, *AVSE Global & ENS Paris-Saclay, France*

Local Members (University of Architecture Ho Chi Minh City, Vietnam)

Thanh Hai Truong, *Vice Rector*
Anh Tuan Vo, *Faculty of Urban Infrastructure Engineering*
Dinh Nhan Dao, *Faculty of Civil Engineering*
Huu Hieu Tran, *Financial Planning Office*
Le Minh Ngo, *Faculty of Architecture*
Mai Anh Tran, *Science - Technology Management and International Relations Office*
Pham Si Nguyen Tran, *Science - Technology Management and International Relations Office*
Quang Thanh Truong, *Faculty of Civil Engineering*
Song Hong Pham, *Faculty of Civil Engineering*
Thi Hong Hanh Vu, *Faculty of Architecture*
Thi Kim Dung Pham, *General Administration Office*
Thi Le Thai, *Science - Technology Management and International Relations Office*
Thi Quynh Nhu Nguyen, *Faculty of Civil Engineering*
Van Phuc Tran, *Academic Affairs Office*
Viet Anh Vu, *International Education Institute*

International Members

Thu Anh Nguyen, *University of Sydney Vietnam Institute, Vietnam*
Bao Han Nguyen, *AVSE Corporation, Vietnam*
Dat Vu Khoa Huynh, *AVSE Global & Norwegian Geotechnical Institute, Norway*
Huu Quyet Nguyen, *Gustave Eiffel University, France*
Le Hung Tran, *Gustave Eiffel University, France*
Ly Tran, *University of Sydney Vietnam Institute, Vietnam*
Quynh Anh Dam, *University of Sydney Vietnam Institute, Vietnam*
Tuan Anh Do, *AVSE Global & BOYD Corp, Vietnam*
Van Truong Nguyen, *Gustave Eiffel University, France*

INTERNATIONAL SCIENTIFIC COMMITTEE

Duc Phi Do, *Orleans University, France, Vietnam & France*
Duc Duy Ho, *Ho Chi Minh City University of Technology, Vietnam*
Ekaterina Buldakova, *IEGRAS, Russia*
Fahmi Zaïri, *University of Lille, France*
Frédéric Dau, *Arts et Mertiers ParisTech (ENSAM), France*
Giang Nguyen, *University of Adelaide, Australia & Vietnam*
Gregory J. Hancock, *University of Sydney, Australia*
Hannah Blum, *University of Wisconsin-Madison, USA*
Hoang Anh Pham, *Hanoi University of Civil Engineering, Vietnam*
John Papangelis, *University of Sydney, Australia*
Jose Turmo, *Universitat Politècnica de Catalunya, Barcelona Tech, Spain*
Le Minh Ngo, *University of Architecture Ho Chi Minh City, Vietnam*
Le Hung Tran, *Université Gustave Eiffel, France*
Martin Cyr, *University of Toulouse, France*
Masahiko Shinozaki, *Toyo University, Japan*
Minh Tuan Ha, *HUTECH University, Vietnam*
Minh Duc Tran, *University of Architecture Ho Chi Minh City, Vietnam*
Mohammad Arif Kamal, *Aligarh Muslim University, India*
Mohd Syahrul Hisyam Mohd Sani, *UiTM Cawangan Pahang, Malaysia*
Ngoc Truc Nguyen, *VNU School of Interdisciplinary Studies, Vietnam National University, Vietnam*
Ngoc Hieu Pham, *Hanoi Architectural University, Vietnam*
Ngoc Binh Ta, *Institute of Construction Economics - Ministry of Construction, Vietnam*
Nguyen Khuong Le, *University of Canberra & University of Transport Technology, Australia & Vietnam*
Nguyen Hoang Hung Tran, *Ho Chi Minh City University of Technology, Vietnam*
Nguyen Hoang Long Truong, *University of Architecture Ho Chi Minh City, Vietnam*
Phi Long Nguyen, *Vietnam Aviation Academy, Vietnam*
Quang Huy Nguyen, *Insa Rennes, Vietnam*
Quang Tuan Nguyen, *University of Transport and Communications, Vietnam*
Quoc Bao Bui, *Ton Duc Thang University, Vietnam & France*
Quoc Vinh Nguyen, *Ho Chi Minh City City University of Technology, Vietnam National University, Vietnam*
Quynh Hoa Ta, *Hanoi University of Civil Engineering, Vietnam*
Rute Sousa Matos, *University of Évora, Portugal*
Sadegh Nadimi, *Newcastle University, UK*
Song Hong Pham, *University of Architecture Ho Chi Minh City, Vietnam*

Tai Thai, *The University of Melbourne, Australia*
Tan Van Vu, *University of Architecture Ho Chi Minh City, Vietnam*
Thai Huyen Nguyen, *Hanoi Architectural University, Vietnam*
Thanh Hung Dang, *University of Architecture Ho Chi Minh City, Vietnam*
The Truyen Tran, *University of Transport and Communications, Vietnam*
Thi Ho Vi Le, *University of Architecture Ho Chi Minh City, Vietnam*
Thi Thu Trang Ngo, *University of Architecture Ho Chi Minh City, Vietnam*
Thi Khanh Phuong Nguyen, *Hanoi University of Civil Engineering, Vietnam*
Thi Thanh Mai Nguyen, *Hanoi University of Civil Engineering, Vietnam*
Thi Tuyet Dung Nguyen, *Ha Noi Architectural University, Vietnam*
Thi Thu Huong Ta, *Hanoi University of Civil Engineering, Vietnam*
Thi My Thanh Truong, *University of Transport Technology, Vietnam*
Thi Hong Hanh Vu, *University of Architecture Ho Chi Minh City, Vietnam*
Thi Huong Lan Vu, *Hanoi University of Civil Engineering, Vietnam*
Thu Trang Dam, *Hanoi University of Civil Engineering, Vietnam*
Thu Hang Tran, *University of Transport and Communications, Vietnam*
Thuc Trang Dang, *Scene Plus Architects Co., Ltd., Vietnam*
Thuong Anh Nguyen, *EDF, France*
Toufik Karech, *Unuiversity of Batna2, Algeria*
Trung Phong Le, *Thuyloi University, Vietnam*
Truong Vu Vu, *Nguyen Tat Thanh University, Vietnam*
Van Hiep Dinh, *Institute of Planning and Transportation Engineering, Hanoi University of Civil Engineering, Vietnam*
Van Mien Tran, *Ho Chi Minh City University of Technology, Vietnam*
Van-Thanh-Van Nguyen, *McGill University, Canada*
Varoujan Sissakian, *Komar University of Science and Technology, Iraq*
Viet Huy Nguyen, *Hanoi University of Civil Engineering, Vietnam*
Xi Zhao, *Beijing University of Civil Engineering and Architecture, China*
Xuan Hong Vu, *University Claude Bernard Lyon 1, France*
Zhongqiang Liu, *Norwegian Geotechnical Institute, Norway*

ORGANIZERS

CIGOS

AVSE GLOBAL

UAH
UNIVERSITY OF ARCHITECTURE
HO CHI MINH CITY

THE UNIVERSITY OF SYDNEY | Vietnam Institute

Under the Auspices of

SIMSG ISSMGE
Technical Committee 309
Machine Learning

SPONSORS

Silver

BlueScope

ATAD Partnership Success

HUNG PHU REAL ESTATE INVESTMENT CORPORATION

Bronze

STECHCO

ACE Instruments ACE INSTRUMENT Geotechnical Sensors & Smart Solutions

ityLand.

MINH LONG THỜI TRANG CHO NỘI THẤT

atlas

PREFACE

The International Conference series on Geotechnics, Civil Engineering and Structures (CIGOS), initiated in 2010, has progressively established itself as a prominent international forum fostering high-quality scientific exchange and collaboration among academics, researchers, engineers, and industry practitioners. Over successive editions, CIGOS has continuously evolved to address emerging global challenges and technological transformations in the fields of geotechnics, civil engineering, and structural design.

The eighth edition, CIGOS 2026, is proudly co-organized by the Association of Vietnamese Scientists and Experts, the University of Architecture Ho Chi Minh City, and the University of Sydney Vietnam Institute, under the auspices of the International Society for Soil Mechanics and Geotechnical Engineering TC-309 and Vietnam Federation of Civil Engineering Associations. The conference is held in Ho Chi Minh City, Vietnam, on April 16–17, 2026, reaffirming its strong connection to both international excellence and regional development.

CIGOS 2026 is organized under the central theme:

“Innovation in Planning, Design and Civil Infrastructure for Resilient and Sustainable Transformation”

This theme reflects the urgent need to address pressing global challenges, including climate change, rapid urbanization, and resource constraints, through innovative, sustainable, and digitally enabled engineering solutions. It further emphasizes the growing importance of interdisciplinary approaches in shaping resilient infrastructure systems for the future.

The conference attracted a wide range of contributions from researchers and professionals worldwide, covering key domains including:

- Artificial Intelligence, Data Analytics, and Digital Transformation: highlighting the integration of machine learning, digital twins, and intelligent systems in engineering practice;
- Construction, Materials, and Structures: focusing on sustainable materials, circular economy strategies, and advanced structural solutions;
- Geosciences, Environment, and Energy: addressing geo-environmental challenges, climate resilience, and sustainable energy systems;
- Planning, Architecture, and Infrastructure Management: emphasizing integrated approaches to urban development and infrastructure systems.

Among the accepted contributions, five keynote and invited lectures were delivered by internationally recognized experts, addressing themes such as digital transformation in construction, geotechnical risk and resilience, AI-driven infrastructure management, and sustainable materials innovation.

The editors would like to express their sincere gratitude to the co-organizing institutions – AVSE Global, UAH, and SVI – whose leadership and coordination have been instrumental in the successful realization of this event. We also acknowledge the invaluable contributions of the international advisory board, scientific committee, and reviewers, whose dedication ensured the scientific quality of the proceedings. Our heartfelt thanks go to the keynote speakers, authors, and participants for their commitment and enthusiasm in sharing knowledge and advancing the field.

It is our hope that this volume – comprising contributions from academia, research institutions, and industry across the globe – will serve as a valuable reference for current research and practice, and inspire future innovations toward a more resilient, sustainable, and digitally empowered built environment.

Gif-sur-Yvette, France — Cuong Ha-Minh
Sydney, Australia — Cao Hung Pham
Ho Chi Minh, Vietnam — Hanh T.H. Vu
Oslo, Norway — Dat Vu Khoa Huynh

TABLE OF CONTENTS

KEYNOTE AND INVITED LECTURES

Architecture, Health, and Happiness

Thuc Hao Hoang[1,2,3], Nguyen Phuong Le[3]

[1] Vietnam Association of Architects, Hanoi, Vietnam
[2]Hanoi University of Civil Engineering, Hanoi, Vietnam
[3]1+1>2 Architecture Firm

hoangthuchao@gmail.com

Abstract. In the age of AI boom and globalization, when the world is confronted with climate and environmental crises, alongside intensifying social inequities, architecture is increasingly acknowledged not just as the organization of space, but as an ethical, socially and ecologically responsibility. We have persistently pursued architecture through a more unique lens: slower, more grounded, deeply connected to local communities, and with respect for all living beings. This approach evolves and reinterprets modernity through the essential "genes" of local identity, positioning architecture around values of humanity, equity, and the pursuit of happiness for people and all species. Each project is "bespoke," carefully tailored to the terrain, climate, and real needs of its specific context. Architecture becomes living entity that is capable of interacting and coexisting symbiotically with its users and the surrounding environment. The architect's role subsequently expands beyond design toward companionship, committed contribution, social responsibility, creative aspiration, and community empowerment through co-design and co-construction practices. Through this lens, architecture becomes a living process: one that nurtures identity, inspires communities, and contributes meaningfully to shaping a resilient and sustainable future for both humanity and the ecosystems we inhabit.

Keywords: *Happy architecture, Sustainable and resilient development, Indigenous architectural genes/DNA, Local identity, Social and ecological responsibility.*

Environmentally resilient drinking water supply systems: Lessons from an Australian "Black Summer"

Stuart J. Khan[1][0000-0001-5147-145X] and Lucky Ly[2][0000-0002-4848-1259]

[1]School of Civil Engineering, University of Sydney, NSW 2006, Australia.
[2]School of Civil & Environmental Engineering, University of New South Wales, NSW 2052, Australia.

stuart.khan@sydney.edu.au

Abstract. Among the most widely anticipated implications of global climate change are an increased frequency and intensity of extreme weather events. Consequently, drinking water supplies will need to be safely and effectively managed under increasingly challenging environmental circumstances. In many cases, they will need to endure more frequent and intense events including droughts, wildfires and exceptionally heavy rainfall. In order to maintain successful operations during and following these types of events, drinking water supply systems will require a high degree of environmental resilience. A series of severe weather events, including a 3-year drought, extreme wildfires and heavy drought-breaking rainfall challenged water supply operations across many parts of Australia during the summer of 2019/20. The fires were so widespread and intense, that this period is now referred to as Australia's 'Black Summer'. The challenges faced by water utilities were recorded during and following the Black Summer events. Data collection was achieved through an industry workshop, followed by an industry survey and then a series of interviews with some of the most directly impacted water industry participants. This information provides insights to characteristics of water supply systems that demonstrated environmental resilience, as well as those which proved to be more vulnerable to service interruptions during extreme environmental challenges. By analysing these insights, conclusions are drawn about how improved environmental resilience may be achieved. The most important factor contributing to environmental resilience was flexibility. This flexibility was manifested in diverse ways, but ultimately enabled water utilities to respond to changing circumstances by changing the ways in which water was supplied, stored, treated or delivered.

Keywords: *Bushfires; Wildfires; Drinking Water; Resilience.*

From Smart Systems to Situated Intelligence: Cultural Knowledge and Ethical Design for Vietnam's Digital Futures

Jane Gavan

[1] University of Sydney, City Road, Camperdown 2006 NSW Australia

jane.gavan@sydney.edu.au

Abstract. Vietnam is entering a decisive phase of digital transformation driven by artificial intelligence, data analytics, smart infrastructure, and large-scale urban development. While these technologies promise efficiency and economic growth, dominant models of "smart systems" often privilege data-driven optimisation while overlooking forms of knowledge embedded in everyday cultural practices. This paper introduces the concept of situated intelligence as a framework for understanding knowledge emerging through relationships between people, materials, environments, and community experience. Drawing on interdisciplinary practice-led research conducted in Vietnam between 2014 and 2026, the paper examines how cultural research can complement technological innovation by revealing ecological knowledge, social memory, and survival practices often absent from digital governance frameworks. A central case study is the exhibition Southern Vietnamese Cuisine During the Resistance War at the War Remnants Museum in Ho Chi Minh City. The paper argues that Vietnam's technological future depends on integrating digital innovation with culturally grounded knowledge systems and proposes the development of wise systems that combine computational capability with ethical reflection and participatory governance.

Keywords: *Vietnam, digital transformation, smart systems, situated intelligence, cultural research, museum studies, sustainability.*

Some Thoughts on Smart Infrastructure

Kenichi Soga[1][0000-0001-5418-7892]

[1] University of California Berkeley, Berkeley CA 94720, USA

soga@berkeley.edu

Abstract. Smart infrastructure can be defined as a long-lasting, adaptable, data-informed system that maintains its performance even with deterioration, disruptive hazards, and changing demand. Conventinal design methods rely on demand forecasts at the time of design, but these forecasts can drift as user behavior, land use, energy systems, and technologies (such as telework, automation, and electrification) evolve throughout an infrastructure's life. Furthermore, climate change increases exposure to flooding, earthquakes, wildfires, and severe storms. This paper argues that smart infrastructure relies on closing the loop between measured asset behavior and the services it provides. Continuous monitoring offers evidence for life expectancy estimations, risk assessment and mitigation, and lifecycle cost-benefit analyses. By integrating sensing technology with digital twins, engineers and infrastructure owners can learn from real variability, anticipate emerging threats, and respond proactively to degradation and potential cascading failures within interconnected networks. Realizing this vision requires multi-scale sensing, reliable AI and machine learning for decision support, socio-technical digital twins that incorporate equity, and advancements in low-carbon, self-healing materials, as well as automated construction, inspection, and maintenance processes.

Keywords: *Smart infrastructure, Sensing and monitoring, Digital twins.*

The Architectural Profile of Saigon - Ho Chi Minh City Across Periods

Phu Cuong Pham[1]

[1] University of Architecture Ho Chi Minh City

cuong.phamphu@uah.edu.vn

Abstract. Over time, Saigon - Ho Chi Minh City has accumulated diverse architectural layers - from indigenous and Sino-Vietnamese forms to French colonial ensembles, mid-20th-century tropical modernism, and contemporary high-rise development. Drawing on archival research, field observations, and typological mapping, the study identifies key urban and architectural typologies and their associated morphological characteristics. The presentation argues that urban heritage extends beyond colonial monuments to include modernist, vernacular, and everyday urban fabric. In today's context of rapid redevelopment, land-use pressures, and market-driven dynamics, both tangible heritage and cultural continuity are increasingly threatened. The presentation further contends that integrated conservation strategies are needed to balance identity, memory, and future growth in fast-changing megacities.

Keywords: *Architecture, Saigon, HCMC, Heritage, building morphology*

ARCHITECTURE, INDUSTRIAL DESIGN, PLANNING

A Bibliometric Review of Aquaponics in Sustainable Architecture: Implications for Cooling and Economic Resilience in Mosque

Sayyidati Khalishah Azzahra[1*] and Nangkula Utaberta[2]

[1*] School of Architecture and Built Environment, FETBE, UCSI University, Kuala Lumpur, Malaysia
[2] School of Architecture and Built Environment, FETBE, UCSI University Kuala Lumpur, Malaysia, Badan Riset dan Inovasi Nasional (BRIN), Indonesia, Intitut Teknologi Sepuluh November, Surabaya, Indonesia, Universitas Airlangga, Surabaya, Indonesia

sayyidatikhalishahazzahra@gmail.com

Abstract. Aquaponics, an integrated system of aquaculture and hydroponics, has gained attention in sustainability studies primarily for its contributions to food security and environmental conservation. However, its role in sustainable architecture remains underexplored. This paper addresses this gap through a comprehensive bibliometric review of 1,055 peer-reviewed articles published between 2020 and 2025, retrieved from the Scopus database. Employing bibliometric mapping and cluster analysis with VOSviewer, the study identifies three dominant research clusters: (1) aquaponics as a sustainable food-energy-water nexus, (2) aquaponics in green technology and environmental engineering, and (3) aquaponics in social innovation and urban resilience. A significant research gap is noted regarding the integration of aquaponics in religious and community contexts, particularly in mosque designs aimed at passive cooling and economic resilience. The mosque, chosen as a case study, serves as a pivotal socio-economic hub in Muslim communities, especially in tropical regions. This paper proposes strategic directions for embedding aquaponic systems within mosque infrastructure to enhance climate-responsive design, improve local food security, and promote economic empowerment. The findings advocate for mosques as productive spaces that support community resilience and transcend their traditional roles, thus offering innovative, culturally sensitive approaches to incorporate ecological technologies into the built environment.

Keywords: *Aquaponics, Sustainable Architecture, Mosque Design, Climate-Responsive Design, Community Resilience, Bibliometric Review.*

A Modular Floating Village for Sustainable Living in the Mekong Delta, Vietnam: A Design-Based Research Approach

Nguyen Thanh Tan

HUTECH University, Ho Chi Minh City, VIETNAM

nt.tan@hutech.edu.vn

Abstract. This paper investigates a modular floating village for sustainable living using a design-based research approach in the Mekong Delta, Vietnam – an area characterized by seasonal flooding, tidal variability, and limited access to centralized infrastructure, which challenges the long-term feasibility of informal floating settlements. Applying a design-based research methodology, this study systematically examines how environmental, material, and socioeconomic constraints are translated into design decisions and evaluated through specific performance indicators. The study examines an interlocking brick assembly method that enables simple, mortarless assembly in both vertical and horizontal directions, forming modular floating columns and expandable housing units. A basic house is configured with four modular columns continuously connected in a monolithic fashion from foundation to roof, while multiple houses are grouped into clusters linked by walkways and organized around a common community center. The results show improved buoyancy and vertical adaptability to changing water levels, enhanced lifecycle performance despite a 10-30% higher initial cost compared to traditional floating houses, and better functional integration of water supply and drainage, wastewater storage, and solar energy systems. Overall, this study contributes a scalable, performance-based framework for floating settlements in flood-prone riverine contexts.

Keywords: *Modular floating village, Design-based research, Floating housing, Interlocking tiles, Mekong Delta.*

An Architectural Framework for Sustainable Elevated Urban Railway Stations in Ho Chi Minh City

Long Truong Nguyen Hoang[1][0009-0004-4689-0245] and Nhi Phan Nu Quynh[2][0009-0004-4641-5794]

[1] University of Architecture Ho Chi Minh City, Ho Chi Minh City, Vietnam
[2] University of Architecture Ho Chi Minh City, Ho Chi Minh City, Vietnam

long.truongnguyenhoang@uah.edu.vn

Abstract. Vietnam's rapid economic growth has accelerated the demand for sustainable urban infrastructure, with elevated urban railways emerging as a key component of metropolitan transport planning. Ho Chi Minh City (HCMC), the nation's economic hub, is implementing an ambitious plan to develop eight elevated railway lines, reinforcing Vietnam's COP26 commitment to achieving net-zero emissions by 2050. This development underscores the urgent need for sustainable architectural design of railway stations. This study investigates international and regional case studies of elevated railway stations, alongside an assessment of HCMC's urban context, to establish sustainable design principles. The research follows a two-phase methodology: (1) synthesis of global and regional best practices and evaluation frameworks (LOTUS, LEED, Green Mark, and China's TB/T 10429-2014), and (2) field-based surveys and questionnaires targeting both users and experts in HCMC. The resulting framework highlights design orientations that integrate environmental performance, operational efficiency, and cultural appropriateness, providing a foundation for sustainable station architecture in Vietnam.

Keywords: *Sustainable Urban Infrastructure, Elevated Railway Stations, Ho Chi Minh City, Viet Nam.*

An Assessment of High-Rise Hotel Architecture in Nha Trang, Khanh Hoa from Green Building Perspective

Long Truong Nguyen Hoang[1][0009-0004-4689-0245], Truc Nguyen Thi Thanh[2][0009-0002-8988-4318]

[1] University of Architecture Ho Chi Minh City, Ho Chi Minh City, Vietnam
[2] University of Architecture Ho Chi Minh City, Ho Chi Minh City, Vietnam

long.truongnguyenhoang@uah.edu.vn

Abstract. Global environmental concerns necessitate a shift towards sustainable practices across all sectors, including the energy-intensive architecture, construction, and tourism industries. Vietnam's "Net Zero" commitment by 2050, reflected in Khanh Hoa province's "Green Tourism Development Plan" and "Khanh Hoa Green Tourism Standards" for Nha Trang, emphasizes green urban models and renewable energy. High-rise hotels, with their significant energy demands, are key targets for green building principles. Nha Trang's rapidly expanding coastal high-rise hotel sector is characterized by repetitive, visually uninspired designs that often clash with the local environment. Extensive glazing without adequate solar shading contributes to high energy consumption for cooling. This lack of design innovation ignores opportunities to integrate local cultural identity and harness the region's climate. A paradigm shift towards green building principles is urgently needed. This research assesses Nha Trang's high-rise hotel architecture against established green building criteria, identifying architectural deficiencies. A two-phase methodology is employed: Phase 1 surveys the existing high-rise hotel inventory; Phase 2 conducts in-depth analyses of selected case studies, evaluating their architectural performance against green building standards. The results will critically evaluate current practices and propose design recommendations for sustainable high-rise hotels in Nha Trang, contributing to a model of sustainable tourism development.

Keywords: *High-Rise Hotel, Hotel Architecture, Nha Trang, Khanh Hoa Province, Vietnam.*

Architectural Adaptation of Coastal Rural Housing to Climate Conditions in the Mekong River Delta: A Case Study of Thoi Thuan Commune, Vinh Long Province

Long Truong Nguyen Hoang[1][0009-0004-4689-0245] and Trang Tran Thi Thuy[2][0009-0006-5775-1886]

[1] University of Architecture Ho Chi Minh City, Ho Chi Minh City, Vietnam
[2] University of Architecture Ho Chi Minh City, Ho Chi Minh City, Vietnam

long.truongnguyenhoang@uah.edu.vn

Abstract. The Mekong River Delta of Vietnam is highly vulnerable to climate change, experiencing increasingly frequent and severe droughts, saline intrusion, heavy rainfall, tidal inundation, coastal erosion, and rising temperatures. Thoi Thuan Commune in Vinh Long Province, located in the lower Mekong River Delta, is particularly exposed to these compounded climate stressors. Although traditional rural housing in this area—characterized by elevated floors, sloping roofs, natural ventilation, and locally sourced materials—has historically demonstrated climate responsiveness, recent socio-economic transformations, livelihood changes, population growth, and rapid urbanization have revealed significant limitations in its long-term adaptive capacity. This study systematically assesses architectural adaptation strategies of coastal rural housing to local climate conditions using a criteria-based evaluation framework and identifies design implications for climate-resilient rural housing in the Mekong River Delta. A two-stage research methodology was employed, comprising a preliminary field survey of 50 rural houses in Thoi Thuan Commune, followed by an in-depth assessment of 20 representative cases grouped into five housing typologies (A–E). These case studies were evaluated using eight architectural climate-adaptation criteria covering site conditions, spatial organization, structural systems, materials and technologies, building envelopes, and user-initiated adaptive measures. The findings provide an evidence-based foundation for developing context-specific design guidelines that integrate local building traditions with modern, sustainable construction technologies to enhance the climate resilience of rural housing in the region.

Keywords: *Adaptive Architecture, Coastal Rural Housing, Mekong River Delta, Thoi Thuan Commune, Vinh Long Province, Vietnam.*

Architectural Strategies for Natural Lighting in Vietnamese Catholic Churches, Case Study in Lam Dong Province

Long Truong Nguyen Hoang[1][0009-0004-4689-0245] and Tan Duong Vu[2][0009-0006-4812-4514]

[1] University of Architecture Ho Chi Minh City, Ho Chi Minh City, Vietnam
[2] University of Architecture Ho Chi Minh City, Ho Chi Minh City, Vietnam

long.truongnguyenhoang@uah.edu.vn

Abstract. Natural light in Catholic church architecture serves not only functional purposes of illumination and comfort but also embodies symbolic and theological meaning, reinforcing spiritual experience. This study investigates natural lighting strategies in Catholic churches of Lam Dong province, Vietnam, where architectural expressions range from European Gothic and Romanesque models to modernist and vernacular adaptations. A mixed-methods approach was employed: a survey of 109 churches in the Diocese of Da Lat established key variables such as architectural style, floor plan, altar orientation, and window or skylight design. Six representative churches were then selected for in-depth analysis, complemented by field observations, expert interviews, and congregational surveys. Findings reveal that natural lighting strategies are shaped by stylistic choices, spatial typologies, and contextual adaptations. While traditional stained glass and clerestories conveyed transcendence and mystery, contemporary churches employ skylights, glazing, and indigenous materials to balance symbolic resonance with climatic comfort. This research highlights natural light as both a theological metaphor and an ecological design principle. By situating daylighting within Lam Dong's cultural and climatic context, the study contributes to sustainable sacred architecture and offers design strategies that integrate spirituality, ecology, and cultural identity.

Keywords: *Daylighting, Catholic Churches, Sacred Architecture, Lam Dong, Vietnam*

Age-Friendly Design in Vietnam: Balancing Sustainable Development Goals with the Needs of the Elderly

Hong Loan Nguyen[1][0000-0001-5635-1262]

[1] University of Architecture Ho Chi Minh City, 196 Pasteur, Xuan Hoa ward, Ho Chi Minh City, 70000, Vietnam

loan.nguyenhong@uah.edu.vn

Abstract. Vietnam is undergoing a rapid population aging process, posing new demands on the planning, design, and management of living environments for the elderly. This paper proposes strategic directions and a set of architectural design solutions that are age-friendly, including the renovation of existing buildings and the development of new models, while closely aligning with the Sustainable Development Goals. The research is based on a selective synthesis and analysis of international and domestic sources, combined with consideration of the architectural-urban context, socio-cultural conditions, and the adaptability of the elderly to various types of buildings in Vietnam. This leads to the development of an approach framework, design strategies, and solutions for residential and public housing. The results highlight the crucial role of architectural design in enhancing safety, accessibility, environmental comfort, health support, promoting social cohesion, and integrating technology, while ensuring balance with sustainable development goals. The paper also identifies the need to improve technical standards, management policies, and operational mechanisms, thereby aiming for a more comprehensive, adaptable, and humane living environment for the elderly.

Keywords: *Age-friendly Design, Elderly, Sustainable Development, Design Strategies, Design Solutions, Vietnam.*

Analyzing the Morphological Language of Óc Eo Architecture in the Relationship Between Numerology, Proportions, and Geometric Forms – A Case Study Based on Photogrammetry Survey Data

Tran Trung Hieu[1][0000-0002-2210-9854]

[1] Faculty of architecture and Art – HUTECH University, HCMC 72308, Vietnam

tt.hieu@hutech.edu.vn

Abstract. This paper investigates the morphological language of Óc Eo architecture - an architectural tradition associated with the ancient kingdom of Funan - through the relationship between numerology, proportions, and geometric forms. Focusing on temple-tower ruins located in the southern provinces of Vietnam, the study uses photogrammetry-based methods to collect spatial data from existing Óc Eo structures. The resulting datasets support precise dimensional analysis of architectural elements, such as base layouts, elevation ratios, and structural modules. Through this process, the study identifies consistent formal patterns and proportional relationships that suggest an underlying design logic based on modular arithmetic and geometric ordering, rather than purely decorative or intuitive construction practices. The research highlights recurring spatial ratios - such as 1:1, 1:2, and 1:$\sqrt{2}$—and the frequent use of square-based planning systems that align with fundamental geometric operations. These quantitative patterns imply the presence of a rule-based approach to architectural composition, likely codified through practical knowledge systems. This research is intended as a first step toward formulating a formal architectural framework for Funan-period structures, which can be applied in restoration, reconstruction, and heritage conservation. By establishing this foundational reference, the study aims to support future photogrammetry surveys across other regions in Southeast Asia that once belonged to the ancient Funan cultural sphere, enabling broader comparative studies and contributing to the long-term preservation and understanding of this early architectural legacy.

Keywords: *Traditional Vietnamese architecture; Wooden joint and tenon; Vertical facade ratio; Roof slope; Sustainability.*

Application of Four Sacred Beasts motif and decorative component words on Modernist Architecture in Saigon (The case of Independence Palace)

Vinh, Le Long[1]

[1] Van Lang University, No. 69/68, Dang Thuy Tram St., Binh Loi Trung Ward, Ho Chi Minh City, Vietnam

vinh.ll@vlu.edu.vn

Abstract. Vietnamese architecture, spanning from traditional styles to the Indochinese and Modernist periods, has consistently utilized symbolic decorative motifs. Elements such as the Tu Linh (Four Sacred Beasts), scroll patterns, and the characters Tho (Longevity) and Van (Swastika) represent Oriental cosmic and humanistic philosophies. These motifs are prevalent across structures ranging from royal palaces to communal houses and temples. Traditionally, the harmonious and consistent use of wood and stone defined the unique character of Vietnamese architecture. In Saigon's modernist architecture (1954-1975), these traditional motifs were reinterpreted using reinforced concrete. While Modernism is fundamentally defined by geometric volumes and expansive planes with minimal detail. The Independence Palace - an exemplary modernist work-successfully integrated a series of traditional Vietnamese symbols. These motifs do not merely provide aesthetic highlights; they embody profound philosophical meanings and serve as powerful icons of Vietnamese cultural identity within the framework of modern design.

Keywords: *Decorative patterns, Modernism Architecture, Decorative Motifs, Four Sacred Beasts and Component Words*.

Application of advanced technology for building envelope architecture in Vietnam

Van Tin Nguyen[1][0000-0003-3064-3042]

[1] University of Architecture Ho Chi Minh City, 196 Pasteur, Xuan Hoa ward, Ho Chi Minh City, 70000, Vietnam

tin.nguyenvan@uah.edu.vn

Abstract. The building envelope plays a critical role in controlling microclimate, indoor comfort, safety, and energy performance in contemporary architecture. In Vietnam, the application of advanced building envelope technologies faces numerous challenges due to harsh climatic conditions, construction capability constraints, investment costs, and operational requirements. This study clarifies the concept of "advanced technologies" for building envelopes and examines their potential application within the Vietnamese context. A directed literature review combined with contextual analysis was employed to identify key technology groups, assess their performance contributions, and synthesize their advantages and limitations. The study proposes a conceptual framework linking climatic, functional, technological, and sustainability requirements to building envelope design strategies, together with synthesis tables that map performance relevance and indicative applicability across different building types in Vietnam. Findings highlight the significant potential of smart and adaptive envelopes (SAF), advanced glazing and dynamic shading (AGDS), double-walled envelopes (DSVF), energy-integrated envelopes (BIPV/BIPVT), thermal storage materials (TSIM), green envelopes (GBIF), IoT/Digital Twin systems, and multifunctional envelopes (MFF), while also indicating challenges related to cost, maintenance, technological infrastructure, and climatic diversity. The study provides a systematic, decision-support framework for selecting and integrating advanced building envelope technologies for sustainable architecture in Vietnam.

Keywords: *Application, Advanced Technology, Building Envelopes, Architecture, Strategy, Solutions, Vietnam*

Architectural Decoration of Chinese Assembly Halls in Ho Chi Minh City and the Cultural Hybridity with Local Influences

Ma Hoa Thien[1]

[1] Master's student in Applied Arts, Van Lang University

mathien2209@gmail.com

Abstract. The architecture of Chinese assembly halls (Hoi Quan) in Ho Chi Minh City serves as a vivid testament to the migration history of Chinese communities and their cultural interactions with the Vietnamese. These heritage structures not only fulfill religious and communal functions but also stand out for their rich system of architectural decoration, including intricate wood carvings, ceramic reliefs, gilded lacquer, and Chinese calligraphy—all of which embody profound symbolic meanings and refined aesthetic values. This paper focuses on examining the cultural hybridity reflected in the decorative elements of the assembly halls, aiming to identify the artistic fusion between Chinese traditions and Vietnamese local influences. The study was conducted through field surveys at representative assembly halls such as Tue Thanh, Nghia An, and On Lang. The paper demonstrates that the decorative systems of Chinese assembly halls in Ho Chi Minh City have preserved core traditional Chinese elements (the Four Sacred Creatures, Eight Treasures, cloud motifs) while incorporating local adaptations such as lotus flowers, bamboo imagery, Southern Vietnamese wood materials, and regional ceramic tiles. This cultural hybridity not only enriches the aesthetic language of the architecture but also reflects the cultural adaptability and identity formation of the Chinese diaspora in Southern Vietnam. The paper proposes viewing these assembly halls as "living heritage" and highlights the potential of integrating traditional decorative elements into contemporary community space design, thereby contributing to the preservation and promotion of cultural values amid rapid urbanization.

Keywords: *Chinese Assembly Hall Architecture, Architectural decoration, Cultural hybridity, Local cultural identity, Living heritage.*

Colonial Industrial Architecture Heritage in Saigon Ho Chi Minh City

Nguyen Vu Mai Han [1] and Vu Thi Hong Hanh [2]

[1 2] University of Architecture Ho Chi Minh City, VIETNAM

han.nguyenvumai@uah.edu.vn

Abstract. Industrial heritage and adaptive conservation have emerged as important frameworks for addressing the future of historic industrial sites in rapidly urbanizing cities. In Ho Chi Minh City, formerly known as Saigon, the legacy of French colonial industrial architecture, developed from the late 19th to the early 20th century, offers a valuable lens through which to examine the intersection of heritage preservation and urban development. This study aims to identify and evaluate the architectural, historical, and social values of colonial-era industrial buildings in Saigon, with a focus on their potential for adaptive reuse. Six representative sites were selected for field survey and analysis: Ba Son Shipyard, Binh Dong Wharf Warehouse, Yarn Factory No. 1, Saigon Brewery, Tran Phu Printing Factory, and Saigon Locomotive Enterprise. These buildings exhibit distinctive features such as prefabricated steel structures, thick brick masonry, arched windows, and hybrid architectural forms that reflect both Western industrial design and local adaptations. Through typological and spatial analysis, the research highlights the significance of these structures as tangible evidence of early industrialization and urban modernization in southern Vietnam. The findings support adaptive reuse as a sustainable strategy that preserves architectural identity while accommodating contemporary urban needs. This approach not only safeguards cultural heritage but also contributes to the socio-economic and spatial revitalization of Ho Chi Minh City.

Keywords: *industrial heritage, adaptive conservation, French colonial industrial development pre-1954, adaptive reuse, Saigon HCMC, urban conservation*

Decorative sculptures on Champa tower temples in Ninh Thuan, Viet Nam (case studies: Hoa Lai, Po Klaong Girai, and Po Ramé temple)

Anh Thuy Thi Ngo[1]

[1] Van Lang University, No.69/68, Dang Thuy Tram St., Binh Loi Trung Ward, Ho Chi Minh city, Vietnam

anh.ntt@vlu.edu.vn

Abstract. The decorative sculptures of Champa tower temples reflect a blend of Indian religious ideology and inherent beliefs, resulting in unique artworks that embody the plastic values of the Cham people developed over many years. The research thus shows Ninh Thuan province still has Champa tower temples, including Hoa Lai, Po Klaong Girai, and Po Ramé, in the system of typical Cham cultural and artistic heritages. They were made with bricks and stones serving as the primary materials and containing unique values in terms of plastic language, decorative motifs, and block layout. These are also an organic re-lationship between sculpture and architecture of works serving beliefs and re-ligions in the Panduranga sub-region, clearly reflecting the process of for-mation and development-ment in each stage bearing the marks of an entire histori-cal period, and are a to the glory of the ancient Champa kingdom. Over time, with ups and downs, the Cham people's traditional architectural art and culture are being lost, forgotten, and gradually losing the attention of society. The research results meet the requirements for sustainable cultural development in Ninh Thuan province in particular and Vietnam in general, contributing to the preservation, inheritance, and promotion of traditional national values in the era of integration, affirming the unique artistic value of the visual language, decorative motifs, and geometric composition of the Cham temple and tower heritage sites in this sub-region.

Keywords: *Champa temple, Decorative sculptures, Cultural identity, Sustainable cultural development.*

Designing For Children: Analyzing Seven Spatial Layers in Preschool Classroom Interiors

An Nguyen Thi Tam[1,2,3], Eakachat Joneurairatana[1] and Veerawat Sirivesmas[2]

[1] Faculty of Decorative Art, Silpakorn University, Bangkok, Thailand
[2] Faculty of Interior Architecture, University of Architecture University, HCMC, Vietnam
[3] Institute of International Education, University of Architecture, University, HCMC, Vietnam

an.nguyenthitam@uah.edu.vn

Abstract. The built environment can impact human development through physical and mental interactions between spatial components and users – particularly in space experienced from early childhood. For young children, the classroom is a primary daily environment where they spend nearly eight hours per day, and it plays an important role in their development and learning through spatial components. The paper is developed based on the concept of seven spatial layers in the preschool classroom interior. It aims to analyze and investigate the key components of each layer and how they interact to influence children's development and learning within the interior space. The research methodology employed in this paper includes a literature review of academic sources, such as peer-reviewed journal articles, relevant documents, books, and publications related to interior architecture. The main outcome of this paper is a set of theoretical diagrams that illustrate the seven spatial layers, including detailed components and their potential to enhance children's developmental needs as well as children's learning experience. These findings of this paper offer valuable insights for educators, architects, interior designers, and particularly parents, who are involved in creating nurturing environments for young children.

Keywords: *young children, preschool interior classroom, 7 spatial layers, children's developmental needs, children's learning experience*

Designing Underground Commercial Spaces Integrated with TOD in Dense Urban Areas: An Architectural Solution for the Sustainable Core of Ho Chi Minh City

To Quynh Truong Nguyen[1] [009-0004-5389-9731], Hai Thanh Truong[2] [0000-0003-0703-2948]

[1,2] University of Architecture Ho Chi Minh City

hai.truongthanh@uah.edu.vn

Abstract. The rapid urbanization process in Ho Chi Minh City has increased the scarcity of land funds, posing a requirement for the effective exploitation of underground space as a strategic solution to integrate public transport infrastructure with urban functions. In this context, this study focuses on the architectural design of underground commercial space as a key spatial organizational element in the public transportation-oriented urban development (TOD) model, with the scope of the study being the central urban area of Ho Chi Minh City - where many metro lines are expected to intersect in the future. The study approaches underground architecture as an integrated structure between transportation systems, commercial activities, and public spaces, and clarifies the role of architectural design in optimizing spatial organization, functional layout, pedestrian approach, and the ability to harness natural light in underground conditions. TOD's core principles, including walkability, mixed-use development, and access to high-capacity public transportation, are transformed into specific architectural strategies at the building scale and transitional spaces [7]. Through design analysis and exploration, the study proposes a spatial model in which the underground commercial space is not only an extension of the transport ifrastructure but becomes an integrated, flexible and capable component of restructuring the public space system in a compact urban context. The results of the study confirm the role of architectural design in improving TOD efficiency, improving urban space quality and reducing pressure on surface infrastructure in HCMC and other Vietnamese cities.

Keywords: *Underground, Underground commercial spaces, Sustainability, TOD*

Digitizing Architectural Survey Data of the Hue Citadel for Preservation and Promotion of Cultural Heritage Values

Ngoc Duc Vo[1*] and Vu Thao Linh Nguyen[2]

[1] University of Sciences, Hue University. 77 Nguyen Hue St., Hue City, Vietnam
[2] High school for gifted students, University of Sciences, Hue University. 77 Nguyen Hue St., Hue City, Vietnam

vngocduc@hueuni.edu.vn

Abstract. The Hue Citadel, has recognized as a UNESCO World Cultural Heritage Site since 1993, is a masterpiece of East-West architectural combination. It is tightly integrated system of walls, gates, bastions, Eo Bau, defensive roads, and moats forming a structure of exceptional architectural, landscape, and historical value. However, in recent decades, urbanization and the passage of time have posed significant challenges to the preservation and promotion of this heritage site. This study assesses the current condition and identifies the cultural values and tourism potential of heritages located in the southern sector of the Citadel. Utilizing photogrammetry, the research reconstructs 3D models and illustrative maps. The data collection process has its own complexities, as the southern wall spans approximately 2,230 meters in length and 89 meters in width. Initial results include the creation of the digital 3D data of the Southern Citadel, which serves as a foundation for preservation efforts and sustainable tourism development in accordance with the site's cultural and historical context.

Keywords: *Hue Citadel; Photogrammetry; 3D; Digital heritage; Preservation.*

Enhanced Modular Housing Drawing from Khmer Vernacular Architecture: A Simulation-Based Approach for Climate-Responsive Social Housing in Southern Vietnam

Hoang-Minh Nguyen[1][0009-0001-5616-6865], Thanh-Long Phan[1][0009-0004-1307-3708], Minh-Anh.T. Nguyen[1][0009-0005-9232-3177], Thao-Duy.T. Nguyen[1][0009-0001-0241-4202], Duc-Cuong Le[1][0009-0001-3651-5845] and Tran-Trung Nguyen[1][0000-0003-4532-1652]

[1] Faculty of Architecture, Van Lang University, 69/68 Dang Thuy Tram Street, Binh Loi Trung Ward, Ho Chi Minh City, Vietnam

trung.nt@vlu.edu.vn

Abstract. The increasing need for affordable housing, coupled with the erosion of cultural identity in Vietnam's southern provinces, underscores the necessity of sustainable and culturally relevant housing options. This study proposes a modular housing concept that integrates Khmer vernacular architectural elements with performance-driven design. A simulation-based methodology is used to examine two typologies—a compact 20-ft unit and a scalable 40-ft module—employing Autodesk CFD and Ecotect Analysis to assess natural ventilation, daylight distribution, and solar heat gain under typical Mekong Delta climatic conditions. Important vernacular methods, such as roofs with high pitches, elevated floor systems, and variable spatial arrangements, are standardized and modularized. Simulations show that ventilation-related measures (e.g., air-change rate, ACH) are approximately 30% higher than the reference baseline under the same boundary conditions. These results are presented as simulation-based evidence, accompanied by a validation and sensitivity framework to facilitate construction-ready implementation. The results suggest that embedding local climatic logics into digital performance workflows can inform climate-responsive, culturally grounded social housing in tropical regions, offering practical insights for architects, policymakers, and developers.

Keywords: *Building Performance Simulation, Climate-Responsive Design, Khmer Vernacular Architecture, Modular Housing, Sustainable Social Housing.*

Exploring exhibition space configuration using space syntax: A case study of the Dak Lak Museum, Vietnam

Tran Vu Tho[1][0009-0003-5767-0814], Le Quan[2][0009-0001-7015-1985] and Tran Ngoc Thanh Trang[3][0009-0000-5714-2032]

[1,2,3] Hanoi Architecture University, Hanoi, Vietnam

thanhtrang167@gmail.com

Abstract. The spatial configuration of exhibition spaces plays an important role in shaping accessibility, circulation, and spatial experience in museums. While Space Syntax has been widely applied in architectural research, its use as an analytical tool for evaluating museum exhibition layouts remains relatively limited, particularly in local museum contexts. This study explores exhibition space configuration using Space Syntax through a case study of the Dak Lak Museum, Vietnam. Convex maps, justified graphs, and selected syntactic measures including integration, choice, and connectivity are employed to examine spatial accessibility and movement potential embedded in the exhibition layout. Rather than directly measuring visitor behavior, the analysis focuses on identifying structural tendencies that may influence circulation patterns and spatial perception. The results indicate variations in spatial accessibility across the exhibition space, suggesting implications for exhibition layout organization and circulation planning. As a single case study, the findings are context-specific and should be interpreted as indicative rather than generalizable. The study highlights the value of Space Syntax as an analytical support tool for evaluating exhibition spaces and suggests that future research should integrate empirical visitor observation and behavioral data to further validate and extend these findings.

Keywords: *Space Syntax; Exhibition Space Configuration; Museum Exhibition Design; Case Study; Spatial Analysis*.

