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ABSTRACT BOOK

2nd Symposium on
Technologies for Sustainable
Urban Development

*A FUTURE WITH TECHNOLOGIES IS THE FUTURE
FOR SUSTAINABILITY*

**TechSUD
2025**



CYBERJAYA | 8 NOVEMBER 2025

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Abstract Book of the 2nd National Symposium on Technologies for Sustainable Urban Development (TechSUD 2025)
Cyberjaya, Selangor, Malaysia, 8 November 2025

Editors: Chun Kiat Chang (Chief); Jeen Ghee Khor; Eng Hwa Yap

Published by:

Wawasan Open University

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PREFACE

TechSUD 2025 is the 2nd National Symposium on Technologies for Sustainable Urban Development have been held on November 8, 2025 in CyberSecurity Malaysia, Cyberjaya, Malaysia. The symposium was organised by the Technological Association Malaysia (TAM) and Wawasan Open University, and supported by the strategic partners, Malaysia Board of Technologists (MBOT), Construction Industry Development Board (CIDB) Malaysia, CyberSecurity Malaysia, River Engineering and Urban Drainage Research Centre, Universiti Sains Malaysia (REDAC, USM) and Universiti Teknologi MARA (UiTM).

In recent years, it has become increasingly evident that sustainability is no longer an option in development. As Malaysia reinforces its national commitment toward sustainable growth, the need for collaborative platforms that bridge technology, research, and policy has never been more critical. This year's symposium placed a strong focus on Environmental, Social, and Governance (ESG) principles, addressing the key challenges confronting today's urban landscapes. With cities under mounting pressure from climate change, rapid urbanisation, and shifting societal expectations, integrating ESG considerations into every stage of urban development has become essential.

TechSUD 2025 aims to foster meaningful dialogue and collaboration around sustainable infrastructure, green technologies, resilient urban systems, and inclusive governance practices that align with global ESG standards.

The symposium witnessed the active participation of all 200 attendees, who engaged enthusiastically in the scientific program featuring 26 oral presentations, which are also included in the Proceedings. This symposium offered an ideal platform for field experts to present technical papers, fostering the exchange of knowledge, management approaches, and solutions among attendees from various backgrounds, ultimately contributing to the advancement of sustainable urban development practices.

The attendees of the symposium represented a diverse mix of academia, research institutions, industry, non-governmental organisations, and government agencies. Each brought unique perspectives and expertise,, enriching the discussions with a wide range of insights. This interdisciplinary exchange of ideas and information created a valuable opportunity for mutual learning and a deeper understanding of the complexities surrounding sustainable urban development. The symposium's emphasis on collaboration and knowledge-sharing across different sectors seeks to foster innovation and drive progress towards a more sustainable and promising future.

The Organising Committee extends sincere gratitude to all partner organisations and individuals for their support and contribution. The success of TechSUD 2025 is a testament to the dedication and collaborative spirit of all participants. Special thanks are extended to the session chairpersons, reviewers, and publishers for their cooperation, and to PLYTEC Holding Sdn. Bhd. for their generous sponsorship, which was instrumental in making this symposium a resounding success.

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Chun Kiat Chang (Chief)
Jeen Ghee Khor
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Ts. Dr. Mohd Muzzammil Ismail

Vice President (Head of Division)

Sustainable Development Technologies Division, MIGHT

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Strengthening Smart City Development through Application and Digital Infrastructure Security

Mr. Muhammad Arman Bin Selamat

Head of Department

Malaysia Vulnerability Assessment Centre (MyVAC)

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TOPIC 1: SMART CITY INNOVATIONS THROUGH AI AND BIG DATA

**A FUTURE WITH TECHNOLOGIES IS THE FUTURE
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PM2.5 SOURCE APPORTIONMENT VIA SOURCE CATEGORY CLASSIFICATION USING FEED FORWARD NEURAL NETWORK (FNN)

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ABSTRACT

Classification of PM2.5 source category is essential for effective air quality management and pollution mitigation strategies. PM2.5's smaller size, longer atmospheric persistence, and ability to carry toxic compounds make it the priority target for regulatory intervention. In addition, it poses greater dangers by reaching deep lung tissue and entering circulation, contributing to chronic cardiovascular, cerebrovascular, and oncological diseases. This study presents a method for PM2.5 source apportionment via the classification of source categories using a Feed-Forward Neural Network (FNN). The methodology comprised data collection and organisation, followed by Shapiro-Wilk normality test and Spearman's correlation tests to assess data distribution and relationships, Min-Max normalisation to scale features, exploratory analysis using box plot, and finally, the development and evaluation of a classification model. The model utilises a comprehensive dataset of PM2.5 concentration and meteorological parameters to classify emission sources such as vehicular emissions, industrial activities, and natural dust. The PM2.5 concentration was collected using E-BAM, and the chemical compositions were traced by ICP-OES. The model in this study achieves an overall accuracy of 81% for PM2.5 source apportionment. Class-specific performance metrics, including accuracy, precision, sensitivity, and specificity, are also presented for each PM2.5 source category. The proposed method offers a computationally efficient and scalable solution for real-time source apportionment, supporting targeted pollution control measures. This work highlights the potential of machine learning approaches, specifically FNNs, in enhancing atmospheric pollution source identification and contributes to advancing data-driven environmental decision-making.

Keywords: PM2.5 Source Apportionment, Feed-Forward Neural Network (FNN), PM2.5 Source Classification, Air Pollution, ICP-OES.

TRANSFORMING CONSTRUCTION HEALTH AND SAFETY: STAKEHOLDER AWARENESS OF DIGITAL TWIN TECHNOLOGY IN MALAYSIA

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ABSTRACT

Industry 4.0 is transforming the construction industry through intelligent technologies, with digital twin (DT) technology emerging as a key tool for enhancing performance, decision-making, and especially health and safety. The Construction Industry Development Board (CIDB) in Malaysia launched the Construction 4.0 Strategic Plan (2021–2025) to help stakeholders adapt to the changing demands of Industry 4.0 at both national and international levels. However, many stakeholders in the Malaysian construction industry remain unaware of the potential of digital twin technology, largely due to a continued reliance on traditional construction practices. This study aims to assess the level of awareness among industry stakeholders regarding the adoption of DT technology in construction. A quantitative research method was employed using a structured questionnaire, with respondents comprising developers, main contractors, and subcontractors participating and yielding an 85% response rate. The findings indicate that the highest awareness index (75.4%) was related to the use of DT for monitoring worker safety and predicting hazards, followed by a 72.4% index reflecting awareness of DT's effectiveness in improving health and safety. Conversely, only 54% of respondents were fully familiar with the concept of digital twins, marking the lowest awareness score. Additionally, 63.4% of respondents believed DT technology is straightforward to understand for maintaining safety. These results raise an alarming concern, revealing a significant gap in awareness and technological adoption within the construction sector. Despite DT's proven effectiveness in enhancing safety and reducing risks on-site, its implementation is hindered by limited understanding and resistance to change. Therefore, there is an urgent need for more comprehensive education, training, and engagement initiatives to promote the adoption of DT as a crucial tool for improving safety and overall project performance in Malaysia's construction industry.