Form-Finding Strategies for Stadium Roofs: Advancing the Architectural Design of Tensile Membrane Structures

Loc Nguyen[1] [0009-0007-3556-8316] and Hai Truong Thanh [2][0000-0003-0703-2948]

[1] Flexiiform co., ltd.
[2] University of Architecture in Ho Chi Minh city

23kt21@uah.edu.vn

Abstract. Tensile membrane structures (TMS) are increasingly applied in contemporary stadium design. Thanks to their ability to span large distances and minimal material usage. The architectural look of TMS not only satisfies functional requirements but also aesthetics. Their lightweight, flexible properties make the design more dynamic. However, in the early stage of the design process, the architect must truly understand the nature of TMS before choosing how to start the first sketch of the stadium cover. A critical distinction in TMS design is that it requires an integrated 'form-finding process' governed by equilibrium constraints, rather than a linear sketch-to-engineering workflow. As TMS is directly influenced by equilibrium tensile forces, the shapes must develop along with the structure and construction solutions. While forming is normally considered a technical process, this research positions it as a creative and design-led method to enhance the architectural outcome. This study focuses on a form-finding method that supports architects in designing a TMS stadium roof with a clear process. The research emphasizes that a deeper understanding of membrane behavior, boundary conditions, and structural typologies is the key to having a good TMS design. However, rather than focusing on quantitative computational analysis, this study establishes a qualitative decision-making framework. To demonstrate its applicability, some typical stadium roof case studies are used. The study shows how to start roof design following support conditions, tensioning strategies, and membrane shape. It also highlights the benefits of integrating the method at an early stage, saving time and the cost of the construction stage later. The research contributes fine form-finding strategies for stadium roofs to architects who want to start basic steps before developing the concept into the details of tensile membrane structures. It starts by defining categories of the stadium roof shape, then clarifies critical steps to make sure the initial design satisfies key TMS principles, and finally combines these approaches to form a final strategy.

Keywords: *tensile membrane structures; form; finding method; stadium roof design*

From Indigenous Wisdom to Urban Resilience: Case Studies of Flood-Adaptive Housing in Can Tho

Tran Thi Minh Hien[1], Manh Thuy Ai[1], Tran Van Khoa[2], and Vo Thuy Duong[3]

[1] Faculty of Architecture, Van Lang University, 69/68 Dang Thuy Tram Street, Binh Loi Trung Ward, Ho Chi Minh City, Vietnam
[2] Faculty of Civil Engineering, Ho Chi Minh City University of Technology and Engineering, 01 Vo Van Ngan Street, Thu Duc Ward, Ho Chi Minh City, Vietnam
[3] Faculty of Civil Engineering, College of Engineering, Can Tho University, Campus 2, 3/2 street, Ninh Kieu ward, Can Tho city, Vietnam

[*] hien.ttm@vlu.edu.vn

Abstract. Can Tho is increasingly threatened by flooding due to climate change, rising sea levels, and rapid urbanization. While government responses mainly focus on large-scale infrastructure such as road elevation, dikes, and drainage system upgrades, these measures often create new problems, including flooding inside houses and rigid architectural forms. In contrast, local residents have developed diverse household-level adaptation strategies that combine indigenous knowledge with modern practices. This study examines four representative cases: a house on Huynh Thuc Khang Street that applies the principle of communicating vessels for drainage; a riverside house with dual frontages that allows flexible movement between street life and river-based activities; a house on Tan Trao Street with a "sacrificial" ground floor designed to absorb floodwater; and a townhouse on Tran Hung Dao Street, where repeated floor elevation and material adjustments have normalized flooding as part of daily life. These cases highlight three core principles of flood-adaptive architecture: spatial flexibility, the creative use of simple physical principles, and the acceptance of water as a permanent urban condition. Beyond technical solutions, these strategies reflect cultural resilience, community creativity, and the enduring spirit of "living with floods." The findings suggest that sustainable urban planning in Can Tho should integrate grassroots innovations with large-scale infrastructure, in order to strengthen resilience while preserving the city's cultural identity.

Keywords: *Flood Adaptation Strategies, Indigenous Wisdom, Resilience*.

Hanging Gardens in Townhouse Architecture: A Micro-Scale Solution for Urban Environmental Regeneration in Vietnam

Hai Truong Thanh [1][0000-0003-0703-2948]

[1] University of Architecture Ho Chi Minh City, Viet Nam

hai.truongthanh@uah.edu.vn

Abstract. Rapid urbanization and high population density in Vietnamese cities have led to the decline of green spaces and deterioration of microclimatic conditions. Townhouses, the predominant housing typology, often lack vegetation due to limited land resources and dense construction. This study examines the potential of hanging gardens as a sustainable architectural intervention to regenerate micro-scale urban environments and enhance residential quality of life. A mixed-method approach was employed, combining surveys of 25 townhouse projects in Ho Chi Minh City and Hanoi, on-site measurement of microclimatic indicators (temperature, humidity, PM2.5), semi-structured interviews with residents and experts, and comparative analysis with international cases from Singapore and Japan. Results reveal that hanging gardens reduced average surface temperature by 2–3°C, increased relative humidity by 5–7%, and lowered fine particulate matter (PM2.5) by 15–18%. In addition, 82% of surveyed residents reported improved thermal comfort, and 95% emphasized the enhanced aesthetic value. Despite these benefits, high investment costs, intensive maintenance requirements, and insufficient policy support present significant challenges to implementation. The study concludes that hanging gardens offer a feasible climate-adaptive and landscape-regenerative solution for Vietnamese townhouses. Findings provide a scientific basis for integrating vertical greenery into architectural design guidelines and highlight the need for policy frameworks that promote green architecture as part of sustainable urbanization strategies.

Keywords: *Hanging gardens; Townhouses; Microclimate; Urban landscape; Vietnam.*

Heat Stress on the Balcony: Investigating the effects of facade heat and external AC Units

Bach Huynh[1][0009-0000-6428-3415] and Vi Le[1][0000-0003-1732-0548]

[1] University of Architecture Ho Chi Minh City, 196 Pasteur, Xuan Hoa Ward, Ho Chi Minh, Viet Nam

vi.lethiho@uah.edu.vn

Abstract. Balconies serve as vital semi-outdoor spaces in tropical residential architecture, yet they are often exposed to extreme heat stress that limits their usability. This study investigates the combined impact of facade surface temperature and air conditioning external units on outdoor thermal comfort (OTC) on residential balconies in Cau Ong Lanh Ward and Ban Co Ward, Ho Chi Minh City, Vietnam. In-situ climatic measurements were conducted in August, focusing on air temperature, surface temperature of adjacent walls, and radiant heat emissions from active AC outdoor units of 296 houses. Observations were paired with behavioral data indicating residents' willingness to use the balcony under different thermal conditions. Results reveal that balcony environments frequently exceed strong heat stress thresholds during daytime hours, driven by direct solar gain on facades and waste heat from outdoor units. Facade orientation and proximity to mechanical units were found to significantly influence the microclimate at occupant level. Most residents avoided using balconies during peak hours, identifying heat from outdoor units as a major discomfort factor. The findings highlight the need to reconsider mechanical unit placement, facade material choices, and shading strategies in balcony design. This study contributes to a growing body of knowledge on climate-responsive residential architecture in tropical regions, emphasizing the integration of mechanical systems and passive design to restore balcony usability and improve occupant well-being.

Keywords: *Balcony, heat stress, facade heat, outdoor air-conditioning unit, Ho Chi Minh City.*

Heritage and Modernity: Lessons from French Colonial Catholic Church Architecture in Northern Vietnam

Nguyen Van Vu[1], Nguyen Viet Huy[2], Do Trong Chung[2]

[1] Friendly Architecture Joint Stock Company, Hanoi, Vietnam
[2] Hanoi University of Civil Engineering, Hanoi, Vietnam

huynv@huce.edu.vn

Abstract. This study examines the role and value of Catholic churches built in the Northern Delta during the French colonial period, aiming to draw lessons for the modernization of church design. Through a survey of representative structures such as Phat Diem, Trung Lao, So Kien, and Dai On churches, the research indicates that these churches are the result of an intersection between European and indigenous architecture: materials, roof structures, spatial organization, and decorative motifs. The article argues that instead of viewing French colonial church architecture as heritage to be preserved, it should be considered as design documentation – a place where a hybrid architectural language can develop in a contemporary context. Modernizing church design does not equate to "Westernization," but rather a continuous, selective creative process, blending tradition and modernity, indigenous and globalized elements. Based on this, several design principles are proposed for contemporary Catholic churches in Vietnam, aiming to ensure harmony between sacredness, cultural identity, and modern technology.

Keywords: *Catholic church, French colonial period, Northern Vietnam, indigenous, hybrid, heritage preservation, Gothic, Baroque, Romanesque.*

Hybrid Structural Solutions for Vernacular-Inspired Designs in Community Cultural Halls: A Case Study in Lam Dong, Vietnam

Nhu-Phuc Nguyen[1[0009-0004-4717-8807]], Tuan-Kiet N.Phan[1[0009-0000-9610-9251]], Gia-Bao Tran[1[0009-0008-2821-0735]], Van-Bang To[1[0009-0002-7507-981X]] and Tran-Trung Nguyen[1[0000-0003-4532-1652]]

[1] Faculty of Architecture, Van Lang University, 69/68 Dang Thuy Tram Street, Binh Loi Trung Ward, Ho Chi Minh City, Vietnam

trung.nt@vlu.edu.vn

Abstract. Rapid urbanization and the decline of traditional architectural methods pose urgent and complex challenges to the preservation of vernacular identity in rural and indigenous communities. This work examines hybrid structural techniques that integrate traditional materials—mainly bamboo and wood—into novel support systems for culturally expressive buildings. This research emphasizes the distinctive high-rise pitched roofs of community culture halls, drawing inspiration from the nhà rông typology of Vietnam's Central Highlands. It suggests bamboo-based arching frameworks and modular building methods as a contemporary reinterpretation of traditional forms. A case study in Lam Dong Province functions as a framework for evaluating structural performance, local material accessibility, and building viability. The study assesses load-bearing efficiency, spatial symbolism, and environmental sustainability through comparative modeling of modular bamboo slats, trussed frameworks, and lightweight shell constructions. Results indicate that bamboo-wood hybrid systems provide an effective combination of safety, durability, cultural authenticity, and ecological awareness. This method preserves local spatial identity while empowering communities through participatory construction techniques and flexible design frameworks tailored for rural rejuvenation.

Keywords: *Bamboo-Timber Hybrid Structure, Cultural Sustainability, Community Cultural House, Community space, Lâm Đồng (Vietnam), Modular Construction, Vernacular-Inspired Design.*

Lighting as medium for Storytelling in Interior Architecture Space: Exhibition-Based Study of Interior Design Students at UAH

Vinh Nguyen Huu[1] and An Nguyen Thi Tam[2]

[1] Faculty of Interior Architecture, University of Architecture, HCMC
[2] Faculty of Interior Architecture, University of Architecture, HCMC

an.nguyenthitam@uah.edu.vn

Abstract. In interior architecture, lighting is one of key elements, playing an important role in shaping not only the spatial composition but also emotional experience. This element impacts both the visual and symbolic aspects of a space as well as influence on the user physically and psychologically. Therefore, lighting should be considered as a technical component, but as a medium in storytelling and identity-expression within interior spaces. This paper is situated within the context of lighting design education at the Faculty of Interior Architecture (FIA), University of Architecture Ho Chi Minh City (UAH). The aims of this paper include to explore how interior design students at UAH use lighting as a medium for spatial storytelling within interior exhibition spaces; to analyze the narrative strategies employed in student-designed lighting installations to express themes such as well-being, optimism, and identity, as well as investigate how lighting-based spatial storytelling contributes to design learning and pedagogical development in interior design education. The research methodology includes literature review of academic sources, collecting data by visual observation, qualitative analysis of student work, and survey-based reflection through exhibition conducted at UAH. Findings offer insights into improving lighting design pedagogy and highlight the potential of lighting as a storytelling tool in space.

Keywords: *Storytelling tool, lighting medium, interior architecture space, design education*

Modernizing Vernacularity In Public Interior Design: An Approach From Lê Trung Hưng Woodcarving Aesthetics

Thanh Trung Quang[1] and Huy Nguyen Viet[2]

[1] Vietnam National University, Hanoi- School of Interdisciplinary Sciences and Arts, VIETNAM
[2] Hanoi University of Civil Engineering, VIETNAM

huynv@huce.edu.vn

Abstract. The paper proposes an approach to vernacular modernization in the interior design of contemporary public buildings through the study and transformation of the aesthetic values of woodcarving art of the Lê Trung Hưng period—a distinctive heritage of village communal house architecture in the Red River Delta of Northern Vietnam. Based on the analysis of morphological, symbolic, technical, and decorative structural elements in traditional woodcarving art, the research demonstrates the potential for creatively and systematically transferring these values into contemporary design. By juxtaposing the design language of tradition and modernity, the paper argues that elements such as rhythm, form, folk symbolism, and natural materials can function as "genetic codes" within the structure of modern interiors, thereby contributing to the creation of local identity in urban public spaces. The study also proposes a set of design principles structured across three levels of transformation: (1) morphology and structure, (2) materials and craftsmanship, and (3) symbolism and function.

Keywords: *Vernacular Architecture, Vernacular Modernization, Traditional Woodcarving, Woodcarving Art in the Lê Trung Hưng Period, Interior Design of Public Buildings.*

Mapping Balcony Morphology in Ho Chi Minh City: Identity, Use, and Thermal Performance

Bach Huynh Huu[1][0009-0000-6428-3415] and Hanh Vu Thi Hong[1][0009-0005-4327-2721]

[1] University of Architecture Ho Chi Minh City, 196 Pasteur, Xuan Hoa Ward, Ho Chi Minh, Viet Nam

22kt03@uah.edu.vn

Abstract. In high-density, heat-vulnerable cities like Ho Chi Minh City (HCMC), balconies operate as both microclimatic buffers and social extensions of living space. This study investigates how balcony design impacts both thermal performance and urban social function, using clustering-based morphology mapping to identify typical balcony genotypes. A detailed dataset at HCMC was compiled, covering orientation, elevation, floor height, WWR, width, depth, railing height, solidity, transparency, enclosure, shape, and type. Findings reveal diverse genotypes with varied thermal behavior—shading, orientation, and enclosure reduce overheating—but social use is influenced more by intent than comfort. Enclosed balconies support resting or working; open balconies are used for drying or short tasks. The study identifies a large number of second-floor balconies obstructed by signage and repurposed as storage or being abandoned, which altered the balcony spatial expression. This transformation removes them from public life, reducing their contribution to the urban social environment. The research underscores balconies as climate and culture interfaces—and highlights how design misuse can sever that connection.

Keywords: *Balcony Morphology, Urban identity, Tube housing, Ho Chi Minh City.*

Quan Ho villages of Bac Ninh – Cultural heritage and architectural values for conservation and sustainable tourism development

Nguyen Dinh Phong[1] [0009-0002-7343-8452], Dang Hoang Vu[1] [0009-0008-6555-1096], and Khuat Tan Hung [1] [0009-0004-5357-9957]

[1] Faculty of Architecture, Hanoi Architectural University, Vietnam

phongnd@hau.edu.vn

Abstract. Exploiting the value of traditional architectural heritage through tourism is an important strategy, bringing many benefits to both local communities and tourists. Heritage tourism helps to preserve, conserve and promote the cultural, historical and architectural values of an area, and is also a path for sustainable development: creating jobs, raising awareness of the community and tourists about heritage. The article identifies the role and value of traditional Quan Ho villages in Bac Ninh province from the perspective of cultural and architectural heritage. From there, the study proposes solutions to exploit the value of Quan Ho villages to develop a sustainable tourism economy and also an opportunity to preserve traditional heritage villages.

Keywords: *Heritage conservation, Traditional village, Quan Ho village, Cultural tourism, Sustainable development.*

Space - Time - Identity: Repositioning The Architectural Values Of Northern Vietnam (1954 – 1986) In The Contemporary Context

Dang Hoang Vu[1] [0009-0008-6555-1096] and Nguyen Dinh Phong[2] [0009-0002-7343-8452]

[1] PhD, Faculty of Architecture, Hanoi Architectural University, Hanoi, Vietnam.
[2] PhD, Faculty of Architecture, Hanoi Architectural University, Hanoi, Vietnam.

[1]vudh@hau.edu.vn | Tel: +84 904 005 030
[2]phongkts@gmail.com | Tel: +84 912 417 410

Abstract. Northern Vietnamese architecture from 1954 to 1986 offers a wealth of valuable insights still relevant today. This article identifies and systematizes the distinctive architectural values of this era to inform current design. It analyzes key aspects such as planning, spatial organization, façade, structure, materials, and ornamentation, based on surveys of representative buildings from that period. Conducted within the 2022–2024 research project "Preserving, Promoting, and Renewing Traditional Values in the Development of Vietnamese Architecture," this study proposes ways to integrate traditional values into contemporary design. The research clarifies the significance of this important phase in Vietnamese architectural history, providing both theoretical and practical foundations for crafting sustainable, culturally-aware architecture in a global context.

Keywords: *Modern Vietnamese architecture; Northern Vietnam 1954 - 1986; traditional values; architectural preservation; contemporary architecture*.

Study the performance of natural ventilation in free-running houses in Ho Chi Minh City, Vietnam

Hung Thanh Dang[1][0000-0002-3285-257X] and Nigel Downes[2][0000-0002-5570-5724]

[1] Faculty of Architecture, University of Architecture Ho Chi Minh City, 196 Pasteur, Xuan Hoa, Ho Chi Minh City, Vietnam
[2] College of Environment and Natural Resources, Can Tho University, Can Tho, Vietnam

hung.dangthanh@uah.edu.vn

Abstract. Exposed to a prevailing warm and humid climate, Vietnamese residents delightfully live in open spaces with a close connection to nature and natural ventilation. For example, ancient houses feature open layouts and sponge structures with multiple layers to promote passive and consistent airflow between indoor and outdoor environments. These designs result in supporting human comfort, well-being, and strong environmental interactions. However, those have been disrupted over time by rapidly negative changes in outdoor environments, especially in large cities, due to global warming and the urban heat island effect. Both environmental shifts have influenced housing design preferences, occupants' behavioural adjustments in adapting and operating cooling means, and their level of tolerance to warming conditions. At the same time, urban densification has also restricted the effect of airflows in open houses. The paper studies the performance of natural ventilation in free-running houses in Ho Chi Minh City through on-site investigations and physical measurements of both dwelling structures and environmental conditions. Findings reveal a conflict in environmental relationships between thermal and air movement parameters. While thermal values showed strong correlations, airflow was less predictable. Indoor wind conditions were generally insufficient and unacceptable to maintain human comfort in naturally ventilated homes. Meanwhile, the outdoor wind flow remained beneficial for cooling. These results underscore the need for current and future housing designs to better adapt to changing urban environments. Ensuring adequate airflow is crucial in supporting residents' comfort, health, and well-being in increasingly dense cities.

Keywords: *Free-running houses, Natural ventilation, Comfort, Energy use, Ho Chi Minh City.*

Tiny house: an infill development opportunity in Ho Chi Minh City, Viet Nam

Ta Quang Hai [1] and Duong Dong Hung[1]

[1] University of Architecture Ho Chi Minh City, HCMC, Viet Nam

hai.taquang@uah.edu.vn

Abstract. Changes in lifestyles are among the key factors driving the transformation of contemporary housing models. In response to the significant environmental impact caused by conventional housing construction and consumerist lifestyles, tiny houses, or micro-housing solutions, have attracted increasing global attention in both academic research and practical design. These compact housing types offer notable advantages such as affordability, efficient land use, and adaptability, making them particularly suitable for dense urban areas and for individuals pursuing minimalist lifestyles. This theoretical study introduces the concept of infill tiny houses and examines their potential implementation in the context of Ho Chi Minh City. It proposes design guidelines that take into account the city's climate conditions, cultural characteristics, and socio-economic realities. In the face of rising housing demand and limited land resources, micro-housing presents a promising and complementary role alongside existing housing models. It offers a sustainable approach that minimizes environmental impact, adapts to changing lifestyle needs, and provides an affordable solution to urban housing challenges.

Keywords: *Tiny House; Micro-housing; Infill; Housing Model; Affordable Housing; Multifunctional Space; Minimalist Lifestyle*.

Transforming Tradition: Adaptive Design of Transitional Spaces in High-Rise Apartments in Ho Chi Minh City

Kiet Nguyen Anh Tran [1] and Hanh Thi Hong Vu [2]

[1] Binh Duong University, No. 504 Binh Duong Avenue, Phu Loi Ward, HCMC, Vietnam
[2] University of Architecture Ho Chi Minh City, 196 Pasteur, Xuan Hoa Ward, HCMC, Vietnam

hanh.vuthihong@uah.edu.vn

Abstract. Rapid urbanization in Ho Chi Minh City underscores the urgent need to improve living quality and promote sustainable urban development. Current planning trends increasingly favor green, human-centered approaches responsive to local conditions. In this context, transitional spaces in high-rise apartment architecture play a critical role in mediating between public and private realms and enhancing residential quality. Focusing on mid-rise apartment buildings (≤25 floors, 80–100 m^2 units), this study proposes design strategies that adapt and transform traditional architectural elements-such as thresholds, semi-open spaces, and community-oriented circulation-into contemporary housing models. The research employs a qualitative design methodology, combining field surveys, spatial analysis, and typological comparisons of local housing models. This process informs the development of an adaptive design framework that integrates traditional transformation into contemporary architecture, contributing to sustainable, human-centered urban living in Vietnam.

Keywords: *Adaptive design, Tranditional Space, Expanded Functional Spaces (EFS), Adaptable or Evolving Functional Spaces (AFS), Integrated Green Spaces (IGS), High-rise Apartment, Ho Chi Minh City.*

Typology of Modernist Dwelling in the Central Ho Chi Minh city

Duong Quoc Viet[1][0009-0008-6883-0883] , Huynh Minh Thuan[2][0009-0009-7863-6475] and Vu Thi Hong Hanh[3][0009-0005-4327-2721]

[1] Hong Tin Construction Trading Service, Vietnam
[2] PAU Architecture and Construction Consultancy, Vietnam
[3] University of Architecture Ho Chi Minh City, Vietnam

hanh.vuthihong@uah.edu.vn

Abstract. Between 1954 and 1986, modernist architecture in Ho Chi Minh City developed in diverse forms, reflecting architectural thinking shaped by the principles of international modernism while being creatively adapted to tropical climatic conditions and selectively integrating vernacular traditions. Beyond public and institutional buildings such as administrative offices, schools, religious structures, and cultural facilities, modernist design found its most tangible and intimate expression in residential architecture—where modernist ideals were reconciled with the practical realities of everyday urban life. Representative dwelling types-such as villas, townhouses, shophouse and low-rise apartments—are expressed through spatial organization, façade design, and construction methods. Each typology demonstrates a distinct approach to the urban context and historical conditions, revealing the depth of modernist thinking in Vietnamese residential design. Identifying and analyzing these housing typologies offers a clearer understanding of how modernist architecture was applied to everyday living spaces in Saigon, marked by significant characteristics shaped through cultural, economic, and socio-political lenses.

Keywords: *Typology, Modernist Architecture, Function, Transformation, Tropical Adaptation, Ho Chi Minh City.*

Preserving the traditional values of Cham jewelry art in contemporary design

Anh Tram Thi Nguyen[1]

[1] Van Lang University, No.69/68, Dang Thuy Tram St., Binh Loi Trung Ward, HCMC, Vietnam

anh.nguyenthi@vlu.edu.vn

Abstract. In the overall view of Champa's art; Jewelry is a significant art form that plays a considerable role in identifying the national identity. The existence and development of jewelry are closely linked to the historical context, creating unique characteristics and meanings in its forms. These characteristics reflect the daily life, religion, customs, and beliefs of the Champa people throughout history. Most notably, the jewelry carries elements of fertility and Totemism, as well as symbolic and natural images from the daily lives of the Champa people. Currently, traditional Champa jewelry is becoming increasingly rare, and the traditional crafting techniques are being lost. Therefore, it is essential to preserve and promote the value of traditional jewelry in contemporary jewelry design, while still maintaining the distinctive and recognizable identity of the Champa people. This research is based on fieldwork, survey, describe, inquire case study analysis, data collection and experimentation to address the urgent issue of Champa traditional jewelry making. From there, it proposes a number of suitable solutions to preserve traditional values, promote brocade art, and combine it with contemporary Champa jewelry.

Keywords: *Champa, Contemporary Design, Jewelry Art, Identity, Identity, Tradition.*

Sustainable Fashion Development in Vietnam: Integrating Recycled Materials, Clean Technologies, and Circular Economy Models

Nguyen Thi Ngoc Quyen

Faculty of Architecture and Arts, HUTECH University, Vietnam

nt.quyen@hutech.edu.vn

Abstract. Vietnam's fashion industry, the world's third largest by export value, faces increasing pressure to reduce its environmental impact. This study proposes the 3V framework—Green Materials, Circular Lifecycle, and Sustainable Culture—to guide sustainable transformation. We evaluate its effectiveness through (i) a cradle-to-gate life-cycle assessment (LCA) of a 220 g knit T-shirt and (ii) a cross-sectional survey of 68 textile SMEs. Substituting 60% conventional cotton with recycled PET (rPET) lowers global warming potential by 42% (7.9 to 4.6 kg CO_2-eq) and reduces blue-water consumption by 58%, demonstrating material substitution's significant role in achieving Vietnam's net-zero fashion target by 2050. Survey results identify major barriers including high rPET costs (mean = 4.31/5), limited access to measurement tools (mean = 4.05), and certification challenges. Additionally, a pilot educational module enhances sustainability literacy among undergraduates by 34.7%, indicating consumer mindset shifts are achievable through targeted interventions. These findings validate the 3V framework as a scalable roadmap for advancing sustainable fashion in Vietnam via integrated actions on materials, processes, and cultural awareness.

Keywords: *Sustainable Fashion, Circular Economy, Recycled Materials, Clean Production Technologies, Life Cycle Assessment (LCA), Green Supply Chains.*

A New Approaching Framework for Assessing the Quality of Open Public Spaces in Ho Chi Minh City

Hai Truong Thanh [1][0000-0003-0703-2948]

[1] University of Architecture Ho Chi Minh City, Viet Nam

hai.truongthanh@uah.edu.vn

Abstract. Open public spaces play a crucial role in enhancing quality of life, fostering social cohesion, and supporting sustainable urban development. In Vietnam, the rapid increase of urbanization has created an urgent need for a comprehensive assessment framework to measure and improve the quality of these spaces. This paper proposes a new approaching framework for assessing the quality of open public spaces, grounded in the synthesis of international theories and the practical context of Vietnam. The research methodology includes literature analysis, field surveys in major cities, and expert consultations in the fields of architecture, urban planning, and sociology. The findings result in the development of an assessment framework consisting of five main groups of criteria: (i) accessibility and connectivity, (ii) functions and flexibility, (iii) facilities and supporting services, (iv) socio-cultural identity, and (v) ecological–sustainability. This framework not only provides a scientific basis for academic research but also serves as a practical tool to assist policymakers and urban designers in planning and improving public spaces in Vietnam.

Keywords: *Open public space; Quality assessment; Urban design; Vietnam; Sustainability.*

Adaptive development of port-ecological urban systems in coastal cities: the case of Thi Nai Lagoon, Quy Nhon.

Ha Huy Thach [1], Pham Ngoc Tuan[1], Le Nguyen Viet Lam[1] and Dinh Binh Phuong Minh[1]

[1] Ho Chi Minh City University of Architecture

thachurb@gmail.com

Abstract. Port-ecological urban systems in coastal cities have rapidly evolved due to urbanization and global trade through maritime supply chains. Assessing the dynamics and development mechanisms of port cities within coastal contexts helps us understand urban adaptation to future pressures and supports the creation of analytical frameworks for sustainable development. Thus, this study proposes the Adaptive Model as an analytical framework for port city development, using Quy Nhon's urban area in Thi Nai Lagoon as an empirical case study. The findings reveal: (1) From its establishment to 2024, Quy Nhon' urban has transformed from a simple transport hub relying on natural resource exploitation into a complex adaptive system integrating natural and urban social spaces; (2) The diverse functions of the urban system play a crucial role in its development, while leveraging social factors to drive urban reorganization and innovation; (3) Through the Panarchy framework, urban spaces surrounding Thi Nai Lagoon act symbiotically to promote the lagoon's sustainable development. This study contributes to the theory of urban development adaptability by providing an analytical framework for the sustainable use of natural resources in port cities. It also offers new perspectives on integrating cultural and natural development, adaptive urban planning, and maritime economy, helping port cities enhance their adaptability and mitigate potential risks, helping port cities prepare for future uncertainties and capitalize on emerging opportunities in global trade, tourism, and urban expansion.

Keywords: *resilience ; port-ecological urban ; adaptive development*

Analysing the Potential of the 15-Minute City Model for Urban Space Restructuring in Vietnam

Vo Trong Nghia[1,2] [0009-0004-4064-1096]

[1] University of Social Sciences and Humanities, Ho Chi Minh City, Vietnam
[2] Vietnam National University, Ho Chi Minh City, Vietnam

votrongnghia@hcmussh.edu.vn

Abstract. The 15-minute city (15MC) has become a prominent model in contemporary urban planning, emphasising proximity-based access to housing, employment, services and green space. While adopted in high-income contexts such as Paris, Melbourne and Singapore, its applicability in rapidly urbanizing countries remains understudied. This paper reviews the theoretical foundations of the 15MC in relation to transit-oriented development, smart growth, resilience and spatial justice and synthesizes international experiences to identify governance instruments, planning tools and mobility strategies that support proximity-based restructuring. A systematic bibliometric and narrative review was applied, drawing on global literature, policy frameworks and statistical evidence to assess relevance for Vietnam. Results show that urban growth, motorcycles and weak governance limit the model, yet opportunities exist through integrated service hubs, multimodal mobility and institutional reforms. The study concludes that the 15MC can advance more equitable, resilient and sustainable transformation when aligned with the 2024 Law on Urban and Rural Planning and Sustainable Development Goal 11. By placing proximity-based urbanism in emerging economies, the paper contributes both conceptual refinement and policy implications.

Keywords: *15-minute city, mixed use neighbourhoods, proximity-based planning, smart growth, spatial justice, urban restructuring, Vietnam*

Application Flood-Sensitive Urban Design Based on the Hydrological System: A Case Study in Huong River Basin, Hue urban, Vietnam.

Nguyen Quoc Thang[1], Dam Thu Trang[2] and Pham Anh Tuan[3]

[1] Faculty of Architecture, Hue University of Sciences, Hue University, Hue, Vietnam; Nguyen Quoc Thang was funded by the Master, PhD Scholarship Programme of Vingroup Innovation Foundation (VINIF), code VINIF.2024.TS100;
[2] Institute of Conservation and Sustainable Development, Hanoi University of Civil Engineering, Hanoi, Vietnam
[3] Department of Landscape Architecture, Faculty of Architecture and Planning, Hanoi University of Civil Engineering, Hanoi,

gvnqthang@husc.edu.vn

Abstract. Huong River Basin, in Hue urban, located in central Vietnam, has a unique landscape associated with this river, as well as being seriously affected by annual flooding. Mechanical measures of raising the foundation or building dikes to prevent floods have not been effective in regulating floods. In addition, the potential of the hydrological system with the characteristic of water-bearing depressions has not been significantly exploited. This paper aims to determine the characteristics of flow morphology according to elevation, terrain slope, and soil as well as the water retention capacity of each sub-basin to show evidence for the application of sustainable flood-sensitive urban areas based on the characteristics of water-bearing depressions interconnecting to the hydrological network in the study area, which will both favor regulate floods and promote the urban landscape identity.

Keywords: *Flood, Flood-Sensitive Urban Design, Hydrological system, Landscape infrastructure, Biophysical factor, Basin*

Applying GIS to Enhance the Effectiveness of Planning for Industrial Zones and Industrial Clusters in Hanoi, Vietnam

Phuong M.T. Le[1] [0009-0003-3534-6044], Huong T.D. Nguyen[2] [0009-0005-3809-3315] and Anh Le Vu [3] [0009-0009-7544-5067]

[1,2,3] Hanoi Architectural University, Vietnam

leminhphuong@hau.edu.vn; huongntd@hau.edu.vn; anhvule@hau.edu.vn

Abstract. This paper presents a methodology for developing a comprehensive GIS database to support industrial park and industrial cluster planning in Hanoi, Vietnam. The study systematically collects, standardizes, and integrates spatial and attribute data from multiple sources, including current land-use surveys, statistical records, and administrative inventories. A structured geodatabase was designed incorporating key thematic layers—administrative boundaries, land use, transportation networks, and industrial facility information—organized within the VN-2000 coordinate system framework. This database architecture enables planners to perform spatial queries, overlay analysis, and data visualization for evidence-based planning decisions. The resulting GIS platform provides an integrated view of both spatial and attribute data, facilitating more efficient and transparent planning processes for industrial parks and clusters. The methodology developed in this study demonstrates replicability potential for application in other Vietnamese provinces seeking to modernize their industrial planning frameworks through geospatial technologies.

Keywords: *Geographic Information System (GIS), Evidence-based planning, industrial parks, Industrial clusters, Sustainable development.*

Better Planning of the Bus Network to Support Transit-Oriented Development in Ho Chi Minh City

Chinh Q. Ho[1][0000-0001-8006-0123], Long X. Nguyen[2], Nguyen L. Q. Tram[3]

[1] Institute of Transport and Logistics Studies, The University of Sydney Business School, NSW 2006 Australia
[2] Faculty of Civil Engineering, Ho Chi Minh City University of Technology (HCMUT), 268 Ly Thuong Kiet Street, District 10, Ho Chi Minh City, Vietnam
[3] Vietnam National University Ho Chi Minh City, Linh Trung Ward, Thu Duc District, Ho Chi Minh City, Vietnam

chinh.ho@sydney.edu.au

Abstract. Transit-Oriented Development (TOD) seeks to integrate land use and transport to promote sustainable urban growth, yet its success depends critically on the structure and performance of public transport networks. In Ho Chi Minh City (HCMC), where the bus system remains the dominant mode despite the opening of Metro Line 1 and the construction of Line 2, the effectiveness of TOD will rely on how well buses complement emerging rail services. This paper develops the first validated General Transit Feed Specification (GTFS) dataset for HCMC and applies it to evaluate the bus network against four established planning principles: spatial coverage, service frequency, route simplicity, and route directness. Spatial and network analyses reveal strengths in route legibility and directness but highlight deficiencies in frequency, temporal coverage, and integration with metro stations. Several routes run parallel to the metro, diverting scarce resources from underserved areas. The findings demonstrate the need to restructure bus services as feeders and circumferential links that enhance first–last mile access and support densification around rail corridors. By bridging a critical data gap and providing a replicable analytical framework, this study offers practical guidance for aligning bus planning with TOD objectives in HCMC and similar rapidly developing cities.

Keywords: *Transit Oriented Development, Bus Network Planning, HCMC, Integrated Transport Network, GTFS.*

Designing Urban Identity for Sustainable Development in Vietnam

Ha Nguyen Thi Viet[1] [0009-0008-1797-7949]

[1]University of Architecture Ho Chi Minh City (UAH), Vietnam

ha.nguyenthiviet@uah.edu.vn,

Abstract. Urban identity is increasingly recognized as a foundational dimension of sustainable urban development, particularly in transitional Vietnamese cities undergoing rapid globalization and administrative restructuring. Yet, its integration into planning remains limited and fragmented. This study adopts a design-oriented perspective, framing urban identity as a strategic tool to strengthen cultural distinctiveness and enhance community resilience. Tay Ninh Province and Ho Chi Minh City are examined as case studies to illustrate how spatial design and policy alignment can preserve and activate local identity. Grounded in theories of cultural sustainability and creative urbanism, the research conceptualizes urban identity as a form of "soft value" - an iconic and participatory infrastructure shaping perceptions of culturally embedded space. Employing qualitative methods including document analysis, field observation, and design experiments, the study identifies three key mechanisms for embedding identity into urban planning: (1) coherent visual communication systems, (2) culturally oriented public space design, and (3) bottom-up community co-creation. Findings indicate that fragmented visual environments, generic development patterns, and weak civic engagement undermine identity in both contexts. Conversely, integrated design frameworks and grassroots creative ecosystems can drive sustainable spatial and social transformation. The study recommends institutionalizing urban identity as a formal pillar of Vietnamese urban planning - bridging physical infrastructure, cultural narratives, and active citizen participation to shape inclusive, resilient, and future-ready cities.

Keywords: *urban identity, sustainable urbanism, cultural planning, creative city, Vietnam, participatory design, visual communication.*

Determining Land Cover Transformation Trend in the Huong River basin, Hue urban, Vietnam.

Nguyen Quoc Thang [1], Dam Thu Trang [2] and Pham Anh Tuan[3]

[1] Faculty of Architecture, Hue University of Sciences, Hue University, Hue, Vietnam
[2] Institute of Conservation and Sustainable Development, Hanoi University of Civil Engineering, Hanoi, Vietnam
[3] Department of Landscape Architecture, Faculty of Architecture and Planning, Hanoi University of Civil Engineering, Hanoi, Vietnam

gvnqthang@husc.edu.vn

Abstract. Urbanization has significantly altered the land cover (LC) of the Huong River basin, spanning an area of 22682.6 ha, comprising 12 sub-basins, including the area around Hue city in central Vietnam. The most visible LC changes are in the northern and southern Huong River sub-basin are 35.7% and 42.3 %, in the Buffer sub-basins of Ta Trach and Huu Trach are 58.8 % and 42.2 %, in the Southern and Northern Lagoon-Sea-sub-basins are 46,7 % and 48 % respectively, oppositely the Ta Trach and Huu Trach Sub- basins in the upstream have the least change rate (17.8% and 3%). By analyzing LC change over 20 years, this research identifies two LC Transformation trends in the study area: The Constant LC accounts for 42% of the total research area, including evergreen forests, rice, and shrubs, thanks to the corresponding biophysical factors such as terrain, climate type, and hydraulic that significantly affect the formation of these. Their spatial distributions closely align with terrain features. Mountainous areas are occupied by evergreen forests (pure mosaic), hilly zones feature a mix of forests and shrublands (mixed mosaic), plains are mainly agricultural land (pure mosaic), and lagoon areas combine water and rice (aquatic-leaning mosaic). On the other hand, the Variable LC includes a significant increase in settlement, aquaculture, and shrub, as well as a decrease in water, deciduous, and barren, reducing the basin's ecological resilience and water regulation ability, which needs to be controlled and limited by supplementing the missing landscape infrastructure factors that we have identified in each sub-basin. Therefore, this study provides important clues to determine the invariant urban landscape morphology to be promoted and promptly adjust negative changes for sustainable urban development.

Keywords: *Land cover; Land Cover Transformation Trend, Constant Land Cover, Variable Land Cover, Landscape infrastructure, Biophysical, Urban landscape morphology*

From LULC Transitions to Drought Adaptation: Linking Urban Fragmentation with NDVI-LST Dynamics in Phan Rang-Thap Cham City, Ninh Thuan Province (currently Khanh Hoa Province)

Nguyen Quoc Vinh[1,2*] and Pham Linh Dan[1,2] [0009-0006-5743-5859]

[1] Faculty of Civil Engineering, Ho Chi Minh City University of Technology (HCMUT), 268 Ly Thuong Kiet Street, Dien Hong Ward, Ho Chi Minh City, Vietnam
[2] Vietnam National University Ho Chi Minh City, Linh Xuan Ward, Ho Chi Minh City, Vietnam

*vinh.bmkt@hcmut.edu.vn

Abstract. Rapid urbanization has transformed land use and exacerbated climate change impacts, intensifying drought risk in arid regions. This study investigates how land use/land cover (LULC) transitions within urban fragments influence the relationship between land surface temperature (LST) and the normalized difference vegetation index (NDVI), thereby shaping drought adaptation capacity. Using multi-temporal Landsat imagery (1988, 2005, 2021) for Phan Rang-Thap Cham City, LULC maps were derived and correlated with NDVI and LST to construct a Drought Adaptation Index (DAI). The findings demonstrate a strong inverse correlation between NDVI and LST, highlighting that vegetation loss and compact urban expansion substantially increase surface temperature and reduce adaptive capacity. Over time, DAI values declined sharply in the urban core (0.41 → 0.15) and urban expansion zones (1.00 → 0.20), indicating heightened vulnerability, while suburban areas maintained relatively high adaptation levels. These results confirm that the dynamics of urban fragmentation, expressed through LULC transitions, critically determine drought resilience. Integrating NDVI-LST indicators into spatial planning provides a robust framework for enhancing urban adaptive capacity and informing climate-resilient development strategies in drought-prone cities.

Keywords: *Urban fragmentation dynamics; LULC transitions; NDVI-LST relationship; Drought adaptation index; Phan Rang-Thap Cham.*

Adaptive Futures for Cu Lao Pho: Integrating Floating Villages into Urban Transformation

Vu Thi Hong Hanh[1] and Nguyen Ly Bao Ngoc[2]

[1] University of Architecture Ho Chi Minh City
[2] Institute of Postgraduate Training – Urban and Regional Planning, University of Architecture Ho Chi Minh City

hanh.vuthihong@uah.edu.vn; 24qh15@uah.edu.vn

Abstract. Cu Lao Pho (CLP), a historic urban island with over 300 years of development, is located in the heart of Bien Hoa and is currently undergoing rapid urbanization driven by increasing migration. A defining feature of this area is its floating village—a unique form of riverine settlement on the Dong Nai River. These communities, shaped by traditional livelihoods such as cage fish farming and life on raft houses, contribute not only to the local economy but also to the preservation of a distinctive river culture. However, the sustainability of these floating villages is increasingly threatened by challenges such as water pollution, environmental degradation, seasonal flooding, and mounting urban development pressures. This paper explores the spatial, socio-economic, and cultural values embedded within these floating communities and proposes strategies for their sustainable conservation. It also examines the potential to integrate floating settlements into future urban and landscape planning frameworks, highlighting both the challenges and opportunities in the broader context of CLP's urban transformation.

Keywords: *Floating villages,, cultural heritage, raft houses, climatic adaption, urban resilience, cultural tourism, adaptive conservation*

Integrating Blue Economy and Logistics into Coastal Urban Planning: A Strategic Framework for Sustainable Development in Binh Khanh, Can Gio, Vietnam

Dinh Binh Phuong Minh[1], Ha Huy Thach[1], Le Anh Duc[2], Pham Ngoc Tuan[1]

[1] University of Architecture of Ho Chi Minh City, HCMC, Vietnam
[2]Van Lang University, HCMC, Vietnam

phuongminhdinh83@gmail.com

Abstract. Coastal urban areas drive economic growth-imposing significant strain on marine ecosystems, transportation networks, and infrastructure. To address these impacts, the Blue Economy promotes sustainable ocean resource use, fostering economic growth while preserving biodiversity. Although extensively implemented in fisheries, marine energy, coastal tourism, and maritime transportation, its integration into city for logistics planning remains an unexplored domain. This research bridges the gap by examining Binh Khanh, Can Gio in Ho Chi Minh City, a key node in regional economic networks, logistics hubs, and transport corridors. The study then pursues three objectives: (1) assessing Binh Khanh's spatial, ecological, and infrastructural conditions to understand urban-coastal interactions; (2) developing a strategic framework that integrates Blue Economy principles into urban logistics planning; and (3) proposing an integrated spatial model and strategies for Binh Khanh towards Blue Economy. Key strategies include offshore renewable energy integration, strengthening maritime trade routes, and decentralizing coastal supply chains to enhance regional connectivity. Blue corridors, combining eco-sensitive development zones and sustainable transport pathways, reinforce long-term ecological stability. The spatial planning model applies data-driven mapping to optimize logistics while preserving fragile biosphere of Can Gio Mangrove. This scalable and adaptable proposal extends beyond Binh Khanh to offer a forward-thinking approach, ensuring coastal urban expansion remains sustainable, equitable, and resilient for decades to come.

Keywords: *Blue economy, City logistics, Urban planning, Strategic framework.*

Integrating Nightscape Theory into Urban Design and Planning: A Theoretical Approach to Enhancing the Nighttime Economy in Ho Chi Minh City

Thuy Trang Luong[1][0009-0000-8033-5190] and Thuc Trang Dang[2][0000-0002-5097-4095]

[1] Hanoi Architectural University
[2] Scene Plus Architects

lttrang.hau@gmail.com

Abstract. This literature review–based paper examines how nightscape theory—integrating environmental, perceptual, and socio-economic perspectives—can be operationalized into practical planning tools, while identifying theoretical gaps in the current spatial planning framework of Ho Chi Minh City. Through an analysis of three international case studies (Ghent's Lighting Plan, France's Trame Noire, and Lyon's Lighting Master Plan), the paper demonstrates that integrating nightscape principles produces measurable outcomes, including 30–50% energy savings, increased tourism revenue, and enhanced biodiversity protection. These cities have successfully operationalized nightscape principles through specific planning criteria, clear governance frameworks, and interdisciplinary approaches. The paper repositions nightscape from a descriptive concept to an integrated analytical framework for Ho Chi Minh City and proposes a phased implementation pathway encompassing institutional capacity building, interdisciplinary coordination mechanisms, and integration into statutory planning instruments. This research contributes to narrowing the theory–practice gap in the context of expanding night-time economies, where evidence-based spatial planning approaches are increasingly necessary.

Keywords: *Nightscape, night-time economy, urban planning, sustainable development, Ho Chi Minh City.*

Kon River Basin - A Landscape to Be Shared by Tourists

Rute Sousa Matos[1] [0000-0002-7715-0256] Huyen Thi Nguyen[2] [0000-0001-5780-8869] Phan Thi Le Thuy [2] [0000-0001-7381-8864] and Tho Van Phan[2] [0000-0002-0887-5966]

[1] University of Évora - CHAIA, Largo Marquês de Marialva 8, 7000-809 Évora, Portugal

rsm@uevora.pt

[2] Quy Nhon University, 170 An Duong Vuong, Quy Nhon South ward, Gia Lai, Viet Nam

nguyenthihuyen@qnu.edu.vn

Abstract. The Kon River originates in Vietnam's Kon Tum Plateau and flows into the Thi Nai Lagoon at Quy Nhon, serving as a natural corridor and a structuring element of the landscape. It plays a central ecological, cultural, and historical role, shaping the identity of the villages along its course. This study investigates the Kon River Basin with the invariant elements of its landscape features that are vital to preserving both ecological in-tegrity and cultural continuity. In contrast to the dominant tourism model along Vietnam's coastline marked by luxury resorts and exclusive develop-ment this research proposes an alternative landscape-based approach. It introduces visitors to the everyday environments of Gia Lai's rural communities, highlighting the inherent value of lived landscapes while promoting re-silience, inclusivity, and sustainability. The methodology is qualitative, com-prehensive, and transdisciplinary. It integrates remote sensing and GIS with multi-scalar analysis of territorial planning instruments, historical cartography, literature review, and extensive fieldwork. These efforts supported the identification, inventory, and safeguarding of the Kon Basin's ecological and cultural invariants ranging from cultural and immaterial heritage to tradi-tional land-use patterns and ecologic sensitive areas which form the basis for sustainable, culturally grounded planning. The resulting proposal is structured around four strategic pillars regarding ecology and culture.

Keywords: *Kon river basin landscape, Ecology, Culture, Tourism*

Linking Gentrification and Sense of Community for Sustainable Transformation: A Case Study from Vietnam

Binh Minh Nguyen[1,3] [0009-0008-5056-7503], Diep Thuy Duong Doan[1,3][0009-0002-5606-1868], and Chanh Toan Pham[2,3][0009-0009-6110-7219]

[1] Faculty of Urban Studies, University of Social Sciences and Humanities (HCMUSSH), 10-12 Dinh Tien Hoang, Sai Gon Ward, Ho Chi Minh City, Vietnam
[2] Faculty of Civil Engineering, Ho Chi Minh City University of Technology (HCMUT), 268 Ly Thuong Kiet Street, Dien Hong Ward, Ho Chi Minh City, Vietnam
[3] Vietnam National University Ho Chi Minh City, Linh Xuan Ward, Ho Chi Minh City, Vietnam

thuyduongfus@hcmussh.edu.vn

Abstract. The growth of Ho Chi Minh City's urban infrastructure, especially Metro Line 1 (Ben Thanh - Suoi Tien), has increased worries regarding how transit-oriented development alters community life and social unity. Although gentrification and sense of community (SOC) have been thoroughly examined in Western settings, there is still a lack of evidence from megacities in Southeast Asia. This research examines the impact of socioeconomic status, residential situation, and mobility resources on perceived gentrification (PG) for individuals residing or employed near Metro Line 1 stations, and how PG, in turn, affects SOC. A structured household survey of 150 respondents was conducted, with 54.7% female and 45.3% male participants. Results show moderate perceptions of gentrification, strongest in rising housing prices (62.0% agreement) and commercial turnover (58.7%), while SOC indicators remained high, with 71.3% reporting mutual neighbor support and 68.0% expressing optimism about neighborhood improvement. Cluster analysis revealed four hidden groups, with 32.2% of respondents noticing considerable change. Regression findings reveal that housing prices negatively impact SOC ($B = -2.084$, $p = 0.043$), whereas the existence of chain stores positively affects SOC ($B = 3.564$, $p < 0.001$). These results present empirical proof from Vietnam regarding the balance between redevelopment and social sustainability, yielding practical consequences for transit-oriented planning in swiftly urbanizing areas.

Keywords: *Perceived Gentrification, Sense of Community, Urban Transformation, Sustainable Development*

Physical Characteristics of Urban Streets in Relation to Street and Neighborhood Satisfaction in Vietnam

Vu Hong Son Pham[1,2][0000-0002-9788-0627], Chanh Toan Pham[1,2][0009-0009-6110-7219], Tung Duong Le[1,2][0009-0005-8250-0694], and Binh Minh Nguyen[1,2][0009-0008-5056-7503]

[1] Faculty of Civil Engineering, Ho Chi Minh City University of Technology (HCMUT), 268 Ly Thuong Kiet Street, District 10, Ho Chi Minh City, Vietnam
[2] Vietnam National University Ho Chi Minh City, Linh Trung Ward, Thu Duc District, Ho Chi Minh City, Vietnam

*pctoan.sdh241@hcmut.edu.vn

Abstract. The quality of transportation infrastructure plays a crucial role in ensuring safety, accessibility, and connectivity. In addition, the physical attributes of urban streets contribute significantly to residents' overall satisfaction with their neighborhoods. Aspects related to public health and long-term well-being strategies, especially in developing countries, must align with goals for sustainable urban development in the future. This study aims to examine how the relationships between physical street characteristics and street and neighborhood satisfaction vary across different distance ranges from metro stations in Vietnam. The study employs correlation analysis and a clustering algorithm to evaluate the relationships. The results indicate that seating is associated with neighborhood satisfaction, while three attributes - shelter and canopy, spatial proportions, and parking space - are positively correlated with street satisfaction. In addition, the study identifies patterns in street characteristics across different radius bands measured from the station.

Keywords: *Physical Environment, Urban Street Characteristics, Neighborhood Satisfaction, Mental Health.*

Preservation and Promotion of Traditional Craft Village Values in the Context of Modern Urban Space: Case Study of Weaving, Rice Paper, and Bamboo Blind Craft Villages in Ho Chi Minh City, Vietnam

Truong Thai Hoai An[1], Doan Nguyen Duy Anh[1], Tran Gia Bao[1]

[1]Urban Planning Department, Ho Chi Minh City University of Architecture, Vietnam

an.truongthaihoai@uah.edu.vn

Abstract. Vietnam's traditional craft villages represent an important cultural heritage, but they are facing significant threats from rapid urbanization. This study examines three craft villages in Ho Chi Minh City (HCMC): Phú Hòa Đông (rice paper making), Thái Mỹ (weaving), and Tân Thông Hội (bamboo blinds). Using a multidimensional approach—including literature review, field surveys, and spatial analysis—we propose three adaptive development models: tourism-oriented, creative innovation, and co-evolution. These models integrate cultural preservation with economic feasibility and urban integration. The results show that appropriate spatial organization can sustain the heritage of these craft villages while addressing urbanization challenges. The study provides a reference framework for sustainable development, applicable to similar contexts nationwide, emphasizing the need for policy support in heritage preservation amid urban expansion. Specifically, through analysis, urbanization has reduced the production space of these craft villages by 40-60%, leading to job losses and cultural decline. The tourism model for Phú Hòa Đông leverages its riverside location to increase income by 20%; the creative innovation model for Tân Thông Hội focuses on technology to reduce pollution by 30%; and the co-evolution model for Thái Mỹ creates buffer zones to balance urban development and preservation. These proposals are based on lessons from international cases such as Jingdezhen (China) and Heyri (Korea), highlighting the role of community-government collaboration. The study emphasizes that, with over 5,400 craft villages nationwide, applying these models can contribute to the United Nations' SDG 8 and SDG 11, promoting green economy and heritage protection.

Keywords: *Traditional craft villages; Urbanization; Cultural preservation; Sustainable development; Craft village tourism; Creative innovation; Co-evolution; Ho Chi Minh City*

Redesigning Spaces beneath Metro Infrastructure in Ho Chi Minh City: A Model for Organizing Multifunctional Public Spaces toward Sustainable Urban Development

Ha Van Anh Khoa[1][0009-0001-3885-6600] and Truong Thanh Hai[2][0000-0003-0703-2948]

[1] University of Transport and Communications, Hanoi 100000, Vietnam
[2] Ho Chi Minh City University of Architecture, Ho Chi Minh City 700000, Vietnam

hai.truongthanh@uah.edu.vn

Abstract. This paper examines the neglected spaces beneath Ho Chi Minh City's Metro Line 1 and proposes a model for their sustainable redevelopment. While the metro is expected to reduce congestion and emissions, elevated sections create underutilized voids that risk becoming polluted or vacant without proper planning. Drawing on a mixed-methods approach comprising secondary data analysis, field surveys using structured observation protocols, and international precedents, the study classifies these spaces by proximity to stations and develops a three-layer model: (1) functional zoning to enhance vitality, (2) sustainable integration to address environmental and social challenges, and (3) geotechnical measures to ensure safety. The model emphasizes multifunctional uses-recreational, cultural, economic, and ecological-adapted to local conditions such as density, flooding, and sidewalk economies. Scenario-based projections indicate increased green space access and job creation within TOD catchment areas, providing a roadmap for transforming "lost spaces" into active urban assets.

Keywords: *Forgotten urban space; below metro infrastructure; multifunctional public space.*

Reimagining Coastal Urbanism Adaptive Planning Strategies in Vietnam Mekong Delta

Qui Hoang Kim Vu

University of Architecture Ho Chi Minh City, Vietnam

qui.vuhoangkim@uah.edu.vn

Abstract. The coastal delta region of Ca Mau and Bac Lieu in southern Vietnam represents one of the most fragile and dynamic edges of the Mekong Delta. Facing compounding environmental stressors—including saline intrusion, coastal erosion, tidal flooding, and land subsidence—this territory demands a rethinking of conventional urban planning and urban design practices. Rather than resisting environmental change with rigid infrastructure, the need emerges to develop spatial strategies that integrate urbanization with ecological processes, socio-economic systems, and climate variability. This study investigates how urban planning and urban design strategies can be reoriented in vulnerable coastal regions through the lens of comparative international case studies. Specifically, it examines the planning and design frameworks of three deltaic territories: the Netherlands' Room for the River program, the polder-based rural–urban systems of Bangladesh, and the Sponge City initiatives and green infrastructure corridors in the Yangtze River Delta of China. These case studies are selected for their relevance in negotiating the interface between urban systems and hydrological regimes, and for offering alternative models of coexistence with water and sediment-based landscapes. The findings are synthesized into a set of strategic spatial recommendations for the Ca Mau – Bac Lieu coastal belt. These include: a polycentric urban network connected through ecological corridors and aquaculture systems, soft-infrastructure approaches utilizing mangrove forests, seasonal wetlands, and absorbent urban edges, and multifunctional public spaces that serve both hydrological and social functions. The design propositions are illustrated through spatial scenarios, mapping overlays, and diagrammatic models that reflect both present conditions and future climate trajectories.

Keywords: *Delta urbanism, Coastal belt, Climate adaptation.*

Semi-public Spaces as Soft Infrastructure for Sustainable Compact TOD in Ho Chi Minh City.

Quang Nguyen Thanh[1][0009-0002-9711-9966] and Hai Truong Thanh[2][0000-0003-0703-2948]

[1,2] University of Architecture Ho Chi Minh City.

hai.truongthanh@uah.edu.vn

Abstract. Transit-Oriented Development (TOD) serves as a pivotal model for compact and sustainable urban growth. This orientation depends not only on "Hardware" (infrastructure and planning elements) but also on "Software" (soft infrastructure and quality of life). This finding explores the role of semi-public spaces as a form of intermediary soft infrastructure that supplements and enhances the connectivity between architectural works and public transport networks. Furthermore, these spaces act as social interaction hubs contributing to sustainable development. The research methodology includes literature review, field surveys along Metro Line 1 in Ho Chi Minh City, and expert consultations in architecture, urban planning, and sociology. From there, the factors influencing the development of this spatial typology are analyzed. These findings contribute to establishing evaluation criteria for urban design guidance, prioritizing spatial continuity and multi-functional usage, optimized through the strategic design of soft infrastructure.

Keywords: *Semi – public space, social interactive space, compact city, sustainability, TOD - Transit-Oriented Development*

The Attractiveness of Pedestrian Streets in Hanoi's Historic Center - A Perspective from Historical, Cultural, and Landscape Dimensions

Hung Khuat Tan [1] [0009-0004-5357-9957] and Lien Pham Thi Ngoc [2] [0009-0009-6605-3176] *

[1,2] Hanoi Architectural University, 127-129 Tran Phu Street, Ha Dong Ward, Hanoi, Vietnam

hungkt@hau.edu.vn, lienptn@hau.edu.vn

Abstract. Pedestrian streets in Hanoi have become vital components of weekend cultural life for both residents and tourists. The historic inner-city area, with over a thousand years of history, serves as a convergence point of diverse cultural flows and is characterized by a dense concentration of urban heritage, distinctive natural landscapes, and vibrant traditional commerce rooted in Vietnamese social practices such as “Buôn có bạn, bán có phường” (trading in community). These factors contribute to a unique urban morphology and cultural atmosphere. However, the rapid pace of urbanization and the widespread, often uncoordinated expansion of pedestrian zones have led to homogenized spatial forms, the disruption of historic landscapes, and, in some cases, physical damage to culturally significant structures. These trends pose critical challenges to maintaining the identity and sustainability of pedestrian spaces in heritage-rich areas. This study aims to identify the key factors that contribute to the attractiveness of pedestrian streets and assess their effectiveness in enhancing public space quality within historical urban contexts. The research focuses on two representative case studies: Hanoi’s Old Quarter and the area surrounding Hoan Kiem Lake. These sites were selected for their high concentration of cultural assets and their leading role in the city's pedestrian street network. The study employs a combination of field observations, behavioral mapping of user activities, participatory evaluation through community feedback, and pilot tactical urbanism interventions This multi-method approach allows for a comprehensive understanding of how spatial, cultural, and experiential factors interact to shape user perceptions of attractiveness. Based on the findings, the study proposes urban planning and design strategies aimed at enhancing the experiential quality and cultural resonance of pedestrian zones in heritage areas. Ultimately, the goal is to support a more balanced relationship between heritage conservation and contemporary urban development, contributing to the long-term sustainability and identity of Hanoi's historic core.

Keywords: *Pedestrian Streets; Attractiveness; Hanoi’s Old Quarter; Area surrounding Hoan Kiem Lake*

Tracing the Urban Renewal Trajectories of the Hang Bang Canal, Ho Chi Minh City

Nguyen The Hung[1][0009-0008-8374-9071] and Ahn Yonghan[1][0000-0002-5542-7314]

[1] Hanyang University, Ansan, Gyeonggi-do, 15588, Korea

yhahn@hanyang.ac.kr

Abstract. Urban renewal is pivotal in transforming aging urban areas, yet its long-term spatial effects remain difficult to assess due to extended timelines and complex dynamics. In Ho Chi Minh City, the Hang Bang Canal renewal project—centered around the Bình Tây Market area—has recently completed its second phase after more than a decade, but its prolonged implementation (2015–2025) has generated fragmented spatial signals that complicate evaluation and planning for Phase 3. This study applies a sequence alignment framework to systematically examine how physical changes induced by the project have shaped surrounding spatial configurations over time. By integrating built-environment indicators with Space Syntax analysis, annual transformations in project-related morphological elements were quantified in GIS and matched with configuration shifts via sequencing models. Results reveal that spatial impacts accumulate asymmetrically; while direct interventions create localized order, the broader network exhibits significant structural resistance. Transformations are highly localized, constrained by "resistant zones" where established socio-spatial logic buffers against top-down shifts. Network propagation is further hindered at disconnected spatial cores and orthogonal canal bends, where the "spatial memory" of the pre-existing fabric persists. These findings highlight the project's success in establishing localized "activation nodes" while exposing its failure in achieving systemic synchronization. The study underscores the necessity of synchronized temporal–spatial planning to mitigate fragmentation, providing a data-driven foundation for adaptive management in Phase 3.

Keywords: *urban renewal, morphology, space syntax, sequencing, Ho Chi Minh City, Hang Bang canal*

Understanding the needs and ideas of children in developing public parks in Ho Chi Minh City

Le Nguyen Viet Lam[1][0009-0008-3583-5290]

[1] University of Architecture Ho Chi Minh City, Vietnam

vietlam1808@gmail.com

Abstract. Ho Chi Minh City has a high urbanization rate and a rapidly growing urban population. Therefore, the city is facing an increasing demand for urban space and high-quality urban development to meet the diverse needs of urban residents, including children. In Vietnam, children receive special attention and care, with the goal of creating an environment that promotes their holistic development. Numerous studies have demonstrated the positive impact of public parks on children's development, including physical, cognitive, aesthetic, and skill development. Meanwhile, current public parks are primarily built by adults, lacking the comprehensive participation and consideration of children's needs, desires, and opinions. Consequently, these parks fail to attract children and meet their actual needs. This article collects children's opinions through short discussions, evaluations of design elements, and their drawings. This is a qualitative, experimental study aimed at initially exploring the key needs and opinions of children, providing a basis for further research in the future, with the goal of applying this knowledge to the development of public parks, creating parks that attract children to play and participate in activities.

Keywords: *Public parks, Children, Ho Chi Minh City, Needs and ideas.*

Urban Acupuncture for Resilient Saigon Riverfronts: Planning Blue-Green Multifunctional Infrastructure to Foster the Service Economy in Ho Chi Minh City

Dang, Thuc Trang [1][0000-0002-5097-4095], Phan Nguyen Hoang Nguyen[2][0000-0002-6339-8373]

1 Scene Plus Company Limited, 20 Dao Duy Anh, Ho Chi Minh City, Vietnam

trang.dangthuc@sceneplus.vn.com

Abstract. Ho Chi Minh City has launched multiple initiatives to redevelop the Saigon Riverfront into multifunctional spaces integrating ecological resilience, service economy, and tourism. Waterway transport and tourism play an essential role in regional connectivity and in leveraging the urban river landscape. However, the implementation of these strategies still faces challenges of spatial disconnection, fragmented functions, and limited community activation.

This paper proposes the application of urban acupuncture as a flexible and adaptive approach through small but strategic interventions at "acupuncture points" capable of generating ripple effects in landscape, ecology, and economy. Based on site surveys in selected areas along the Saigon River—Binh My (upstream), Thu Thiem–Nha Rong–Khanh Hoi (central), and Thieng Lieng Island (downstream)—the study identifies potential intervention sites and introduces a model of multifunctional green infrastructure that integrates soft mobility systems, ecological parks, flexible public spaces, urban piers for river tourism, culturally distinctive nighttime economic service clusters, and intermodal water–land transport nodes.

The findings suggest that an interconnected urban acupuncture network can reframe the Saigon River as a resilient and adaptive corridor, offering lessons for other Vietnamese riverfront cities.

Keywords: *Urban Acupuncture, Blue-green infrastructure, Resilient Riverfronts, Multifunctional Public Space, Service Economy, Waterfront Planning, Urban Regeneration, Waterway, Saigon River, Ho Chi Minh City.*

Vehicle Routing Optimization Scheme with Time Window Constraints for Construction Material Delivery

Vu Hong Son Pham[1,2], Thuy Dung Dau[1,2*], Van Nam Nguyen[1,2], Minh Nhut Tran[1,2] and Nghiep Trinh Nguyen Dang[1,2]

[1] Faculty of Civil Engineering, Ho Chi Minh City University of Technology (HCMUT), 268 Ly Thuong Kiet Street, Dien Hong Ward, Ho Chi Minh City, Vietnam
[2] Vietnam National University Ho Chi Minh City, Linh Xuan Ward, Ho Chi Minh City, Vi-etnam

dtdung.sdh241@hcmut.edu.vn

Abstract. Construction logistics often require solving complex vehicle routing problems with strict vehicle capacity and time window constraints to ensure the efficient and timely delivery of materials. To address this challenge, this study presents cheetah optimizer (CO), a meta-heuristic algorithm inspired by the predatory behavior of cheetahs. The CO has demonstrated a well-balanced trade-off between exploration and exploitation, which successfully reduces the risk of premature convergence and enables robust exploration of the solution space. A construction material delivery case study is developed to evaluate the algorithm's effectiveness. The analysis indicates that the proposed strategy can generate high quality delivery plans and maintain stable performance across multiple trials. These findings highlight the potential of the approach to improve decision support for time constrained routing and resource coordination in complex construction logistics environments.

Keywords: *Vehicle routing problem, Material distribution, Logistics management, Cheetah optimizer.*

Wildfire Impacts and Watershed Sustainability: An Interdisciplinary Approach to Climate Resilience in the Urban–Rural Interface of the Global South

Virginia Vásquez[1] [0000-0001-6438-4435], Andrés Iroumé[2] [0000-0001-8148-1309], Galo Valdebenito[2] [0000-0003-1872-9484], Andrés Horn [2] [0000-0002-8926-2810], and Alejandra Schueftan [2,3] [0000-0001-5282-7286]

[1] Universidad Austral de Chile. Valdivia, Chile
[2] Research Centre on Natural and Anthropogenic Risks (RiNA), Universidad Austral de Chile, Chile
[3] Center for Sustainable Urban Development (CEDEUS). Chile

vvasquez@uach.cl

Abstract. This article presents an interdisciplinary framework and empirical findings on the impacts of wildfires on watershed sustainability, focusing on wildland–urban interface territories in southern Chile. Unlike previous studies mainly centred on biophysical impacts, this work integrates socio-territorial and rural habitability dimensions, proposing ecological, hydrological, and social connectivity as a key category for understanding and strengthening territorial resilience. The study examines catchments in central–southern Chile affected by recent wildfires, combining spatial analysis, multiscale environmental evaluation, socio-territorial characterization, and photographic records. The results show that fire disrupts ecological and hydrological connectivity, accelerates soil degradation, and exposes the vulnerability of rural housing, generating territorial fragmentation and long-term challenges for recovery. The findings highlight the importance of integrating connectivity as a transversal category for resilience assessment and governance frameworks. In comparative terms, the Chilean case confirms international evidence but reveals persistent gaps in the articulation between scientific knowledge, public policy, and territorial management. The study aligns with the Sustainable Development Goals 11 (Sustainable Cities and Communities), 13 (Climate Action), and 15 (Life on Land), and contributes transferable insights for territories of the Global South facing similar risks of ecological fragmentation and social vulnerability.

Keywords: *Wildfires, Connectivity, Territorial resilience*

ARTIFICIAL INTELLIGENCE, DIGITAL TECHNOLOGIES

AI Language Models as Cognitive Mediators in Environmental Risk Perception: Framing Effects and Human Responses

Karina Stankevica[0000-0002-2059-4729], Zane Vincevica-Gaile[0000-0003-2868-0434] and Maris Klavins[0000-0002-4088-9348]

Department of Environmental Science, University of Latvia, Riga LV-1004, Latvia

karina.stankevica@lu.lv

Abstract. As artificial intelligence (AI) becomes increasingly integrated into scientific communication, education, and public discourse, large language models (LLMs) are emerging not just as tools but as cognitive mediators. They shape how individuals receive, interpret, and respond to complex global issues, such as environmental risk. This study explores how LLMs influence user perception of environmental problems through an ecolinguistic framework by analyzing narrative framing, cognitive accessibility, and emotional modulation of responses to environmental prompts. By attributing the issue of honeybee population decline as a case prompt, six LLMs (GPT-5, Claude 3, Gemini 1.5, Meta AI, Mistral, and DeepSeek) were compared across three framings: positive, neutral, and negative. Obtained narratives were analyzed using Voyant text analysis tools to assess lexical focus, readability, vocabulary density, and emotional tone. Results revealed that framing strongly directs model narratives: positive prompts shift toward recovery and solutions, neutral prompts emphasize scientific explanation, while negative prompts intensify towards crisis and threat. Differences were also observed across models, with some producing longer, more complex, or more emotionally charged outputs. The findings demonstrate that both prompt framing and model architecture shape how environmental issues are cognitively and emotionally mediated.

Keywords: *Artificial Intelligence, Large Language Models, Environmental Risk Perception, Cognitive Framing, Sustainability Communication, Framing Effects, Emotional Modulation*

Automated Infrared Thermography and Machine Learning Framework for Seepage Detection in Earthen Dams

Vaishnavi Bherde[1][0000-0003-3058-8418] and Umashankar Balunaini[2][0000-0003-0813-7872]

[1] Doctoral Scholar, Department of Civil Engineering, IIT Hyderabad, Kandi, Sangareddy-502284
[2] Professor & Corresponding Author, Department of Civil Engineering, IIT Hyderabad, Kandi, Sangareddy-502284,

buma@ce.iith.ac.in

Abstract. Seepage detection is a crucial issue in the stability of existing earthen dams; if it remains undetected can lead to catastrophic failure. Traditional seepage detection techniques, such as visual inspections and piezometers, are constrained by their high labor effort, lack of real-time monitoring, and extensive spatial coverage. Over the past few years, Infrared (IR) thermography has emerged as a promising non-invasive technique due to its ability to capture thermal anomalies indicative of water movement. However, existing IR image analysis methods have significant drawbacks, including the inability to separate seepage-induced temperature patterns from those driven by external variables such as solar heating or shading. Manual interpretation of infrared data restricts scalability for continuous or large-scale monitoring. To overcome these constraints, this study suggests a sophisticated framework for seepage detection using infrared image classification. The framework combines conventional convolutional neural networks (CNNs) with cutting-edge preprocessing techniques for edge detection, texture analysis, and thermal gradient modeling. The algorithm models a binary classification to distinguish seepage from other thermal anomalies, and adaptive preprocessing approaches to minimize noise. The findings demonstrated that the framework has a remarkable accuracy of 91% and can be effectively used for real-time applications, which can be further improved by automated processing, which decreased the interpretation time. Overall, this study can serve as a substantial development in real-time seepage monitoring, potentially improving the safety and maintenance of vital infrastructure and averting breakdowns that might cost thousands of lives and millions of dollars in damages.

Keywords: *Earthen dams, seepage detection, infrared images, convolutional neural network.*

Comparative Evaluation of Neural Networks for Predicting Concrete Compressive Strength

Nhi V. Nguyen[1], Luong V. Le[1], Nhat-Phi Doan[2], and Van Than Tran[1,*]

[1] Faculty of Civil Engineering, Ho Chi Minh City Open University, Ho Chi Minh City, Vietnam
[2] Faculty of Civil Engineering, Industrial University of Ho Chi Minh City, Ho Chi Minh City, Vietnam

*than.tv@ou.edu.vn

Abstract. Accurate prediction of concrete compressive strength plays a vital role in optimizing structural design and material usage. This study compares the performance of three machine learning (ML) models, Radial Basis Function Network (RBFN), Multilayer Perceptron (MLP), and Kolmogorov–Arnold Network (KAN), using a benchmark dataset with eight input variables. Models were trained with standardized data and optimized through grid search and cross-validation. Evaluation using R^2 and mean squared error (MSE) revealed that MLP achieved the highest predictive accuracy (R^2 = 0.897), followed by KAN (R^2 = 0.825) and RBFN (R^2 = 0.757). SHapley Additive exPlanations (SHAP), a game-theoretic explainability approach based on Shapley values, were employed to interpret the model predictions by quantifying the contribution of each input feature. The SHAP analysis confirmed curing age and cement content as the most influential factors affecting concrete compressive strength. The findings support the use of ML models, particularly MLP, as effective tools for concrete strength prediction and design optimization.

Keywords: *Concrete Compressive Strength · Multilayer Perceptron · Radial Basis Function Network · Kolmogorov–Arnold Network · SHAP*

Digital Technologies for the Safety Assessment of Aging Infrastructures

Gabriella Bolzon[0000-0002-7783-9774], Mohammad Hajjar[0009-0003-9359-9592] and Caterina Nogara[0000-0003-1493-566X]

Politecnico di Milano, piazza Leonardo da Vinci 32, 20133 Milano, Italy

gabriella.bolzon@polimi.it

Abstract. The European Alpine region is home to several dams built several decades ago but still in use for energy production and environmental protection. The safety of these large infrastructures is usually ensured by a monitoring system based on local measurements collected by instruments such as collimators, calipers, strain-gages, thermometers. The number of sensors installed and the acquisition frequency (often, at least daily) produce a huge amount of data that are processed by statistical or self-learning algorithms to highlight any deviations from the expected system response. However, the possible anomaly source is not easily identified based solely on the information thus gathered. Current technological advances permit to supplement traditional measurements with quantitative full-field data acquired by non-contact infrared or vision-based cameras, which can be mounted on drones. The maps produced in this way can also be processed by deep learning algorithms that can remove noises and improve accuracy. Furthermore, such measurements can facilitate the development of reliable simulation models based on the physics of the system response. The opportunities currently offered by digital technologies and their limitations in the outlined context are discussed in this contribution based on the authors' experience in the dam sector. However, some observations apply similarly to the safety assessment of other infrastructures.

Keywords: *Infrastructures; Energy; Safety; Monitoring; Data Processing; Self-learning Algorithms.*

Digital Transformation in Infrastructure Project Management: An AI-Powered Platform for the Ministry of Construction

Tuan Anh Nguyen [1], Anh Binh Tran[1*[0009-0009-3089-5160]], Chi Hieu Nguyen[2] and Quoc Hoang Do[1]

[1] Institute of Information Technology in Civil Engineering, Hanoi University of Civil Engineering, Hanoi, Vietnam
[2] Construction Economics, Management, and Investment Authority, Ministry of Construction, Hanoi, Vietnam

binhta@huce.edu.vn

Abstract. The management of large-scale infrastructure projects—such as roadways, railways, waterway, and airports—has traditionally relied on manual reporting, paper-based documentation, and time-consuming data aggregation. These processes hinder real-time decision-making and reduce the overall transparency and responsiveness of government oversight. This paper presents the development and implementation of a digital project management platform tailored for the Ministry of Construction (Vietnam). The platform enables contractors to submit monthly, weekly or daily progress reports electronically, replacing traditional paper submissions. All reported data is automatically aggregated and structured for easy analysis, monitoring, and reporting. A key innovation of the system is the integration of an AI-powered assistant based on the Model Context Protocol (MCP), which allows users at the Ministry to interact with the project database through natural language queries. This AI chatbot supports instant retrieval of detailed project information, automated report generation (in Word/Excel formats), and flexible filtering of key performance metrics. The digital platform has already demonstrated significant improvements in efficiency, accuracy, and transparency in managing infrastructure investment projects. It reduces reporting time from weeks to minutes, enhances data consistency, and empowers decision-makers with real-time insights. This case study highlights the transformative potential of AI and digitalization in public-sector infrastructure management, offering a scalable model applicable to other governmental bodies in developing countries.

Keywords: *Infrastructure Management, Digital Transformation, AI Chatbot, Model Context Protocol, Government Reporting, Construction Monitoring, Public Investment, MCP*.

Inverse Parameter Identification for Beam-End Bolted Connections Using Machine Learning-Aided Optimization Framework

Van Thu Huynh[1], Cao Hung Pham[1,*], Hoang Vu Le[1], Van Phuc Tran[2], and Song Hong Pham[2]

[1] School of Civil Engineering, The University of Sydney, NSW 2006, Sydney, Australia
[2] Faculty of Civil Engineering, University of Architecture Ho Chi Minh City, 196 Pasteur Street, District 3, Ho Chi Minh 700000, Vietnam

caohung.pham@sydney.edu.au

Abstract. This paper presents an efficient machine learning–aided optimization framework for inverse parameter identification in finite element model updating (FEMU). The framework is tested on benchmark load–deflection responses of shear beam-end bolted connections in cold-formed steel channels obtained from a recent experimental program at the University of Sydney. Specifically, a Gaussian process regression (GPR) model is constructed as a surrogate model to approximate the FE simulations developed in ABAQUS software. By leveraging the trained GPR, a global sensitivity analysis (GSA) is conducted to identify the most influential material and geometric parameters under uncertainty, enabling an effective reduction in parameter dimensionality for the subsequent optimization process. Finally, Bayesian optimization (BO) is employed to calibrate the selected parameters by minimizing the discrepancies between numerical and experimental responses. The results demonstrate that the proposed framework successfully updates the FE model with high accuracy while significantly improving computational efficiency. This integrated approach provides a robust and practical solution for inverse parameter identification of bolted connections and can be extended to other complex structural assemblies requiring reliable FEMU under uncertainty.

Keywords: *GPR, FE updating, GSA, Bayesian optimization, Cold-formed steel*

Multiscale Digital Twin of the Physical Behavior of a Bio-Sourced Artificial Fiber Using Machine-Learned Interatomic Potentials: A First Attempt

Alexandre Leotta[1], Cuong Ha-Minh[1][0000-0002-8994-0650]

[1] Université Paris-Saclay, CentraleSupélec, ENS Paris-Saclay, CNRS, LMPS - Laboratoire de Mécanique Paris-Saclay, 91190 Gif-sur-Yvette, France

cuong.ha-minh@ens-paris-saclay.fr

Abstract. Over the last decade, the rising demand for high-performance construction materials has increasingly intersected with growing environmental concerns. This convergence highlights an urgent need for full decarbonization and the development of sustainable material solutions. As part of a strategy to reduce the carbon footprint of buildings, bio-based natural fibers, in particular cellulose-based ones, have been introduced as alternatives to conventional synthetic fibers. However, cellulose-based materials have not yet matched the mechanical performance of traditional fibers used in technical applications. A significant scientific challenge remains the limited knowledge of these fibers at the atomic scale. In this paper, a multiscale approach is adopted, utilizing molecular dynamics (MD) analysis via the LAMMPS software and a novel machine learning-based force field, MACE. Two distinct MACE models, trained on mixed and purely organic datasets, were employed to study three different scales: 1-, 3-, and 7-chain cellulose structures. As an initial exploration of this approach, the study focuses on the minimization phase to evaluate the accuracy, applicability, and computational efficiency of these machine-learned interatomic potentials.

Keywords: *High Performance Bio-sourced Artificial Fiber, Multi-scale Modeling, Molecular Dynamics, Interatomic potentials, Machine learning.*

Performance Evaluation of a Context-Aware Chatbot Using RAG for Answering Welding Material-Standards Compliance Questions

Van Thu Huynh[1], Cao Hung Pham[1], Anna Paradowska[1] and Michail Karpenko[2]

[1] School of Civil Engineering, The University of Sydney, NSW 2006, Sydney, Australia
[2] New Zealand Heavy Engineering Research Association (HERA), Auckland, New Zealand.

caohung.pham@sydney.edu.au

Abstract. This study presents a context-aware chatbot based on a Retrieval-Augmented Generation (RAG) system, designed to support efficient and reliable question answering on welding material standards. This system excels at integrating retrieval mechanisms with the generative capabilities of large language models (LLMs), resulting in contextually relevant and well-grounded responses that enhance user interaction and usability. Within this framework, challenges associated with interpreting welding material standards, arising from their length, technical complexity, and heterogeneous document formats, are systematically addressed. To evaluate the performance of the proposed system, a set of benchmark questions was developed and assessed using RAG-Checker metrics, including context utilization, faithfulness, precision, recall, F1 score, and claim recall. The results demonstrate that the proposed system improves the accessibility and interpretability of complex welding material standards, offering a practical tool for engineers and inspectors for rapid and reliable information retrieval. In addition, a web-based RAG chatbot application was developed to facilitate user interaction and real-time access to the proposed system in practical engineering workflows.

Keywords: *Welding material standards, Retrieval-Augmented Generation (RAG), Large language models (LLMs), Chatbot*

Post-Earthquake Structural Damage Recognition Using Transfer Learning

Luong V. Le[1], Nhi V. Nguyen[1], Van Than Tran[1], and Thanh Danh Tran[1],*

[1] Faculty of Civil Engineering, Ho Chi Minh City Open University, Ho Chi Minh City, Vietnam

*danh.tt@ou.edu.vn

Abstract. Post-earthquake structural damage assessment is crucial for effective disaster response and recovery, enabling rapid decision-making on structural integrity and prioritizing necessary repairs. This paper examines the application of transfer learning strategies—feature extraction and fine-tuning—utilizing MobileNet to classify structural damage levels in post-earthquake scenarios. A dataset of 2,180 images, split into four damage categories—no damage, light damage, average damage, and severe damage—was used to train and evaluate the models. The findings demonstrate that both strategies are effective in classifying damage levels. However, the fine-tuning strategy's accuracy was higher at 91.11% compared to the feature extraction strategy's 89.44%. The outcomes demonstrate the effectiveness of transfer learning in assessing structural deterioration and highlight that fine-tuning outperforms this approach for this specific application.

Keywords: *Damage Classification; Transfer Learning; Deep Learning; MobileNet.*

Prediction of Liquefaction-Induced Ground Settlement Using Radial Basis Function Network: A Comparative Study with MLP and KAN

Phuoc T. H. Bui[1], An T. T. Phan[1], Dung V. Hoang[1], and Van Than Tran[1],*

[1] Faculty of Civil Engineering, Ho Chi Minh City Open University, Ho Chi Minh City, Vietnam

*than.tv@ou.edu.vn

Abstract. Accurate prediction of ground settlement resulting from soil liquefaction is essential for seismic hazard assessment and resilient geotechnical design. This study explores the use of a Radial Basis Function Network (RBFN) to estimate liquefaction-induced settlement based on key soil parameters, including unit weight (γ), soil layer depth (d), standard penetration test blow count ($N_1(60)$), and cyclic stress ratio (CSR). To benchmark its performance, the RBFN model is compared with two widely used machine learning models: the Multilayer Perceptron (MLP) and the Kolmogorov–Arnold Network (KAN). All models are trained and evaluated on the same dataset, with predictive accuracy assessed using the coefficient of determination (R^2). Among the models, RBFN achieves the highest predictive performance, with an R^2 score of 0.937, outperforming MLP (0.899) and KAN (0.908). These findings highlight the potential of RBFN to effectively capture complex nonlinear relationships between soil properties and settlement behavior, providing a robust and interpretable approach for post-liquefaction deformation prediction.

Keywords: *Liquefaction · Ground Settlement · Radial Basis Function Network · Multilayer Perceptron · Kolmogorov–Arnold Network*

The availability of Industry 4.0 technologies for improving the product life cycle towards sustainability

Ngo Thi Thu Trang[1]

[1] University of Architecture Ho Chi Minh City, Ho Chi Minh City, Vietnam

trang.ngothithu@uah.edu.vn

Abstract. Under the influence of the fourth industrial revolution, we have seen many big changes in manufacturing, marketing, and in the way we interact with our surrounding environment. However, from the viewpoint of sustainable development, the Industry 4.0 technologies can be exploited to bring benefits not only to human life but also to ecosystems. This article has analyzed the potential of key Industry 4.0 technologies to enhance industrial production toward greater sustainability. Through an examination based on the stages of product life in Life Cycle Assessment (LCA) framework—from raw material extraction, material processing, and component manufacturing to assembly and packaging, distribution and purchasing, installation and use, service upgrading and maintenance, and finally disposal and recycling—the findings reveal significant contributions. By collecting and analyzing information throughout the process, these technologies help in predicting of environmental impacts, cut down many middle steps in processes from design to production and distribution, and foster the development of a circular economy. Even though most Industry 4.0 technologies play a role in advancing sustainability, three technologies are applied most extensively are additive manufacturing, the industrial Internet of Things, and big data and analytics. In a product life cycle, raw material extraction, material processing and component manufacturing, and disposal and recycling are the stages got attention from most of Industry 4.0 technologies - where they play a critical role in saving materials and reducing waste generation.

Keywords: *Industrial 4.0 Technologies, Life Cycle Assessment, Sustainability.*

Transformer-Based Recognition of Post-Earthquake Building Collapse Modes

Than V. Tran[1], Trung Hieu Tran[2], and Thanh Danh Tran[3*]

[1] Institute of Photonics, Leibniz University Hannover, Hannover 30167, Germany
[2] SCQC, Ho Chi Minh City, Vietnam
[3] Faculty of Civil Engineering, Ho Chi Minh City Open University, Ho Chi Minh City, Vietnam

*danh.tt@ou.edu.vn

Abstract. Accurate assessment of structural damage following earthquakes is crucial for swift disaster response and effective risk mitigation. In this study, we propose a Transformer-based visual classification framework to identify building collapse modes—non-collapse (NC), partial collapse (PC), and global collapse (GC)—using scene-level structural images. These images capture the overall geometry and damage state of buildings, serving as a reliable basis for evaluating global structural performance. We benchmark three Transformer architectures: Vision Transformer (ViT), Data-efficient Image Transformer (DeiT), and Swin Transformer. Experimental results demonstrate that DeiT achieves the highest accuracy (73.97%), followed by ViT (72.60%) and Swin Transformer (70.55%). These findings underscore the effectiveness of Transformer-based models in post-earthquake structural assessment and highlight the potential of data-efficient attention mechanisms for global damage classification tasks.

Keywords: *Collapse mode classification; Earthquake damage assessment; Transformer-based image recognition; Scene-level structural images.*

A BIM-Based System for Extracting Formwork Quantity in High-Rise Building Projects

Hang Thu Thi Le[1][0000-0002-4150-6601]

[1] University of Architecture Ho Chi Minh City, 196 Pasteur, Xuan Hoa Ward, Ho Chi Minh City, 700000, Vietnam

hang.lethithu@uah.edu.vn

Abstract. Formwork quantity takeoff for construction projects is a time-consuming process that typically requires a high degree of accuracy. Building Information Modeling (BIM) has become a prevailing trend and is widely adopted in many countries, including Vietnam. However, in practice, most construction projects still rely on manual or semi-manual methods for estimating formwork quantities. Additionally, many popular 3D modeling software tools currently in use lack built-in functionality for automatically calculating formwork volume, posing challenges for quantity surveyors (QS) and contractors in cost estimation and construction planning. This paper presents a BIM-based system for calculating formwork quantities in construction projects that use a parametric algorithm. The developed system is built on a visual programming platform integrated with widely used 3D modeling software. The proposed system has been tested on a real-world project to calculate the formwork surface areas of structural components, including foundations, slabs, walls, stairs, beams, and columns. The results demonstrated that the developed system significantly reduces the time required by the quantity surveyors and minimizes the common errors typically associated with traditional estimation methods. Moreover, by embedding data directly within the 3D visual model, the developed system enables contractors to make faster, more informed decisions throughout the planning and construction management processes.

Keywords: *Building Information Modeling; Formwork Quantity Take-off; Parametric; Automatic; Quantity Surveyors.*

Barriers to IoT Adoption in the Construction Industry: A Case Study in Vietnam

Vu Hong Son Pham[1,2], Thuy Dung Dau[1,2*], Minh Nhut Tran[1,2] and Tan Trung Nguyen[1,2]

[1] Faculty of Civil Engineering, Ho Chi Minh City University of Technology (HCMUT), 268 Ly Thuong Kiet, Dien Hong Ward, Ho Chi Minh City, Vietnam
[2] Vietnam National University Ho Chi Minh City, Linh Xuan Ward, Ho Chi Minh City, Vietnam

dtdung.sdh241@hcmut.edu.vn

Abstract. The integration of Internet of Things (IoT) into the construction sector presents significant opportunities to enhance efficiency, resource management, and overall project outcomes. However, the adoption of these technologies entails numerous challenges that warrant careful examination. This study adopts a rigorous research approach, beginning with a comprehensive review of existing literature and expert perspectives. Drawing on data collected through surveys and analyzed using factor analysis, the study categorizes and consolidates the challenges into structured groups. This methodological framework enables a clearer understanding of the barriers to IoT implementation. By systematically examining these challenges, the study provides valuable insights to guide stakeholders toward the successful integration of IoT within the construction industry.

Keywords: *Internet of Things, Technology, Digitalisation, Construction management, Obstacles.*

The Application of Satellite Backscattering in Infrastructure Displacement Monitoring

Duong Tran Nhat[1], Phu Nguyen Duc[1*], Thang Nguyen Quang[1], Dung Le Tien[1], Cuong Nguyen Viet[1]

[1] Viphap Company (www.viphap.com)

ducphunguyen@viphap.com

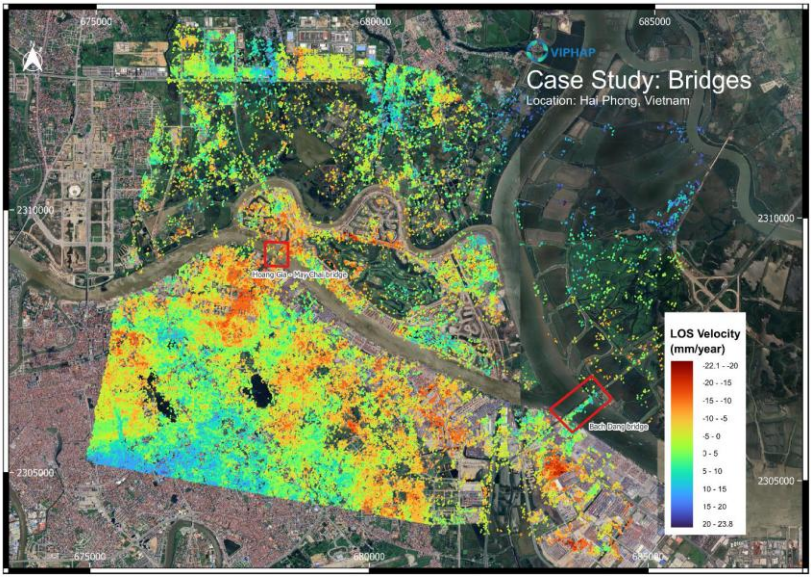
Abstract. Infrastructure health monitoring plays a vital role in ensuring the safety, reliability, and longevity of critical assets such as bridges, dams, and urban transport systems. As these structures are increasingly exposed to growing operational loads and environmental stressors, the ability to detect early-stage deformation and long-term structural changes becomes essential for effective asset management. In practice, monitoring these changes remains challenging. Traditional methods, such as strain gauges or GNSS sensors, can provide very accurate measurements, but only at specific installed locations. This creates gaps in coverage, meaning that important changes may go unnoticed if they occur outside instrumented points. In addition, installing and maintaining these systems is costly and time-consuming, making it difficult to apply them across large numbers of bridges. Another limitation is that data is only available from the moment sensors are installed, leaving no way to understand how a structure behaved in the past. To overcome these challenges, this study explores the use of Persistent Scatterer InSAR (PS-InSAR) as a satellite-based approach for large-scale infrastructure monitoring. Instead of relying on physical sensors, PS-InSAR uses radar images acquired repeatedly by satellites to measure tiny movements of the Earth's surface over time. By comparing the phase of radar signals between multiple acquisitions, it is possible to detect displacements at the millimeter scale.

Criterion	Traditional In-Situ Sensors	PS-InSAR Remote Sensing
Coverage	Sparse (localized point-based)	Comprehensive (entire structure & approaches)
Cost-Efficiency	Low (High absolute hardware/labor cost)	High (Economies of scale across bridge inventory)
Historical Data	None (Data begins at installation)	Retrospective (Available via satellite archives)
Scalability	Low (Complexity grows per site)	High (Single acquisition covers entire city)

One of the key strengths of this approach is that many man-made structures—such as steel structures and reinforced concrete—naturally reflect radar signals

very well. These stable reflection points, known as persistent scatterers, allow us to track structural movement reliably over time. Even in challenging environments like bridges over water, where the surrounding surface often produces weak or inconsistent signals, the structural elements themselves provide sufficient information for analysis.

The processing workflow follows several essential steps to ensure reliable results. First, a large set of radar images collected over time is carefully aligned so that each pixel corresponds to the same physical location. Interferograms are then generated to capture phase differences between images, which contain information about displacement. Because atmospheric conditions, especially humidity, can affect radar signals, corrections are applied to remove these effects and isolate the true structural movement. Finally, time-series analysis is used to reconstruct displacement histories for each point, and when possible, data from different satellite viewing directions are combined to better understand the direction of movement.



As a representative application, this study presents a case study of how bridge structures behave over time. This includes both short-term variations, such as seasonal expansion and contraction, and long-term trends, such as gradual settlement. Being able to separate these effects is particularly important for identifying early warning signs of structural problems.

Compared to conventional monitoring methods, PS-InSAR offers several practical advantages. It provides continuous coverage across entire structures rather than isolated points, requires no on-site installation, and can be applied to many bridges at once. Perhaps most importantly, it allows access to historical satellite data, making it possible to look back in time and understand how a structure has evolved even before monitoring officially began.

Rather than replacing traditional sensors, this approach is best seen as a complementary tool. While in-situ instruments provide highly precise local measurements, PS-InSAR offers a broader, system-level perspective. Together, they enable a more complete understanding of structural behavior.

Overall, this work demonstrates how satellite-based monitoring can support a shift from reactive inspection toward more proactive and data-driven infrastructure management. By identifying subtle deformation trends early, it becomes possible to plan maintenance more effectively, reduce long-term costs, and improve the safety and reliability of bridge systems.

Remark from CIGOS Committee: this last abstract is an extended abstract accepted for oral presentation, without a paper published in the proceedings.