Keywords: Digital Innovation, Preventive Safety Measures, Smart Infrastructure Development, Technology Acceptance, User Engagement.

PREDICTING COMMUTER TRAIN NOISE IN URBAN COMMUNITIES USING ARTIFICIAL NEURAL NETWORKS

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ABSTRACT

Urbanization intensifies across Southeast Asia, the need for intelligent environmental monitoring has become critical in building smart and resilient cities. This study investigates railway induced noise pollution in suburban residential zones of Klang Valley, Kuala Lumpur, utilizing data driven methodologies to support sustainable urban planning. Focusing on commuter train operations, the research integrates on-site acoustic data collection with empirical modelling to evaluate environmental noise levels across varying distances and train speeds. Noise exposure was quantified using A-weighted equivalent continuous noise levels (LAeq), and regression-based analysis via Minitab software was applied to uncover significant relationships between operational and environmental parameters. The findings reveal consistent exceed of permissible noise thresholds in proximity to railway tracks, posing potential health risks. Beyond empirical insights, this study demonstrates the potential of Artificial Neural Network (ANN) noise analytics as a digital solution for real-time urban soundscape management. The integration of ANN and field data in environmental noise assessment not only strengthens compliance with Department of Environment regulations but also provides a scalable framework for predictive noise mapping essential for future-ready smart city infrastructure.

Keywords: Artificial Neural Network (ANN), Railway, Noise Pollution, Empirical Model, Environmental.

TECHNOLOGY ADOPTION AND NATURE-BASED SOLUTIONS IN SUSTAINING ARTISAN FAMILY BUSINESSES IN A UNESCO WORLD HERITAGE SITE

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ABSTRACT

Artisan family businesses (AFBs) serve as a custodian of cultural heritage, particularly in UNESCO World Heritage Sites (WHS) such as Melaka and George Town, Malaysia. Their survival across generations reflects resilience and a commitment to preserving traditional craftsmanship. However, AFBs face increasing threats from rapid urban development, tourism dependency, and environmental change. This paper explores how incremental integration of Artificial Intelligence (AI) tools and nature-based solutions (NbS) can support AFB sustainability within the broader vision of smart heritage cities. Based on ethnographic case studies of 16 AFBs operating for more than five decades, this paper identifies technology use and ecological practices already in place. Rather than proposing radical revolution, this research found that small-scale digital transformation and environmental practices aligned with local traditions can help AFBs to sustain their business and stay relevance in a changing urban landscape.

Keywords: Artisan Family Businesses, World Heritage Site, AI, Nature-Based Solutions, Smart Heritage Cities.

SIMPLY SUPPORTED REINFORCED CONCRETE DEEP BEAM STRUCTURAL SHEAR CAPACITY PREDICTION USING THE ARTIFICIAL NEURAL NETWORK

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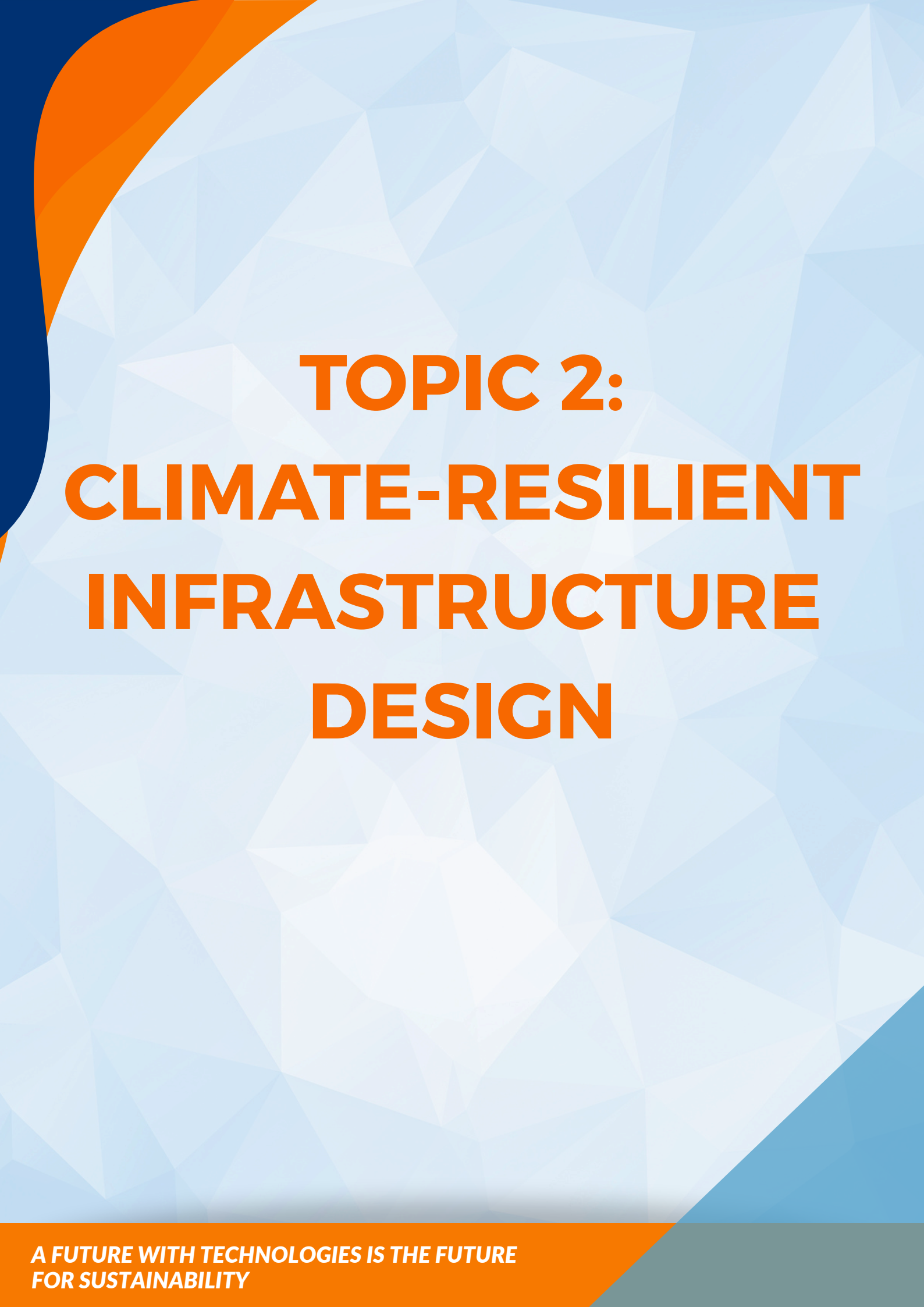
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ABSTRACT

This study develops an optimized artificial neural network (ANN) model for predicting structural shear capacity of simply supported reinforced concrete (RC) deep beams, addressing limitations of traditional methods like Strut-and-Tie models which use unclear rules and the need of many assumptions. Using a dataset of 76 experimental observations with 13 input parameters, we systematically evaluated various Artificial Neural Network (ANN) architectures, training algorithms, and activation functions. The Levenberg-Marquardt algorithm demonstrated superior performance across configurations. Our results revealed that a two-hidden-layer ANN significantly outperformed single-layer counterparts, with the optimal configuration employing radial basis function activation with 11 neurons in the first hidden layer and 12 neurons in the second, achieving the lowest training Root Mean Square Error (RMSE) of 0.2345. Validation against experimental data confirmed exceptional predictive fidelity, with correlation coefficients of $R = 0.999$ for training/validation datasets and $R = 0.992$ for testing data. Most predictions exhibited percentage errors below 5%. The developed ANN provides a reliable, high-accuracy computational tool that reduces reliance on extensive experimental testing while enabling efficient and safe practical design applications in structural engineering.