CONSTRUCTION, MATERIALS, STRUCTURES

A decision-making model for selecting appropriate solutions to enhance cost control

Truong Giang Dinh[1,2], Nguyen Minh Thuy Trang[1,2*], and Duc Long Luong[1,2]

[1] Faculty of Civil Engineering, Ho Chi Minh City University of Technology (HCMUT), 268 Ly Thuong Kiet Street, Dien Hong Ward, Ho Chi Minh City, Vietnam
[2] Vietnam National University Ho Chi Minh City, Linh Xuan Ward, Ho Chi Minh City, Vietnam

[*] tnmthuy.sdh231@hcmut.edu.vn

Abstract. Cost control in construction is a continuous process spanning the entire project life cycle-from pre-investment planning and execution to acceptance, handover, and operation. It is a critical management function that ensures expenditures adhere to the approved budget, thereby improving capital utilization and maximizing contractors' profit margins. Effective operation requires coordinated engagement among stakeholders, an appropriate control regime, and modern analytical tools. In response to these practical imperatives, this study conducts a diagnostic assessment of the existing cost-control system and systematically analyzes and appraises alternative measures to strengthen cost-control capability in construction projects. Furthermore, employing the Best-Worst Method (BWM) as a multi-criteria decision-making (MCDM) approach, the study develops a prescriptive model to screen and select optimal, context-appropriate solutions, thereby providing a basis for supporting contractors in refining their cost-control systems throughout project delivery.

Keywords: *Cost control system, Multiple-criteria decision-making (MCDM), Best – Worst method (BWM).*

A low-cost recycling approach for industrial fabric waste: A case study supporting green transition in Vietnam's garment sector

Ngoc Quyen Nguyen[1*], Van Giang Nguyen[2]

[1] Faculty of Architecture and Arts, HUTECH University, Vietnam
[2] Faculty of Civil Engineering, HUTECH University, Vietnam

*ntn.quyen@hutech.edu.vn

Abstract. Textile waste management, particularly industrial fabric scraps, remains a significant challenge in Vietnam's garment sector, especially for small and medium-sized enterprises (SMEs) with limited access to advanced recycling technologies. This study proposes a low-cost, pilot-scale recycling approach that utilizes a simple vibrating mold system to convert fabric scraps into functional composite materials, partially replacing conventional aggregates in construction materials. Two matrix materials-unsaturated polyester resin (UPE) and ordinary Portland cement (OPC) were employed to fabricate flexible and rigid composite specimens, respectively, which were evaluated for mechanical properties such as tensile and compressive strength in accordance with Vietnamese technical standards. Additionally, a novel performance-cost efficiency index (KEI) was introduced to assess and optimize material utilization efficiency under resource-constrained conditions. The results indicate that composite materials incorporating fabric scraps have promising potential for non-structural applications including outdoor paving, erosion control, and interior components, while also contributing to the reduction of textile waste discharged into the environment. However, further studies on long-term durability and environmental impacts are necessary to ensure comprehensive sustainability. This approach not only promotes circular economy principles but also offers a feasible and environmentally friendly recycling model aligned with the growing demand for green and sustainable construction materials in Vietnam and emerging economies.

Keywords: *Textile waste recycling; Composite panels; Green construction; Low-cost processing; KEI index; Sustainability; Circular economy.*

An Improved Localized Damage Model with Adaptive Mesh Refinement for Multiple Cracks

Manh Van Pham[1], Minh Ngoc Nguyen[2], Tinh Quoc Bui[2]

[1] University of Architecture Ho Chi Minh City, Ho Chi Minh City 70000, Viet Nam
[2] Duy Tan Research Institute for Computational Engineering (DTRICE), Duy Tan University, Ho Chi Minh City 70000, Viet Nam

manh.phamvan@uah.edu.vn

Abstract. This paper presents a study on crack propagation under mechanical loading in problems with multiple predefined notches, based on an improved local damage model integrated with an adaptive mesh refinement (AMR) algorithm recently developed by our previous research. The proposed model employs a modified equivalent strain norm, which combines the concept of bi-energy norm and Mazars' damage criterion. In our earlier research, we showed that integrating this model with AMR greatly reduces computational costs in damaged areas when applying the finite element method. Local refinement of the mesh is applied to the damaged zones during computation. This process is initiated by marking elements at every load increment, where each marked element is divided into four smaller ones, resulting in the appearance of hanging nodes. These subdivided regions are treated as n-gons and constructed using the Laplace shape function. In many previous studies, crack initiation has been observed to occur at stress concentration points or predefined notches, followed by propagation governed by the evolution of the damaged zone during the loading process. However, these investigations have primarily focused on single-notch configurations. The present study aims to address this limitation by extending the analysis to scenarios involving multiple notches located at various positions. Under such conditions, cracks can initiate at different sites and propagate simultaneously or sequentially as loading progresses. The effectiveness and accuracy of the model are validated through several numerical examples

Keywords: *Local damage; Adaptive mesh refinement; Laplace shape function; Multiple cracks.*

An Integrated Framework for Controlling Construction and Demolition (C&D) Waste Costs in Vietnam: A Lifecycle Approach

Bac An Hoang[1][0000-0002-1258-5435] and Huyen Tran Thi Thanh[2]

[1] University of Architecture Ho Chi Minh City, Vietnam
[2] ThuyLoi University – Southern Campus, Vietnam

an.hoangbac@uah.edu.vn

Abstract. Vietnam's rapid urbanization has led to significant challenges in managing construction and demolition (C&D) waste. Traditional cost management practices in the local industry often overlook the "cost iceberg" of hidden expenses, such as material wastage and rework, which substantially erode project profitability. This paper proposes an integrated, lifecycle-based framework for proactive C&D waste cost control. Using a mixed-methods approach, the study identifies governance and human-related factors - specifically poor environmental awareness and a lack of stakeholder coordination - as the primary barriers to effective waste management. These factors create systemic inefficiencies that discourage sustainable practices. To address these challenges, the proposed framework integrates three key pillars: Building Information Modeling (BIM) for design optimization, Lean Construction for process streamlining, and on-site recycling for resource transformation. The study concludes that effective waste cost control in Vietnam necessitates a shift from reactive disposal to a value-driven governance approach, supported by technical integration across the project lifecycle.

Keywords: *Construction and Demolition Waste (C&D Waste), Lifecycle Cost Management, Integrated Framework, Circular Economy, Lean Construction, Building Information Modeling (BIM), Vietnam*

Effect of Cement Content and Curing Time on the Compressive Strength and Elastic Modulus of Cement Stabilized Compressed Earth Blocks

Dao Ngoc Khanh Vy[1], Dang Vu Hiep[1] and Nguyen Trung Hieu[2].

[1] Hanoi Architectural University (HAU), Hanoi, Vietnam
[2] Hanoi University of Civil Engineering (HUCE), Hanoi, Vietnam

hieunt@huce.edu.vn

Abstract. The northern mountainous regions of Vietnam are facing significant challenges in the development of sustainable housing due to limited economic conditions, underdeveloped transportation infrastructure, and an unstable supply of industrial construction materials. Cement-stabilized compressed earth blocks (CSCEB), which utilize locally available soil and are stabilized with cement, represent a promising solution for low-cost and environmentally friendly construction in these areas. This study investigates the mechanical behavior of CSCEBs produced with cement contents of 0%, 8%, 10%, 12%, and 15%, using sandy clay soil from Hoa Binh province. Compressive tests were performed on prismatic specimens (50 mm × 50 mm × 100 mm) at ages of 7 and 28 days. The results indicate that both cement content and curing time significantly influence the compressive strength and elastic modulus of the blocks. After 28 days of curing, compressive strength increased from 0.6 MPa (0% cement) to 5.3 MPa (15%), while the elastic modulus rose from 105 MPa to 1625 MPa. A strong linear correlation ($R^2 > 0.97$) was found between the elastic modulus and compressive strength, enabling the prediction of elastic modulus from compressive strength. Additionally, cement hydration consumes water, enhances bonding among soil particles, and improves material rigidity. CSCEBs with cement contents of 10% or higher meet or exceed the structural strength requirements for load-bearing walls, confirming their potential as a sustainable and cost-effective housing material in Vietnam's mountainous regions.

Keywords: *Cement stabilized compressed earth block, Compressive strength, Elastic modulus, Cement content.*

Effect of Ground Granulated Blast Furnace Slag on Cl^- Suppression Effect by Silicate-based Surface Penetrants

Takuya Kondo[1], Tomohiro Hamada[1] and Koshi Yamamoto[1]

[1] National Institute of Technology, Kochi College, Nankoku City, Kochi, JAPAN

tkondou@ce.kochi-ct.ac.jp

Abstract. In this paper, blast furnace mortar was prepared with the specific surface area and substitution ratio of ground granulated blast furnace slag test factors. A surface penetrants applied to these specimens. The modifying effect was quantitatively evaluated using a Vickers hardness test. A saltwater immersion test was also conducted to identify the apparent diffusion coefficient of the modified area. A quantitative evaluation was then conducted on the relationship between the modifying effect and the apparent diffusion coefficient, and the possibility of quantitatively evaluating these relationships was demonstrated.

Keywords: *Granulated blast furnace slag, Surface penetrants, Vickers hardness*.

Efficient Time-Cost Management with the Portia Spider Algorithm

Vu Hong Son Pham[1,2], Thuy Dung Dau[1,2], Van Nam Nguyen[1,2], Minh Nhut Tran[1,2] and Nghiep Trinh Nguyen Dang[1,2*]

[1]Faculty of Civil Engineering, Ho Chi Minh City University of Technology (HCMUT), 268 Ly Thuong Kiet Street, Dien Hong Ward, Ho Chi Minh City, Vietnam
[2]Vietnam National University Ho Chi Minh City, Linh Xuan Ward, Ho Chi Minh City, Vietnam

ndntrinh.sdh232@hcmut.edu.vn

Abstract. Managing construction projects efficiently demands a precise time-cost balance. Due to the problem's discrete nature, meta-heuristic methods are well-suited. This paper presents the Portia spider algorithm (PSA), which integrates advanced solution modification strategies specifically tailored for discrete optimization problems. Effective project management requires minimizing costs while adhering to time constraints, and PSA is designed as a potential approach to address these challenges. A 29-activity project, incorporating both direct and indirect costs and capturing the complex interrelations among tasks, serves as the basis for a detailed evaluation of the PSA's performance. By simulating real-world project conditions, the study demonstrates how PSA outperforms conventional population-based techniques. The findings reveal that PSA consistently produces superior solutions, achieving significant cost savings and improved scheduling efficiency. These results highlight the potential of PSA to significantly advance the field of time-cost optimization, offering a valuable resource for civil engineers aiming to enhance project management performance and efficiency.

Keywords: *time-cost optimization, meta-heuristic algorithm, project management, direct cost, indirect cost.*

Experimental study on the load-bearing capacity of Cajuput piles to reinforce the soft soils under low-rise houses in Dong Thap Province, Vietnam

Quang-Thanh Truong[1] and Khai Do[2]

[1] Department of Civil Engineering, University of Architecture Ho Chi Minh City, Ho Chi Minh City, Viet Nam
[2] University of Architecture Ho Chi Minh City, Ho Chi Minh City, Viet Nam

thanh.truongquang@uah.edu.vn

Abstract. Cajuput trees, commonly found in the wetlands of the Mekong Delta, Vietnam, have long been used as natural reinforcement for shallow foundations. This study evaluates the effectiveness of cajuput piles in improving weak soils through static plate load tests with reinforcement densities of 16, 25, and 36 piles per square meter. Results show a distinctly nonlinear load–settlement response, reflecting the deformation behavior of soft soils. Increasing pile density reduces settlement and enhances both stiffness and bearing capacity; however, the improvement from 25 to 36 piles/m^2 is marginal compared to that from 16 to 25 piles/m^2. An optimal density of 25 piles/m^2 is recommended, offering a balance between performance, cost-effectiveness, and ease of installation, thus providing a sustainable solution for shallow foundation design in soft ground conditions of the Mekong Delta.

Keywords: *Soft soils, Cajuput piles; Cajuput pile-reinforced soil foundation; Static load compression plate test, Bearing capacity, Load-settlement behaviour.*

Exploring Students' Perceptions of Sustainable Construction Driving the Improvement of Construction Education in Vietnam

Binh Nguyen[1, 2*], Huynh Kim Huyen Nguyen[1, 2] and Quoc Thai Phan[1,2]

[1] Faculty of Civil Engineering, Ho Chi Minh City University of Technology (HCMUT), 268 Ly Thuong Kiet Street, Dien Hong Ward, Ho Chi Minh City, Vietnam
[2] Vietnam National University Ho Chi Minh City, Linh Trung Ward, Thu Duc City, Ho Chi Minh City, Vietnam

[*]binh.nguyen2010931@hcmut.edu.vn

Abstract. In the contemporary global context, although the construction field plays a crucial role in national economic development, it has also brought considerable negative environmental impacts. For instance, this field not only generates tons of waste and dust but also CO2 emissions annually. Numerous efforts have been made to tackle these ecological problems, such as implementing Building Information Modeling (BIM) in environmental management and the adoption of green building standards such as the International Green Construction Code (IGCC) and Leadership in Energy and Environmental Design (LEED) which are helping to drive sustainability in the construction sector. However, the civil engineering education programs in Vietnam are currently limited and heavily on theory and providing knowledge about green building through individual subjects. Based on 6 Sustainable Development Goals (SDGs), the paper identifies 40 relevant factors and conducts a survey among Vietnamese university students. The data is analyzed using the Relative Importance Index (RII) to rank these factors and determine which are the most important. The findings of the study contribute to the government's efforts to popularize the sustainable development of the country and offer valuable insights for educational specialists aiming to improve the educational construction program in the future.

Keywords: *Sustainable construction, Sustainable development in Vietnam, Construction education in Vietnam*.

Feasibility Study of Seawater and Sea-Sand in Self-Leveling Mortars for Sustainable Indoor Surface Leveling

Sang-Yum Lee[1], Nguyen Phuc Le[2], and Tri Ho Minh Le[2*]

[1]Induk University, 12 Choansan-ro, Nowon-gu, Seoul 01878, Republic of Korea.
[2]Faculty of Civil Engineering, Nguyen Tat Thanh University, 300A Nguyen Tat Thanh Street, District 4, Ho Chi Minh City, Viet Nam.

lhmtri@ntt.edu.vn

Abstract. The overexploitation of freshwater and natural river sand in cement-based materials poses serious sustainability challenges, particularly in coastal and Mekong Delta regions of Vietnam, where these resources are increasingly scarce or costly. As seawater and unwashed sea-sand are locally abundant, this study evaluates their combined use in indoor self-leveling mortars for non-structural surface applications. Nine mortar mixes were prepared with seawater replacing tap water at 0%, 25%, and 50%, and sea-sand replacing natural sand at 0%, 50%, and 100%, while keeping cement and superplasticizer contents constant. Flowability increased significantly, from 195 mm (control) to 280 mm (+43.6%) at maximum replacements. Contrary to earlier assumptions, setting times were accelerated, not delayed. Initial setting time dropped from 89 minutes to 60 minutes (−32.6%), and final setting time decreased from 145 minutes to 110 minutes (−24.1%), attributed to ionic activation of early hydration by seawater. Bleeding rose from 0.5% to 2.5% (+400%), and water absorption increased from 8.2% to 12.4% (+51%), with strong positive correlation ($R^2 \geq 0.91$). The highest 28-day compressive strength was 4.65 MPa (control), while the optimal sustainable mix (SW25–SS50) retained 3.58 MPa (about 77% of the control) offering a viable strength–workability balance. Strength declined to 3.05 MPa at full replacement (SW50–SS100). These findings confirm that partial use of seawater (≤25%) and sea-sand (≤50%) can significantly improve workability and early hydration while maintaining sufficient long-term performance. This approach provides a low-cost, locally sourced, and sustainable alternative for mortar production in resource-constrained coastal regions like the Mekong Delta.

Keywords: *Self-leveling mortar, CLSM, seawater, sea-sand, workability, compressive strength, sustainability.*

Field Application of CTS-02 Equipment for Testing and Evaluating Structural Concrete Strength

Hai Dang Le[1][0000-0001-8984-0636], Phan Thanh Cong1 and Vu Truong Vu[1][0000-0003-3865-5646]

[1] Faculty of Civil Engineering, Nguyen Tat Thanh University, Ho Chi Minh City, Vietnam

vtvu@ntt.edu.vn

Abstract. Accurate assessment of the in-situ condition of concrete is essential for ensuring the structural integrity, safety, and longevity of civil infrastructure. Among the key indicators of concrete performance, compressive strength plays a vital role in evaluating the material's condition. Non-destructive testing methods have become increasingly prominent in quality assurance processes due to their ability to evaluate structures without causing damage. Although the rebound hammer test is widely employed for estimating compressive strength, it suffers from limitations such as sensitivity to surface degradation and substantial instrument variability. In this study, the performance of the CTS-02 device, an impulse response-based testing system, is examined for its effectiveness in evaluating concrete strength in both new and existing civil structures, including bridges. For newly constructed elements, the CTS-02 recorded deviations ranging from 5.5% to 10.3% from the design compressive strength values. In aged structures, the device successfully captured significant variations in strength distribution across structural surfaces, reflecting the effects of service conditions. Additionally, the INDX parameter, recorded during testing, proved useful in assessing surface deterioration. Most measurements yielded INDX values within the range of 0.90 to 1.30, indicating no evident damage or structural anomalies. With its precision and multifunctional capabilities, the CTS-02 represents a promising advancement in the application of non-destructive technologies for structural condition assessment and quality control in the construction industry.

Keywords: *Non-destructive testing, concrete strength, concrete test and surveyor type 2.*

Geometrical Imperfection Effects on the Nonlinear Behavior of Glued Laminated Timber Beams

Hong Son Nguyen[1] [0009-0005-5360-8938], Le Thuy Nguyen[1] [0009-0007-4834-9008], Thuy Van Tran Thi[1] [0000-0003-4873-3898], and Vuong Pham Ngoc[2] [0009-0001-6962-9785]

[1] Hanoi Architectural University, Hanoi, Vietnam

thuynl@hau.edu.vn

Abstract. Slender glued laminated timber (GLT) beams subjected to bending may experience pronounced geometric nonlinearity when large deflections develop, leading to stiffness reduction and serviceability-related concerns. In such cases, initial out-of-straightness can significantly modify the load–deflection response even when material behavior remains elastic. This paper presents a numerical study on the nonlinear bending behavior of GLT beams with different initial geometric configurations. Three beam configurations are examined, including a perfectly straight beam and beams with sinusoidal and parabolic initial imperfections defined with amplitudes proportional to the span. A geometrically nonlinear finite element formulation based on Euler–Bernoulli beam theory is employed to capture large-displacement effects. The analysis focuses on the evolution of load–deflection curves, stiffness degradation, and deformation patterns under monotonic bending. The results demonstrate that initial imperfections accelerate the onset of nonlinear response and increase deflection levels for a given load. Among the investigated cases, imperfect beams exhibit earlier stiffness reduction compared to the perfect configuration, with the response strongly influenced by the imperfection profile. The study provides reference results for nonlinear modelling and serviceability-oriented assessment of slender GLT beam systems.

Keywords: *Glued Laminated Timber, Geometrical Imperfection, Nonlinear Analysis, Timber Beam, Large Displacement.*

Impacts of Occupant Behaviour on Household Energy Consumption in High-rise Apartment Buildings in Vietnam

Dirk Schwede[1], Pham Thi Hai Ha[2], Nguyen Thi An Anh[2,3][0009-0005-1879-2186] , Nguyen Thi Hoa[2], Nguyen Thi Khanh Phuong[2] and Nguyen Cong Thang[4]

[1] Department of Architecture and Civil Engineering, Lübeck University of Technology, Germany
[2] Faculty of Architecture and Planning, Hanoi University of Civil Engineering, Vietnam
[3] Faculty of Civil Engineering, Ho Chi Minh University of Technology and Education, Vietnam
[4] Faculty of Building Material,, Hanoi University of Civil Engineering, Vietnam

anhnta@hcmute.edu.vn

Abstract. Today, Vietnam is facing rapid urbanisation. The need to develop and deliver more and more apartment buildings in Hanoi and other major cities across the country to meet the public demand is becoming urgent. According to the National Housing Development Strategy for the period 2021 - 2030 with a vision to 2045, housing development must reach one of the recommended energy-saving standards. Passive design, active design and user behaviour are among three main factors that determine the efficient and economical use of energy in high-rise apartment buildings. The behaviour of building occupants, if well controlled, can make the total impact of energy efficiency of the other two factors increase considerably and contribute to reducing electricity bills. A full-year energy auditing and survey in Hanoi and Ho Chi Minh was carried out within the framework of the CAMaRSEC project with 49 apartments, of which seven case studies have been selected to investigate in a greater detail the roles of the orientation of the apartment and living culture on different levels of household energy consumption. The research results have found that the orientation of the apartment and living culture of the building occupants and/or the next generation(s) has made the amount of energy used in some apartments vary even though they are quite similar in terms of floor plan design and equipment. This study aims to analyse and quantify the significance of occupant behaviour in relation to electricity consumption in high-rise apartment buildings in Vietnam. Through field surveys combined with the collection and analysis of household electricity billing data, the results indicate that differences in cooling and lighting usage patterns can lead to variations of up to 40% in energy consumption among households with similar apartment floor areas. The findings provide an important empirical database to support energy-efficient building design and the development of demand-side electricity management policies in urban areas. This fact also shows that raising awareness and educating/promoting a greener lifestyle can be very important to achieving truly green buildings in reality.

Keywords: *Apartment Building, Energy Efficiency, Occupant Behaviour, Energy consumption, Vietnam residential sector*

Integrating the Probability-Impact Matrix into Construction Risk Management: Evaluating Google AI for Risk Response Proposals

Nguyen Minh Thuy Trang[1,2], Le Anh Tran[1,2*] and Vu Hong Son Pham[1,2]

[1] Faculty of Civil Engineering, Ho Chi Minh City University of Technology (HCMUT), 268 Ly Thuong Kiet Street, Dien Hong Ward, Ho Chi Minh City, Vietnam
[2] Vietnam National University Ho Chi Minh City, Linh Xuan Ward, Ho Chi Minh City, Vietnam

[*]tlanh.sdh232@hcmut.edu.vn

Abstract. In the realm of construction project delivery, managing risks effectively is fundamental to achieving successful outcomes, especially when such risks threaten to disrupt planned schedules. Schedule delays remain a widespread challenge, often resulting in substantial adverse impacts. This study identified eight overarching categories of causes, further broken down into twenty-six specific risk factors. To systematically investigate their origins, a Fishbone diagram was employed, enabling a structured diagnosis of underlying issues and the isolation of those most influential in causing time overruns. Insights from an expert survey were subsequently processed through a Probability Impact Matrix (PIM), which facilitated a severity-based ranking and guided the selection of targeted mitigation actions. In parallel, the research examined the potential contribution of Artificial Intelligence (AI) to risk management practices, focusing on an expert evaluation of Google AI-Gemini. The analysis revealed that AI can generate context-sensitive and dependable strategies, equipping managers with tools to mitigate or eliminate risks and thereby safeguard both project timelines and budgets.

Keywords: *Probability and impact matrix, Risk management, AI Gemini.*

Mechanical Behavior of Cement–Sand–Rubber Mixtures with Recycled Tire Rubber: A Review and Experimental Study

Tan-Loi Luu[1], Duc-Hung Mac[1], Thanh-Nhan Nguyen[1] and Dong-Kiem-Lam Tran[1]

[1]Department of Civil Engineering, University of Architecture Ho Chi Minh City, 196 Pasteur Street, Ho Chi Minh City, Vietnam

lam.trandongkiem@uah.edu.vn

Abstract. The reuse of waste tire rubber in geotechnical engineering has attracted increasing attention due to its potential to reduce environmental impacts and promote sustainable construction practices. Previous studies have reported improvements in ductility, energy absorption, and crack resistance when rubber is incorporated into cemented soils. However, its effect on strength and durability strongly depends on mix composition and replacement level. This study investigates the mechanical behavior of cemented sand–rubber (CSR) mixtures prepared with recycled crumb rubber at varying replacement ratios (0%, 1%, 2%, 5%, and 10% by dry weight of sample mixture). Unconfined compressive strength (UCS) tests at 28 days revealed a progressive reduction in strength with increasing rubber content: the control sample (0% rubber) achieved the highest UCS of 3.84 MPa. Although the inclusion of rubber led to strength loss due to weak interfacial bonding, the mixture with 2% rubber retained a viable strength of 2.14 MPa (−44.3%). Notably, the reduction rate stabilized beyond this point, indicating a saturation of defects. Consequently, a replacement level of 2% is considered the optimal threshold, balancing mechanical performance with the environmental benefits of reusing waste tires. These findings provide insight into optimizing CSR mixtures for sustainable, non-structural applications in geotechnical engineering.

Keywords: *waste tire rubber, Cement–Sand–Rubber Mixtures, Unconfined Compression Tests, rubber content.*

Modifying the Artificial Bee Colony Algorithm to Solve Construction Site Facility Layout Based on Closeness Index

Vu Hong Son Pham[1,2], Le Anh Tran[1,2*] and Thuy Dung Dau[1,2]

[1] Faculty of Civil Engineering, Ho Chi Minh City University of Technology (HCMUT), 268 Ly Thuong Kiet Street, Dien Hong Ward, Ho Chi Minh City, Vietnam
[2] Vietnam National University Ho Chi Minh City, Linh Xuan Ward, Ho Chi Minh City, Vietnam

tlanh.sdh232@hcmut.edu.vn

Abstract. An efficient construction site layout is essential for optimizing resource utilization, particularly in terms of cost, while improving overall project efficiency and productivity. The primary goal of designing a construction site layout is to minimize the transportation of workflows between facilities. These workflows are influenced by the closeness index among site facilities and the distances between their locations. Consequently, determining appropriate positions for a predefined set of facilities represents a complex decision-making task that requires systematic and effective optimization methods. To address this challenge, an improved Artificial Bee Colony (iABC) algorithm is applied. This algorithm builds upon the original Artificial Bee Colony (ABC) algorithm that is an advanced optimization technique inspired by the intelligent foraging behavior of honeybee swarms. The proposed algorithm enhances both local and global search capabilities, making it particularly effective for complex layout optimization problems. To illustrate the model, a numerical example involving a site layout with 9 facilities and 27 available locations is presented. The results highlight the algorithm's ability to minimize total transportation costs, thereby confirming the practical applicability and effectiveness of the proposed approach.

Keywords: *Artificial Bee Colony, Construction Site Facility Layout, Closeness Index.*

Numerical Investigation of the Slope Stability of Road Embankment Derived from Mixed Recycled Concrete Aggregates and Granular Soil

Vanessa Bianca Cadsawan[1], Charles Khao[1], Mark Kevin Ogalino[1], Rendel John Reyes[1], and Ryan Ramirez[1,2]

[1] University of Santo Tomas, Manila 1015, Philippines
[2] National Research Council of the Philippines, Taguig 1631, Philippines

raramirez@ust.edu.ph

Abstract. While recycled concrete aggregates (RCA) are well-known in pavement applications, their significant potential for embankment construction remains largely unexplored. This study directly addresses the challenges of construction and demolition waste management in the Philippines by investigating RCA as a viable alternative fill material for road embankments. This study assessed the physical and mechanical properties of RCA and conducted detailed slope stability simulations to determine its feasibility for sustainable construction. Laboratory tests were performed to evaluate key properties, including particle size distribution, specific gravity, optimum moisture content, and maximum dry density. The study included direct shear tests on granular soil mixed with 5%, 10%, and 15% RCA, with 100% soil as the control, to determine cohesion and angle of internal friction. RocScience Slide2 was used for slope stability simulations, assessing three different pore pressure coefficients (R_u = 0.1, 0.25, 0.4) under static and seismic conditions. Results show that cohesion increases with higher RCA content, reaching a peak at 15%. Conversely, the angle of internal friction experiences a slight decline as RCA content rises. While the 100% soil mixture initially showed a higher safety factor (SF) compared to 5% and 10% RCA mixtures, the 15% RCA blend delivered the highest SF, exceeding 1.5 for static conditions and 1.1 for seismic conditions. This demonstrates optimal stability for the 15% RCA mixture. These findings indicate the potential of RCA as a sustainable and effective embankment fill material for specific infrastructure projects in the Philippines, offering a promising solution for managing construction and demolition waste.

Keywords: *Recycled Concrete Aggregates, Granular Soil, Direct Shear Test, Slope Stability, Safety Factor.*

Optimizing Cement Composites for Sustainability: Technical, Environmental, and Economic Insights

Adriana Estokova[1*][0000-0003-3094-7476], Martin Jas[1][0009-0003-1348-8594], Katarina Rusnakova[1], Robert Figmig[2][0000-0001-8871-0442] and Natalia Junakova[1][0000-0002-2945-5004]

[1] Technical University of Kosice, Faculty of Civil Engineering, Vysokoskolska 4, 042 00 Kosice, Slovakia
[2] Povazska cementaren a.s. Ladce, Slovakia

*adriana.estokova@tuke.sk

Abstract. Concrete is currently one of the most important materials in the construction industry. However, its production generates large amounts of CO_2 emissions and other pollutants, placing a heavy burden on the environment. In view of this, solutions to reducing concrete's negative environmental impact are being sought worldwide. This paper focuses on reducing the carbon footprint of cement composites by replacing some of the commonly produced cement with CO2-neutral waste materials, such as blast furnace slag, which also can improve the properties of concrete. The technical (e.g. compressive strength, bulk density, consistency and specific surface area), environmental (e.g. carbon footprint) and economic (e.g. price) parameters of cement composites have been studied and evaluated using a multicriteria approach. Attention was also paid to the amount of CO_2 produced by consuming electricity to grind the cement mixture. The findings revealed that milling the raw materials can contribute up to 7% to the composite's overall carbon footprint, and the amount of energy consumed depends strongly on the type of material being treated. A composite consisting of a clinker:limestone:blast furnace slag ratio of 65:20:15 after 30 minutes of milling appears to be the most sustainable option when considering all technical, environmental, and economic parameters.

Keywords: *Cement Paste, LCA, Carbon Footprint, Sustainable Concrete, Grinding.*

Optimizing Construction Waste Logistics Using Portia Spider Algorithm

Vu Hong Son Pham[1,2], Thuy Dung Dau[1,2], Van Nam Nguyen[1,2], Binh Nguyen[1,2] and Nghiep Trinh Nguyen Dang[1,2*]

[1]Faculty of Civil Engineering, Ho Chi Minh City University of Technology (HCMUT), 268 Ly Thuong Kiet Street, Dien Hong Ward, Ho Chi Minh City, Vietnam
[2]Vietnam National University Ho Chi Minh City, Linh Xuan Ward, Ho Chi Minh City, Vietnam

ndntrinh.sdh232@hcmut.edu.vn

Abstract. The management and transportation of construction waste present significant challenges in rapidly urbanizing areas, thereby necessitating the development of efficient strategies to minimize cost, travel time, and environmental impact. In this study, the transportation problem is formulated as a multi-depot vehicle routing problem (MDVRP), accounting for practical constraints such as limited vehicle capacities and the existence of multiple waste collection points. To address these complexities, a novel metaheuristic optimization technique known as the Portia spider algorithm (PSA) is proposed. Inspired by the adaptive predatory behavior of the Portia spider, PSA integrates exploration-enhancing strategies with targeted exploitation mechanisms. This dual-phase search structure enables the algorithm to dynamically balance global search with local refinement, thereby enhancing its capability to solve constrained and complex optimization problems. Experimental evaluations performed on simulated datasets demonstrate that the proposed PSA outperforms established benchmark algorithms in terms of operational cost reduction and convergence speed. The findings highlight PSA's potential as a robust and effective tool for tackling real-world logistics challenges, particularly in the context of sustainable construction waste management.

Keywords: *construction waste, vehicle routing problem, meta-heuristic algorithm, Portia spider algorithm.*

Pull-out Resistance of 3D Notched Connections in a Novel Timber-Concrete Composite Floor: Experimental and Numerical Assessment

Van Han Tran [1], Lucile Gérard [2], Tuan-Anh Nguyen [1], Hugues Somja [1]

[1] INSA de Rennes, LGCGM/Structural Engineering Research Group, 20, avenue des Buttes de Coësmes, CS 70839, F-35708, Rennes Cedex 7, France
[2] INGENOVA, Civil Engineering Office, 5 Rue Louis Jacques Daguerre, Saint-Jacques-de-la-Lande 35136, France

tuan-anh.nguyen2@insa-rennes.fr

Abstract. This paper presents an experimental and numerical study on the pull-out resistance of an innovative 3D notched connection for Timber-Concrete Composite floors (TCC floors). Using a unique trapezoidal geometry featuring three shear planes, the 3D notched shear connection delivers strong performance without reliance on costly and time-consuming metallic reinforcements. While prior experimental work already evaluated the system's shear capacity, this study focuses on the pull-out resistance of the notched connection. Six specimens, constructed with C24-grade timber at a controlled 12% moisture content were subjected to monotonic tensile loading until failure to evaluate the system's tensile resistance, stiffness, and ductility. The tests consistently showed a failure mode due to fracture induced by tension perpendicular to the timber grain. This finding, together with prior research on a push-out test series, highlights the significant influence of timber quality on both the maximum tensile strength and the system's overall ductile behavior. To better examine the experimental findings, a finite element model was created in LS-Dyna. The numerical model successfully represented the observed failure modes and showed a strong correlation in the load-displacement curve, offering a good estimation of the mean ultimate value and stiffness within a 5-10% margin of the test data. These results confirm the strong potential of the proposed TCC floor systems in a sustainable building environment.

Keywords: *Timber, timber-concrete floor, notched connection, pull out tests, LS-Dyna simulation.*

Risk of Flooding due to Unfavorable Urban Design in Erbil City, Iraq: A Case Study

Varoujan K. Sissakian [0000-0002-1660-0938]

[1] Komar University of Science and Technology, Sulaimani 46012, KRG, Iraq

varoujan49@yahoo.com

Abstract. Erbil City is the capital of the Kurdistan Region of Iraq; it is a large city with a coverage of about 115 km2 and a population attaining one million. The city is almost built on a flat area, which is around 400 m (a.s.l.). However, the northeastern part is mountainous, attaining an elevation of about 1000 m (a.s.l.). Tens of valleys of different sizes flow down the mountainous area towards the city, especially the northeastern and eastern parts. The city is witnessing a large expansion in all infrastructure facilities, among them are tens of recently constructed residential sites and three ring roads (100 m, 120 m, and 150 m); the latter is still under construction, with many residential sites. Google Earth Pro images were used to check the courses of the valleys, the recently constructed residential sites, and the dumped valleys. During the construction of the 150 m ring road, many valleys were dumped, which developed huge floods in 2019, causing 13 casualties and large economic losses. Tens of recently constructed houses were also flooded and heavily damaged during the flood because they were constructed either along the flood plains of those valleys or were constructed over dumped valleys. To avoid such risks and disasters, it is highly recommended to avoid the courses of such valleys during the planning to expand the infrastructure of the city.

Keywords: *Flood risk, Unfavorable urban design, Erbil City.*

Study on the Development of Permeable Concrete Using Geopolymer Binder Derived from Fly Ash and Blast Furnace Slag

Nguyen-Thi Cao[1], Hoai-Bao Le [2*] and Tan-Phuc Phan[2]

[1] Tien Giang University, Vietnam
[2] Mien Tay Construction University, Vietnam

lehoaibao@mtu.edu.vn

Abstract. This study investigates the mechanical and hydraulic performance of permeable concrete incorporating a geopolymer binder synthesized from fly ash (FA) and ground granulated blast furnace slag (GGBFS) as a partial replacement for Ordinary Portland Cement (OPC). Permeable concrete is recognized for its ability to facilitate water infiltration through an interconnected pore network, thereby reducing surface runoff and mitigating urban flooding. To address the environmental concerns associated with OPC production, geopolymer binders derived from industrial by-products were employed. A series of mix designs was prepared by varying the binder content, while the activator-to-binder ratio was fixed at 0.35 and sodium metasilicate was used as the sole alkaline activator. Compressive strength, total porosity, and water permeability were experimentally evaluated. The results indicate that the geopolymer-based permeable concrete achieved compressive strengths exceeding 20 MPa and water permeability rates greater than 1.5 mm/s under ambient curing conditions. These findings demonstrate the technical feasibility of geopolymer-based permeable concrete for applications such as sidewalks, parks, and low-traffic urban infrastructure, contributing to the development of environmentally responsible construction materials.

Keywords: *Geopolymer, Permeable concrete, Fly ash, GGBFS.*

Recycled concrete fines and waste glass as alternative raw materials for reactive belite clinker

Polyka Bun[1,2][0000-0002-0583-056X], Rachida Idir[3][0000-0002-5464-1220], and Martin Cyr[1] [0000-0002-5012-9131]

[1] Laboratoire Matériaux et Durabilité des Constructions (LMDC), INSA-UPS, 135 Avenue de Rangueil, 31077 Toulouse Cedex 04, France
[2]Institute of Technology of Cambodia, Phnom Penh, Cambodia
[3]Cerema, Univ Gustave Eiffel, UMR MCD, F-77171 Sourdun, France

martin.cyr@utoulouse.fr

Abstract. Belite-rich cements are recognized as promising alternatives to Portland clinker for reducing the carbon footprint of cement production, since they require a lower lime saturation factor and lower kiln temperatures. However, the slow hydration kinetics of belite phases often limit their practical use. In this study, the synthesis of belite clinker was investigated using two recycled mineral by-products: recycled concrete fines (RCF), as a calcium-rich source, and waste glass powder (GP), as a source of silica and alkalis. The raw mixtures were adjusted to a Ca/Si ratio close to 2 with additional lime, and potassium hydroxide was used as a mineralizer. A parametric study was conducted to evaluate the influence of raw meal preparation, burning temperature (1200-1300°C), plateau duration (30-180 min), and cooling method (air vs nitrogen quenching). The results showed that larnite (β-C_2S) was the main phase formed, with minor secondary phases depending on the raw mixture. Rapid quenching did not stabilize α'L-C_2S but increased the crystallinity and slightly enhanced reactivity. Isothermal calorimetry confirmed that nitrogen-quenched samples exhibited a faster and higher hydration peak compared to air-cooled samples, reaching cumulative heats comparable to ordinary belite cements. This work demonstrates the feasibility of producing reactive belite clinker by combining recycled concrete fines and waste glass, highlighting a promising pathway for circular economy in cementitious binders.

Keywords: *belite clinker, recycled concrete fines, waste glass cullet*

Applying Sustainable Materials in Interior Design: Practices and Challenges in Vietnam

Ngo Ngan Ha[1][0000-0003-0914-8100]

[1] Faculty of Architecture - Interior Design - Applied Arts, Nguyen Tat Thanh University, Ho Chi Minh City, Vietnam

nnha@ntt.edu.vn

Abstract. Amidst growing global environmental concerns and the increasing call for sustainable development, the field of interior design is undergoing a crucial transformation in how materials are selected and applied. Sustainable materials play a pivotal role in minimizing ecological impacts while offering innovative aesthetic and functional possibilities for contemporary living spaces. This paper investigates the characteristics, application potential, and current challenges in the use of sustainable materials within interior design practices in Vietnam. Using a qualitative methodology that combines literature review, expert interviews, and selected case studies, the study identifies several categories of sustainable materials including bamboo, reclaimed wood, recycled composites, bio-based paints, and renewable local materials. The research highlights that these materials not only satisfy environmental performance criteria but also possess strong aesthetic qualities and adaptability across diverse design contexts. Nevertheless, their broader application remains constrained by factors such as elevated costs, lack of technical standards, limited public awareness, and insufficient policy incentives. The paper argues that advancing sustainable materials in interior design requires a collaborative approach involving designers, manufacturers, educators, and policymakers. It also stresses the importance of sustainability education and strategic communication in shaping consumer behavior and professional practices. Ultimately, the study advocates for a long-term vision that positions material sustainability as both an environmental imperative and a catalyst for cultural and design innovation.

Keywords: *Sustainable materials; Interior design; Environmental design; Design innovation*

Bamboo Soil Nailing for Slope Stabilization: A Critical Review of Durability and Treatment Strategies

Iffat Hasnath[1][0009-0008-9580-797X] and Md. Azijul Islam[2][0000-0001-9174-7246]

[1] Undergraduate Research Assistant
[2] Assistant Professor, Department of Civil Engineering, BUET, Dhaka-1000, Bangladesh

azijul@ce.buet.ac.bd

Abstract. Bamboo has emerged as a promising natural material for strengthening and stabilizing slopes. Although conventional slope stabilization methods such as retaining walls, steel soil nails, micropiles, and crib walls are effective, they are often expensive, fossil-fuel dependent, and harmful to the environment. Therefore, an eco-friendly and energy-efficient alternative solution is in demand of the hour. In recent years, bamboo has gained attention as a sustainable reinforcement material for slope stabilization. This review explores the current state of research on bamboo soil nails as a bioengineered solution for this aspect. Nowadays, bamboo is considered a potential soil reinforcement material due to its natural abundance, low shrinkage, high tensile strength, flexibility, rapid growth, and moderate density. Despite these advantages, it has limited durability under long-term moisture exposure and is highly prone to attack by biological organisms such as fungi and termites. This necessitates the use of bamboo preservation techniques. Moreover, there is also a lack of standardized design protocols and region-specific implementation strategies, which hinders widespread adoption. By compiling current knowledge, this review aims to focus on different treatment methods to enhance the durability and mechanical strength of bamboo for the wider adoption of bamboo soil nailing in slope stabilization, as well as inspire future studies aimed at its sustainable role in geoengineering applications.

Keywords: *Bamboo soil nail, Slope stabilization, Soil reinforcement, Oil and heat treatment, Borax-Boric acid treatment.*

Effect of Surface Penetrant Application on Corrosion Control in Carbonated RC Structures

Riku SHIMIZU[1], Takuya KONDO[1] and Takumi MATSUDA1

[1]National Institute of Technology, Kochi College, Nankoku City, Kochi, JAPAN

d60071@gm.kochi-ct.jp

Abstract. The anticorrosion effect was investigated by applying silane type surface penetrants to reinforced concrete [RC] specimens that had undergone carbonation. In this study, the corrosion behavior of reinforcing bars was investigated under two different carbonation residue conditions using two types of surface impregnation materials. The application of silane-based surface penetrants blocked moisture intrusion, resulting in differences in anticorrosion performance depending on the exposure period, as observed in the behavior of half-cell potential, polarization resistance, and rebar corrosion after the end of exposure. From these results, the possibility of achieving corrosion prevention by suppressing moisture ingress from the concrete surface into carbonated RC members was discussed.

Keywords: *Carbonation, Silane type penetrant, Silicate-Based, Moisture content, Half-cell potential, Polarization resistance*

Effect of glass textile treatment on thermomechanical and residual behavior of textile reinforced concretes

Trung-Hieu NGUYEN[1], Xuan-Hong VU[2], Xuan-Dung VU[3], Phi-Long NGUYEN[4]

[1] T. H. NGUYEN, Laboratory of Composite for Construction (LMC2), U.C.B. Lyon 1, France
[2] XH. VU, Laboratory of Composite for Construction, U.C.B. Lyon 1, France.
[3] XD. VU, Ho Chi Minh City Univ. of Technology, Faculty of Civil Eng., H.C.M. City, Vietnam
[4] PL. NGUYEN, Vietnam Aviation Academy, Faculty of Civil Eng., H.C.M. City, Vietnam

Xuan-Hong.Vu@univ-lyon1.fr

Abstract. This study investigated the effect of glass textile treatment on thermal-mechanical performance of two TRC composites. One was made with a refractory matrix and the alkali-resistant (AR) glass textiles, while the other was made with a refractory matrix reinforced and the electrical (E)-glass textiles. The AR glass textiles are often used owing to their good resistance to alkaline environment and the E-glass textiles owing to their good electrical insulation. Two loading paths were employed: the thermomechanical test and the residual resistance test. In both cases, the temperature was raised to specified levels (25°C, 75°C, 150°C, 300°C, 450°C, 600°C) and held constant for one hour. These two distinct loading paths facilitated the characterization of the thermomechanical and residual properties of the TRC composites. The tests were also made for the comparison of stress-strain curves and material characteristics in different temperatures and loading conditions. This study highlighted that the glass textile treatment had a significant effect on the thermo-mechanical and residual behavior of TRC.

Keywords: *Textile reinforced concrete (TRC), AR glass textile, E glass textile, textile treatment, Thermomechanical test, Residual resistance test.*

Experimental Study on The Use of Soil-cement for Producing Non-fired Bricks in Vietnam

Cuong H. NGUYEN. [1], Minh D.N. NGUYEN. [2], Cuong X. DO. [1]

[1] Hanoi University of Civil Engineering, Hanoi, Vietnam
[2] Hohai University, Nanjing, China

cuongnh@huce.edu.vn

Abstract. This paper presents the preliminary results of a study on the use of soil–cement technology for the production of non-fired bricks in Vietnam. The research focuses on evaluating key physical and mechanical properties, including compressive strength, water absorption, and abrasion resistance of soil-cement non-fired bricks. The results indicate that with 9% and 18% cement by weight of soil, the bricks achieved compressive strengths of 5.29 MPa and 9.5 MPa, respectively, after 28 days of curing. Corresponding water absorption rates were 15.81% and 14.04%, while abrasion resistance was measured at 0.34 g/cm^2 and 0.28 g/cm^2. According to TCVN 1451:1998 for solid fired clay bricks, 9% cement content corresponds to M50-grade bricks, while 18% cement allows for the production of M75-grade bricks. The use of soil-cement in non-fired brick production presents a promising solution for energy conservation, pollution reduction, and environmental protection in Vietnam.

Keywords: *Soil-cement Brick, Fired Clay Brick, Compressive Strength, Water Absorption, Abrasion Resistance*.

Enhancing Sustainability of Elevated Roadways in Vietnam Using Recycled Tire Rubber and Agricultural Byproducts in Stone Matrix Asphalt

Dinh Vinh Man NGUYEN[1][0000-0003-1250-6298], Lam Ven PHAN[1], Tan Hung NGUYEN[1], Tan Tien NGUYEN[1], Nen NguyenDinh[2]

[1] Vietnamese-German University (VGU), HCMC, Vietnam
[2] University of Architecture Ho Chi Minh City (UAH)

man.ndv@vgu.edu.vn

Abstract. In recent years, the unsustainable exploitation and use of sand in constructing many roadways has led to severe riverbank erosion, threatening residential areas and agricultural productivity in the Mekong Delta region of Vietnam. Elevated roadways are considered a sustainable solution that could minimize sand mining and reduce agricultural, forestry, and fishery land occupation, especially when elevated roadways utilize innovative solutions using sustainable materials. This study investigated the performance of SMA mixtures added with crumb rubbers (SMA_CR) and agricultural by-products for elevated road solutions. Locally sourced aggregates, recycled materials, and agricultural by-products were selected to ensure technical suitability and environmental sustainability. Laboratory tests were conducted to determine dynamic stability and rut depth for SMA_CR. The results showed that SMA_CR mixtures with CR content below 4.5% met regulatory requirements, confirming their suitability for elevated road surfaces. The findings from this study provide practical insights for sustainable elevated road construction and support the adoption of circular economy and sustainable development approaches in transport infrastructure for the region.

Keywords: *Stone matrix asphalt, recycled tire rubber, elevated roadways.*

How to understand the reactivity of metakaolin

J. N'Dri[1][0009-0003-3645-4186], C. Roiland[2][0000-0001-9587-1340], A. Phelipot[1][0000-0002-5850-1284], L. Le Polles[2], C. Lanos[1][0000-0001-5492-3474]

[1] Univ Rennes, LGCGM, France
[2] Univ Rennes, ISCR, France

christophe.lanos@univ-rennes.fr

Abstract. In a context of sustainable development, it is timely to assess the reactive potential of thermally activated clay soils intended for cementitious or geopolymer applications. This study compares four natural clays composed of kaolinite, quartz, illite and goethite in different proportions, focusing on their degree of crystallinity and its potential impact on their reactivity. The main objective is to assess the differences in crystallinity between these clays using several analytical techniques. Firstly, X-ray diffraction (XRD) and infrared spectroscopy (IR) analyses were carried out to characterize the crystalline structure of the minerals present and to establish a classification according to their degree of crystallinity. The results were then compared with those obtained from solid-state nuclear magnetic resonance (NMR) analysis of ^{27}Al to study the structural environment of aluminium. Interpretation of the results of the various analyses revealed a correlation between the degree of crystallinity of the clays and their reactivity, assessed here by an indicator representative of changes in the structural environment of aluminium under the effect of flash calcination. Lower crystallinity, particularly in kaolinite, is associated with greater reactivity. These results have yet to be confirmed by pozzolanic reactivity tests (Chapelle test, reactivity on mortar). This work opens the way to a better selection of raw materials for the production of high-performance "metakaolins" for the formulation of low-carbon cements.

Keywords: *solid-state nuclear magnetic resonance, crystallinity, pozzolanic reactivity.*

Investigation of the effect of Construction & Demolition Waste content on the mechanical and physical properties of Recycled coarse Aggregate Concrete

Toi Tien Pham[1], Tuyen Ngoc Tran[2] [0000-0002-1436-4556], Hai Hong Tran[1], Khoa Ngoc Ho[1], Ha Hong Le[1], and Cong Chi Vu[1]

[1] Hanoi University of Civil Engineering, Hanoi, Vietnam
[2] Hatinh University, Hatinh, Vietnam

tuyen.tranngoc@htu.edu.vn

Abstract. In response to the imperative for sustainable development in the construction sector, this study provides a quantitative assessment of Recycled coarse Aggregate Concrete (c-RAC) as a viable alternative to conventional concrete. We systematically investigated the impact of substituting natural coarse aggregates with Recycled coarse aggregate (c-RA) at 0%, 25%, and 50% replacement levels. The research methodology involved a comprehensive experimental analysis of fundamental mechanical and physical properties, including compressive and tensile strengths, modulus of elasticity, drying shrinkage and thermal conductivity measured at various curing ages. The experimental results established a distinct inverse correlation between the substitution level of c-RA and the resultant engineering properties of the concrete. An increase in the recycled aggregate content consistently led to a discernible reduction in the primary mechanical strength characteristics when compared to the conventional concrete control. Additionally, the reduction in mechanical properties coincided with significant changes in physical attributes, evidenced by an increase in its permeability and a corresponding decrease in its density. These findings underscore the intrinsic complexities and material-specific challenges associated with the utilization of recycled aggregates. The empirical evidence presented provides a critical foundation for the engineering community to optimize mixture proportions and is instrumental in guiding the judicious and broader implementation of these sustainable materials in future construction applications, thereby advancing the principles of a circular economy.

Keywords: *Recycled aggregate, Recycled coarse aggregate concrete, Construction & Demolition Waste (CDW), sustainable construction, mechanical properties, mix proportioning.*

Mechanical performance of short metallic fibers Reinforced concrete after high temperature exposure

Emmanuel Ferrier [1][56026515800] and Xuan Hong Vu[1][6506218679]

[1] Université Claude Bernard Lyon 1, Villeurbanne 69622, FRANCE

emmanuel.ferrier@univ-lyon1.fr

Abstract. The fire behavior of metal fiber concrete is influenced by several factors, including the nature of the fibers, their dosage, the cement matrix, the humidity of the concrete, and the fire exposure conditions (temperature, duration, etc.). This allows the concrete to maintain a certain residual ductility even after exposure to fire. The study involves tests carried out on prisms with dimensions of 140 x 140 x 560 mm^3. The tests are carried out after exposure to 1100 °C for 1 hour. Two formulations with 2 maturation ages are selected. The tests allow us to observe changes in behavior and the beneficial effect of mixed formulations with synthetic fibers and metal fibers. Metal fibers (usually steel) can improve the fire resistance of concrete by increasing its cohesion at high temperatures. They limit cracking and spalling (sudden bursting of the concrete), as they retain a certain mechanical strength up to approximately 500–600 °C. Metal fibers retain some of their mechanical strength up to 500–600 °C, but rapidly lose their effectiveness beyond this (from 700–800 °C).

Keywords: *fire behavior; Short metallic reinforced concrete; flexural test.*

Minimum Indicators For Public Interiors: Evidence From Bibliometrics And Cases

Hoang An Pham Do[1][0009-0003-4516-7373] and Thu Thuy Vo Thi[1][0000-0002-1357-2468]

[1] Faculty of Architecture – Interior Design – Applied Arts, Nguyen Tat Thanh University, Ho Chi Minh City, Vietnam

anphamdo.hcm@gmail.com

Abstract. Sustainable material selection in public interiors is constrained by inconsistent environmental product declaration datasets, limited regional comparability, and the need to balance environmental, technical, health, and social requirements under short refurbishment cycles. This preliminary study maps 2015 to 2025 literature using bibliometric analysis and extracts measurable criteria from four internationally awarded projects with transparent documentation. The synthesis proposes minimum indicators for early design and tender specifications, organized by environmental, technical, health, transparency, circularity, and social dimensions. For contexts with limited product declarations, a staged evidence approach and explicit uncertainty reporting are recommended to support consistent comparison. The case studies are drawn from developed regions, which may limit transferability to contexts with less mature EPD ecosystems.

Keywords: *sustainable materials, public interiors, material selection, bibliometric analysis, environmental product declarations.*

Optimizing Cement Composites for Sustainability: Technical, Environmental, and Economic Insights

Adriana Estokova[1,*] [0000-0003-3094-7476], Martin Jas[1][0009-0003-1348-8594], Katarina Rusnakova[1], Robert Figmig[2][0000-0001-8871-0442] and Natalia Junakova[1][0000-0002-2945-5004]

[1] Technical University of Kosice, Faculty of Civil Engineering, Vysokoskolska 4, 042 00 Kosice, Slovakia
[2] Povazska cementaren a.s. Ladce, Slovakia

*adriana.estokova@tuke.sk

Abstract. Concrete is currently one of the most important materials in the construction industry. However, its production generates large amounts of CO_2 emissions and other pollutants, placing a heavy burden on the environment. In view of this, solutions to reduce concrete's negative environmental impact are being sought worldwide. This paper focuses on reducing the carbon footprint of cement composites by replacing some of the commonly produced cement with CO2-neutral waste materials, such as blast furnace slag, which also can improve the properties of concrete. The technical (e.g. compressive strength, bulk density, consistency and specific surface area), environmental (e.g. carbon footprint) and economic (e.g. price) parameters of cement composites have been studied and evaluated using a multicriteria approach. Attention was also paid to the amount of CO_2 produced by consuming electricity to grind the cement mixture. The findings revealed that milling the raw materials can contribute up to 7% to the com-posite's overall carbon footprint, and the amount of energy consumed depends strongly on the type of material being treated. A composite consisting of a clinker:limestone:blast furnace slag ratio of 65:20:15 after 30 minutes of milling appears to be the most sustainable option when considering all technical, envi-ronmental, and economic parameters.

Keywords: *Cement Paste, LCA, Carbon Footprint, Sustainable Concrete, Grinding.*

Performance of Carbonation-Cured Concrete Incorporating Calcium and Magnesium Oxides

Quoc Nhat Pham[1,2], Quoc Tho Tran[1,2], Thi Kieu Trang Dao[1,2], and Van Mien Tran[1,2]

[1] Faculty of Civil Engineering, Ho Chi Minh City University of Technology (HCMUT), 268 Ly Thuong Kiet Street, Dien Hong Ward, Ho Chi Minh City, Vietnam
[2] Vietnam National University Ho Chi Minh City, Vo Truong Toan Street, Linh Xuan Ward, Ho Chi Minh City, Vietnam

pqnhat.sdh231@hcmut.edu.vn, tvmien@hcmut.edu.vn

Abstract. In response to the growing demand for sustainable construction materials, modern concrete technologies increasingly pursue low-carbon design strategies while maintaining durability and mechanical performance. This study evaluates how CaO and MgO additions by mass of cement (i.e., 15% CaO (calcium oxide or quicklime; L) and 9% CaO plus 6% MgO (magnesium oxide or magnesia; M)) under carbonation curing affect fresh workability and hardened engineering properties. A conventional concrete mixture designed for a 28-day compressive strength of 40 MPa and a ratio of water-to-cementitious of 0.575 served as the reference and as the basis for mixtures 0.575L15 and 0.575L9M6. Fresh workability was measured by slump, and hardened properties (bulk density, water absorption, compressive strength, surface resistivity, and carbonation depth) were determined under water curing and accelerated carbonation curing for all mixtures. The experimental results revealed that mixtures 0.575L15 and 0.575L9M6 showed a slight reduction in slump compared to the reference mixture, while exhibiting notable improvements in durability-related indicators, particularly higher surface resistivity and lower water absorption, after 168 hours of carbonation curing. Further work should examine long-term durability and microstructural evolution of carbonation-cured concretes incorporating CaO and MgO across a wider range of dosages and curing regimes.

Keywords: *Calcium Oxide, Carbonation Curing, Conventional Concrete, Engineering Properties, Magnesium Oxide, Workability*.

Strength and environmental assessment of concrete prepared with glass waste as a full aggregate substitute

Natalia Junakova[1*][0000-0002-2945-5004], Jozef Junak[1][0000-0003-2785-4295], Adriana Estokova[1][0000-0003-3094-7476] and Magdalena Balintova[1][0000-0002-5644-2866]

[1] Technical University of Košice, Faculty of Civil Engineering, Vysokoskolska 4, 042 00 Košice, Slovakia

*natalia.junakova@tuke.sk

Abstract. Construction activity has a significant impact on the environment. The production of concrete consumes a large amount of materials, resources, energy and even finances, which leads to significant social and environmental impacts, especially CO_2 emissions. The paper focuses on assessing the strength characteristics of concrete prepared on the basis of glass waste as a filler and their impact on environment. The mixtures were prepared using glass waste (cullet of colored glass bottles) as a 100% replacement for natural aggregates of fraction 4/8 mm. In one case, cement was used exclusively as a binder, in the other case, cement was replaced by 25 wt.% fly ash from a local biomass incinerator. The mixtures were subjected to monitoring the strength parameters over a period ranging from 14 days to three years and life cycle assessment (LCA) analysis using SimaPro software. The results of the study confirm that waste glass can be effectively used as a substitute for aggregate in concrete production; however, significantly greater environmental benefits are achieved when combined with fly ash as a partial replacement for cement, reducing the overall environmental impact of concrete production by more than 25%.

Keywords: *Concrete, LCA, Fly Ash, Glass Cullet.*

Sulfate Durability and Performance When exposed to marine environment of Sea Sand Geopolymer Mortar

Thuy Chi DANG [1] and Huy Nghia NGUYEN [1]

[1] University of Transport and Communications, Hanoi, Vietnam

nhnghia03@gmail.com

Abstract. This study evaluates the durability of geopolymer mortar produced from fly ash, blast-furnace slag and untreated saline sea sand, focusing on sulfate resistance and stability in marine environments. Experiments were conducted in parallel on 40-MPa geopolymer mortar specimens and control Portland cement mortar. After 15 weeks of immersion in 5% Na_2SO_4 solution, the geopolymer specimens exhibited a slight, stable shrinkage. By contrast, the control cement motar showed significant volumetric expansion, attributable to the formation of expansive products such as ettringite. Furthermore, sea water immersion tests demonstrated that after 90 days of continuous exposure to natural seawater, the geopolymer mortar attained a compressive strength of 56.59 MPa, with no evidence of strength loss compared to air-cured control samples (54.60 MPa). These findings confirm that the chemically inert poly(sialate) gel structure of the geopolymer which lacks free $Ca(OH)_2$ provides dual resistance to both sulfate attack and chloride ingress. This demonstrates the strong potential of geopolymer mortar made with saline sea sand as a sustainable, high-performance material solution for coastal infrastructure.

Keywords: *Geopolymer, Salt-contaminated sand, Sulfate resistance*.

Temperature And Moisture Distribution Measurements Inside Model Biobased Material During Hygrothermal Transfers

Van-Truong NGUYEN[1], Rahima SIDI BOULENOUAR[1], Philippe COUSSOT[1]

[1] Laboratoire Navier, Ecole Nationale des Ponts et Chaussées, Université Gustave Eiffel, CNRS.

Abstract. Understanding coupled heat and moisture transport in biobased construction materials is essential for predicting their hygrothermal performance and improving building energy efficiency. In this study, within the frame of a wider study of the physics of hygrothermal transfers in such materials in our group, we analyze and develop experimental conditions allowing us to investigate one-dimensional (1D) heat and mass transfer in a model cellulose-based material under well-controlled boundary conditions. A reference sample composed of highly pure compressed cellulose fibers is prepared to ensure reproducible porosity and anisotropic thermal properties. Temperature evolution inside the material is monitored using embedded thermocouples, enabling detailed characterization of conductive heat transfer during controlled cooling experiments. The results show excellent agreement with analytical solutions, confirming the validity of the 1D transfer configuration and highlighting the influence of anisotropic thermal conductivity arising from fiber orientation. Moisture migration is examined independently using Magnetic Resonance Imaging (MRI), specifically the Single Point Imaging (SPI) sequence, which allows non-destructive visualization of bound-water distribution during drying. The measured moisture profiles are compared with diffusion-based predictions incorporating sorption behavior and boundary-layer effects, yielding strong consistency between theory and experiment. Finally, the different conditions are obtained for a further study of combined heat-and-moisture experiments and a comparison with the predictions of a full modelling taking into account the specific properties of moisture transport. The resulting datasets will offer a reliable basis for validating and improving hygrothermal models used in building physics.

Keywords: *Biobased materials, Hygrothermal transfer, Magnetic Resonance Imaging (MRI).*

Terminological clarification and classification of lateritic materials: towards a better understanding and valorization of lateritic materials in civil engineering

Yassia Gansonré [1,2][0002-0815-1650], Pierre Breul[2][0000-0003-1231-3496], Abdoulaye Diédhiou[3], Vincent Sambou[3][0000-0002-1042-8348]

[1] Institut Universitaire de Technologie, Université Nazi BONI, Bobo-Dioulasso, Burkina Faso;
[2] Institut Pascal UMR CNRS 6602, Clermont INP, Université Clermont Auvergne, France
[3] Ecole Supérieure Polytechnique de Dakar, Université Cheikh Anta DIOP, Dakar, Sénégal;

gansonreyassia@yahoo.fr

Abstract. In tropical regions, lateritic materials represent an abundant and strategic geotechnical resource, widely used in civil engineering, particularly in low-cost housing and public works, as pavement and dam's construction. However, their use is often hindered by persistent terminological confusion, fueled by the coexistence of numerous designations that lead to misunderstandings in the practices of identification, classification, and optimal utilization of these materials. This research aims to clarify the main terms used in scientific and technical literature and contextualize the use of these materials. Based on a literature review, a critical inventory of existing definitions from foundational studies has been conducted to develop a hierarchical terminological synthesis that clearly distinguishes the materials according to their origin, pedogenetic evolution and to their geotechnical properties. The engineering behavior of lateritic materials provides a basis to specify and classify their components and their uses in engineering practices. It emerges that the semantic diversity in the terminology of lateritic materials reflects multidisciplinary approaches namely geological, pedological, and geotechnical. Depending on their origin, pedogenetic evolution, geotechnical properties, or intended use, these materials can be employed as compressed earth blocks (CEB) or cut laterite blocks (CLB), pavement layers, dikes, ceramics, etc. Moreover, engineering applications should clearly distinguish or classify all aspects of lateritic materials,(gravelly, sandy, and clayey) and specify the appropriate use of each type of lateritic material based on the requirements of specific works and grounded in pratical engineering criteria.

Keywords: *latertitic materials, terminological clarification, classification, uses*

Thermal insulation solution from plant fibres: experimental data and modelling

L. Deborde[1,2] [0000-0002-7760-9215], F. Collet[1][0000-0002-7673-1972], C. Lanos[1][0000-0001-5492-3474]

[1] CAVAC Biomatériaux, France
[2] Université de Rennes, Laboratoire Génie Civil et Génie Mécanique, France

christophe.lanos@univ-rennes.fr

Abstract. The integration of high-performance biobased materials is a lever for reducing the environmental impact of the construction industry. Hemp fibers, a local and annual plant resource, is particularly well suited to insulation applications. The hygrothermal performance of hemp fibers-based insulation (INNOFIB) is being studied at building scale, through experimental monitoring before and after renovation of the attic of an inhabited house, over a period of 18 months. Temperature, relative humidity and heat flow were recorded. By combining these measurements, we were able to assess summer comfort on-site, the apparent thermal conductivity of the insulation and observe the impact of moisture adsorption and desorption on heat transfer. These results confirm the importance of hygrothermal coupling within the bio-based material. WUFI® modelling was carried out to complete the study. The INNOFIB insulation material was created in the materials library with the thermal conductivity measured with heat flux meter and the hygrothermal parameters identified using the inverse method developed at LGCGM. The numerical response of the attic floor before/after renovation is validated by reproducing the demonstrator operating conditions. In the presence of a theoretical sinusoidal load, these simulations make it possible to accurately assess the phase shifts and damping in the two configurations. They can also be used to study the attic floor over a typical year in Bordeaux's climate to produce an energy balance. Simulation of the two configurations enables us to assess the heating and cooling capacity, as well as heat loss through the ceiling. The results show that the developed insulation is effective and the improvement in summer comfort is significant.

Keywords: *Hemp fibers, hygrothermal properties, in site measurement.*

Training in Interior Architecture Design is intricately linked with the objective of Sustainable Development

Vo Thi Thu Thuy

Department of Architecture – Interior Design – Applied Fine Arts, Nguyen Tat Thanh University, Ho Chi Minh City, Vietnam

vttthuy@ntt.edu.vn

Abstract. In the context of global environmental crises, integrating sustainable development (SD) principles into architectural education has become imperative. This synthesis-based study proposes an integrated framework for embedding sustainable development into interior architecture design education through three core dimensions: (1) selecting and applying green materials such as translucent concrete and recycled wood; (2) enhancing ecological elements through the strategic integration of greenery and climate control systems; and (3) establishing a practice-oriented studio training framework that incorporates life cycle assessment (LCA) and building performance simulation (BPS). By synthesizing updated theories, representative case studies, and international best practices, this work aims to equip students with comprehensive knowledge, practical skills, and responsible design thinking needed to meet industry demands and contribute to sustainable architecture. The study concludes with concrete proposals for curriculum integration, interdisciplinary collaboration, and community engagement to nurture a new generation of environmentally conscious designers.

Keywords: *Sustainable development, sustainable design education, interior architecture, green materials, life cycle assessment, design thinking, design education*.

A Fiber-Based Reassessment of EC2 Biaxial Bending Rule Applied in TCVN 5574:2018

Dang-Bao Tran[0000-0003-0367-9779]

[1] Faculty of Architecture and Civil Engineering – Thu Dau Mot University, Vietnam

baotd@tdmu.edu.vn

Abstract. This study examines the applicability of the Eurocode 2 (EC2) biaxial bending interaction equation as a practical design check for rectangular reinforced concrete (RC) beams subjected to biaxial bending without axial force within the framework of TCVN 5574:2018. Although TCVN does not explicitly include the EC2 interaction formula, its provisions for nonlinear sectional analysis allow verification against fiber-based reference models. The objective is to assess whether EC2 can provide a reliable and conservative tool for Vietnamese practice. A nonlinear fiber model was implemented in MATLAB R2023a and applied to three reinforcement layouts, each evaluated at 36 points on the EC2 interaction boundary, producing 108 cases in total. Prior to the biaxial analysis, the model was verified under uniaxial bending to confirm convergence and numerical reliability. Two indicators were investigated: (i) the normalized concrete stress (, reflecting the degree of concrete strength utilization, and (ii) the normalized reinforcement strain (, representing the ratio of the maximum steel strain to the ultimate design strain defined in TCVN 5574:2018. Concrete stress utilization remained consistently below unity, ranging from 0.56 to 0.95 with an average of 0.80, indicating significant but non-uniform reserve capacity. By contrast, reinforcement governed the response: yielding developed in most cases, though only a subset of points reached the ultimate strain. Within the present scope of rectangular cross-sections, the findings confirm that the EC2 biaxial interaction rule, when interpreted in TCVN 5574:2018, ensures safety through reinforcement-driven limit states while underutilizing concrete strength–highlighting its conservative yet practical applicability in Vietnamese design practice.

Keywords: *Reinforced concrete section; Biaxial bending; Eurocode 2; TCVN 5574:2018; Nonlinear fiber model; Interaction curve.*

A Machine Learning-Based Optimization of CFRP Design for Flexural Strengthening of RC Beams using Genetic Algorithm

Dang Dai Nam Nguyen [0009-0008-4600-4345], Hoang Nam Phan [0000-0002-8108-5522], Manh Hung Ho

Faculty of Road and Bridge Engineering, University of Science and Technology - Danang University

phnam@dut.udn.vn

Abstract. This study presents a machine learning-based optimization framework for the design of carbon fiber-reinforced polymer (CFRP) sheets used in the flexural strengthening of reinforced concrete (RC) beams. Traditional analytical and numerical approaches often require extensive computation and do not fully exploit the potential for rapid design iteration. In this work, supervised machine learning models trained on a comprehensive dataset generated from finite element simulations and experimental results are used to predict the flexural capacity of CFRP-strengthened RC beams. Key design parameters such as CFRP sheet thickness, width, tensile strength, and prestress level are treated as input features. A genetic algorithm is coupled with the trained model to minimize the CFRP volume by optimizing the CFRP design parameters, while satisfying flexural capacity, serviceability, and prestress/anchorage constraints. The proposed hybrid framework demonstrates high accuracy in performance prediction and provides optimal CFRP configurations that outperform baseline designs. This approach significantly reduces design time and supports data-driven decision-making for structural retrofitting practices.

Keywords: *CFRP strengthening, Machine learning, Genetic algorithm, Flexural capacity prediction, Design optimization*

A Study on the Application Prospects of Rigid-Frame Bridge Structures for Small-Span Bridges in Vietnam

Tuan Minh Ha[1][0000-0003-4040-7078], Kim-Anh Duong[2], Minh-Thanh Do[2], Yoshiaki Nakai[3], and Mitsuhiro Tokuno[3]

[1] Vietnam – Japan Institute of Technology, HUTECH University, Ho Chi Minh City, Vietnam
[2] Faculty of Civil Engineering, HUTECH University, Ho Chi Minh City, Vietnam
[3] Asahi Engineering Co. Ltd., Ishikawa, Japan

hm.tuan@hutech.edu.vn

Abstract. In Vietnam, simply supported reinforced concrete beam structures are popularly used for small-span bridge projects (6m<L<20m). This study evaluates the application potential of the Easy Rahmen Bridge (ERB), a type of rigid-frame structure using H-shaped steel girders, aiming to optimize design and construction. The ERB bridge offers advantages such as reducing the size of foundations and abutments, shortening construction time, and lowering maintenance costs due to the elimination of bearings and expansion joints. To assess its feasibility, a survey was conducted with 33 experts from the fields of investment, design, construction, and academia. The results indicate that nearly 88% of respondents find the technology feasible , and over 87.9% are willing to adopt it if the cost is competitive and a pilot project is available for evaluation. However, the main challenges include the span length limitation (L<25m) relative to Vietnam's river conditions and the necessity of establishing specific standards for design, construction, and acceptance. This paper proposes further research to address these difficulties, opening up prospects for the widespread application of ERB bridges in the future.

Keywords: *Rigid-frame bridge, Small-span bridge, Feasibility study, Vietnam infrastructure, Stakeholder survey.*

A novel method for designing reinforced concrete shear walls in tall buildings using deep learning

Hoang-Giap Tran[1,2], Van-Nhat-Thanh Bui[1,2*], Trong-Tri Huynh[1,2], Nhat-Linh Tran[1,2], Minh-Quan Nguyen[1,2], Minh-Huy Le[1,2], Pham-Gia-Phuc Tran[1,2], Thien-Phu Nguyen[1,2], Duc-Duy Ho[1,2]

[1]Faculty of Civil Engineering, Ho Chi Minh City University of Technology (HCMUT), Ho Chi Minh City, Vietnam
[2]Vietnam National University Ho Chi Minh City, Ho Chi Minh City, Vietnam

[*]thanh.bui1201@hcmut.edu.vn

Abstract. Recently, the use of artificial intelligence (AI), deep learning, and artificial neural networks in civil engineering has been an inevitable and rapidly emerging trend. This study presents a novel and efficient method for determining the cross-sectional dimensions and reinforcement area of reinforced concrete (RC) shear walls. A deep feedforward neural network (DFNN) is implemented and customized to investigate the correlation between internal forces, wall length, edge region length, wall thickness, and reinforcement area. Leveraging this relationship, the study proposes a method where internal forces and wall length serve as input to predict the optimal reinforcement area and cross-sectional dimensions of the edge region in RC shear walls. The proposed method demonstrates high accuracy (over 97%) in predicting shear wall designs within the training data domain. For application on shear wall designs, the DFNN model is successfully utilized to design shear walls in three additional buildings, confirming that greater similarity between the training dataset and input data leads to more accurate results. Recognizing that DFNN performance is influenced by training data and network architecture, this work signifies a substantial step forward in applying data-driven techniques to structural engineering, paving the way for future advancements in structural design optimization.

Keywords: *Artificial neural networks; Deep Learning; Reinforced concrete; Shear wall; Structural design.*

Analysis of Fracture of 3D-Printed Cementitious Materials Using a Combination of Digital Image Correlation and Acoustic Emission

Kaiyuan Zhu [1][0009-0009-9295-1615], Longsheng Wang [1][0009-0002-1657-081X], Zili Huang [1][0000-0003-4260-8033] and Giang D. Nguyen [1][0000-0003-2348-7563]

[1] School of Architecture and Civil Engineering, University of Adelaide, SA 5005, Australia

g.nguyen@adelaide.edu.au

Abstract. 3D-printed cementitious materials are based on layer-by-layer additive manufacturing technology, which inevitably results in weak interfaces between layers. This significantly reduces structural strength, promoting the propagation of abrupt and brittle cracks under extreme loading conditions. The orientation of the 3D-printed filament relative to the loading direction significantly affects structural performance. In this study, notched three-point bending experiments were performed under a servo-controlled system (i.e. crack mouth opening displacement (CMOD) control) to evaluate their flexural behaviour with snapback (or Class II behaviour). Digital image correlation (DIC) and acoustic emission (AE) were combined to capture full-field strain and damage evolution, thanks to stable post-peak behaviour and observation of a Class II response. The results showed the effect of interlayer bonding on flexural strength and cracking. Thanks to controllable response with snapback, a more accurate estimation of mode I fractured energy can be obtained. The findings highlight the importance of complete post-peak behaviour to obtain intrinsic properties and offer valuable insights for optimising the structural design of 3D-printed cementitious materials.

Keywords: *3D Printing, Cementitious Materials, Fracture, Snapback, Digital Image Correlation, Acoustic Emission.*

Analysis of change in vibration responses for tall buildings under earthquake

Hong-Huan Chiem[1,2], Thi-Truc-Ngan Nguyen[1,2*], Van-Nhat-Thanh Bui[1,2], Tong-Hy Duong[1,2], Trong-Nghia Nguyen[1,2], Hoang-Tinh Le[1,2], Minh-Quan Tran[1,2], Khanh-Hoang Vu[1,2], Duc-Duy Ho[1,2,]

[1] Faculty of Civil Engineering, Ho Chi Minh City University of Technology (HCMUT), Ho Chi Minh City, Vietnam

[2] Vietnam National University Ho Chi Minh City, Ho Chi Minh City, Vietnam

*ngan.nguyen170602@hcmut.edu.vn

Abstract. With the continuous advancement of science and technology, tall buildings worldwide, including in Vietnam, are growing not only in height but also in structural complexity. As the building heights increase, the challenges in design become more demanding, particularly in evaluating structural responses to dynamic loads such as earthquakes. Consequently, the vibration analysis of tall buildings under seismic conditions has become a crucial topic for structural research. This study investigates the dynamic behavior of a reinforced concrete tall building under both free vibration and earthquake-induced vibration. Firstly, the structural tall building is simulated by using the finite element method. Then, the structural vibration responses, including accelerations, natural frequencies, and mode shapes, are analyzed. Acceleration data is collected at various elevations along the building height. The frequency domain decomposition (FDD) method is employed to identify the vibration characteristics (i.e., natural frequency and mode shape) through the analysis of acceleration data induced by the earthquake. Finally, the vibration characteristics under earthquake excitation are compared and evaluated against those obtained from the free vibration analysis.

Keywords: *Vibration; Natural frequency; Mode shape; Tall building; Earthquake*.

Analytical Study on Interface Models between Precast Permanent Formwork and Cast-in-Place Concrete for the Flexural Behavior of Reinforced Concrete Beams

Van Rin Tran[0009-0006-2543-9433], Cong Chanh Doan, Minh Hai Nguyen[0000-0002-7085-2597], Hoang Nam Phan [0000-0002-8108-5522]

Faculty of Road and Bridge Engineering, The University of Danang - University of Science and Technology

phnam@dut.udn.vn

Abstract. The use of precast permanent formwork systems has emerged as a promising solution to reduce labor demands and provide an additional protective layer that enhances the durability of reinforced concrete (RC) structures. Furthermore, because the formwork becomes an integral part of the structural cross-section, the incorporation of permanent formwork has been shown to improve the flexural capacity of RC beams. However, their flexural behavior strongly depends on the bond performance at the interface between the precast formwork and the cast-in-place concrete. This study aims to deepen the understanding of this mechanism by conducting numerical analyses that consider the effects of interface debonding on the flexural performance of RC beams. Several interface modeling approaches, including contact cohesive behavior, spring connections, frictional contact, and cohesive zone modeling, were utilized to clarify the corresponding flexural responses of beams under different interface conditions. By comparing these numerical results with previous experimental data for various interface configurations, this study identifies suitable interface models for accurately capturing the debonding failure mechanisms in RC beams, corresponding to different surface conditions of the permanent formwork.

Keywords: *Flexural behavior, Permanent formwork, Interface debonding, Surface interaction modeling, FEA, Parametric study*

Artificial Neural Network Models for Predicting the Expected Peak Displacement of Seismic Isolation Systems Using Single Friction Pendulum Bearings

Nhan Dinh Dao[1][0000-0003-3429-8477] and Dan Van Tran[1]

[1] University of Architecture Ho Chi Minh City, Ho Chi Minh City, Viet Nam

nhan.daodinh@uah.edu.vn

Abstract. This study developed artificial neural network (ANN) models that accurately predict the expected peak displacement of isolation systems using single-friction pendulum bearings during strong earthquake scenarios. Each earthquake scenario is represented by a set of strong earthquake motions, containing both pulse-like and no-pulse motions. The data for developing the ANN models was obtained from 1,250,000 nonlinear time-history analyses of 135 isolation systems subjected to 9,000 ground motions. To provide easy-to-use models, the ANN models utilize standard parameters, including the friction coefficient and effective radius of the bearings, as well as spectral accelerations representing the earthquake scenarios. In addition to developing the ANN models, this study also examines the impact of ground motion types and the selection of spectral acceleration on the accuracy of the ANN models. The results from this study provide reliable tools for designing isolation systems and insight into the effect of selective parameters on the accuracy of the prediction.

Keywords: *Friction bearings ; artificial neural network ; peak displacement.*

Comparison of Wind Tunnel and Numerical Responses of a Cable Stayed Bridge

Roberto Gomez-Martinez[1][0000-0003-2732-0293], Raul Sanchez-Garcia[1][0000-0002-4429-7083], Marco Mendoza-Mendoza[1], Luis Arenas-Garcia[1] and Oscar Rosales-Gonzalez[1]

[1] Instituto de Ingeniería, Universidad Nacional Autonóma de México

rgomezm@iingen.unam.mx

Abstract. Due to their high flexibility, low damping, and the geometric configuration of the deck and pylons, cable-stay bridges are highly susceptible to wind effects during both construction and service phases. These structures may experience vibration phenomena such as vortex shedding at low wind speeds, and instabilities such as flutter and buffeting at higher wind speeds. To analyze these effects, scale models of bridges are typically tested in wind tunnels to study static and dynamic wind loads, aeroelastic instabilities, and vortex-induced vibrations. In addition to these experimental tests, this study investigates the same cable-stayed bridge through fluid-structure interaction (FSI) simulations, which also account for the topography of the construction site. The simulated response is then compared with results from an aeroelastic wind tunnel model of the complete bridge. The main objective of this paper is to review the aerodynamic response of the Carrizo cable-stayed bridge.

Keywords: *Cable Stayed Bridges, Wind tunnel testing, CFD simulation*.

Comparative Analysis of Seismic and Static Performance in Reinforced Concrete and Bamboo-Concrete Hybrid Structures for Multi-Storey Buildings in HCMC, Vietnam

Phi-Long Nguyen[1][0000-0002-2827-2951] and Trung-Phong Le[2,*][0009-0008-4796-6220]

[1] Vietnam Aviation Academy, 104 Nguyen Van Troi street, Phu Nhuan ward, Ho Chi Minh city, Vietnam
[2] Thuyloi University, 175 Tay Son street, Kim Lien ward, Ha Noi Capital city, Vietnam

*phonglt@tlu.edu.vn

Abstract. The escalating demand for sustainable construction materials in seismic-prone regions has prompted innovative approaches to high-rise building design. This study presents a comprehensive theoretical comparative analysis of three structural design schemes for a hypothetical 10-story building located in Ho Chi Minh City, Vietnam: Scheme A (traditional reinforced concrete, RC), Scheme B (RC with lightweight floors and partitions), and Scheme C (optimized bamboo-concrete hybrid with truss and cable systems). Employing finite element modeling under both static gravity loads and seismic response spectrum analysis per Vietnamese standards, the investigation evaluates key performance metrics including top displacement, inter-story drift ratios, axial force demand-capacity ratios, and concrete volumes. Results indicate that Scheme C exhibits superior seismic resilience, with negligible performance deviations between static and seismic conditions (e.g., 0.08% increase in top displacement compared to Scheme A's 53.50%), achieving a 100% pass rate for axial force checks on columns and walls, Scheme B provides intermediate benefits, with a 98.70% drift increase under seismic loads and a 55% pass rate for columns. These findings underscore the potential of bamboo-concrete hybrids to enhance structural efficiency, sustainability, and resilience in multi-story constructions.

Keywords: *Reinforced concrete Bamboo, Bamboo-concrete composite, Seismic analysis, multi-storey building, Sustainable construction, Comparative design*.

Damage Assessment after the Blast of Ultra High Performance Concrete Columns: A Numerical Study

Van Tu Nguyen[0000-0002-0298-5080], Hoang Long Le [0000-0003-0654-7712], and Viet Chinh Mai[0000-0001-7601-3391]

Institute of Construction Technology, Le Quy Don Technical University, 236 Hoang Quoc Viet, Ha Noi, Viet Nam

lehoanglong@lqdtu.edu.vn

Abstract. This study numerically investigates the blast resistance and post-blast performance of ultra-high-performance fiber-reinforced concrete (UHPFRC) columns. The Karagozian–Case (K&C) material model combined with the CONWEP blast loading approach in ABAQUS is employed to analyze deformation response, failure mechanisms, and residual load-carrying capacity under near-field explosive scenarios. Validation against published experimental results confirmed the reliability of the numerical predictions in terms of deflections and damage distribution. On this basis, pressure–impulse (P–I) diagrams are established to characterize structural performance at multiple damage levels. The findings highlight the capacity of UHPFRC columns to maintain structural integrity and dissipate blast energy effectively, thereby providing a quantitative basis for damage assessment and performance-based design of protective structures.

Keywords: *Ultra-High-Performance Fiber-Reinforced Concrete (UHPFRC); Blast resistance; Numerical simulation; Columns; CONWEP.*

Damage detection in a cable-stayed bridge model using 1DCNN with channel attention and augmented FBG data

Huu-Quyet Nguyen[1][0000-0001-7186-4509], Ngoc-Lan Nguyen[2][0000-0002-0078-4074], Thanh Bui-Tien[2][0000-0002-4001-9246], Hoa Tran-Ngoc[2][0000-0003-2161-8064], Franziska Schmidt[1][0000-0001-9277-9805] and Le-Hung Tran[1][0000-0002-5644-0959]

[1] EMGCU/MAST, Université Gustave Eiffel, 77454 Marne-la-Vallée, France
[2] Faculty of Civil Engineering, University of Transport and Communications, Hanoi, Vietnam

huu-quyet.nguyen@univ-eiffel.fr

Abstract. This study proposes a deep learning-based method for structural damage detection in a laboratory-scale cable-stayed bridge using time-series strain data collected from Fiber Bragg Grating (FBG) sensors. A one-dimensional Convolutional Neural Network (1DCNN) is integrated with a Channel Attention (CA) mechanism to enhance the model's ability to focus on informative features across sensor channels. To address the challenge of limited data, various data augmentation techniques such as noise injection, signal reversal, window cropping, random shifting, temporal warping and segmenting are applied. The proposed 1DCNN-CA model is trained to classify multiple damage simulation scenarios, including intact and damaged cases under different loading conditions. Experimental results show that the proposed model outperforms 1DCNN, achieving higher classification accuracy and better generalization. The integration of the CA mechanism allows the network to adaptively weigh important feature channels, improving sensitivity to structural changes. This work demonstrates the potential of combining advanced deep learning architectures and smart sensing data for accurate, automated structural health monitoring in complex bridge systems.

Keywords: *Laboratory-scale model, time-series data, 1DCNN, channel attention mechanism, data augmentation techniques.*

Differential pressure on large building roofs during a tornado

Ngoc-Tinh Nguyen[1,*], Thanh-Viet Tran[1,*], Quoc-Lam Nguyen[1], Khanh-An Dang[1], and Linh-Ngoc Nguyen[2]

[1] Faculty of Civil Engineering, Duy Tan University, Da Nang 550000, Vietnam
[2] Ngoc Linh Tile Co.Ltd

nguyenngoctinhsxd@gmail.com

Abstract. Tornado effects on a building are complex because a tornado is essentially a low-pressure field (990-890 hPa of minimum) in a small range (typically 50-300 m in diameter), develops within severe winds, which can, in cases of closed or partially vented structures, produce direct differential pressure loads, therefore it is extremely dangerous to large low-rise buildings, especially roof of them. The recent research show that opening the vent to the outside can significantly reduce the pressure difference between the inside and outside of the building. However, a typical tornado is usually small in diameter compared with industrial buildings, which affects the pressure difference between the inside and outside of the building during the tornado. In this paper, the authors present new investigations of differential pressure on the roof of a large low-rise building with openings during a tornado equivalent to EF1 level in the EF-Scale. Through this, explain why an industrial building roof was destroyed by a small tornado in Vietnam.

Keywords: *Tornado, Wind, Pressure, Building.*

Direct Tension and Flexural Tests on Prefabricated HSC Panels Embedded with CFRP Strips for Strengthening Applications

Tran Duc Dang[1] , Manh Cuong Nguyen[1], Van Quang Nguyen[1], Thanh Trung Vu[2], Thuy Duong Tran[1] and Trung Hieu Nguyen[1,*]

[1] Department of Civil Engineering, Hanoi University of Civil Engineering, Hanoi, Vietnam
[2] Vietnam Institute for Building Science and Technology

hieunt@huce.edu.vn

Abstract. This study examines the structural performance of thin high-strength concrete (HSC) panels reinforced with embedded carbon fiber–reinforced polymer (CFRP) strips, referred to as HSC-CFRP panels. Unlike conventional externally bonded CFRP sheets, the strips (10 mm wide, 0.167 mm thick) were placed within 10 - 20 mm thick HSC overlays to improve bond quality and protect the reinforcement from environmental effects. An experimental program was carried out with direct tension tests and four-point bending tests on small-scale panels. The tension tests measured the load-deformation behavior, while the bending tests evaluated the overall load-deflection response. Results showed that the embedded CFRP strip within an HSC matrix contributed effectively to load resistance and worked well together with the HSC matrix. These findings confirm that HSC-CFRP panels can be applied for strengthening reinforced concrete structures, improving both strength and durability.

Keywords: *CFRP, high-strength concrete (HSC), HSC-CFRP prefabricated panel, direct tensile test, flexural test.*

Effect of steel fibers in ultra-high-performance concrete on the flexural behavior of two-layer concrete beams

Nguyen Van Quang[1*], Pham Thanh Tung[1], Tran Van Dau[1], Dang Tran Duc[1] and Nguyen Trung Hieu[1]

[1] Hanoi University of Civil Engineering (HUCE), Hanoi, Vietnam

*quangnv@huce.edu.vn

Abstract. Ultra-High-Performance Fiber-Reinforced Concrete (UHPFRC) is a new-generation cementitious material with superior mechanical properties. One promising application of UHPFRC is in the repair and strengthening of reinforced concrete members, where the tensile behavior of the material can be effectively mobilized. This study aims to clarify the influence of fiber content—the key factor governing the tensile response of UHPFRC—on the flexural performance of plain concrete beams. Eight beam specimens with dimensions of 100 × 100 × 400 mm were fabricated, including two single-layer plain concrete beams as reference specimens and six two-layer beams. The latter were composed of 80 mm plain concrete in the compression zone and a 20 mm UHPFRC layer in the tension zone, with fiber volume fractions of 0%, 1%, and 2%. Four-point bending tests demonstrated the effectiveness of using UHPFRC as a tensile layer. Owing to the fiber-bridging effect, the strengthened beams exhibited improved ductility, avoided sudden brittle failure, and played a significant role in sustaining and enhancing the load-carrying capacity after the initiation of the first crack.

Keywords: *Ultra-High-Performance Fiber-Reinforced Concrete, UHPFRC, Strengthening, Two layers, Normal Concrete.*

Effect of Circular Web Openings on the Shear Strength of Cold-Rolled Aluminium Channel Sections

Xuyang Chen[1][0009-0007-4589-4617] , Song Hong Pham[2][0000-0002-2894-8907], and Cao Hung Pham[1][0000-0002-5503-5839]

[1] School of Civil Engineering, The University of Sydney, NSW 2006, Australia
[2] Faculty of Civil Engineering, University of Architecture Ho Chi Minh City, Vietnam

xuyang.chen@sydney.edu.au

Abstract. Cold-rolled aluminium channel sections have recently been introduced as an alternative to conventional extruded aluminium members, offering improved material efficiency and manufacturing productivity. Due to their thin webs and the relatively low elastic modulus of aluminium, these sections are prone to shear buckling, while the presence of web openings can further reduce shear capacity by interrupting shear load transfer and post-buckling resistance mechanisms. This paper presents an experimental and numerical investigation into the shear behaviour of cold-rolled aluminium channel sections with circular web openings. An experimental program was conducted at the University of Sydney using a dual-actuator test rig to apply predominantly shear loading while minimizing the influence of bending moments. BlueScope Permalite commercial purlin C250 channel specimens with shear span-to-depth ratios of 1.0 and 2.0 were tested to investigate the influence of web opening sizes on their ultimate shear strength and failure mechanisms, achieved by varying the ratio of opening diameter to web depth. Detailed finite element (FE) models were developed in ABAQUS to simulate the experimental setup in order to benchmark the test results and extend the database for parametric study. The FE predictions are validated against the test results in terms of ultimate shear capacity and failure modes. The results demonstrate that increasing the size of circular web openings leads to a significant reduction in shear capacity. The combined experimental and numerical findings provide insights into the shear load transfer and post-buckling behaviour of CRA channel sections with web openings.

Keywords: *Cold-Rolled Aluminium. Channel Section, Shear Strength*

Effects of Different Layer Thickness of 3D-Printed Per-manent Formwork on the Serviceability Behavior of Re-inforced Concrete Beams

Bunleang MAK[1], Tae-Kyung KIM[1], Sangwoo OH[1], Jinsuk LEE[1], Seongcheol CHOI[2], and Chang-Su SHIM[2*]

[1] Ph.D. Student, Department of Smart Cities, Chung-Ang University, Seoul, Republic of Korea
[2] Professor, Department of Civil and Environmental Engineering, Urban Design and Studies, Chung-Ang University, Seoul, Republic of Korea

csshim@cau.ac.kr

Abstract. The development of 3D-printed permanent formwork (3DPF) has introduced innovative construction methods, offering a digitally manufactured alternative to conventional formwork with advantages in automation, design flexibility, reduced labor, and material efficiency. However, the influence of printing parameters, particularly layer thickness, on the structural behavior of reinforced concrete (RC) members remains insufficiently investigated. This study examines the flexural cracking behavior of RC beams incorporating 3DPF with different layer thicknesses. Cracking load, flexural stiffness, and crack patterns under service conditions were evaluated. Two beam specimens were fabricated with 10 mm and 15 mm layer thicknesses, respectively, and tested under four-point bending. Instrumentation included steel strain gauges attached to the reinforcement and a displacement transducer at mid-span. The results demonstrate that layer thickness significantly influences crack development and stiffness. The 3DPF-15 specimen showed delayed crack initiation, and slightly higher flexural cracking resistance, while the 3DPF-10 specimen exhibited earlier crack formation and a greater number of flexural cracks. These findings highlight the importance of selecting an appropriate 3DPF layer thickness to enhance the serviceability and durability of composite beam members.

Keywords: *3D-printed permanent formwork (3DPF), cracking load, flexural cracks, crack pattern, service conditions.*

Elastic Shear Buckling of Beams with

Assorted Shaped Corrugated Webs

Jingyi Zhang and John Papangelis

School of Civil Engineering, University of Sydney, Australia

john.papangelis@sydney.edu.au

Abstract. The preponderance of beams with corrugated webs in the construction industry has increased in recent years. The majority of these beams usually have thin trapezoidal corrugated webs and flanges composed of thick plates. One important design aspect of these beams is the assumption that the longitudinal stiffness of the corrugated web is negligible. Therefore, the design moment capacity is calculated entirely from the flanges while the shear capacity is derived from the shear strength of the web. One major advantage of beams with corrugated webs is the enhanced resistance to shear buckling over beams with flat webs without the need to weld stiffeners to the web. In the past, most research on beams with corrugated webs has focused on beams with webs that have trapezoidal shaped corrugations. However, it may be possible to increase the shear buckling capacity by using different shapes for the corrugated web. In this paper, a finite element analysis is used to analyse the elastic shear buckling of beams with corrugated webs of assorted shapes. The corrugated shapes include trapezoidal, sinusoidal, circular, triangular, elliptical and parabolic. The aim is to determine which corrugated shape has the best performance in resisting shear buckling. The results show that curved corrugated webs have higher elastic shear buckling stresses than corrugated webs with flat panels. In some cases, the circular corrugation shape has an elastic shear buckling stress which is more than twice the value of the elastic shear buckling stress for a trapezoidal corrugation shape.