Keywords: Shear Capacity, Artificial Neural Network, Artificial Intelligence, Deep Reinforced Concrete Beam.



TOPIC 2: CLIMATE-RESILIENT INFRASTRUCTURE DESIGN

**A FUTURE WITH TECHNOLOGIES IS THE FUTURE
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THERMAL PERFORMANCE OF DOUBLE, TRIPLE, AND QUADRUPLE GLAZING: A FIELD STUDY IN DUBAI

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ABSTRACT

Buildings in hot climates face significant challenges in reducing indoor heat gain, making glazing performance critical to energy efficiency. This study investigates the thermal performance of three glazing types commonly considered for Dubai's climate: double glazing (DG), triple glazing (TG), and quadruple glazing (QG). A field-based hot box apparatus was used to simulate building compartments, each fitted with one glazing type, and exposed to Dubai's summer sky conditions. Environmental data loggers recorded internal air temperature and relative humidity, while an independent weather station provided baseline microclimate measurements. The objective was to determine whether QG, given its lower U-value, offers superior thermal performance compared to TG and DG. Results show that QG consistently achieved lower peak internal air temperatures, particularly during peak solar hours (12 PM–3 PM), indicating reduced heat transfer. However, in the evening, QG compartments retained slightly more heat, resulting in marginally higher temperatures than TG and DG. Overall, findings confirm that increasing glazing layers enhances thermal resistance and reduces indoor heat gain, with QG delivering the lowest peak air temperatures among the three. This study demonstrates that multi-layer glazing, particularly QG, can improve building energy efficiency in hot climates by mitigating heat transfer through windows. The outcomes provide practical insights for architects, engineers, and policymakers in selecting glazing systems for energy-efficient building design in regions with extreme thermal conditions.

Keywords: Thermal Performance, Double Glazing, Triple Glazing, Quadruple Glazing, Hot Arid Climate.

OPTIMISATION OF AERATED ALUM COAGULATION (ACC) PROCESS FOR MATURED LEACHATE TREATMENT

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ABSTRACT

This study evaluates the performance of aerated chemical coagulation (ACC) using alum for treating mature landfill leachate collected from the Simpang Renggam Landfill Site (SRLS). Due to the leachate's high concentration of refractory pollutants, including ammoniacal nitrogen (AN), and its low biodegradability, conventional coagulation treatment method is often ineffective. Alum was selected for its widespread use and cost-effectiveness, while aeration was integrated to enhance coagulant dispersion and improve the pollutant removal. Jar test experiments were conducted by varying alum dosage (500–2500 mg/L), pH (4.0– 8.0), aeration rate (0.5–2.5 L/min), and aeration time (10–60 minutes). The optimal condition was achieved at 2000 mg/L alum dosage, pH 5.0, aeration rate of 2.0 L/min, and 20 minutes of aeration, resulting in the highest AN removal efficiency of 22%. While AN concentration remained above discharge standards, the results highlight the potential of ACC as a cost-effective pre-treatment method. This study contributes to the advancement of hybrid physicochemical techniques for matured leachate treatment, with further integration recommended to achieve regulatory compliance.

Keywords: Landfill, Stabilised leachate, Physicochemical method, Ammoniacal Nitrogen, Colour Removal.

NUMERICAL SIMULATION OF FIRE RESISTANCE PERFORMANCE IN INSULATED METAL PANELS: A REVIEW

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ABSTRACT

Insulated Metal Panels (IMPs) are widely used in modern construction due to their thermal efficiency, lightweight nature, and ease of installation. However, their fire resistance performance is critical for building safety, necessitating reliable assessment methods. While experimental fire testing remains essential, numerical simulations have emerged as a cost-effective and efficient tool for evaluating IMP behavior under fire conditions. This review paper systematically examines the state-of-the-art in numerical modeling techniques for predicting the fire resistance of IMPs, focusing on key methodologies, challenges, and future directions. The review begins with an overview of IMP composition, common insulation core materials (such as polyisocyanurate, polyurethane, and mineral wool), and the key factors influencing their performance in fire. Various simulation techniques, such as finite element analysis (FEA), computational fluid dynamics (CFD), and multi-physics simulations, highlighting their applications in predicting thermal and structural responses. Commonly used software tools (e.g., ANSYS, ABAQUS, and Fire Dynamics Simulator (FDS)) are reviewed in terms of their application in fire modeling. A critical analysis of experimental validation methods, including standard fire tests (ASTM E119, ISO 834), is presented to assess simulation accuracy. Key findings from previous studies are synthesized, demonstrating how factors like insulation material properties, panel thickness, and boundary conditions influence fire resistance. Challenges in numerical modeling, such as the high-temperature material degradation and computational costs, are discussed. Finally, the paper outlines future research directions, including advanced material modeling, machine learning and multi-physics coupling. This review provides valuable insights for researchers and engineers seeking to enhance IMP fire resistance through numerical simulations, bridging the gap between theoretical models and real-world applications while reducing reliance on costly experimental testing.

Keywords: Insulated Metal Panels (IMPs); Fire Resistance; Numerical Simulation; Thermo-Mechanical Analysis; Finite Element Modeling (FEM)

NUMERICAL ANALYSIS OF RETAINING WALL FOR HILLSIDE DEVELOPMENT IN TROPICAL WEATHERED SLOPES

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ABSTRACT

Hillside developments in tropical regions, such as Malaysia, are frequently subjected to rainfall-induced slope failures due to steep topography, heterogeneous subsurface conditions, and intense weathering of rock into residual soils. This study investigates the performance of an anchor-reinforced concrete (RC) retaining wall system designed to stabilize a hillside slope at Kuala Terengganu. The research employs advanced numerical modeling using Finite Element Model (FEM) to simulate the effects of rainfall infiltration on pore-water pressure (PWP) and slope stability under both unreinforced and reinforced conditions. The methodology integrates site-specific geotechnical data, including borehole logs, Standard Penetration Test (SPT) results, and resistivity imaging, with numerical simulations that adhere to Eurocode 7 Design Approach 1, Combination 2 (DA1-C2). Steady-state and transient seepage analyses were performed to assess PWP distribution, followed by slope stability evaluations using the Limit Equilibrium Method (LEM). The results show that rainfall significantly increases PWP, especially along the weathered rock interface, reducing the Factor of Safety (FoS) and triggering critical failure surfaces. In addition, the inclusion of the anchor-reinforced retaining walls supported by soil nails, micropiles, and drainage measures lowered peak PWP and saturation zones, thereby enhancing overall slope stability. The findings confirm the effectiveness of reinforcement systems in mitigating shallow landslides in tropical slopes. Recommendations include the integration of drainage components, use of coupled seepage-stability analysis, and incorporation of field monitoring for improved model calibration. This study contributes to the advancement of sustainable geotechnical practices for hillside infrastructure and aligns with global climate adaptation efforts by addressing the increasing risk of rainfall-induced geohazards.