Keywords: *Structures, Shear, Buckling, Beam, Corrugated Web, Finite Element Analysis.*

Evaluation of Bolt Characteristics in End-Plate Connections Using Fibre Optic Technology

Aleksander Kozlowski[1[0000-0003-0920-6681]], Tomasz Siwowski,[1[0000-0002-2003-000X]], Maciej Kulpa[1[0000-0002-8550-7382]] and Damian Nykiel[1[0000-0003-2259-5917]]

[1] Rzeszow University of Technology, Rzeszow, 2 Poznanska, POLAND

kozlowsk@prz.edu.pl

Abstract. The mechanical behavior of bolts plays a crucial role in the safety and reliability of both individual connections and entire steel structures. Key factors influencing bolt performance include design parameters as well as manufacturing and technological processes. In standard tensile strength tests, safety assessment is typically based on the average axial deformation of the bolt shank. Such an approach neglects the effects of mechanical and thermal processing, does not differentiate between the threaded region and the transition zone adjacent to the nut, and disregards stress concentrations caused by thread notches within the clamping length. This paper presents the application of advanced measurement techniques for the assessment of bolt behavior under tensile loading, including non-contact methods such as digital image correlation (DIC) and innovative fiber optic sensing technology. Based on experimental observations, practical recommendations are formulated. Owing to the complex interaction of multiple factors governing the tensile response of bolted connections, bolt testing should be conducted on complete assemblies comprising the bolt, nut, and washers. Furthermore, deformation measurements should be performed along the entire bolt length. The paper presents preliminary results obtained from bolt tensile tests carried out within an ongoing research project at Rzeszów University of Technology.

Keywords: *steel structures, bolted connections, end-plate joints, tensile tests, fiber optic sensors*

Experimental and numerical study of hybrid steel-timber beams in bending

JURKIEWIEZ Bruno[1][0000-0001-9927-1801], ARNOULD Vincent[1,2][0009-0000-5336-5757], DURIF Sébastien[2][0000-0002-1202-4179], BOUCHAIR Abdelhamid[2][0000-0003-2179-421X]

[1] Université Claude Bernard Lyon 1, Laboratory of Composite Materials for Construction (LMC2), 82 boulevard Niels Bohr, 69100 Villeurbanne, France
[2] Université Clermont Auvergne, Clermont Auvergne INP, CNRS, Institut Pascal, F-63000 Clermont-Ferrand, France

bruno.jurkiewiez@univ-lyon1.fr

Abstract. The combination of timber elements and steel beams can be of high interest for mechanical performance, regarding mainly local and global instabilities, in addition to the resistance under fire exposure. Compared to concrete-based structures, steel-timber girders allow to reduce CO2 emissions and are demountable. In this paper, experiments and numerical modelling are performed to analyze the behavior of various configurations of steel-timber beams in bending. Two timber beams are connected to the web and the flanges of the steel beam. In order to define the material properties of the tested elements, each component (timber and steel) has been tested separately. Then, timber and steel beams were connected and tested up to failure. The observed behavior shows a limited effect of composite action in the elastic domain. However, the effect is significant at the ultimate stage. Actually, the combination of timber and steel elements improves the resistance to lateral torsional buckling and local buckling of the steel beam. FEM is finally carried out, and numerical results are compared to measurements. These results highlight the potential of the steel-timber hybrid elements for further developments.

Keywords: *Steel-timber element, Hybrid structures, Bending tests, Numerical analysis.*

Generative Adversarial Networks for Structural Response Prediction of 2D Trusses

George Papazafeiropoulos[1][0000-0002-9404-4447], Quang-Viet Vu*[0000-0002-4814-8835], Nguyen Pham Dinh[2][0009-0006-7134-3539], and Dai-Nhan Le[3]

[1] School of Civil Engineering, National Technical University of Athens, Athens, Greece
* Faculty of Advanced Technology and Engineering, VNU Vietnam Japan University, Hanoi, Vietnam
[2] Faculty of Civil Engineering, VNU Hanoi-University of Engineering and Technology, 144 Xuan Thuy, Cau Giay, Hanoi, Vietnam
[3] Center of Excellence in Applied Mechanics and Structures, Department of Civil Engineering, Chulalongkorn University, 10330, Bangkok, Thailand

vq.viet@vju.ac.vn

Abstract. Generative Adversarial Networks (GANs) have recently emerged as powerful tools for learning complex, high-dimensional data distributions. This study explores a novel application of GANs in the benchmark 2D 10-bar truss structure subjected to static loads. A GAN framework is developed to generate high-fidelity structural response data of the 10-bar truss, which includes 10 cross sectional area values corresponding to each truss design and 4 output variables resulting from the static response of the corresponding truss, i.e. maximum stress, minimum stress, maximum horizontal displacement and minimum horizontal displacement. Numerical experiments on the benchmark truss examples demonstrated not only that the GAN exhibits stable behavior after training, but also that the proposed GAN model can generate artificial data which is quite realistic and follows the same distribution as the real structural data taken from static analyses. This finding suggests that GANs can serve as efficient surrogate models for structural analysis, potentially transforming the design paradigm for high-performance structures.

Keywords: *Generative Adversarial Networks (GANs), Generator, Discriminator, Fake Data, Structural Response Prediction, 10-bar truss.*

Geometric Nonlinear Analysis of Glued Laminated Timber Columns with Different Initial Imperfection Profiles

Le Thuy Nguyen[1][0009-0007-4834-9008], Hong Son Nguyen[1] [0009-0005-5360-8938], Thuy Van Tran Thi[1][0000-0003-4873-3898] and Vuong Pham Ngoc[2] [0009-0001-6962-9785]

[1] Hanoi Architectural University, Hanoi, Vietnam
[2] Vietnam Maritime University, Haiphong, Vietnam

vanttt@hau.edu.vn

Abstract. Initial geometric imperfections are unavoidable in glued laminated timber (GLT) columns due to material heterogeneity, manufacturing tolerances, and construction deviations. These imperfections play a critical role in activating geometric nonlinearity and significantly influencing the stability behaviour of compression members. While design standards commonly assume a sinusoidal imperfection shape, the influence of alternative imperfection profiles remains insufficiently clarified. This study investigates the effect of different initial imperfection shapes on the geometrically nonlinear buckling response of GLT columns subjected to axial compression under linear elastic assumptions. Three representative imperfection profiles with identical mid-height amplitudes are considered, namely sinusoidal, parabolic, and localized Gaussian shapes. An analytical second-order beam–column formulation, incorporating P–Δ effects and first-mode imperfection projection, is employed to derive the load–midspan displacement relationship and the displacement amplification factor. The results reveal pronounced imperfection sensitivity as the applied load approaches the critical Euler load. For identical imperfection amplitudes, different imperfection shapes lead to distinct displacement responses and amplification characteristics, highlighting the combined influence of imperfection magnitude and spatial distribution. The proposed framework provides a simple and efficient basis for evaluating imperfection sensitivity in slender timber compression members.

Keywords: *Glue Laminated Timber Column, Initial Imperfection, Geometric Nonlinear Analysis, Buckling Response.*

Influence of Infill Walls on Progressive Collapse Behavior of Reinforced Concrete Frames Under Sudden Column Loss Scenarios

Phu-Anh-Huy Pham [1, 2] [0000-0002-9476-0910], Cao-Vinh Le [1, 2], Van-Tien Nguyen [2, 3]

[1] Institute of Research and Development, Duy Tan University, Da Nang, 550000, Vietnam.
[2] Faculty of Civil Engineering, Duy Tan University, Da Nang, 550000, Vietnam.
[3] Huu Tien Limited Construction Company, 55000, Danang, Vietnam.

*phampanhhuy@duytan.edu.vn

Abstract. Progressive collapse represents a critical threat to reinforced concrete (RC) frame structures subjected to sudden column loss induced by abnormal loading or seismic events. Although masonry infill walls (IWs) are commonly treated as nonstructural components, they can substantially alter load redistribution mechanisms by enhancing lateral stiffness or, conversely, by triggering soft-story behavior that concentrates damage. This study develops and validates a nonlinear full-frame modeling framework in OpenSees to quantify the influence of IWs on the progressive collapse response of RC frames. The model incorporates fiber-based forceBeamColumn elements, zeroLength joint springs, and equivalent multi-strut representations for infill walls calibrated against experimental data. A ten-story, three-bay RC frame is analyzed through nonlinear dynamic time-history simulations under the El Centro 1940 ground motion, considering bare frames, fully infill frames with different wall thicknesses (70 mm and 330 mm), and a soft-story configuration with first-story infill removal. The results demonstrate that fully infilled frames significantly reduce interstory drift and internal force demands, with column bending moments and shear forces reduced by up to approximately 30–35% and beam force demands reduced by as much as 50%, primarily due to suppression of P–Δ amplification and the development of alternative load-transfer paths. In contrast, soft-story configurations negate these benefits, leading to localized deformation and increased force demand. The findings highlight the critical importance of accounting for geometric nonlinearity and realistic infill modeling in progressive collapse assessment and provide mechanistic insights to support design strategies aimed at enhancing the robustness of RC frames.

Keywords: *progressive collapse; infill walls; reinforced concrete frames; nonlinear dynamic analysis; catenary action; soft story.*

Improving Bi-objective Truss Optimization by Feasible Boundary Search and Metaheuristics

Anh-Vu Nguyen[1] and Hoang-Anh Pham[1,2*]

[1] Department of Structural Mechanics, Ha Noi University of Civil Engineering, 55 Giai Phong, Hanoi, Vietnam
[2] Frontier Research Group of Mechanics of Advanced Materials and Structures (MAMS), Ha Noi University of Civil Engineering, 55 Giai Phong, Hanoi, Viet Nam

anhph2@huce.edu.vn

Abstract. Metaheuristic algorithms are increasingly utilized in structural optimization, particularly for truss structures, due to their ability to handle diverse problems without requiring initial starting points or derivative calculations. However, their computational cost is a notable drawback. In multi-objective truss optimization, finding optimal solutions that satisfy complex design constraints, such as stress and displacement, involves extensive iterative computations, significantly increasing the computational cost. This study introduces the Feasible Boundary Search technique (FBS) to multi-objective metaheuristic-based optimization of planar and spatial trusses, targeting the minimization of weight and displacement of the structures. Two multi-objective metaheuristic algorithms, namely the third evolution step of generalized differential evolution (GDE3) and the multi-objective Rao algorithm (RAO), combined with FBS are applied to four bi-objective benchmark examples to demonstrate the effectiveness of the proposed strategy. Numerical results show that FBS can improve the optimized structural weight. Especially, both GDE3 and RAO equipped with FBS demonstrate better performance than that of the original algorithms, considering some performance indicators such as hypervolume, generational distance, and inverted generational distance.

Keywords: *Bi-objective Truss Optimization, Metaheuristics, Feasible Boundary Search, GDE3, Rao algorithm*

Investigation on the Flexural Strengthening Efficiency of RC Stepped Beams with Insufficient Anchorage Length Using Carbon Fiber-Reinforced Polymer (CFRP)

Xuan Tam Nguyen[1] , Van Thuat Dinh[2] , Thuy Duong Tran[2] and Trung Hieu Nguyen[2][*]

[1] Thang Long Architectural Construction Company Limited, Hanoi, Vietnam
[2] Faculty of Building and Industrial Construction, Hanoi University of Civil Engineering, Hanoi, Vietnam

hieunt@huce.edu.vn

Abstract. The paper presents an experimental study evaluating the flexural strengthening efficiency of reinforced concrete (RC) stepped beams with deficiencies caused by insufficient anchorage length, using carbon fiber-reinforced polymer (CFRP) sheets. Due to their discontinuous geometry, RC stepped beams develop stress concentrations at depth transition zones and often experience various failure mechanisms that are difficult to predict. The experimental program involved two beam specimens with the reinforcement detailed at the minimum anchorage length at the section transition: one unstrengthened control specimen and one specimen strengthened with externally bonded CFRP sheets. The results indicate that CFRP modified the failure mechanism and confirmed its effectiveness in enhancing both the stiffness and ultimate strength of the beams.

Keywords: *Flexural strengthening, Stepped beams, CFRP.*

Long-term Structural Performance of an All-FRP Bridge Assessed Using DFOS Measurements

Tomasz Siwowski[1][0000-0002-2003-000X], Aleksander Kozłowski[1][0000-0003-0920-6681] and Maciej Kulpa[1][0000-0002-8550-7382]

[1] Rzeszow University of Technology, 12 Powstancow Warszawy Str., 35-959 Rzeszow, Poland

siwowski@prz.edu.pl

Abstract. FRP (fibre-reinforced polymer) composite bridges have been in service since the mid-1990s, allowing assessment of their long-term performance. Many of the early FRP bridges in the USA and Western Europe were equipped with monitoring systems to evaluate their structural integrity over time. The data from these field tests are now becoming available, offering valuable insights into the durability and performance of FRP composite bridges. In Poland, the first all-FRP composite bridge was also fitted with a modern structural health monitoring (SHM) system, enabling long-term performance assessment. Over nearly a decade of use, the bridge's strains, stiffness, and dynamic properties have been analysed three times through static and dynamic load tests. This paper compares the results of these load tests and provides insights into the bridge's long-term performance. The innovative strain measurement system, based on distributed fibre-optic sensing (DFOS), enables assessment of changes in load-carrying capacity, stiffness, and dynamic behaviour during service. Research findings show that the bridge has maintained satisfactory structural integrity and durability over nearly ten years of operation.

Keywords: *FRP bridge, distributed fibre optic sensing, structural health monitoring, load test, safety.*

Multi-Objective Optimization of Gravity Retaining Walls Using Simple Differential Evolution

Vu Truong Vu [1][0000-0003-3865-5646]

[1] Faculty of Civil Engineering, Nguyen Tat Thanh University, Ho Chi Minh City, Vietnam

vtvu@ntt.edu.vn

Abstract. This study introduces an application of the simple Differential Evolution algorithm to determine the Pareto front for gravity retaining walls. The objective is to simultaneously optimize for the minimum cross-sectional area and maximum factor of safety. The design of the gravity retaining walls is constrained by essential factors of safety related to sliding, overturning, and base soil bearing capacity. Unlike the original Differential Evolution algorithm, which employs fixed mutation and crossover parameters, the simple Differential Evolution algorithm utilizes a random value within the interval (0, 1) for the mutation factor and crossover constant. The efficacy of this optimization method is demonstrated across four distinct case studies. These cases incorporate varying parameters, including wall height, properties of cohesionless backfill soil, base soil bearing capacity, surcharge load, and backfill slope.

Keywords: *differential evolution, simple differential evolution, multi-objective optimization, gravity retaining wall.*

Numerical Simulation and Parametric Evaluation of Steel Beam–Column Connections with Reduced Beam Sections Using Opensees

Viet-Hieu Pham [1,2] and Phu-Anh-Huy Pham [1,2*[0000-0002-9476-0910]]

[1] Institute of Research and Development, Duy Tan University, Da Nang, 550000, Viet Nam
[2] Faculty of Civil Engineering, Duy Tan University, Da Nang, 550000, Viet Nam

* phampanhhuy@duytan.edu.vn

Abstract. This study investigates the seismic performance of steel beam–column connections with Reduced Beam Section (RBS) detailing using a nonlinear finite element framework developed in OpenSees. The proposed model integrates fiber-based beam–column elements, zeroLength panel zone springs, and rotational springs at the RBS region to capture plastic hinge formation and joint-level inelastic behavior. Four connection configurations are examined, including a conventional welded joint (NoRBS) and three RBS variants (RBS80, RBS65, and RBS50), subjected to the El Centro 1940 ground motion. The results indicate that NoRBS joints exhibit limited ductility and low energy dissipation, whereas RBS detailing significantly enhances seismic performance by relocating plastic hinges away from critical weld regions. Among the RBS configurations, RBS80 largely preserves strength but restricts deformation capacity, while RBS50 provides high ductility at the expense of strength and stability. In contrast, RBS65 achieves the most balanced response, combining stable hysteretic behavior, high cumulative energy dissipation, and adequate strength retention. These findings confirm the effectiveness of RBS detailing and demonstrate that the proposed OpenSees-based framework provides a reliable and efficient tool for evaluating and optimizing seismic performance of steel moment-resisting connections.

Keywords: *beam–column connection, Reduced Beam Section, middle-flange stiffener, energy dissipation, OpenSees, ductility, panel zone.*

Numerical study on the strengthening effectiveness of uniaxially-loaded reinforced concrete columns with CFRP

Phuoc Lanh Le[1,*], Truong Thang Nguyen[1] and Trung Hieu Nguyen[1]

[1] Hanoi University of Civil Engineering (HUCE), Hanoi, Vietnam

*lanhlp@huce.edu.vn

Abstract. This article presents a numerical simulation model using ABAQUS software to study the behavior of reinforced concrete (RC) columns strengthening with Carbon Fiber Reinforced Polymer (CFRP) when being subjected to uniaxial eccentric compression. The proposed numerical model takes into account the following aspects: (i) The adhesion behavior of CFRP fiber reinforced panels to the concrete column surface; and (ii) The orientation of strengthening CFRP layers (in both horizontal and vertical directions along the column height). Besides, other parameters are also investigated include concrete strength, uniaxial eccentricity (e), and corner radius of the column cross-section (r_c). Having obtained relatively good agreement with a number of published experimental research works, the proposed numerical model is capable of being used for parametric studies, from which the obtained results show that: (i) The numerical simulation model can predict the performance of reinforced concrete columns; (ii) RC columns strengthening with CFRP sheets earns increment in both strength and ductility; (iii) CFRP sheets applied longitudinally are effective when RC columns are subjected to large eccentricities; and (iv) Increasing the corner radius and decreasing the concrete strength will increase the strengthening effectiveness of RC columns with CFRP.

Keywords: *Reinforced concrete, Column, Strengthening, Uniaxial bending, CFRP.*

Nonlinear Optimization of Cracking Moment in RC Sections According to TCVN 5574:2018 Using Differential Evolution

Van Giang Nguyen[1*], Nguyen Thanh Dat[2]

[1] Faculty of Civil Engineering, HUTECH University, Vietnam
[2] Faculty of Civil Engineering, Vietnam Aviation Academy, Vietnam

*nv.giang@hutech.edu.vn

Abstract. Crack control is a critical serviceability requirement in reinforced concrete (RC) structures, particularly in aggressive environments where strict limits on crack width are imposed. In Vietnam, the design standard TCVN 5574:2018 permits the use of bilinear and trilinear tensile stress–strain models to represent the nonlinear tensile behavior of concrete. However, analytically determining the minimum required tensile reinforcement area As that satisfies both the cracking moment and crack-width constraints remains challenging due to implicit dependencies on the neutral axis depth. This study proposes a nonlinear optimization framework based on the Differential Evolution (DE) algorithm to address this issue. Within the framework, DE is employed as a global optimizer to minimize As, while the cracking response is evaluated numerically by satisfying internal force equilibrium and nonlinear material relations in accordance with TCVN 5574:2018. The method is validated using both the calibration dataset and an independent experimental dataset. Results indicate that the DE-based numerical framework achieves deviations below 5% in cracking moment evaluation and reduces the required reinforcement area by up to 8% relative to conventional analytical design calculations, while meeting serviceability limit-state requirements. The proposed approach enables direct integration into automated design workflows and provides a robust computational tool for code-aligned RC design under nonlinear serviceability conditions.

Keywords: *Cracking moment, Nonlinear behavior, TCVN 5574:2018, Differential Evolution, Reinforced concrete, Optimization.*

Nonlinear static and dynamic analysis of reinforced concrete slabs subjected to different load levels

Chi-Khai Nguyen[1,2], Hong-Huan Chiem[1,2], Nguyen-Duc-Tin Pham[1,2], Van-Tuong-Khanh Vo[1,2], Tuan-Dat Lam[1,2], Tran-Huu-Tin Luu[1,2], Manh-Hung Tran[1,2], Van-Sy Bach[1,2*], Duc-Duy Ho[1,2]

[1]Faculty of Civil Engineering, Ho Chi Minh City University of Technology (HCMUT), Ho Chi Minh City, Vietnam
[2]Vietnam National University Ho Chi Minh City, Ho Chi Minh City, Vietnam

[*]bvsy.sdh2412@hcmut.edu.vn

Abstract. Reinforced concrete slabs are structures commonly used in civil engineering. It is necessary to analyze the static and dynamic behavior of reinforced concrete slabs to evaluate the working state of the slabs. This study performs the nonlinear static and dynamic analysis of reinforced concrete slabs subjected to different load levels. Firstly, a reinforced concrete slab is simulated by the finite element method to analyze the slab's static and dynamic behaviors and the corresponding responses (i.e., displacement, natural frequency, mode shape) under various load levels. For the numerical simulation, the nonlinear material behaviors and the simultaneous operation of concrete and reinforcing steel are considered. The reliability of the simulation is verified by comparing the bending moment between the numerical and calculated design results. Secondly, the natural frequency change-based method and the mode shape change-based method are employed to detect the crack in the reinforced concrete slab. The crack's occurrence in the slab is analyzed and assessed according to each load level corresponding to the actual working state of the target slab. The results show that the natural frequency change-based and the mode shape change-based damage identification methods are highly effective in detecting cracks in the reinforced concrete slabs.

Keywords: *Dynamic; Nonlinear; Reinforced concrete; Slab; Static; Structural analysis.*

Operational modal analysis for railway steel arch bridges in Poland

Duc C. Nguyen[1,*,[0000-0002-3393-0197]], Marek Salamak[2[0000-0003-3602-0575]], Andrzej Katunin[3[0000-0002-9386-5104]] and Grzegorz Poprawa[4[0000-0001-7863-1011]]

[1] Mien Trung University of Civil Engineering, Ministry of Construction, Dak Lak, Vietnam
[2] Silesian University of Technology, Faculty of Civil Engineering, Department of Mechanics and Bridges, Akademicka 2A, 44-100 Gliwice, Poland
[3] Silesian University of Technology, Faculty of Mechanical Engineering, Department of Fundamentals of Machinery Design, Konarskiego 18A, 44-100 Gliwice, Poland
[4] UIGP, Sosnowiec, Poland

*nguyencongduc@muce.edu.vn; marek.salamak@polsl.pl; andrzej.katunin@polsl.pl; marek.salamak@polsl.pl; andrzej.katunin@polsl.pl

Abstract. Operational modal analysis (OMA) is used to analyze the structural dynamics of civil engineering structures under actual operating conditions where forces are unknown or unmeasured. OMA can extract the modal parameter identifications of heavy structures using only output field vibration signals, no input excitation forces. This study presents the application of OMA method for determining natural frequencies and mode shapes of railway steel arch bridges in Poland. The stochastic subspace identification (SSI) technique is employed as the core algorithm to identify dynamic characteristics of a structure from the field vibration testing and structural health monitoring data. OMA approach can calculate both bending and torsional modes of the railway bridge, providing valuable data-driven insights for structural performance and safety assessments.

Keywords: *Railway Bridge, Vibration Analysis, Operational Modal Analysis, Stochastic Subspace Identification.*

Optimizing Seismic Analysis of Complex Structures Using Substructuring and Component Mode Synthesis: Application to Nuclear Facilities

Van Ngan Nguyen [1] , Van Nhat Le [1] , Daniela Masini [2] and Silvano Erlicher [2]

[1] Egis Group, UK
[2] Egis Group, France

van-ngan.nguyen@egis-group.com

Abstract. Seismic analysis of multi-building facilities often demands high-fidelity finite-element (FE) models with many degrees of freedom to capture building-to-building interactions, driving up runtime and storage. We present a practical procedure that combines substructuring with the Craig–Bampton Component Mode Synthesis (CMS) method to condense substructures into superelements while preserving dynamic fidelity. Applied to an EPR nuclear island (NI), reduced models reproduce the full-model response with substantially lower cost; computation time and file size decrease by over 50%

Keywords: *Seismic analysis, Substructuring techniques, nuclear facilities*.

Performance of Modular Buildings

Huu-Tai Thai[0000-0002-4461-9548]

The University of Melbourne, Parkville, VIC 3010, Australia

tai.thai@unimelb.edu.au

Abstract. Modular or prefabricated construction methods are modern methods of construction which can allow most of the building components to be manufactured off-site in a factory-controlled environment. Therefore, they can save construction time and reduce construction waste onsite compared with traditional construction methods. Such modern construction methods also offer a promising pathway towards decarbonising the building and construction industry because of their ability in enabling the reuse of structural components as well as recycling construction waste. Buildings constructed by modern methods might perform and behave differently with those constructed by conventional methods due to using different joining methods in connecting structural elements. This paper presents a summary of recent study on the overall behaviour and performance of modular buildings subjected to different loading scenarios such as wind, earthquakes, impact and fire. The paper will provide structural engineering researchers and practitioners with a better understanding of this new type of building, which will ultimately make them more confidence in adopting the new construction methods to benefit the end-users, especially the housing sector and low-income households.

Keywords: *Modular Building, Earthquake Resistance, Structural Robustness, Fire Resistance, Inter-Module Connection.*

Prediction of Load-Displacement Curves for Cold-Formed Steel Axial Compression Members Using Machine Learning

Jie Dong[1], Puxin Zhang[1] , Xi Zhao [1,*]

[1] Beijing University of Civil Engineering and Architecture, Beijing, China

[*] zhaoxi@bucea.edu.cn

Abstract. Cold-formed steel (CFS) members have been widely adopted in construction owing to their high strength-to-weight ratio, ease of transportation, and rapid assembly. However, their thin-walled nature renders them highly susceptible to initial geometric imperfections introduced during fabrication, transportation, storage, and erection, which can significantly compromise their load-bearing capacity. Consequently, the accurate acquisition of geometric information, extraction of imperfection patterns, and investigation of their influence on numerical simulations are essential for achieving reliable computational modeling. Most existing machine learning studies on CFS members have primarily focused on predicting ultimate load-carrying capacity. Although ultimate strength is a critical mechanical property, it represents only a single state in the structural response. To enable machine learning to serve as a true surrogate for numerical simulation, it is necessary to capture the entire load-bearing process, including the full load–displacement curve. While conventional finite element (FE) analyses provide valuable mechanistic insight, they are often computationally intensive and inefficient for modern engineering applications. To address this challenge, this study proposes a machine-learning-based surrogate modeling framework that integrates automated modeling, analysis, and parametric processing to predict complete load–displacement curves of axially compressed CFS members. The training dataset is generated through an automated modeling algorithm that incorporates the stochastic characteristics of geometric parameters. The resulting load–displacement data are segmented into ascending and descending branches, fitted with generalized mathematical expressions, and their coefficients are used to establish a comprehensive numerical database encompassing 10,000 axially compressed cold-formed C-section steel members. On this basis, an enhanced neural network algorithm-an iterative back-propagation neural network (ReBpNN)-is further developed. Comparative results demonstrate that, relative to the conventional BpNN approach, the proposed ReBpNN not only achieves higher predictive accuracy but also exhibits improved robustness and stability in capturing the mechanical behavior of CFS members.

Keywords: *Cold-formed steel member, Stochastic geometric parameter modeling, axial compression member, Load-displacement curves, ReBpNN machine learning method*

Recent Research on the Strain Rate Effect on Single Timber Fasteners

Nasim Ghasemi[1], Ayon Das[1[0000-0002-1780-1096]], Benoit Gilbert[1[0000-0002-4352-3069]] and Hong Guan[1[0000-0001-5053-5052]]

[1] Griffith University, Gold Coast, QLD 4222, Australia

b.gilbert@griffith.edu.au

Abstract. Tall timber buildings are becoming increasingly popular and must be designed to withstand extreme dynamic events, such as earthquakes and progressive collapse. However, the behaviour of modern timber connections under dynamic loading is under-researched, potentially leading to unsafe infrastructure. This paper presents key outcomes of a recent research programme conducted at Griffith University on the mechanical behaviour of single timber fasteners subjected to various strain rates. The pull-through, pull-out, and embedment behaviour of self-tapping screws inserted in Glued Laminated Timber (Glulam) and Laminated Veneer Lumber (LVL) were tested and important results are discussed. Additionally, the embedment behaviour of steel dowels, also inserted in Glulam and LVL, was measured and is presented. All tests were conducted using two fastener diameters, typically loaded in two directions (parallel- and perpendicular-to-grain), and under four different strain rates, with failure developing between 200 s (quasi-static) and 0.2 s. Results showed that the behaviour of the fasteners is sensitive to strain rate for both investigated materials. The withdrawal pull-out strength of 7 mm screws inserted in Glulam increased by up to 23%, while the pull-through resistance exhibited lower strain rate sensitivity, with an increase of up to 17%. For the 12 mm dowels, the parallel- and perpendicular-to-grain embedment strengths increased by up to 21%, and 20%, respectively.

Keywords: *Timber fasteners, Strain rate, Embedment strength, Withdrawal capacity.*

Reliability-Based Optimization of Kingpost Cross-Sections in Top-down Basement Construction Using the Differential Evolution Algorithm

Van Giang Nguyen [1,*]

[1] Faculty of Civil Engineering, HUTECH University, Vietnam

*nv.giang@hutech.edu.vn

Abstract. This study presents a reliability-based structural optimization approach for determining the optimal cross-section of temporary Kingpost columns in basement construction using the Top-down method. The design process integrates the Load and Resistance Factor Design (LRFD) methodology specified in AISC 360-22, where the resistance factor ϕ is calibrated with respect to a target reliability index β. A differential evolution (DE) algorithm is employed to minimize the cross-sectional area of H-shaped steel columns while satisfying constraints on axial strength, shear, slenderness, and global buckling. The optimization procedure incorporates the ϕ–β–Pf relationship to ensure safety with quantifiable reliability. A Python-based tool was developed and applied to a typical project case. Results show a reduction in material use by approximately 5–10% while maintaining structural performance and reliability. The approach demonstrates a practical method for balancing safety and efficiency in temporary structural design during complex basement construction.

Keywords: *Kingpost column, Top-down method, differential evolution algorithm, LRFD, AISC 360, reliability index.*

Study on the Degradation of Reinforced Concrete Construction Quality in Coastal Areas

Anh Phan Tuan[1], Tuan Nguyen Trong[1], Long Tran Ngoc[1,*], Thai Tran Anh

[1] Department of Civil Engineering, Vinh University

{longvinhuni;phantuananh20041999;trongtuanmct;thaitran17th4}@gmail.com

Abstract. This paper presents a study on the deterioration of reinforced concrete quality over time. This study aims to evaluate the deterioration of concrete over time, thereby helping to evaluate the bearing capacity of the structure and the life of the project. The quality of concrete overtime depends on many factors: initial quality, surrounding environmental conditions (temperature, humidity), Cl- ion penetration, CO2, concrete carbonation, area... Some corrosion prediction models to evaluate the deterioration of concrete quality have been proposed such as: Linear degradation model, Corrosion-induced degradation models, Probabilistic degradation models, Eurocode & FIB Model Code models, Mechanistic-based models,... Each of these models has its own advantages, disadvantages as well as scope and conditions of application. Besides, it is also possible to evaluate the deterioration of reinforced concrete quality by using a combination of experimental methods and numerical simulation. This is a suitable and effective method, especially for complex reinforced concrete structures.

Keywords: *Concrete, Models, Deterioration, RC frame, Corrosion.*

Study on the influence of cement content and reinforcement ratio on cracking behavior of reinforced concrete structures due to shrinkage deformation

Manh Hung NGUYEN[1*], Trung Hieu NGUYEN[1]

[1] Hanoi University of Civil Engineering (HUCE), Hanoi, Vietnam

hungnm1@huce.edu.vn; hieunt@huce.edu.vn

Abstract. In construction works in general, reinforced concrete structures remain the most widely used structural material. Over time, reinforced concrete structures may develop various types of damage such as cracking, spalling, and leakage. Among these, cracking is a critical factor affecting the long-term performance of reinforced concrete structures. Among the different causes of concrete cracking, shrinkage has been and continues to be a subject of particular interest to researchers. The paper presents several research findings on cracking in reinforced concrete structures caused by concrete shrinkage deformation. The influence of cement content in concrete mixtures on cracking behavior is investigated experimentally. In addition, the effect of reinforcement ratio on cracking in reinforced concrete structures is analyzed using a mathematical model. The obtained results provide a basis for mitigating shrinkage-induced cracking, which has become increasingly common in construction projects in recent years.

Keywords: *Shrinkage deformation, cracking, concrete, tensile strength.*

Shear Interaction Efficiency between Tendons and FRP Sheets for Shear Strengthening on Unbonded Post-Tensioned Concrete T- Beams

Dien Ngoc Vo-Le[1], Long Nguyen-Minh[2]

[1] Faculty of Civil Engineering, College of Engineering, Can Tho University, Campus II, 3/2 street, Ninh Kieu Ward, Can Tho City, Viet Nam
[2] Faculty of Civil Engineering, Ho Chi Minh City University of Technology (HCMUT), 268 Ly Thuong Kiet Street, Dien Hong Ward, Ho Chi Minh City, Vietnam

vlndien@ctu.edu.vn

Abstract. Tendons in prestressed concrete beams reduce inclined tensile stresses and delay the initiation of diagonal cracks in shear spans, thereby enhancing resistance to shear cracking. However, the influence of tendon profiles on the shear behavior of unbonded post-tensioned concrete (UPC) beams strengthened with fiber-reinforced polymer (FRP) sheets has not been extensively investigated. This study presents an experimental investigation into the interaction between tendon profiles and FRP sheets shear strengthening in UPC beams. An experimental program was conducted on twelve UPC beam specimens, including eight beams strengthened with FRP sheets and four control beams, considering two tendon profiles: straight and parabolic. The results showed that parabolic tendon profiles significantly enhance diagonal crack resistance, shear capacity, deformation capacity, and energy absorption compared to straight profiles. However, the contribution of FRP sheets to shear resistance in beams with parabolic tendon profiles is lower than that in beams with straight ones. This suggests that as the effectiveness of the tendon profile increases and the relative contribution of FRP shear strengthening to the overall shear capacity of UPC beams is diminished.

Keywords: *Shear, Shear strengthening, Post – tension concrete beams, FRP sheets, Unbonded tendons, Tendon profile.*

Ultimate strength of flexural cold-formed channel members subjected to asymmetrical axis bending using AISI S100 methods

Huy Hoang Vu [1] [0009-0002-4454-9559], Quoc Anh Vu [2] [0000-0003-0442-4620], and Cao Hung Pham [3] [0000-0002-5503-5839]

[1, 2] Faculty of Civil Engineering, Hanoi Architectural University, Hanoi, Vietnam
[3] School of Civil Engineering, The University of Sydney, Sydney NSW 2006, Australia

anhvq@hau.edu.vn

Abstract. The study adapts the AISI S100 methods for evaluating the capacity of cold-formed steel members, specifically channel sections subjected to bending about the asymmetrical axis, where the web is in compression. The methods considered include the Effective Width Method (EWM) as defined in AISI S100 and two versions of the Direct Strength Method (DSM) from the 2016 and 2024 editions of the specification (AISI S100-16 and AISI S100-24). Sixteen commercially available Hoa Sen Group sections are analyzed to compare the strengths predicted by these methods, using the strengths obtained from the Effective Width Method as the reference baseline. The findings show that the strengths calculated using the 2024 edition of the DSM are considerably higher than those obtained using the 2016 edition. Compared to the Effective Width Method, AISI S100-24 generally provides overly optimistic (unconservative) predictions, whereas AISI S100-16 tends to produce more conservative results.

Keywords: *EWM, DSM, ultimate strength, AISI S100, channel section, cold-formed, asymmetrical axis.*

Vertical forced vibration of a monoblock railway support under a dynamic load

Le-Hung Tran[1] [0000-0002-5644-0959] and Thuy-Duong Le[2]

[1] MAST/EMGCU, Université Gustave Eiffel, France
[2] University of Engineering and Technology, VNU-Hanoi, Vietnam

lethuyduong@vnu.edu.vn

Abstract. This paper investigates the forced vertical vibration of ballasted railway tracks under dynamic loading. The rail is modeled as an infinitely long, uniform Euler–Bernoulli beam resting on a periodic system of identical supports. Floquet's theorem is applied to derive rail vibrations, while the dynamic behavior of each support is represented by a continuous foundation model. In the frequency domain, this model reduces each support to a spring with equivalent stiffness, allowing analytical treatment of the coupled system. By integrating the two formulations, analytical solutions for the forced vibration of two rails are obtained in the frequency domain. The framework can be extended to symmetric and dis-symmetric configurations, which are less accessible to conventional methods. Numerical simulations reveal the influence of load position on monoblock railway support responses. The proposed analytical framework thus provides an effective tool for studying vibration and noise in ballasted railway tracks. Its capacity to capture both symmetric and dis-symmetric loading scenarios makes it valuable for analyzing rail dynamics and supporting infrastructure design.

Keywords: *Dynamic structure, Railway, Euler-Bernoulli.*

ENERGY, ENVIRONMENT, GEOTECHNICS

Numerical Investigation of CO_2 Plume Migration and Leakage through Fault Pathways in Geological Carbon Storage

Le Nguyen Hai Nam[1,2], Ta Quoc Dung[1,2], Truong Viet Long[1,2], Bui Trong Vinh[1,2]

[1] Faculty of Geology and Petroleum Engineering, Ho Chi Minh City University of Technology, 268 Ly Thuong Kiet Street, Dien Hong Ward, Ho Chi Minh City, Vietnam
[2] Vietnam National University Ho Chi Minh City, Linh Xuan Ward, Ho Chi Minh City, Vietnam

lnhnam@hcmut.edu.vn

Abstract. Climate change mitigation requires the large-scale deployment of Carbon Capture and Storage (CCS), with geological carbon storage (GCS) in deep saline aquifers representing a promising pathway to reduce atmospheric CO_2 concentrations. The integrity of caprock formations is critical for ensuring long-term containment; however, transmissive faults and fractures may act as preferential leakage pathways under elevated reservoir pressures. This study employs a numerical simulation framework with grid discretization to investigate the migration and leakage behavior of CO_2 plumes through a fault-like conduit. Reservoir and fluid properties are derived from regional case studies, while multiple injection scenarios (rates of 4,000–6,000 m^3/day at varying distances from the leakage path) are evaluated over a 100-year post-injection period. Results show that the leakage risk strongly depends on the well's proximity to the fault. At 50 m, CO_2 leakage occurs during injection, with peak rates exceeding $1.0 \times {}^{10\text{-}6}$ m^3/day, whereas at 100 m, leakage is delayed and significantly reduced. At 200 m, no leakage is observed over the simulation timeframe, confirming a safe margin for containment. Sensitivity analysis indicates injection rate and distance are key factors influencing leakage efficiency. These findings offer crucial insights for CCS site selection, well placement design, and risk management, thereby ensuring safe and effective CO_2 storage in fault-prone geological settings.

Keywords: *Geological Carbon Storage (GCS), CO_2 plume migration, fault leakage pathways, numerical simulation.*

Assessing Driving Forces for the Adoption of Green Supply Chain Management Practices in the Construction Industry

Vu Hong Son Pham[1,2], Minh Nhut Tran[1,2*], Thuy Dung Dau[1,2], Bao Quyen Nguyen Hua[1,2] and Le Anh Tran[1,2]

[1] Faculty of Civil Engineering, Ho Chi Minh City University of Technology (HCMUT), 268 Ly Thuong Kiet Street, District 10, Ho Chi Minh City, Vietnam
[2] Vietnam National University Ho Chi Minh City, Linh Trung Ward, Thu Duc District, Ho Chi Minh City, Vietnam

nhut.tran03@hcmut.edu.vn

Abstract. The development of sustainable construction practices is a growing global trend, and Vietnam is actively embracing this movement. In recent years, Vietnam has demonstrated a strong commitment to cleaner production by enhancing resource efficiency and reducing emissions and pollution, aiming to safeguard environmental quality and public health while promoting sustainable development. This transformation poses both challenges and opportunities for the Vietnamese construction sector to integrate with international sustainability standards. This study explores the critical perceived factors associated with green supply chain management (GSCM) practices within Vietnam's construction industry. The research methodology includes surveys targeting construction management experts and supply chain stakeholders to gather data for in-depth analysis. The study identifies and ranks the key drivers facilitating green supply chain adoption, providing valuable insights for organizations to refine their sustainable development strategies. Understanding these driving factors enables businesses to make informed strategic decisions, enhancing operational efficiency and reducing environmental impact. Furthermore, the findings offer guidance for optimizing resource allocation and formulating policies that maximize economic, social, and environmental benefits.

Keywords: *Driving factor, Supply chain management, Construction industry, Factor analysis, Vietnam*.

Flood Hazard Mapping Using Geomatics, Downscaling, and Extreme Value Analysis Integrated with Hydrologic and Hydraulic Modeling: A Case Study in the Ha Thanh River Basin, Vietnam

Van Tho Phan[1,2][0000-0002-0887-5966], Patrick Willems[1][0000-0002-7085-2570], Ngo Anh Tu[2][0000-0002-8909-7755], Tan Do Nghi [2][0000-0002-1883-6696], Truong Quang Hien[2][0009-0001-9281-6976], and Xuan Nguyen Huu [2][0000-0001-9977-461X]

[1] Hydraulics and Geotechnics Section, Department of Civil Engineering, KU Leuven, Belgium
[2] Faculty of Natural Sciences, QuyNhon University, Vietnam

phanvantho@qnu.edu.vn

Abstract. Floods are recognized as one of the most common and destructive natural hazards, posing significant threats to both local communities and disaster management agencies. These threats are particularly prevalent in high-risk flooding areas, such as along the Ha Thanh river in the central region of Vietnam, where recurrent flooding has caused considerable losses to infrastructure and human life. The first step to managing these risks is a flood hazard assessment. This requires simulation of historical flood events and forecasting future flood scenarios. Such simulation and forecasting are particularly challenging in regions with limited data availability. This study uses recent advances in geomatics technology, including drones, echo sounders, and global navigation satellite systems, to construct detailed terrain models and analyze flood probabilities based on observed rainfall data. Both hydrological and hydraulic models are applied to simulate past flood events, and the simulation results are validated against actual flood traces to ensure accuracy. Based on these validated models, the study incorporates statistical extreme value and downscaling analysis to develop future flood risk scenarios for the study area. The findings highlight the importance of integrating geomatics, statistical methods, and hydrological-hydraulic modeling in creating accurate flood hazard maps. These tools provide essential support for local authorities and communities in understanding potential flood risks and preparing more effective plans to minimize damage from future flooding.

Keywords: *Extreme value analysis, geomatics, Ha Thanh River, hydrological, hydraulic, flood hazard*

Framing the Environment: A Comparative Analysis of Large Language Models' Responses to Ecological Prompts

Zane Vincevica-Gaile[0000-0003-2868-0434], Karina Stankevica[0000-0002-2059-4729] and Maris Klavins[0000-0002-4088-9348]

Department of Environmental Science, University of Latvia, Riga LV-1004, Latvia

zane.gaile@lu.lv

Abstract. The application of large language models (LLMs), a form of generative artificial intelligence (AI), in environmental science research is increasing rapidly, offering innovative solutions and new methodological approaches. LLMs can be used in various fields of environmental studies, for example, to analyze social media texts to classify cultural ecosystem services, to address the systemic complexity in environmental contexts in environmental engineering, to automate and systemize the listing of environment-related keywords and context extraction, to visualize research in ecology and geosciences by satellite data imaging and assessment, to perform biodiversity surveys, and beyond. These models are not passive conveyors of information but rather active narrative constructors, generating content that may evoke emotions, shape beliefs, and suggest behavioral intentions. Ecolinguistics is an interdisciplinary scientific branch that researches issues simultaneously related to language expression, environmental issues and nature, human and social perception, and reflection. In this context, LLMs may play a significant role in enhancing societal environmental awareness and individual perceptions of environmental risk. This study aims to assess the impact of internal parameters and architectures on the generation of responses by selected LLMs, with a focus on narrative structure, emotional tone, and framing. Six widely used LLMs (GPT-5, Claude 3, Gemini 1.5, Meta AI, Mistral, and DeepSeek) were compared based on their performance in prompts and responses related to environmental risk perception. The study proposes a methodological framework for comparative analysis of LLMs for AI-generated responses to ecological prompts to evaluate cognitive perception of narratives.

Keywords: *Environmental Discourse, Cognitive Mediation, Framing Analysis, Generative AI Ethics, Sustainability Communication, Large Language Models.*

Leaching Potential of Heavy Metals from Sewage Sludge Application to Agricultural Lands

Elif Irmak Erdem[1][0009-0008-5520-1025], Günseli Erdem[2][0000-0002-4061-4336], Bedri Kurtuluş[3][0000-0001-6646-9280], Nadim K Copty[1][0000-0002-4807-7790]

[1] Boğaziçi University, Institute of Environmental Sciences, İstanbul, Türkiye
[2] Yeditepe University, Department of Civil Engineering, İstanbul, Türkiye
[3] Muğla Sıtkı Koçman University, Department of Geological Engineering, İstanbul, Türkiye

ncopty@bogazici.edu.tr

Abstract. The application of sewage sludge as a fertilizer has gained increasing attention as a sustainable approach to nutrient recycling and organic waste management. However, its use poses potential environmental and health risks due to the presence of heavy metals and other contaminants in the sludge. This study evaluates the risks of heavy metal contamination associated with sewage sludge application to agricultural soils collected from the Konya Closed Basin, a major agricultural region in Türkiye. Kinetic and equilibrium sorption experiments were conducted to determine the rates of heavy metal adsorption onto soil surfaces and to assess the soil's retention capacity under equilibrium conditions. Column experiments incorporating soil–sludge mixtures were subsequently performed to evaluate metal leaching behavior under two irrigation regimes: drip irrigation (continuous, low application rate) and flood irrigation (pulsed). Sludge characterization results indicated that Zn, Fe, and Al concentrations in the sewage sludge were notably high. Sorption rates were relatively rapid, with equilibrium achieved within 48 hours for all metals tested. Under non-continuous irrigation, transient peaks in metal mobilization were observed following each irrigation event. Despite the high metal content of the sludge, both irrigation schemes showed limited leaching potential, with aqueous-phase metal concentrations decreasing rapidly to below 1 mg/L. Overall, this study enhances understanding of the interactions between heavy metals, soil properties, and irrigation practices, contributing to improved risk assessment and sustainable sludge management in agricultural environments.

Keywords: *Sewage Sludge, Soil pollution, Heavy Metals.*

Microbial-Induced Soil Improvement: Strengthening Loose Sand Using *Sporosarcina ureilytica* under Laboratory Conditions

Nguyen Anh Xuan[1,2][0009-0002-8965-0562], Ho Thai Khoi[1,2][0009-0000-1430-779X], Nguyen Khanh Son[1,2][0000-0002-4173-687X] and Nguyen Ngoc Tri Huynh[1,2,*][0000-0003-2085-3564]

[1] Department of Silicate Materials, Faculty of Materials Technology, Ho Chi Minh City University of Technology (HCMUT), 268 Ly Thuong Kiet Street, Dien Hong Ward, Ho Chi Minh City, Vietnam
[2] Vietnam National University Ho Chi Minh City, Linh Xuan Ward, Ho Chi Minh City, Vietnam

nnthuynh@hcmut.edu.vn

Abstract. Improving the stability of loose sandy soils without relying on traditional cement-based binders is a growing focus in sustainable geotechnical engi-neering. This study explores the application of Microbially Induced Calcium Carbonate Precipitation (MICP) for enhancing the strength of loose sand us-ing *Sporosarcina ureilytica*, a urease-positive bacterium capable of precipitat-ing calcite through urea hydrolysis. The experimental procedure involved saturating sand columns with bacterial solutions followed by cementation fluids (urea and calcium chloride) over multiple treatment cycles. Mechani-cal testing was conducted using a model-scale rainfall simulator combined with penetration resistance measurements. Results indicated significant sur-face stabilization and improve erosion resistance after six treatment cycles, with visible calcite bridging between sand particles. Microstructure analysis con-firmed calcium carbonate deposition along grain boundaries. This research demonstrates the potential of MICP as a low-carbon, biologically driven ground improvement technique suitable for weak, cohesionless soils. The method requires no cementitious materials, aligns with sustainable construc-tion goals, and offers an environmentally friendly alternative for applications such as erosion control, slope stabilization, and shallow foundation support. The findings provide valuable insight into nature-based soil reinforcement strategies and open up new directions in bio-mediated geotechnics.

Keywords: *MICP, Bacteria, Biomineralization*.

Morphodynamic Changes in a Portuguese Inlet System: Coastal Engineering Effects and Sediment Transport Dynamics

Tiago Abreu[1][0000-0003-3438-3479], Ángela Fontán-Bouzas[2][0000-0003-0221-3707], Paulo A. Silva3[0000-0002-7305-5403], Luís Vasconcelos[4][0000-0002-9209-5750] and Paulo Baptista[3][0000-0002-6718-9528]

[1] CESAM & ISEP, Polytechnic of Porto, Porto, Portugal
[2] CIM-UVIGO GEOMA, University of Vigo, Spain
[3] CESAM & University of Aveiro, Aveiro, Portugal
[4] CITTA & IPV, Polytechnic Institute of Viseu, Viseu, Portugal

taa@isep.ipp.pt

Abstract. This study investigates the morphodynamic evolution of the Figueira da Foz inlet and adjacent beaches over the period 2008-2022, assessing the impacts of natural forcing and human interventions. Located along Portugal's dynamic Atlantic coast, the inlet has experienced significant changes following the 2009 extension of the northern jetty and recurrent dredging operations, which have disrupted the natural longshore sediment transport. Utilizing high-resolution bathymetric surveys and comprehensive wave climate data, the research analyzes morphological changes in response to storm activity and engineering modifications. The results indicate that sediment accumulation has significantly increased north of the inlet, resulting in a beach expansion of more than 250 m at Figueira da Foz, while simultaneously exacerbating erosion pressures to the south, particularly at Cova Gala beach. The study highlights pronounced seasonal variations in wave and storm activity, with winter storms playing a critical role in shaping coastal morphodynamics. These findings emphasize the importance of continuous monitoring and adopting Integrated Coastal Zone Management strategies to reconcile navigational safety with long-term environmental resilience. Ultimately, this research contributes to understanding the interactions between anthropogenic changes and natural processes in coastal environments, offering valuable insights for future coastal management initiatives.

Keywords: *Coastal Morphodynamics, Sediment Transport, Jetty Extension, Dredging Impacts, Shoreline Evolution.*

Physical properties of cementless materials using classified woody biomass combustion ash and waste shells

Koto Yamasaki[1], Syuichiro Sawada[1], Takuya Kondou1and Koshi Yamamoto1

[1] National Institute of Technology, Kochi College

d60158@gm.kochi-ct.jp

Abstract. To investigate the fundamental physical properties of cementless materials made from combustion ash emitted from wood biomass power plants, fly ash emitted from thermal power plants, and shell lime as a substitute for slaked lime, compressive strength tests, splitting tensile tests, static elastic modulus tests, length change tests, and mass measurements were conducted. The test mix was constant with a water-binder ratio of 70%, a slaked lime replacement rate of 26%, and a fly ash replacement rate of 10%. The test results showed that the use of shell lime showed differences in fundamental properties compared to slaked lime. In addition, some improvements were observed in the strength of the materials during air curing, which had been an issue until now.

Keywords: *Wood biomass Combustion ash, Slaked lime, Oysters, Scallops,*

Sustainable Integration of Sewage Sludge in Mortar: Toward Low-Carbon Cement Substitution

Tang Kien Ky[1,3], Vu Anh Quang[1,3][0000-0001-8699-9385], Ho Thai Khoi[2,3][0009-0000-1430-779X], Nguyen Anh Xuan[2,3][0009-0002-8965-0562],Nguyen Quynh Truc My[2,3] and Nguyen Ngoc Tri Huynh[2,3,*][0000-0003-2085-3564]

[1] Department of Energy Materials And Applications, Faculty of Materials Technology, Ho Chi Minh City University of Technology (HCMUT), 268 Ly Thuong Kiet Street, Dien Hong Ward, Ho Chi Minh City, Vietnam
[2] Department of Silicate Materials, Faculty of Materials Technology, Ho Chi Minh City University of Technology (HCMUT), 268 Ly Thuong Kiet Street, Dien Hong Ward, Ho Chi Minh City, Vietnam
[3] Vietnam National University Ho Chi Minh City, Linh Xuan Ward, Ho Chi Minh City, Vietnam

nnthuynh@hcmut.edu.vn

Abstract. The disposal of sewage sludge from urban wastewater treatment processes presents a significant environmental concern, especially when the sludge contains hazardous trace elements such as hexavalent chromium (Cr^{6+}). This study investigates the potential reuse of sewage sludge as a partial replacement for cement in mortar. The raw sludge exhibits high moisture content and organic matter, with a loss on ignition of approximately 41.5%, classify-ing it as hazardous waste in worst-case scenarios due to elevated Cr^{6+} con-tent. Thermal treatment at 750 °C effectively removes organic compounds, improves mineral stability, and reduces structural impurities. Characterization using XRD, FTIR, and SEM-EDS indicates that thermally treated sludge con-tains primarily inert phases such as SiO_2 and Al_2O_3. Mortar specimens with 5–15% sludge replacement were tested for water demand, setting time, and compressive strength. Results show that untreated sludge significantly in-creases water demand and delays setting, while treated sludge improves workability and compatibility with cement hydration. Compressive strength at 28 days remains acceptable for non-structural applications when sludge content does not exceed 10%. Although pozzolanic contribution appears limited, the treated sludge acts as a stable filler and contributes to immobilizing hazard-ous components. This suggests its potential as an eco-friendly additive for low-strength mortar in paving or plastering applications.

Keywords: *Sewage sludge, mortar, cement replacement, waste valorization.*

The Environmental Safety of the Inwashed Tailing Dams

Alan Lolaev [1,2][0000-0003-0943-6807], Aleksan Oganesyan[1][0000-0001-6292-037X] and Gurgen Mirzoev [1][0009-0003-4177-6614]

[1] VSC RAS, 1 Williams Str., Mikhailovskoe vil., RNO, 363110, Russia
[2] NOSU, 44-46 Vatutina str., Vladikavkaz, 362025, Russia

abl-2010@mail.ru

Abstract. The article considers the need to move to the strategy for assessing and predicting the stability of the enclosing dams at tailing dumps. The object of research is the Fiagdon tailing dump located in the North Caucasus region of Russia. Calculations of the danger of man-made massifs are carried out. An important step to ensure the safety of tailing dumps and prevent environmental pollution is the standardization of methods and the creation of a unified classification of data to further improve the quality and processing of the results obtained. The article presents a method for assessing the risk of the hazard of tailings facilities - the Tailings Hazard Index (THI) and the Tailings Risk Index (TRI). These methods help to identify the most risk-prone facilities and plan measures to prevent emergencies. It also notes the need for further work on developing a unified methodological approach to studying the properties of tailings to increase the accuracy and reliability of data, as well as the safety of operations of tailing dumps.

Keywords: *Tailing dump, Tails, Tailings Hazard Index, Tailings Risk Index.*

A Comparative Study on the Shear Behaviour of Iron and Steel Slag as Sustainable Alternatives for Conventional Railway Sub-Ballast Layers

M D Godson[1][0000-0002-0255-0941] and Bande Giridhar Rajesh[2][0000-0001-7240-9946]

[1] PhD Scholar, Indian Institute of Technology Dharwad, India
[2] Assistant Professor, Indian Institute of Technology Dharwad, India

ce23dp004@iitdh.ac.in

Abstract. The growing demand for sustainable infrastructure has driven the quest for eco-friendly substitutes for natural aggregates, such as basalt or granite, typically utilized in railway sub-ballast layers. The extensive use of these natural resources has led to serious environmental and economic consequences, underscoring the pressing need for viable alternatives, among which industrial by-products offer considerable potential as a replacement for the railway sub-ballast layer. Although previous research has primarily focused on evaluating individual slag types against conventional materials, a comparative analysis of various slag types, such as iron and steel slag, has not been thoroughly investigated till now. Hence, this study addresses these challenges by evaluating the shear performance of iron slag and steel slag as alternatives to traditional sub-ballast materials. The primary objective is to determine whether these waste-derived aggregates can satisfy or outperform the mechanical performance necessary for railway applications. A series of laboratory experiments was conducted to assess and compare the geotechnical properties of iron slag and steel slag. The primary experimental approach entailed large-scale direct shear testing with different normal stresses to assess the shear strength parameters. Results demonstrated that both iron slag and steel slag exhibit shear strength properties comparable to or exceeding those of natural aggregates. Notably, Steel slag exhibited higher internal friction angles, signifying improved inter-particle resistance and structural integrity under stress. These findings validate that both slag forms can function as effective alternatives in sub-ballast applications without hindering mechanical performance.

Keywords: *Iron Slag, Steel Slag, Shear Strength, Railway Sub-Ballast, Industrial Waste Utilization.*

A Novel Method for Creating Loose Granular Samples in DEM

Q. Hung Truong [1][0009-0003-8280-4087], Ngoc Quy Hoang[2][0000-0002-3050-8396], The-Bao Nguyen[3][0009-0003-5285-4702], Jiyun Nan[4][0000-0001-7853-3454] and Khoa M. Tran [2][0000-0002-0371-3271]

[1]Faculty of Civil Engineering,Van Lang School of Technology, Van Lang University, 69/68 Dang Thuy Tram Street, Binh Loi Trung Ward, Ho Chi Minh City, Vietnam
[2]Faculty of Civil Engineering,Ho Chi Minh City University of Technology (HUTECH), Thanh My Tay Ward,Ho Chi Minh City
[3]Institute of Architecture,Construction,and Transportation,Thu Dau Mot University, No.6,Tran Van On Street,Phu Loi Ward,Ho Chi Minh
[4]School of Civil, Environmental and Architectural Engineering, Korea University, 145 Anam-ro, Seongbuk-gu, Seoul, Republic of Korea.

tm.khoa@hutech.edu.vn

Abstract. The generation of granular samples for Discrete Element Method (DEM) simulations plays a critical role in accurately representing the mechanical behavior of materials. This study presents the Modified Deleting Method (MDM), a novel approach designed to generate loose granular samples under predefined pressure conditions. The MDM begins with densely packed samples consisting of primary (interest) particles and auxiliary particles, which are used to aid the packing process. These samples are then subjected to a target pressure, achieving equilibrium. The auxiliary particles are progressively removed by size reduction, allowing the primary particles to rearrange into a looser structure while maintaining the desired pressure. The proportion of the auxiliary particles was systematically examined. The factor significantly impacted sample porosity, packing density, and structural characteristics. One-dimensional compression tests were performed to validate the effectiveness of the method, confirming its ability to generate granular samples with exceptionally high void ratios under high applied pressure. For example, a sample with a uniform particle size distribution (D_{50} of 0.36 mm) achieved a void ratio of 0.89 when subjected to a vertical pressure of 80 kPa. The results of one-dimensional compression tests demonstrate that the MDM provides a reliable and flexible tool for DEM-based studies, offering customizable sample properties for geotechnical and material science applications.

Keywords: *DEM, loose granular, generation of sample, MDM*

Application of Numerical Methods to Analyze the Geotechnical Behavior of GFM Made from Dredged Sludge for Military Infrastructure Foundations

Pham Tri Thuc[1] and Phan Huy Dong[2]

[1] Military Academy of Logistic, Hanoi, Vietnam

trithuchvhc@gmail.com

[2] National University of Civil Engineering, Hanoi, Vietnam
phdong65@gmail.com

Abstract. The sustainable reuse of dredged sludge in construction is gaining attention due to the depletion of natural sand resources and environmental concerns associated with sludge disposal. This study investigates the geotechnical performance of GFM (Granular cement-treated soil for Filling Material), a novel engineered fill material produced from dredged sludge stabilized with a small proportion of cement and polymer. The material exhibits characteristics comparable to artificial sand. The primary objective of this research is to apply numerical methods to evaluate the mechanical behavior of GFM when used as a foundation material for military infrastructure such as internal roads, housing, warehouses, and technical yards. Laboratory experiments were conducted to determine input parameters including shear strength, stiffness, and compressibility. These were used in finite element models developed in PLAXIS to simulate different loading conditions. The study also evaluates and selects appropriate constitutive soil models to capture the behavior of GFM accurately. Results demonstrate that GFM is suitable for light to moderate load-bearing applications, with performance metrics meeting design standards for settlement and bearing capacity. The research contributes to the understanding of cement-treated dredged materials and supports their practical application in military construction as a sustainable alternative to traditional fill materials.

Keywords: *GFM material, dredged sludge, Sustainable fill.*

Applying the Non-isothermal Unified Hardening Constitutive Model for One-dimensional Thermomechanical behavior of Weathered Granite Soil

Hanh Nguyen-Cong[1], Ju-Won Ryu[2], Huu Ba Dinh[3], Young-Jip Yoon[4], Young-Sang Kim[5]

[1,2,4] Department of Architecture and Civil Engineering, Chonnam National University, Gwangju 61186, Republic of Korea
[3] Basic Research Laboratory (BRL), Department of Civil Engineering, Chonnam National University, Gwangju 61186, Republic of Korea
[5] Department of Civil Engineering, Chonnam National University, Gwangju 61186, Republic of Korea

geoyskim@jnu.ac.kr

Abstract. This study applied the non-isothermal unified hardening (NUH) constitutive model to capture the thermomechanical response of low-plasticity weathered granite soil (WGS), a silty sand commonly found around underground structures along the Gwangju Metro Line (Korea). Drained heating-cooling oedometer tests were conducted on normally consolidated (NC) and overconsolidated (OC) specimens under thermal cycles between 20 °C and 60 °C. The experimental results indicated that NC specimens exhibited thermally induced volumetric contraction during thermal cycle (irreversible plastic strain), whereas OC specimens predominantly showed thermo-elastic expansion. The NUH model successfully reproduced the overall thermomechanical behavior of both NC and OC states, showing close agreement with the experimental data using a single unified parameter set. However, under OC conditions, the purely elastic assumption characterized by the thermo-elastic compression index did not fully predict the slight irreversible volumetric consolidation upon cooling observed experimentally.

Keywords: *Cyclic heating-cooling, Non-isothermal unified hardening model, Weathered granite soil, Thermomechanical behavior.*

Assessment of Recycled Construction Materials as Partial Replacement for Pavement Subgrade

Dana Nicole Barluado[1], Keanu Lanz Guerra[1] and Dr. Lea Bronuela-Ambrocio[1]

[1] University of the Philippines - Diliman, Diliman, Quezon City 1101, Philippines

kcguerra1@up.edu.ph

Abstract. Construction and demolition waste (CDW) comprises debris generated from infrastructure, including bridges, roads, and buildings. Several countries have adopted the integration of CDW to build new infrastructure due to its substantial cost reduction. The Philippines has not yet established a standard for the incorporation of CDW into construction practices. The increasing demand for construction materials has expedited the quarrying of virgin aggregates, causing erosion, instability, and environmental degradation, highlighting the need for alternatives This study investigates the feasibility of utilizing recycled construction materials—specifically recycled concrete aggregate (RCA) and recycled asphalt pavement (RAP)—as a partial substitute for the pavement subgrade the potential of recycled construction materials—specifically recycled concrete aggregate (RCA) and recycled asphalt pavement (RAP)—as a partial replacement for the pavement subgrade is examined. The investigation focused on reducing solid waste in the construction industry while meeting standards set by the Department of Public Works and Highways, including the California Bearing Ratio (CBR) for strength and durability, the Atterberg Limits for plasticity, and the constant head permeability test for drainage performance. Based on the results, all samples prepared passed the permeability and plasticity requirements, achieving the best performance for samples comprising 75% soil, 12% RCA, and 12.5% RAP. A simple construction cost analysis was calculated, revealing that incorporating recycled materials could result in savings of 1.83% to 7.33% from the project cost. These findings show that recycled construction materials can be viable while being economically advantageous when used in pavement subgrade.

Keywords: *Pavement subgrade, Recycled concrete aggregates, Recycled asphalt pavement, pavement subgrade construction*

Bio-stabilisation of Soil: Leveraging Native Bacteria for Subgrade Strength Improvement

Syamili Sarma[1] and Anil Kumar Mishra [2][0000-0003-2752-2768]

[1] Indian Institute of Technology Guwahati, Guwahati, Assam, India

s.syamili@iitg.ac.in

Abstract. The California Bearing Ratio (CBR) is a critical indicator of subgrade strength in pavement design. Conventional soil stabilisation techniques often rely on energy-intensive and environmentally harmful materials such as cement and lime. This study explored a sustainable bio-mediated approach, Microbially Induced Calcite Precipitation (MICP), to enhance the CBR value of coal mine overburden soil using a native ureolytic bacterium isolated from local soil environments using a selective enrichment medium. The best isolate among eight strains was selected based on the bio-cementation potential and cultured under optimised conditions to induce calcite precipitation via urea hydrolysis. A novel methodology incorporated the bacteria into the waste soil to ensure optimal calcite deposition without exceeding the soil's optimum moisture content. The experimental results demonstrated a significant improvement in CBR values, up to a 3.5-fold increase compared to untreated samples under soaked conditions. This eco-compatible stabilisation technique offers a viable and scalable alternative to traditional methods, aligning with circular economy principles and sustainable infrastructure development goals.

Keywords: *MICP, Native ureolytic bacteria, Bio-cementation, Subgrade.*

Comparative analysis of bending moments in diaphragm wall with helical anchors: Experimental findings from scaled model tests

Ragini Vishwakarma[1] [0009-0004-4313-5172], Satyendra Mittal[2] [0000-0001-6216-9205], Vishwas A. Sawant[1] [0000-0002-6730-4311]

1 Civil Engineering Department, Indian Institute of Technology Roorkee, Roorkee 247667, India
2 University of Patanjali, Haridwar 249411, India

ragini_v@ce.iitr.ac.in

Abstract. Diaphragm walls are widely used to support deep excavations in urban environments, where surcharge loading from adjacent structures can significantly influence wall behavior. This study presents a series of plane-strain physical model tests investigating the bending moment response of a diaphragm wall embedded in sandy soil and supported by helical anchors. The effects of surcharge offset distance, anchor inclination angle, and anchorage configuration (unanchored, single-row, and double-row) were examined under staged excavation. Bending moments were derived from measured lateral earth pressures along the wall depth. The results show that anchorage substantially reduces bending moments compared to the unanchored condition, with double-row helical anchors providing the most effective reduction. An anchor inclination of approximately 15° was found to be optimal for minimizing bending moments and wall deformation. The findings offer experimental insight into the structural performance of anchored diaphragm walls and may aid in enhancing preliminary design practices for deep excavations.

Keywords: *Diaphragm wall; Helical anchors; Bending moment; Physical modeling; Deep excavation.*

Comparison of Measured and Simulated Lateral Displacement of Retaining Walls in Deep Excavation with Combined Diaphragm and Steel Sheet Pile Walls

Tan Vo[1,2], Trong Nghia Le[1,2*[0000-0001-7609-3707]], Vi Hao Ta[1,2], Duy Pu Tin Le[1,2], Bao Tien Dung Nguyen[1,2] and Minh Trung Nguyen[1,2[0000-0001-5761-3156]]

[1] Faculty of Civil Engineering, Ho Chi Minh City University of Technology (HCMUT), 268 Ly Thuong Kiet Street, Dien Hong Ward, Ho Chi Minh City, Vietnam
[2] Vietnam National University – Ho Chi Minh City (VNU-HCM), Linh Xuan Ward, Ho Chi Minh City, Vietnam

letrongnghia@hcmut.edu.vn

Abstract. This study investigates the performance of a hybrid retaining wall system combining diaphragm walls and steel sheet piles in a deep excavation project in Ho Chi Minh City. The excavation reached a depth of 7.8 m in soft soils up to 15 m thick, and finite element back-analysis using the Hardening Soil model was calibrated with inclinometer data. Results show that lateral displacement in-creased with excavation depth, with maximum deflection at mid-height and no-ticeable toe movement at the base. The difference between the predicted and observed displacements was quantified by a root mean square error (RMSE) of 22.73 mm and a peak displacement error of only 0.1% at the final excavation stage, confirming the reliability of the numerical model. The results showed that CDM improvement effectively reduced predicted ground deformation and improved the agreement between simulated and monitored displacements. This integrated approach provides valuable insights into the design and performance of hybrid retaining systems combined with ground improvement in deep excavations on soft clay.

Keywords: *Deep excavation, Hybrid retaining wall, Finite element method*

DEM approach to investigate the effects of soluble particles on soil behavior

Ngoc Quy Hoang[1][0000-0002-3050-8396], M. Khoa Tran[1][0000-0002-0371-3271], The-Bao Nguyen[2][0009-0003-5285-4702], Jiyun Nan[3][0000-0001-7853-3454], and Q. Hung Truong [4][0009-0003-8280-4087]

[1]Faculty of Civil Engineering, HUTECH University, Thanh My Tay Ward, Ho Chi Minh City
[2]Institute of Architecture,Construction,and Transportation,Thu Dau Mot University , No.6,Tran Van On Street,Phu Loi Ward, Ho Chi Minh
[3]School of Civil, Environmental and Architectural Engineering, Korea University,145 Anam-ro, Seongbuk-gu, Seoul, Republic of Korea.
[4]Faculty of Civil Engineering, Van Lang School of Technology, Van Lang University, 69/68 Dang Thuy Tram Street, Binh Loi Trung Ward, Ho Chi Minh City, Vietnam

hung.tq@vlu.edu.vn

Abstract. The dissolution of soluble materials in natural soils plays a critical role in geomorphological processes and in the stability of natural and engineered systems. This phenomenon is particularly relevant in contexts such as dam foundations, mine tailings, volcanic ash deposits, and CO_2 sequestration sites, where the progressive loss of soluble constituents can compromise soil integrity. The study numerically investigates the mechanical response of mixtures of soluble granular specimens (sand–salt mixtures) subjected to vertical loading through oedometer simulations using the Discrete Element Method (DEM). Soil specimens of sand (normal stiffness $K_{n.sand} = 1\times10^5$ N/m) and soluble salt ($K_{n.salt} = 1\times10^3$ N/m) with salt volume fractions of 2% and 10% were compressed vertically up to 160 kPa under zero lateral strain. Dissolution of salt particles was modeled by gradually reducing the size of salt particles (rate of 0.0001) after loading to 160 kPa. During compression and dissolution, micro-mechanical parameters including vertical displacements, contact forces, coordination numbers, stress distributions, and porosities were continuously monitored to evaluate the evolution of soil structure. Results indicate that prior to dissolution, mixture behavior was largely unaffected by salt content, with only minor differences in the compression index. Once dissolution commenced, removal of salt particles created honeycomb-like voids, disrupting granular packing and allowing sand particles to rearrange, particularly under higher stress, thereby increasing compressibility. Dissolution also induced a sharp increase in the earth pressure coefficient (K_0), reflecting enhanced stress anisotropy. This effect was more pronounced at higher salt contents, and elevated K_0 values persisted after dissolution. The study highlights the significant role of soluble particle dissolution in governing granular soil behavior.

Keywords: *compressibility, DEM, dissolution, granular, oedometer, soluble*

Dynamic Time-Domain Finite Element Assessment of Seismic Stability in a Deepwater Canyon Head Slope

Huynh Dat Vu Khoa

Norwegian Geotechnical Institute, Oslo, Norway

Khoa.D.V.Huynh@ngi.no

Abstract This paper presents a dynamic finite-element investigation of seismic slope stability for a deepwater canyon head slope, focusing on prediction of earthquake-induced permanent seabed deformations. The study combines pseudo-static screening with refined two-dimensional time-domain analyses under extreme level earthquake (ELE) and abnormal level earthquake (ALE) design events. Soil parameterisation incorporates consolidation under in-situ shear stress due to slope inclination, strain-rate enhancement during seismic loading, and cyclic degradation expressed through equivalent loading cycles. Small-strain stiffness profiles derived from in-situ correlations verified consistency of the adopted framework. Dynamic analyses were performed in the finite element program PLAXIS using a modified Mohr-Coulomb model that allows depth- and slope-dependent variation of strength and stiffness. Sensitivity analyses examined soil characterisation, damping assumptions, excitation direction, and earthquake duration. Results show that pseudo-static methods overestimate failure volumes compared with time-domain simulations. Predicted deformations remain localised within the upper ~20 m of the slope, with permanent displacements ranging from centimetres under ELE to decimetre-scale under ALE. The governing mechanism is localised shallow slumping rather than large-scale mass failure.

Keywords: *Seismic Slope Stability; Dynamic Time-Domain Analysis; Finite Element Modelling; Offshore Geotechnics; Permanent Seabed Displacement.*

Effect of Liquidity Index on shear-induced anisotropy in clay slurries using Small Angle X-ray Scattering

Viet Khuyen Bui[1,2], Kenichi Soga[1], Itai Einav[2], Francois Guillard[2]

[1] School of Civil Engineering, The University of Sydney, Sydney, NSW 2006, Australia

[2] Department of Civil and Environmental Engineering, University of California, Berkeley, USA

vietkhuyen.bui@sydney.edu.au

Abstract. Clay is a crucial material in Geotechnical Engineering due to its frequent natural occurrence in practice. However, its complex microstructure poses significant challenges in predicting its behavior under shear. This research investigated the evolution of fabric in two clay minerals, kaolinite and Na-montmorillonite at different Liquidity Index (LI) values of 3 and 5 under different shearing conditions using Small Angle X-ray Scattering (SAXS). The results demonstrated that LI played a key role in controlling microstructural anisotropy and particle orientation. A lower LI of 3 promoted the development and persistence of oriented microstructures, particularly in kaolinite, which exhibited higher anisotropy than Na-montmorillonite under the same shear conditions. In contrast, increasing the LI to 5 reduced anisotropy and led to more randomly oriented microstructures due to enhanced particle dispersion and weaker interparticle interactions. Na-montmorillonite showed consistently low anisotropy at both LI values, reflecting the dominant influence of particle swelling and water absorption. These findings provided experimental data for calibrating rheological models that account for fabric evolution in clay slurries.

Keywords: *SAXS, shear, kaolinite, montmorillonite, fabric orientation.*

Enhancing Landslide Susceptibility Mapping Accuracy Using a Hybrid Naïve Bayes–Neural Network Model: A Case Study in the Mountainous Region of Quang Nam, Vietnam

Ba-Quang-Vinh Nguyen[1,2][0000-0002-9846-4289] and Van-Tiep Nguyen[1,2][0000-0002-9846-4289]

[1] School of Civil Engineering and Management, International University, VNU-HCM, Ho Chi Minh City, Vietnam
[2] Vietnam National University, Ho Chi Minh city, Vietnam

nbqvinh@hcmiu.edu.vn

Abstract. Landslide susceptibility mapping is a vital tool for hazard mitigation and sustainable land-use planning, especially in mountainous terrains. This study examines the efficacy of a hybrid machine learning approach that combines Naïve Bayes (NB) and Multilayer Perceptron (MLP) models to enhance the accuracy of landslide prediction in the mountainous region of Quang Nam Province, Vietnam. Using over 500 landslide points and ten conditioning factors derived from topographic, hydrological, geological, rainfall, and land use data, we developed and compared three models: (i) NB, (ii) MLP, and (iii) a hybrid NB–MLP model. The hybrid model uses NB-estimated probabilities as an additional input feature to the neural network, enhancing its predictive capacity. Model performance was evaluated using the Area Under the Receiver Operating Characteristic Curve (AUC). On the training dataset, the AUC values were 71.5% for NB, 87.9% for MLP, and 89.0% for the hybrid model. On an independent validation dataset, the corresponding AUCs were 71.9% (NB), 84.7% (MLP), and 85.9% (hybrid). These results demonstrate that the hybrid approach yields superior accuracy and generalization compared to individual models. The proposed framework provides a robust and scalable method for assessing landslide susceptibility.

Keywords: *Landslide susceptibility, Hybrid machine learning, Quang Nam*

Estimation of Shrinkage Curve of Nam Dong Soil Based on Atterberg Limits

Tran T.P An[1][0000-0001-8290-2152], Fredlund Delwyn G.[2], Nguyen Thi Thuy[1], and Le Thi Cat Tuong[3]

[1] Department of Hydrogeological and Geotechnical Engineering, University of Sciences, Hue University, Hue City, Vietnam
[2] University of Saskatchewan, Saskatoon, Saskatchewan, Canada
[3] Faculty of Civil Engineering, MienTrung University of Civil Engineering (MUCE), Tuy Hoa City, Vietnam

ttphuongan@hueuni.edu.vn

Abstract. Nam Dong is a mountainous area of Hue, Vietnam, situated within a tropical monsoon climatic zone. The climate exerts a profound influence on rock weathering process. The weathering in this region is both intense in magnitude and extensive in spatial distribution. With the development of local infrastructure, many constructions and roads have been built on weathered soil formations. Studies on unsaturated soil properties have become increasingly important but remain underexplored. Previous research on the geotechnical characteristics of soils in Nam Dong has primarily focused on saturated soil mechanics. This paper explores the initial step into the application of unsaturated soil mechanics by investigating the shrinkage limit and shrinkage curve of Nam Dong soils. The SC plays important role in constructing the degree of saturation soil-water characteristic curve. This study is based on the experimental plastic limit and liquid limit data of weathered soils in Nam Dong. The *SL* was obtained using plasticity chart, and the SC fitting parameters are derived from empirical equations. As a result, both the *SL* and SC of the researched soils can be estimated without direct measurement of the SC.

Keywords: *Atterberg limits, shrinkage curve, shrinkage limit*

Evaluation of Slope Stability Due to Rainfall Intensity: A Case Study in Dalat, Vietnam

Pham Duy Khang[1], Nguyen Van Hieu[1], To Thanh Sang[1*]

[1] University of Architecture Ho Chi Minh City, 196 Pasteur, District 3, Ho Chi Minh City, Vietnam

[*]sang.tothanh@uah.edu.vn

Abstract. Da Lat, Vietnam, with its rugged terrain and heavy rainfall driven by climate change, always faces the threat of landslides. This paper quantifies the susceptibility of a representative residual-soil slope to rainfall-induced failure by tracking the reduction in its factor of safety (FoS) under a suite of storm events. A coupled hydro-mechanical finite-element model was developed with shear-strength parameters and hydraulic conductivities obtained from site-specific geotechnical investigations. Synthetic rainfall histories with systematically varied intensity–duration combinations were applied as boundary conditions to simulate infiltration and the resulting pore-pressure evolution. The results show the FoS dropping from 1.149 to 1.029 as cumulative rainfall increases, driven by rapid loss of matric suction and buildup of positive pore-water pressure in the soil cover. The derived FoS–rainfall envelopes furnish practical thresholds for early warning and inform the design of slope-stabilisation measures, thereby enhancing the long-term resilience of critical tourist infrastructure in the region.

Keywords: *Slope stability, rainfall, climate change, factor of safety.*

Failure Process Analysis of Layered Clayey Slopes using the Material Point Method

Toan Minh Le[1,2*,[0000-0001-5805-9302]], Luigi Pugliese[3,[0000-0002-2008-0381]], Andrea Parise[3,[0000-0003-1462-4001]], Enrico Conte[3,[0000-0002-3674-5085)]] and Antonello Troncone[3,[0000-0002-5595-9281]]

[1]Faculty of Civil Engineering, Ho Chi Minh City University of Technology (HCMUT), 268 Ly Thuong Kiet Street, Dien Hong Ward, Ho Chi Minh City, Vietnam
[2]Vietnam National University Ho Chi Minh City (VNU-HCM), Linh Xuan Ward, Ho Chi Minh City, Vietnam
[3]Department of Civil Engineering, University of Calabria, Rende (Cosenza), Italy

*lmtoan@hcmut.edu.vn

Abstract. This paper investigates the failure characteristics of layered clayey slopes using the Material Point Method (MPM) and the Drucker–Prager (DP) model. A representative two-layer clayey slope is considered. The analysis comprises two main steps. First, MPM is integrated with the Strength Reduction Method (SRM) and a perfectly plastic DP model to evaluate slope stability. Subsequently, a dynamic MPM simulation is coupled with a strain-softening DP model to reproduce the strain-driven weakening behavior of clay during post-peak deformation. Preliminary numerical results confirm the effectiveness and accuracy of MPM in both the slope stability analysis and the simulation of the entire failure process. Moreover, the findings show that the strain-softening parameter and the undrained shear strength ratio between the two clay layers play critical roles in controlling the failure mechanism, large deformation, and post-failure responses. These initial results provide a useful basis for further in-depth investigations into slope failure processes in layered clays and for developing more effective stabilization measures.

Keywords: *Material point method, Layered clayey slopes, Strain-softening.*

Geostatistical modelling of shallow marine sediments using synthetic CPTu data for offshore wind foundation design in Southern Vietnam continental shelf

Do Duy Khoan[1,2] [0009-0000-5752-3003], Varvara Zania[3][0000-0001-8270-1246], Evangelos Katsanos[3][0000-0003-2574-5327], Lara F. Pérez[4][0000-0002-6229-4564], Nguyen Van Thinh[2][0000-0002-6001-4864], Nhu Viet Ha[2][0000-0003-1812-950X], Ta Quoc Dung[5][0000-0002-1609-8239]

[1] PetroVietnam Exploration and Production Corporation (PVEP), Hanoi, Vietnam
[2] Hanoi University of Mining and Geology (HUMG), Hanoi, Vietnam
[3] Denmark Technical University of Denmark (DTU), Denmark
[4] Geological Survey of Denmark and Greenland (GEUS),
[5] Ho Chi Minh City University of Technology (HCMUT), Ho Chi Minh City, Vietnam

khoandd@pvep.com.vn

Abstract. As offshore wind energy development accelerates across Southeast Asia, accurate characterization of shallow marine sediments has become a critical prerequisite for foundation design and geotechnical risk assessment. In southern Vietnam, where sediment heterogeneity and limited site investigation data pose significant challenges, this study introduces a novel geostatistical workflow that utilizes synthetic Cone Penetration Test (CPTu) data to emulate real sediment behavior under conditions of data scarcity and confidentiality. The workflow integrates synthetic CPTu generation and geostatistical modelling to characterize spatial variability of sediments up to 50 m depth. CPTu and borehole profiles were generated using statistical parameters derived from deltaic-to-marine analogues, particularly in Southern Vietnam. Ordinary Kriging (OK) and Sequential Gaussian Simulation (SGS) were applied to interpolate cone resistance (qc), undrained shear strength (Su), friction ratio (Rf) and soil behavior type index (Ic), allowing both deterministic mapping and stochastic uncertainty assessment. Variogram parameters were also quantified while 3D parametric models of sediment stiffness and facies were constructed in Petrel subsurface software to visualize subsurface variability. The resulting 2D and 3D models highlight spatially continuous sediment zones and reveal distinct weak layers and bearing capacity transitions, which are critical for the preliminary assessment of possible foundation solutions (monopiles and jacket foundation) used to support offshore wind turbines. This research establishes a reproducible, transferable framework for offshore geotechnical modelling under data-limited conditions, providing a valuable tool for early-phase site de-risking, foundation screening, and regional planning of offshore wind projects along Vietnam's southern continental shelf and other tropical margins.

Keywords: *Synthetic CPTu, Geostatistics, Ordinary Kriging, Sequential Gaussian Simulation, Sediment modelling, Offshore wind foundations.*

Geotechnical Seismic Isolation of Bridge Piers founded on Caissons: numerical analyses vs. centrifuge tests

Domenico Gaudio[1][0000-0001-8957-5764] and Fabrizio Murillo[2]

[1] Dipartimento di Ingegneria Strutturale e Geotecnica, Sapienza Università di Roma, via Eudossiana 18, 00184, Rome, Italy
[2] Dipartimento di Ingegneria Civile e Ambientale, Politecnico di Milano, Piazza Leonardo da Vinci 32, 20133, Milan, Italy

domenico.gaudio@uniroma1.it

Abstract. Caisson foundations supporting long-span bridges have exhibited favourable seismic performance, largely due to Dynamic Soil-Structure Interaction (DSSI); nevertheless, standard engineering practice often assumes fixed-base condition for the bridge piers, thereby overlooking DSSI to maintain conservatism and confining the soil-caisson response to the linear-elastic regime. While intended to ensure safety, this approach may result in overly conservative design and increased costs, as well as compromise the system performance when subjected to strong-ground motions. To date, few studies have investigated the seismic response of caisson foundations, focusing on the circumstances in which the hysteretic and irreversible soil behaviour is temporarily mobilised, thus possibly leading to the instantaneous activation of bearing capacity. The occurrence of this phenomenon can substantially reduce structural demand and, when pursued on purpose, result in a safe design, provided that both peak and permanent displacements remain within acceptable thresholds. A novel approach for the seismic design of caisson foundations is therefore emerging, which is usually termed as Geotechnical Seismic Isolation (GSI). This study extends previous research by reproducing the results from dynamic centrifuge tests available in the literature with 3D FE analyses. Five simulations were conducted to evaluate the seismic performance of a caisson-pier-deck system embedded in a soft and very soft clay layer, subjected to moderate and strong recorded ground motions. The results show that the main characters of the centrifuge tests are captured, which forms the basis for future numerical investigation aimed at assessing GSI beneficial effect on the design of bridge piers on caisson foundations.

Keywords: *Caisson foundation, Bridge pier, Dynamic Centrifuge test, 3D FE analysis, Geotechnical Seismic Isolation.*

Influence of Central Drain Diameter on Coefficient of Radial Consolidation in Soft Soils: Lab and Numerical Insights

Cong Kien Nguyen[1], Tien Dung Nguyen[1], Dat Vu Khoa Huynh[2]

[1]VNU Vietnam Japan University, Hanoi, Vietnam

[2]Norwegian Geotechnical Institute, Oslo, Norway

nt.dung@vju.ac.vn

Abstract. This paper presents experimental and numerical studies on the variation of coefficient of radial consolidation (c_r) obtained from radial consolidation (RC) tests with different central drain (CD) diameters. Experiments were carried out on undisturbed and remolded soil samples collected from three test sites in Vietnam's Red River Delta. Concurrently, finite element analysis using the Soft Soil model in PLAXIS was performed to support and validate the laboratory observations. Finding results consistently indicate that, for a given soil under the same applied pressure, a smaller CD diameter results in a larger c_r value. This behavior is primarily attributed to the systematic variation of the permeability change index (C_k) with alterations in CD diameter. The study establishes relevant linear correlations between c_r values obtained from different CD diameters, offering a practical framework for interpreting RC test results and enhancing the reliability of c_r values for prefabricated vertical drain (PVD) design. These findings fundamentally challenge the classical assumption of a constant c_r for a given soil and highlight the need for standardized RC testing protocols.

Keywords: *Radial Consolidation test, Coefficient of Radial Consolidation, Central Drain Diameter, Soft Soils, Finite Element Analysis.*

Influence of Sample Height on the Liquefaction Resistance of Sand–Kaolinite Mixtures

Dong-Kiem-Lam Tran[1] and Sung-Sik Park[2]

[1]Department of Civil Engineering, University of Architecture Ho Chi Minh City, 196 Pasteur Street, Ho Chi Minh City, Vietnam
[2]Department of Civil Engineering, Kyungpook National University, 80 Daehakro, Bukgu, Daegu, 41566, Republic of Korea
lam.trandongkiem@uah.edu.vn

sungpark@knu.ac.kr

Abstract. This study investigates the influence of sample size on the cyclic behaviour and liquefaction resistance of sand-Kaolinite mixtures using cyclic direct simple shear (CDSS) testing. The primary materials used are Silica sand and Kaolinite, mixed at a ratio of 90% sand to 4% Kaolinite by weight. Samples were prepared with relative densities of 60% and the sample heights tested were 17.5 mm, 20.0 mm, 22.5 mm, and 25.0 mm, while maintaining a constant diameter of 63.5 mm. The study focuses on the effect of sample height on cyclic behaviour and liquefaction resistance of the sand-kaolinite mixture. Excess pore pressure generation during cyclic loading showed initial rapid generation, largely independent of sample size for low CSR values, but displayed a clear dependence on sample height, with larger samples showing slower rates of EPP accumulation. Moreover, the results show that increased sample heights lead to higher liquefaction resistance. The CRR_{15}, which is the cyclic stress ratio required to cause liquefaction in 15 cycles, increases with sample height, demonstrating a linear relationship. Additionally, the impact of the sample size ratio (D/H) on CRR_{15} was analyzed, revealing that a decrease in D/H ratio results in a decrease in CRR_{15}.

Keywords: *Liquefaction resistance, sand-kaolinite mixture, sample height, cyclic simple shear test.*

Investigation into physical attributes of monazite tailings

Ismail Adeniyi Okewale[1 [0000-0003-1115-7479]] and Hendrik Grobler[2]

[1, 2] Department of Mining Engineering, University of Johannesburg, South Africa

iaokewale@futa.edu.ng

Abstract. The need to source for rare earth elements and the development of renewable and nuclear energy is of utmost importance worldwide. One of the significant source for these elements are monazite ore and they are mined and processed. The materials left after processing the ore to obtain the pure elements are termed tailings and their disposal and handling are problematic due to their adverse impacts on social, economy and environment of human as well as the entire ecosystem. There have been investigations on tailings but not exhaustive and study on monazite tailing is still lacking. This paper presents the physical attributes of monazite tailings through the conduction of index and physical tests as well as the comparisons of the properties with other studies. The samples were obtained in disturbed form and they are subject to laboratory tests without subjecting to any treatment. The specimens have varying particle sizes and well graded in nature. The mean particle size D_{50}, coefficient of uniformity Cu, coefficient of curvature Cc and fines content Fc have an average values of 0.92 mm, 323, 1.78 and 32% respectively. The tailings are non-clayey and non-plastic. The monazite tailing's fabric is less heterogeneous and isotropic with inter particle and inter cluster voids. Silica is the dominant chemical compositions with 72.64% followed by alumina with 10.66% and potassium oxide with 10.33% proportion. Quartz is the major mineral with 78% proportion and the other compositions are orthoclase and albite with 15% and 7% proportions respectively. The characteristics of monazite tailings are similar to some tailings and also differ from some tailings. This shows the cumbersome nature of this inevitable artificial material. The physical attributes of materials could have positive effect on geotechnical behaviour of monazite tailings.

Keywords: *Monazite, tailings, rare earth elements, renewable energy, construction.*

Investigation of CO_2 interactions with backfilled stopes in deep underground mines

Ruslan Duisenbek and Ali Mortazavi

School of Mining & Geosciences, Nazarbayev University, 53 Kabanbay Batyr Ave., Astana, 010000, Kazakhstan

ali.mortazavi@nu.edu.kz

Abstract. The potential for storing CO2 in depleted underground mines is examined in this study. The storage of CO2 in depleted underground mines is proposed by this study. There is a lot of potential for storing CO2 in mine development structures and backfilled openings due to the trend toward the closure of underground mines in many mining countries. Compared to traditional CCS projects, injecting CO2 into backfilled stops has a number of advantages. A more economical option is to utilize the existing mining infrastructure and backfilled openings, which are porous and are not tightly filled. For a deep underground mine (1,000–2,000 m depth), the total development volume typically ranges between 600,000 and 2,000,000 m^3, depending on the mine size and complexity. Larger operations (block caves, panel caves) can exceed these estimates significantly. The interaction between the surrounding rock, backfill, and CO2 introduces complex mechanical and thermal stress field interactions that pose challenges for traditional empirical analysis. Numerical and analytical studies of CO2 penetration and interactions with backfill material and backfilled stopes are the goal of this research. Geomechanical stability and integrity analysis of the caprock and underground mine host rock will be investigated. To address these challenges, advanced numerical modelling will be utilized to look into mechanisms involved in CO2-backfill interactions. A typical stope in deep underground mine conditions will be considered and analyzed in 3D and under realistic boundary conditions associated with deep mining.

Keywords: *CO2 storage, underground mining, Backfill.*

Numerical simulation of a landslide in sensitive clays using MPM

Antonello Troncone[1[0000-0002-5595-9281]], Luigi Pugliese[1[0000-0002-2008-0381]], Andrea Parise[1[0000-0003-1462-4001]], Toan Minh Le[2,3[0000-0001-5805-9302]] and Enrico Conte[1[0000-0002-3674-5085]]

[1] Department of Civil Engineering, University of Calabria, Rende (Cosenza) Italy
[2] Faculty of Civil Engineering, Ho Chi Minh City University of Technology (HCMUT), 268 Ly Thuong Kiet Street, Dien Hong Ward, Ho Chi Minh City, Vietnam
[3] Vietnam National University Ho Chi Minh City (VNU-HCM), Linh Xuan Ward, Ho Chi Minh City, Vietnam

andrea.parise@unical.it

Abstract. Landslides in sensitive clays are characterized by high velocities and long run-out distances, posing significant challenges to the geotechnical community. Despite extensive research, accurately modelling their kinematics remains a persistent challenge. In this study, the Material Point Method (MPM) is employed to analyze the complete failure process of the Sainte-Monique landslide (Quebec, Canada), a well-documented event involving sensitive clays, by incorporating a strain-softening constitutive model. This specific event is extensively described in the literature, providing a clear failure mechanism and detailed geotechnical characterization. To validate the numerical simulation, the observed post-failure profile and run-out distance are compared with the model results. The findings confirm the effectiveness of MPM in accurately predicting both the evolution of the failure surface and the subsequent run-out process. Notably, the simulated failure mechanism reflects the documented behavior, appearing naturally without prior constraints on the shape or position of the failure surface. Furthermore, the final profile shows strong agreement with field measurements. These findings highlight the potential of MPM as a powerful tool for predicting the run-out and failure mechanism of landslides in highly sensitive clays, requiring only a limited set of conventional geotechnical parameters.