Keywords: Rainfall Infiltration, Slope Stability, Retaining Wall, Tropical Residual Soil, Weathered Rock.

INTEGRATING CLIMATE-RESILIENT INFRASTRUCTURE DESIGN FOR SLOPE REMEDIAL WORKS AND SENCEIVE FLATMESHTRIAxIAL TILT SENSORNODES AS SUSTAINABLE MONITORING APPROACH

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ABSTRACT

Slope instability poses significant threats to infrastructure, economics and environments especially under the growing pressure of climate change and extreme weather conditions. Malaysia especially has high rainfall throughout the year which has been a main trigger for rainfall-induced landslide. Thus, a deep-seated rainfall- induced slope failure at FT185 Seksyen 44.1, Jalan Simpang Pulai Blue Valley, Daerah Kinta, Perak as an active and ongoing construction site is taken as a case study for this research. This case study exposed to extreme weather that causes its slope instability that resulted to damage to existing valley and main road. Hence, this research purpose is to investigates the integration of TerraLink System as climate – resilient infrastructure design introduces as permanent remedial works as mitigation measure to withstand climate change and the introduction of Triaxial tilt sensor as sustainable monitoring approach during the construction and post-construction for this project. The TerraLink system as an innovative new system in Malaysia, introduced as it can be constructed in steep topography and its functionality that can widen the platform in a restricted area which correlates well with this case study that needed to be stabilised its terrain and reconstructed damaged road. Furthermore, as a high-risk project exposed to extreme weather, proper enhancement of real-time monitoring capabilities is needed for early detection of slope instability to ensure risk associated with climate-induced landslide is strategically mitigated. The data collected from triaxial tilt sensor that's equipped with wireless data transmission, which can facilitate immediate data sharing and issues timely alert can prevent environmental damages, save lives of the construction workers, and the road users as it contributes to long term human safety and socio-economic stability, which are the key pillars of sustainability.

Keywords: Deep-Seated, Rainfall-Induced Landslides, Triaxial Tilt Sensor, Terralink System, Climate-Induced Landslide.

EVALUATING ROAD ACCIDENT CAUSES AT JAMBATAN SULTAN ABDUL HALIM MU'ADZAM SHAH USING SPSS

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ABSTRACT

This study examines the major causes of road accidents in the Sultan Abdul Halim Muad'zam Shah Bridge which is the longest bridge in Malaysia. As the problem of traffic accident has become an issue of global concern, especially when it comes to the incidents on bridges, this paper aims at determining and prioritizing the major factors of such accidents, which include the behavior of a driver, the vehicle-related factors, and the environmental conditions. Based on the accident data in provided by Jambatan Kedua Sdn Bhd (JKSB) the study uses a quantitative approach in examining the data using descriptive statistics, chi-square tests, and likelihood ratio analysis using the SPSS package. The findings show that, driver behavior, which includes loss of vehicle control, speeding, negligence, and fatigue, is the major cause of accidents on the bridge, whereas issues associated with vehicles contribute to accidents on the bridge minimally. Only a slight correlation was found between the frequency of accidents and environmental factors, such as road surface, and weather conditions. This study also shows the urgency of specific interventions including the enforcement of traffic laws, driver education, vehicle maintenance and improved traffic surveillance technologies. The present study outcomes will not only help solve the problem of bridge safety but will also align with Sustainable Development Goal 11 by ensuring safer, more resilient infrastructure and transport systems.

Keywords: Road Traffic Accidents, Bridge Safety, Accident Causation Analysis, SPSS Statistical Analysis, Driver Behavior.

DEVELOPMENT OF AN ACCIDENT PREDICTION MODEL FOR LONG-SPAN BRIDGES USING SPSS: A CASE STUDY OF JAMBATAN SULTAN ABDUL HALIM MU'ADZAM SHAH

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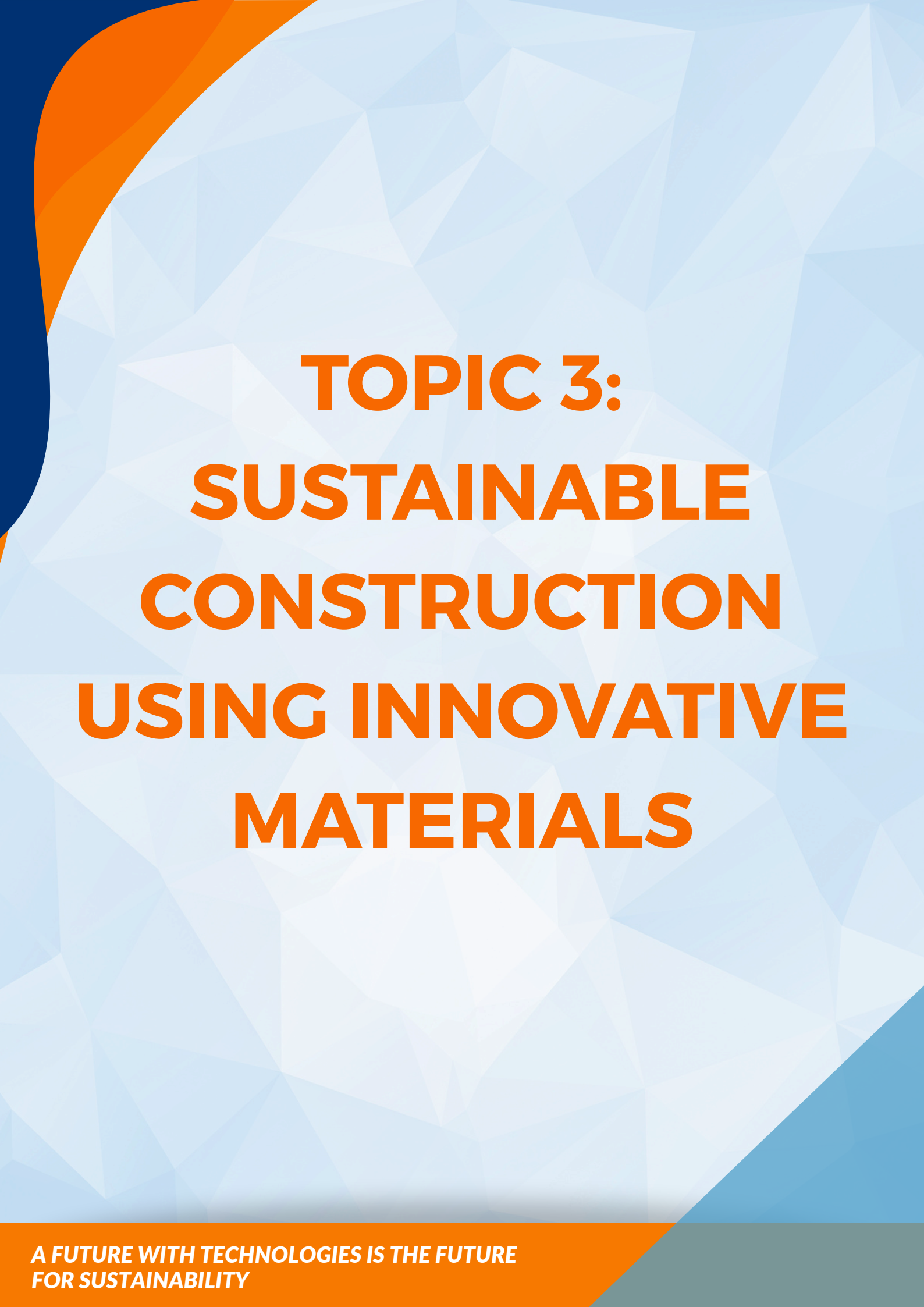
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ABSTRACT