Keywords: *material point method (MPM), landslides run-out, sensitive clays, strain softening.*

Numerical study on the behaviour of embankment over soft soil reinforced with granular columns

Mayank Nishant [1] [0000-0002-2568-8230], Suresh Kumar [1] [0000-0002-5528-0260]

1 Indian Institute of Technology (BHU), Varanasi, Uttar Pradesh, India

mayank.nishant.rs.civ18@iitbhu.ac.in

Abstract. The continued growth in the urban population has caused a scarcity of suitable land available for infrastructure development. The application of innovative solutions to address these challenges is the need of the hour. In recent decades, granular columns have been prominently used to aid soft soil against significant traffic loads. Traditional laboratory tests and field investigations, although useful, sometimes, cannot fully reproduce the complicated conditions found in real-life projects, especially for structures like embankments, and foundations. In addition, carrying out large-scale field tests can be expensive and difficult to manage. For these reasons, numerical methods especially the Finite Element Method (FEM) have become reliable and widely used tools for solving difficult geotechnical problems. A three-dimensional numerical modeling of embankment over granular column reinforced clay bed foundation was done. A finite element analysis was done using a numerical tool for the constitutive modeling of the embankment and the clay bed with the columns. Existing laboratory model test results were used to validate the numerical model successfully. The ultimate bearing capacity obtained from numerical analysis was 36.75 kPa at 50 mm of footing settlement. The ultimate loading capacity was improved by 1.76 times (64.73 kPa) for embankment supported by floating columns and 2.13 times (78.31 kPa) for the end-bearing columns. The deformation characteristics of the embankment were examined to evaluate the effect of different column configuration. Results obtained from the numerical study indicated that the embankment withstands higher vertical stress for end-bearing column-supported clay beds. Also, the stress concentration ratio under static loading was higher for end-bearing columns. The numerical study done in this work will help better understand the deformation and failure pattern exhibited by soft soil foundation systems supported by granular columns and geosynthetic encasement.

Keywords: *Ground Improvement, Soft soil, Granular column, Finite element analysis, Geosynthetics*

Numerical Investigation of Soil Bag Mechanical Behavior Based on the UH Model

Wang Jing[1], Yao YangPing[2], Wang NaiDong[3], and Liu HaoYuan[4]

Beihang University, Beijing 100191, China

wangnd@buaa.edu.cn

Abstract. The mechanical behavior of soil bag structures is studied by analyzing the interaction between the geotextile bag and its fill material using an enhanced numerical modeling method based on the CSUH constitutive model. The soil bags are initially considered as a uniform material, and their mechanical response is studied within the UH model framework by transforming the tensile force in the bag membrane into confining pressure acting on the fill soil. The mechanical behavior of cylindrical soil bags with circular cross-sections is studied. The effects of membrane strength, loading conditions, and relative density of the fill material are considered in investigating the strength and deformation characteristics of the soil bags. The key findings are as follows: (1) Increasing the strength of the bag membrane enhances the overall strength of the soil bag and reduces its deformation; (2) An increase in the relative density of the internal soil fill leads to higher soil bag strength and reduced deformation; (3) Under increased external loading, the mobilized strength of the soil bag increases while its deformation decreases. The calculation method is further validated through limiting conditions, in which it degenerates to the conventional triaxial compressive stress state. This study established an analytical calculation method for soil bags and discussed the evolution of its mechanical behavior based on relevant parameters, providing theoretical support for the practical engineering application of soil bags.

Keywords: *Soil bag, CSUH model, Numerical modelling, Mechanical behavior.*

Physicochemical Properties Of Biopolymer-Modified Bentonite For Use In Barrier Systems

Muhsina Shirin Barbhuiya[1] and K Ravi[2]

[1] PhD Scholar, Indian Institute of Technology, Guwahati, Assam, India
[2] Associate Professor, Indian Institute of Technology, Guwahati, Assam, India

muhsina@iitg.ac.in

Abstract. The challenge of safely managing industrial and municipal waste continues to be an important environmental issue due to the risks of inducing long-term contamination. The swelling properties and low permeability of bentonite are the basis of its wide use within engineered barriers, however, under chemically aggressive environments, bentonite may perform poorly. This research investigates the physics and chemistry as well as the plasticity of modified bentonite using naturally sourced biopolymers with the intention of using such modifications in engineered barrier applications. Two biopolymers, xanthan gum and guar gum, were used in this study, both at a 5% dry weight basis, to modify the properties of bentonite through physical and chemical interactions. Upon completion of the modification process, bentonite's properties including pH, electrical conductivity (EC), and Atterberg limits were re-analysed. The results showed that additions of xanthan and guar gums caused substantial changes in both pH and EC; this indicates modified ionic interactions of bentonite, which led to greater dispersion behaviour of the bentonite. The Atterberg limit tests confirmed that there was a large increase in both LL and PL, which subsequently resulted in increased PI values when compared to unmodified bentonite. The modifications of bentonite indicate that the workability and water retention of bentonite would greatly improve and thus would enhance the performance of bentonite as a barrier material. Additionally, the results support the use of xanthan and guar gums as viable alternatives to virgin (completely processed) additives.

Keywords: *bentonite, biopolymers, plasticity.*

Sustainable Stabilization of Saline Soil Using Alkali-Activated Binders: Strength Development and Microstructural Mechanisms

Jiyun Nan[1,2][0000-0001-7853-3454], Jinze Li[1][0000-0003-0451-6285], Hongjie Lin[1][0000-0002-8877-4128], Jiankun Liu[1][0000-0002-3064-8575], Ngoc Quy Hoang[3][0000-0002-3050-8396], Zhifeng Ren[4][0000-0003-4675-0301], and Q. Hung Truong [5][0009-0003-8280-4087]

[1] School of Civil Engineering, Sun Yat-sen University, Guangzhou 510275, China.
[2] School of Civil, Environmental and Architectural Engineering, Korea University, 145, Anam-ro, Seongbuk-gu, Seoul 02841, Republic of Korea
[3] Faculty of Civil Engineering, Ho Chi Minh City University of Technology, Thanh My Tay Ward, Ho Chi Minh City, Vietnam
[4] College of Architecture and Energy Engineering, Wenzhou University of Technology, Wenzhou, 325000, China
[5] Faculty of Civil Engineering School of Technology, Van Lang University, HCMC, Vietnam

liujiank@mail.sysu.edu.cn

Abstract. Saline soils in cold and arid regions pose significant challenges to infrastructure development due to their poor mechanical performance and vulnerability to environmental degradation. Traditional cement-based stabilization methods often result in high carbon emissions and limited durability. To address these issues, this study explores an environmentally friendly and sustainable soil stabilization approach using alkali-activated binders. The objective is to enhance the mechanical strength and microstructural integrity of saline soil through a composite binder composed of lime, fly ash, and sodium silicate. Nine mix proportions were designed. Unconfined compressive strength (UCS) tests were performed to assess the strength evolution over various curing periods. To understand the mechanisms behind strength development, X-ray diffraction was used to identify hydration products, while scanning electron microscopy was employed to observe microstructural evolution. The results revealed that the formation of C-S-H and needle-like ettringite effectively filled pores and cemented particles, leading to a denser internal structure and improved UCS performance. The optimal mix exhibited a 1.65-fold increase in UCS after 28 days of curing compared to the uncured state. This study demonstrates the potential of alkali-activated materials as low-carbon, durable alternatives for ground improvement, offering valuable insights for resilient and sustainable civil infrastructure design.

Keywords: *Alkali-activated binder; Saline soil stabilization; Unconfined compressive strength; Microstructural analysis; Low-carbon materials.*

Synergistic Effect of Eco-friendly Bentonite-Coir Fiber stabilizers on the Geomechanical Characterization of Kuttanad Soil

Anakha Raj Deepa, Shilpa Mary Sam, Seethalakshmi P., and Jayachandran K.

[1]Department of Civil Engineering , College of Engineering Trivandrum, Kerala, India
[2]Department of Civil Engineering , National Institute of Technology Calicut, Kerala, India

shilpa_p220078ce@nitc.ac.in; seetha@nitc.ac.in; seetha@nitc.ac.in

Abstract. Kuttanad soil, a soft and highly compressible silty clay native to the backwater regions of Kerala, India, presents persistent challenges due to its low shear strength and high plasticity. In this study, the combined application of bentonite and coir fibers as eco-friendly stabilizers to improve the geotechnical characteristics of Kuttanad soil was investigated. Bentonite content was varied from 0%, 2%, 4% and 6%, while coir fibers were added at 0.5%, 1%, and 1.5% by weight with the virgin soil. The unconfined compressive strength (UCS) of Kuttanad soil increased by 28%, 53%, and 48% for bentonite contents of 2%, 4%, and 6%, respectively. The addition of 0.5% coir fiber along with bentonite up to 6% in Kuttanad soil did not result in significant strength gains. With 1% coir fiber, strength improvements of 48% and 78%, respectively, were observed for soil with 2% and 4% bentonite; however, for soil with 6% bentonite, the additional improvement was limited to 8% with 1% coir fiber inclusion. With 1.5% coir fiber, strength improvements of approximately 60-100% were achieved across all bentonite percentages as compared to that of untreated Kuttanad soil. The negative influence of expansive bentonite inclusion was explored by investigating the Free Swell Index. Differential Free Swell Indices (DFSI) indicated that the treated soil showed only marginal swelling. Hence, the results indicate that the addition of bentonite and coir fibers can serve as a promising and eco-friendly method for stabilizing Kuttanad soil.

Keywords: *Kuttanad Soil; Bentonite; Coir fiber; Shear Strength; Swelling.*

Thermal Impact on the Behavior of Bentonite Clay for Geo-Environmental Barrier Applications

Priyanka Das[1] and AK Mishra[2][0000-0003-2752-2768]

[1 2] Indian Institute of Technology, Guwahati, Assam, India

priyankad4103@iitg.ac.in

Abstract. The use of bentonite for liner applications in geo-environmental engineering is very efficient due to its high swelling potential. Its effectiveness, however, with prolonged exposure to high temperatures is reduced. This study examines the effects of thermal conditions on the behavior of bentonite from the Barmer district in Rajasthan, India. The clay sample was heated to 500 °C and subsequently tested with deionized water. Laboratory investigations included compaction test, specific gravity, particle size distribution, free swell index and consistency limits such as liquid limit and plastic limit, conducted both before and after heating. The data was compared to evaluate the impact of heat on the performance of bentonite. The results illustrate the performance of bentonite under conditions replicating high-temperature environments that are typically found in geo-environmental barrier systems. This is fundamental for the efficient design and long-term integrity of containment systems employing bentonite-based liners.

Keywords: *Bentonite Clay, Heating, Soil Index Properties, Compaction*.

Twin Tunnel–Piled Foundation Interaction: Excavation Sequence and Soil Nonlinearity in Urban Settings

Van Vi Pham[1], Tai Tien Nguyen[2,3], Minh Tuan Pham[4], Ngoc Anh Do[2,3], Daniel Dias[5,*]

[1]Faculty of Mechanical-Automotive and Civil Engineering, Electric Power University, Hanoi, Vietnam
[2]Department of Underground and Mining Construction, Faculty of Civil Engineering, Hanoi University of Mining and Geology, Vietnam
[3]Tunnelling and Underground Space Research Team, Hanoi University of Mining and Geology, Hanoi, Vietnam
[4]Department of Geotechnical Engineering, Faculty of Geology and Petroleum Engineering, Ho Chi Minh City University of Technology (HCMUT), Ho Chi Minh City, Vietnam
[5]Laboratory 3SR, Grenoble Alpes University, Grenoble, France

daniel.dias@univ-grenoble-alpes.fr

Abstract. Underground construction has become a key component of modern megacity infrastructure, providing effective solutions to growing urban mobility challenges. Among these, subway networks play a pivotal role in delivering high-capacity transit. Within this framework, the present study explores the influence of twin circular tunnel excavation on the performance of building–pile foundations through two-dimensional (2D) numerical modeling. The analysis considers different tunnel excavation sequences and three constitutive soil models: the linear elastic perfectly plastic Mohr–Coulomb (MC) model, the Hardening Soil (HS) model, and the Hardening Soil model with small-strain stiffness (HSS). The tunneling process is simulated using the Convergence–Confinement Method (CCM), which provides a simplified yet robust approach for evaluating ground deformations and induced internal forces. Particular emphasis is placed on the interaction between twin tunnels and adjacent pile foundations, with attention to how excavation sequence affects the structural response. Comparative analyses are performed to assess variations in displacements and internal forces within the building–pile system during tunnel advancement. The findings reveal the critical role of both excavation sequence and the selected constitutive soil model in governing the induced structural response. These results emphasize the necessity of accurate soil modeling to ensure reliable design in complex urban environments.

Keywords: *Twin tunnels, Convergence-Confinement Method, Pile Foundation, Soil constitutive model.*

Upward and Downward Shaft Resistance of Driven Piles in Expansive Soils

Hai M. Nguyen[1], Lan V. H. Bach[2], Trung T. Le[3], and Thuy T.N. Nguyen[4]

[1] Universal Engineering Sciences, Houston, Texas, USA.

haitdmu@gmail.com

[2] University of Architecture Ho Chi Minh City, Vietnam.

lan.bachvuhoang@uah.edu.vn

[3]Thu Dau Mot University, Ho Chi Minh City, Vietnam.

lttrung@tdmu.edu.vn

[4] Vietnamese-German University, Binh Duong, Vietnam.

thuygeo9@gmail.com

Abstract. A static loading test program, including both tension and compression tests, was conducted on driven W6x9 section piles embedded in expansive soils to support solar photovoltaic arrays in the Texas Gulf Coast region of the United States. The tested piles were installed to depths of 7 and 10 feet below the existing ground surface. Six days after installation, static load tests were performed to failure. Analysis of the results indicates that the upward shaft resistance was approximately 82% of the downward shaft resistance. These findings suggest that a reduction factor of 0.82 may be appropriate when designing driven H-piles for uplift resistance in expansive soils, particularly when estimating uplift capacity based on the undrained shear strength of the soil. This reduction factor may vary for different pile types and site conditions. Furthermore, the results indicate that a single type of load test (tensile or compressive) on driven H- piles may be sufficient, eliminating the need to conduct both tests.

Keywords: *Driven Pile, Static Loading Tests, Expansive Soils, Shaft Resistances*

Use of the SWC-050 Pressure Plate for Measuring of the SWCC on a Mountain Soil from Vietnam

Tran T.P An[1][0000-0001-8290-2152], Fredlund Delwyn G.[2], Le Thi Cat Tuong[3], Nguyen Thi Thuy[1] and Tran Thi Ngoc Quynh[1]

[1] Department of Hydrogeological and Geotechnical Engineering, University of Sciences, Hue University, Hue City, Vietnam
[2] University of Saskatchewan, Saskatoon, Saskatchewan, Canada
[3] Faculty of Civil Engineering, MienTrung University of Civil Engineering (MUCE), Tuy Hoa City, Vietnam

ttphuongan@hueuni.edu.vn

Abstract. The soil-water characteristic curve (SWCC) is required for the estimation of unsaturated soil property functions (i.e., shear strength and permeability) in geotechnical engineering. This paper presents the results obtained when using a pressure plate apparatus recently developed by GCTS. The new apparatus consists of 3 pressure plate cells and 1 air pressure control system. The SWC-050 is evaluated in terms of its ability and efficiency in measuring the drying branch of the SWCC for a weathered soil. The paper presents the gravimetric water content SWCC (*w*-SWCC) and the degree of saturation (*S*-SWCC) results on the weathered soil. The amount of water removed from the soil under applied air pressure was monitored by weighing pressure plate cells until the equilibrium condition was achieved. The shrinkage curve for the soil is also measured and used for the calculation of the *S*-SWCC. The paper also presents an assessment of limitations of the apparatus that were observed while conducting the Pressure Plate tests.

Keywords: *S-SWCC, volume change, air-entry value*.

INFRASTRUCTURE, MANAGEMENT AND INVESTMENT, TRANSPORTATION

A Brief Review of Non-Destructive Testing Methods for Assessing Steel Fiber Dispersion in Concrete

Ali Sophian[1][0000-0003-4991-6362], Nen NguyenDinh[20000-0002-4850-8984], and Ali Aryo Bawono[3][0000-0003-4991-6362]

[1] Dept. of Mechatronics Engineering, International Islamic University Malaysia, Malaysia
[2] University of Architecture Ho Chi Minh City, Vietnam
[3] Faculty of Rail and Urban Transport, Technical University of Munich Asia, Singapore

ali.bawono@tum-asia.edu.sg

Abstract. Steel Fiber Reinforced Concrete (SFRC) offers enhanced mechanical properties crucial for modern construction, but its performance heavily relies on the dispersion of steel fibers within the matrix. Inhomogeneous dispersion can significantly compromise structural integrity yet assessing it reliably remains challenging. Traditional destructive methods are limited, highlighting the need for effective Non-Destructive Testing (NDT) techniques. This paper presents brief literature review synthesizing research from the past 15 years on NDT methods for evaluating inhomogeneous steel fiber dispersion in hardened SFRC. The review covers electrical, magnetic/inductive, ultrasonic, acoustic emission, ground penetrating radar (GPR), X-ray/Computed Tomography (CT), and microwave methods. Their principles, capabilities, and limitations are examined, and recommendations are provided for developing robust quantitative NDT methods.

Keywords: *SFRC, Fiber, NDT, Assessment.*

AI-Powered Pavement Assessment and Decision Support for Smart Expressway Management

Vu Hong Son Pham[1,2]; Nguyen Van Tien Khoi[1,2] and Luu Xuan Loc[1,2]

[1] Ho Chi Minh City University of Technology, Ho Chi Minh City, Vietnam.
[2] Vietnam National University, Ho Chi Minh City, Vietnam.

nvtkhoi.sdh242@hcmut.edu.vn

Abstract. Road infrastructure systems have long been regarded as the backbone of economic and social development at national and regional levels, as exemplified by the U.S. Interstate Highway System, China's expressway network, and Vietnam's rapidly expanding expressway system. However, the accelerated investment in the construction and expansion of these networks has led to a growing demand for effective, scalable, and intelligent approaches to highway infrastructure quality management. To support the modernization of pavement quality management for expressway systems, this study proposes an integrated framework that leverages advanced digital technologies to automate patrol operations and pavement condition assessment. The proposed highway quality management system combines machine learning–based image recognition, digital GIS mapping, GPS positioning, and a decision support system (DSS) to provide a comprehensive and operational evaluation of pavement conditions. The framework is developed based on the YOLOv8 model and achieves a mean average precision (mAP@50) of 90.2% for road surface damage detection, with damage severity levels classified and spatial features extracted to accurately localize detected defects. Beyond damage identification, the developed software integrates a rule-based DSS module that translates detection outputs into actionable maintenance recommendations, dynamically updates condition information, and supports real-time infrastructure monitoring. By enhancing the visibility of pavement deterioration across the transportation network and supporting data-driven budget allocation, the proposed framework contributes to improved efficiency and transparency in expressway maintenance management. Future work will focus on expanding and diversifying the training dataset to improve model generalizability under varying environmental conditions, as well as validating and refining the DSS parameters through real-world deployment to enhance its adaptability and practical effectiveness. Overall, the proposed system represents a step toward resilient, sustainable, and intelligent road infrastructure management within the broader context of modern Intelligent Transportation Systems (ITS).

Keywords: *Intelligent Transportation Systems (ITS), Road surface Assessment, Decision Support System (DSS).*

Field investigation of fundamental natural frequencies of steel bridge structures using accelerometer data

Hai Dang Le[1][0000-0001-8984-0636]

[1] Faculty of Civil Engineering, Nguyen Tat Thanh University, Ho Chi Minh City, Vietnam
lhdang@ntt.edu.vn

Abstract. The identification of fundamental natural frequencies is a crucial step in structural health monitoring, providing valuable insight into the dynamic performance and safety of bridge infrastructure. This study focuses on steel overpasses in Ho Chi Minh City, Vietnam, where baseline data on the dynamic characteristics remain limited. Ambient vibration testing was employed as a non-destructive and cost-effective method to evaluate the structural response. Accelerometers were strategically placed at mid-span locations of six representative overpasses, Thu Duc, Hang Xanh, Nguyen Thai Son, Hoang Hoa Tham, Go Vap Intersection and Tan Thuan 1, to capture vibration signals under operational conditions. The recorded time-domain responses were processed using Fast Fourier Transform (FFT) to extract dominant frequency components. Results revealed the first natural frequencies as 2.5 Hz for Thu Duc, 3.6 Hz for Hang Xanh, 2.1 Hz for Nguyen Thai Son, 2.8 Hz for Hoang Hoa Tham, 2.6 Hz for Go Vap and 2.6 Hz for Tan Thuan 1. These values were further compared with empirical frequency estimations, demonstrating strong consistency despite limited structural detail data. The outcomes confirm that accelerometer-based monitoring of ambient vibrations provides reliable information on the dynamic characteristics of steel bridges. This approach not only supports early detection of potential structural damage but also offers a practical tool for planning maintenance of transportation infrastructure.

Keywords: *Structural Health Monitoring, natural frequencies, bridge and Fast Fourier Transform*.

Identifying Critical Risk Factors in High-Rise Construction Projects Using a Relative Importance Index

Nghia Hoai Nguyen[1,2 [0000-0002-7818-5004]], Tran Thanh Ha[1,2 [0000-0001-5175-0547]*] and Tran Hoai Anh[3]

[1] School of Civil Engineering and Management, International University, HCMC, Vietnam
[2] Vietnam National University, HCMC, Vietnam
[3] Binh Duong Provincial Construction Investment Project Management Unit, HCMC, Vietnam

ttha@hcmiu.edu.vn

Abstract. This study aims to identify and prioritize the critical risk factors that significantly influence high-rise construction projects in Vietnam. Through a comprehensive literature review and expert consultations, a list of 47 initial risk factors was established. These factors were categorized into six groups: technical-construction, schedule, economic-financial, legal-contractual, design, and environmental-safety-social. A questionnaire survey was administered to construction experts, who assessed each risk factor using a five-point Likert scale. The Relative Importance Index method was applied to rank and prioritize the identified risks. The results revealed that economic-financial risks were the most critical, with delays in contractual or periodic payments, financial capacity of project owners and contractors, and incomplete payment of approved quantities ranking highest. The findings provide empirical evidence to support construction professionals and policymakers in developing targeted risk mitigation strategies and resource allocation plans for high-rise construction projects in developing economies.

Keywords: *High-rise construction, Risk management, Critical risk factors, Relative Importance Index, Project performance*

Risk management of material supply for construction contractors in expressway projects in Vietnam.

Tran Phu Loc[1][0000-0001-7657-5693] and Nguyen Minh Duc*[2][0000-0002-4753-4670]

[1,2] Ho Chi Minh city University of Transport, Vietnam

Duc.nguyen@ut.edu.vn

Abstract. Vietnam is undergoing rapid socio economic development, driving the need for extensive investment in transportation infrastructure, particularly expressways. These projects are essential for enhancing regional connectivity, facilitating trade, and reducing travel time. As a result, the government has prioritized expressway development, mobilizing large-scale investment and numerous contractors. However, construction contractors have encountered significant challenges, with material supply risks emerging as one of the most critical issues. Reliable supply of construction materials is vital to ensuring project continuity, timeliness, and quality. Disruptions in the supply chain can lead to delays, cost overruns, compromised standards, financial losses, reputational damage, and even bankruptcy. Despite the importance of these risks, existing research in Vietnam remains limited, focusing mainly on general delays or broad risk factors rather than the specific complexities of material procurement and logistics in expressway construction. To address this gap, this study systematically identifies potential risks in the construction material supply process for construction contractors. Using qualitative and quantitative risk assessment methods, it evaluates the likelihood and severity of risks, classifies them by impact, and proposes mitigation strategies to the Vietnamese context. The findings are expected to provide practical guidance for contractors, project managers, and policymakers, helping to reduce material-related disruptions and improve the successful delivery of current and future expressway projects.

Keywords: *Risk management, Material supply, Expressway projects*

A Lane-Changing Model for Motorcycles

Vu Minh Chien[1], Nen NguyenDinh[2,[0000-0002-4850-8984]*]

[1]Nguyen Tat Thanh University, 300A Nguyen Tat Thanh, Ho Chi Minh Vietnam

[2 *]University of Architecture Ho Chi Minh City (UAH)

* nen.nguyendinh@uah.edu.vn

Abstract. This study addresses a critical gap in microscopic traffic simulation for motorcycle-dominated cities, where widely used lane-changing models—primarily developed for cars—do not adequately capture two-wheeler behaviour. Using naturalistic traffic data collected in Ho Chi Minh City from on-vehicle and roadside cameras, trajectories and kinematic variables were extracted via computer vision (YOLOv8) and distance measurements. The analysis identifies key determinants of motorcycle lane-changing, including speed, relative spacing, available gap width, gap acceptance, and rider aggressiveness. Based on these findings, a parameterised motorcycle-specific lane-changing model was developed, calibrated, implemented in a microscopic simulation platform, and validated against field observations. Results show a substantial improvement over the default car-based settings, achieving approximately 83% behavioural similarity. The proposed data-driven framework improves simulation fidelity and supports urban traffic analysis, road-safety assessment, and traffic management in high-motorcycle contexts.

Keywords: *Lane changing model, Motorcycle, Two-wheelers, microscopic traffic simulation*

A continuous speed-profile model for roundabouts based on trajectory data

Luís Vasconcelos[1] [0000-0002-9209-5750] and Tiago Abreu[2] [0000-0003-3438-3479]

[1] CITTA & IPV, Polytechnic Institute of Viseu, Viseu, Portugal
[2] CESAM & ISEP, Polytechnic Institute of Porto, Porto, Portugal

vasconcelos@estgv.ipv.pt

Abstract. Roundabouts have been widely adopted worldwide as safer and more efficient alternatives to conventional intersections. Numerous studies have demonstrated a clear correlation between vehicle speeds – both at the approaches and within the circulatory roadway – and crash frequency, including both vehicle-vehicle and vehicle-pedestrian conflicts. In addition to safety, vehicle speed profiles in roundabouts significantly influence environmental factors such as air pollutant emissions and noise. As a result, roundabout design guidelines typically recommend checking the deflection of vehicle paths as a means of controlling speeds. However, existing models often fail to capture the detailed variations in speed throughout different sections of the roundabout. The study combined a critical review of international speed prediction methods (TRL, FHWA and CROW) with empirical trajectory data collection in Coimbra and Viseu, Portugal. Drone footage captured multiple trajectories under free-flow conditions, while a GPS datalogger recorded detailed kinematic data from a single driver across nine roundabouts. Benchmarking results confirmed the limitations of current approaches: TRL merely checks geometric compliance without producing speed estimates, FHWA predicts only minimum speeds at the circulatory ring, and CROW is restricted to conventional layouts. To overcome these shortcomings, a continuous speed-profile model was developed. It assigns a desired speed to each point along the trajectory, constrained by curvature (centripetal comfort), desired speeds and braking feasibility, using parameters of acceleration, deceleration and maximum centripetal acceleration. Calibration using empirical speed profiles and RMSE as the error metric shows good agreement between observed and predicted speeds. Preliminary validation indicates that the model provides a realistic representation of speed-related driver behavior under free-flow conditions, with direct applications in roundabout design assessment and in the strategic placement of pedestrian crossings.

Keywords: *Roundabouts; Speed profiles; Trajectory data; Intelligent Driver Model; Geometric design; Vehicle dynamics.*

Assessing the 1993 AASHTO rigid pavement design drainage coefficient's local applicability in the subgrade of the Philippines

Sarah Micaela C. Nuñez[1] [0009-0007-6611-2792], Juliana Bathan[2] [0009-0007-4270-0354], Dr. Lea B. Bronuela-Ambrocio[2] [0000-0002-8260-761X], Asst. Prof. Matthew Alcantara[2], and Dr. Gil G. Cruz[2] [0009-0006-4486-1584]

[1] University of the Philippines Diliman, Quezon City, Philippines
[2] University of the Philippines Diliman, Quezon City, Philippines

scnunez@up.edu.ph

Abstract. The American Association of State Highway and Transportation Officials (AASHTO) pavement design guide is widely recognized and continuously improved to reflect advancements in materials, methods, and conditions. The Philippines is still utilizing the 1993 AASHTO Pavement Design Guide, despite the limitations and revisions. Among its parameters, one of the critical parameters is the drainage coefficient (Cd); it significantly influences pavement slab thickness due to its sensitivity to drainage quality and exposure to near-saturation moisture conditions. In the pavement design guide of the Philippines, a value of 1 was specified for Cd, which may lead to inaccurate pavement thickness design and long-term structural issues. This study investigated the Cd values that are appropriate to Philippine conditions by conducting laboratory tests on subgrade properties and analyzing the country's road specifications and climatic conditions. Findings emphasize the necessity of recalibrating the Cd value, especially in roads where the subgrade acts as the main drainage layer. Relying on the default Cd value of 1.0 may lead to inaccurate pavement thickness designs and long-term structural issues. Furthermore, the results show that while road dimensions have minimal impact on Cd, soil type plays a substantial role. Soil Types 1 (Fine-Grained Soils in which Silt and Clay-Sized Particles Dominate) and 2 (Sands and Sand-Gravel Mixtures with Moderate Fines), characterized by fine particles and lower permeability, require reduced Cd values (e.g., 0.9 - 0.7) due to poor drainage, whereas Soil Type 3 (Sands and Sand-Gravel Mixtures Relatively Free of Plastic Fines), with minimal fines and high permeability, supports higher Cd values (e.g. 1.15 - 1.10). These findings demonstrate the value of localized design parameters for more reliable and cost-effective pavement designs in the Philippines.

Keywords: *AASHTO 1993, drainage coefficient, local calibration, sensitivity analysis, rigid pavement*

Deep Learning for Real-Time Traffic Signal Control: Detecting Priority Vehicle

Quang Nguyen Huy Minh[1], Cuong Phan Huu[1], Long Viet Ho[2] and Nen NguyenDinh[3,*[0000-0002-4850-8984]]

[1]Nguyen Tat Thanh University, Ho Chi Minh, Vietnam, No.300A Nguyen Tat Thanh, Xom Chieu Ward, Ho Chi Minh City, 700000, Vietnam
[2] Campus in Ho Chi Minh City, University of Transport and Communications, No. 450-451 Le Van Viet Street, Tang Nhon Phu Ward, Ho Chi Minh City, 700000, Vietnam
[3] University of Architecture Ho Chi Minh City, Ho Chi Minh, Vietnam, No. 196 Pasteur, Xuan Hoa Ward, Ho Chi Minh City, 700000, Vietnam

*nen.nguyendinh@uah.edu.vn

Abstract. Rapid population growth in major urban areas has placed unprecedented pressure on transportation systems, with traffic congestion emerging as one of the most critical challenges. This problem is particularly severe at intersections, where delays directly hinder the mobility of emergency and special-purpose vehicles. To address this issue, this study proposes an intelligent traffic signal control system that leverages traffic cameras and deep learning technology to detect and prioritize these vehicles. The system integrates real-time image and audio analysis to enhance vehicle identification accuracy, employing CNN-based sound event detection (SED) for audio recognition and YOLO for image-based detection. This combination enables cross-validation, reducing reliance on human intervention. Importantly, the system is designed to operate under diverse environmental conditions, reflecting its resilience in the face of global climate change and increasingly unpredictable urban environments. Furthermore, the system is scalable and can be seamlessly integrated into future smart transportation infrastructures, contributing to more efficient and responsive urban traffic management.

Keywords: *Emergency detection, Real-time, Deep learning, CNN-based SED, YOLO.*

Developing the 15-Minute City Model Integrated with Green Transport Infrastructure in the Thu Thiem New Urban Area

Nguyen Van To[1], Nen NguyenDinh[2,*][0000-0002-4850-8984]

[1]Nguyen Tat Thanh University, 300A Nguyen Tat Thanh, Ho Chi Minh Vietnam
[2*]University of Architecture Ho Chi Minh City (UAH), Corresponding author,

[*]nen.nguyendinh@uah.edu.vn

Abstract. As rapid urbanization reshapes HCMC, the newly planned Thu Thiem urban area stands at a pivotal moment in redefining how the city addresses traffic congestion, environmental degradation, and limited accessibility to essential public services. This study evaluates the feasibility of implementing the "15-minute city" concept in Thu Thiem, emphasizing the role of green transport infrastructure in enabling sustainable, inclusive, and accessible urban living. The model prioritizes proximity to key amenities and services within a 15-minute travel radius through active and low-emission mobility modes. The research is grounded in the Transit-Oriented Development (TOD) framework, which promotes compact, walkable, and mixed-use communities centered around high-quality public transit systems. Central to the study is an analysis of green mobility systems, including low-emission vehicles, cycling infrastructure, electric and hybrid public transit options, and the planned integration with Ho Chi Minh City's metro system. The methodology combines spatial analysis using Geographic Information Systems (GIS), accessibility modeling through OpenRouteService (ORS), and the development of a Green TOD Accessibility Index. Multi-Criteria Analysis (MCA) is employed to evaluate the connectivity and integration of public transit, non-motorized travel networks, and the spatial distribution of key urban functions. The findings reveal significant gaps in Thu Thiem's green mobility infrastructure. While the area exhibits high development potential, its current design features fragmented cycling networks, insufficient electric public transport services, and limited connectivity with planned metro lines. These deficiencies hinder the realization of a fully functional 15-minute city and restrict the promotion of zero-emission mobility behavior. To address these challenges, the study proposes reorganizing key urban amenities within a 5–10 km radius, expanding electric bus systems, upgrading pedestrian and cycling infrastructure, and strengthening TOD-based planning around future metro stations. Although policy instruments are briefly considered, the study primarily focuses on spatial and infrastructural interventions to guide the implementation of the 15-minute city model in Thu Thiem.

Keywords: *15-minute city; transit-oriented development (TOD); green transport; spatial accessibility; metro accessibility; urban planning; geographic information systems (GIS); Thu Thiem; sustainable urban planning.*

Fly Ash-Cement Composite: A Possibility for Pavement Sub-base

Mahabir Panda [0000-0002-6677-8451], Rahul Samal and Aditya Kumar Das [0000-0003-1499-2824]

[1] National Institute of Technology Rourkela, Odisha-769008, India *
[2] National Institute of Technology Rourkela, Odisha-769008, India
[3] National Institute of Technology Rourkela, Odisha-769008, India

* Panda.mahabir@gmail.com

Abstract. Fly ash is one of the main by-products of coal based thermal power plants mushrooming in good number in India. This is generally toxic in nature, corrosive or reactive that can have bad environmental consequences. Disposal of this waste costs money and manpower. The best way to tackle this situation is by utilizing this waste product in engineering works. In India, the scarcity of good quality aggregates at many construction sites has forced the researchers to utilize various waste products of different industries in the construction of various works including in road pavements. The main objective of this study is to utilize locally and abundantly available fly ash as a sub-base material in road pavement. Since the available fly ash does not have the desirable engineering properties for application in pavement sub-base, it was decided to stabilize the fly ash with varying percentages of cement. In this study, only aggregate free stabilized mixtures (fly ash and cement only) were considered. Laboratory samples involving fly ash and varying concentrations of cement were prepared, and various tests like CBR test, UCS test and flexural strength test were conducted to justify the efficacy of the fly ash-cement composite for application in pavement sub-base totally avoiding use of conventional stone aggregates.

Keywords: *Fly Ash, Sub-base, CBR, UCS, Flexural Strength.*

GIS-Based Spatial Analysis for Identifying and Reducing Traffic Black Spots in Ho Chi Minh City

Khanh Nguyen[1], Hung Vu Viet[2] and Nen Nguyen Dinh[3,*]

[1] Nguyen Tat Thanh University, Ho Chi Minh City, Viet Nam
[2] University of Transport and Communications, Ho Chi Minh City, Viet Nam
[3,*] University of Architecture Ho Chi Minh City (UAH), Ho Chi Minh City, Viet Nam

[*]nen.nguyendinh@uah.edu.vn

Abstract. This study applies a multi-layered GIS-based framework to identify and prioritize traffic black spots in Ho Chi Minh City (HCMC), a rapidly growing metropolis facing severe road safety challenges and limited access to detailed crash data. The research integrates three spatial analysis techniques: Kernel Density Estimation (KDE) to highlight crash concentration areas, Global and Local Moran's I to measure spatial autocorrelation, and the Getis-Ord Gi* statistic to identify statistically significant hot spots. Results reveal a strong clustering pattern of crashes (Moran's I = 0.4073, z > 32, p = 0.001), with high-risk areas concentrated along major arterials such as National Highway 1A, CMT8, Dien Bien Phu, and Vo Van Kiet. These findings provide a decision-support basis for road authorities to implement targeted countermeasures, optimize resource allocation, and improve traffic safety outcomes in developing urban contexts.

Keywords: *Traffic Black Spots, GIS, Kernel Density Estimation, Moran's I, Getis-Ord Gi*, Spatial Analysis, Ho Chi Minh City.*

Influences of Built Environment Factors on Motorcycle-To-Urban Train Mode Shift of TOD Residents: Evidence from Mixed-Traffic Hanoi, Vietnam

Vu Van-Huy[1][0009-0005-5544-3428] and Pham Duc Manh[2]

[1,2] Faculty of Civil Engineering, VNU University of Engineering and Technology, No.144, Xuan Thuy Street, Cau Giay District, Hanoi, Vietnam

huyvv@vnu.edu.vn

Abstract. Rapid urbanization and the dominance of motorcycles have shaped the mobility landscape in Hanoi, Vietnam, posing challenges to sustainable urban transport. In response, urban train systems have been introduced to reduce reliance on private vehicles. While the built environment's role in influencing travel behavior has been widely studied in car-oriented cities, limited research exists on how these factors affect motorcycle users in mixed-traffic contexts like Hanoi. This study examines the impact of six built environment dimensions - density, diversity, design, distance, destination, and demand management (collectively known as the "6Ds") - on the likelihood of motorcycle users shifting to urban rail within Transit-Oriented Development (TOD) areas of Hanoi. Based on a structured questionnaire survey of 434 residents (268 urban rail users and 166 motorcyclists) living within 1 km of Hanoi's two operational metro lines, the study employs t-tests and binary logistic regression to analyze perceptions and mode shift potential. Results show significant differences in perceived built environment quality between users and non-users, with distance to station, pedestrian-friendly design, and demand management emerging as key predictors of mode shift. Findings offer context-specific insights for enhancing TOD policies and promoting sustainable mobility in motorcycle-dominant Southeast Asian cities.

Keywords: *Built Environment; Motorcycle; Urban Train; TOD; Mode Shift.*

Influence of fiber reinforcement on the strength properties of alkali-activated fly ash for pavement applications

Suresh Prasad Singh[1]*, Yash Tarane[2], and Datla Neeraj Varma[3]

[1]Professor, Department of Civil Engineering, National Institute of Technology Rourkela, India.
[2]M. Tech. Scholar, Department of Civil Engineering, National Institute of Technology Rourkela, India
[3]PhD Scholar, Department of Civil Engineering, National Institute of Technology Rourkela, India.

spsingh@nitrkl.ac.in

Abstract. Class-F fly ash (FA) is a byproduct of coal-based thermal power plants (TPP), containing a considerable amount of aluminosilicate in the glassy phase. However, the poor pozzolanic/cementitious behavior of FA limits its direct usage in pavements. In this paper, Class-F FAwas activated with sodium hydroxide (NaOH) solution and its strength properties were assessed by incorporating varying percentages of polyester fiber. The compaction characteristics, unconfined compressive strength (UCS), and California bearing ratio (CBR) of the stabilized material were evaluated at different NaOH concentrations (4 M, 8 M, and 10 M) and fiber contents (0.1%, 0.2%, 0.4%, and 0.6%). The compaction characteristics of the FA was strength properties (UCS and CBR) improved with the addition of alkali solution. A 28-day UCS of 4.98 MPa and 28-day soaked CBR of 574% was observed at 8 M NaOH solution. These strength value further improved with the addition of discrete fiber. The specimens prepared with 8 M NaOH and 0.2% fiber, the 28-day UCS and CBR values improved by 2.13 and 1.94 times, respectively. As per IRC: 37 2018, this mix proportion fits the minimal strength requirement of cementitious subbase (1.5 MPa to 3 MPa) and base (4.5 MPa to 7 MPa).

Keywords: *Fly ash, alkali activation, fiber reinforcement, and strength properties.*

Proposed Design Basis for Embankment Slopes on the Cam Lo–La Son Expressway Downstream of the Khe Ngang Reservoir

T.N Doan[1], Nguyen Hoang Son[2], and Mai Quang Huy[3]

[1,3] University of Transport and Communications, Vietnam
[2] Thuy loi University, Vietnam

dtnoi@utc.edu.vn

Abstract. Flood releases from reservoirs pose severe risks to nearby road and bridge infrastructure due to overtopping and scour. This study focuses on the Cam Lo–La Son Expressway in Central Vietnam, located 1.92 km downstream of the Khe Ngang Reservoir, where the Tu Ca Bridge and embankments are highly exposed to flood hazards. Historical floods (1984, 1986, 1999) were simulated using HEC-HMS for rainfall–runoff generation and HEC-RAS 2D for hydraulic routing. Key parameters including velocity and depth were analyzed to assess erosion risk through the Shields criterion and a hazard index framework, while riprap dimensions were designed using the FHWA Hydraulic Toolbox (HEC-23/Isbash method). The results indicate that the maximum flow velocity reached 1.97 m/s, while the corresponding water depth was 8.05 m, resulting in a hazard index of 15.9 m^2/s, which is classified as an extreme hazard level. The computed critical shear stress ($\tau c \approx 0.38$ Pa) was far exceeded by modeled shear stresses (>15 Pa), confirming high erodibility. Riprap with $D50 \approx 0.36$ m, thickness 0.55–0.72 m, apron length 3.6–5.4 m, and toe-down 0.5–1.0 m over filter layers is recommended. These findings provide practical design guidance for enhancing resilience of expressway embankments and bridge foundations downstream of reservoirs under extreme flood events...

Keywords: *Embankment slope design; Flood protection; Riprap stability; Scour and overtopping; Downstream reservoir hazards; Cam Lo–La Son Expressway.*

Real-Time Vehicle Counting Using YOLOv10 and ByteTrack: A Case Study in Ho Chi Minh City

Cuong Phan Huu[1], Quang Nguyen Huy Minh[1] ,Nen Nguyen Dinh[2], Long Viet Ho[3,*[0000-0002-9719-888X]

[1]Nguyen Tat Thanh University, Ho Chi Minh, Vietnam, 300A-Nguyen Tat Thanh, Xom Chieu Ward, Ho Chi Minh City, 700000, Vietnam
[2]University of Architecture Ho Chí Minh City, Ho Chi Minh, Vietnam, No. 196 Pasteur, Xuan Hoa Ward, Ho Chi Minh City, 700000, Vietnam
[3]Campus in Ho Chi Minh City, University of Transport and Communications, No. 450-451 Le Van Viet Street, Tang Nhon Phu Ward, Ho Chi Minh City, 700000, Vietnam

longhv_ph@utc.edu.vn

Abstract. Accurate traffic volume data at urban intersections is essential for effective traffic management and infrastructure planning. Yet, manual vehicle counting remains common in developing countries, despite being labor-intensive, error-prone, and unsuitable for peak-hour conditions. This study proposes a real-time automated vehicle counting system that integrates the YOLOv10 object detection model with the ByteTrack multi-object tracking algorithm. The proposed system is capable of detecting and tracking multiple vehicle types, including cars, motorcycles, buses, and trucks, under real-world traffic scenarios. The model was trained using a traffic image dataset collected from online sources, while its performance was assessed on a real-world traffic video recorded at a signalized intersection in Ho Chi Minh City, Vietnam. Experimental results demonstrate high detection accuracy, robust tracking stability, and real-time processing capability, while significantly reducing labor requirements and operational costs compared with traditional manual counting methods. Beyond accurate vehicle counting, the traffic data generated by the proposed YOLOv10-ByteTrack framework provide a reliable and continuous source of information for traffic monitoring and statistical analysis. This enables transportation agencies to efficiently collect large-scale traffic volume data, reduce reliance on manual surveys, and support data-driven decision-making in urban traffic management. Overall, the study confirms the technical feasibility, cost-effectiveness, and scalability of combining state-of-the-art deep learning with multi-object tracking for urban traffic monitoring. The proposed solution contributes to the development of intelligent transportation systems and supports data-driven traffic management, showing strong potential for smart city applications in Vietnam and other rapidly urbanizing regions.

Keywords: *YOLO; ByteTrack; Vehicle counting; Urban intersection; Multi-object tracking; Deep learning; Smart city;*

Understanding User Satisfaction with Flexible Intercity Mobility: Insights from Vietnam's Minibus Services

Vu Van-Huy[1][0009-0005-5544-3428]

[1] Faculty of Civil Engineering, VNU University of Engineering and Technology, No.144, Xuan Thuy Street, Cau Giay District, Hanoi, Vietnam

huyvv@vnu.edu.vn

Abstract. This study investigates passenger satisfaction with high-quality intercity minibuses in Vietnam, focusing on service quality dimensions that influence user perceptions. Data were collected through a structured two-part questionnaire, capturing socio-demographics, travel frequency, and perceptions of service quality across 38 items. Exploratory factor analysis (EFA) revealed eight underlying constructs including safety and security, reliability, service level, assurance, image, empathy, comfort on board, and premium on board services, which together explained 56 percent of the total variance. Multiple linear regression (MLR) analysis revealed that empathy, comfort on board, and assurance were the strongest predictors of passenger satisfaction. Other constructs, including premium on-board services, also had positive impacts, highlighting the importance of amenities such as flexible pick-up/drop-off points, convenient booking and payment methods, comfortable seating, quiet on-board environment, timely service, and stable ticket fares. Age and travel frequency influenced satisfaction levels, with older passengers reporting higher satisfaction, while frequent users exhibited slightly lower satisfaction, possibly reflecting elevated service expectations. These findings emphasize the critical role of empathetic service, travel comfort, and premium on-board features in shaping passenger perceptions of intercity minibus quality. The results offer practical insights for operators to enhance service offerings, improve user experiences, and promote sustainable growth in the intercity minibus sector.

Keywords: *Passenger satisfaction; Intercity minibus; EFA; Service quality; Premium on-board services*

BOOK OF ABSTRACTS

Edit: Cuong Ha-Minh, Cao Hung Pham, Hanh T.H. Vu, Dat Vu Khoa Huynh
Layout: Anh Vu Viet
Cover: Anh Vu Viet

The text of the various abstracts in this book was set individually by typists under the supervision of each of the authors.