This study examines the incidences of accidents on long-span bridges which in this case is the Jambatan Sultan Abdul Halim Mu'azam Shah (the Second Penang Bridge). The research will address such questions as the accident-prone place, the type of vehicle most involved and the contributing factors that may lead to accidents, such as the structural vulnerabilities, the condition of the traffic and the environmental factors that affect the accidents. With the data sampled by Jambatan Kedua Sdn. Bhd. (JKSB) between 2020 and 2024, the study applies statistical analysis and predictive modeling in the SPSS to analyze the trend of accidents and develop a linear regression model to predict accidents factors. Descriptive statistics and data visualization were performed to find out trends over various bridge types and the type of vehicles that crossed the bridge. The findings indicate such areas as mid-span parts and sharp curves to be dangerous areas because of structural tensions and exposure to an environment. Most accidents are known to be caused by the use of privately-owned vehicles and motor cycles and this is associated with large volumes of traffic and road conditions which are very unfavorable. The predictive model shows that the combination of traffic data and structural parameters may enhance the model accuracy of accident forecasting and deliver meaningful directions to safety plans. Further, predictive model developed can be applied in similar bridges which will benefit policymakers, engineers, and transportation authorities towards sustainable and resilient urban transportation system.

Keywords: Bridge Accident, Prediction Model.



TOPIC 3: SUSTAINABLE CONSTRUCTION USING INNOVATIVE MATERIALS

AN OVERVIEW OF CONSTRUCTION WASTE GENERATION AND MINIMISATION STRATEGIES IN SETAPAK, KUALA LUMPUR

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ABSTRACT

The construction industry is a significant sector that influences the country's economy. However, this industry also stands as a major contributor to environmental challenges, particularly in the form of construction waste. The rapid growth of construction activities has led to a significant increase in waste generation, raising serious concerns regarding its impact on environmental quality and public health. This study investigates construction waste management practices in Setapak, Kuala Lumpur, whereby in this suburban area, the waste materials are not sorted adequately on many construction sites, making it difficult to recycle or reuse them effectively. This results in large quantities of mixed waste being sent to landfills instead of reusing or recycling valuable resources like metals, concrete and wood. This improper waste management practices might lead to the contamination of water bodies, soil degradation and air pollution. The primary aim of this study is to identify the key factors contributing to construction waste generation and to propose practical strategies for minimising waste in Setapak. A quantitative research approach was employed, with data collected via online survey questionnaires distributed to various construction parties. The data were analysed using the Statistical Package for the Social Sciences (SPSS) and Microsoft Excel. The findings indicate that effective waste minimisation strategies such as onsite waste segregation and the implementation of Reduce, Reuse and Recycle (3R) practices can significantly reduce waste accumulation and conserve natural resources. Additionally, the study identifies poor materials handling, design errors and inefficiencies in material procurement as primary contributors to construction waste in the area. These factors lead to excessive waste generation, which could be reduced through better planning and site management. This study serves as a reminder to construction companies and related organisations that the issue of construction waste must be addressed seriously to protect the environment and promote sustainable development.

Keywords: Construction Waste Management, Sustainability, Human Health, 3R Practices, Environment

EFFECT OF ASPHALT AGEING ON THE CHEMICAL AND RHEOLOGICAL PROPERTIES OF REJUVENATED ASPHALT BINDER INCORPORATED WITH BIO-OIL

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ABSTRACT

The use of rejuvenators derived from renewable resources, such as bio-oil, has gained significant attention in sustainable pavement engineering. This study investigates the chemical and rheological changes in rejuvenated asphalt binder subjected to artificial ageing. A bio-oil derived from waste cooking oil (WCO) was used as a rejuvenator to restore the properties of aged asphalt binder. The evaluation includes chemical analysis through SARA fractionation and Fourier Transform Infrared Spectroscopy (FTIR), along with rheological testing for fatigue resistance using the Dynamic Shear Rheometer (DSR). Results indicate that the incorporation of bio-oil alters the chemical composition and improves the fatigue resistance of aged binders, though ageing still leads to notable oxidative changes. SARA fraction analysis reveals that after 20 hours of long-term ageing, the rejuvenated asphalt binder contains less asphaltene percentage compare to other asphalt binder. FTIR analysis shows that rejuvenation of aged binder with treated WCO reduces the carbonyl index (I_C) while increasing the sulfoxide index. In the unaged condition, the rejuvenated asphalt binder demonstrates the lowest I_C value. However, after 20 hours of ageing, the rejuvenated asphalt binder exhibits the highest I_C value, indicating a greater degree of asphalt ageing. It also noted that after 40 hours ageing simulation the sulfoxide index of asphalt binder was found decrease illustrating degradation of sulfoxide compound after ageing simulation. These findings support the potential of bio-oil as a viable rejuvenator in asphalt recycling applications as well as increase the sustainability in road construction industries.

Keywords: RAP, Bio-oil, SARA Fraction, FTIR, and DSR

CHARACTERISATION OF MODIFIED RAPID SETTING BITUMEN EMULSION OF RS-1K AND RS2-K INCORPORATED WITH FLY ASH AND ITS INFLUENCE ON THE PHYSICAL BEHAVIOUR

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ABSTRACT

Modification on the bitumen emulsion with usage of coal combustion end-product has emerged a promising approach to improve the conventional properties of ready-made industrial bitumen emulsion. It is aligning with promoting the sustainable solution or innovation for the pavement industries, such as application as tack coat for road pavement. This study is investigating on the application of fly ash incorporated with the bitumen emulsion as the mineral additives to improve the performance of bitumen emulsion while reducing the waste to the environment. This includes exploration of the optimum additive content that can give optimum performance of the modification. Study is conducted with fly ash contents as the variable parameter which are 0%, 2% and 4%. This will include the series of physical testing conducted on the fly ash modified bitumen emulsion to evaluate the physical characteristic and comparing with the current standard applicable. It is to ensure the innovation are compliance with Malaysian Standard (M.S.) 161 which outlined on the standard properties of pavement material shall be use. Physical characteristic is examined through aggregate coating, sieve, viscosity, particle by charge test while stability is determined through residue by evaporation and demulsibility test. Results shows that existence of fly ash in the Rapid Setting (RS), RS-1K and RS-2K improves the durability, adhesiveness and workability of the bitumen emulsion but restricted to only small amount to comply with the standard. This outcome will contribute to the pavement industries and environment achieving goal of waste reduction and its applicability on alternatives usage in engineering use.

Keywords: Modified Bitumen Emulsion, Fly Ash, Demulsification, Tack-Coat, Adhesion.

BEYOND WOOD: EVALUATING PLASTIC PANELS AS THE NEXT GENERATION OF TEMPORARY WORKS FORMWORK

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ABSTRACT

The search for lighter, more durable, and sustainable formwork solutions is intensifying as the construction industry faces mounting cost pressures and environmental targets. This paper investigates whether polymer-based formwork panels, such as polypropylene (PP) can serve as credible alternatives to plywood in temporary works for concrete casting. Drawing on published research and experimental performance data, the study compares mechanical strength, weight, construction efficiency, sustainability, and cost. Evidence shows that reusable thermoplastic panels are generally lighter than plywood, can deliver equal or superior concrete surface finishes over multiple reuse cycles, and may achieve lower life-cycle environmental impacts and costs when realistic reuse rates are considered. Nevertheless, temperature sensitivity and related deflection management remain critical design considerations. Overall, under appropriate conditions, plastic panels can match or exceed plywood in technical performance while supporting more sustainable construction practices.

Keywords: WONDERBoard, Plywood, Formwork, Concrete, Polypropylene.

PERMANENT FORMWORK FOR SUBSTRUCTURE CONCRETE: DOES IT DELIVER ON QUALITY AND EFFICIENCY?

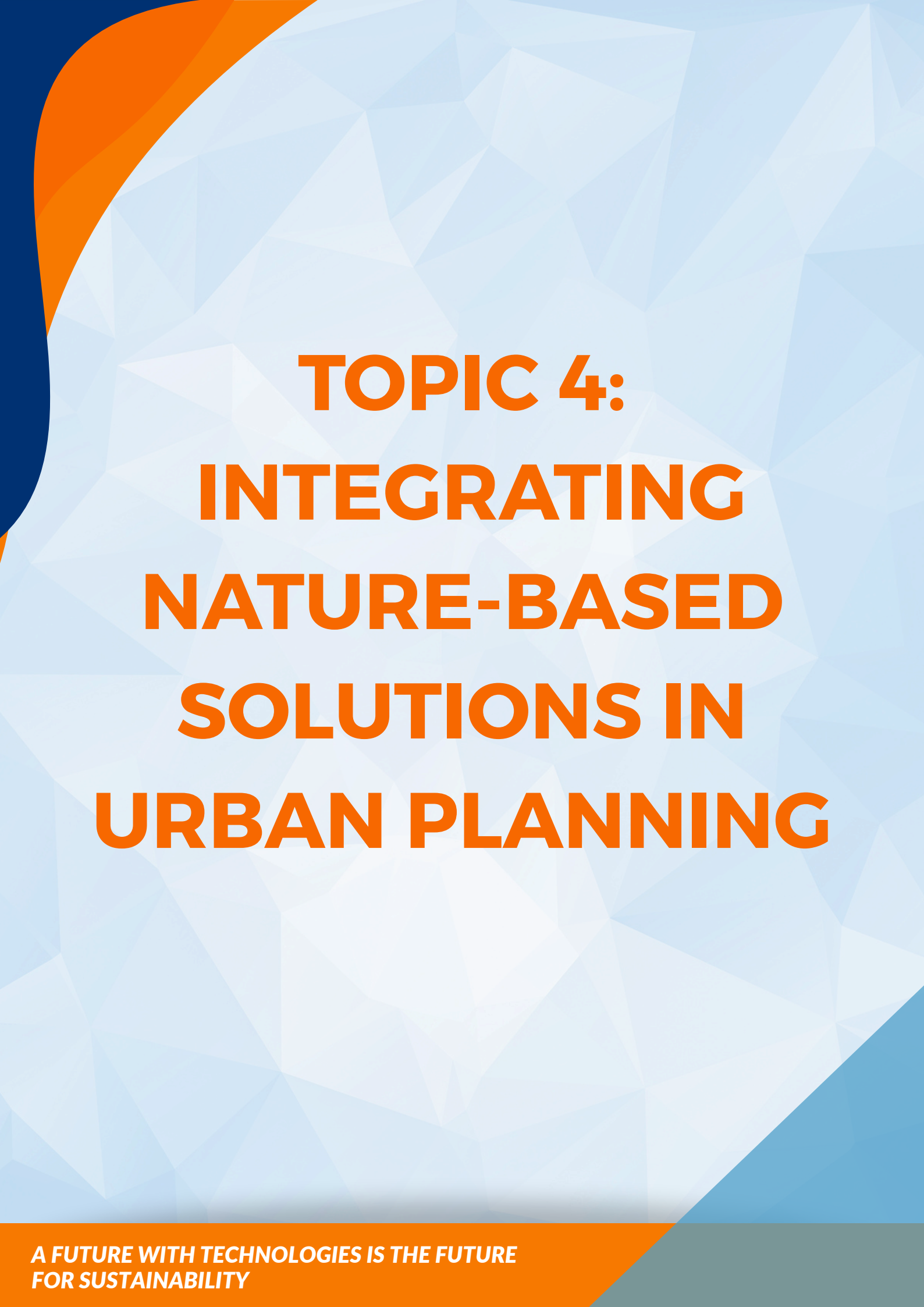
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ABSTRACT

Sacrificial (stay-in-place) formwork is increasingly adopted for below-ground concrete elements as an alternative to timber/plywood. This study appraises steel mesh with polyethene permanent formwork, such as Pecaform, against conventional timber systems for foundations, ground beams and pile caps. Criteria include installation time, labour and skill requirements, safety, cost, reusability, and concrete quality (formed finish, voiding), drawing on manufacturer's technical data, best-practice installation guidance, and documented site experience. Evidence indicates that permanent formwork can shorten programme and reduce manual handling by eliminating striking and enabling backfilling prior to the pour, thereby decreasing operatives' exposure within excavations. Correct detailing and execution are critical. BS 7973 compliant spacers, appropriate spacing, and load capacity relative to backfill pressure, along with effective vibration control, are required to control deflection, maintain reinforcement cover, and prevent concealed voids. When these measures are applied, formed surfaces below ground are generally acceptable for the intended service environment; however, as stay-in-place systems, reusability is limited in substructure applications. Overall, stay-in-place formwork appears to be a practical alternative for many below-ground pours, offering efficiency and safety benefits without compromising concrete quality when installed to recognised best practice. Further independent, quantitative trials are recommended to substantiate cost and quality outcomes across different element geometries and ground conditions.

Keywords: Pecaform, Scarificial, Formwork, Concrete, Polyethene.



TOPIC 4: INTEGRATING NATURE-BASED SOLUTIONS IN URBAN PLANNING

PERFORMANCE OF TAPIOCA STARCH AS COAGULANT AID IN THE ELECTROCOAGULATION FOR LEACHATE TREATMENT

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ABSTRACT

High colour intensity in landfill leachate remains a critical environmental concern, as it indicates the presence of refractory organic compounds and negatively affects treatment efficiency. In Malaysia, most landfills produce leachate with colour concentrations exceeding the permissible limit of 100 Pt-Co. Therefore, this study aims to optimize leachate treatment using electrocoagulation process enhanced with tapioca starch as a coagulant aid to improve colour removal of leachate. In the experimental setup, rectangular aluminium plates aluminium (5 x 17 cm) were utilized as electrodes. Colour removal efficiency was investigated at different current density (6.67 - 33.33 mA/cm²), electrolysis time (30 - 150 min) and dosages of tapioca starch (2 - 10 g/L). The findings revealed that the augmented process achieved an optimal colour removal efficiency of 99.91% at 33.33 mA/cm² current density, 90 minutes electrolysis time, and 8 g/L tapioca starch dosage. In comparison, the single electrocoagulation process without the addition of tapioca starch coagulant aid required longer electrolysis time of 120 minutes to achieve comparable colour removal. Hence, this study confirms that tapioca starch is an effective coagulant aid, capable of enhancing the electrocoagulation process for landfill leachate treatment. In conclusion, the optimized electrocoagulation process using tapioca starch provides a sustainable and efficient solution for treating landfill leachate, offering sustainable environmental technologies specifically on wastewater treatment industry.

Keywords: Leachate, landfill leachate treatment, electrocoagulation, coagulant aid, tapioca starch



TOPIC 5: EMERGING TECHNOLOGIES FOR INTELLIGENT BUILDING MANAGEMENT

**A FUTURE WITH TECHNOLOGIES IS THE FUTURE
FOR SUSTAINABILITY**

BUILDING INFORMATION MODELLING THREE-DIMENSIONAL RECONSTRUCTION AND CONDITION ASSESSMENT OF HISTORICAL BUILDING IN MALAYSIA

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ABSTRACT

The conservation of historical buildings in Malaysia is increasingly hindered by aging infrastructure, incomplete documentation, and the absence of coordinated maintenance strategies. This study presents a semantically enriched Building Information Modelling (BIM) framework for three-dimensional (3D) reconstruction and condition assessment of historical buildings, demonstrated through a case study of a heritage building located in Johor Bahru. Instead of conventional point cloud scanning, the approach combines 360-degree panoramic imagery from Metareal with two-dimensional (2D) floor plans to manually develop a detailed BIM model in Autodesk Revit. This image-based workflow was adopted to address common historical project constraints, particularly the high cost, limited accessibility, and technical complexity associated with point cloud capture. Semantic attributes such as defect type, severity, urgency, and previous interventions were embedded within the BIM environment using custom instance parameters and visual filters, improving documentation transparency and reliability. Condition assessment concentrated on architecturally and culturally significant components such as decorative ceilings, masonry walls, timber windows, and tiled floors, which are vulnerable to deterioration in Malaysia's tropical climate. Restoration scenarios were digitally simulated to evaluate material alternatives regarding cost, durability, and historical authenticity, supporting evidence-based decision-making. Although the framework demonstrates strong potential for interdisciplinary collaboration with conservation specialists and heritage stakeholders, this aspect remains a limitation in the present study, as validation was performed only through simulation. Overall, the study confirms the feasibility of image-based, semantically enriched BIM as a non-invasive, replicable tool for digital historical documentation and sustainable conservation planning in Malaysia. Future research may integrate photogrammetry to enhance geometric accuracy and actively involve stakeholders to reinforce collaborative validation.

Keywords: Building Information Modelling (BIM), 3D Reconstruction, Condition Assessment, Historical Building

A REVIEW OF BUILDING INFORMATION MODELLING AND DIGITAL TWIN APPLICATIONS IN PREVENTION THROUGH DESIGN

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ABSTRACT

The integration of advanced digital technologies such as Building Information Modelling (BIM) and Digital Twin (DT) in construction safety has the potential to support the implementation of Prevention through Design (PtD) practices. By integrating BIM and DT applications into PtD practices, it could enhance hazard identification, design risk analysis and decision-making processes at the early stages of construction projects. However, the implementation of BIM and DT technologies into PtD practices is still slow. This paper conducts a comprehensive review that examines the current state of BIM and DT adoption within PtD contexts by analysing existing literature. The study identifies current applications, categorises the key benefits such as real-time monitoring, predictive analytics, and improved stakeholder collaboration and evaluates the major implementation challenges, including interoperability issues, high costs, and skill shortages. Findings from this review aim to provide a foundational understanding for researchers and raise awareness among industry stakeholders seeking to enhance construction safety through integrated digital solutions. These findings suggest a need for clearer implementation frameworks, standardised data protocols, and targeted workforce upskilling initiatives to fully realise the potential of BIM and DT in PtD practices. Thus, these technologies have the capacity to transform PtD from a reactive, checklist-based process into a dynamic, data-driven strategy for accident prevention.

Keywords: Building Information Modelling, Digital Twin, Prevention through Design, Construction Safety, Safety Risk Management

CURRENT PRACTISE OF BUILDING INFORMATION MODELLING AND RADIO FREQUENCY IDENTIFICATION FOR MODULAR CONSTRUCTION: A SYSTEMATIC REVIEW

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ABSTRACT

Improper material management remains a significant issue in modular construction, leading to material loss, supply delays, defects from improper storage, lack of real-time monitoring, and data inconsistencies. These issues undermine the full potential of modular construction implementation. With emerging technological advancements, the integration of Building Information Modelling (BIM) and Radio Frequency Identification (RFID) offers promising solutions. However, the extent to which the integrated RFID-BIM workflows have been studied and applied in modular construction is still unclear. To address this gap, this study conducts a systematic review following the PRISMA methodology, focusing on peer-reviewed publications from 2015 to 2025 indexed in Scopus, Web of Science, and ScienceDirect. Studies were selected based on predefined inclusion and exclusion criteria, targeting those that address RFID, BIM, and modular construction-related workflows. A thematic analysis was conducted to identify key Topics from selected studies highlighting RFID-BIM workflow practices, challenges, and insights in modular construction. The review reveals that RFID-BIM integration is commonly used for real-time tracking, data visualisation, and quality control of components. Most studies capture component-specific data using RFID and link it to a centralized model for monitoring construction progress. Despite this, there are variations in system setup, lifecycle coverage, and technology used. While technical implementation is often addressed, limited attention is given to workflow structure, integration requirements, and decision-making processes. There is a clear lack of standardised frameworks to guide practical adoption in modular construction, particularly in optimising material flow across all stages. The findings provide a comprehensive overview of current research, highlight key limitations, and identify underexplored areas such as lifecycle data integration and performance benchmarking. This review contributes to a deeper understanding of how RFID-BIM integration can optimise material management in modular construction and offers recommendations to guide future research and implementation strategies.

Keywords: Modular Construction, Building Information Modelling (BIM), Radio Frequency Identification (RFID), material management.

DIGITAL HERITAGE SUSTAINABILITY FRAMEWORK (DHSF): INTEGRATING AUGMENTED REALITY AND ESG PRINCIPLES FOR CULTURAL HERITAGE CONSERVATION

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ABSTRACT

One of the pressing challenges faced by modern cities is the conservation of cultural heritage buildings in the face of rapid urban development. Current frameworks often emphasize documentation and restoration but lack integration with emerging technologies and measurable sustainability indicators. The purpose of this study is to improve and conserve Wawasan Open University (WOU)'s Homestead, a colonial villa in Penang, Malaysia, hence proposing the Digital Heritage Sustainability Framework (DHSF), a novel approach that integrates Augmented Reality (AR) with Environmental, Social, and Governance (ESG) components. Compared to the available heritage frameworks, the DHSF ensures that conservation activities are not just technologically enhanced but cautious about the environment, socially inclusive and governance-driven. The DHSF framework follows a six-phase process: (1) Heritage assessment, (2) Community co-creation, (3) AR design and development, (4) Deployment, (5) Sustainability planning, and (6) Impact evaluation. The framework contributes to Construction 4.0 by embedding digital transformation and participatory innovation within heritage conservation, while aligning with UNESCO's Historic Urban Landscape approach and United Nations Sustainable Development Goals (SDGs 4, 11, and 16). By integrating AR-driven engagement with ESG metrics, DHSF provides a replicable model for balancing digital innovation, cultural authenticity, and sustainability policy objectives. Without requiring significant infrastructure changes, this structure enables mobile devices to access historical narratives, archival photos, and guided virtual tours. Replication across heritage sites of different sizes and contexts is made possible by scalability, and the use of publicly accessible consumer technology makes it cost-effective. The DHSF technique is the main topic of this study; future research will gather empirical data and carry out a thorough impact analysis.

Keywords: Augmented Reality, Digital Heritage Preservation, ESG Framework, Smart Heritage Engagement, Sustainable Cultural Conservation

TOWARD A BIM MANAGER COMPETENCY FRAMEWORK FOR DIGITAL CONSTRUCTION

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ABSTRACT

The increasing adoption of Building Information Modelling (BIM) in construction has transformed how projects are delivered, coordinated, and managed across disciplines. Central to this digital shift is the BIM Manager, who plays a vital part in ensuring data integrity, collaborative workflows, and compliance with emerging standards. However, existing competency frameworks remain fragmented, lacking role-specific detail, regional adaptability, and integration of sustainability or ESG (Environmental, Social, and Governance) priorities. This paper presents the conceptual foundation of an ongoing research initiative to develop a BIM Manager Competency Framework tailored to digital construction environments. Grounded in a PRISMA-guided systematic literature review, the study examines established global frameworks, including the BIM Excellence Initiative (BIMe), buildingSMART's BIMcert Handbook, ISO 19650 role definitions, and general project management models by Project Management Institute and Association for Project Management. Preliminary analysis reveals inconsistent definitions, narrow technical focus, and limited applicability to ESG-oriented leadership. In response, the paper proposes five preliminary competency domains: technical proficiency, information management, project integration and collaboration, leadership and communication, and sustainability and ESG awareness. These domains form the basis of a conceptual framework that will be refined through empirical validation and support the development of a role-specific self-assessment tool. By addressing current gaps, the research contributes to advancing digital leadership in construction and provides a foundation for structured training, certification, and ESG-aligned workforce development under Construction 4.0.

Keywords: Building Information Modelling (BIM), BIM Manager, Competency Framework, ESG Competencies, Self-Assessment Tool

CONTRACTORS' INSIGHTS: THE INFLUENCE OF BUILDING INFORMATION MODELLING (BIM) ON CONSTRUCTION PROJECT SUCCESS IN MALAYSIA

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ABSTRACT

As the emphasis on sustainable digital transformation in the built environment intensifies, it is essential to comprehend the way Building Information Modelling (BIM) enhances project efficiency and effectiveness. The study focused on three essential BIM potentials, namely, clash detection and coordination, construction monitoring, and cost estimation, and their relationship with project success measures. This study examines the impact of BIM implementation on the success of construction projects from the viewpoint of contractors in Malaysia. A quantitative methodology was employed to gather data from 100 contractors classified as CIDB Grade G5 and higher. Correlation and regression analyses revealed that all three BIM potentials exhibit a strong positive correlation with project efficiency, including adherence to schedules, cost management, and productivity, as well as effectiveness, encompassing client satisfaction, diminished design errors, and project performance. Among the three criteria, cost estimation emerged as the most important predictor of project efficiency, while construction monitoring had the greatest influence on project effectiveness. The findings highlight the importance of BIM in addressing persistent industry challenges, such as project delays, cost overruns, and fragmented coordination. This research augments both theoretical and practical comprehension by validating BIM's importance in enhancing project outcomes and supporting Malaysia's Construction 4.0 Strategic Plan. It highlights the imperative for targeted skill development and organisational readiness among contractors to effectively leverage BIM's capabilities. The research findings provide essential insights for construction stakeholders, including project managers, policymakers, and contractors, in making strategic decisions that align with ESG principles and the nation's sustainable urban development goals.

Keywords: Building Information Modelling (BIM), Project Success, Project Efficiency, Project Effectiveness, Contractor Perception



TOPIC 6: THE FUTURE OF SUSTAINABLE ELECTRONICS IN URBAN DEVELOPMENT

**A FUTURE WITH TECHNOLOGIES IS THE FUTURE
FOR SUSTAINABILITY**

THE CONSTRUCTION PROFESSIONALS' AWARENESS OF BIM-BASED ENVIRONMENTAL MANAGEMENT SYSTEM IN MALAYSIAN CONSTRUCTION PROJECTS: A PILOT STUDY

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ABSTRACT

The application of Building Information Modelling (BIM) as a contemporary construction project management tool has been growing rapidly in the past decades. Its ability to transform and improve modern construction project management as compared to the traditional methods has contributed numerous changes to the industry. However, there are limited research on the use of BIM in managing risks on the environmental aspect of the construction projects. The purpose of this paper is to analyse the capability of BIM as an advanced tool to improve the Environmental Management System (EMS) in the Malaysian construction industry, in enhancing the environmental risk management in construction projects; besides, it also aims to investigate the significant difference in awareness mean reported by the construction professionals from various demographic backgrounds. Particularly, it examines the statistically significant difference from the aspects of respondents' age and years of involvement in the construction field. A pilot survey was conducted among the 36 construction professionals, who were selected using stratified random sampling. Descriptive and 1-way ANOVA tests were performed to analyse the data. The results revealed that the respondents agreed that the integration of BIM-EMS provides great potential for environmentally cautious practices but there are no significant differences that can be seen between the tested demographic aspects. Generally, this study shows that the application of BIM is beneficial to the organizations mainly in an effort to fulfil the environmental regulatory compliance which allows for a more effective and sustainable environmental risk management in the future construction projects.

Keywords: Building Information Modelling, Environmental Management System, Environmental Risk Management, Construction Project Management, Construction Professional

